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Electronics Australia

April 1985
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A-923

Electronics Australia

Volume 47, No. 4
April 1985

Want to build a novel heart monitor? By picking this unit up, you can actually listen to your heartbeat. It's just the thing for biofeedback, rate testing, or just plain fun. See page 42.

Playmaster Series 200

A stubborn technical hitch has forced postponement of the third article on the Playmaster Series 200 stereo amplifier. We've now solved the problem and will publish full details in the constructional article next month (see page 48).

What's coming

Next month we intend to describe an improved version of our 50V/5A switchmode power supply and a true RMS to DC converter for digital multimeters. See also page 112.

Pioneer car stereo player

Pioneer's KE-A433AM car cassette player was the first on the market to be fitted with a decoder for the Motorola C-QUAM system, the stereo AM standard chosen by Australia. We take a close look at this new product on page 28.

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Video effects for home movies

Commercial video effects units cost a fortune but this simple unit can be built for less than $70. It provides inverse video, colour removal and lithographic picture effects. Details page 34.

SIEMENS

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Distribution: Distributed by Gordon and Gotch Limited, Sydney.

Registered by Australia Post — publication No. NBP0240. ISSN 0313-0150

Printed by Magazine Printers Pty Ltd, Regent Street, Chippendale and Masterprint Pty Ltd, Dubbo, NSW for The Federal Publishing Company Pty Ltd.

*Recommended and maximum price only.

TV has great potential for the future

Without doubt, the most exciting technical event this year has been the symposium entitled "In the Dawn of Tomorrow" which was presented in February by the Federation of Australian Commercial Television Stations. A one-day affair, it presented the future of television technology.

On the non-technical side, there were informative addresses given by the Minister for Communications, Mr M. Duffy (per videotape), the Secretary of the Department of Communications, Mr R. Lansdowne and the Federal Director of FACTS, Mr J. Malone. These three addresses emphasised the great degree of cooperation which exists between the DOC, FACTS and the technical community at large. Which is all very encouraging.

However, it was the technical papers and the ensuing demonstrations which really stimulated discussion amongst the audience. These were delivered by technical staff from Scientific Atlanta, USA, Philips and the Sony Corporation. The first two companies' technical people described the "Multiplexed Analog Components" system for television transmission. BMAC, which is a variant of this system, has been adopted for Australia's satellite transmissions.

BMAC is a real advance for television transmissions. It is basically a system of transmitting the chrominance and luminance information in sequential form rather than simultaneously, as in the present PAL system. It makes use of a frame store into which the picture signals are fed in compressed form and then read out again, to obtain a picture of the correct 4:3 aspect ratio, with better bandwidth and complete freedom from colour fringing, colour noise and cross chrominance effects.

As well, the transmission is much more efficent in that it does not waste almost 20% of the time transmitting sync and blanking signals. It uses the extra time gained to transmit extra channels of audio (which are high quality) and Teletext. After all that, it still ends up with a system which will provide reliable picture sync even when the signal-to-noise ratio is 0dB, ie, when the carrier power is equal to the noise!

We plan to give a full technical run-down on BMAC in a future issue. In the meantime, the Department of Communications is to be congratulated for deciding to opt for BMAC. There seems little doubt that it will eventually supersede PAL for all television transmissions.

But if BMAC was exciting, Sony's demonstration of High Definition Television was absolutely startling. We saw videotapes on a screen fully 2.4 metres wide, with a 5:3 aspect ratio. There was no comparison with today's dim and blurry video projection systems. Sony's HDTV projection system was bright and astoundingly sharp, better than the presentation in many cinemas, where the focus is often far from optimum. It rivalled the definition of 35mm slides! And the picture was so wide and dramatically detailed that there was no need for panning and close-up shots. You had to really scrutinise it to see any evidence of the line structure.

The reaction of all who saw it was the same. It was incredible. The feeling was, "So what if it needs 20-odd Megahertz of bandwidth — let's have it!".

Leo Simpson

Letters to the editor

More debate on engineers

As a mechanical engineer with a hobby interest in electronics (amateur radio) I have been following the continuing debate on engineers with interest.

I am unable to comment on what is actually taught, as opposed to what should be taught to electronics students, but I do know from personal contact with assorted graduates in various fields over the years that many of them have had a good theoretical knowledge of their subject but no concept of practical application.

There are a number of reasons for this sorry state of affairs, not least of which is the quality of our education system. Our so-called education system is on a long slippery downhill slope from which it has little chance of recovery without drastic action. Any system can only be judged by its results, and the results are such that a number of universities and colleges of advanced education have felt it necessary to establish remedial English and maths classes to counter the number of semi-literate and semi-numerate students that enter their doors.

With regard to universities, they were once thought of as establishments for providing a good broad general education, with any specialisation being done via higher degrees. This concept has, of course, fallen by the wayside. We now have universities which provide two main streams of education: inconsequential studies or specialist (to the detriment of all else) studies. The former provides a degree that is not worth the paper it is (badly) written on; the latter is like a building with no foundations.

The other major problem in this area are the students themselves. Too many of them see a university degree as a meal ticket and do not really care what they do, or how they do it, as long as they obtain the meal ticket at the end of it. Moreover, too many of them see their degree as a means of getting a job which will obviate the necessity of them getting their hands dirty by indulging in any practical application of their knowledge. Tertiary educated people are too superior to indulge in anything tacky.

Finally, as a mechanical engineer of somewhat longer standing than Mr. P. Stuart (EA, February 1985) I must disagree with his assertion that "mechanical engineers do not learn about petrol motors during their study course." The study of heat engines, a necessary part of thermodynamics, requires a working knowledge of both two stroke and four stroke internal combustion engines as well as steam engines, and such information is to be found even in text books which are considered to be basic primers in thermodynamics (the works of Joel and Rankine, for example).

In addition, in my day it was a rare student that did not attempt to utilize his newly acquired knowledge by experimenting with fuels, supercharging and the like to try to make his car or motorbike the fastest thing on wheels.

F. Robertson,
Charnwood, ACT

Rank triplers now available

I am writing to offer some comments on the article which appeared in the November 84 issue of this magazine concerning Rank triplers.

The comments in that issue are not in question as they basically outlined the problem that had frustrated us on many occasions and that was the periodical shortage of supply. This shortage was due to a problem the manufacturer had with the dyes used to produce this component.

Since December 1, 1983 when NEC Home Electronics Australia Pty Ltd acquired 100% interest in the company known as Rank-NEC Pty Ltd, every effort has been made to overcome the inconsistent supply.

We are very pleased to announce that new dyes have been produced and that stocks of triplers are now plentiful in each of our branches. Future ordering levels have been successfully negotiated to ensure this situation remains.

It is probably an opportune time to remind technicians that to replace faulty components with those recommended by manufacturers will always provide a far more satisfactory service for the customer, and will not create unnecessary side effects which can prove very costly to the servicing company, through poor reliability, performance or unrecoverable rework costs.

The present trade price for our tripler,' part number 36501015, is $40.17 plus tax, with a recommended retail price of $71.06.

Thank you for this opportunity to comment and I wish you and your publication the very best for the future.

F. Standring, National Manager,
Service and Spare Parts,
NEC Home Electronics Australia Pty Ltd.

Give recent graduates a go

Over the last fews months I have been reading with considerable interest the continuing correspondence to your August 1984 editorial. While I do not consider it a fair assessment of a graduate engineer, I took it as an opportunity to assess my own dexterity. While I knew the general theories behind each question, I admit in honesty that I could not answer a few of them with the fluency and conviction I would like, so I sat down and refreshed myself like any good engineer worth his salt should.

I can identify strongly with your graduates because I graduated three years ago and entered into a very competitive industry where I needed a start before I could truly prove my ability. I was raw, with a million ideas and theories crammed into my head as I approached my first interview for probably the same reason your graduates did. I knew the theories but it was difficult to recall precise answers fluently because of one reason nobody has yet touched on — the pressure of an interview on the inexperienced graduate.

I agree totally that engineers must keep abreast of technology and should possess a keen interest in diverse areas of the industry, but most of this comes after graduation.

As for the engineers versus technicians battle, a few words of advice from one of the young brigade of engineers; a smart engineer will advocate a harmonious relationship with his not so decorated working companion. That way he'll never need to go cap in hand whenever in need of advice. And as is the way with the world, the reverse is also true.

Finally, as you have taken engineers to task, I would like to challenge you and a good many others throughout the industry. Next time you interview a graduate or any applicant, don't assess him or her on a 30 minute "Sale of the Century" interview. For the sake of a prosperous electronics industry here in Australia, give them more than a fair chance. Too many potentially excellent engineers are not getting the chance to

prove themselves, and thus benefit the country.

This has been a valid topic for discussion and I hope that it has been as useful to others as it has been to me. It should show that one should never be content with knowledge. It's an ongoing strive for the perfection that can never be attained with complete satisfaction.

M. McGinty,
Como, WA.

Philips stereo TV receivers

I wish to pass on to you our appreciation for the article in the February edition of *Electonics Australia,* concerning the Philips stereo TV receivers. The article has done justice to the product and highlighted the fact that there is still one TV receiver manufacturer in Australia capable of designing TV receivers for the Australian market.

You may not be aware that recently these products won an Australian Design Award and that the personnel involved in the design and development of these sets at Clayton, won, in the consumer category, the Prince Philip Prize for Australian Design.

Two minor points relating to the article, which may be worth mentioning, are:

- On page 15, SCART socket: no mention is made of the five pin DIN socket on the back of the set. This socket allows constant level "un-coloured" stereo audio output for use by VCRs or hifi systems, as well as stereo audio input to the receiver. This socket is particularly useful in some situations; eg, for recording and playing back stereo audio on "stereo play-back only" VCRs equipped with a "simulcast" facility.
- On page 17, quasi-split IF stages: it is interesting to note that apart from the improvement in "buzz", this circuit gives 6 to 10dB improvement in sound recovery, regardless of whether the broadcast is mono or stereophonic. This is particularly useful in fringe areas.

I. Maskiell,
Chief Engineer,
Home Entertainment Division,
Philips Consumer Products.

Burglar alarms for round houses

I bought the January, 1985 issue of *Electronics Australia* with the intention of building the Multi-Sector Home Burglar Alarm, but then realised that as I don't live in a circular house, it would not be of much use to me.

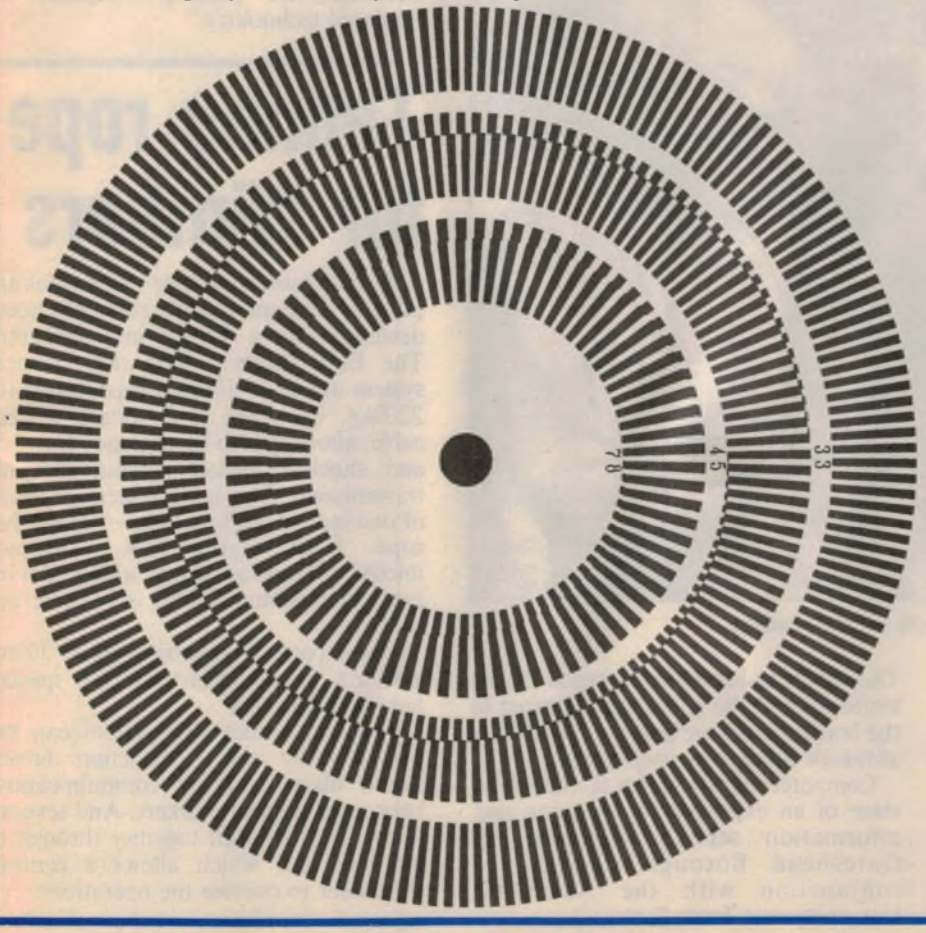
Will you be publishing another version later for ordinary rectangular houses?

G. H. Croll,
Slacks Creek, Qld.

Comment: Unfortunately our Burglar Alarm will only work with sectors. Other geometrical shapes cause it to attract burglars, instead of repelling them.

Accurate turntable strobe disc

Your article and project on the Turntable Strobe came at just the right time! I have been concerned with correcting my turntable speed, but I have been concentrating on another source of error that you have not addressed in your recent article. The bar disc that you are using (in fact every available bar disc) is in error; due to the simple fact that the required number of bars is not a whole number. For example, at 45 rpm, you need 133.333 bars, and of course 133 are used on the disc. This gives an error of 0.25%, and means that the high accuracy of your frequency source is wasted. I have developed a solution to this problem which will be of interest to all the people building your turntable kit.



The solution is to use a strobe disc with a non-integral number of bars around the circle! Sounds impossible, but it's not. If you arrange the bars in a spiral then the bars will remain steady, but they will be "swept" by a discontinuity . . . this is much easier to see in action that it is to describe!

There is another solution, which is preferable, and that involves a change in strobe rate. 195Hz is the lower strobe rate that yields an integral number of bars at the three standard speeds. At this rate the number of bars is 351, 260 and 150. I can supply such a disc to any of your readers who are interested in building a strobe at the 195Hz rate. To order one, write to me at 8 Bolton St, Beaumaris 3193, enclosing $2 and a stamped self addressed envelope of at least 12cm square (to avoid folding).

There is another use for non-standard strobe discs, and that is for the early records that were produced in a variety of speeds, eg, 76 and 80 rpm. I can produce a strobe disc in any combination of (up to) three speeds and to any nominated strobe rate. (Same price: $2 per disc.)

D. Yee,
Beaumaris, Vic.

News Highlights

Conditions right for "reborn" Australian communications industry

An opportunity for a reborn Australian communications industry exists in the current climate of accelerating technological change and rapid expansion in the industry, according to Mr Ian McKenzie.

Mr McKenzie — Group General Manager of Philips Industries Holdings Limited and Vice President of the Australian Electronics Industry Association — said the volume of data transferred over telecommunications network is increasing at a rate of 25-30% per annum throughout OECD countries.

"As a result, the demand for data communications equipment is expanding rapidly, with total industry sales exceeding $4 billion in 1982."

The most immediate impact of these rapid changes has been to raise research and development costs dramatically, according to Mr McKenzie.

He cited the example of ITT's Pentaconta switching system, which was developed in the 1960s for approximately $40 million with an expected commercial lifetime of 20 years. This is currently being replaced by fully electronic digital systems with R&D costs of $2000 million and an expected significantly shorter commercial lifetime.

Where is the Australian communications industry to position itself in this rapidly changing and expanding market?

"The huge research and development costs — coupled with the need for close links with integrated circuit manufacture, and the need to recover development costs on an increasingly competi ive world market — mean that Australia's industrial options in this field are, inevitably, limited," Mr McKenzie said.

"It is in the area of terminal equipment value added networks and new markets that the greatest opportunity exists for a reborn Australian communications industry," Mr McKenzie said.

"As with an infant, the opportunities will have to be nurtured.

"Failure to identify communication industry infants with real growth potential, to support them during their infancy when the cold winds of international competitive dominance may kill them at birth, will lead to a situation where Australian industry becomes the passive recipient of imported technology."

Armchair shopping for the disabled

Teleshopping — armchair shopping for the elderly and the disabled.

At Gateshead, in north-east England, a new service allows the elderly and disabled to do their grocery shopping from the comfort of their own homes. Called "teleshopping", the new service involves the users' own television set in conjunction with a small keyboard.

The system allows the user to call up details of 1000 grocery items, 50 bakery products and 300 pharmaceutical goods. The shopping list is simply typed on the keyboard and the goods are delivered to the home. Goods are paid for on delivery although the service itself is free.

Computerised shopping is the latest stage of an experimental shopping and information service organised by Gateshead Borough Council in conjunction with the Newcastle University and Tesco Stores.

Talking rope for climbers

A mountaineering rope that carries an integral communications cable has been developed by a British manufacturer. The Elite Contact 2000 talking rope system utilises a climbing rope, tested to 2200kg, in which is a spirally coiled cable, allowing it to be stretched knotted and shocked loaded without loss of transmission. The basic system consists of two individuals linked together via the rope. Each man wears a throat microphone and a hardhat with a built-in headset. Communication is possible up to 4km.

Ropes come in lengths of up to 300m and are joined electrically by special linking connectors.

The communications system can be extended by special junction boxes which allow two-way communication between a team of workers. And several teams can be linked together through a terminal unit which allows a central supervisor to oversee the operations.

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Simply brilliant! That's the all-new Bondwell 14 portable personal computer. Small wonder it has become one of America's top-selling computers in just a few short months – and now the same thing is happening here in Australia.

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That's if you **ever ever need** any other software: the Bondwell 14 comes with over $1200 worth of top quality business software (including Wordstar word processing!).

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- **16 user definable keys for incredibly easy use**
- **CP/M version 3.0 including a host of utility software – even a SPEECH synthesiser (it can read to you in English!)**
- **Ergonomically designed keyboard & durable cabinet for complete portability**
- **PLUS over all this famous Micropro bundled software: Wordstar, Calcstar, Mailmerge, Datastar, Reportstar - worth over $1200.00!**

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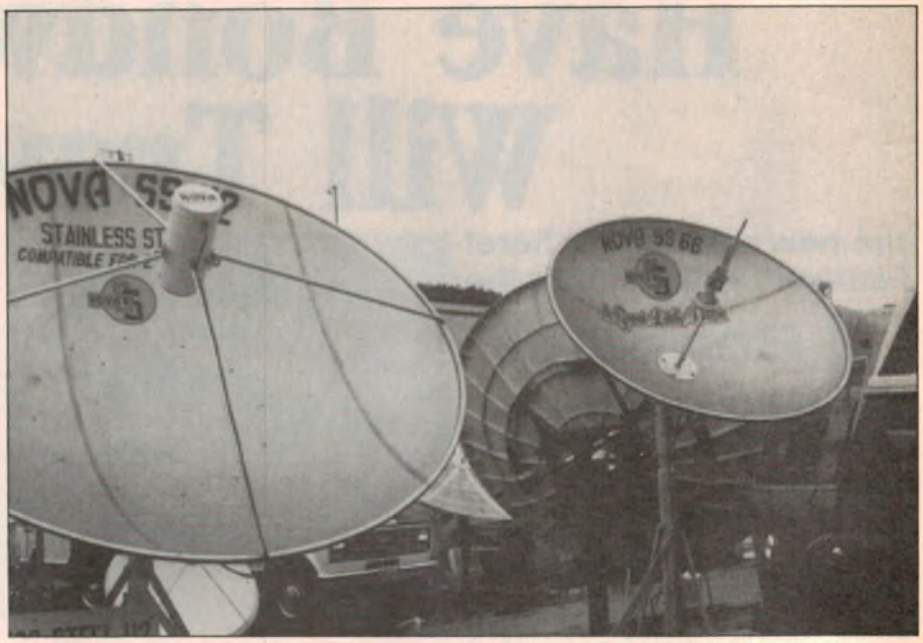
Winter consumer electronics show



Satellite TV receivers featured strongly at the Las Vegas Consumer Electronics Show.

More than 1400 exhibitors displayed their products at the 13th annual Winter Consumer Electronics Show held in Las Vegas this year. The show, held over four days in January, attracted over 100,000 visitors, a new WCES record, making this show the most heavily attended in history. The show occupied more than 9 hectares in the Las Vegas Convention Centre, Las Vegas Hilton, Riviera, and Sahara hotels.

On the computer front, "New Atari", whose booth was opened by the governor of Nevada, released their new line up for 1985 comprising the 8-bit 65XE to retail at $120, the 128K 130XE at $140, the 130ST at $399, the 216K 260ST at $499, and the top of the line 520ST which will retail at $599. The XE series boast "Macintosh" like graphics, animation features, and 4-channel sound, whilst the second family of computers, the ST series, is based on the 16/32 bit MC68000 microprocessor. Neither unit has inbuilt disk drives, but the company is expected to offer a 3.5-inch disk drive at less than $100 retail. (It is still unclear what Atari propose to do in Australia but no doubt these prices are somewhat lower than those that would apply should they proceed.)

Coleco Industries had plenty of Adam computers running at their booth, despite the shock decision to drop the unit only three days before the show. Coleco is rumoured to have sold between 150,000 and 200,000 units to the close out house "Odd Lot Trading Co".

The company will continue to provide software for the ill fated unit.

Video Technology, manufacturer of the Dick Smith "CAT" computer, exhibited the unit, drawing crowds with their claim of Apple software compatibility. Also featuring heavily at the show were an increasing number of compact disc units, including Yamaha's CDX2 at $399 and the Sony CD-5 portable unit.

Also on show was the Pioneer CLD 900 which plays both video and compact discs, and a Clarion auto CD which accepts discs still inside the plastic case to save unnecessary mobile fumbling! Other manufacturers included GE, Mitsubishi, Sampo, Sanyo, and Carver.

For those wishing to record their own, Compusonics exhibited their DSP1000 system, which allows recording and customising of records onto quad density floppy diskettes using a 32-bit "personal" computer!

Video cassette recorders were again in force with several new entrants from Korea and Japan promising to rock the US market. Sampo exhibited their VR9500 unit, a front loading 2-head machine retailing for $399, whilst Goldstar and Samsung both plan units at $349 in April.

AM stereo had an encouraging showing with various standard receivers being exhibited by Sherwood, National, Sparkomatic, and Audiovox. Motorola demonstrated their C-QUAM encoding system for AM broadcasters. Industry sources reveal that demand for AM stereo has not been great, due to the lack of a single standard, a problem foreseen and avoided in Australia.

— Garry Cropp, Dick Smith Electronics

New optical fibre system handles five TV transmissions

An optical fibre transmission system, capable of handling up to five television transmissions simultaneously, has been released in Australia by the Video Systems Division of GEC Australia Ltd.

The new system uses a single optical fibre for analog transmissions. This makes it more economical than digital systems for the short-distance transmissions that are normally associated with security applications.

One of the system's most attractive features is its ability to transmit a television signal without processing being necessary.

In addition, the multiplex signal transmission reduces costs per channel; and the system's reduction of modal noise contributes towards pictures of a superior quality.

Major components of the system include a transmitter using an RF amplifier, Laser Diode (LD) bias circuit, LD Module, automatic temperature and power controls, and power supply circuits.

The receiver unit includes an Avalanche Photo Diode Module (APD), bias circuit, RF amplifier and power supply circuits.

Images are produced by converting the optical input signal to an electrical signal, amplifying it, and removing the VHF band television signals.

GEC Video Systems consultants say the system can transmit for up to four kilometres without requiring the help of relay amplifiers.

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One that can pay off handsomely in increased productivity and profits: Because it is designed to be flexible enough to meet all your business needs - today and in the future.
Whether you use it as a stand-alone work station or in a fully integrated system, you'll find the M24 a high performance machine. And a hard working addition to your office.
Its faster processing and high resolution graphics will help make any computer task a computing pleasure. In addition, you can expect more standard features. More expansion slots. More options for future growth.
As you'd expect, the M24 is also totally compatible with the MS-DOS operating system. It runs the most popular off-the-shelf software (including Symphony, Lotus 1-2-3, Framework and Flight Simulator) with no modification.
Financial analysis. Forecasting. Budgeting. Word processing. Inventory. The Olivetti -AT&T M24PC does it all.
And its flexibility means that when it's time to expand, the M24 will actually make your computer growing pains painless.
Now the Olivetti-AT&T PC is ready for business.

Standard System ONLY $3995

Includes Olivetti M24 base unit with 128K RAM, one 360K disk drive, high res. green screen monitor, IBM-style keyboard, full MS DOS Operating system with GW Basic.

Expanded system $4495

As above with an extra 360K disk drive and a total of 256K RAM.

MS-DOS and Flight Simulator are trade marks of Microsoft Corporation. Lotus 1-2-3 and Symphony are trade marks of Lotus Corporation. Framework is a trade mark of Ashton Taite

Specifications

Basic Unit:
- ☐ 16-bit CPU (8Mhz)
- ☐ Socket for optional 8087 numerical processor.
- ☐ 16KB ROM for bootstrapping, power-on diagnostics and BIOS.
- ☐ Alphanumeric and graphic monochrome and colour display controller with 4 simultaneous "shades of grey" or colours from a palette of 16.
- ☐ Asynchronous serial port (RS232)
- ☐ Parallel port (Centronics)
- ☐ Sound circuitry
- ☐ Calendar/Clock with battery
- ☐ One expansion slot (7-slot bus optional)

Display:
- ☐ 80 x 25, 40 x 25 (col. x lines) characters.
- ☐ 640 x 400 pixel resolution

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A 927

News Highlights

US manufacturer to build Webster computer board

David Webster (right) with Paul R. Clarke, President, Sigma Information Systems, USA.

A computer board, created in Bayswater, Victoria, for an Australian-designed minicomputer, will be built and mass-marketed by a US board level manufacturer to the vast DEC-compatible systems builders' industry in the USA, Canada, United Kingdom and Europe. The product, a dual height Winchester disc controller designed by local minicomputer manufacturer Webster Computer Corporation, and incorporated in the company's PRISM minicomputer range, was launched as an independent board to the USA systems builders' market late last year.

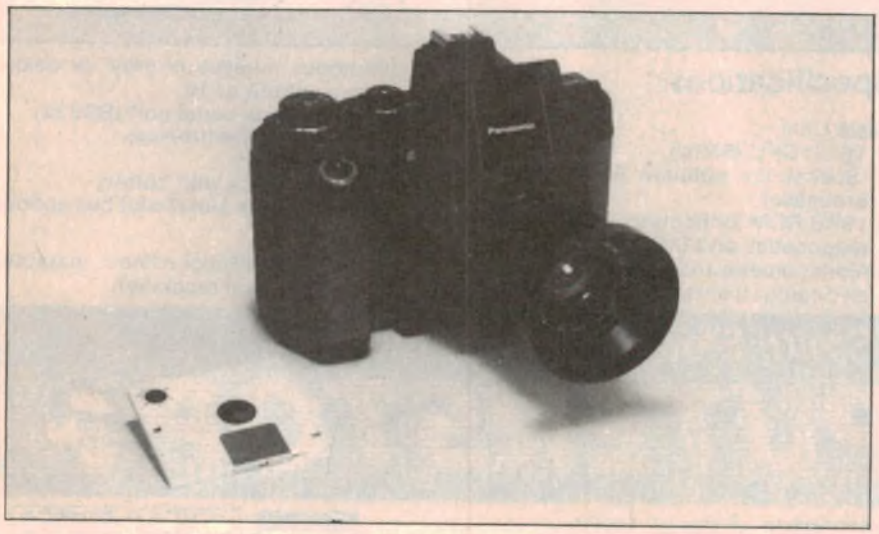
A recent technology exchange agreement between Webster, and Sigma Information Systems Inc headquartered in Los Angeles, but with sales outlets throughout the North American and European continents, will give Sigma the rights to maximise product availability of the controller in these areas. According to the agreement, Webster will continue to address low volume sales within these boundaries and co-operate with Sigma in support and promotion of the product. Territories not covered by the agreement, which include Australia, Asia and the Middle East, will be addressed separately by Webster.

Mr David Webster, Managing Director of Webster Computer Corporation, recently returned this month to his Bayswater headquarters after signing the agreement in Los Angeles with Mr Paul Clarke, President of Sigma Information Systems Inc. Sigma has already indicated interest in manufacturing other new boards currently undergoing design in Webster's Research and Development laboratory, he added.

Sigma Information Systems Inc is based in the Los Angeles suburb of Anaheim, and is a manufacturer of computer chassis and board level products compatible with DEC (Digital Equipment Corporation) and IBM central processing units.

The disc controller, which Sigma will market as the SDC-RQD11-A, is the first dual height controller to implement DEC's Mass Storage Control Protocol. This means that the disc drive can communicate with the host computer using all standard DEC operating systems without software modification.

Electronic still camera from Matsushita



Matsushita's new electronic still camera and a "Still Video Floppy".

National's parent company in Japan, Matsushita Electric Industrial Co Ltd, has recently developed an electronic still camera (ESC) that uses a new floppy disk called a "Still Video Floppy" in place of conventional film. The ESC system is based on the company's new Interline Transfer-Charge Coupled Device (IL-CCD).

This new device features high resolution picture quality of 350 or more horizontal TV lines and 400 or more vertical lines. The total number of picture elements (pixels) is 300,000.

The floppy disk can store a maximum of 50 pictures, and the camera can take as many as seven shots per second. The technical format for image recording used in the Still Video Floppy is the standard approved in May, 1984 by 32 companies in the video and camera field.

Although final marketing plans have yet to be finalised, Matsushita is currently conducting market research in the industrial and medical fields. No plans have been announced as yet to market the camera in Australia.

LOOK

Hardware Prices from less than 1 cent per piece

SELF TAPPING SCREWS

Nickel Plated Steel

From Less Than 1 Cent each

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Huge Savings with Trade Packs (Contents 500)

Nickel Plated Brass Spacers Packs 100

TAPPED 4BA

H 1380 Length 9mm **$ 9.50**
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Bolts Cheesehead Steel, Nuts Brass

		Pack	Price
H 1045	4BA x 6mm	25	$ .95
H 1047	4BA x 6mm	500	5.95
H 1050	4BA x 12mm	25	.95
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H 1060	6BA x 12mm	25	.95
H 1062	6BA x 12mm	500	7.50
H 1070	Nut Hex 4BA	25	1.00
H 1072	Nut Hex 4BA	500	12.50
H 1080	Nut Hex 6BA	25	1.00
H 1082	Nut Hex 6BA	500	12.50
H 1090	4BA S/Proof Washer	50	.95
H 1092	4BA S/Proof Washer	500	5.95
H 1095	4BA Flat Washer	50	.95
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RUBBER FEET Packs 100

H 0916 16mm Diam. **$8.00**

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These solderless breadboards enable circuits to be literally thrown together in an instant, yet all components remain reusable. A necessity in all research laboratories to save on expensive development costs.

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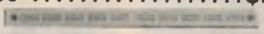
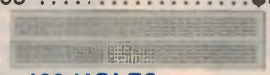


640 HOLES

P 1005 ..... **$9.80**

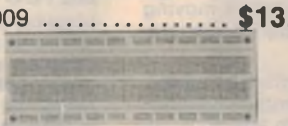


640 + 100 HOLES

P 1007 ..... **$11.95**

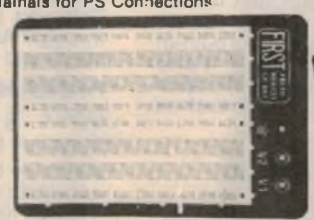
640 + 200 HOLES

P 1009 ..... **$13.95**



400 + 1280 HOLES

Accepts up to 16 x 15 Pin D.I.L.IC's. Screw Termainals for PS Connections



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Accepts up to 24 x 16 pin D.I.L. IC's. Metal Backing Plate for Shielding of sensitive circuitry.

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Non-static sheeting for storing CMOS IC'S, LSI'S etc. 1000 times better than aluminium foil. Will store up to 150 IC'S on one 225 x 150mm sheet.

H 0600 **$3.50 per sheet**

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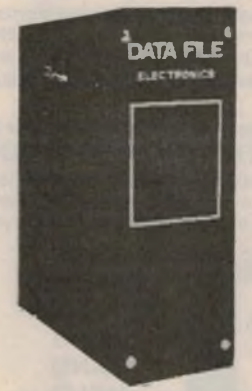

Holds 12 magazines, each on a spring out wire rod. Just the shot for each year's set of Electronics Australia, ETI or any of your favourite magazine.

Suits all A4 size publications (275 x 210). Very smart Royal Blue colour with beautiful gold embossing.

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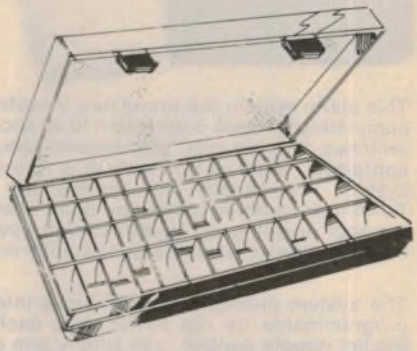

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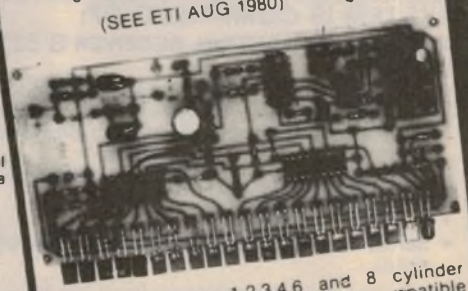
0-1000 RPM/0-10,000 RPM K 4324
(SEE ETI AUG 1980) **$24.50**



Unit suitable for 1,2,3,4,6 and 8 cylinder vehicles, 2 stroke or 4 stroke * Fully compatible with conventional, CDI and transistorized ignition systems * Includes protection circuitry to prevent noise and high voltage spikes from the points and coil circuit damaging the eletronics

Display flashes when over-reving occurs. Only 3 connections required to electrical system

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UHF WIRELESS SECURITY SYSTEM

Just imagine a Security/Alarm system you can install in about an hour—uses no wiring or cables and costs less than $1 for the mounting hardware.

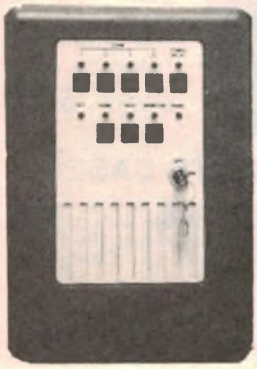
NEW UHF 317MHZ MICROPROCESSOR CONTROL WIRELESS SECURITY ALARM SYSTEM

Commercial grade, quality alarm systems are expensive—just phone one of the "Name" security firms and get a quote for your home—our estimate is that it will be anything up to $1,000 just for the equipment—**then there is the installation**-countless holes punched through walls, miles of wiring and a day or two of installers labour and **thats around $25 per hour these days.**
Hardly worth the effort is it? After all what have you got to loose? — only the Video Player, CD Player, Camera, HI FI, TV, Jewellery and so on. ! !

Well all that is now changed — with our brilliantly engineered BONAX Wireless Security System ***Read on—***

TAKE IT WITH YOU IF YOU MOVE

Apart from the flawless operation of the Bonax system—one of the great features is its application with rented or leased premises—lets face it, money spent on installing a wired system in your Home or Office, Factory etc. is irrevocably lost when you move on. With the Bonax you simply take it with you.



MAIN CONTROL RECEIVER
S 5210

HAND HELD REMOTE CONTROL
S 5230

REMOTE SIREN
S 5250

WIRELESS REED SWITCH
S 5220

PASSIVE INFRA RED DETECTOR
S 5240

This alarm system is a brand new inovative design that features completely wireless connection to all accessories, even the reed switches. It is the most professional security system we've ever appraised. Think of how easy it is to install a 'Wireless' alarm system. The benefits are endless. e.g. arming your Flat or Townhouse with an alarm you don't need to run wires through the roof or drill great holes through your walls. When moving house the alarm is simple to dismantle and re-install elsewhere.

The system divides protected areas into four different zones, programmable by dip switches in each transmitter/detector. **Pocket remote control** can simply arm or disarm any zone i.e. alarm your house perimeter from your bedside when retiring etc. this allows essential protection in some zones while cancelling other zones as desired. Each transmitter/detector unit can be programmed into interior or perimeter zone. Zones can be programmed for instant or delayed trip. The system has a built-in ear piercing siren for intrusion and panic alarm signals. It also has another dry relay output with normally closed, normally open contacts for connecting to other alarm reporting devices such as telephone dialer, additional outdoor siren etc.

SYSTEM IS COMPRISED OF:

4-ZONE MAIN CONTROL RECEIVER S 5210 **$299.00**

FEATURES:

- Wireless reception of external or internal sensors or detectors.
- Selectable home or away modes for selecting internal and external arming or just external to allow movement inside the building.
- Built in Piezo electric siren gives different signals to indicate different functions.
- N/O + N/C Contacts.
- Sends signal down power line to activate one or more remote sirens.

The main control receiver runs on 250V AC with a 12V 1.2AH battery for emergency backup. All other units with the exception of the line carrier, run on a 9V battery each. The average life expectancy is approximately one year. System works around the 317MHz frequency where there is less chance of false alarm. The range of the unit is nominally 80 metres in open space.

ALARM AND INDICATION SOUNDS

Intrusion Alarm — Panic Alarm — Arm Tone — Disarm Tone — Exit Click Tone — Monitor Tone — Tampering Alarm.

DETECTOR/TRANSMITTER UNIT (REED SWITCH) S 5220 $39.50

Suitable for Windows and Doors

This consists of an enclosed reed switch and compact UHF transmitter and a removable enclosed magnet. The unit is at rest when magnet and reed are side by side (within 25mm or 1 inch). When the magnet is moved away more than approximately 1 inch the alarm signals to the Main Control Reciever and the alarm is sounded. In practise the Reed/transmitter is mounted on the door or window frame with the magnet on the moving door or window.

PASSIVE INFRA RED MOVEMENT DETECTOR S 5240 $99.00

Ideal for the lounge room, family room or hallways e.g. anywhere where an intruder is likely to pass through. Mounts up on the wall or on top of bookshelves etc. Detects movement within an area of 9M by 9M by sensing intruder body heat movement through the protected area. Will not false trigger with the family cat or curtain movement etc.— as is the case with the cheaper Ultrasonic alarms.

REMOTE PIEZO SIREN $89.00

This unit is an optional line carrier receiver. Receives signal through 'AC' line i.e. it would ideally be located in, say, the roof space and plugged into mains power.

HAND HELD CONTROL TRANSMITTER UNIT S 5230 $39.50

A real joy to use— keep it at the bedside table-allows you to say alarm the house perimeters when retiring or you can take it with you when you go out, arming your system after you lock the door. Unit is a function control transmitter—to send 4 different signals.

Off—To disarm the system before entering. **Home**— To instantly arm the system with 'perimeter' detection only. **Away**—To arm complete system after a given exit delay time of about 40 sec., **Panic**—To start an emergency signal whenever needed, in any mode.

WILL IT INTERFERE WITH MY NEXT DOOR NEIGHBOUR IF HE ALSO INSTALLS A BONAX ?

Fortunately no — each system is custom coded by the owner when commissioned The chances of him programming the same code are non existant—in fact it is quite feasible to have a whole apartment block fitted out with an individual Bonax System in each apartment.

COMPLETE SYSTEM

S 5200 **$599**

TO SUIT AVERAGE HOME
Package Consisting of:

One	S 5210	Master
Two	S 5220	Reeds
One	S 5240	Passive IRD
One	S 5250	Siren
One	S 5230	Remote

One complete set of Batteries

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● PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 • 999 • 007 ●

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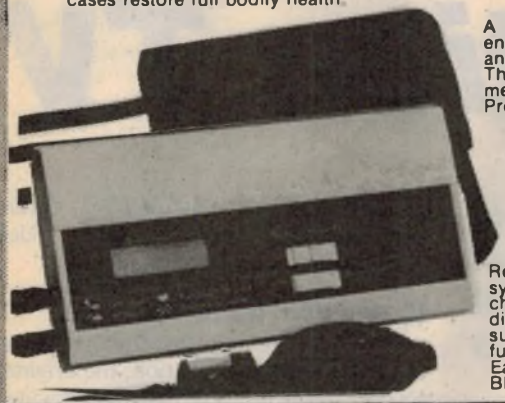
A simple (take the reading yourself) periodic check of your blood pressure and pulse provides an "inward look" into a vital aspect of your bodily health. Heart desease strikes down many people in their early 40's (or even 30's). The tradgedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health.



A Superb Gift for the dedicated fitness enthusiast **Absolutely essential** for those over 40 and concerned with their health, or on Fitness Therapy. Use this **easy to operate** Monitor to measure your pulse (or heart rate) and Blood Pressure.

DON'T PAY ~~$150~~

X 3055

Now Only **$89**

Remember high blood pressure is in itself symptomless and the usual forerunner to future chronic heart disease. **Features** include "error" display warning of incorrect use. Handbook supplied will enable anyone in your family to be fully conversant with this monitor in minutes. Easy to read display of Systolic and Diastolic Blood Pressure and Pulse Rate.

BUILD THESE FABULOUS KITS

OSCILLOSCOPE SENSATION!

(See EA Oct '84)

K 2000

Only $249

Over the years many people have asked, "Do you have a CRO kit?"—Our answer— up until now— has been that built and tested units were not dearer than kits, if you could get a kit at all. The Altronic K 2000 Cathode Ray Oscilloscope kit has a guaranteed 5MHz band width but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz scope is usually adequate to troubleshoot most micro processor and other digital circuitry as well! This is a wonderful opportunity to learn electronics and end up with a valuable piece of test equipment as well. The Altronic K 2000 kit is absolutely complete. The chassis is prepunched and every component including nuts and screws are provided, along with instructions.

BENCH TOP POWER SUPPLY

3—30V to 1 amp Max. with variable current limit.

Electronics Australia have released this superb new supply kit in **our very attractive H 0480 Instrument case**—thus complementing the Frequency Counter, Function Generator projects etc.

FEATURES:

- ★ Output variable between 3 and 30V
- ★ Short circuit Protection
- ★ Full I Amp output over entire voltage range
- ★ Load switching
- ★ Current limiting fully variable-twin selectable ranges. ★ Dual Scale Meter
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- ★ Housed in our Deluxe "ABS" instrument case

SPECIFICATIONS:

- ★ Output Voltage — 3 to 30 Volts
- ★ Output Current — 0 to 1 Amp (fully variable)
- ★ Load Regulation — Better than 0.2% from 0 to full load
- ★ Output Ripple — Less than 2mV RMS

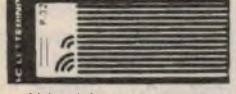
K 3210 ..... Fantastic Value **$55.00**

STATE OF THE ART

PRESSURE SENSITIVE—ETCH RESISTANT PC ART AIDS BY IZUMIYA

Altronics proudly announce the inclusion to our range of the FANTASTIC IZUMIYA PCB ARTWORK AIDS—The incredible feature of IZUMIYA tapes, symbols etc. is, unlike most others, they are etch resistant—that is you can lay artwork direct on to the copper face of the PCB and etch directly with ferric chloride! — Naturally you can use them to prepare finished artwork to paper, film, metal in the normal manner.

SINGLE SHEET PACKS



ALL $1.95ea or 10 Up
SAVE OR MIX $1.60

DOUGHNUTS		
2mm	H 8601	
3mm	H 8604	
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3 x 2mm	H 8610	
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CREPE DESIGN TAPES		
H 8702	0.5mm x 16M	$2.95
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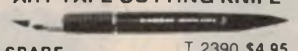
H 8705	2.0mm x16M	$2.95
H 8710	Pack of any 4	$10.00

ART TAPE CUTTING KNIFE



SPARE PACK OF 6 BLADES T 2390 $4.95 T 2392 $1.25

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Ideal for Trade Users

Contents vary each style as dimensions differ, as a guide doughnuts contains 250 PCS

DOUGHNUTS		
2mm H 8802	$3.50	$3.25
3mm H 8803	3.50	3.25
4mm H 8804	3.50	3.25
TEAR DROPS		
3mm H 8830	$4.95	$4.50
4mm H 8840	4.95	4.50
T-CONNECTORS		
1.6mm H 8816	$5.75	$5.50
2.5mm H 8825	5.75	5.50
IC PADS		
4 x 2.8mm H 8841	$3.50	$3.25
4 x 2.5mm H 8842	3.50	3.25

The promise of . . .

High definition TV

Within five years, high definition television should become reality in Japan. Coupled with direct satellite broadcasting, cable TV and large flat panel displays, the new technology signals a communications revolution.

by GENE GREGORY*

**Professor of International Business, Sophia University, Tokyo.*

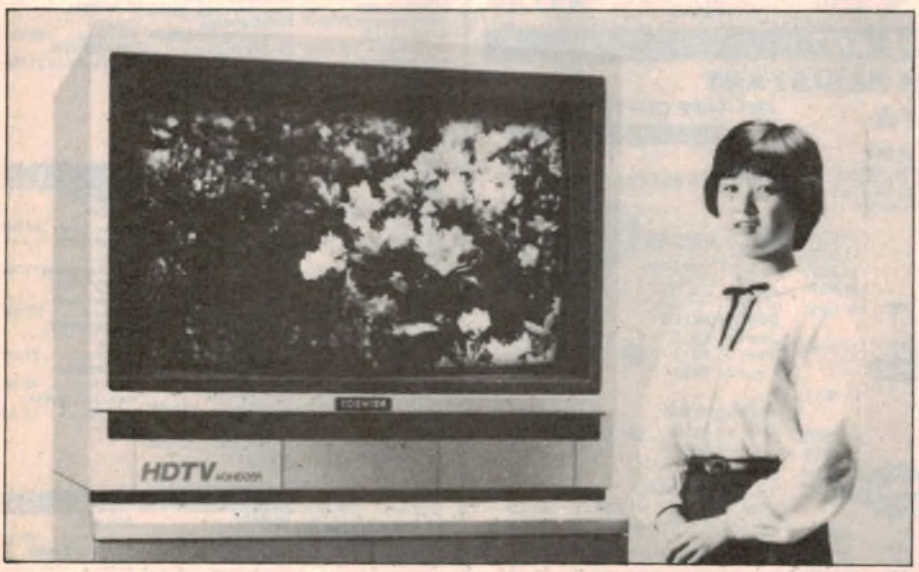
The first two generations of television technology originated in Europe and America. The third generation — high definition television (HDTV) — will bear a heavy "Made in Japan" imprint. It promises a revolution in the way we view television.

On January 14, 1984, the Japan Broadcasting Corporation (NHK) demonstrated a new HDTV system that uses considerably less bandwidth than previous HDTV technologies. With this demonstration, NHK engineers achieved a breakthrough that may eventually prove to be as important as the invention of colour broadcasting.

The introduction of this new band-compression technology constitutes a major step forward in the long march of the television industry. Stated simply, the more lines a television system has, the sharper and more detailed is the picture it will produce. In the language of the television engineer, the greater the detail, the higher the definition.

The definition of a TV picture is a function of the number of scanning lines across the screen inside the receiver's cathode ray tube. After more than a decade of research and development, RCA set the current US standard with the introduction of the 525-line NTSC system in 1940. In Europe, a somewhat sharper image was obtained by the 625-line German PAL and the 819-line (black and white) French SECAM systems after World War II.

Then in 1981, at the Society of Motion Picture and Television Engineers, representatives of NHK and a group of Japanese equipment manufacturers unveiled the working prototype of a high definitive television (HDTV) system using 1125 lines, more than twice the present American standard. Using a somewhat larger screen width, the new HDTV picture contains five times as much video information as a conventional one.



Note the new aspect ratio of this HDTV receiver from Toshiba.

Excessive bandwidth

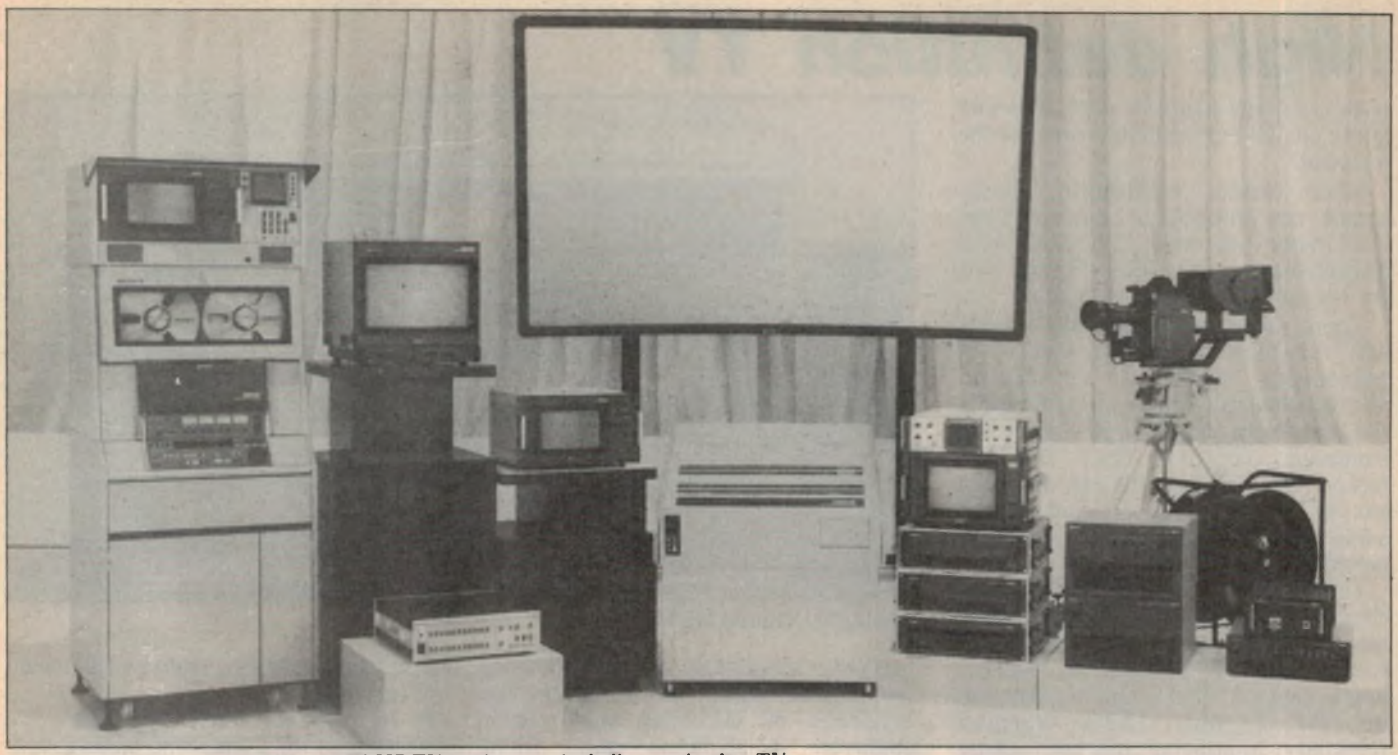
The main problem, however, was that to transmit this information, the original NHK system required 30MHz of video bandwidth, which is equivalent to the total broadcast spectrum of five VHF or UHF television channels in the US. In other words, a country that has five conventional television channels could have only one HDTV channel if no additional channels were available under international conventions. Since the broadcast spectrum is limited, the bandwidths available for use in each country are limited by international considerations. These considerations virtually precluded the introduction of HDTV in its original form.

NHK's multiple sub-Nyquist sampling encoding (MUSE) system overcomes this obstacle, thus clearing the way for the third generation of television. This process squeezes television signals into a channel less than half the normal size using special circuitry at the transmitter and in the television receiver.

By overcoming the voracious appetite for bandwidth, NHK engineers capped a research program that began in 1968 with the fundamental question: given the physical limitations of visual perception and normal, comfortable viewing distances, what should the TV picture be like for optimal human comfort and information reception?

After a series of tests, it was determined that the preferred viewing distance is about four times the height of the screen, and that our eyes resolve about one minute of arc. This translates into a picture made up of 1750 lines. But since even for a completely new system the bandwidth required is impractical, NHK engineers finally settled on 1125 lines, transmitted at 30 frames (or 60 fields) per second, and a 20MHz luminance bandwidth. And for better, more comfortable viewing, a larger screen with a 5-3 aspect (width to height) ratio was established as the ideal.

Once these main specifications had been determined, everything had to be re-invented. A high resolution camera tube — the 1-inch (2.54cm) diode-gun



Sony have produced a whole range of HDTV equipment, including projection TV.

impregnated-cathode Saticon (DIS) — was developed and made available to leading video manufacturers for production engineering. A three-tube colour camera using DIS was produced with the necessary 1125 scanning lines and frame rate, including circuitry to correct registration errors at 570 points in the picture. At present, given pick-up tube limitations, current camera technology is just barely able to produce a satisfactory HDT image with studio-type cameras.

At the receiving end, a new series of 30 to 55-inch high-definition picture tubes has also been developed, upstaging experiments in flat-screen technology. Other new developments include a 70mm laser telecine to convert film pictures into HDTV television signals; new equipment for program production; and terrestrial and satellite transmitters. This, in turn, meant the redesign of videotape recorders used in broadcasting.

Parallel development

Two parallel developments in television broadcasting are critical to the ultimate success of HDTV: direct satellite broadcasting and digital signal processing. In fact, direct satellite broadcasting is the key to high definition television. To test that key, NHK put an experimental medium-scale broadcast satellite, "Yuri", or BSE, into orbit in April 1978.

Based on these experiments, the world's first operational direct broadcasting satellite, the BS-2a, was put into orbit on January 23, 1984, within days after the announcement of the bandwidth compression breakthrough, adding powerful thrust to the television revolution and the emergence of new information systems of which television is a critical component.

At present, due to the breakdown of two of the three transponders of the BS-2a satellite, NHK is operating on only one channel. This services remote mountainous areas, outlying islands and a million or so households located in congested urban districts among high buildings. Direct satellite broadcasting will expand in August 1985 with the scheduled launching of the BS-2b and is expected to be ready for HDTV broadcasts when the larger four-channel BS-3a goes into geostationary orbit in 1988. Although the final decision on the timing of the first HDTV transmissions has yet to be made, it is generally believed that the launching of the BS-3a will provide the appropriate occasion for the inauguration of services.

Compatibility

A number of key problems remain to be resolved before the final decision is made, however. The problem of compatibility with existing television receivers is especially difficult. Methods of chrominance multiplexing, luminance bandwidths and line rates all differ from those currently in use in Japan, the US and Europe. This means that a satisfactory scheme for phasing in the new system without immediately making existing sets obsolete must be devised.

Since HDTV broadcasts cannot be launched until there are some receivers "out there", the solution would seem to lie in the direction taken with colour TV: making HDTV broadcasts compatible with existing sets, even though the reception cannot benefit from the full effects of the new system. It took 20 years after colour television was introduced to phase out monochrome sets in Japan. While the transition to HDTV is likely to be faster, this will largely depend on the arrangements for gradual transition.

CBS, which has made a major commitment to HDTV in the US, has devised a scheme whereby a 1050-line transmission is divided between two channels. Existing sets, according to this scheme, could receive conventional 525-line broadcasts on a single channel.

Digital processing

But consensus on this issue is proving elusive. Some of the industry's wise men, especially in the US, see no real need to shift to high definition broadcasts soon. Pseudo-HDTV effects are obtainable with full digitisation of the video circuits. Digital receiving systems (digital TV transmission systems have yet to be developed) have the advantage of higher fidelity in signal processing which can improve picture quality almost as much as HDTV, even with the existing broadcast signal.

By using large enough RAM (random access memory) IC devices, it is possible to double or triple the number of scanning lines simply by storing them for display in the desired sequence. Digital receivers can also be designed for high-quality TV stereo, special effects (such as freeze-frame, split-screen and zoom), and

High definition TV

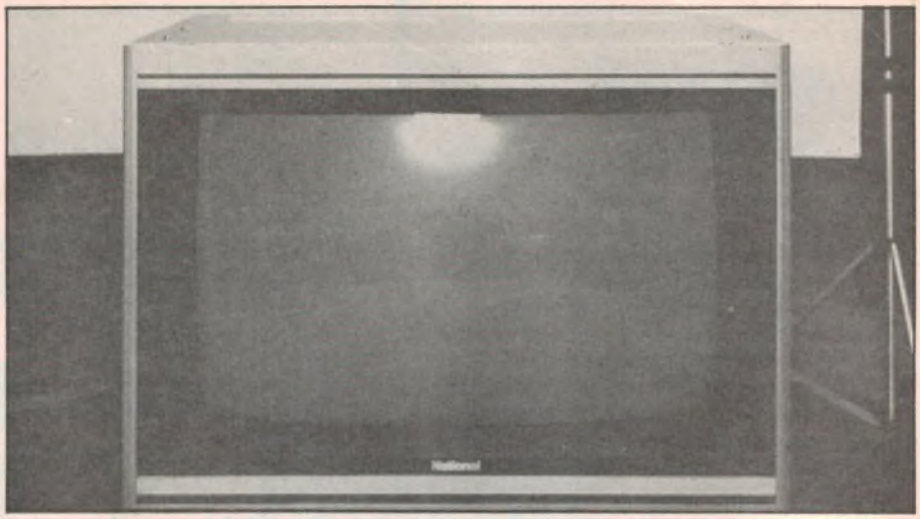
teletext storage and retrieval. Flicker and ghost elimination circuitry can also be included.

Since neither bandwidth, obsolescence, nor problems of standards arise with digital television, it is clear, as a Matsushita executive has affirmed that the future of TV has to be digital.

There are other compelling reasons why this must be so. The number of components required in a digitised receiver is substantially lower, decreasing the adjustment steps in production while increasing reliability. Sony engineers reckon that through the use of digital circuitry they can reduce the number of components from the 400 required at present to less than 100.

Unlike HDTV, which has been developed mainly by a broadcaster rather than a manufacturer, and which uses entirely new technologies of Japanese origin, digital TV has found its champion in ITT Europe. ITT's German subsidiary, Intermetall, has been selling its seven-chip Digitvision circuits for as low as US$25 and, in time, the price will decline.

For leading Japanese makers, however, digital and high definition TV are not mutually exclusive. Sony, Sanyo, Sharp, Matsushita, and Toshiba have been among the early developers of digital signal processing using ITT chip assemblies. In August 1983, both Sony and Matsushita announced breakthroughs in digital TV circuitry, with Sony claiming more than 60 patents pending on a design that incorporated "non-interlace scanning" and which doubles the number of lines on the TV screen. To produce the 1150-line picture, each line of the received broadcast is stored in a digital memory before being clocked out at double speed to the TV screen.

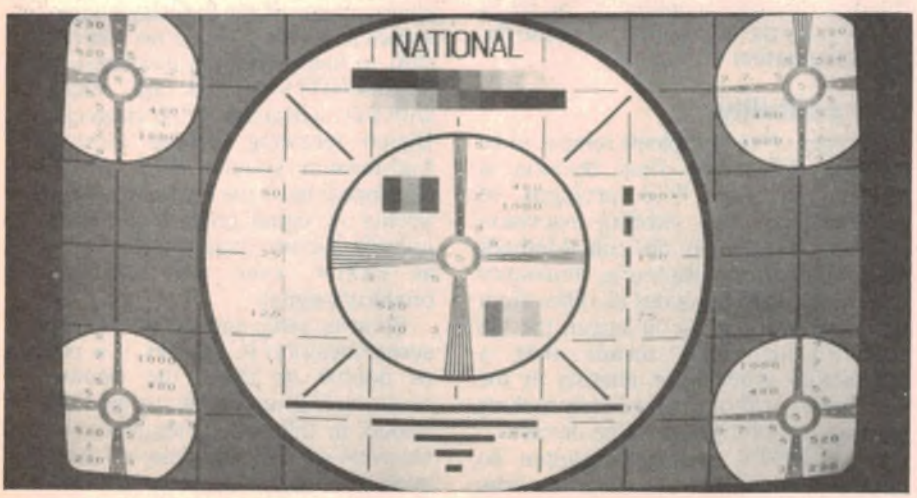


This is the National HDTV receiver.

Sony's new system also features complete separation of the luminance and colour signals which reduces the incidence of flickering and colour spillover. A dynamic comb filter, developed by ITT and incorporated into one of the Digivision ICs assembly, enhances picture resolution, providing reproduction of images free of interference.

At the same time, based on NHK's 1125-line HDTV technology, Sony has developed a high-definition video system with video recording, timebase correction and other capabilities. Elements of the system, prototypes of which were demonstrated as early as 1981, include:

- A high definition 3-tube TV camera, which incorporates the NHK 1-inch Saticon high-resolution pick-up tube;
- A 1-inch wideband VTR, with a new high-density recording format;
- A wideband digital timebase corrector, featuring a newly developed wideband AD converter;
- 20-inch and 30-inch high-definition Trinitron monitors, with a fine-pitch picture tube.
- A 100-inch high-definition TV projector, with a wideband picture tube.



High definition TV test pattern from National.

Cost problems

Even so, dramatic progress has been elusive, despite the best efforts of NHK and set makers. Last May, both Sony and Matsushita announced that their first high definition television sets still will not be ready for market until 1986, and then at the handsome sum of around 500,000 yen ($2500) per set — not including the parabolic antennas that might be needed to receive HDTV transmission by direct satellite broadcast. At present prices, the dish antenna plus tuner is available for 200,000-300,000 yen ($1000-1500), all of which pushes the price for a total installation into the million yen bracket.

At these price levels, industry analysts estimate, it is going to take seven to 10 years for the market to reach the takeoff point. There are about 100,000 adventurous buyers in Japan who can be expected to snap up almost any new product, but for anything like a boomlet to develop, prices of the sets themselves must be brought down to the 200,000 yen level and antenna prices lowered proportionately.

HDTV sets are expensive at the moment because the TV decoder needed for bandwidth compression will need memory chips totalling 10 megabits. However, as 256K RAM devices decline in price with rising production, this memory cost will decline sharply. Makers have also indicated that they are taking other measures to trim costs. At the same time, antenna prices can be expected to decline with new technologies and rising scale economies with increased output.

High definition TV

Toshiba's digital HDTV uses the "Digivision" chip set from ITT.

Toshiba and Alcoa NEC Communications Company (an affiliate of NEC Corp) will supply home receivers and parabolic antennas to Satellite Television Corporation (STC) of the US, under agreements concluded at the end of 1983. STC is in the final stages of preparations for a major satellite broadcasting blitz. Toshiba's system consists of a parabolic antenna for receiving super-high-frequency (SHF) 12GHz signals, an outdoor converter, and a tuner connected to the TV set — all for 240,000 yen ($1200).

New plastic antennas with built-in converters, reportedly under development by half-a-dozen makers — including appliance makers Yagi Antennae and Nitto Electric — could bring prices down to the 10,000 yen ($50) per set level, some financial analysts estimate. At this point, both direct satellite broadcasting and HDTV will become much more interesting propositions.

While digital TV will not wait for high definition television transmissions, HDTV technology is finding its immediate applications on other fronts. Since it comes close to duplicating 35mm film when projected, HDTV systems are expected to be widely used in movie production. Fully automatic HDTV cameras have the advantage of easy operation. Tape, unlike film, is not wasted in the editing process, but can be reused more than once. And instead of shipping prints to theatres around the world, motion picture companies will be able to distribute a taped version by satellite.

With this use in mind, Sony now has an entire integrated line of HDTV motion picture production equipment which is designed specifically to obtain economy and production efficiency in film making and distribution.

What is good enough for the film industry is good enough for the home. Since high definition videotape recorders are an integral part of the NHK system, they can be marketed independently as stand-alone video systems appealing to the same people who purchase expensive audio equipment. High definition tape can be reproduced directly from motion pictures, conserving the original quality.

Practical HDTV

For ultimate conversion of present systems to HDTV, several intermediate steps must be taken:

- Some agreement has to be reached on exact standards. Since HDTV systems are large-scale, they require large investments. And all but public corporations such as NHK would likely hesitate to make investments on this scale, in the absence of universally accepted standards.
- There is the problem of the cost of band compression. Until this problem is resolved, either HDTV will be limited at the supply side with too few channels available to carry HDTV broadcasts, or the sale of receivers will be restricted, causing hesitation among commercial and public broadcasters alike.
- Even if the chicken-and-egg syndrome is overcome, the transition from conventional to HDTV broadcasting is fraught with complexity. Some scheme, perhaps similar to the CBS formula, must be found which does not make existing TV receivers obsolete. Digital TV could provide an answer by simplifying the conversion process.

Two circumstantial factors suggest that these problems will be resolved or eventually vanish. All major Japanese electronic equipment makers have developed a line of HDTV cameras, recorders and other video equipment. To a large extent, the future growth of these companies depends on the market for the next generation — HDTV generation — of television. Likewise, NHK is fully committed to the development of HDTV.

Given the preponderance of the Japanese manufacturers in the global television industry, this alliance between NHK and the Japanese makers may well be sufficiently powerful to reduce the apparent obstacles to insignificance.

No one in the Japanese industry these days doubts that the powerful mix of HDTV, digital TV and direct satellite broadcasting all add up to explosive and continuing growth. Among them, the three technologies provide a good 25 years of potential growth through product and production innovation.

Add to this the consequences of the merging of television and computer, television and telephone, and television and printers in the new media. A foretaste of things to come is seen in Matsushita Electric Industrial Company's new digital set that can simultaneously process signals from regular TV stations, videotext services, and home computers. And, last October, Mitsubishi Electric Corp began marketing a US$1060 TV set with a built-in printer that turns out hard colour copy of images received on the screen. The TV is just a step away from becoming a facsimile terminal!

Flat-screen displays

Mitsubishi Electric has also joined the race for flat, full-colour liquid crystal displays with the announcement last year of the world's first large system. Boasting a picture field of 1.2 × 1.8 metres (the size of the tatami used in traditional flooring), it can display full-colour animation, patterns and characters input from a videorecorder, video camera or computer. The system, initially priced at 10-30 million yen ($50,000-150,000) per square metre, will first be used for visual services at theatres, music halls and sports arenas, but also heralds the advent of the flat-screen wall TV.

Thus far Mitsubishi, Matsushita, Sony, Sanyo and Seiko — all working on active-matrix type liquid crystal displays — have been notably silent about commercial introduction dates for their new flat screen colour TV sets. But rapid-fire advances in technology have overcome many of the limitations of low contrast, narrow viewing angles and slow responses to electrical signals, thereby opening the door to such lucrative markets as colour television, computer displays, large-screen projectors and

ultra-high definition graphics.

Initially, such liquid crystal displays will be used in pocket colour TVs which are expected to appear on the market in the next two-to-three years. Japanese television manufacturers are mobilising resources to offer large area matrix displays up to the size of the Mitsubishi wall unit for use in homes with HDTV. Flat screen, many in the industry claim, could be the breakthrough that would solve the chicken-and-egg problem stymying the industry today. The problem of obsolescence would be considerably mitigated for Japanese householders if that big box suddenly could be replaced with a thin panel screen.

While many doubters remain, noting that large-size LCDs cost much more and perform less well than the conventional cathode ray tube, few of them are in Japan. Even the conventional caveat that flat-screen technology still has some distance to go before it will make the 30-year-old cathode ray tube (CRT) obsolete is dismissed as nonsense.

Work on thin-film transistor materials, especially polycrystalline silicon, is proceeding rapidly in Japanese laboratories. With the higher speed at which electrons move through these semiconductor materials, response to electrical signals is faster than other alternative materials, including amorphous silicon, which is a decided advantage for HDTV liquid displays.

Once this application is perfected by leaders such as Sharp Electronics Corporation, which is by far the largest producer of flat-screen displays at present, and major competitors such as Epson, Hitachi and Toshiba, the sky itself will not be the limit. The eventual market for full-size flat displays will grow at an astronomical rate.

All things considered, television is poised for explosive development that will make past booms look microscopic by comparison. HDTV, plus multi-functional digital television, personal computer-television, character-multiplex television, direct satellite broadcasting (DSB) television, systems television, interactive CATV, teletext, videotext — all add up to a mammoth tidal wave of new products which defies meaningful forecasts. Projections made by Nomura Research Institute (NRI) are that, by 1990, at least 45% of the consumer electronic products sold in world markets will not have existed before 1980.

By combining steady improvements in production efficiency with continuing changes in technology, Japanese consumer electronics firms are destined to play the predominant role — very much like the role they play in the continuing development of video cassette recorders.

Six-inch wafers: bigger is better!

One day silicon wafers will be the size of Frisbees, but meanwhile, six-inch (15cm) "platters" will have to make do. The new platters will dramatically increase production efficiency.

by DAVE SYLVESTER

In the early days of the semiconductor industry, chips were made on thin silicon discs an inch (2.54cm) in diameter. Perhaps resembling the holy bread of a Roman Catholic communion, they were called wafers. But as chip makers move toward making chips on silicon wafers six inches in diameter, the largest size ever used commercially, the name no longer seems to fit.

"Six-inch wafers shouldn't be called wafers at all," says G. Dan Hutcheson, vice president of San Jose market researcher VLSI Research Inc. "They're too big for that. Rather, six-inch wafers are more like platters . . . It takes two hands to hold them."

Whether called wafers or platters, these silicon discs are putting the semiconductor industry on the brink of a significant leap in productivity. So many more chips can fit on the surface of a six-inch wafer without attendant cost increases that, by next year, nearly every major chip maker in the United States plans to establish production lines capable of processing the larger wafers.

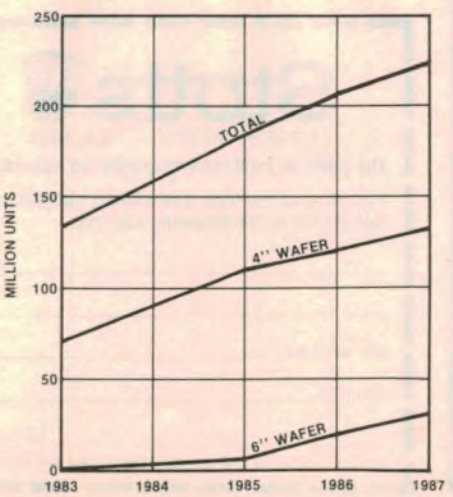
"It's a significant step," says Gene Norrett, a semiconductor industry analyst at Dataquest Inc, another San Jose market researcher. "It'll add significant capacity."

This fall, the move is in full swing. This year, the worldwide semiconductor industry, including captive and merchant manufacturers, is expected to use about two million six-inch wafers in making their chips. That represents a fourfold increase over the 500,000 six-inch wafers used in 1983, according to VLSI Research.

By 1987, chip makers will use about 28 million six-inch wafers, VLSI predicts, accounting for nearly 13% of the silicon wafers started in chip production. Some believe that to be a conservative estimate, while others forecast that large wafers will account for at least 30% of total chip production by 1987. As the US and European chip-making industry grows from this year's $15.2 billion to about $22.4 billion in 1987, nearly all new plants will operate with six-inch equipment.

"I can't envision anybody putting in new capacity that isn't six-inch," says Art Stabenow, vice president for wafer fabrication at National Semiconductor Corp. in Santa Clara. The reason for the move is simple economics: It is cheaper to make chips with six-inch wafers than with any other size, because the number of chips on the wafer increases faster than the cost of production.

Part of the reason is a trick of geometry. Though the diameter of a six-inch wafer is only 50% larger than that of a standard four-inch wafer, its area is 125% greater. Especially important is a wafer's central area, from which good, properly functioning chips can be produced. That centre is called the "sweet spot". As Stabenow says, "The sweet spot always grows faster than the diameter does." Another plus is that the number of chips lost near the wafer's edge diminishes as a percentage of the total. "Six-inch wafers will allow manufacturers to make dice more cheaply than they could on any other diameter," he says.



At the same time, production cost increases only half as fast as the wafer area, compared with a four-inch wafer, says Daniel Klesken, a semiconductor stock analyst at Montgomery Securities and San Francisco. Based on average industry figures, a four-inch wafer costs about $180 to buy and process into chips, not including chip assembly and testing, he says. But when a manufacturer masters the production process, a six-inch wafer costs $300 to process into chips, he says.

Exact comparisons are difficult because chip makers are reducing chip size as well. However, by squeezing chip size and using larger wafers, Intel Corp of Santa Clara was able to produce about four to five times as many 8051 microcontroller chips on one wafer.

With such tremendous improvements in production, the move to six-inch wafers will help keep the chip industry on track in driving down prices at the traditional 25% a year. In addition, it will help control the need to invest scarce capital in new plants, because each plant will be much more productive.

The move to six-inch production is not easy. Last October, at a new plant in Albuquerque, N.M., Intel should have had operating at significant volume the first six-inch production line for merchant chip makers. However, putting the line into production has been more difficult than the company expected.

Without being specific about the problems, Intel says it has installed at least a dozen new pieces of production equipment and is having trouble getting them to cooperate. "It's been a disappointment," chairman Gordon Moore says.

Generally, the technical problems stem from the wafer's extra size: It is more difficult to make the layers of chemicals and the etching of electronic circuits uniform across a larger surface. For instance, photoresist, a chemical layer, is applied by spinning the wafer with a droplet on its centre. With the larger wafer, the edge spins faster than the centre, creating uneveness. So the photoresist must be changed chemically and the speed of the spinning slowed down. Similar problems are encountered in other stages of production. In diffusion furnaces, for instance, heat

may not spread across the wafer surface evenly.

However, the company that solves these problems first will grab a competitive advantage. "It's a gamble that everyone takes," Hutcheson says.

While Intel works out the bugs, other US companies also are preparing to open six-inch wafer plants. Both National Semiconductor and Sunnyvale chip maker Advanced Micro Devices Inc planned to start six-inch lines by the end of last year. And Texas Instruments Incs of Dallas started a new line in Miho, Japan, for production of 256K dynamic random-access memories earlier this year.

Other companies are considering converting existing production lines to six-inch lines. Besides starting a six-inch line in Scotland in early 1985, Motorola Inc plans to convert its plant in Austin to six-inch production. The decision is not easy. Because the six-inch wafers are larger, every piece of equipment can run fewer wafers each hour, cutting down throughput. "Nothing is free," semiconductor group director James Fiebiger philosophises.

Japanese competition

The aggressiveness of US companies well could help them in their competitive fight with Japan. During the 1981-83 recession, Japanese chip makers expanded their production with five-inch wafer-fabrication lines while US makers waited for the recession to end. Now, as US companies install six-inch lines; the Japanese are playing catch-up. "The laggards this time around are the Japanese," says Eli Sayegh, a semiconductor stock analyst for Rowe & Pitman in San Francisco.

Not for long. While US producers work the bugs out of the production lines, Japanese companies are planning to take advantage of these lessons and should move into six-inch production within a year, says Dataquest's Norrett.

Chip industry experts do not think that the move to larger wafers will end with the six-inch wafer. "I have seen an eight-inch wafer," says David Lam, vice chairman of equipment maker Lam Research Inc of Fremont, Calif. "Looks like a dinner plant."

Even beyond, some see no reason for the industry not to proceed to 10-inch or possibly 12-inch wafers, handled entirely automatically in ultra-modern wafer-fabrication plants by the end of the century. "The silicon Frisbees," jokes Howard Bogert, semiconductor service director at Dataquest.

Eight-inch wafers the next step

IBM's East Fishkill, NY, site has announced the production of the largest silicon crystals yet produced by the company. The experimental crystals have a diameter of eight inches.

The manufacture of crystals involves a number of complex processes. First, chunks of purified silicon, derived from common sand, are reduced to a liquid in temperatures exceeding 1400° — 25 per cent as hot as the Sun! At this point, a silicon "seed", the size and shape of a pencil, is dipped into the molten silicon. The "seed" is then lifted slowly, pulling with it a trail of molten silicon which hardens to form a crystal.

The crystal column is drawn up into the cooling chamber of the crystal growing machine, and removed when it reaches a manageable temperature. The diameter of the crystal is determined by the temperature of the molten silicon and the speed at which the seed is lifted. The entire process takes about 24 hours.

The finished crystal is ground into a solid cylinder, and sliced into thin wafers. The building of computer chips on the surfaces of the wafers involves hundreds of manufacturing processes, beginning with polishing the wafers to a mirror-like shine. The finished chips contain thousands of electronic circuits.

Five-inch wafers hold nearly 850 chip sites — and the experimental eight-inch wafers have the capacity to hold more than 2000 chip sites. Productivity is expected to increase as a result of this development, and the overall cost per chip is likely to be reduced.

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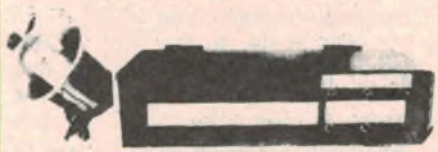

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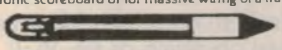

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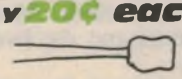

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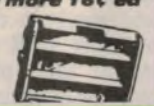

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Hitachi VT-88E hifi stereo VCR

Stereo hifi sound at both normal and half speeds is available from the new VT-88E VHS cassette recorder from Hitachi, with similar performance from both speeds. It also includes comprehensive programming features and infrared remote control.

We have already expounded the virtues of hifi VCRs, in last January's hifi review. As an audio recorder, a hifi VCR offers much better sound quality than a conventional cassette deck. The new machines offer a wider dynamic range, lower noise and distortion, improved bandwidth characteristics, and much less wow and flutter. Plus stereo, of course.

In order to obtain this hifi quality, the sound track width needs to be wider and the relative speed between head and tape increased. This is in comparison to the linear sound track of conventional VCRs. As a consequence, the same helical scanning system is used for both the video and audio signals.

Two extra head are fitted to the video drum and these impose the twin frequency-modulated sound carriers onto the tape just ahead of the video signal. To avoid crosstalk between the audio and video heads, they are aligned at different azimuth angles. The audio heads are aligned +/−30 degrees while the video heads remain at their original +/−6 degrees.

Two other factors also reduce the crosstalk between the audio and video signals:

In the case of VHS, the left and right channel frequency modulated signals have separate carriers centred on 1.4MHz and 1.8MHz respectively.

When recording, the FM audio signals are recorded deeply into the magnetic layer of the tape by using high currents and wide gap tape heads. The video heads on the other hand use low currents and narrow gaps, to produce a shallow recording.

The Hitachi VT-88E

Hitachi's VT-88E hifi VHS VCR is a front loading unit with overall dimensions of 435 × 119 × 370mm (W × H × D). Mass is approximately 11kg. The front panel finish is black with smoked grey perspex used for the front cassette loading flap and as a window for the three vacuum fluorescent displays. An infrared remote control unit is supplied and duplicates most of the features on the front panel of the VCR itself.

Central to the front panel are the controls for the tape transport mechanism: Stop, Play, Pause, Frame Advance, Fast Forward, Reverse and finally the Record switch. These provide the standard control features found on most VCRs such as frame-by-frame viewing, fast frame scanning in both forward and reverse directions and fast foward and reverse.

To the left of the tape transport controls is the counter and 'tape remaining' display. This shows the tape counter, and the remaining recording and playback times. It also has symbols to show VTR (video tape player), ATR (audio tape player), cassette, camera, counter and the remaining recording and this display section are the Reset and Memory pushbutton switches and a hifi indicator. The Memory function stops the tape in rewind at the reset or 0000 indication of the tape counter.

At the top right of the VT-88E is the clock and channel indicator display. This shows the present time, the timer programming and the channel program number.

Below this is the Peak Level Indicator showing the audio levels of each channel, for levels extending from −20dB up to +8dB. This display can be switched off with the Dimmer switch which also serves the purpose of dimming the clock display. At the right of this display are situated the recording level slider controls, to adjust the level of the audio signals when recording.

The remaining controls on this side of the VCR are the Channel select buttons, which increment or decrement the channel numbers for selections from 0 to 63. Two indicators just above the level controls show whether the received television signal is either in a stereo or bilingual format.

At the far left of the player are the Operate and Timer switches and the stereo phones socket, which has an output level adjustment. The Operate switch initiates power to the VCR, but when switched off keeps power for the clock and timer. The Timer switch is used to set the VCR to record a program at the time set by the program clock.

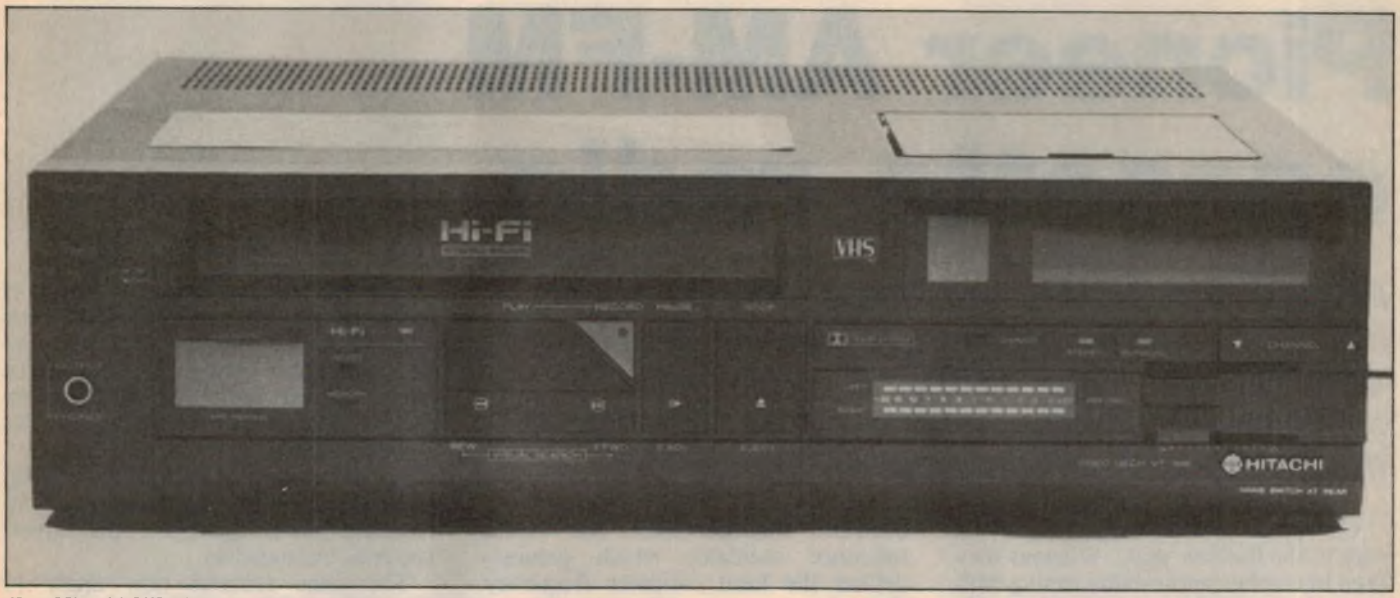
Hidden controls

A flip-down cover that stretches virtually along the entire lower portion of the front panel encloses a multitude of control features. This is used to hide controls that are not often used in the normal operation of the VCR.

At the right hand side, occupying the entire portion below the record level indicators and level sliders, are located the Time Setting controls. These provide for time and programming setting of the 12 hours clock with AM and PM indicators and the five program 14-day timer.

An Instant Recording Timer (IRT) allows immediate recording of a program. The player is then switched off at the preselected time programmed on the program timer.

To the left under the flip-down cover are the picture and audio controls including the Dolby switch, the combined hifi/normal and automatic level switch (ALC), audio channel selection, the tracking and picture control and finally the audio/video tape



The Hitachi VT-88E hifi VCR: an impressive and versatile performer.

recorder/index select switch.

The hifi/normal/ALC select switch performs two functions. Firstly during playback, with the switch in, the playback is only from the linear track for normal sound. When the switch is out, hifi sound is played back. Secondly, while recording, the switch enables an automatic level control when pressed in. Manual level control is available, when the switch is out.

The ATR/VTR/Index select switch is again a multi-function switch. As an audio hifi deck operating at half speed, the switch is set to the ATR position. The VTR position records at normal speed and also records the video information. Note that if hifi sound only is wanted (in the VTR position) it is still necessary to record a video signal so that the speed of the tape is locked at a constant speed.

The Index position records a location marker so that on playback the tape will be stopped automatically at the beginning of the recording, when the switch is in the VTR position. In the case of the ATR position, an index is recorded whenever the pause button is pressed. This allows programming so that the tape can stop at various locations in the recording.

The audio channel select switch operates for playback and determines whether channel 1, channel 2 or both channels are fed to the output terminals. Note that channel 1 is the mono track output from a normal recording and Channel 2 is used for the second language in a bilingual recording or transmission.

Among the remaining controls is Tracking, which adjusts the position of the capstan relative to the heads for best playback response. This is useful if the recording was made on a different VCR which may have a slightly different setting. The Picture control provides a soft to sharp range for adjusting the level of detail of the video.

At the top of the VCR are the video setting controls. The RF output can be selected to provide either channel 3 or 4, using the RF channel switch. A TV test pattern is available so that the TV set can be fine-tuned to the frequency output from the VCR. This pattern comprises a black screen with two vertical white bars.

A 39-channel memory preset can be programmed to store any of the channels of the VHF and UHF bands. It has automatic frequency setting and control, however this can be negated by pressing the fine tuning button during the setting up procedures.

At the rear of the VT-88E are several outlets and control switches. There are Belling Lee antenna and RF output sockets and RCA type sockets for audio out, audio in, and video out. A power switch for the VCR switches the main power off. A vertical sync adjustment is provided for correction of "rolling" should this occur. Also an auto/colour switch forces colour when in the colour position. This is useful if poor signal reception provides only a black and white reception when in the auto selection.

Test results

The VT-88E video performance is equivalent to standard VHS machines and consequently, our tests concern mainly the audio quality. One feature that interested us was what effect the half speed feature, which effectively doubles playing times, actually has on audio performance. This half speed feature is only available when recording audio signals alone.

Total harmonic distortion was measured at half speed with and without the automatic level control (ALC). As expected, the distortion was higher with the ALC in operation. For a signal recorded at 0dB level we measured 1.3% at 100Hz, 0.55% at 1kHz and 1.9% at 6.3kHz without ALC. With ALC the results were 1.8%, 1.8% and 2% respectively.

At the +5dB level, distortion without ALC was slightly lower at 1.2% at 100Hz, 0.45% at 1kHz and 1.6% at 6.3kHz.

At normal speed, and with a TV signal being received, distortion at 0dB measured 1.2% at 100Hz, 0.55% at 1kHz and 1.8% at 6.3kHz, all without ALC. With ALC the results were 1.3%, 1.7% and 2.9% respectively. These readings represent mainly second harmonic distortion so the sound quality is better than the figures suggest.

At the + 5dB level, distortion without ALC was 1% at 100Hz, 0.5% at 1kHz and 1.6% at 6.3kHz.

As the figures show, the distortion results are not significantly different between full and half speed. But what happens to the frequency response at full and half speed?

At full speed and 0dB the response

Continued on page 116

Pioneer AM-FM cassette radio

Pioneer was the first to have a stereo AM/FM car radio on the market incorporating the Motorola decoder. The KE-A433AM is a full-featured receiver with inbuilt cassette player. It is presently the cheapest such receiver on the market.

Car radios have certainly come a long way in the last few years. Whereas they used to employ permeability tuning with manual or pushbutton operation, the better quality receivers now use all electronic tuning which is usually referred to as frequency synthesis.

The system invariably employs a dedicated microprocessor and crystal reference oscillator which precisely defines the local oscillator frequency. The microprocessor defines the top and bottom of the AM and FM bands and the station spacing (9kHz for AM and 100kHz for FM) and thereby determines that the receiver can never be mistuned.

Frequency synthesised tuning is highly desirable, for several reasons. For FM reception, the lowest distortion and best separation between left and right audio channels are only obtained when the receiver is tuned exactly to the station's carrier.

A deviation of only 0.25% (25kHz) amounts to quite bad mistuning and resultant loss of quality — the station becomes unlistenable.

The same remarks now apply to reception of AM stereo transmissions. If the receiver is not exactly tuned to the carrier the reception, at best, will be poor. At worst, the Motorola decoder will be unable to react to the presence of

The Pioneer KE-A433AM is a full-featured cassette/radio unit with feather-touch presets for 12 FM and 6 AM stations.

the pilot tone and the reception will stay resolutely in mono, and be distorted to boot.

Pioneer have had the advantage in the Australian marketplace by being the first to have a frequency-synthesised car radio with the inbuilt Motorola AM stereo decoder. Their model KE-A433AM has been a popular seller since it was released onto the market late last year.

The styling and presentation of the Pioneer set is similar to many competing models. It is built to the compact DIN format and so can be installed into just about any car dash or console.

A liquid crystal display provides readout of the station frequency, indicates whether a stereo transmission is being received, the tuning mode and the station preset number. For car use the LCD is better than the alternative LED or vacuum fluorescent displays which can be rendered virtually unreadable in bright sunlight.

For night-time use the liquid crystal display is not quite so advantaged but the readout is still legible due to the pleasant green backlighting. At the same time, all the controls are backlit at night for ease of use.

Three modes of tuning are possible: Memory, Seek and Manual. In the Memory mode the driver merely pushes the band button and one of the three rocker buttons to select one of the 12 preset FM stations or 6 AM stations. These station settings are stored in memory (via a simple tuning procedure) while ever the receiver is connected to the car battery.

To enable the Seek mode, the righthand knob is pushed to display the "Seek" legend on the display. Then it is merely a matter of either twisting the same knob to the left or right to send the unit down or up the band. Even here, there are two levels of operation which are dependent on station signal strength. Pushing the "Loc.S" button means that only the strong stations will be tuned in the Seek mode.

The manual tuning process is similar — just twist the righthand knob to shift the tuner up or down by 9kHz in the AM mode and by 25kHz in the FM mode.

In the AM mode you can select wide or narrow band operation. The former gives a wider audio bandwidth but in many reception areas the narrow band is the more listenable.

The tape player is a fairly standard unit which incorporates auto-replay. This automatically starts the tape playing when rewind is complete. The 70μs button is pressed when playing a metal or chromium dioxide tape. Unfortunately, though, Dolby B noise reduction is not a feature which is a pity since most pre-recorded cassettes are recorded with Dolby these days.

Inside, the Pioneer KE-A433AM is just as crowded as car radios have always been. Except that now it is crowded with the tape transport and several printed circuit boards which are themselves crowded with teensy-weensy surface-mounting components. The Motorola 13020P is there too. We checked.

Fitting the Pioneer set is just as tedious as with other car radios, too. Unless, you are an experienced installer, don't make the mistake of thinking that you can install one of these units in an hour on a Saturday afternoon while listening to the cricket. It is never that easy.

The Pioneer set has three positive supply leads, one for the control illumination, one for the main circuitry and the third for the microprocessor memory. As well, there is a bunch of leads for four sets of loudspeakers (the lefthand concentric knob incorporates a front/rear fader) plus the usual in-line coax socket for the antenna connection. Apart from that, all the lead terminations are via automotive bullet connectors.

Time did not permit us to carry out full objective tests. However, we can report that the unit performs well in actual use. It is easy to drive and produces wide range sound with a good pair of loudspeakers, especially in the FM mode. In the AM mode, in wideband operation, it also sounds quite a deal better than we have come to expect with AM car reception.

Stereo separation is quoted as being less in the AM mode than for FM; 40dB at 1kHz for FM versus 30dB for AM. In practice, both figures are more than adequate for good stereo effect and there is little to pick between the two modes on normal program material.

In summary, the Pioneer must be rated as a good buy. It provides all the convenience features of a frequency synthesised tuner, with Motorola C-QUAM decoding, four-way speaker operation and neat styling. Recommended retail price is $349.

Further information on Pioneer car equipment can be obtained from most car sound system installers (L.D.S.)

Australia's inaugural hifi awards

CESA hifi Grand Prix awards

Six products have been declared winners in their various categories for Australia's inaugural hifi industry awards. They are all familiar brand names: Aiwa, KEF, Luxman, NAD and Yamaha, which won two awards.

by LEO SIMPSON

As noted in the Editorial for the January 1985 issue, Australia now has an annual hifi industry award. Hosted by CESA, the Consumer Electronic Suppliers Association, they are to be known as the "CESA Grand Prix Awards", a mouthful if ever there was one.

The concept of Australian hifi awards has been a gleam in the eyes of a number of people in the hifi industry for a long time but it is only now that it has come to fruition. They have started off rather quietly, with not a few hifi distributors taking the attitude that they would "sit back and see how it goes". For that reason and the lack of prior promotion, the inaugural awards do not feature some very well known and deserving models.

Eight categories were proposed for the inaugural awards. They were to be for best amplifier, tuner, receiver, compact disc player, cassette deck, turntable, loudspeaker system and a special category tentatively labelled "technological development".

Judging such awards is no simple matter. Nor are the logistics. To simplify matters, the organising committee of the Consumer Electronics Suppliers Association, the host organisation for the awards, decided that individual distributors would have to submit their products for consideration.

The submissions would be all collected together by CESA and handed over to an independent judging committee made up of journalists who regularly write on the subject of high fidelity.

The judging committee would first consider the products on the basis of their technical specifications, value for money and popularity in the marketplace.

Then, if the judges found it necessary to make up a "short list" for final consideration, they could obtain the actual products for evaluation.

This is what actually happened in practice. The three journalists on the committee were: Greg Borrowman, editor Australian Hifi and contributor to the *Melbourne Herald*, David Frith who writes for the *National Times* and the *Sydney Morning Herald* and myself.

It would have been very appropriate to also have Dennis Lingane, a freelance audio journalist of considerable reputation and prime mover for the awards on the judging committee, but his domicile in Perth, WA, made that not feasible for this year.

Let us discuss each category in turn and the products submitted.

Amplifiers

Six amplifiers or preamplifier/amplifier combinations were submitted for consideration in this category. They were the Aiwa GX110 and BX110 preamp/power amplifier, the Dual CV1460 integrated amplifier, the NEC A-11E amplifier, the Luxman C-05 and and M-05 preamp/power amplifier and the Yamaha A-500 integrated amplifier.

Being the inaugural awards, the judges decided to make up a few rules as they went along, to legitimise matters. The first of these rules was that the product must be generally available if at all possible. No particular problem there, which was not surprising since the distributors could be relied on to only submit current products.

The second rule was tougher though. It specified that any product to be considered must be available separately and not just as part of a complete rack system. The reasoning behind this was that a particular rack component might

The NAD 7140 won the receiver Grand Prix award by reason of its high performance and circuit innovations.

well be worthy of an award but it could be teamed with components of lesser calibre, which would take away some of the attraction of buying an award-winning component for the buyer.

This rule was tough on Aiwa because its submitted preamp/power amplifier combination is only available in a rack system. So is their TX-110 tuner which was also submitted. Aiwa did not miss out completely though, as we shall see.

Of the remaining five products in the amplifier category, two stood out. The Yamaha A-500 and the Luxman combination. The Yamaha amplifier is keenly priced for its specs and very popular in the marketplace but, when you came right down to the nitty-gritty, not really outstanding. Rather, it is a good all-rounder. So the judges decided to go right over the top and opt for the very expensive Luxman. This is clearly an outstanding combination although few people can afford it.

Receivers

Only two models were submitted for this category, the Sharp SA-107 and the NAD 7140. Under several criteria, the laurels went to the NAD. The 7140 does not really have the looks of a winner. It is spartan in the extreme, as are all NAD products but its performance is very good and it has a number of innovative features which place it well to the forefront of receiver design.

First and foremost, it has very high music power output compared to its relatively low continuous power ratings. It is rated at only 40 watts continuous per channel into 8Ω loads but will easily deliver twice that power on a short term basis.

In addition it incorporates a soft-clipping circuit so that its effective power, or if you like, ultimate loudness before noticeable clipping occurs, is considerably higher than its nominal ratings suggest.

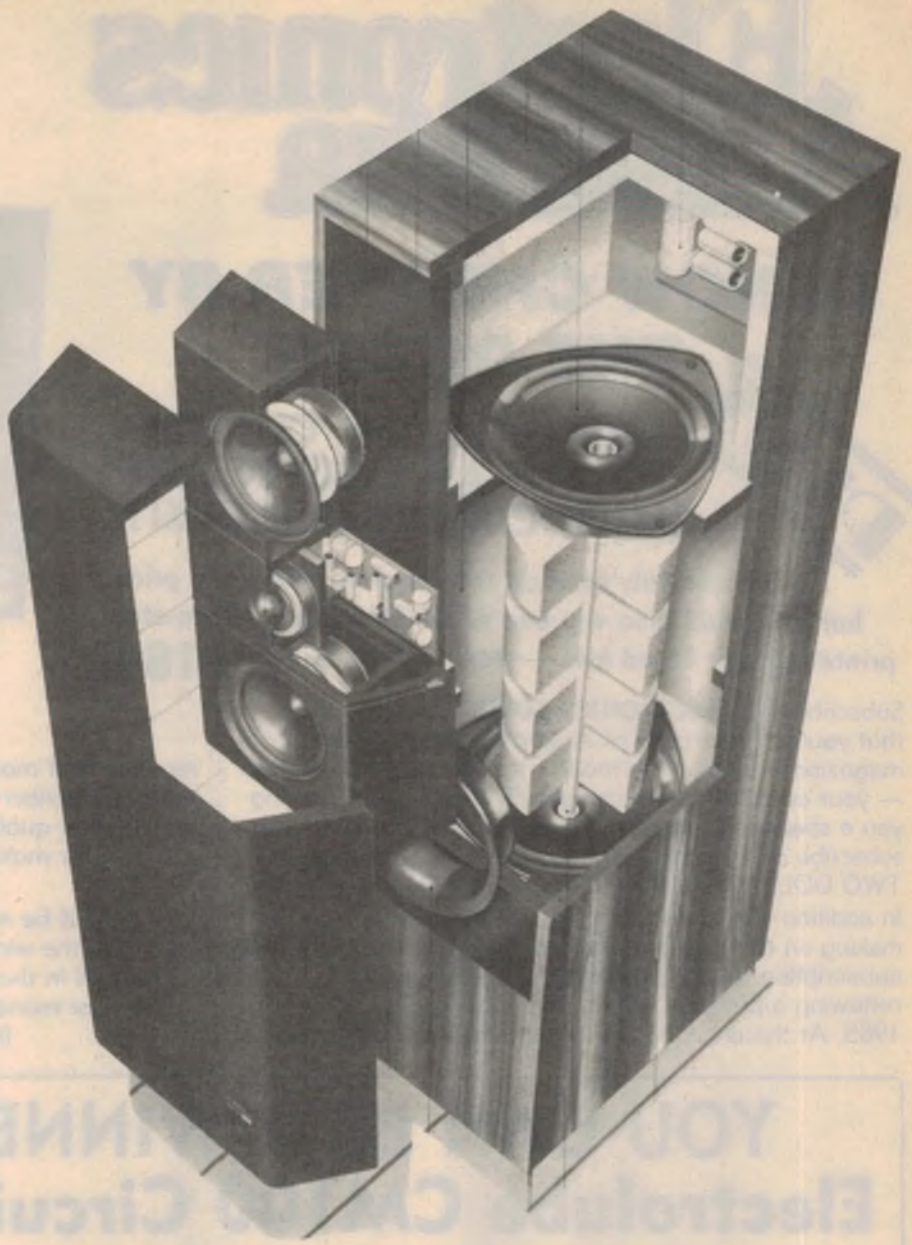
On the tuner side, the NAD incorporates the clever Schotz dynamic high blend circuit which greatly increases the apparent signal to noise ratio in the stereo mode on weak signals.

Clearly, the NAD was the winner in a race of two but it could have placed very favourably amongst a field of all-comers. The judges had no qualms in making the award.

Tuners

Only two models were considered in this category, the Aiwa TX-110 and the Yamaha T-80. This amounted to a no-contest, after the elimination of the TX-110, as explained above. But it was not as easy as that for the Yamaha. The judges seriously considered whether they should make an award at all.

The Yamaha T-80 is certainly a good frequency synthesised tuner, with Yamaha's zero intermodulation mixer circuit, low distortion FM detector and an RF control which is desirable in very strong signal areas. But it can only be regarded as cheap and nasty as far as the AM side is concerned. On balance though, the Yamaha got the nod, since there are presently no AM/FM tuners which could be regarded as offering a high standard of AM reception.



The KEF 104.2 won the Grand Prix award for loudspeaker systems because of its clear lead in technological innovation and outstanding sound quality.

Cassette decks

Three decks were entered in this category, the Aiwa ADF-990, the Dual C-844 and the Sharp RT-107. One model stood out clearly for performance, value-for-money and styling, the Aiwa. A three-head deck with automatic bias and equalisation, Dolby B, C and dbx noise reduction and very jazzy styling, it also could have placed well against much tougher competition.

Turntables

Five brands of turntables were entered. They were: Dual CS-505 Mk II, NAD 5120, Rotel RP-850, Sharp RP-107 and the Aurex SR-L7F by Toshiba. Here the judges were placed in a quandary. None of the turntables was regarded as being particularly outstanding or innovative. Sure, the NAD has its floppy printed circuit board tonearm which can be regarded as innovative but it has not been well received by buyers.

On the face of it, the judges had five

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The kit contains the following:

- 12 sheets of autopositive film.
- 6 double-sided fibreglass blank boards, all measuring 160 x 100mm (Eurocard size).
- Universal exposure and assembly frame.
- A Photoflood lamp.

All necessary chemicals:

- developers • fixer • film clearing solution • photoresist • copper etchant • and a combined soldering flux/protective lacquer
- A complete set of photographic dishes.
- A liquid measure.
- A retouching pen.
- A liquid-crystal thermometer.
- A couple of 1.1mm PCB drills.

And all extras like:

- Plastic gloves.
- A photoresist applicator.
- Cotton wool.
- Film clips.
- A scouring pad.
- And a full set of step by step instructions.

NOTE: The above competition does not apply to readers in Queensland or South Australia, due to the laws relating to lotteries in those states.
NSW Lottery Permit No. TC84/2457
Victoria Lottery Permit No. 84/884

Australia's inaugural hifi awards

stayers but no odds-on favourite. They then came to the decision that no award should be made. The idea here was that the future of the awards had to be considered. A high standard had to be set at the outset otherwise the awards would be regarded as of little importance.

Compact Disc Players

This category was quite disappointing as far as the judges were concerned. In no other category are there so many new products and so much interest being generated amongst consumers. After all, it is the compact disc player which is the product most likely to rejuvenate the flagging hifi market place.

Only three models were submitted: the NEC CD-705E, the Toshiba XR-Z70 and the Yamaha CD-2. The judges seriously considered the last two. After an exhaustive comparison test they unanimously preferred the brighter sound quality of the Toshiba player but the Yamaha won out by reason of its low price ($699) for a remote control deck, its better tracking and error correction and its innovative second-generation technology.

Loudspeakers

Four loudspeaker systems were submitted: Bose 901-V, Boston Acoustics A-70, KEF 104.2 and the Stax F83. Of these, the Bose and the KEF are the most interesting but the Bose was judged to be essentially a long running design, albeit now highly refined in its fifth variant. The KEF stood head and shoulders above the rest. It is clearly innovative, has superlative sound and is very good value for money.

In fact there are so many innovations in the KEF 104.2, it is difficult to know where to start. There are the vertically opposed drivers coupled into a common cavity and hydraulically designed (to assure low air turbulence) bass port, the chassisless midrange drivers and high efficiency ferro-fluid cooled tweeter.

There is also the exceptional matching between stereo pairs, the impedance equalisation which presents a flat 4Ω resistive load to the amplifier over the whole audio spectrum, the tilted-up listening axis to suit most listeners' requirements and the automatic overload protection. At a price of around $2000 before the recent currency problems it was and still is an outstanding loudspeaker. It would probably still be the winner against all comers.

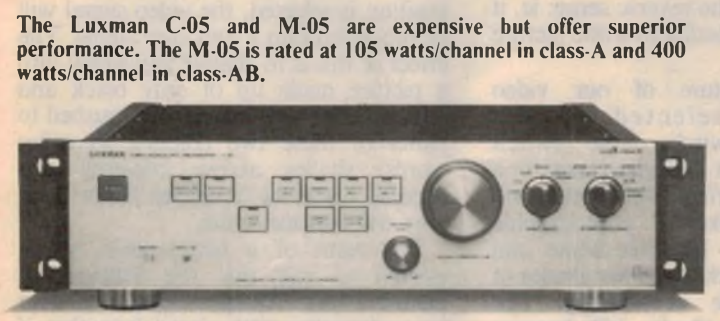
Technological development

This category was also a disappointment for the judges. It could have easily embraced one of the new second-generation CD players or one of the hifi VCRs. But there were no product submissions. What were submitted were the Bose 1201 car sound system, the ITT Tricon combined television and hifi system, and the Shure V15-MR moving magnet cartridge.

The first two were not seriously considered by the judges and the Shure cartridge was regarded as an excellent product but one which was evolutionary rather than revolutionary. No award was therefore made.

Let us hope that next year's awards, which are open for submissions in August 1985, are much better patronised by Australian hifi industry. And let us hope that there will be a video category products since video and audio are rapidly converging on the home entertainment scene.

The Luxman C-05 and M-05 are expensive but offer superior performance. The M-05 is rated at 105 watts/channel in class-A and 400 watts/channel in class-AB.



Special effects for your home movies

Ever thought of adding special effects to your video recordings? Commercial effects units cost a fortune but this unit can be built for less than $70. It provides the following features: inverse video, colour removal, lithographic picture and contrast enhancement.

by FRANCO UBAUDI

Video movie-making seems to be the in thing these days. Video cassette recorders and cameras have flooded into our homes during the last five years and we've taken to recording everything from the exciting to the mundane.

So just think what you could do with a video processor. How often have you wished that you could add special effects to your video movies, especially to the more humorous portions? Or have you ever wanted to brighten up a gloomy picture or add more contrast to a dull scene? The ability to do such things can be just what's needed to add new life to an old recording or to make a goof less obvious.

While it is only a low-cost unit, our new Video Processor boasts a number of really worthwhile features. In use, it is interposed between the camera and the VCR, and the front panel controls set to give the required effect. Alternatively, you can interpose the unit between your VCR and the TV set. The only proviso here is that the TV must have a video input socket.

Main features

What exactly does the unit do? This can be best explained by taking a close look at the front panel controls.

As can be seen, the front panel of the Video Processor carries four toggle switches and three control knobs. On the left is the power switch. It must be switched on at all times, even if only to allow a video signal to pass through unaffected. The accompanying red LED provides power on/off indication.

Next is the Colour:B/W selector. Its function is self-explanatory — it simply turns a colour picture into a black and white picture. Unfortunately, this switch does not work in the reverse sense; ie, it cannot convert a black and white picture to colour.

The main feature of our video processor is selected by the Normal/Invert switch. This switch allows you to invert the video signal for a really interesting effect. The picture will appear rather like a photographic negative — black becomes white and white becomes black. All other shades of grey will change accordingly. For example, a light shade will become darker.

The colour on the other hand, does not change — only its shade. This is because we are effectively only inverting the luminance signal. As a result, light colours will become darker and vice versa.

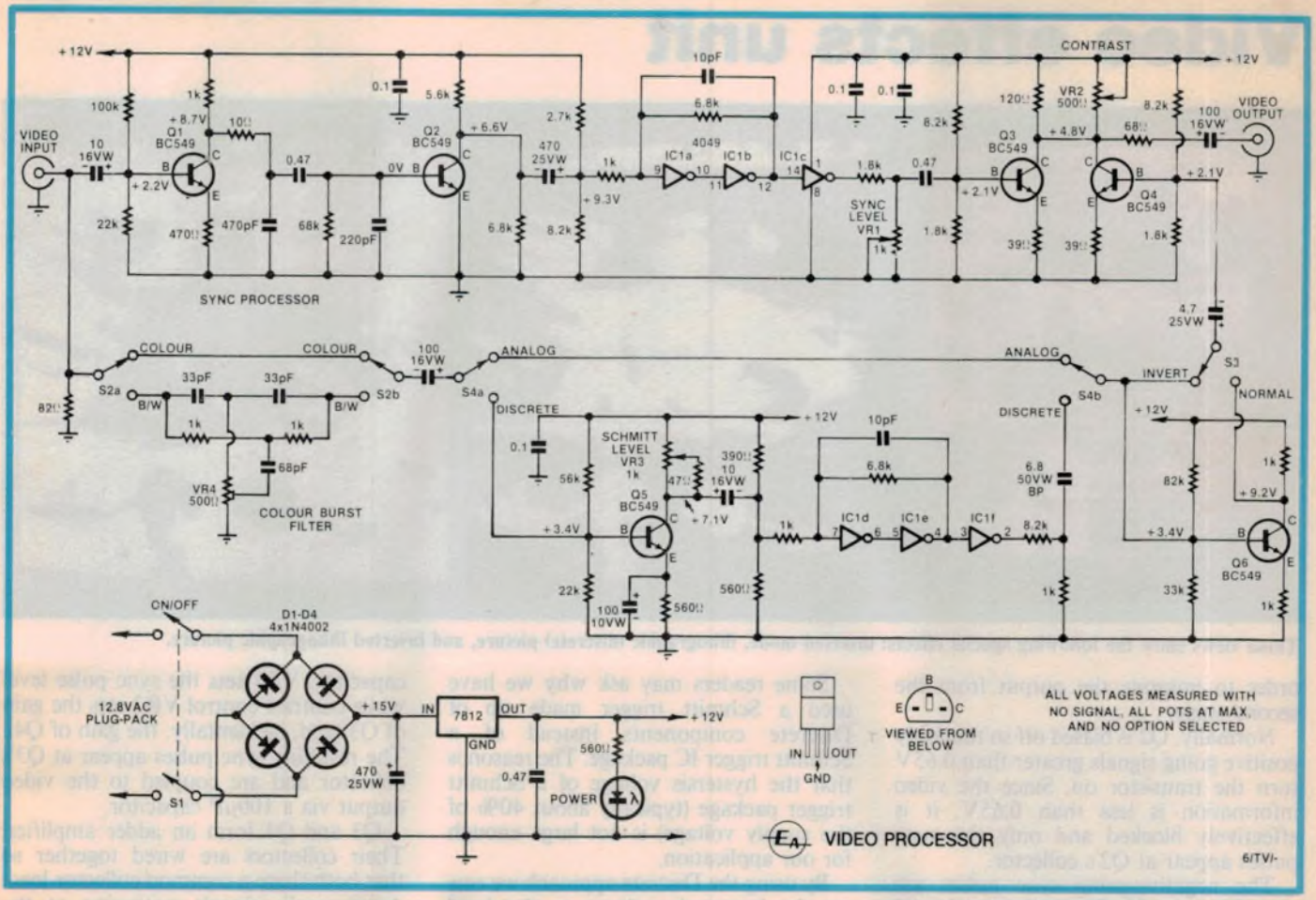
In fact, the Normal/Invert switch is particularly useful when watching the cricket. If the Aussies are playing the West Indies and getting murdered, just flick the invert switch and all will be well. Handy little gadget, isn't it?

The remaining switch on the front panel is the Analog/Discrete signal selector switch. When selected to the analog position, this allows the video signal to pass through the processor as an analog signal.

On the other hand, if the Discrete position is selected, the video signal will be processed into a two level signal. The effect of this is to change any signal into a picture made up of only black and white — all shades of grey are pushed to either of these two colours. In other words, shades above mid-grey will become black while shades below mid-grey will become white.

For want of a better term, we've elected to call this the lithographic picture effect. This process can be used in conjunction with signal inversion if required.

The Video Processor is housed in an attractive metal console case.



The circuit consists of a sync processor (Q1-Q3) and a video processor (Q5-Q6).

Control knobs

Now let's take a look at the various control knobs. The first knob sets the size or amplitude of the sync signal. This adjustment is necessary because signal processing affects the amplitude of the sync signal and we need to restore it to normal.

Next is the Contrast control knob which varies the amplitude of the video signal to give a full range of tonal values between black and white. If the amplitude of the video signal is too high, some of the darker greys will be reproduced as black while lighter greys will become white.

Conversely, if the video amplitude is too low, we will not get the full tonal gradation from black to white.

The final control, the Schmitt Level knob, is used only when the Discrete option is selected. This control varies the amount of signal which is converted into one of two levels, either black or white.

How it works

Six NPN transistors and one 4049 hex inverter IC make up the circuit for the Video Processor.

So why have transistor amplifier stages been used instead of op amps? The reason for this is quite simple: a video signal includes frequency components of the order of several megahertz. No cheap, readily available op amp is capable of operating at such high frequencies.

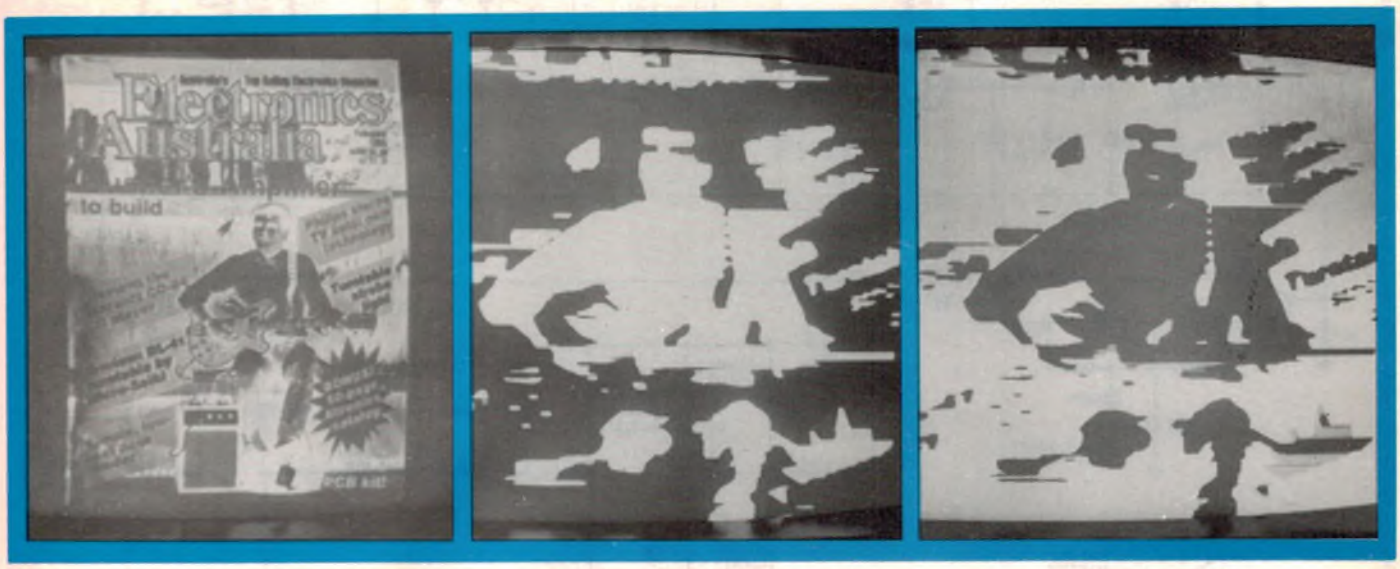
Basically, the circuit can be split into two sections: a sync processor and a signal processor. Let's start with the sync processor. This comprises transistors Q1, Q2 and Q3, and inverter stages IC1a, b and c.

Transistor Q1 functions as an inverter stage with a gain of two. While this stage inverts the entire video waveform, its primary function it to invert the sync pulse. The signal output is extracted from Q1's collector and fed via a low pass filter (10Ω and 470pF) to a second inverting transistor stage, Q2.

The filter is used to remove as much unnecessary signal content as possible in

Normal on-screen picture. Compare this with the photographs on page 36.

Video effects unit



These views show the following special effects: inverted mode, lithographic (discrete) picture, and inverted lithographic picture.

order to improve the output from the second stage.

Normally, Q2 is biased off so that only positive-going signals greater than 0.65V turn the transistor on. Since the video information is less than 0.65V, it is effectively blocked and only the sync pulses appear at Q2's collector.

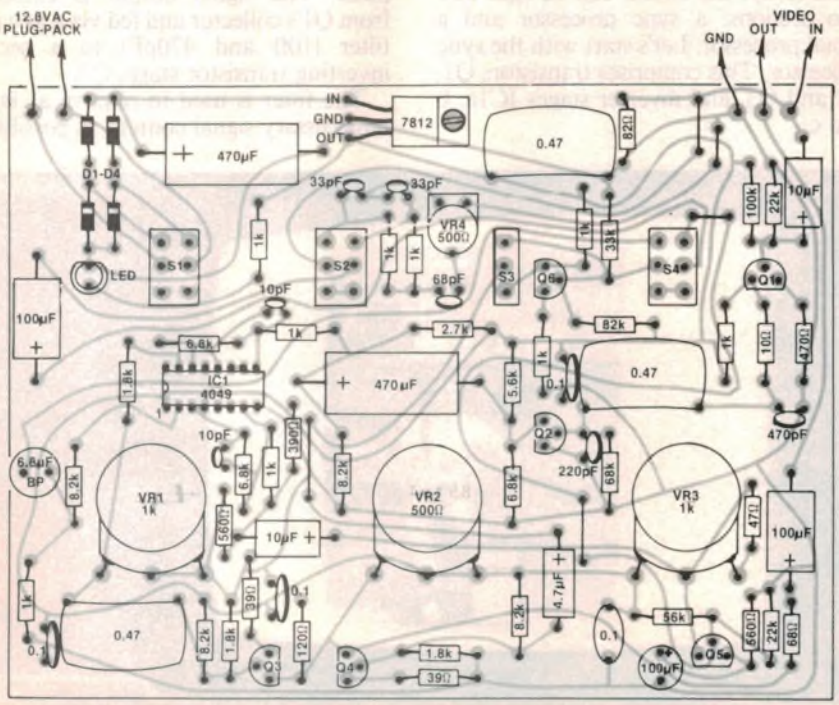
The negative-going sync pulses are now fed to a 470μF capacitor, re-biased and applied to a Schmitt trigger stage consisting of IC1a, 1b and the associated 1kΩ and 6.8kΩ resistors. This stage amplifies and cleans up the sync pulse to ensure a jitter-free picture.

Some readers may ask why we have used a Schmitt trigger made up of Discrete components instead of a Schmitt trigger IC package. The reason is that the hystersis voltage of a Schmitt trigger package (typically about 40% of the supply voltage) is not large enough for our application.

By using the Discrete approach we can set the hysteresis voltage to the level required. The resistor values shown give a hysteresis of about 8V.

Finally, the amplified sync pulses are inverted by IC1c and coupled to the base of Q3 via a voltage divider and a 0.47μF capacitor. VR1 sets the sync pulse level while contrast control VR2 sets the gain of Q3 (and, incidentally, the gain of Q4). The resulting sync pulses appear at Q3's collector and are coupled to the video output via a 100μF capacitor.

Q3 and Q4 form an adder amplifier. Their collectors are wired together so that both share a common collector load. As a result, signals appearing at the collector of Q3 are algebraically added to any signals appearing at the collector of Q4.



Parts overlay diagram. The pot lugs are soldered to PC stakes.

Signal processing

Let's now take a look at the signal processing circuitry. Its main components are a colour burst filter, common emitter amplifier Q5, inverters IC1d, e and f, and common emitter stage Q6.

Switches S2, S3 and S4 select the various effects. When switched to the positions shown on the circuit diagram, the video input signal is directly coupled to the base of Q4 via a 4.7μF capacitor. Since Q4 is an inverting amplifier, the video output signal at its collector will be inverted.

Note, however, that the sync pulses appearing at the video output socket will be of the correct polarity due to adder stage Q3, Q4. It's really very simple: a large amplitude sync signal from Q3 is added to the smaller, inverted sync pulses from Q4 to produce a sync signal of the correct amplitude and polarity.

During use, VR1 is simply adjusted for a stable, jitter-free picture.

Obtaining an inverted video image is thus quite easy. All we have to do is couple the video signal to an inverting transistor stage (Q4) and then add in sync pulses of the correct polarity and

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CS-1060	60 MHZ	3	6	1mV/div	$1795	$2064.25
CS-2075	75 MHZ	4	8	1mV/div	$2425	$2788.25
CS-2110	100 MHZ	4	8	1mV/div	$2895	$3329.25
CS-2150	150 MHZ	4	8	1mV/div	$2995	$3444.25
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Video effects unit

amplitude (Q3).

Suppose now that S2 is switched to the Normal position. The video signal is now fed to unity gain inverter Q6 before passing to Q4 in the adder amplifier. Thus, with S3 in the Normal position, the signal undergoes two stages of inversion and a normal (unprocessed) signal appears at the video output socket.

Switch S2 selects either a colour or B/W picture. Actually, removing the colour information from a video signal is not all that easy and requires quite complex circuitry. Fortunately, there is a simpler solution!

A colour TV set can only reproduce a colour picture if it receives a colour burst signal. This signal normally serves as a phase reference for the colour decoder. If the colour burst signal amplitude drops below a preset level, or if the signal is removed, the colour killer circuitry cuts in and "kills" the colour.

That makes our job easy — we can convert a colour picture to B/W simply by filtering out the 4.43MHz colour burst signal.

This function is performed by a passive twin T filter network consisting of VR4 and its associated components. When S2 is switched to the B/W position, the filter inserts a deep notch in the video waveform at 4.43MHz to effectively remove the colour burst signal. Trimpot VR4 enables the filter to be adjusted to the correct centre frequency.

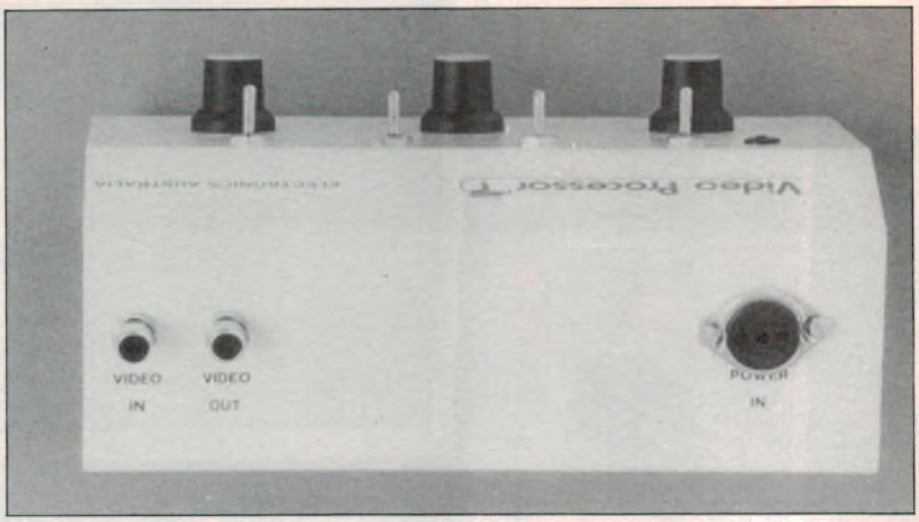
Unfortunately, the colour burst filter also filters out some of the wanted video information, giving a slight degradation in picture quality. In particular, there is some loss of picture sharpness and detail. These losses are not serious, however, and are a small price to pay in order to keep the circuit simple.

The final section of the signal processor is based on inverting amplifier Q5 and Schmitt trigger IC1d, e.

Here's how it works. When S4 selects the Discrete position, the video signal is fed to common emitter amplifier Q5 which has variable AC gain as set by VR3. Q5 amplifies the video signal and feeds it to the Schmitt trigger which effectively removes all "greys" from the picture.

In effect, some of the greys are pushed to white and the darker greys are pushed into black. VR3 varies the amplitude of the video signal so that low contrast pictures (eg, night-time scenes) operate the Schmitt trigger.

Inverter IC1f provides polarity correction of the Schmitt trigger output. From there, the signal is applied to a resistive divider which sets the video level and then coupled to S4b via a 6.8μF bipolar electrolytic capacitor. Depending on the setting of S3, the signal is then either fed to inverting stage Q6 or coupled directly into Q4 in the adder amplifier.



The rear panel carries RCA video input and output sockets and a power input socket.

Power supply

The power supply uses a 12VAC plugpack transformer to drive a bridge rectifier (D1-D4) and a 470μF filter capacitor. This provides about 15VDC and this is fed to a 12V 3-terminal regulator (7812). The regulated 12V DC powers all the circuitry, including an indicator LED wired across the supply rails in series with a 560Ω resistor.

Construction

The Video Processor is housed in an attractive metal case with a sloping front panel. Of New Zealand manufacture, this case features a sturdy aluminium base finished in grey enamel and fitted with small rubber feet. The top cover has a contrasting white finish and is secured to the base by four self-tapping screws.

A Scotchcal front panel artwork was used to give the unit a professional appearance. This artwork is reproduced full-size with this article.

All the circuitry, including the pots and switches, is accommodated on a printed circuit board measuring 162mm x 121mm and coded 85tv4.

Begin construction by assembling the PC board according to the wiring diagram. No special procedure need be followed although we suggest that the smaller components be installed first. The LED should initially be solder-tacked at the extremities of its leads.

Note that the 0.47μF capacitors should rest against the PC board as

PARTS LIST

1 PC board, code 85tv4, 162mm x 121mm
1 metal console box, 175(W) x 150(D) x 25(hf) x 60mm(hr), Betacom IC5-2
1 Scotchcal front panel, 170mm x 255mm
1 12VAC plugpack transformer
3 DPDT miniature toggle switches
1 SPDT miniature toggle switch
3 control knobs
1 socket to suit plugpack transformer
2 panel-mounting RCA sockets
14 PC stakes

Semiconductors

4 1N4002 diodes
1 7812 12V 3-terminal regulator
1 red LED plus mounting bezel
1 4049 hex inverter/buffer
6 BC549 NPN transistors

Capacitors

2 470μF 25V axial electrolytics
3 100μF 16V axial electrolytics
2 10μF 16V axial electrolytics
1 6.8μF 50V bipolar PC-mounting electrolytic
1 4.7μF 25V axial electrolytic
3 0.47μF polyester (greencap)
4 0.1μF ceramic
1 470pF ceramic
1 220pF ceramic
1 68pF ceramic
2 33pF ceramic
2 10pF ceramic

Resistors (0.25W, 5% tolerance)

1 x 100kΩ, 1 x 82kΩ, 1 x 68kΩ, 1 x 56kΩ, 1 x 33kΩ, 2 x 22kΩ, 4 x 8.2kΩ, 3 x 6.8kΩ, 1 x 5.6kΩ, 1 2.7kΩ, 3 x 1.8kΩ, 8 x 1kΩ, 3 x 560Ω, 1 x 470Ω, 1 x 390Ω, 1 x 120Ω, 1 x 82Ω, 1 x 68Ω, 1 x 47Ω, 2 x 39Ω, 1 x 10Ω.

POWER IN

VIDEO OUT

VIDEO IN

Video Processor

ELECTRONICS AUSTRALIA

POWER

B/W

COLOUR

INVERT

NORMAL

DISCRETE

ANALOG

SYNC LEVEL

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SCHMITT LEVEL

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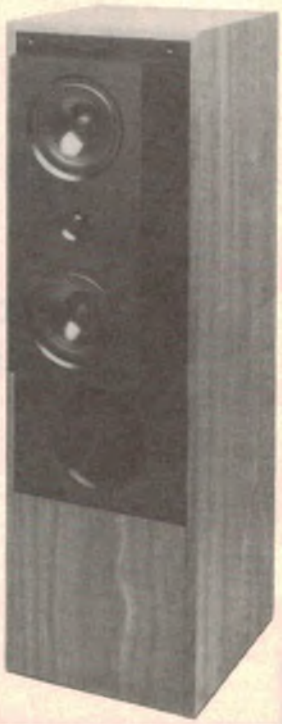

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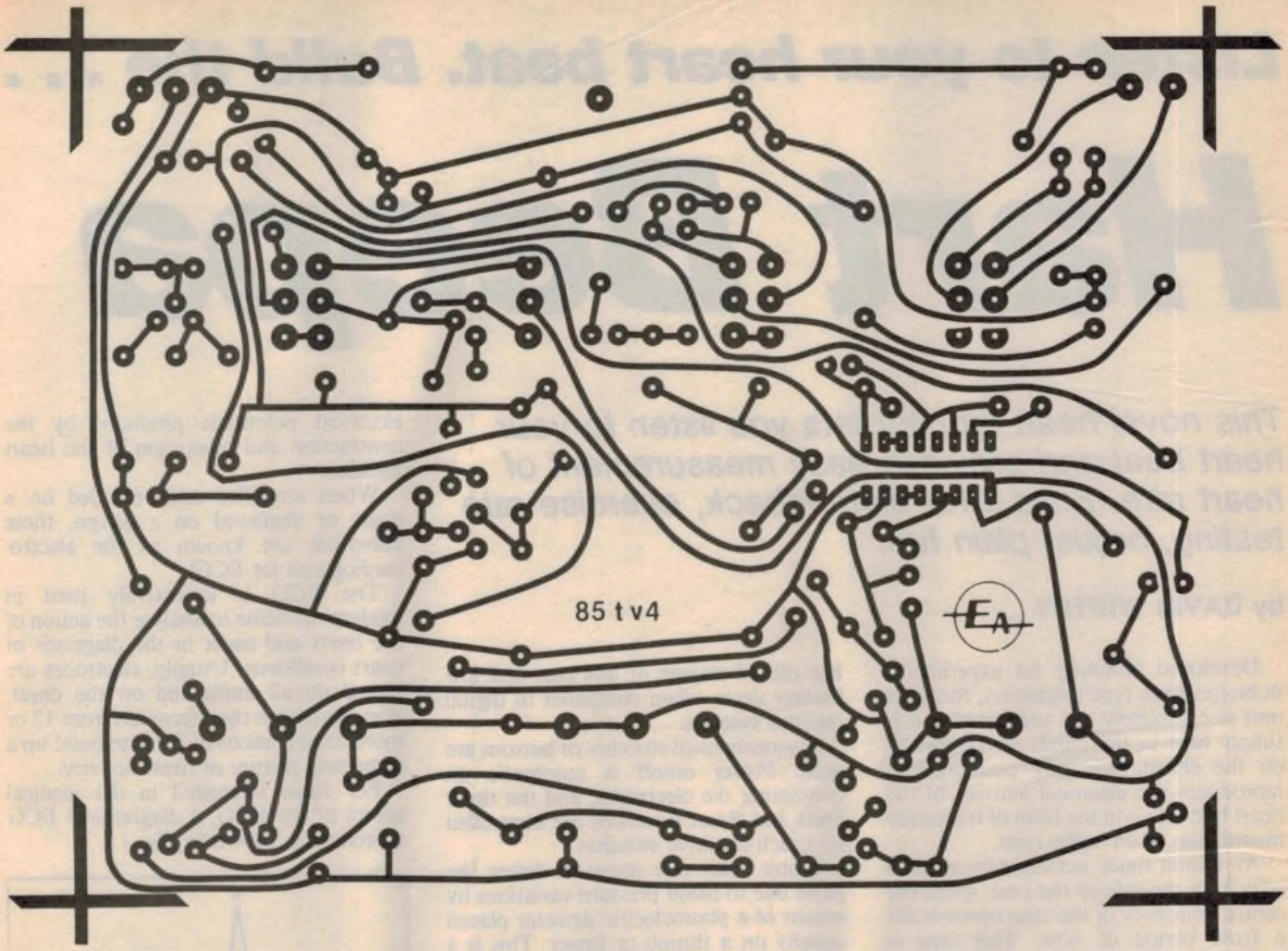


Video effects unit

shown in the wiring diagram. The metal tab of the 7812 regulator is mounted flat against the board and is secured using a small screw and nut.

PC stakes are used to terminate the external wiring connections and the pot lugs. The pots rest on the circuit board and should be mounted as close to the PC stakes as possible. Some judicious bending of the pot lugs will be necessary.

The four switches are soldered directly to the board. Make sure that they are correctly located before soldering. Check your work carefully and note the orientation of the semiconductors and electrolytic capacitors.

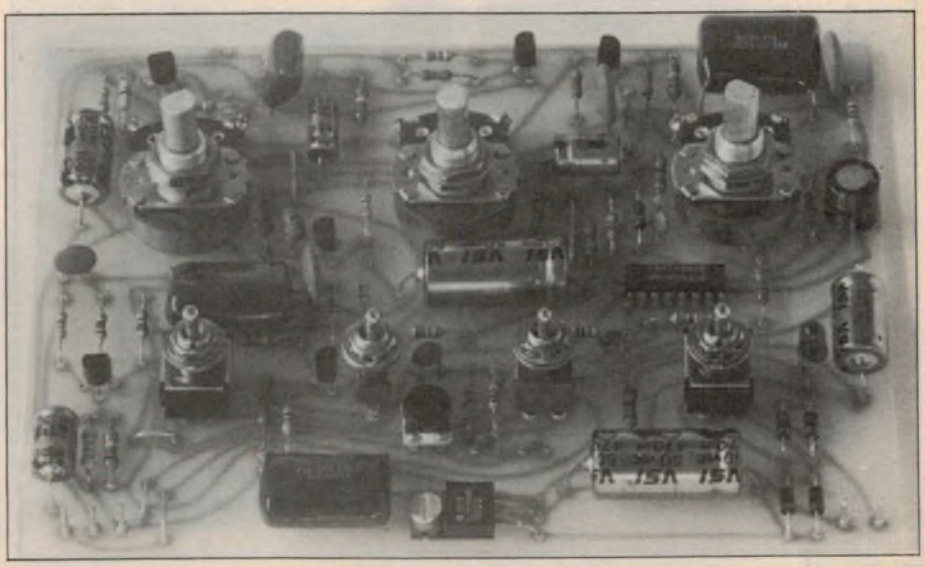
The PC board must be tested before it is mounted in the case. Connect a suitable video source (eg, a camera or VCR) to the input socket and a VCR or colour monitor to the output. Switch on, check the operation of the various controls, and adjust VR4 so that the unit "kills" the colour when the B/W option is selected.

In order to obtain a stable picture, it will usually be necessary to adjust the Sync and/or Contrast controls each time Invert or Normal are selected. Note that there is a certain amount of interaction between these two controls.

Assuming the board checks out, your attention can be turned to the metalwork. Trim the Scotchcal label to size, then carefully affix it to the lid of the case. The case can now be drilled to accept the front and rear panel hardware.

We used two panel-mounting RCA sockets for the video input and output connections. The only other item on the rear panel is the power socket.

Finally, the PC board can be secured to the lid by means of the switch and pot bushings, and the wiring to the rear panel completed. The LED is affixed to the front panel using a bezel. Note that it may be necessary to adjust the length of the LED leads.



The final version differs slightly from this prototype board assembly.

Listen to your heart beat. Build the . . .

Hart Beepa

This novel heart monitor lets you listen to your heart beat and provides easy measurement of heart rate. Build it for biofeedback, exercise rate testing, or just plain fun.

by DAVID WHITBY

Developed primarily for experiments in biofeedback type relaxation, this little unit is completely self contained and is simply held in the hands (or positioned on the chest). Correctly positioned, it reproduces the electrical activity of the heart (the ECG) in the form of frequency modulation of an audio tone.

An inbuilt timer, activated by a touch switch on the side of the case, shifts the centre frequency of the tone upwards for a fixed period of time. This time is internally adjustable, but is best set to either 15, 20 or 30 seconds. By counting the beats which occur during this time and multiplying by the appropriate factor (4 for 15 seconds, 3 for 20 seconds or 2 for 30 seconds), the heart rate is obtained.

This method is simple and reliable and has the advantage of low cost and low battery drain when compared to digital readout systems.

No mechanical switches or buttons are used. Power on/off is automatic on contacting the electrodes, and the timer Start and Reset functions are controlled by touch-sensitive switches.

Many heart rate monitors detect the pulse due to blood pressure variations by means of a photoelectric detector placed usually on a thumb or finger. This is a valid and useful method. It works well on most people, but problems can be encountered when blood pressure is on the low side or circulation is reduced due to cold temperatures or some other factor.

The *Hart Beepa* does not rely on the pulse. Instead it detects and amplifies the electrical potentials produced by the contraction and relaxation of the heart muscles.

When amplified and recorded on a chart or displayed on a screen, these potentials are known as the electrocardiograph (or ECG).

The ECG is extensively used in modern medicine to analyse the action of the heart and assist in the diagnosis of heart conditions. Usually, electrodes are placed on all limbs and on the chest. Waveforms are then recorded from 12 or more combinations of these to build up a composite picture of heart activity.

For those interested in the medical aspect of the ECG, a diagramatic ECG waveform is shown in Fig. 1.

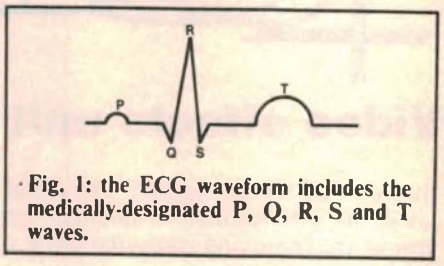


Fig. 1: the ECG waveform includes the medically-designated P, Q, R, S and T waves.

By presenting the ECG as an audio tone, as in the *Hart Beepa*, it becomes possible to actually hear the individual parts of the waveform, especially when the heart rate is slowed down.

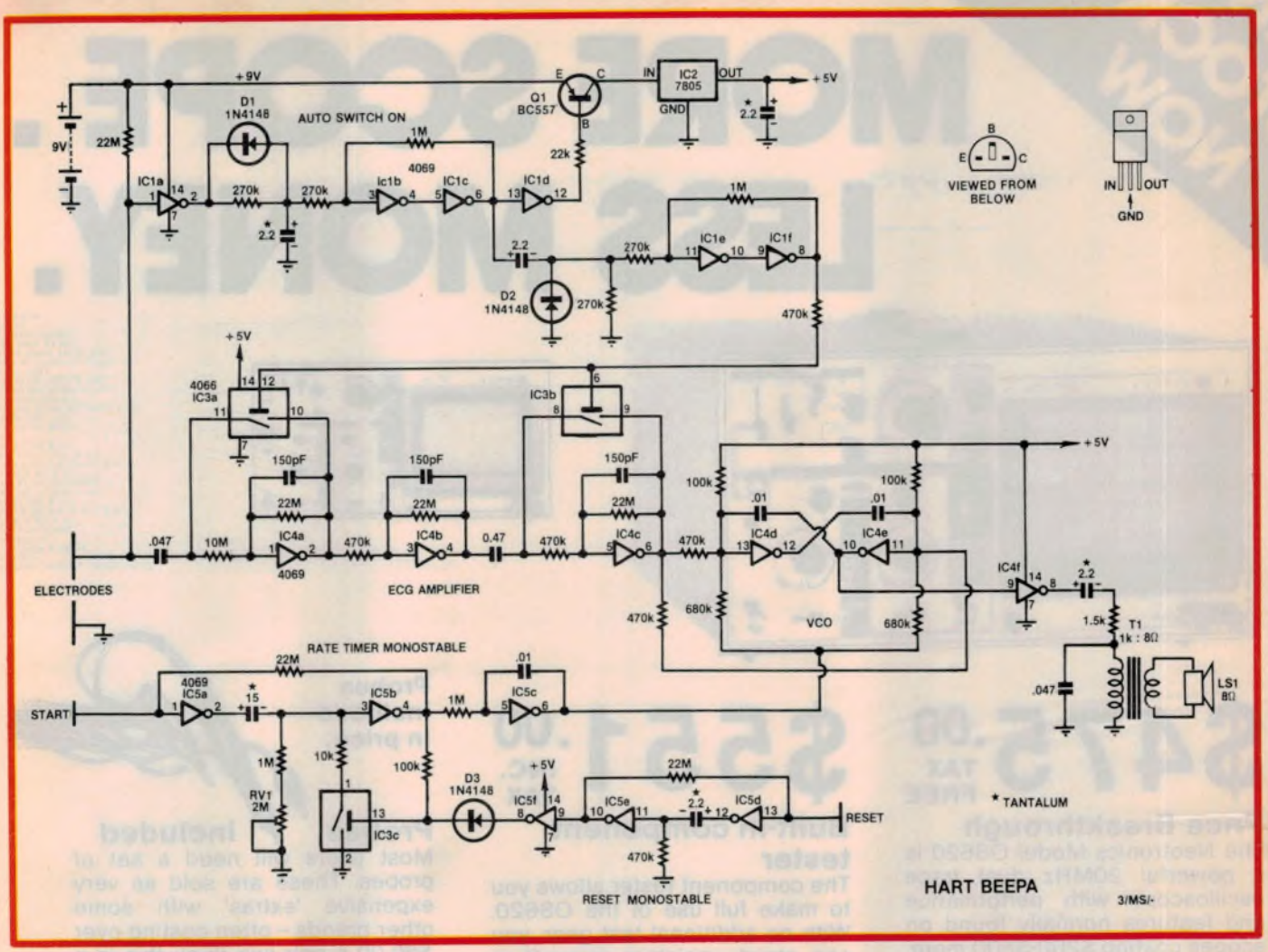
Biofeedback

This is a technique that has become popular in recent years. Basically it consists of monitoring a particular body parameter such as skin temperature, muscle activity, brain wave activity (EEG) or heart activity, and learning to relax and consciously change the reading to a more favourable level. This is said to lead to improved health and a sense of well being.

In the case of the heart, the exact rate is not at all critical and 60-100 beats per minute can be considered quite normal. The rate depends on many factors — small children may have rates over 150 beats per minutes. The heart rate also increases dramatically during strenuous exercise.

However, it may be generally stated

The Hart Beepa is housed in a plastic case with silk-screened lettering.



The circuit consists of an ECG amplifier, a VCO, a timer, and an automatic on/off switch.

that as a person becomes more relaxed (preferably in a comfortable position), then the heart rate becomes slower. Similarly, by consciously learning to lower the rate the state of relaxation may be increased.

This is where the *Hart Beepa* comes in — by simply listening to the rhythmic heart waveform while in a comfortable resting position, it is possible to learn to lower the rate and so produce an increased state of relaxation.

Actual rate readings may be taken from time to time if desired by operating the timer as previously discussed. Measurement of heart rate before and after exercise is an established technique for determining fitness levels — especially in the time taken for the rate to return to the at rest level after exercise.

Apart from this "serious" application the *Hart Beepa* will find much use as an experimental and educational "technical toy". Just passing it around a group of friends produces much fascination as the individual heart rhythms are made audible.

Where to buy the kit

The *Hart Beeper* can be purchased from Technicraft Electronics, 338 Katoomba St, Katoomba, NSW 2780. Phone (047) 82 3418.
Three versions are available:
(1) A complete kit of parts, including full instructions and information leaflets but no battery. Price $35.00 plus packing and postage. Order BP001.
(2) As above but with fully assembled and tested circuit board. Price $49.50 plus packing and postage. Order BP002.
(3) Fully built and tested unit with heavy duty battery. Price $59.50 plus packing and postage. Order BP003.
Packing and postage: Australia $4.75; New Zealand $7.50 (airmail).

Circuit description

The circuit is built around standard CMOS ICs and may be broken down into four sections: an ECG amplifier, a voltage controlled oscillator (VCO), a rate timer, and an automatic on/off switch. We'll consider each section in turn.

ECG amplifier: This consists of three CMOS inverter stages (IC4a,b,c) connected as an AC amplifier with an overall gain of approximately 800. The bandwidth extends from 0.5Hz to 70Hz and the input impedance is 10MΩ.

High input impedance is essential for reliable ECG work and is readily obtainable with CMOS devices.

The average ECG signal, as measured between the palms of the hands, into a high impedance is around 1mV so that a signal of around 800mV is available at the output of the amplifier.

From the chest, signals of 3 — 5mV are common, depending on positioning and electrode spacing. With the electrode spacing on the *Hart Beepa*, approximately 2mV can be expected from the chest, thus producing about twice the frequency swing as when held

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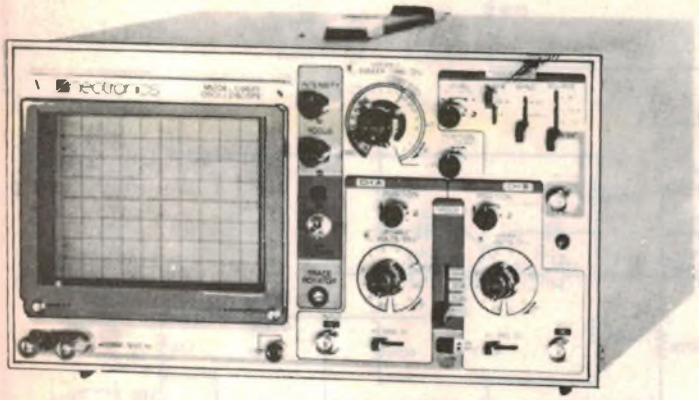

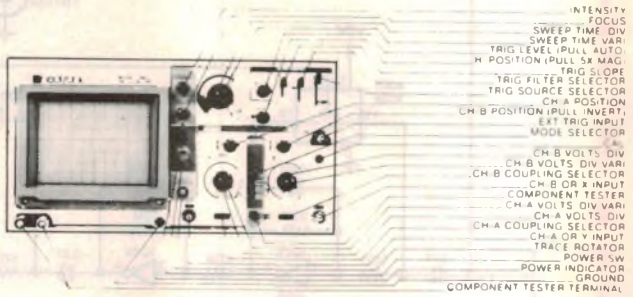

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The component tester allows you to make full use of the OS620. With no additional test gear, you can check resistors, capacitors and zener diodes as well as trouble shoot solid state circuits. Testing signals are available via the COMP. TEST terminals.

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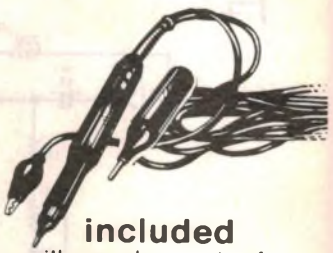

Probes included

Most users will need a set of probes. These are sold as very expensive 'extras' with some other brands – often costing over $60.00 a pair (we think this is a bit like selling a car and then saying it's extra for the tyres!). The Neotronics OS620 comes complete with a pair of high quality probes.

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The Neotronics OS620 is a precision measuring instrument. The tube is 150mm flat screen/ internal graticule type with 2kV acceleration potential. The bandwidth is a full 20MHz on both channels. Others offer round faced tubes, plastic graticules, less bandwidth, yet cost more! Intensity modulation is built in.

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Hart Beepa

in the hands.

Because the circuit floats with respect to the mains, AC interference is not a problem as it is with equipment that is connected to the "outside world". Complex differential amplifiers, as used in mains operated equipment, are unnecessary for clean ECG signals and, as an added bonus, complete electrical safety is ensured.

The two CMOS bilateral switches (IC3a,b) are used to ensure fast baseline stabilisation of the amplifier after switch on. This is accomplished by holding the switches on for approximately 1 second after power up. This allows the .047μF and 0.47μF coupling capacitors to quickly charge to their operating potentials so that the amplifier can start operating almost immediately.

Without this feature the amplifier would remain off-scale for 10 seconds or more due to the long time constants and high gain necessary for ECG work.

Baseline stability during operation is enhanced by the use of electrodes which have a low DC offset potential. Many metals produce considerable DC potentials (100mV or more) when in contact with the skin (due to battery effect — skin oils, perspiration etc) and this would cause erratic baseline behaviour.

The electrodes supplied with the kitset have been specially plated to minimise this effect and produce reliable and repeatable results.

Voltage controlled oscillator: This is a conventional cross-coupled multivibrator using CMOS inverters IC4d and IC4e. The frequency of oscillation is determined mainly by the inverter thresholds, the two .01μF capacitors and the two 100kΩ timing resistors.

Two more timing resistors, both of 470kΩ, are connected to the ECG amplifier output and allow modulation of the oscillator frequency by the ECG waveform. The two 680kΩ resistors set two distinct centre frequencies, depending upon the output of the rate timer monostable.

The exact frequency of operation is not all that critical and, with the timing constants chosen, the average centre frequency will be approximately 650Hz under normal operation, shifting up to approximately 880Hz during the timing period.

The output of the oscillator is buffered by IC4f and fed to a small loudspeaker via an RC network and a 1kΩ:8Ω audio transformer. The 1.5kΩ resistor determines the volume and was chosen by experiment. Various transducer types (both piezo and moving coil) were tried but the speaker/transformer combination produced the most pleasant sound.

The .047μF capacitor across the transformer primary reduces the harmonic content to further smooth the output sound.

Rate timer: This again is built around CMOS inverters and comprises a negative edge triggered monostable (IC5a,b) with finger touch triggering made possible by a 22MΩ feedback resistor.

The timing period is determined by the inverter thresholds, the 15μF capacitor, RV1 and a 1MΩ resistor.

RV1 is a precision 15-turn cermet pot with a range of adjustment from approximately 12 seconds to over 30 seconds. The timer is easily set up — all you need is your watch.

A 15 second period will generally be the most suitable for rate determination but, if you are after greater accuracy, the timer may be set to 20 or 30 seconds. Simply multiply by the correct factor to get the rate (x4 for 15s, x3 for 20s, or x2 for 30s).

A reset facility is provided by a similar (but shorter time period) touch triggered monostable (IC5d,e) for use in case of miscounts etc.

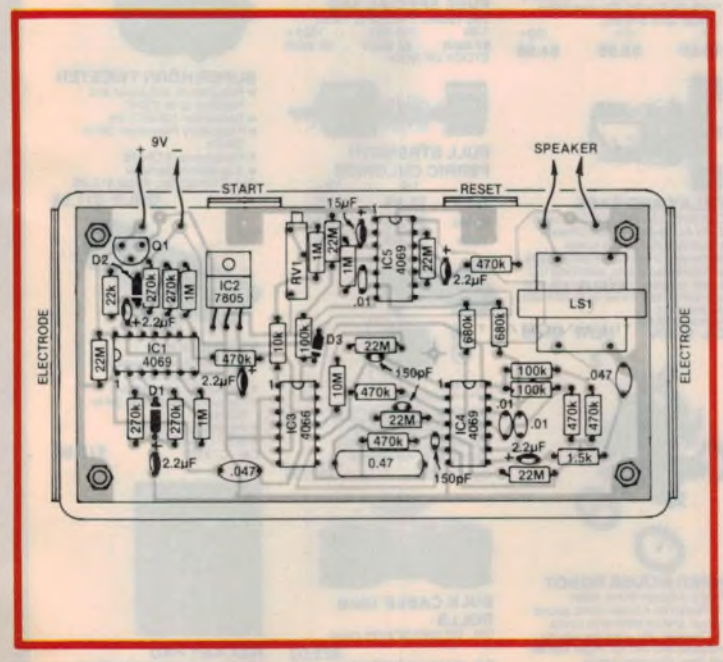
The CMOS bilateral switch (IC3) is used to quickly discharge the 15μF timing capacitor at the end of the timing cycle or when the reset circuit is operated. This allows immediate retriggering of the timer and prevents any inaccuracies which would occur if any charge were left on the timing capacitor at the start of a timing cycle.

An integrating network (1MΩ/.01μF) is used around IC5c to provide a "soft" shift in the oscillator frequency when the timer changes state (this is more pleasant to the ears than a sharp transition).

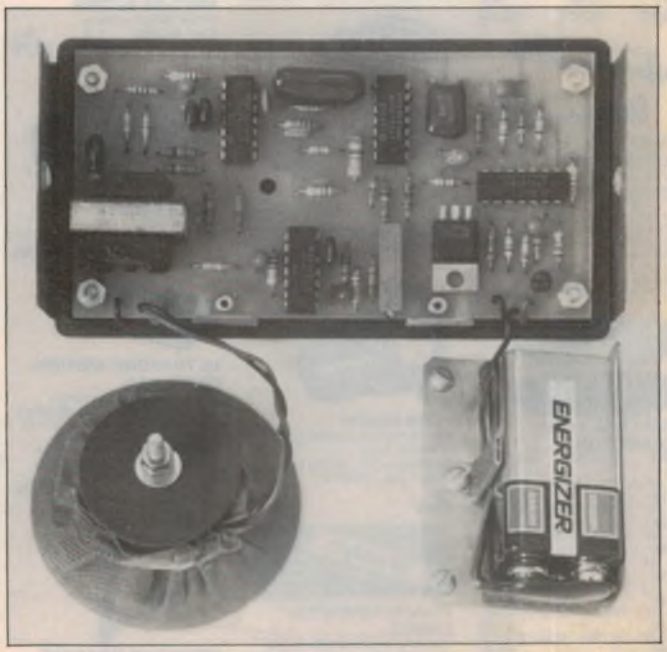
Automatic switch-on circuit: IC1a's input is normally held high by the 22MΩ resistor. When the body subsequently comes into contact with the electrodes, pin 1 is forced low and the pin 2 output goes high.

After a time interval determined by the following RC circuit, Schmitt trigger IC1b,c changes state and turns on Q1 via inverter stage IC1d. This supplies power to IC2 which provides a regulated +5V output for ICs 3, 4 and 5.

A second Schmitt trigger (IC1e,f) supplies power to the baseline stabiliser circuit (IC3) for approximately one



Parts layout diagram for the Hart Beepa.



This view shows the fully-assembled PC board.

rie

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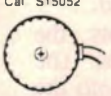

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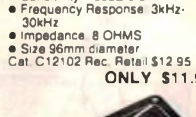

SUPER HORN

- Wide dispersion tweeter handles up to 100W.
- Sensitivity: 105dB/0.5m
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- Impedance: 8 OHMS
- Size: 145x54mm

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second after switch on.

Operating current for the whole circuit is approximately 4.5mA. Any grade of battery will give long life but, for most reliable service and long shelf life, an alkaline type is highly recommended.

Construction

The unit is built into a moulded plastic case measuring 65 x 120 x 40mm. This case features an attractive front panel with screened lettering, and will be supplied ready drilled.

All components are mounted on a printed circuit board which is fastened to the lid of the case. The two wraparound electrodes connect to the board via the mounting screws. The metal touch switch tabs for the timer are supplied rivetted and soldered to the board.

Fit the resistors to the PC board first, followed by the capacitors, the 15-turn potentiometer, the transformer and the semiconductors. Note carefully the orientation of the tantalum capacitors and the semiconductors.

After assembly and checking, solder the battery clip leads to the PC board and connect the loudspeaker. The speaker is mounted using a fibre disc and screw "pedestal". The disc is attached to the magnet using double-sided adhesive tape and the screw located through a hole in the board.

A small piece of red cloth is used for the speaker grille. This is simply stretched over the face of the speaker and fastened by a rubber band around the magnet.

Mechanical assembly

No great mechanical ability is required here.

First, attach the electrodes to the base with the countersunk screws, fasten with four nuts from the top and tighten firmly. The PC board is now placed over the screw threads, so that it rests on the nuts, and then fastened with another four nuts on the component side.

Tighten the nuts firmly with a nut-driver, then screw the two ¼-inch threaded spacers onto the remaining threads of the left side mounting screws (away from the speaker transformer). The battery holder can now be mounted on the spacers using the two short round-head screws supplied.

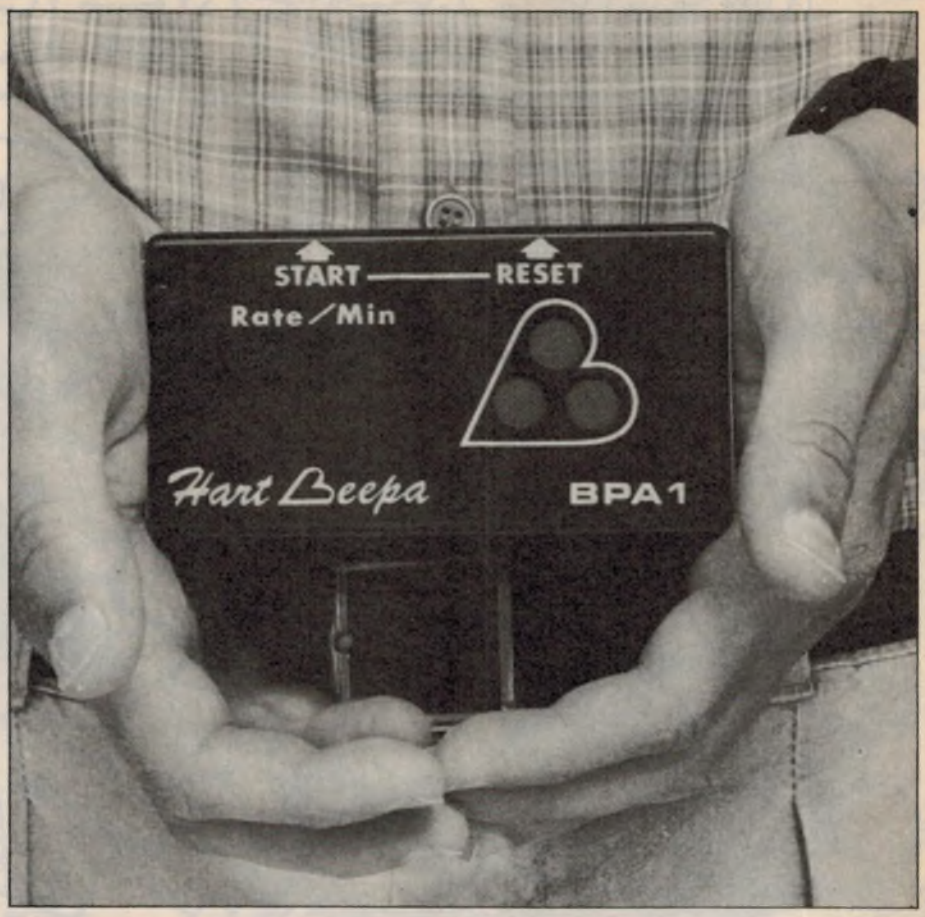
Testing

Fit a 9V battery and connect the electrodes together using a clip lead. If all is well you should hear a tone in the speaker.

Now, using another clip lead, momentarily short the timer start button to the electrodes. The tone should immediately shift to a higher pitch.

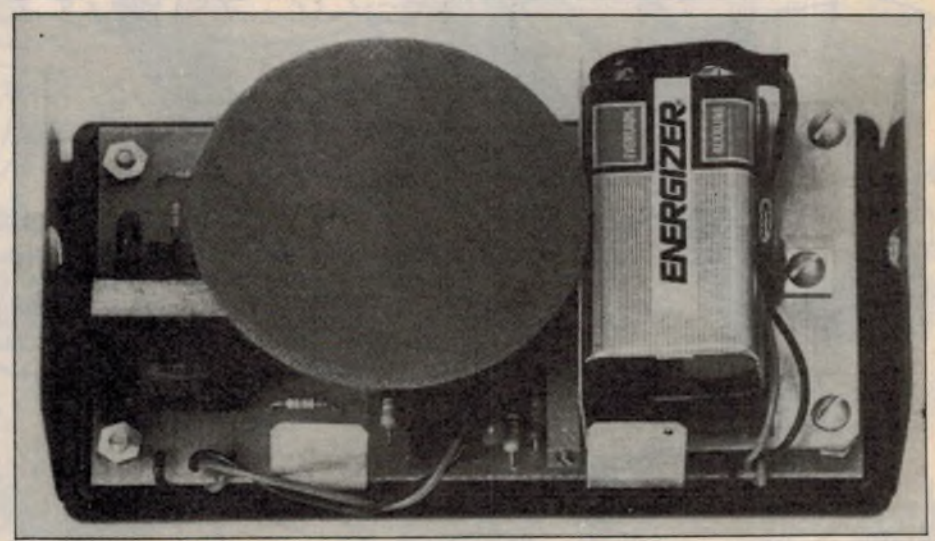
Assuming that the circuit works correctly, use your watch (or a stopwatch) to check the duration of the higher tone. Turning RV1 clockwise will increase the time while turning RV1 anticlockwise will reduce the timing period. Adjust RV1 for either 15, 20 or 30 seconds.

Finally, the case can be assembled and the two end screws fitted to secure everything in position. The *Hart Beepa* is now ready for use.

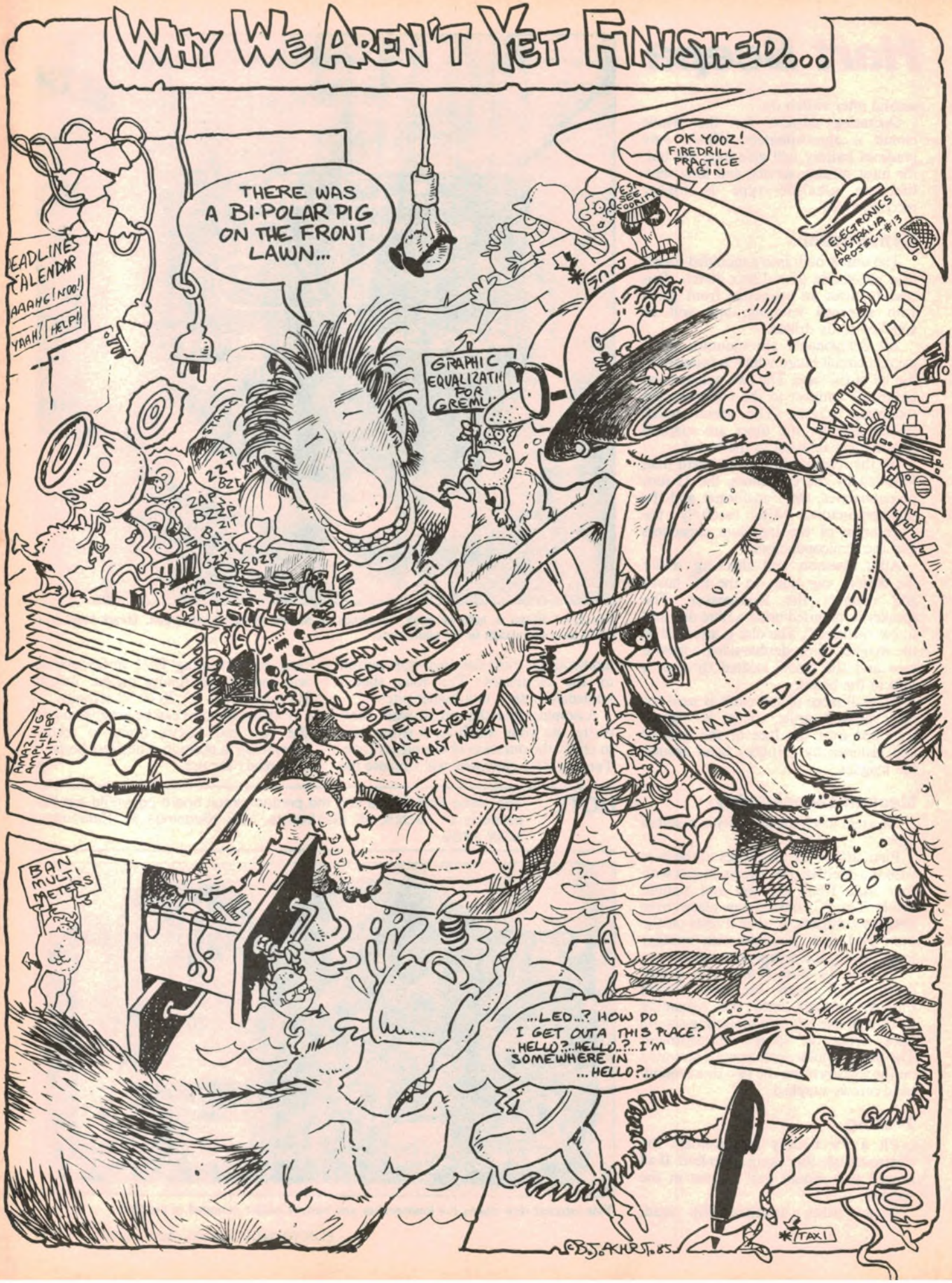


The Hart Beepa is held between the hands as shown in this photograph. Heart beats are heard as a slight shift in the audio tone.

NOTE The name *Hart Beepa* and the printed circuit board copyright are the property of Technicraft Electronics, 338 Katoomba St, Katoomba, NSW 2780.



This internal view shows the loudspeaker and battery holder mounted in position.


WHY WE AREN'T YET FINISHED...
DEADLINES CALENDAR
AAAHG! (NOO!)
YAAH! HELP!
THERE WAS A BI-POLAR PIG ON THE FRONT LAWN...
OK YOOZ! FIREDRILL PRACTICE AGIN
YES I SEE COORITY
ELECTRONICS AUSTRALIA PROJECT #13
GRAPHIC EQUALIZATI" FOR GREML
DEADLINES DEADLINES DEADL DEADL DEADLI ALL YESYERD OR LAST WEEK
MAN. ED. ELECT. OZ.....
AMAZING AMPLIFIER KIT....
BAN MULTI METERS
...LED...? HOW DO I GET OUTA THIS PLACE? ...HELLO?...HELLO...?...I'M SOMEWHERE IN ...HELLO?...
TAXI
©BJ.AHURST.85

Playmaster Series 200 amplifier

Yaaarrgh!!! It's not in here. *Electronics Australia* has tripped up again. The third article on the Playmaster Series 200 has had to be held over. Readers are up in arms all over the country. Why?

As the illustration on the opposite page indicates, we have had some problems with the mighty Playmaster Series 200 amplifier which have prevented us from bringing you the third article on construction. Not to put too fine a point on it, the phono inputs have been the problem. Because the phono inputs are physically close to the transformer, hum was being induced into them. This was in spite of the fact that the transformer is a low flux-leakage toroidal type which we enclosed in a metal box.

Loud rectifier buzz radiated from the transformer was being induced into the signal loop formed when a cartridge is connected to the inputs.

The problem was exacerbated by the additional gain and circuit components required for the moving coil mode. If we judged the phono inputs in moving magnet mode to be unacceptable (and we did), it was horrendous for the moving coil mode.

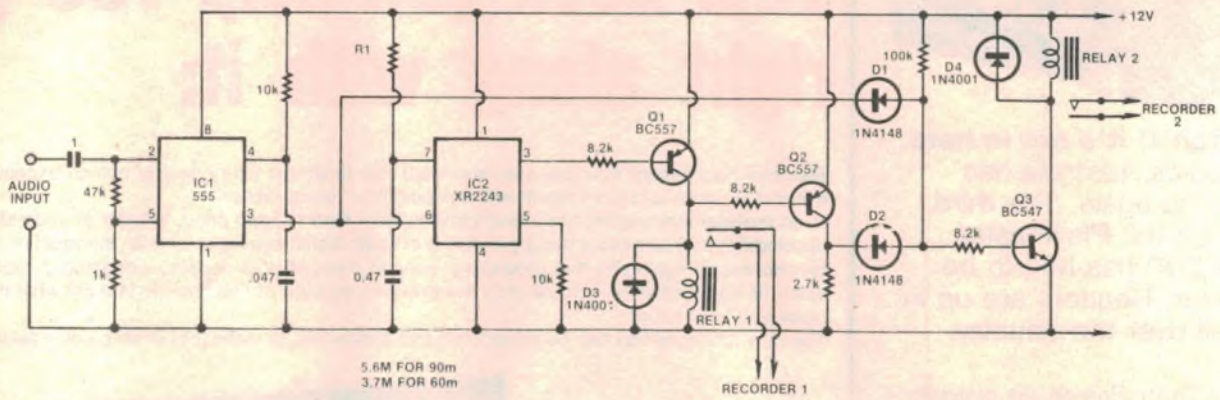
We had been battling with this dilemma for several months and have now fully resolved it. The reason it has taken so long to resolve the problem has been that we were reluctant to downgrade the performance parameters in any way. And we have not. Unfortunately, the solution was arrived at too late to present the third article.

Briefly, we have had to modify the circuit layout for the phono preamplifier and, unfortunately, omit the circuit components for the moving coil circuitry. In fact, we have had to construct an entirely new prototype amplifier to fully prove the design. We will bring you the details next month in the constructional article. Promise! Really, we will!

We apologise to readers and our advertisers for any inconvenience. It will be well worth the wait.

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. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.



Sequential controller for tape recorders

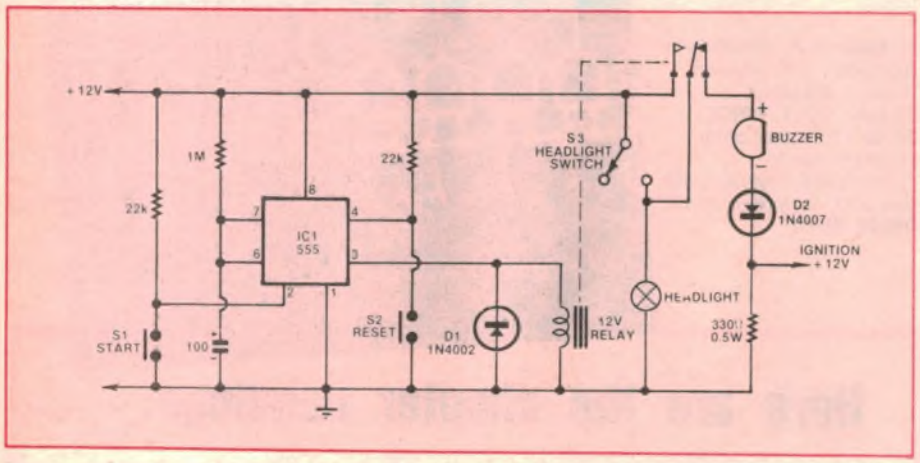
Up to 90 minutes of recording can be performed automatically using this sequential switch to control two cassette recorders. It is activated by an audio signal from a clock radio.

IC1 (a 555) operates as an audio trigger, with pin 3 going high when the input signal to pin 2 exceeds 1V. Once pin 3 goes high, monostable oscillator IC2 (an XR2243) is triggered. R1 and the 0.47μF capacitor set the monostable period. R1 should be around 5.6MΩ for a 90-minute recording period, although component tolerances may call for some experimentation.

During the first half cycle of IC2's operation, its output (pin 3) will be low. Q1 thus turns on and drives relay RLY 1 to control one of the cassette recorders. After 45 minutes, pin 3 of IC2 goes high and Q2 turns on. D2 is now reverse biased and Q3 turns on to activate RLY 2.

Diodes D1 and D2 form an AND gate. These work in conjunction with Q2 to ensure that Q3 remains off prior to the initial audio signal and during the first half cycle of IC2. When Q1 is on, Q2 is off and the base of Q3 is pulled low via D2 and the 2.7kΩ resistor. Similarly, when pin 3 of IC1 is low, Q3 is held off by D1.

I. Davies
Cheltenham, Vic. **$20**



Headlight control circuit

This circuit incorporates both a headlight reminder and a delay circuit. The reminder circuit is quite standard. Connected between the ignition and headlight switches, it operates a buzzer if the headlights are left on when the ignition is switched off. It is, however, disabled when the delay is activated.

A 555 timer IC is used to provide a preset period of headlight operation when the ignition is switched off. Configured as a bistable oscillator, the 555 controls a relay for the duration of the delay once the "Start" switch has been pressed.

The duration of the cycle is determined by the setting of the 1MΩ potentiometer and can be varied over the range one to 120 seconds. This provides a delay during which the driver can exit from the car and lock the garage or negotiate the garden path. The cycle can be terminated at any time by pushing the reset switch.

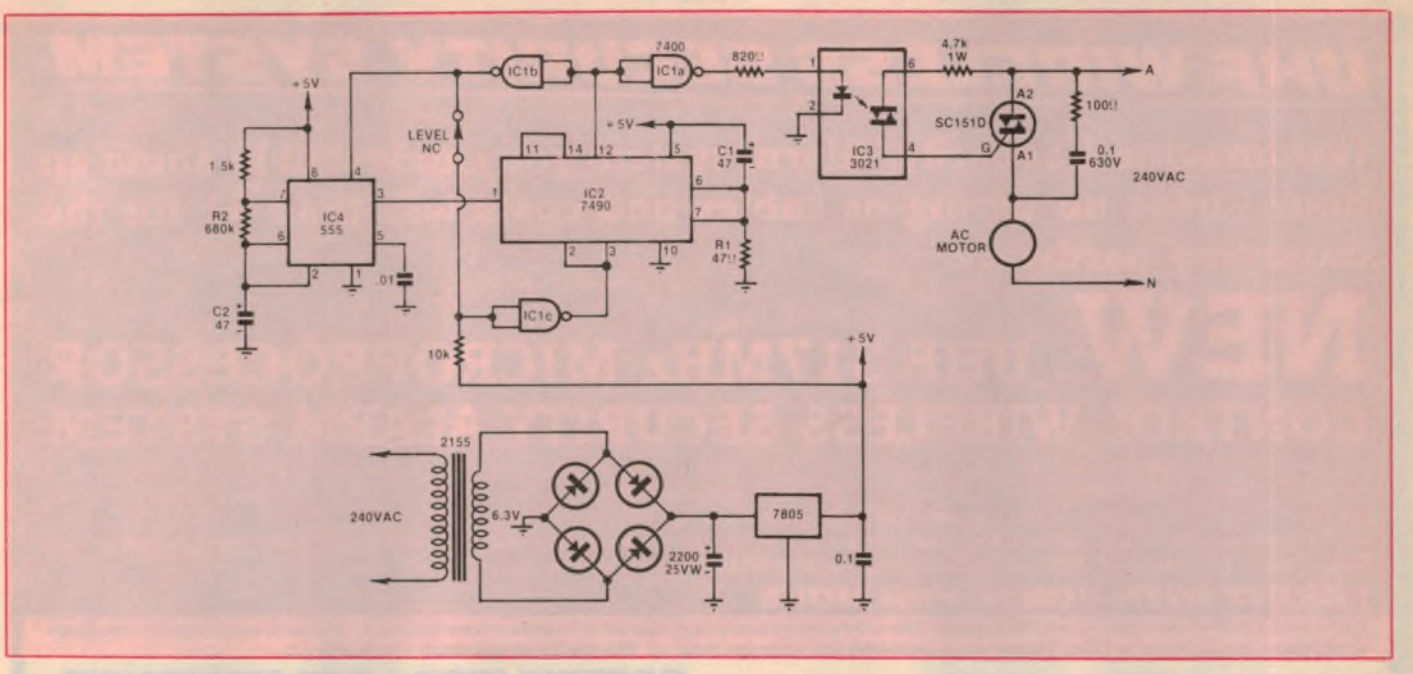
P. Howarth,
Gunnedah, NSW **$20**

Program for RS232 printer interface

This corrected version of the program used for the RS232 Printer Interface published in EA, February '81 can be used with the Super 80 computer. It can also be used with other machines having 16K of RAM when interfaced to 300 baud printers.

The error occurred in line 19 (:FOR I = 1 TO BR:READ D:NEXT I). The NEXT I should be at line 24. The program has also been shortened to facilitate the compatibility with 16K computers.

```
CLS
1 ' brother EP-44 Printer Program for
  SYSTEM 80
2 ' Modified & Errated by R. De La
  Torre
```



Cistern pump timer

This circuit was devised as a demonstration unit for toilet cisterns. The pump operates when pin 12 of IC2 is low. This causes the output of inverter IC1a to be high which operates the optocoupler IC3 to turn on the Triac.

At switch-on, the combination of R1 and C1 cause the 7490 decade counter to set to BCD 9 (1001). This means that pin 12 will be high and the Triac will be off. The output of IC1b will also be low which disables the 555, IC4. If the water level switch is open (ie, tank full), the output of IC1c is low and the 7490 is not reset and the circuit remains in this condition.

When the water level switch closes, IC1c will reset IC2 which causes pin 12 to go low and turn on the Triac. This also enables the 555 which delivers pulses to the 7490. This then counts up the pulses until pin 12 again goes high, turning off the pump. With the values shown for R2 and C2, the pump cycle time is about seven minutes.

D. Anderson,
Penguin, Tas. **$15**

```
 3 POKE 16396, 23
 6 POKE 16553, 255:MS = 32641
 7 POKE 16422, 129:POKE16423,
   127
 9 FOR I=0 TO 123: READ
   D:POKE MS+I, D:NEXT I
19 FOR I=1 TO 3:READ D
20 DH = INT(D/256):DL =
   D-256*DH
21 POKE MS+42, DL:POKE
   MS+43, DH
22 POKE MS+84, DL:POKE
   MS+85, DH
23 POKE MS+94, DL:POKE
   MS+95, DH
24 NEXT I
30 POKE 32701, 50:CLS:END
31 DATA 243, 62, 255, 211, 254, 229,
   33, 255, 1, 43, 62, 4, 211, 255, 124
32 DATA 181, 32, 247, 225, 121, 254,
   13, 40, 3, 254, 32, 216, 245, 229,
   197
33 DATA 6, 9, 55, 245, 245, 33, 5,
   252, 205, 33, 2, 33, 222, 0, 43, 124,
   181
34 DATA 32, 251, 241, 31, 245, 48,
   19, 33, 4, 252, 24, 19, 14, 2, 175,
   13
35 DATA 40, 2, 24, 219, 62, 10, 24,
   215, 24, 47, 198, 0, 33, 5, 252, 205
36 DATA 33, 2, 0, 0, 33, 222, 0, 43,
   124, 181, 32, 251, 16, 212, 17, 222,
   0
37 DATA 203, 74, 40, 11, 33, 4, 252,
   205, 33, 2, 27, 122, 179, 32, 251,
   241
38 DATA 241, 254, 13, 40, 198, 183,
   40, 197, 193, 225, 241, 201, 615
39 DATA 450, 222, 146, 108, 51, 23,
   8, 1
40 ' For EP-44 responses :—
41 ' BAUD RATE — 300
42 ' BIT LENGTH — 7
43 ' PARITY — Z
44 ' NEWLINE — CR + LF (NOTE
   TO HAVE LISTINGS WITH 2
   LINE
45 ' SPACES BETWEEN LINES
   THEN NEWLINE — CR only)
46 ' CODE — 7 BIT
47 ' ER — N
48 ' THIS PROGRAM SHOULD
   WORK ON ANY RS-232C
   PRINTERS WITH
49 ' 300 BAUD
50 ' WITH THE CIRCUIT IN EA
   February 1981
```

R.De La Torre,
Adamstown, NSW. **$20**

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1 x LA-5406	Remote

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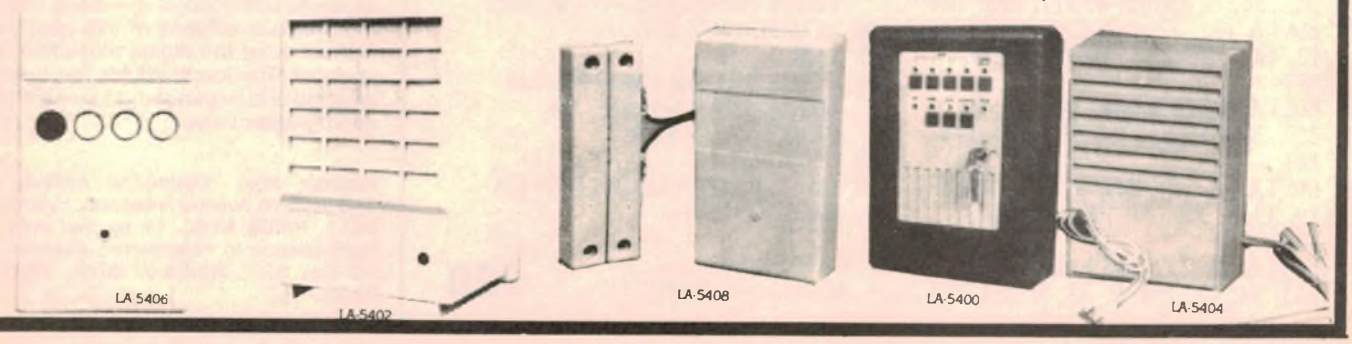

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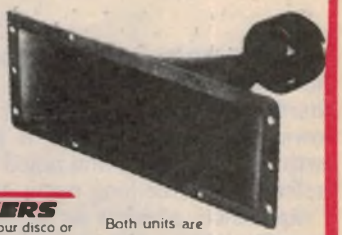

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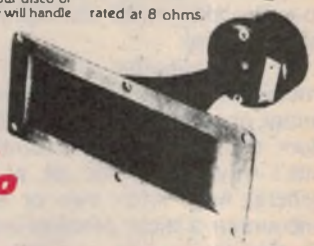

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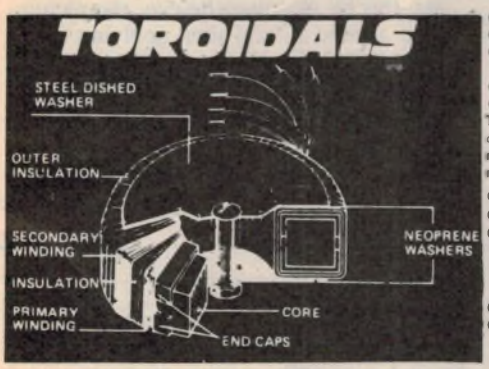

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The Serviceman

Close encounters of the first kind

One's first encounter with a particular model set can sometimes be both frustrating and unprofitable. If it so happens that the fault is a complex or multiple one, and one has only limited data on the set, then this result is almost certain. Such was the case with my main story this month — in addition to which, it bounced!

This frustration and possible financial loss is all part of the game. One can hardly charge the customer for one's own lack of experience; it has to be written off as such, and noted for future reference. In the long run it adds to the "experience" which is part of one's stock-in-trade, along with test equipment and basic training.

In the majority of cases the first encounter with a set may involve only a minor or straightforward problem, but it does provide the opportunity to find one's way around the set, at least in a general way. After two or three such encounters a sticky problem is not nearly as frightening; the general layout is known, a manual will have been acquired, and the job cab be tackled with confidence.

But this story wasn't like that. While aware of the model set I had never had to work on one, and the only data I had was a copy of the circuit. Add to that several faulty components at the same time and you have a perfect scenario for wasted time and frustration.

The culprit was a Pye model 20A17, 51cm colour set, and the owner's complaint was that, at switch-on, there were "... bangs and sparks." Fortunately, he was able to provide some useful background leading up to this behaviour. It seemed the set was from his holiday cottage down the coast, a beachside residence which was pretty well exposed to winds off the water and where corrosion from salt spray tends to be something of a problem in general

And, being a holiday cottage, it was usually unoccupied for months at a time; a made-to-order situation for the accumulation of dust and salt-laden moisture in vital parts of the set. He didn't really need to tell me that the fireworks had occurred at the first switch-on after just such a long idle period. He went on to add that the "bangs and sparks" stopped and the set went completely dead before he could switch it off.

Nor did I need a textbook to tell me where to look first when I took the back off the cabinet; I went straight to the ultor cap on the picture tube. Sure enough, there was every indication of a flashover. The ultor cap was of clear plastic which I recognised as belonging to a Philips tripler. In fact, the chassis turned out to be a Philips KT2, the Pye brand now being closely associated with the Philips organisation.

And, while I knew little about the KT2 chassis, I was well acquainted with this particular type Philips tripler and the associated ultor cap. Unfortunately, I have not found these caps to be very reliable, being prone to flashover in much less exacting environments than the one just described.

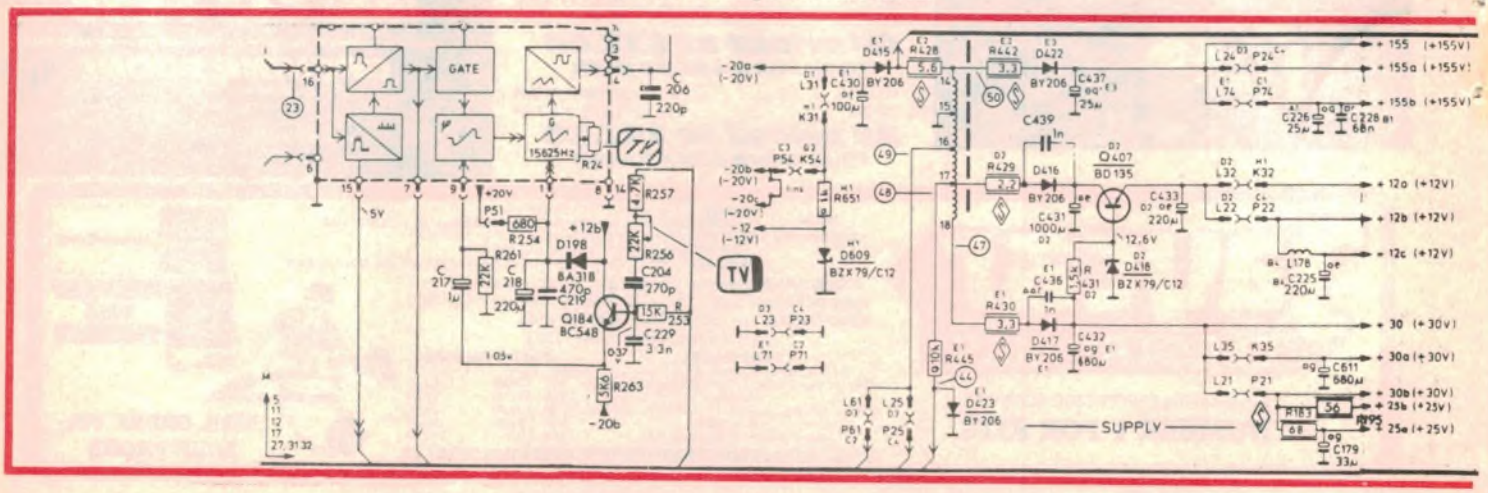
Weakness

One of their weaknesses is that they do not always grip the glass of the picture tube, often tending to lift on one side under the stress of the ultor lead unless this is very carefully positioned. And if the cap does lift, it provides an entry point for dust and moisture, with inevitable results.

In this case the edge of the cap showed signs of burning in several places, plus several black hair-like marks where the current had tracked across it. From here it had found a path across the clear area of glass surrounding the ultor, via moisture laden dust, to the aquadag coating.

I have sometimes salvaged situations like this by cleaning the cap, the picture tube around it, and then applying some "Silastic" under the cap and around it. This doesn't always work. Sometimes the cap is too badly carbonised, while cleaning the picture tube is not always

Below: the relevant circuit section of the Pye 20A17. Quite a number of components had failed.



successful, particularly if, as in this case, there is a coating of paint, usually red, between the ultor and the aquadag.

I felt it was worth a try in this case, becaused the cap was in better condition than some I have salvaged, so I went ahead and cleaned everything up. Then, on another hunch, I checked the main fuses (F596, 597) and found one of them blown. This would account for the sudden cessation of fireworks observed by the owner.

I replaced the fuse, refitted the ultor cap, crossed my fingers and switched on. Splat — crackle — pop! The owner hadn't exagerated; it was a fireworks display and a half. It lasted only a second or so before I switched off, but it was serious enough to worry me. In particular, I feared that the EHT was excessive — something which can happen in some line output stages — and which can easily puncture the picture tube. That would have to be checked.

But first I had to replace the ultor cap. As I mentioned in these notes some time ago (July, 1982) I make it a practice to save the ultor caps from discarded triplers, particularly the Rank Arena variety which are very good. Thus I can replace a faulty ultor cap, whereas I might otherwise have to replace the entire tripler.

So that was what was done in this case but, before refitting the cap onto the tube, I hooked it up to the EHT probe, just in case there was excessive EHT. As it turned out the EHT was virtually spot on, but I realised something else was wrong; there was no sound. I refitted the ultor cap and tried again and this produced the first sign of life on the screen; a bright horizontal line.

Voltage checks

At this stage it was logical that I should check the various voltage rails, of which the circuit indicated there were four. The main rail is at 131V and comes straight from the bridge rectifier and filter components in the main power supply. The other three are derived from tappings on the line output transformer. One is at 155V, via a safety resistor, diode, and filter capacitor; the second at 30V using a similar circuit; and the third at 12V via similar components plus a voltage regulator network.

Which was all very fine on paper, but quite another matter when I started looking for these parts of the circuit in the actual set. The general layout of the set reminded me of the old Philips K9; three main boards, one on the left which is essentially the signal processing board, one on the right which is mainly the line deflection circuitry, and one on the bottom which carries most of the frame circuit, plus the sound channel.

But there the similarity ended. Some early sections of the frame circuit are on the signal processing board, as are some sections of the power supply. Other sections of the power supply are on the line board. And, while I have no doubt that Mr Philips had good reasons for doing things this way, I found it far more confusing than the more clear cut divisions of sections as used on the K9.

The end result was that I spent a lot of time — I nearly said "wasted', but it wasn't really — finding my way around the set and locating the voltage rails I wanted to check. When I did finally track them down I found that the main 131V rail was normal, as was the 155V rail from the line output transformer, but that the 30V and 12V rails were dead.

In one sense this was not surprising because the 30V rail supplies the vertical deflection output stage, while the 12V rail supplies earlier vertical stages, some of the sound channel, and the signal processing board. More to the point was the reason for their failure and one of these was immediately obvious. The 30V rail is fed through a 3.3Ω safety resistor, R430, and the 12V rail similarly via a 2.2Ω unit, R429. Both had been overloaded to destruction.

These safety resistors are, in fact, nothing more than marginally rated resistors — about half watt in this case — which are designed to be sacrificed in the event of an overload. In short, they are little more than a glorified fuse.

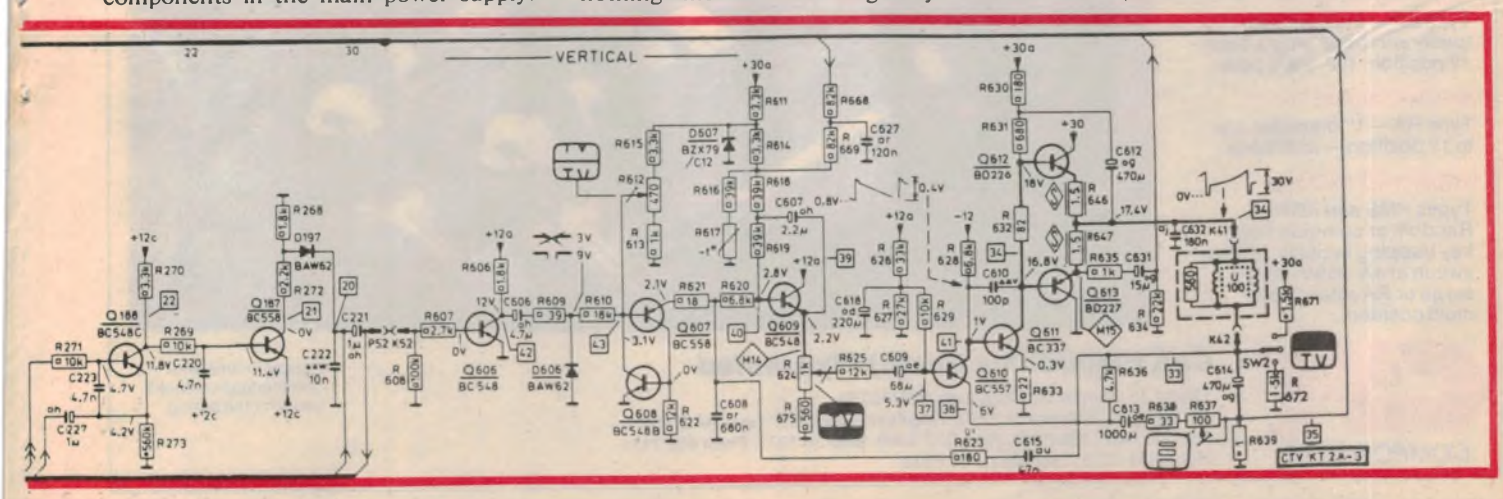
I decided that the best approach was to replace these resistors to determine, first, whether they continued to cook and, even if they did, to give me a few moments to make appropriate voltage measurements in an effort to isolate the reason. I futher decided to tackle them one at a time, to make things less hectic.

I tackled the 12V rail first, hoping that this would restore the sound at least, and prepare the way for restoring the vertical deflection. This circuit consists of the 2.2Ω resistor already mentioned, diode D416, 1000μF filter capacitor C431, regulator transistor Q407, zener diode D418, and some minor components.

At switch-on the substitute 2.2Ω resistor showed signs of distress immediately, but held on long enough for me to make a couple of quick measurements, one of which established that there was no DC voltage at the collector of Q407. The reason was quickly established; diode D416 was short circuit, probably as a result of the original fireworks display.

Replacing D416 produced some worthwhile results at last. We had sound and every indication that most of the set was working. The remaining fault was the dead 30V rail and lack of vertical scan. Taking a punt I checked its diode, D417, in the hope that it, too, might have suffered the same fate as D416. But things are never that easy; it was intact.

I could find nothing else wrong around this part of the circuit, and the implication was that the excessive current drain was due to a fault in the vertical output stage, which is a complementary symmetry pair, Q612 and 613. This stage is fed by a string of six transistors, Q606 to Q611, all mounted on the previously mentioned bottom board. Two other stages in this string, Q187 and Q188, are on the signal processing board, along with module U177 (more on this section later).



Output stage

Of more immediate importance was the vertical output stage, mainly because two 1.5Ω safety resistors in the emitter circuits of Q612 and Q613 both showed signs of having been overloaded, even though a measurement showed that they had increased their value only very slightly. I replaced them as a matter of course and, at the same time, checked both transistors for possible breakdowns, using a conventional analog ohmmeter. Both checked out OK.

At this stage I decided to upgrade the resistor in position R430 in order that I could apply some brute force if needed, and have a little more time to make measurements before the resistor failed completely. So I organised a unit of around 3W rating. At the same time I found it relatively easy to interrupt a link conveniently located between this 30V rail and the collector of Q612, the upper one of the output pair.

Using this setup I was able to confirm that all the excess current drain was due to the output pair; as soon as this was disconnected all signs of distress around the 30V rail vanished. And it was only a step from here to discover that Q612, which had tested OK with the ohmmeter, was in fact breaking down at the higher voltage. (Another trap for young players — and older ones!)

The transistor was replaced and this improved matters a good deal, but things were still not right. The stage was still drawing more current than it should, with every indication that both transistors were permanently turned on. This, in turn, suggested that this could be due to lack of drive. A check with the CRO confirmed this; there was no sawtooth drive to the output stage.

And this is where things started to go wrong; partly due to a wrong decision on my part and partly due to lack of information on the circuit. The circuit shows very little in the way of waveform information in this section; just the output waveform and the drive waveform to the output pair. (I subsequently gained access to a manual for this chassis, but it provided very little more waveform information.)

The fault obviously lay somewhere between the output stage and sawtooth generator at the other end of the vertical chain. I wasn't quite sure where this sawtooth circuit was, but imagined it was in the module U177. And Murphy's Law states that, in endeavouring to find a fault in a circuit chain, one will always start at the end furthest from the fault. Also, if one attempts to circumvent this law by starting in the middle, one will always proceed first in the wrong direction.

In my case I initially went to the wrong end of the chain in an attempt to determine whether the sawtooth was actually being generated, an exercise that I imagined would be simple enough. Instead I found myself struggling with a totally unfamiliar circuit, which I still haven't worked out, even with the aid of the manual. After much contemplation of the circuit and manual it appears that the sawtooth is generated in the Q188, Q187 network which, apparently, functions as some kind of switching arrangement.

Just how it generates the sawtooth I don't know, but it is fed with two lots of pulses from U177 — pins 7 and 15 — which presumably are derived from the sync pulses. In addition it is fed with a complete video signal from the video detector. Maybe someone else can explain it.

Anyway, the point is that I suddenly realised that I had allowed myself to be sidetracked; that I was spending a lot of time trying to work out the theory of the circuit when, in terms of finding the fault, this didn't matter two hoots. Murphy had well and truly conned me. (Well, I have to blame someone!)

With this realisation I did what I should have done in the first place;

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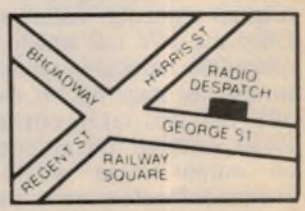

checked for a sawtooth waveform at the base of Q606. And when I did, there it was; a typical vertical sawtooth waveform. To be sure, I had no data against which to check its amplitude, but its mere presence was enough.

From this point I was able to trace the waveform through as far as the base of Q609, but at the emitter of this stage, where it is supposed to come out, there was nothing. Nor was the reason hard to find; Q609 was short circuit, collector to emitter.

Replacing it restored the drive to the output stages and, in turn, allowed me to restore the 30V supply to these without overloading this supply rail. The heavy duty replacement for R430 was removed and the correct safety resistor fitted, which functioned without any signs of distress.

And, of course, we had vertical scan and a picture. A first class picture too and, apart from routine tidying up, that was the end of the story. Or so I thought.

Setbacks

After finishing it off I left it running on one end of the bench as a routine check before the customer called to pick it up. It ran like that for several hours until I left the workshop briefly, then came back to find the set completely dead. It was a nasty shock.

The only bright spot was that I now knew my way around the set a lot better than when I started. A quick check revealed that safety resistors R429 (12V rail) and R430 (30V rail) had both burned up again. Feeling a little more confident now I replaced both safety resistors, switched on, and watched. Both resistors started to cook immediately.

Taking a punt, I removed R430, fitted a new R429, and tried again. And for once I had taken things in the right sequence, because the fault turned out to be our old friend diode D416, the one I had previously replaced. This was somewhat disconcerting because my replacement had been rated rather higher than the one which had failed. I wasn't very happy about it but, in the absence of any obvious fault, I could only write it off as coincidence.

A new diode put everything back to normal. It was largely a repeat of the original sequence: failure of D416 had killed the 12V rail which, in turn, had robbed the vertical output stage of drive, turned this stage full on, overloaded the 30V rail, and taken out safety resister R430. Allowed to continue, the turned-on output stage would also have overloaded safety resistors R646 and R647 in this stage.

I put the set on test again for the remainder of the day, and all the following day, and it didn't miss a beat. As far as I could determine there was nothing wrong with it; nor could I find any reason why the second diode had failed. So it was duly returned to the customer and several weeks have gone by without any repercussions. Let's hope that's the end of it.

Footnote

Not long after I had written the above, but before I could deliver it to the EA office, the set bounced. It was frame collapse again, but only partial this time, leaving about 50mm of vertical scan.

It didn't take long to find the reason; Q612 in the vertical output stage — and the one I had replaced — had packed it in. No other damage had resulted and a new transistor put everything right again. But I can't help wondering — why did two of the components I replaced fail a second time? Is it coincidence or is there a subtle fault somewhere generating an occasional spike that is taking these components out?

That's a horrible thought, I know, but I can't discount it entirely. On the other hand, there is not much I can do about it except keep my fingers crossed and wait and see. If the same thing happens again — well, let's hope it doesn't.

Reader feedback

And now for a comment from the mailbag. Mr C.H.S. (MIE Aust) of East Kew, Victoria, writes concerning a story which appeared first in the June 1983 notes, with a sequel in the following August notes. Very briefly it concerned a National 22/23 TV receiver which refused to tolerate the 2A fuses specified on the cabinet sticker and the circuit, and which ultimately had to be fitted with 4A fuses for reliable operation.

At the time I eventually concluded that the difference was due to the fact that the 2A fuses were specified for the hot chassis version of this set, whereas the one on the bench used a (factory fitted) transformer. It seemed to me that the losses in the transformer probably resulted in enough extra current to justify the larger fuses and that these had, in fact, been fitted originally, but that the cabinet sticker was wrong.

After apologising for the belated comment, C.H.S. goes on to support my suggestion that the transformer was the culprit, but for a different reason. This is how he sees it.

Your notes in the June 1983 (pp 81, 82) and August 1983 (pp 70, 71) issues of *Electronics Australia* have just come to my attention and I would like to comment on the problems you had with the National 22/23 TV receiver.

I refer particularly to your surmise that the differences in the fuse blowing tendencies of the various versions of the receiver was due to the presence or absence of mains transformers.

I am certain that your surmise is correct, but that the reason for the difference is not the additional current due to transformer losses but to the transient current which flows at switch-on.

When an iron cored transformer is energised a transient current will flow for a short period; a fraction of a second for small transformers used in electronic equipment, but for much longer in large transformers used in electricity supply systems.

The magnitude of this current varies over wide limits and depends on the precise point of the supply voltage wave at the moment of switch-on. The mechanism involved is explained in the attached extract from *Wireless World*, December 1978.

The elegant solution with small transformers is to fit time-delay (slow blow) fuses, but a commen practice is to fit ordinary fuses with a rating well above that required for the steady-state current.

I am sorry that these comments are so belated, possibly too much so for mention in your column, but at least they will put your mind at rest, confirming the conclusion you drew at the time.

Thank you C.H.S. As you can see, your belated comment was well worth publishing. I have no doubt that your theory is the more correct one, and the random nature of the switch-on surge would help explain some of the inconsistencies I observed at the time.

After some thought I decided against publishing the material from *Wireless World*, on the basis that it would probably make rather heavy going for most servicemen, being strictly in the engineering category. However, the reference (December 1978) is there for anyone who feels inspired to follow it up.

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by DOUGLAS BOLTON

Probably the most common system employed these days for amateur processing of black and white film is the "time-temperature" method using a light-proof developing tank. Although colour processing is outside the writer's experience, it is also presumably the only system for colour work. The temperature, for black and white films, is generally standardised at 20°C, so that the developing time is ultimately determined by the film used and the working strength, or degree of dilution, of the developer. This time is arrived at by reference to tables of data provided by the film and/or developer manufacturer, and from the worker's own experience.

In any case, the times are normally based on regular agitation of the tank during development, usually for ten seconds every minute, on the minute. It is fair to say that almost everyone in this situation makes use of an analog or digital stopwatch, or a ringer-timer which "goes off" like an alarm clock at the end of the preset period.

So far so good. However, in the writer's experience, complications can ensue. Particularly in a domestic situation (the classic kitchen bench or bathroom set-up), it is possible to be distracted from the critical task of watching that second hand to ensure that one agitates the tank at the correct intervals, and to ensure that development is terminated at the appropriate time. Domestically, one's attention may be taken by something on the radio or TV, or by any one of a dozen minor household crises.

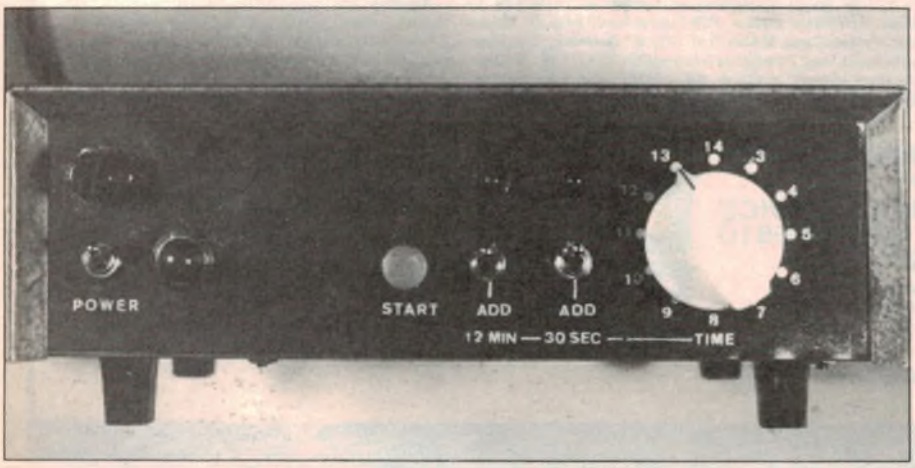
Even in a professional darkroom, a knock on the door, a question bellowed through the door or the presence of a second person in the darkroom can have the same result.

It is with the foregoing in mind that this project was devised, developed (no pun intended) and constructed. What it does is this: at switch on a loud beeping tone is heard. Ignoring this for the moment, you start pouring developer solution into the loaded tank and, while pouring, you press the START switch with the free hand. This stops the beeping, which is replaced by a continuous note of five or six seconds duration.

At this point, having finished pouring, you give the tank its first agitation. One minute after pressing the START switch another long note occurs to indicate that it is agitate time again, and so on every minute.

At the end of the preset time, which is selected by a 12-position rotary switch and two toggle switches, the pulsed tone starts up again to indicate that it is now time to terminate development; ie, to pour the developer out of the tank. After rinsing the film can be fixed, again using the timer to indicate the preferred fixing time.

Be assured that the note emitted by the buzzer specified is very noticeable and impossible to ignore!



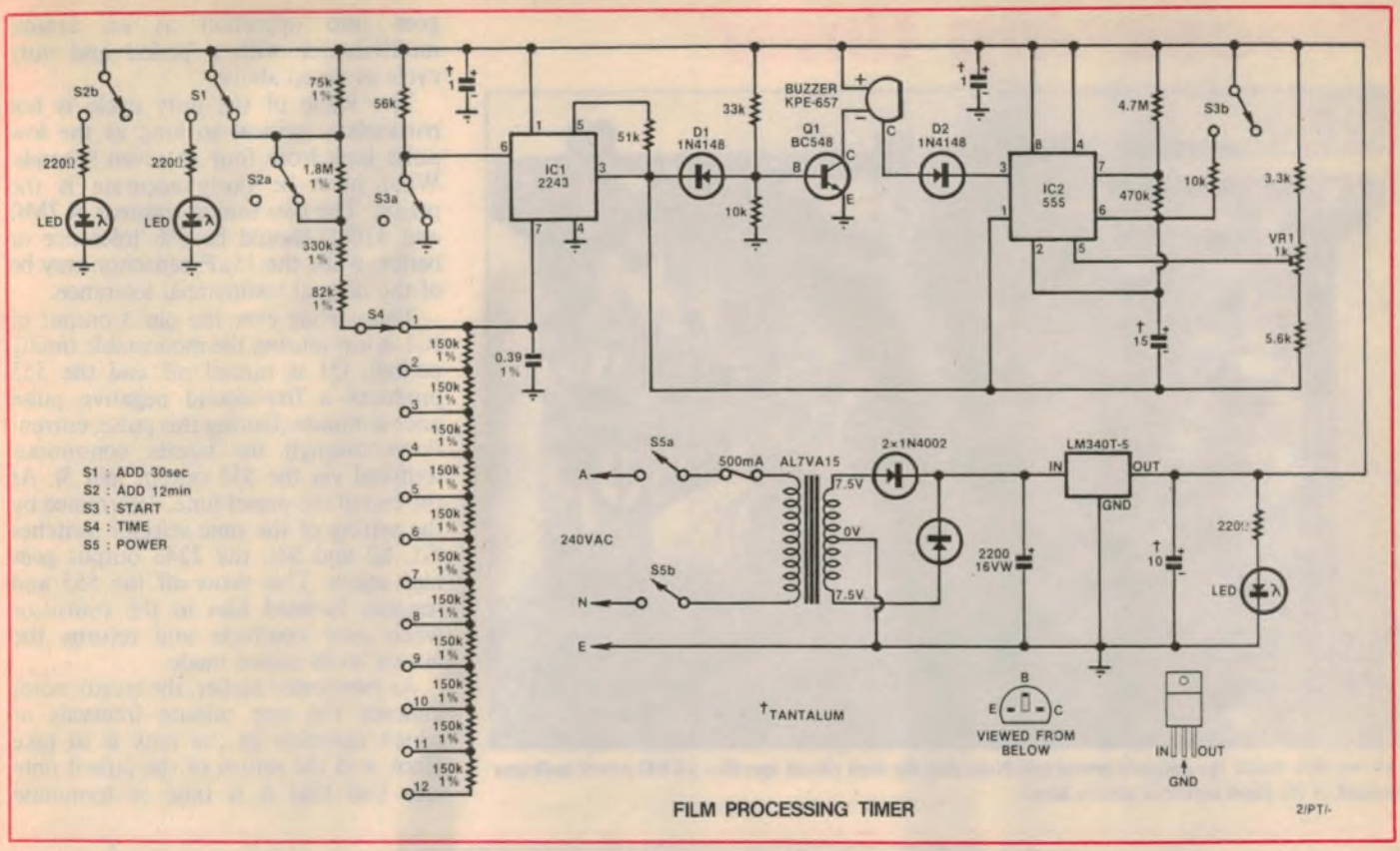
The prototype covers the range from 3 to 26.5 minutes in half minute increments.

How it works

Let's now discuss how the circuit works. It might be as well to start with the aforementioned buzzer. This is a piezo device made by Murata and designated type KPE-657. It needs a DC supply of from 3 to 28V and, with the 5V supply rail used here, draws 6 or 7mA. It has three terminals, marked "+", "C" and "−".

The terminal marked "+" is actually the common and is connected to supply positive. If the terminal marked "C" is taken to supply negative a continuous 3kHz note results, while if the "−" terminal is connected to negative the note is pulsed. The pulse rate varies inversely with the supply voltage and is about 2Hz at 5V. The three terminals "+", "C" and "−" from here on will be referred to as *common*, *continuous* and *pulsed* respectively.

Looking at the circuit diagram we see that the common terminal goes to +5V,



IC1 provides the basic timing function while astable oscillator IC2 provides the timing for the continuous tones.

the continuous terminal is connected via a diode to the output of 555 timer IC2, and the pulsed terminal is in series with the collector of common emitter NPN transistor Q1. The transistor is normally biased on by the voltage divider network connected to its base.

Now let's consider the 2243 timer (IC1) to the left of the transistor on the circuit. Although this device has been described in a feature article in an earlier issue of *EA*, a recap might be in order.

At the heart of the 2243 is a symmetrical square wave oscillator, the frequency of which is determined by an external RC network connected to pin 7. The oscillator does not start spontaneously at switch on, but must be triggered by application of a positive pulse of at least 1.5V to the trigger terminal at pin 6. Input impedance of the trigger is 25kΩ; there is a 56kΩ resistor from +5V to pin 6 and a normally closed pole of the START switch (DPDT spring return) from there to ground. Operation of the switch thus applies a little over +1.5V to pin 6 by voltage divider action and the oscillator starts.

The oscillator output is connected internally to the first of a string of cascaded bistable flipflops. Each time the oscillator output goes negative, the first flipflop changes state; whenever that flipflop output goes negative the second one changes state, and so on through to the last one in the string. The output of the last stage is a negative going pulse, 2^{10} or 1024 times as long as the period of the basic oscillator.

So overall, the operation of the 2243 goes like this: at switch on the oscillator is quiescent and the output at pin 3 is high. On application of a trigger pulse at pin 6 the oscillator starts, and pin 3 is set low by a secondary action of the trigger signal. When the oscillator has completed 1024 cycles, the output at pin 3 switches high again.

The length of the low pulse at pin 3 is 1024 times the oscillator period, or 1024RC seconds. The maximum permitted values of R and C are 10MΩ and 1000μF, meaning that it is theoretically possible to have an output pulse length of just less than 17 weeks!

The 51kΩ resistor from output to reset at pin 5 stops the oscillator when pin 3 reverts to high, resulting in a monostable configuration. Omission of the 51kΩ resistor would allow the oscillator to keep running indefinitely (after triggering) as an astable multivibrator of period 2048RC seconds, or slightly less than 34 weeks for the values quoted above.

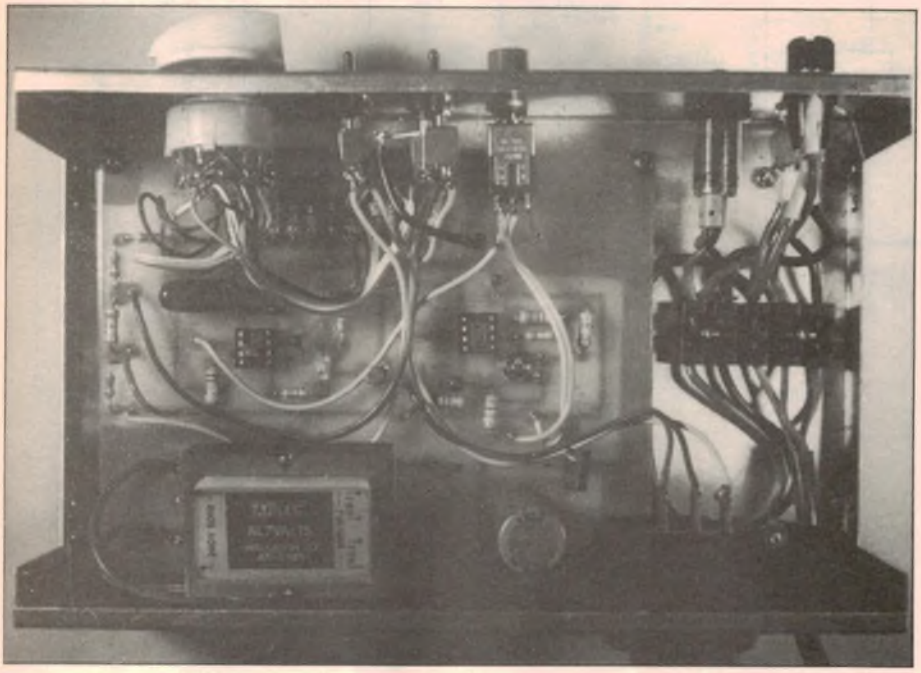
For the present application we want times ranging from three minutes to 26 minutes, and these are set by the 0.39μF capacitor and the chain of resistors and associated switches around pin 7. A combination of 0.39μF and 150kΩ gives a basic oscillator period of 58.5ms and an output pulse at pin 3 of 59.904 seconds, near enough to one minute for our purposes. All the timing resistors are multiples (and one sub-multiple) of 150kΩ; more on this later.

To the right of the buzzer on the circuit is the 555 timer (IC2). This is wired in astable mode with a period of one minute and duty cycle such that the output at pin 3 is low for five or six seconds every minute. The actual period is set to 60 seconds during the setting up procedure by the adjustable voltage divider connected to pin 5 (threshold). Negative return for the 555 is via the output terminal of the 2243. The positive supply pins of the 555 and the 2243 are each bypassed by a 1μF tantalum capacitor close to the appropriate pins on the PCB.

Now let's see how the whole thing works. At switch on, the 2243 is quiescent so pin 3 is high, cutting of the 555. The transistor is on and conducts current through the pulsed terminal of the buzzer, which accordingly emits a pulsed note. Note than the output of the 2243 is at a higher voltage that the transistor base; the diode between them isolates the 2243 output from the transistor bias voltage.

If the START switch is now pressed, the 2243 receives a trigger pulse, the oscillator is enabled and pin 3 goes low. This grounds the transistor base via the diode and thus Q1 turns off, stopping the pulsed note. The 555 is also now enabled, with its negative return completed through the 2243 output; it immediately

Processing timer



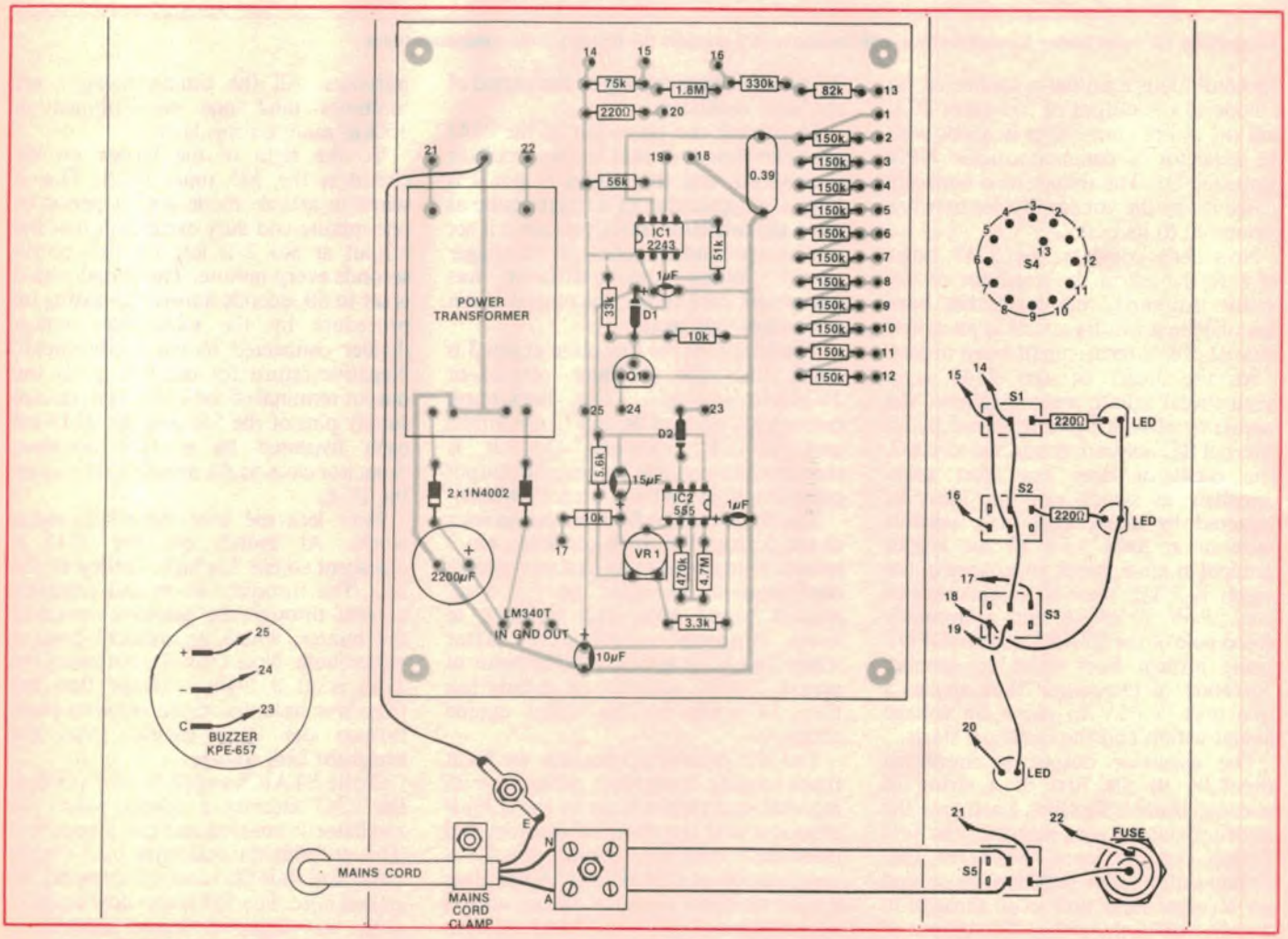
Above: view inside the author's prototype. Note that the final circuit specifies a LED power indicator instead of the neon indicator shown here.

goes into operation as an astable multivibrator with a period and duty cycle as noted above.

The value of the duty cycle is not particularly critical so long as the low pulse lasts from four to seven seconds. What must be fairly accurate is the period. The two timing resistors (4.7MΩ and 470kΩ should be 5% tolerance or better, while the 15μF capacitor may be of the normal commercial tolerance.

Thus, while ever the pin 3 output of IC1 is low (during the monostable timing period), Q1 is turned off and the 555 produces a five-second negative pulse once a minute. During this pulse, current flows through the buzzer continuous terminal via the 555 output (pin 3). At the end of the preset time, determined by the setting of the time selector switches (S1, S2 and S4), the 2243 output goes high again. This turns off the 555 and restores forward bias to the transistor whch now conducts and returns the buzzer to its pulsed mode.

As mentioned earlier, the steady notes indicate the one minute intervals at which agitation of the tank is to take place, and the return of the pulsed note tells you that it is time to terminate



Take care with the mains wiring and sleeve the connections to the power switch (S5) and the fuseholder.

development.

Before describing the 2243 timing network, there are two features of the 555 circuitry which must be explained. First, the diode between the output and the buzzer: it was found at the breadboard stage that, with the 555 cut off and the buzzer pulsing, a direct connection from the 555 output to the buzzer continuous terminal caused a weakening of the pulsed effect, in that the buzzer continued to sound faintly between legitimate pulses. The cause was never pinned down in depth, mainly because nothing was known about the internals of the buzzer circuitry. Inclusion of the diode (D2) was the "fix".

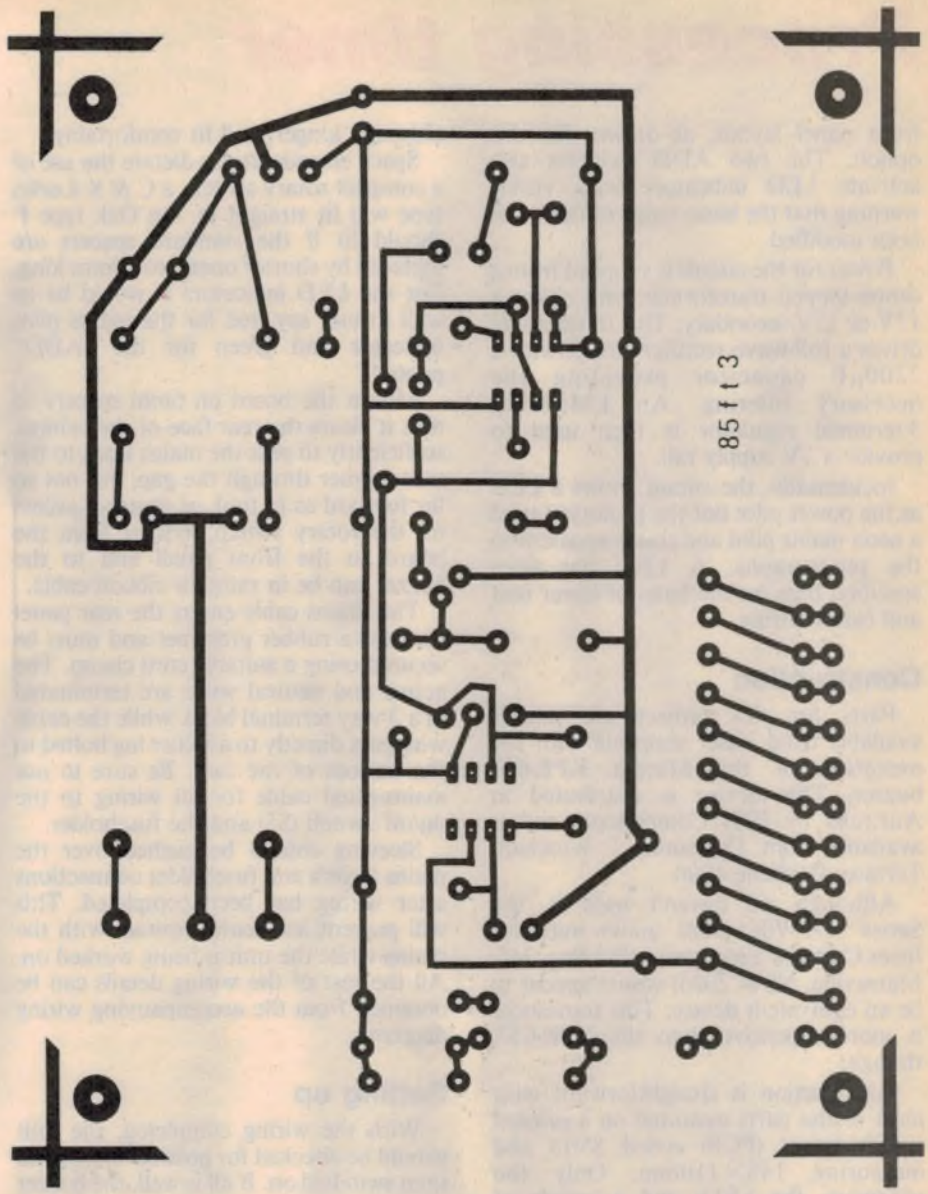
Secondly, there is the 10kΩ resistor connected to +Vcc via the second pole of the START switch and to pin 6 of IC2. A characteristic of the 555 is that, in the astable mode, the charge on the timing capacitor on pin 6 swings between ⅓ and ⅔Vcc. Whenever it reaches ⅔Vcc, the output switches low. The capacitor then discharges to ⅓ Vcc, the output pin 3 goes high and the cycle repeats.

However, when the device is first switched on, the charge on the capacitor is zero, and it has to charge from zero to ⅔Vcc before the first output low appears. From there on, it operates normally. The time taken for the timing capacitor to charge from 0V to ⅔Vcc is about 1½ times that taken to move from ⅓ to ⅔Vcc so that, in our particular case, that first low comes along about 20 to 25 seconds late. All the subsequent lows will be the correct distance apart, but delayed with reference to the starting time.

The answer to the problem is to "fast-charge" the 15μF capacitor, via the 10kΩ resistor and the second pole of the START switch, simultaneously with the triggering of the 2243 and enabling of the 555. When the START switch is operated, the capacitor charges to ⅔ Vcc in less than half a second and the 555 gives a low output pulse almost immediately. Thus, the buzzer sounds right at the start, to be succeeded by further tones at the requisite one minute intervals.

Turning to the 2243 timing network, let us consider the range of times provided and the justification for the choice. Literature from Kodak and Ilford shows that for most popular combinations of film, developer, and various dilutions thereof, development times can range from three minutes to around 24 minutes. Here and there an odd half minute is added to whole numbers of minutes. For example, for Ilford Pan F film and Ilford ID-11 developer diluted 1:1 with water, the recommended time is 8½ minutes.

So the shortest time provided by the 12-position switch is three minutes, as set by the 330kΩ and 82kΩ resistors (in series and permanently in circuit) in combination with the 0.39μF timing capacitor. Now 412kΩ×0.39μF×1024 gives 2¾ minutes; not three minutes. This is a deliberate "error", and was arranged to allow for reaction time and the time needed to get the leak-proof cap off the developing tank at the end of the process.



Here is an actual size reproduction of the printed circuit artwork.

It was found by experiment that 15 seconds was a good safety margin to allow even inexperienced operators to prepare for decanting in an unhurried, panic-free fashion. Intending constructors who wish to opt for the full 3 minutes should substitute 270kΩ and 180kΩ (=450kΩ) for the 330kΩ and 82kΩ resistors.

Following on from position 1 of the switch, each subsequent position adds 150kΩ to the chain, and hence one minute to the time, up to position 12 which gives 14 minutes. The 15 seconds "error", if built in, will be consistent for the entire range of selectable times. That is to say, the buzzer will revert to its beeping mode at "n" minutes minus 15 seconds.

To go beyond 14 minutes, throwing the ADD 12 MIN toggle switch S2 adds a further "twelve-minutes-worth" of resistance, or 1.8MΩ, to the chain; thus the rotary switch now covers the range 15 to 26 minutes. Operating the ADD 30 SEC switch (S1) switches in an extra 75kΩ to add half a minute to any whole number of minutes selected. Thus we end up with a selection of times from three to 26½ minutes at half minute increments.

If, for any reason, it is desired to have quarter minute increments, it would be necessary to arrange for a third toggle switch to add a parallel pair of 75kΩ resistors to the series chain. There is no provision on the PCB pattern or the

Processing timer

front panel layout, as drawn, for this option. The two ADD switches also activate LED indicators as a visible warning that the basic range of times has been modified.

Power for the circuit is supplied from a centre-tapped transformer with either a 12V or 15V secondary. This transformer drives a full-wave rectifier circuit with a 2200μF capacitor providing the necessary filtering. An LM340T-5 3-terminal regulator is then used to provide a 5V supply rail.

Incidentally, the circuit shows a LED as the power pilot but the prototype used a neon mains pilot and this is apparent in the photographs. A LED has been specified here on the basis of lower cost and easier wiring.

Construction

Parts for this project are readily available from kitset suppliers with the exception of the Murata KPE-657 buzzer. This device is distributed in Australia by IRH Components and is available from Delsound, 1 Wickham Terrace, Brisbane 4000.

Although we haven't tried it, the Series X73W06 piezo audio indicator from Creative Electronics (PO Box 240, Matraville, NSW 2036) would appear to be an equivalent device. This transducer is more expensive than the KPE-657, though.

Construction is straightforward with most of the parts mounted on a printed circuit board (PCB) coded 85ft3 and measuring 145×110mm. Only the hardware, the LEDs and a couple of resistors are on the front panel, while the buzzer mounts on the rear panel. Mount the smaller parts on the PCB first before moving on to the voltage regulator, main filter capacitor (2200μF) and the transformer. Use PC stakes to terminate all external connections.

Once construction of the PCB has been completed, attention can be turned to the case. Drill all relevant holes in the base and rear panel first. The buzzer requires a round hole of 27mm diameter; for those who still have such things, a 1⅛ inch hole punch as used for old style valve sockets would do the trick nicely.

Next, fix the front panel label and use it as a template for the front panel holes. Quarter inch (6.35mm) holes are needed for the toggle switches and LED mounts and a 3/8-inch (10mm) hole for the rotary switch; the hole size for the fuseholder depends on the fuse type chosen. The prototype used a "OO" or M58 type, but the more usual 3AG size holder, although longer, will fit comfortably.

Space considerations dictate the use of a compact rotary switch; a C & K-Lorlin type will fit straight in. An Oak type F should fit if the standard spacers are replaced by shorter ones 6 to 10mm long. For the LED indicators it would be as well to use, say, red for the mains pilot indicator and green for the "ADD" pilots.

Mount the board on 6mm spacers so that it clears the rear face of the cabinet sufficiently to pass the mains leads to the transformer through the gap, but not so far forward as to foul, or obstruct access to, the rotary switch. Wiring from the board to the front panel and to the buzzer can be in rainbow ribbon cable.

The mains cable enters the rear panel through a rubber grommet and must be secured using a suitable cord clamp. The active and neutral wires are terminated in a 3-way terminal block while the earth wire goes directly to a solder lug bolted to the bottom of the case. Be sure to use mains-rated cable for all wiring to the on/off switch (S5) and the fuseholder.

Sleeving should be pushed over the mains switch and fuseholder connections after wiring has been completed. This will prevent accidental contact with the mains while the unit is being worked on. All the rest of the wiring details can be obtained from the accompanying wiring diagram.

Setting up

With the wiring completed, the unit should be checked for possible errors and then switched on. If all is well, the buzzer should immediately start beeping. Use your multimeter to check that the regulator output is at +5V, then operate the START switch and confirm that the buzzer emits a continuous tone of about five seconds duration.

This tone should be repeated at approximate one minute intervals until the end of the selected time interval, after which the buzzer should resume beeping. If everything checks out, adjust trimpot VR1 so that the continuous tone occurs at accurate one minute intervals (somewhere between 59 and 61 seconds is good enough).

Assuming that 1% resistors have been used in the timing network of the 2243, accuracy of the total developing time will depend on the 0.39μF capacitor. Ideally, this capacitor shoud be a 1% type, but these are expensive and can be difficult to obtain. In practice, a 10% type will probably be close enough to its nominated value to give reasonable accuracy.

The alternative is to sort through a handful of 0.39μF capacitors until you find one within 1% of the required value. Don't forget that the timer starts beeping 15 seconds short of the selected period to allow time for the developer to be poured from the tank. Thus, when the three-minute position is selected, the buzzer should start beeping after two

PARTS LIST

1 instrument case, 205 × 65 × 130mm, K&W type C853
1 PCB, code 85ft3, 145 × 110mm
1 buzzer, Murata type KPE-657 or equivalent (see text)
1 mains transformer, 12V or 15V CT; Ferguson PL 12/5VA, PL15/5VA; Arlec AL7VA/12, AL7VA/15
1 Scotchcal front panel label, 198 × 57mm
1 pointer knob
1 fuseholder and 500mA fuse
1 mains cord and plug
1 mains cord grommet
1 mains cord clamp
1 3-way mains terminal block
4 6mm tapped spacers
1 solder lug
1 SPDT miniature toggle switch
2 DPDT miniature toggle switch
1 DPDT miniature toggle switch, spring return
1 single pole, 12-position rotary switch
3 LED mounting bezels
4 rubber feet

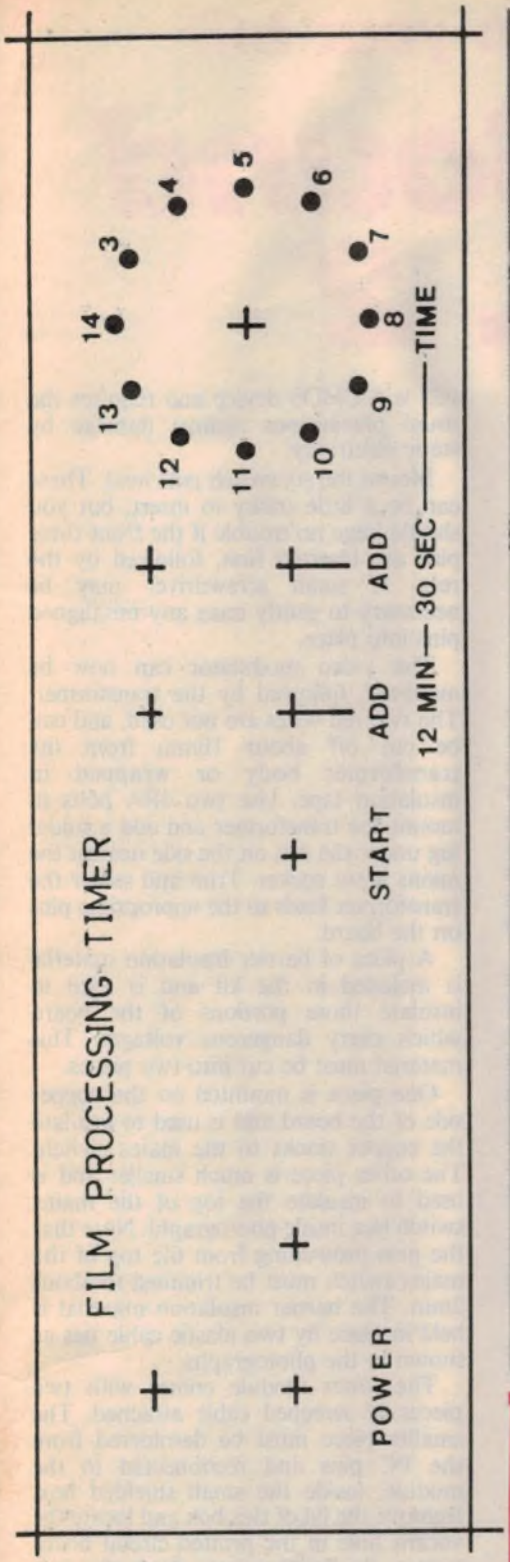
Semiconductors
1 XR2243 timer IC
1 555 timer IC
1 LM340T-5 3 terminal regulator
1 BC548 NPN transistor
2 1N4002 silicon diodes
2 1N914 silicon diodes
1 5mm red LED
2 5mm green LEDs

Capacitors
1 2500μF 16VW PC electrolytic
1 15μF 16VW tantalum
1 10μF 16VW tantalum
2 1μF 16VW tantalum
1 0.39μF polyester, see text

Resistors (0.25W, 5%)
1 × 4.7MΩ, 1 × 470kΩ, 1 × 56kΩ, 1 × 33kΩ, 2 × 10kΩ, 1 × 5.6kΩ, 1 × 3.3kΩ, 3 × 220Ω, 1 × 1kΩ miniature horizontal trimpot

Resistors (0.25W, 1%)
1 × 1.8MΩ, 11 × 150kΩ, 1 × 330kΩ, 1 × 82Ω, 1 × 75kΩ, 1 × 51kΩ

Miscellaneous
Ribbon cable, mains rated cable, machine screws and nuts, solder.



This front panel artwork can be photocopied or used to produce a Scotchcal panel.

minutes and 45 seconds.

Finally, the photographs show a pushbutton for the START switch, whereas the parts list specifies a spring-return toggle switch. Experience with the original unit suggests that a toggle switch would be easier to use because of the light weight of the unit.

Easy to build unit connects to your hifi

Stereo TV Sound Receiver Pt. 2

Last month, we introduced our new Stereo TV Sound Receiver and described the circuitry. This month we present the constructional details and describe the setting-up procedure.

by ANDREW LEVIDO

Stereo television transmission is now firmly established in Australia, with a number of TV manufacturers offering receivers capable of decoding the new transmissions. Unfortunately, these sets retail for around $1000. Spending this much on a new television set is hard for most of us to justify.

As last month's article showed, this receiver from Dick Smith Electronics is an economically attractive alternative. Selling for just $249, it provides true stereo sound facilities at a fraction of the price of commercial units.

Construction

The parts for this project are available only from Dick Smith Electronics as a kit. This comes complete with all parts necessary for the assembly of the receiver, including the prealigned tuner module and a plastic front panel with white lettering on a black background. A comprehensive instruction manual will be included.

Before starting assembly of the Stereo TV Sound Receiver it is advisable to spend a few moments checking the copper pattern on the printed circuit board (PCB). Some of the tracks are quite close together, and short circuits can easily develop during the manufacturing process. The time spent checking for this and other faults in the copper pattern is time well invested, as anyone who has tried to trace a fault of this type in a completed PCB can testify.

Commence assembly by installing the PC pins and wire links on the circuit board. Follow this with the other components, beginning with the resistors and then moving on to the capacitors, ceramic resonators and semiconductors. It is a good idea to mount the resistors with their colour bands all facing in the same direction. This will make checking easier later on.

The LEDs should be mounted about 12mm proud of the board. Leave the tuner module and the transformer to one side at this stage.

Take the usual precautions with the polarised components, particularly the semiconductors which are unlikely to survive incorrect mounting. Note that IC5 is a CMOS device and requires the usual precautions against damage by static electricity.

Mount the six switch pots next. These can be a little tricky to insert, but you should have no trouble if the front three pins are inserted first, followed by the rest. A small screwdriver may be necessary to gently coax any misaligned pins into place.

The video modulator can now be mounted, followed by the transformer. The two red wires are not used, and can be cut off about 10mm from the transformer body or wrapped in insulation tape. Use two 4BA bolts to mount the transformer and add a solder lug under the nut on the side nearest the mains input socket. Trim and solder the transformer leads to the appropriate pins on the board.

A piece of barrier insulation material is included in the kit and is used to insulate those portions of the board which carry dangerous voltages. This material must be cut into two pieces.

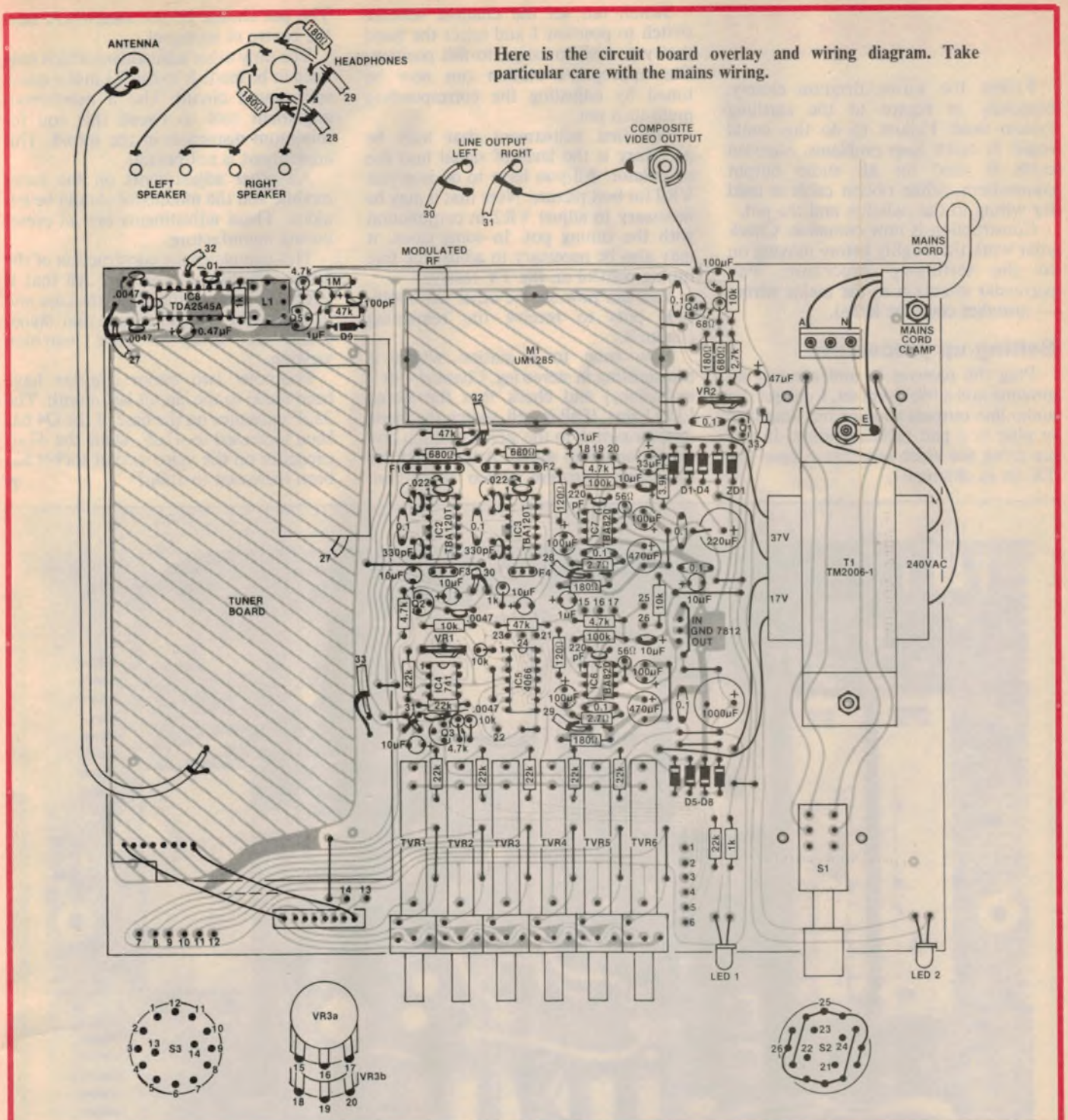
One piece is mounted on the copper side of the board and is used to insulate the copper tracks to the mains switch. The other piece is much smaller and is used to insulate the top of the mains switch (see inside photograph). Note that the pins protruding from the top of the mains switch must be trimmed to about 2mm. The barrier insulation material is held in place by two plastic cable ties as shown in the photographs.

The tuner module comes with two pieces of screened cable attached. The smaller piece must be desoldered from the PC pins and reconnected to the module, inside the small shielded box. Remove the lid of this box and locate the vacant hole in the printed circuit board next to the 560Ω resistor. Note that it is the hole nearest the BF199 transistor.

Solder the centre conductor of the screened cable to this point, and the screen to the inside of the metal box. Feed the cable out through one of the holes in the side of the box and replace the lid. The longer screened cable should be connected to the pair of PC pins on this board nearest the black 3-pin socket.

Use three 6BA screws to mount the tuner module onto the main board — the

This is how the completed stereo TV sound receiver looks.



Here is the circuit board overlay and wiring diagram. Take particular care with the mains wiring.

hole near the back left hand corner of the board is not used at this stage. Nylon nuts are used between the boards as spacers. The screened cables can now be connected to the appropriate PC pins, as shown in the wiring diagram, and the multiway connector plugged into the row of PC pins at the front of the main board.

Next, mount all the rear panel hardware, including the two 180Ω resistors which solder directly to the headphone socket terminals. The two multipole switches and the potentiometer can then be mounted on the front panel and the wire links fitted to the mode select switch.

Final assembly

Slip the front panel over the six pot shafts, position the two LEDs, then install the entire assembly in the bottom of the case. 4BA nuts are used as spacers between the plastic mounting pillars and the PCB. Screw the board down using the long self-tapping screws supplied. Don't forget to include an extra nut between the main board and the tuner board in the back left hand corner of the case.

Now for the mains wiring. Push the mains cable through the grommet in the rear panel, fit the mains cable clamp and terminate the active and neutral leads in the insulated terminal block. The earth wire must be soldered to the lug under the transformer mounting screw.

The rear panel can now be slotted into position and the mains cable pulled back through the entry grommet to take up the slack. All that remains now is to complete the internal wiring.

Follow the wiring diagram closely, especially in regard to the earthing system used. Failure to do this could result in earth loop problems. Shielded cable is used for all audio output connections, while ribbon cable is used for wiring to the switches and the pot.

Construction is now complete. Check your work thoroughly before moving on to the setting-up procedure. Pay particular attention to the mains wiring — mistakes could be lethal.

Setting up procedure

Plug the receiver in and connect an antenna and a television set. Connect the audio line outputs to your hifi amplifier or plug in a pair of headphones. If you are using the video modulator, tune the TV set to channel 1.

Switch on, set the channel selector switch to position 1 and select the band that you wish to assign to this position. The appropriate station can now be tuned by adjusting the corresponding multi-turn pot.

The first adjustment that may be necessary is the level of signal into the modulator. All you have to do is adjust VR2 for best picture. Note that it may be necessary to adjust VR2 in conjunction with the tuning pot. In some cases, it may also be necessary to adjust the fine tuning control on the TV receiver.

You can now set the other five multi-turn pots to receive the remaining channels.

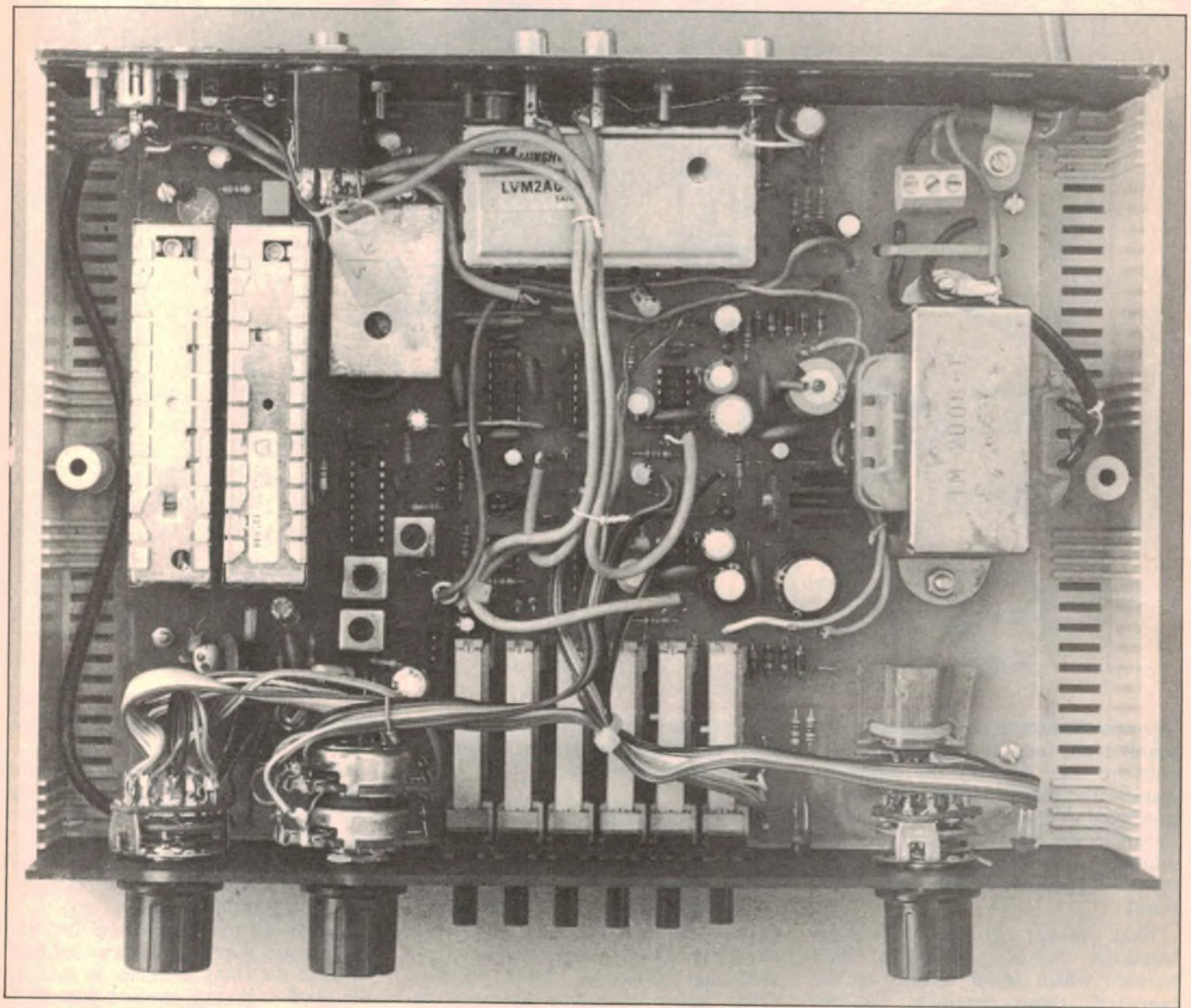
Now tune to a station which is transmitting in stereo (eg, Channel 7 or 9 in Sydney) and check that the stereo LED lights. If all is well, switch the mode selector switch to the stereo position and check for stereo sound. Adjust VR1 for maximum apparent stereo separation. The pot should be set somewhere near the centre of its travel.

The only other adjustment which may need to be made is to coil L1 in the quasi-split sound circuit. Use a non-ferrous alignment tool to tweak this coil for minimum distortion in the sound. This adjustment is not critical.

All other adjustments on the tuner module and the modulator should be left alone. These adjustments are all preset during manufacture.

This completes the construction of the Stereo TV Sound Receiver. All that is left to do is to put the lid on the case and to enjoy the added realism that stereo sound can bring to your television viewing.

Footnote: two minor changes have been made to the circuit last month. The 33μF capacitor on the base of the Q4 has been increased to 47μF, while the 47μF capacitor on the video output socket has been increased to 100μF.



This photograph shows the inside of the completed unit. The two metal cans on the left are the prealigned tuners.

WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR CHIPS ... WOOD FOR C

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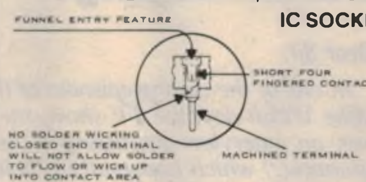

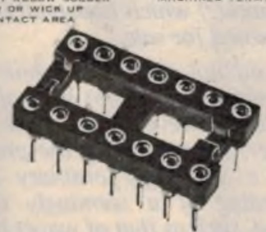

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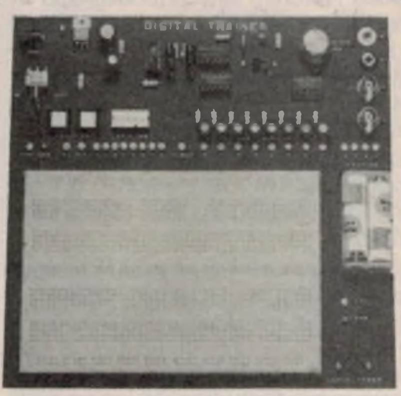

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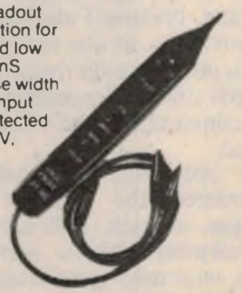

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FORUM

Conducted by Neville Williams

In case you haven't caught up with this intriguing but not-so-new idea, a subliminal message is one that is introduced into otherwise routine audio or video material, surreptitiously and in such a way that the listener or viewer is not actively aware of it. However, the message is supposed to penetrate his/her sub-conscious mind and to influence them in some calculated manner.

"Operating below the threshold of consciousness or perception" is the definition quoted in the Macquarie Dictionary.

The matter has been raised in a letter from a resident of Gulgong, NSW. As you will note, the incident referred to is now as much a part of history as the Mike Walsh daytime TV show but, as sometimes happens, it could not be dealt with at the time because of other commitments. However, as the writer remarks, the subject may be one "to muse over during a coffee break". Better still, it might even start a few friendly arguments!

I suggest you read the letter now, as set out in the accompanying panel.

First off, I'm certain that H.N. wasn't dreaming, because I also caught part of that interview, or one very like it. (They tend to double-up on rival talk shows.) If he needs still further assurance, I was no more convinced by the whole thing than he was!

I'm not quite sure when I first encountered the idea of subliminal messages, as such, although I certainly do remember writers, performers and others, who used to conceal crudities in their work, primarily to take the mickey out of their "establishment" bosses.

I remember, for example, a full-page advertisement (as I recall) in an early issue of "QST" magazine, in which part of the message was displayed as a simulated article heading, followed by a block of supposedly meaningless scribble, in lieu of text. But, much to the dismay

Subliminal sound: what are the wild waves saying?

Dear Sir,

In one of the closing episodes of the Mike Walsh daytime TV show, there was an interview discussing a new gimmick(?) which apparently is being promoted for sale.

I did not catch the whole of the interview, so I'm not sure of all the details. However, from what I could gather, the subject of the promotion was a seemingly ordinary cassette recording of a seemingly ordinary sound, such as that of waves breaking on the beach. But (would you believe?) a so-called "subliminal message" had been added. The nature of the subliminal message was not made clear but, whatever it was or is, it's supposed, somehow, to impress itself upon the sub-concious mind of the listener.

It was claimed that this "feature" offered certain potential therapeutic uses. For example, the subliminal message could be a direction to quit smoking. By listening to the tape repeatedly over a period of time, a smoker would apparently experience a diminishing urge to smoke and may eventually stop altogether.

Other cassettes might contain quite different messages and you would simply select the one you need at the time, based on the labelling.

When asked how one could be sure that the right message was imprinted on the particular tape, the interviewee explained that there was no physical way of finding out (presumably electronically or otherwise) and one had to accept on trust what the label said.

Now that makes me really sceptical. If it is possible to record electronically something which is capable of being absorbed by the conscious or unconscious mind, then it should surely be possible, by electronic means, to detect or decode such recording. How could such subliminal messages be recorded in the first place?

If the claims are not technically sound, the public should be made aware of the situation and some legal restraint placed on the sale of the cassettes.

If, on the other hand, they are legitimate, then, surely, they should be capable of substantiation.

Again, if it is true that people can be influenced subliminally by listening to specially made tape recordings, without being aware of it, I see no reason why the same thing should not be done by radio or television. The possibilities become mind boggling.

Personally, I'm far from convinced by the whole proposition — that is, unless I was dreaming, or failed completely to understand the interview in question.

I'd be most interested in your views via the pages of EA unless, of course, you consider the whole subject too far-fetched for serious comment. On the other hand, it may be something to muse over during a coffee break!

H.N. (Gulgong, NSW).

of the publishers, when a curious reader had a look at the "scribble" through a magnifying glass, it turned out to be none-too-genteel comment on the U.S. President and his Administration. There were red faces all around.

Then there was the cartoonist for a major Sydney newspaper, who amused himself and a section of his fans by thinking up ways to hide subtle crudities in his drawings, in the hope that they would escape the notice of the sub-editors and be duly published.

And, of course, there have been aprocryphal stories about pop groups and producers burying crude suggestions in their master recordings, which would go unnoticed unless you played them at double speed, or backwards, or something!

But there was nothing "subliminal" about any of those exercises; they were essentially games of hide-and-seek!

However, considerable apprehension did arise, some years ago, in respect to the possible use — and abuse — of deliberate subliminal messages, flashed briefly, for example, on to cinema or television screens. Exposure would be too short for the messages to be consciously read or noticed, but long enough — it was said — to register on the sub-conscious mind.

In consequence, viewers' ideas and attitudes might be manipulated without them being aware of it. At least, that was the theory, much debated but, I doubt, ever convincingly demonstrated.

It was never quite clear as to how the surreptitious additions to the main image would be organised. Conceivably, a message could be added to the requisite number of frames in a film or tape but such tampering would be unlikely to go unnoticed for long. Sooner or later, somebody would be sure to "blow the whistle"!

Alternatively, it would be technically possible to superimpose something on the screen by other means but, again, the activities of a deliberate video "flasher" would soon attract attention.

Much the same situation obtains in the audio sphere. People have long expressed apprehension about subliminal messages buried in our audio fare and speculated as to how it might be accomplished. But we are still waiting for documented examples of the practice and evidence that it has or has not proved effective.

The fact that someone has now claimed on a TV talk show to have tapes carrying subliminal messages, and that they have potential therapeutic merit is not, in itself, proof of their validity.

I must agree with H.N.'s proposition that if, by electronic means, one can implant a meaningful message on audio tape, it should be possible, also by

FORUM – *continued*

electronic means, to at least detect the presence of that message and, hopefully, to decode it as well.

The fact is that magnetic tape is a very familiar record/playback medium, and one that has been the focus of worldwide research for more than 50 years, in the context of audio, video, information and data storage, etc, both analog and digital. You name it and it's been recorded on and recovered from magnetic tape!

More than that, scientists and engineers involved in space research have built up a high order of basic expertise in identifying, isolating, enhancing and interpreting coherent information buried in all manner of noise.

It just doesn't add up that a "message" which defies detection, by such technology, or by deliberate listening, can still be sufficiently accessible and lucid to register on the sub-conscious.

If we're wrong about all this and there really is substance in the subliminal, the implications are, indeed, "mind boggling" — not so much for the person who knowingly buys an anti-smoking cassette but, rather, for those who are subjected to influences that they are totally unaware of.

Keeping up with CDs

Turning to a somewhat less nebulous subject, a reader from Kingston Beach, Tasmania, seeks guidance in facing up to the implications of compact discs, with their impressive specifications, including that 96-odd dB of dynamic range and S/N ratio.

He has been a reader of the magazine for around 30 years but says that he particularly appreciated the "Forum" article in the February '84 issue dealing with the subject: "Human ears, compact discs, dynamic range and all that!" He continues:

Most would agree that the quality of signal available from a CD player would be wasted on a 2x5W stereo system driving a pair of 10cm loudspeakers. But what about my Sansui amplifier, which has a quite typical output of 40W RMS per channel with 0.06% THD? Phono S/N ratio is quoted as 76dB and AUX ditto 95dB.

Would gear with this level of performance be able to "deliver the goods" or should I scrap the lot and go for a system with 100W per channel output and a S/N ratio of 100+dB?

In putting the question, I am also considering the situation when my existing (high quality) FM tuner, with a S/N ratio of 72dB in stereo mode, processes the broadcast of a CD record. I must say that, even though the dynamic window may not be as wide as it should be, the system still manages to produce a very acceptable sound. Is this the best I can expect at present off-air, or could things be further improved? (A good antenna, etc is assumed.)

Also, what can one expect when a CD signal or an FM/CD broadcast is fed into one of the new breed of open-reel decks, which claim a S/N ratio of 100dB or so? Would silence still reign supreme or would other nasties raise their heads?

Finally the loudspeakers: Would my Polk Monitor loudspeakers (or others of similar quality) be able to reproduce the full range of the CD signal, provided it survived all earlier obstacles. (The makers of Polk loudspeakers claim a max. output level of 105dB for my model).

I'm sure your readers would be interested to hear reasoned comments on what the lower boundaries of sufficiency are for CD reproduction and, again, what standards would have to be met to do real justice to the signal.

F.B. (Kingston Beach, Tas).

rie

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Unfortunately, it is not practical to suggest firm "lower boundaries" or upper limits for equipment that might qualify for use with CD players, partly because much depends on subjective considerations.

The fact is that a compact disc player would provide consistently cleaner sound than other likely signal sources, even through a humble 2x5W stereo system driving a pair of 10cm loudspeakers. But it could certainly not do justice to the potential quality of the discs.

On the other hand, I would expect F.B's system, based on a Sansui 2x40W amplifier with 0.06% THD, to provide some very acceptable sound, in conjunction with a CD player. The AUX input S/N ratio of 95dB would not be a liability in an average home, where the ambient noise would almost certainly be well above any likely contribution from the amplifier.

But is a power output of 40W RMS per channel really sufficient? That would depend on the sensitivity of F.B's loudspeakers and what he regards as an acceptable maximum level of sound. If it is currently adequate for his listening needs, or there is power to spare, the expense of a more pretentious system may not be justified — at least not as a matter of urgency.

If, on the other hand, F.B. feels that his amplifier is currently being pushed to its limits, there would be a case for a more powerful unit and perhaps for adequately rated loudspeakers no less sensitive than his present ones. The point behind this last remark is that there would be little advantage in picking up an extra 4dB in amplifier power, only to lose it in loudspeaker sensitivity!

Without a first-hand knowledge of F.B's Polk loudspeakers, his listening environment and his personal expectations, it is difficult to be more precise. Let's just suggest that his present system should be capable of very acceptable CD sound up to levels which most householders would judge to be adequate — therefore above that "lower boundary".

If F.B. wants to upgrade in a meaningful way, he will have to dig fairly deeply into his resources.

Where lies the upper limit? For most of us — and I include myself — it's somewhere way up there, beyond what we can afford, or would want to spend, or could conveniently accommodate in our homes. The point is that good compact discs can provide audio signals of a quality that bears comparison with anything available anywhere and, if you aspire to the absolute best and can afford and accommodate and appreciate it, that's the upper limit for you.

But this should also be said: the "best" is notably subject to the law of diminishing returns. There would be a very apparent difference in performance between F.B's hypothetical 2x5W system and his 2x40W Sansui, each with its own peripherals. A new 2x120-200W system would sound somewhat better again, particularly at higher power levels but, beyond that, increments in sound quality would become progressively more subtle and progressively more expensive — perhaps spectacularly so!

Back to earth again: what can be expected when a compact disc is broadcast and received via FM radio? Well, amongst other things:

- The top frequency limit drops from 20kHz to 15kHz: for most, an academic difference.
- THD rises (typically) from 0.005% to 0.15% or more: not bad, but not as good either!
- S/N ratio and dynamic range falls from 95dB to about 70dB: silence is no longer profound.
- Channel separation decreases from 90dB at 1kHz to about 40dB: some loss of stereo imaging.

From the above, it is evident that an FM broadcast system cannot convey to the listener the full potential of a compact disc recording but even so, as F.B. observes, the sound can still be very satisfying. A top-line tuner might conceivably recover the odd decibel here and there but it could not cancel out the residual limitations of the FM system.

Taped copies

F.B. also asks about re-recording compact discs on tape (potentially an infringement of copyright). In fact, even professional quality analog tape decks would impose their own characteristics and limitations on the signal, typically:

- Frequency Response: upper limit (−2dB) ranging between 15kHz and 25kHz, depending on tape, speed, bias, signal level, &c. Lower limit (−2dB) 30Hz,
- S/N Ratio and Dynamic Range: around 70dB, unless boosted to 100+dB by dbx noise suppression (itself not acceptable to all hifi "purists".)
- THD: up to 1%, depending on tape, speed, bias, signal level, frequency, &c.
- Channel Separation: 55dB.
- Wow and Flutter: 0.05% or less.

The above figures can be taken as a rough guide only, varying widely from one type of deck to another, and further complicated by four or five different systems of "weighting" specifications. In broad terms, a direct, open-reel analog tape copy of a compact disc would probably end up comparable in overall quality to an FM broadcast: very good listening but minus the ultimate sonic "sheen" of the original and minus its ultimate quiet, without dbx.

What about a copy of the same disc on the same deck via FM radio? Inevitably, it would not be quite as good as the broadcast which, in turn, would not be quite as good as the disc!

As a genre, compact cassette decks — even the good ones — are a step behind the professional open-reelers. From a CD source, they can still provide very enjoyable listening but without the original "sound out of silence", the totally unstressed dynamics and the glass-hard transients.

It is for such reasons that there is an evident trend away from analog audio tape equipment at both a professional and enthusiast level.

As indicated in the recent report on the Melbourne AES Convention (Dec. '84 issue) many professional studios are currently re-equipping with digital multi-channel recorders, which offer performance figures commensurate with compact disc mastering requirements, plus the considerable advantage of computerised editing and mixing.

Overseas, at enthusiast level, the trend is towards the use of video-based audio equipment, for high quality home recording — a lack of flexibility nothwithstanding.

PCM Adapters such as the Sony 701ES (reviewed in December '83) offer stereo quality which virtually matches that of a compact disc, plus a playing time of 3 to 4 hours on a standard video cassette.

Hifi-stereo VCRs like the National NV-850 (reviewed in January '85) also offer up to 4 hours playing time on a video cassette, with an overall quality broadly equivalent to that of a good FM broadcast and well ahead of an audio cassette deck.

In saying this, however, I am not suggesting that it is either wise or legal to invest a lot of time and money acquiring the means to copy compact discs, either direct or off-air — even though such a pattern appears to be developing overseas.

F.B's best course might even be to devote his dollars to collecting pristine original discs, and his time to enjoying them!

VCR Hifi Sound Explained—Pt. 2

In last month's article we discussed the audio recording process involved in a typical domestic hifi VCR. In this issue, we examine the complementary playback circuitry and processing.

by NEVILLE WILLIAMS

First, a word about video and audio head tracking.

For optimum playback, it is essential that, in traversing the tape, the heads follow a path which coincides closely with the sequence of tracks recorded on the tape. In large degree, this depends on the accuracy and uniformity of the tape transport mechanism from one VCR to the next but, as a precaution, most VCRs to date have a video "tracking" control tucked away somewhere on or under the front panel.

Normally a potentiometer, its effect is to modify voltage levels in the servo loop which relates pulses on the tape-edge control track (therefore the tape travel) to rotation of the head drum. The tracking control is operative only during the playback mode and, most times, can be left in the detent or neutral position. However, it can improve the picture quality from some recordings by slightly advancing or retarding the tape to compensate for a discrepancy in track position.

The NV-850 retains a normal video tracking control to ensure compatibility with conventional cassettes, recorded commercially or on other VCRs. In addition, however, it has an audio tracking control and provision to use the output level meter as an aid to its adjustment.

Contrary to what has been said elsewhere, neither tracking control has any affect on head azimuth angles; these are set to the tightest practical tolerances during manufacture.

In fact, the audio tracking control operates on the same servo loop as the video tracking control and both have essentially the same effect. In due course, they will probably be rationalised into a single knob or even "automated".

The point is that, being much narrower (26μm as compared with 49μm) the audio tracks call for more critical tracking adjustment; hence the

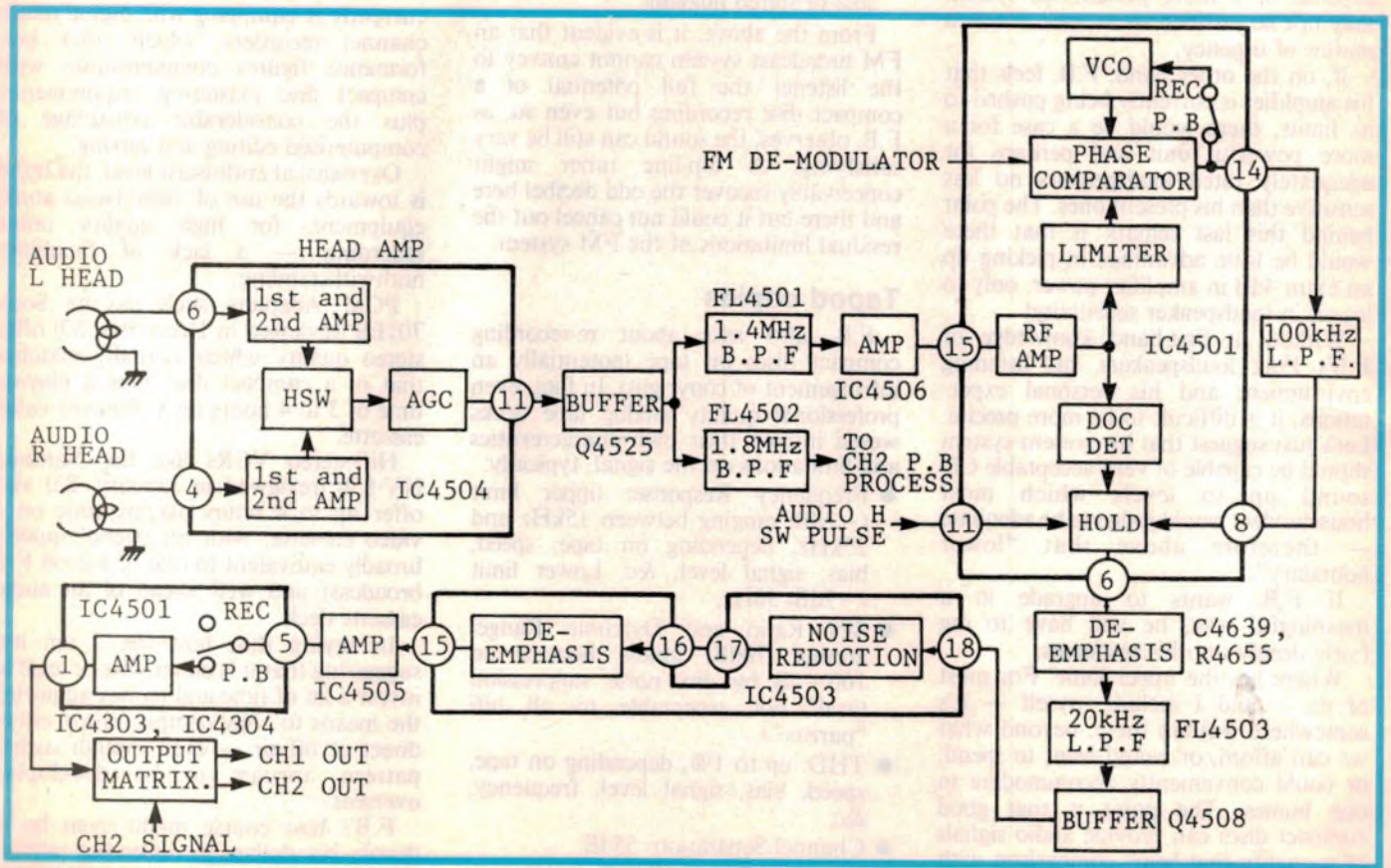
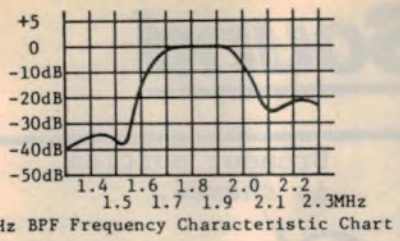
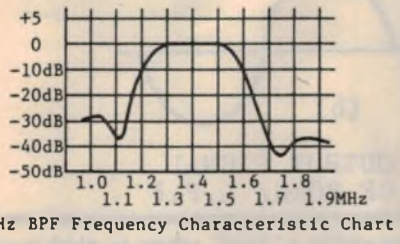


Fig. 7: The audio playback process, as summarised in this block diagram from the Matsushita Training Manual for the NV-850. Certain key sections are used both for Record and Playback.



1.8 MHz BPF Frequency Characteristic Chart



1.4 MHz BPF Frequency Characteristic Chart

Fig. 8: The band pass filters which select and separate the two FM carriers from the composite signal picked up by the two audio heads.

special provisions in the NV-850. Fairly obviously, with precisely positioned tracks (as per Fig. 3 last month) exact audio tracking would automatically ensure exact video tracking.

Problems could arise, however, with tapes in which the tracks are significantly misplaced relative to each other. That would lead to a situation where audio tracking could be optimised only to the extent that it did not unduly prejudice picture quality.

Certainly, a point to watch.

Playback mode

As with the recording mode, the recovery from the tape and the processing of the two FM audio carriers is a complicated procedure, but one which is streamlined by the use of dedicated ICs and also by employing key sections of the electronics for both purposes. Fortunately, this can be done relatively cheaply and reliably, these days, by using transistors or IC elements as signal routing switches, turning them on or off with DC "REC" (Record) or "PB" (Playback) control signals.

For example, during recording, the non-driven end of each head winding is effectively grounded by a shunt transistor, turned on by the REC control signal. For playback, the windings are used the other way around, with the shunt transistor turned off and the formerly driven end effectively grounded by a further shunt transistor and the now-passive recording amplifier.

Fig. 7, in this case reproduced directly from the National NV-850 Training Manual, illustrates the playback processing in block schematic form.

With the deck in Playback mode, the twin FM carrier signals from the two audio heads (left) are fed to flat-response, multi-stage IC preamplifiers, broadly similar to those used for the video signals. This is logical, because the audio carriers share part of the same frequency spectrum on the tape.

From the preamplifiers, the signals pass to an Electronic Head Switching system (HSW). Locked to the rotation of the video drum, it merges the succession of 1/50th second scans into a substantially continuous signal, which an AGC system holds to a convenient, predetermined level.

The composite signal then passes to a buffer amplifier and on to a pair of Band Pass Filters (BPF) centred at 1.4 and 1.8MHz (See Fig. 8) which separate out the two carriers for subsequent independent processing. The block diagram shows the processing for the 1.4MHz (L) channel only, the R channel being virtually identical.

Demodulation

Following the 1.4MHz signal through, it is seen to be amplified and then split two ways, with one feed going through an FM limiter to a demodulator involving the same VCO as used in the recording process, but in alternative mode. With a frequency modulated carrier being fed into the phase comparator, the system spontaneously generates a constantly varying error correction voltage in order to preserve phase lock with the incoming signal.

The relationship between carrier frequency deviation and error correction voltage is, in fact, notably linear, such that the error voltage is a near perfect replica of the original audio modulation — therefore of the L (Left) audio channel signal. Similarly for the R channel signal.

As with most demodulators, the "raw" audio output is mixed with a significant residue of carrier energy, calling for RF filtering, before it is fed to the audio system. At this stage, however, only partial filtering is provided in the way of a 100kHz LPF (Low Pass Filter) between the demodulated output (pin 14) and pin 8, which feeds it back into the Dropout Correction Circuitry (DOC) of the same IC.

The 100kHz LPF (Fig. 9) does markedly reduce the amount of RF superimposed on the audio but, more importantly, it delays the audio signal by just the right amount to complement the action of the dropout compensator.

Dropout compensation

As with a video dropout compensator, common to all domestic VCRs, the purpose of the audio dropout compensator is to subjectively disguise transients or aberrations in the signal caused by foreign particles on the tape or by discontinuities in the coating.

As shown, the DOC detector is fed from the same RF source as the limiter stage and, on detecting an IF signal dropout, generates a pulse which instructs a "Hold" circuit in the audio chain to hold the audio envelope at its current instantaneous value.

At the end of the dropout, when the IF signal reappears, a further pulse triggers a monostable multivibrator (MMV) which generates a supplementary Hold signal, extending the original Hold by a small, predetermined amount.

Because the DOC detector is fed directly from the IF amplifier chain, it can deliver a Hold instruction to the appropriate circuitry *before* the potential audio disturbance enters the audio channel, after having been deliberately delayed in the 100kHz filter, mentioned earlier. And, because the Hold instruction has been lengthened by the supplementary signal from the multivibrator, it is not cancelled until *after* the source signal has had time to recover from the aberration.

Switching noise

The DOC also has to deal with possible noise interference caused by the (electronic) head/head switching mentioned earlier. The switching is initiated by a 25Hz square wave, synchronised with the drum rotation — a head/head switch coinciding with each vertical pulse of the 25Hz control signal, hence 50 pulses per second.

As shown in Fig. 7, the control signal is also fed to the DOC system (shown as "Audio H SW Pulse"). Here, it is frequency doubled to a 50Hz square wave and used to feed a TPG (Trigger Pulse Generator) and MMV (Monostable Multivibrator) which jointly provide further Hold Signals, critically timed to coincide with possible head switching transients.

While the "Hold" circuitry can greatly reduce gross aberrations in an analog waveform, it can still create its own discontinuity, as illustrated in Fig. 10a. Fortunately, however, this can be rounded off considerably when, as shown, the audio signal is passed through a de-emphasis network and a 20kHz low

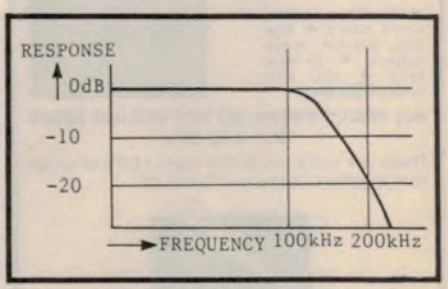


Fig. 9: A 100kHz low pass filter provides useful RF filtering after the demodulator but, more especially, delays the audio signal just enough to complement the action of the dropout compensator.

VCR Hifi Sound

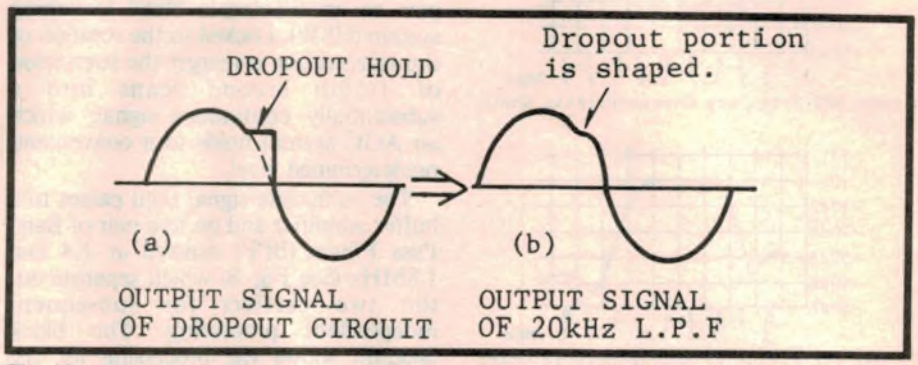


Fig. 10: A segment missing from a waveform is replaced by a "Hold" voltage (a) which is subsequently rounded out (b) by the effect of the de-emphasis network and low pass filter.

pass filter (LPF), followed by a buffer amplifier. Jointly, they have the effect of smoothing out the waveform (Fig. 10b) much as happens with any pulsed or digitised system.

Fig. 11 illustrates the timing of the DOC system in greater detail.

dbx expansion

At this point, the recovered audio signal is still in the compressed form resulting from the dbx processing prior to recording. It now has to be expanded in complementary fashion and this is performed by essentially the same dbx processor as used for recording, but suitably switched to reverse its action.

From the buffer amplifier mentioned above, the compressed audio signal is fed to the voltage controlled amplifier (VCA) of the dbx system, and also to the RMS detector through a weighting network similar to that used in the recording mode. As before, the weighting network increases the sensitivity of the RMS detector to the higher frequencies in the incoming signal, increasing their influence on the control voltage fed to the VCA.

However, in this case, the control voltage is fed to the VCA through an inverting amplifier, thereby reversing its effect on the signal being processed. Instead of dynamically compressing the signal, it now expands it by the same ratio, thereby restoring it to its original form.

As per last month's Fig. 5, signals at dbx 0dB reference are unchanged; those recorded in the range 0 to +5dB are expanded to 0 to +10dB; those in the range 0 to −35dB are expanded to 0 to −70dB.

Thereafter, the expanded audio signals are passed through a de-emphasis network to complement the recording characteristic, thereby achieving a substantially flat frequency response overall and, at the same time, attenuating any residual high frequency background noise. Electrically, they need only to be fed to an amplifier.

Input & output

Over and above the rather specialised audio circuitry just described, a hifi/stereo VCR must logically be able to accommodate source signals and deliver output signals to meet a range of user requirements.

In the case of the NV-850, the design provides for a tuner which can automatically sense a stereo or a multiplex transmission (by reason of standard pilot tones), plus stereo line input and output sockets, &c, and electronic output switching controlled by pushbuttons on the front panel.

When switched to a station transmitting stereo or simulated stereo audio, the tuner automatically demodulates the Main and Sub sound carriers to produce normal left and right channel stereo signals. These are made available for headphone listening, for external amplification and for recording on tape via the twin FM sound carriers.

In this situation, the output switching would normally be set to the L+R position — the manufacturer's way of denoting stereo.

While probably somewhere "down the track" for Australia, the tuner may alternatively sense a multiplex (eg, bi-lingual) sound transmission. In this case, the modulation on the Main and Sub carriers would be kept separate and selected for ultimate listening by switching the external audio system to "L" or "R" as appropriate.

In the normal way, the Main 5.5MHz intercarrier TV sound channel would end up on the analog track in the interests of compatibility with a conventional VCR.

For simulcasts, which have been popular over the past couple of years, hifi VCR owners have the option of

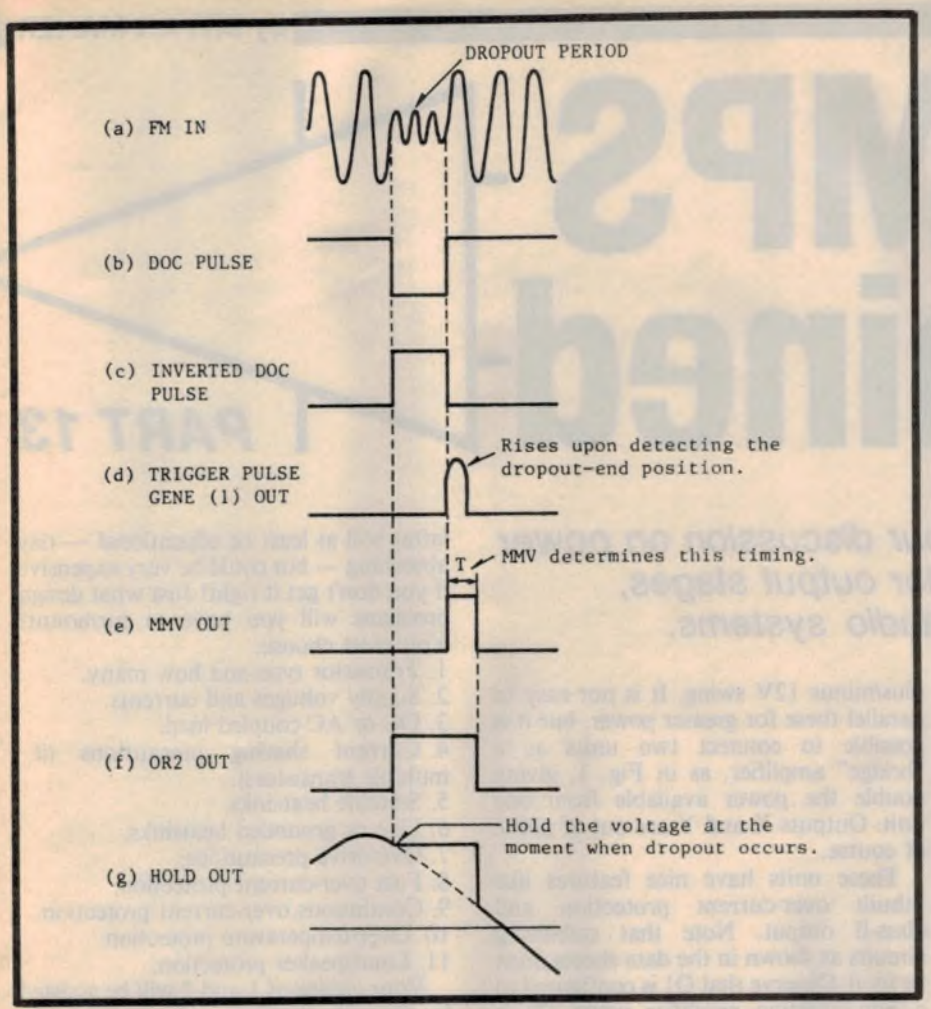


Fig. 11: When a dropout occurs (a) the detector produces a pulse (b). This is inverted (c) to produce a supplementary pulse (d&e), elongating the original pulse (f). This is long enough to straddle the noise transient, as delayed in the LPF.

recording the FM broadcast soundtrack by patching it across from a standard FM tuner. Indeed, hifi VCRs, such as the NV-850, do a fine job of recording any worthwhile stereo signal as a purely audio exercise, even when there is no associated video information.

And, of course, those modern films, with ear-tingling soundtracks, once fated to end up on dull sounding cassettes, can now be heard in the home at a quality level not far removed from a compact disc.

And that really is the "bottom line". One can be intrigued by the circuitry, as described. One might even suspect that a signal so extensively "processed" must somehow be compromised. But the simple fact is that the review published in our January issue rated the listening quality as "superb", with material copied from a compact disc virtually indistinguishable from the original.

For all the complexity of the signal processing, the system obviously works, and works well!

by BRYAN MAHER

OP AMPS Explained

PART 13

This month we continue our discussion on power op amps. We shall consider output stages, feedback and complete audio systems.

Our foray into power operational amplifiers is necessarily brief as even large books do not exhaust this fascinating topic. Discussions on output stages and feedback systems arouse much adrenalin in audiophiles, purists, visionaries, castle-in-the-air builders, pipedreamers and all the Don Quixotes among us, stimulating long debates and lots of fun.

Happily some of it comes down to earth, recognising that electronic circuits do, in fact, obey natural laws, leading to a plethora of published papers, magazine articles and many real circuit designs.

Power output stage

Of all the possible configurations mentioned in EA January 1985, p74 let us restrict our discussion to Fig. 3 of that issue. This shows the three popular variations of the complementary-symmetry scheme using NPN and PNP transistors in pairs. And, for any very high power jobs where PNP types are not available, Fig. 2B and Fig. 2C are used. We have a few options open to us:

(1) Go out and buy a power op amp integrated circuit, eg, National Semiconductor type LH0021.

(2) Make our own output stage using either:

(a) Junction transistors, one NPN and one PNP eg, 2N5686/2N5684

(b) Parallel connected groups of NPNs and PNPs for larger power

(c) A pair of complementary power FETs eg, 2SK134/2SJ49

(d) Parallel connected groups of pairs of FETs.

Of the above choices, (1) is attractive for small power requirements. Such circuits are true operational amplifiers and the LH0021 quoted can supply output currents up to one ampere at plus/minus 12V swing. It is not easy to parallel these for greater power, but it is possible to connect two units as a "bridge" amplifier, as in Fig. 1, giving double the power available from one unit. Outputs X and Y are out of phase of course.

These units have nice features like inbuilt over-current protection and class-B output. Note that stabilising circuits as shown in the data sheets must be used. Observe that Q1 is configured as a non-inverting amplifier while Q2 is connected as an inverting amplifier. Thus the load is driven to double the output voltage, ie, one end up (positive) and the other end down (negative). Correct load impedances must be observed.

If you want still more power and/or the chance to beat your own drum about "proper" bias, class and feedback arrangements, then be a devil — use option (2) a, b, c or d above and build your own. EA has happily furnished you with complete designs, or you could race off and design one yourself. The former choice should guarantee success, the latter will at least be educational — nay absorbing — but could be very expensive if you don't get it right! Just what design problems will you have to surmount? You must choose:

1. Transistor type and how many.
2. Supply voltages and currents.
3. DC or AC-coupled load.
4. Current sharing precautions (if multiple transistors).
5. Suitable heatsinks.
6. Live or grounded heatsinks.
7. Overdrive precautions.
8. Fast over-current protection.
9. Continuous over-current protection.
10. Over-temperature protection.
11. Loudspeaker protection.

Your choice of 1 and 2 will be assisted by data sheets from any of the many manufacturers, maybe from the American-inspired 2N or JEDEC series, the European style BC and BD types, or "in house" numbers such as Motorola MJ or Texas Instruments A or TIS series.

You will choose by reading data sheets, having in mind transistor speed (by comparing values of transition frequency fT), and current and voltage ratings. For example 2N3055 type transistors are really too slow for high performance power operational amplifiers, despite their low cost. Required current and voltage you will

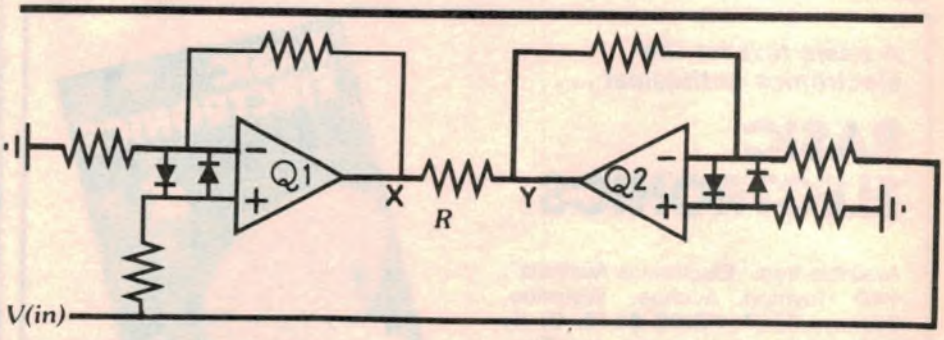


Fig. 1: power op amp using two 1A integrated circuits (type LH0021) in the bridge configuration. Q1 is connecting non-inverting while Q2 is set up as the inverting op amp. X and Y are the differential output points, RL is the load.

first calculate, from your desired power and load impedance. Then select suitable transistors, mainly by inspection of the "safe operating area" (SOA) diagram, as in Fig. 2, keeping an eye on the power temperature derating curve as in Fig. 3, and your heatsink data.

For example, NPN 2N5686 is known as a 300W, 50A, 80V type but, most optimistic reader, you cannot operate it with both those values simultaneously as those numbers multiply to four kilowatts, inviting certain breakdown. The safe operating area diagram says 80V and 200mA are OK; also 6V and 50A or 30V and 10A are just within its limits.

In Fig. 2(a), the SOA curve for 2N5686, the curve from j to k indicates a current limit of 50A because that is all the transistor internal emitter bonding wire will carry.

From k to l shows current limit considering power dissipation, ie, voltage-current product, l to m is the region limited by the danger of second breakdown, and finally m to n is simply the absolute 80V voltage breakdown limit at any current.

Fig. 2(a) is called the "DC safe operating area" meaning that the transistor can safely sit all day anywhere inside the curve. Just the right curve to look at for class A amplifiers.

Contrast this with class B amplifiers where each transistor carries current only half the time, ie 50% mark-space ratio. For this consider Fig. 2(b), this time for a different transistor, 2N3847. Three alternative SOA curves are shown; that marked DC is the direct current or full time limiting area, the smallest one. But this transistor can safely exceed the DC curve for a short time. It may run out to curve X provided the mark-space ratio is not more than 50% and conduction is never longer than one millisecond. For other operation classes this transistor can further exceed these ratings for a very short time to curve Y provided the mark-space ratio is 10% or less and conduction time is always less than 300 microseconds.

Regarding Power Temperature Derating Curves, aspiring designers must carefully note that the example quoted in Fig. 3 is called a 300W transistor, but this power rating only applies at 25°C case temperature, which is almost never obtained. At 110° case temperature this is only a 150W transistor, so Fig. 2 must be appropriately derated too!

Readers should consult some data sheets and see these curves. Luckily for us, as the load current increases, the voltage across the transistor decreases, especially in class B, but this point must be closely watched in class A. Chosen transistors should have a voltage rating

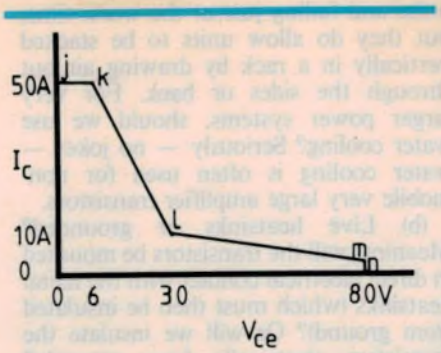


Fig. 2a: safe operating area curve for 2N5686 power transistor at Tc = 25 C. Linear scales are used to show the true curve shape. The vertical axis is the collector current in amps; the horizontal axis is the collector-emitter volts.

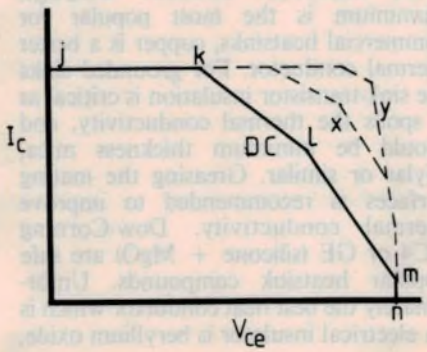


Fig. 2b: safe operating area curve for a typical silicon power transistor at Tc = 25 C. The log scales usually disguise the true shape. For continuous currents we must stay within the curve marked DC. For 50% mark-space ratio faster than 1ms, curve X is allowed, while for 10% mark-space ratio faster than 300μs, curve Y is safe.

greater than the sum of both positive and negative supply voltages.

Current sharing means that if you connect two or more transistors in parallel you cannot assume that they will equally share the current. Here junction transistors are proper villains and FETs

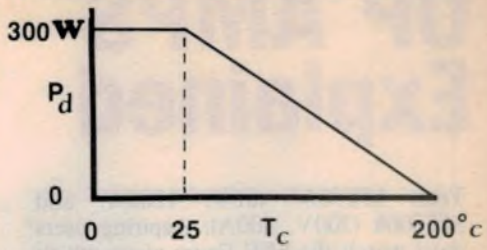


Fig. 3: temperature derating curve for 2N5686 transistor. Vertical axis Pd is the power which may be safely dissipated in heat by the transistor. If the transistor case is at 100 C, we must be satisfied with only about 170W instead of 300W.

are real saints. Junction transistors directly paralleled invite catastrophe as any one conducting more current than its fair share gets hotter, increasing its temperature, which raises its hFE, causing that transistor to conduct more current ... causing more temperature ... and very soon ... Boom!!

The cure is in Fig. 4 where resistors R, typically about 0.1 ohms, produce current-dependent voltage drops which subtract from the effective drive, so reducing the transistor current. Thus all transistors Q must conduct equally.

Also such resistors tend to compensate for change in hFE with drive or temperature.

Conversely, power FETs are nice, co-operative things in that they current share automatically because higher temperature causes less conduction.

A point of view slowly growing amongst modern designers is that paralleling NPN junction transistors is old hat and that it is more economical to buy a single large transistor. Manufacturers are stirring the market with slogans such as "un-parallel to save". Product examples include the Westinghouse WT5700 (1000V, 200A) and WT5705 (600V, 300A), or Power

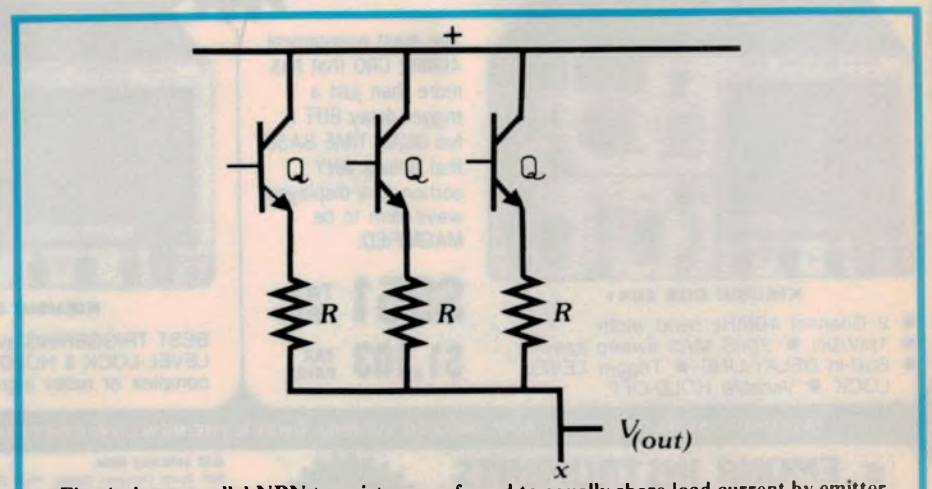


Fig. 4: three parallel NPN transistors are forced to equally share load current by emitter resistors R. The sum of the transistor currents goes to the load at V(out). X indicates the bottom half of the circuit where the same thing is done using complementary PNP transistors.

OP AMPS Explained

Tech MT5007 (80V, 1200A) and MT6008 (200V, 800A). Aspiring users must watch the hFE figure given which can drop off alarmingly at full current. The last two transistors quoted above are Darlingtons with an excellent hFE of 100 at full current. New technologies are used in their manufacture which actually aim at non-linear power switching uses. Your optimistic author looks forward to some avante garde designer using them in large linear operational amplifiers. The present non-existence of large complementary PNP types is still a problem though.

Heatsinks

Heatsinks require a few decisions:

(a) Cooling: Do we use natural convection or use a fan? Usually, natural convection is chosen for small to medium designs up to 100 watts or so, reserving fan cooling for larger sizes. Fans have two nasty habits: creating noise and failing just at the worst time, but they do allow units to be stacked vertically in a rack by drawing air out through the sides or back. For very larger power systems, should we use water cooling? Seriously — no jokes — water cooling is often used for non-mobile very large amplifier transistors.

(b) Live heatsinks or grounded? Meaning, will the transistors be mounted in direct electrical contact with the metal heatsinks (which must then be insulated from ground)? Or will we insulate the transistors electrically from grounded metal heatsinks? Live heatsinks give better cooling but ease of construction often dictates grounded heatsinks with insulated transistors.

(c) Material choice? Though aluminium is the most popular for commercial heatsinks, copper is a better thermal conductor. For grounded sinks the sink-transistor insulation is critical as it spoils the thermal conductivity, and should be minimum thickness mica, Mylar or similar. Greasing the mating surfaces is recommended to improve thermal conductivity. Dow-Corning DC4 or GE (silicone + MgO) are safe popular heatsink compounds. Unfortunately the best heat conductor which is an electrical insulator is beryllium oxide, BeO [the BE(2+) ion has the highest charge-to-radius ratio]. Hence its suspension in silicone grease is used on many heatsinks. (Warning! Beryllium and all its compounds are exceedingly poisonous, especially if inhaled, eaten or allowed into cut fingers or under fingernails.)

For heat energy to flow from a transistor junction at temperature Tj to the transistor's case at temperature Tc, there must be a difference in temperature (Tj − Tc). This difference is known as the "temperature gradient" Tjc. Everything in nature has the capacity to store some heat for a given temperature rise. We call this the thermal capacity, Ch. This heat storage acts like a low pass thermal filter and we call the time taken for the first 63% of any change by the obvious name, the "Thermal Time Constant", using these units:

Heat Energy (in joules)
Temperature T (in degrees centigrade)
Rate of flow of heat energy (in joules per second = watts)
Thermal capacity Θ (in degrees per watt)
Thermal resistance Ch (in joules per degree)
Thermal time constant = ΘCh = seconds.

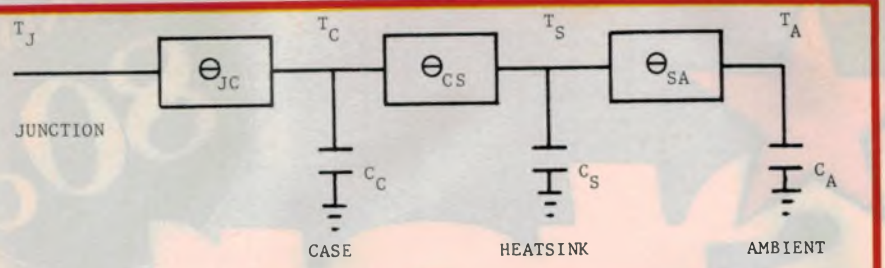


Fig. 5: thermal circuit of the path of heat flow from a transistor junction at temperature Tj to the ambient (usually room air) at temperature TA. The Θ's indicate thermal impedances, the C's are the heat capacities of the case, heatsink and ambient. If the heatsink is completely open to room air well stirred by convection, then CA is virtually infinite.

The statement that the product of Θ and Ch equals seconds is easy to show:

$$\Theta Ch = \frac{\text{degree}}{\text{watt}} \times \frac{\text{watt, second)}}{\text{degree}}$$
$$= \text{seconds}$$

Then the rate of flow of heat, W, say from the junction to the case, is equal to:

$$W = \frac{\text{delta T}}{\Theta} = \frac{Tj - Tc}{\Theta jc} \quad \ldots\ldots (1)$$

$$Tj = Tc + W\Theta jc \quad \ldots\ldots\ldots\ldots (2)$$

where:

W is the rate of flow of heat

Tj is transistor junction temperature

Tc is transistor case temperature "at equilibrium"

jc is thermal resistance from junction to case.

Equation (2) shows why the junction temperature (the only temperature that really matters), can be much higher than that of the case. Equation (1) is said to be a "dual" of Ohm's Law for electrical circuits, and we sometimes talk about the "duality" existing between this thermal system and an electrical system. Two different systems are called "duals" if they are described by the same form of equations (but different constants and variables). We say Tc is case temperature "at equilibrium" meaning that after a junction temperature rise, some time will elapse before the case temperature rises to the value predicted by the equation (2). This effect is not because of any slowness of heat flow but is caused by the heat storage capacities.

Before equilibrium, the case temperature is given by a complex non-linear exponential equation involving seconds of real time, all heat capacities and all thermal resistances. The latter are symbolised by thermal resistances:

Θjc = junction to case

Θcs = case to heatsink

Θsa = heatsink to ambient (room air usually)

Θja = junction to ambient

$\Theta ja = \Theta jc + \Theta cs + \Theta sa \quad \ldots\ldots (3)$

Equation (3) implies that junction, case, heatsink and ambient air are all at different temperatures, as depicted in Fig. 5, with Tj highest.

The thermal resistance Θjc from transistor junction to case is part of the transistor design. For very large transistors, manufacturers have had to find techniques such as "silicon-molybdenum-coppercase" sandwich soldering/brazing to ensure very low Θjc, eg, below 0.25 degrees per watt. The other thermal resistances are your responsibility, zealous amplifier designer! Clearly Θcs is minimum when thermal conducting grease and no insulation are used, and Θsa can be lowered by improved air circulation, larger heatsink fin area, and dull black surfaces. Extremely thin black anodising is best, black paint is a no-no as it just insulates the heatsink from the air. Some very large transistors are designed to favour water cooling.

The heatsink itself can be anything from the back panel of the case (insulated transistors) to large aluminium extruded single-sided or double-sided heatsinks.

Overdrive precautions prevent power amplifiers from smashing your expensive speaker cone or suspension on signal peaks. Especially needed with live signal sources such as your bass guitar, they usually take the form of diodes and/or zeners across base (or gate) to ground to simply place a limit on available drive.

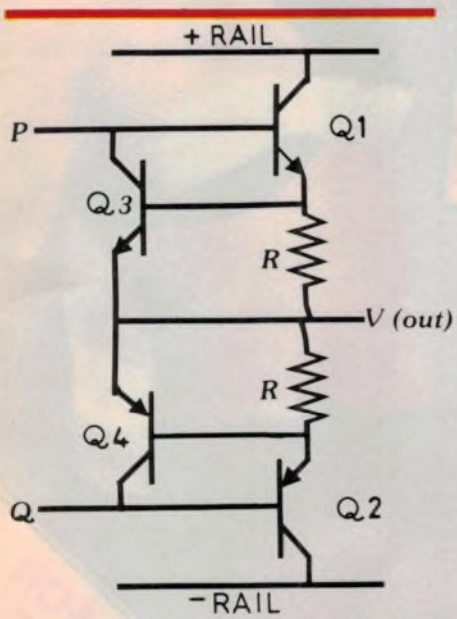


Fig. 6: one possible method for over-current protection of emitter follower output transistors. Low-value resistors R cause a voltage drop due to current through Q1, Q2. Over-current causes enough voltage across R to turn on Q3 or Q4, thereby removing base drive signals at inputs P and Q.

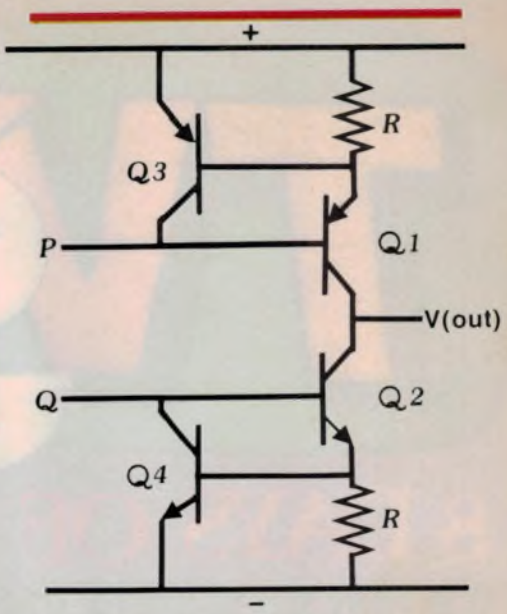


Fig. 7: over-current protection circuit for collector output (common emitter) output stage. This works in similar fashion to Fig. 6 and is the method used in the LH0021 integrated power operational amplifier.

Over-current protection

Over-current protection must be considered separately in terms of the first 20 microseconds or so, followed by the sustained effects. It is quite possible to ruin a power transistor by excessive over-current in as short a time as 15 microseconds. Your repentent author has done just that (shame, shame!). This would be by "second breakdown" changing the crystaline doping distribution when large voltage and current exist simultaneously. Protection circuits obviously must be either very fast or useless (the quick and the dead?), or — as a different philosophy — never allow large rate-of-change of current di/dt to flow at all.

Fig. 6 shows fast over-current protection, Q3, Q4, for emitter follower output transistors Q1, Q2. R is a low value (few tenths of ohm) chosen to produce enough millivolts to turn on Q3 if Q1 current exceeds a nominated limit. Turning on Q3 pulls the drive P away form Q1 base as Q3 (when on) can saturate down to 300 millivolts if necessary. (Q3 when off is effectively not there.)

For designs using collector output, Fig. 7 acts similarly.

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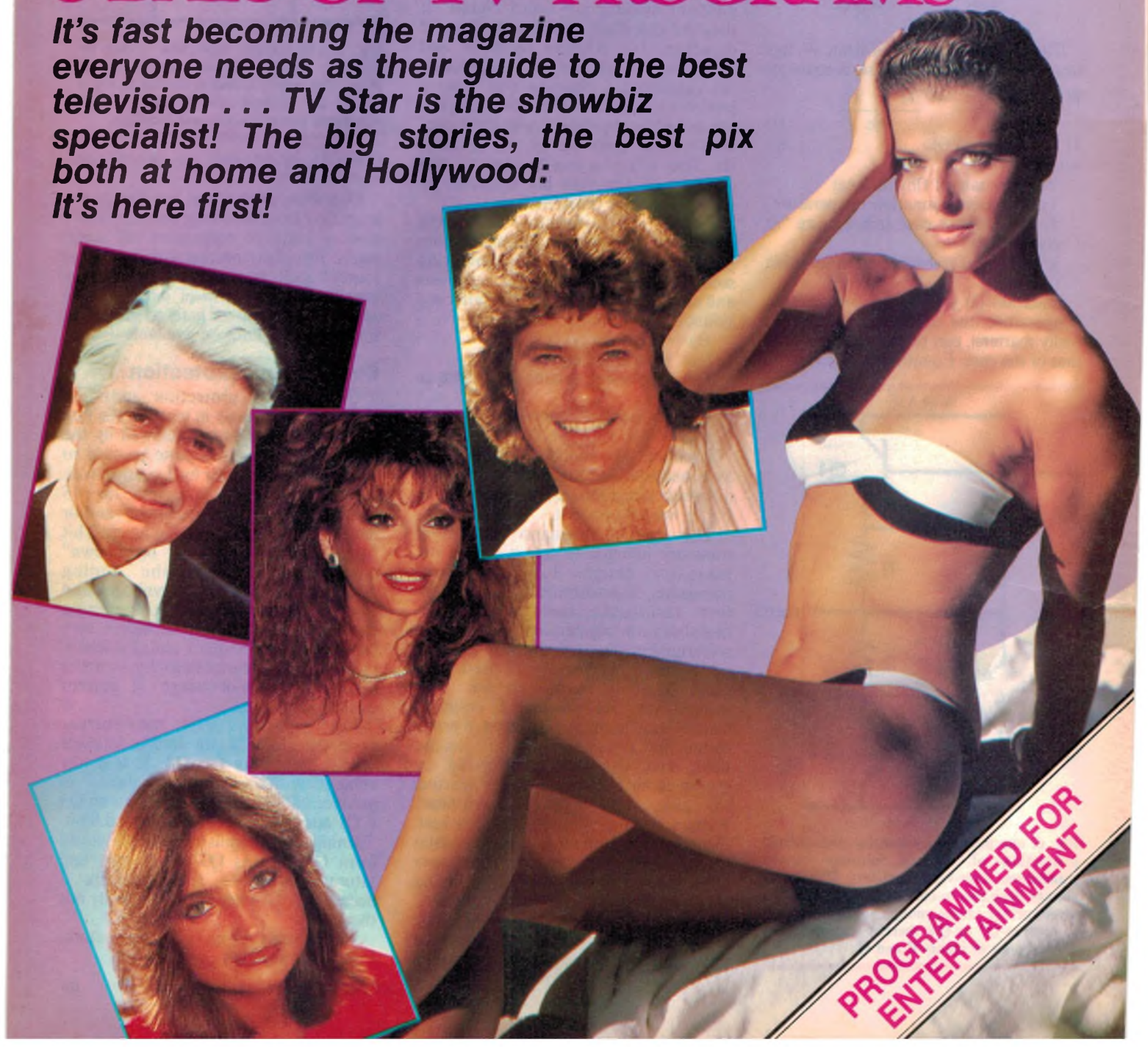

PROGRAMMED FOR ENTERTAINMENT

OP AMPS Explained

A third possibility is to use regulated power supplies, each with its own current limit and no further protection in the amplifier. Good idea — but watch out for any large storage capacitor across that power supply output! Such capacitors can supply hundreds of amps peak current independent of the current-limited regulator.

Over-temperature protection

Overtemperature protection need not be fast. It could take the form of Fig. 8, or alternatively a transistor or other suitable component bolted to the heatsink and operating a relay whose contacts switch all power supplies. Such temperature protection is essential where fans and horizontal air-flow or water cooled heatsinks are used.

Loudspeaker protection circuitry was born when the story "$200 loudspeaker burns out and protects $2 fuse" ceased to be a joke. OK — we have provided overdrive protection — but what if an output transistor fails by collector-emitter or collector-base or drain-source breakdown? Good case for capacitor-coupled output, eh what? Amplifier overcurrent protection is no good now! Hopefully your speaker will survive the single initial thump. But it will probably be burnt out with about 8 amps DC flowing (ie 65V supply/8Ω speaker). Consider those very fast fuses sold for thyristor protection, but put them in the supply rails, not the speaker lead, or use over-current-circuit breakers or relays, or current-limited regulated power supplies.

Feedback philosophy

Fig. 9 is the complete block diagram of the whole amplifier with the feedback section H "closing the loop". The idea of a negative feedback amplifier is that the forward open loop gain G (from difference stage to output) is quite high while the feedback gain H is (usually) less than one, giving the overall amplifier low overall closed loop gain T, from input to output.

The purpose is to achieve a pure, stable, constant overall gain T, free of the errors, non-linearities, distortions and unpredictability of the forward gain. But there is a catch — the moment we close any loop we run the risk of instability.

Just how we calculate closed loop gain T and predict whether or not it will be stable needs exactly the theory explored in parts 1 and 2 of this series (EA, March, April 1984). Readers overcome by enthusiasm are invited to re-read those sections. In case someone has stolen your copy, a summary would go something like this:

Fig. 10 summarises all possible negative feedback closed loop systems, using G to symbolise the gain of all forward sections, ie, difference stage, amplifier, bias and output stage all lumped together. H is the feedback "gain" (often a fraction) measured from the output back to the negative input of the difference stage. This figures uses the usual symbols; the circle represents the "act of comparison" of the difference stage; but any gain of the difference stage is lumped in with G. The signal called "ERROR" is the difference between input and the feedback "FB". If H were a simple voltage divider with "gain" equal to say one-fifth, then FB

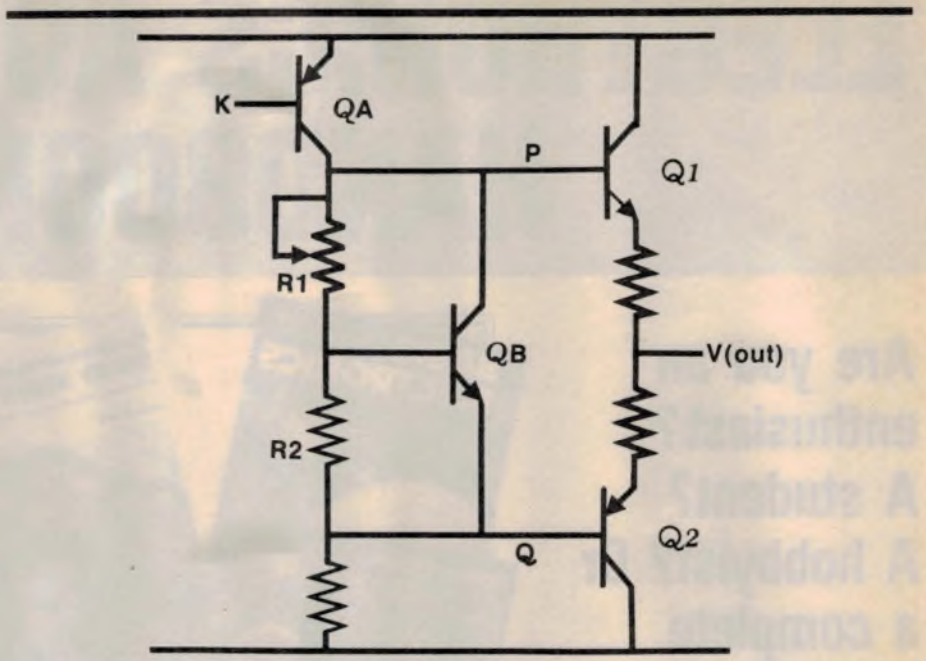

Fig. 8: a method of over-temperature protection for output transistors Q1, Q2. If we develop the bias for the output stage using the "Vbe multiplier" QB (see Fig. 3 last month), we can mount plastic-cased QB on the output stage heatsink. High output temperature will heat QB, reducing the bias developed between P and Q and thus reducing the output current.

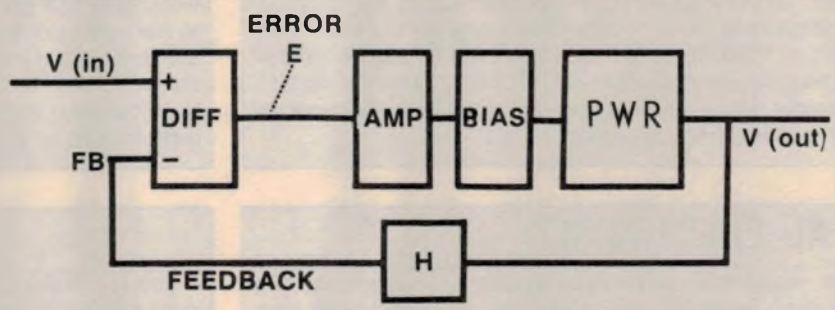

Fig. 9: this block diagram of a complete power operational amplifier assembles all the sections previously discussed. The feedback loop is closed by H. G is the gain from Error E to V(out), T the gain from V(in) to V(out).

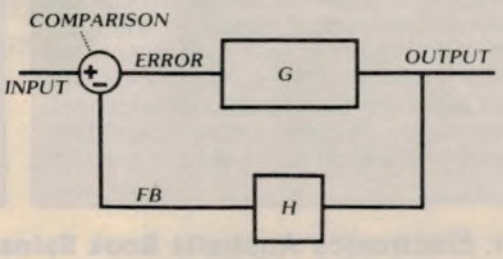

Fig. 10: the general in-phase (non-inverting) feedback system summarises all possible cases.

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OP AMPS Explained

would be simply one-fifth of the output.

To calculate closed loop overall gain T, from input to output:

Output = G × Error
Error = Input − FB
= Input − (Output × H)
Output = G × [Input − (Output × H)]
= (G × Input) − (Output × GH)
Output + (Output × GH) = G × Input
Output (1 + GH) = G × Input

$$\frac{\text{Output}}{\text{Input}} = \frac{G}{(1 + GH)} = T$$

Furthermore, if G is a large number, ie a high forward gain, then the "one" in (1 + GH) doesn't make much difference and:

$$T = \frac{G}{1 + GH}$$

$$T = \frac{G}{GH} \text{ approx}$$

$$T = \frac{1}{H} \text{ approx}$$

Readers please pause, take a deep breath, then plunge in again. As H commonly consists of a handful of passive components like resistors, then H and hence T is very stable, constant and free of distortion, non-linearity or other nasties. That beautiful starry-eyed description turns out to be only an approximation because:

(1) Forward gain G drops off at higher frequencies because of natural time constants and delays.

(2) Phase angle delays arise from the same cause.

(3) Hence G is not a simple number, it is some function of frequency. Being more than a simple gain, we therefore call G a "Transfer Function".

(4) Instability occurs if the phase delay in a feedback circuit happens to be 180° at some frequency, as 180° shift of a sine wave is equivalent to phase reversal making the feedback positive instead of negative. The output then goes completely out of control.

Because there will always be some frequency at which loop phase delay is 180°, to ensure stability (ie prevent oscillation) you must add some components to reduce the loop gain to less than unity at that frequency. This usually means aiming for a loop gain falling at high frequency by just the right amount. Also auxiliary impedance loads are often used to ensure stability under different loads and conditions.

Fig. 11, the EA 20 watt Utility Amplifier (described EA Nov, 1984, p 100) illustrates many points discussed in this series. Q4 is the difference stage with input at base and feedback at emitter. Q3 is the amplifier while Q5, a Vbe multiplier, forms the bias network adjusted by VR1. Darlington emitter followers Q1 and Q2 provide (approximately) unity gain output power stage with capacitor coupling to the load. Low frequency response is ensured by the large size (1000μF) capacitor chosen.

Stability is ensured by the 82pF capacitor from Q3 collector to base. This forms another auxiliary local negative feedback loop just around this transistor, reducing its gain at high frequencies at sufficient slope. As well, to prevent instability when "funny" loads are driven, the auxiliary load, 4.7Ω in series with 0.1μF, is permanently connected across the output. Such precautions are useful if loads like high impedance headphones or capacitive speakers are used.

The Playmaster Series 200 high quality, high power audio amplifier (refer EA, Jan, 1984) is an excellent example of much of the theory we have been considering. Q1, Q2 form the input difference stage configured as a long tail pair using Q3 as a high impedance active tail. Note the use of PNP transistors, and push-pull or differential output to the high gain amplifier Q4, Q5, a second LTP which has the current mirror Q6, D3 as a high impedance load.

The 500Ω potentiometer is the bias circuit for the complementary Parallel Source Follower (approx unity gain) output FETs Q7, 8, 9, 10. Because the current mirror Q6 is such a high impedance load, the signal lost across the 500Ω pot is insignificant. Hence even harmonics due to unequal top-bottom drive are extremely small. The feedback path (which we have called H) consists of a simple resistive voltage divider at audio frequencies, using 22kΩ and 1kΩ ohms. Hence:

H = 1k ohm/(22k ohm + 1k ohm)
H = 1/23 (at audio freq)

Because G for this design is very high (two long tail pairs and current mirror) then:

T = 1/H = 23

should be an excellent approximation, enabling the FB network to reduce distortion to very low levels.

At zero frequency, ie DC, H reverts to 1.0 (for DC stability) by the action of the 47μF, 16VW capacitor.

Next month we'll look at some special power op amps, including motor and lamp drivers, variable class and nested differentiating feedback loop audio amplifiers. Bye!

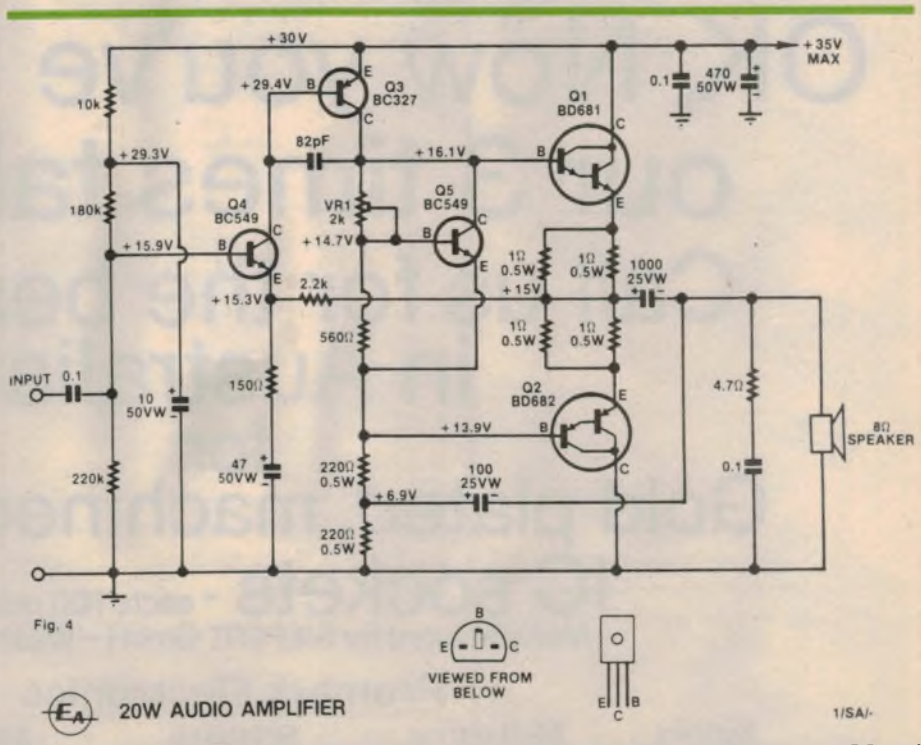


Fig. 4

Fig. 11: circuit diagram for the EA 20 watt amplifier. Note the Vbe multiplier circuit (Q5) and Darlington emitter followers Q1 and Q2.

MPF-IP Micro-Professor development system

The MPF-IP Micro-Professor is a product of the Multitech Industrial Corporation of Taiwan. The MPF-IP is a complete microprocessor system based on the Z-80. It comes with detailed instruction manuals and a full range of options and accessories.

by FRANCO UBAUDI

The Micro-Professor is not an evaluation kit. It is a multi-purpose product intended to satisfy the needs of Education, Control, Interfacing and Development. There are two models, the MPF-I and the MPF-IP. We reviewed the latter version.

The MPF-IP is one neat board measuring 157 × 220mm which accommodates a Z-80 processor chip, two 2K RAMs, one 8K ROM, two I/O port ICs and 12 other ICs for such tasks as decoding. The board is fitted with a 49-key keyboard with QWERTY layout and a 20-digit, 14-segment alphanumeric green vacuum fluorescent display.

Also included on the board is a cassette interface for program storage and retrieval and a speaker is provided for system and programmer use. With the speaker, the user may generate programs for producing anything from alarm sounds through to music.

The entire board assembly is enclosed in a plastic binder which can be opened and closed like a book. The unit is powered from a 9V DC plugpack. Battery back-up for the RAM is included to store programs when power is removed from the unit.

Included with the basic MPF-IP are three softcover manuals. There is a 130-page User's manual, a Monitor Program Source Listing, and an Experiment Manual. The monitor program manual contains a listing of the monitor program in both Z-80 assembler mnemonics and Z-80 assembled hex code. Included in the monitor program is a full Two-Pass Assembler, a Line Assembler and a Dissambler. The MPF-IP also offers a long list of subroutines, 44 in all.

What is a two pass assembler? It is itself a program which is used to convert other programs into machine code. The conversion process takes two steps or passes, hence the name. In the first pass the assembler produces a symbol table which contains all the labels and their corresponding values found in the program. In the second pass the assembler uses the symbol table to generate the actual machine code, or as it is sometimes called, the object code.

Because the two-pass assembler generates a symbol table during execution, more memory is required to produce the machine code program than is actually required to store it. Therefore, in the situation when there is insufficient memory for the two-pass assembler to work a one-pass assembler may be used. With this assembler, as each program line is entered the line is also assembled. An advantage of this is that your program is also checked for instruction errors as you enter it.

The function of the disassembler is simply to produce a mnemonic program from Z-80 hex machine code. It is a very useful tool for reading EPROM's.

Useful Commands

You can enter hex code directly by using the M command. The M command is simply a display and alter function for the contents of memory. Therefore, with this command you can enter a complete program or change only certain locations. An example of its use is,

⟨M⟩ = FB00: 12 13 14,

to insert 12 into the location FB00, while 13 and 14 are placed into successive locations. The F command is used to insert data into a specified memory range. For example if you required the hex value 34 to be placed in every memory location from FC00 to FD00, the F command will do the job. The command line to do it is

⟨F⟩ = FC00 FD00 34.

Another command is the R command, to display and alter the contents of registers. The Z-80 has quite a lot of internal registers in comparison to other CPUs. Actually the Z-80 has 22 separate registers in all. The use of the R command is as follows,

R (return)

to display all registers. To display just the C register for example, the command

R : C (return)

is used.

Next is the W command which is used for storing programs or data on tape. Its format is as follows:

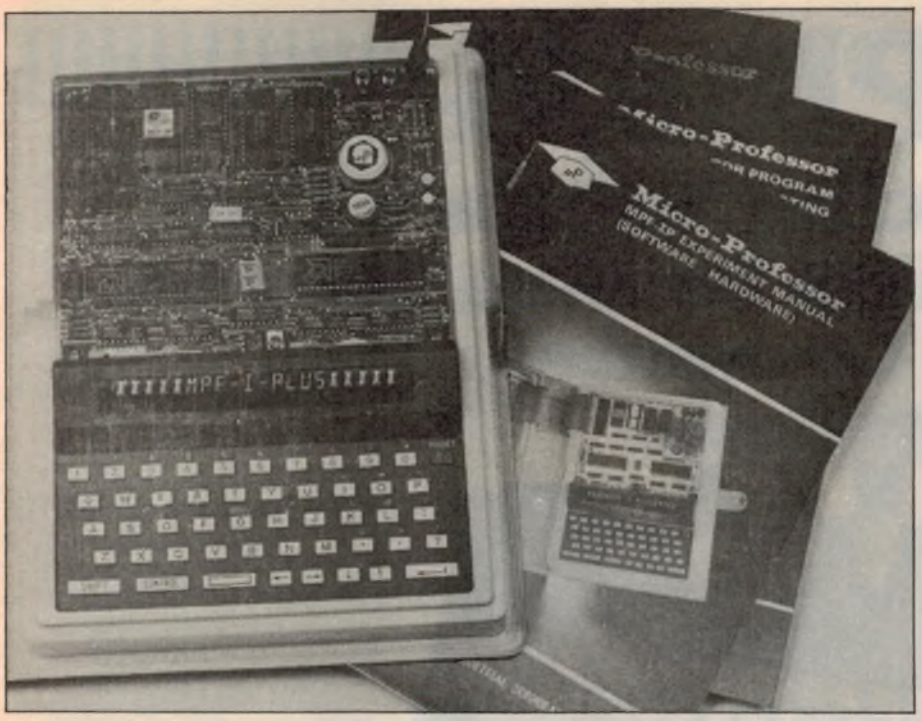
W ⟨starting address⟩ space ⟨ending address⟩ space ⟨filename⟩ (return).

To retrieve data or programs from tape, the L command is used. Its format is

L ⟨filename⟩ (return).

The read program is stored into the same location in RAM as it originally occupied. As well, a checksum is performed by the MPF-IP. The operation of the checksum is as follows: when a program is originally stored, a checksum value is calculated and also stored on the tape. When the program is read back into the MPF-IP a checksum is again calculated by the system; if both checksums agree all is well, otherwise an error message is issued.

A useful command for the inexperienced programmer is the J command. This command is used for the calculation of relative addresses for jump instructions. Another useful command is the I command, which is used for inserting data into memory. For example data 1 2 3 4 5 is inserted at location F800



The Micro-Professor is a single board system which comes complete with three manuals.

as follows:
⟨I⟩ = FE00/
⟨I⟩ = F800 1 2 3 4 5

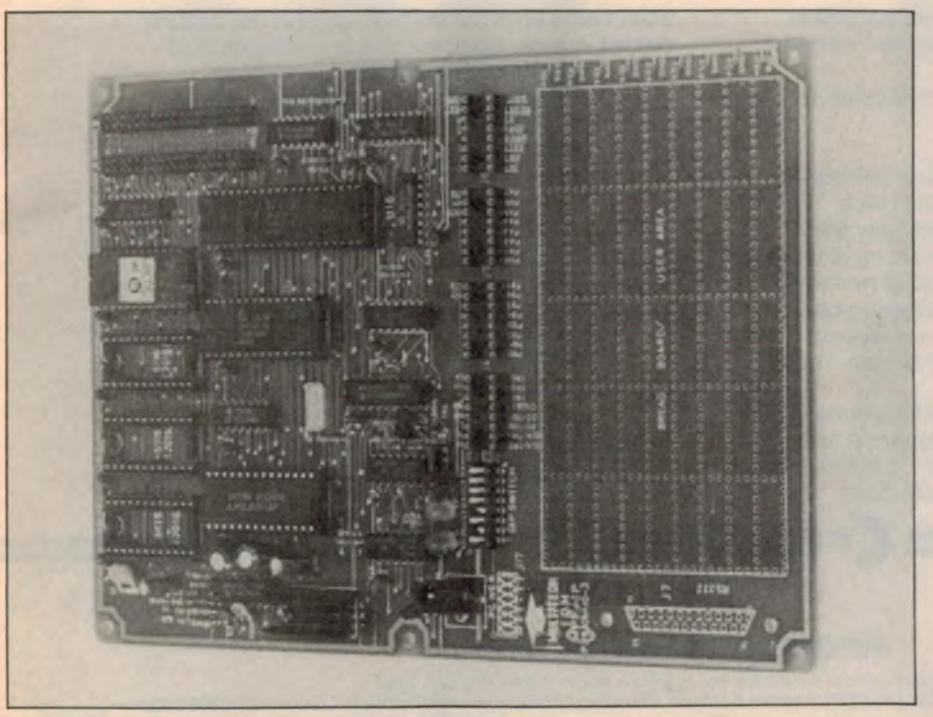
Simple isn't it? But the value of the I command is in that the data is "inserted", hence any data already present is shifted into higher memory addresses rather than over written.

A complementary command to the I command is the D command. This command is used to delete data from memory in much the same manner as the I command is used to insert data.

Debugging

To help the user debug programs, two commands are provided by the MPF-IP. The first is the B command which is used to set and clear breakpoints within a program. Note that only one breakpoint can be used at any time.

The second debugging method is provided by the S command. With this command you can execute a program one instruction line at a time. Therefore each time you press the S key another instruction line is executed.



This the memory expansion board for the MPF-IP.

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MPF-IP Micro-Professor

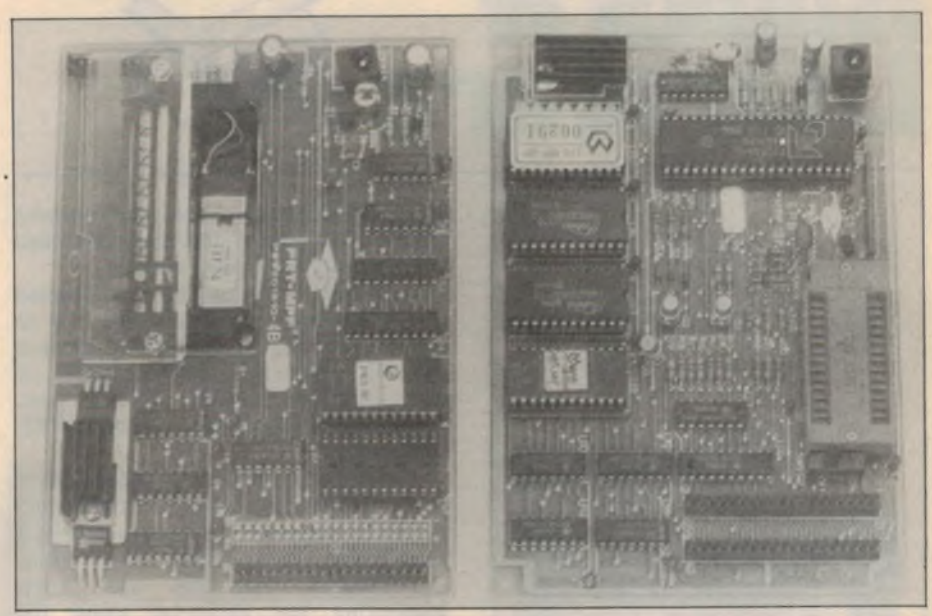
Text Editor

To enter the editor you hold the E key down while pressing the control key, or control E for short. After typing control E, you will be prompted to enter a starting and ending address for the text buffer. The editor will now prompt you to start entering your program. To exit from the editor you just hit the return key twice. If you need to re-enter the text editor the R command can be used.

With the R command you can re-edit a program that already exists in the text buffer. Therefore, when you use the E command to enter the editor the MPF-IP automatically resets the text buffer pointer, which means any new program entered is written over the top of any old program. That's the difference betweeen the E and R editor entry commands. To exit from the editor to the monitor the Q command is used.

There are many other commands available for the editor, however to save space they will only briefly be mentioned in point form.

* To insert lines when in the editor there is an I command.
* To delete a line the D command is available.
* To display n number of lines in the file from the current line use P n command.
* To display all lines in a file the Z command is used.
* To move the cursor to the bottom of a file use the B command.
* To move the line pointer down to the nth line in the file use the G n command.
* To move the line pointer up n lines use the U n command.
* To move the line pointer down n lines use the N n command.
* To move the line pointer to the top of a file use the T command.
* To print the line number of the line currently displayed use the L command.
* To locate a particular string in a file use the F /???/ command, where ??? is the string to be located.
* To change a string use the C /???/XXX/ command to change the string ??? to XXX.
* To display the addresses of the top and bottom of a file use the S command.
* To toggle the state of the printer control (ON or OFF) use the X command.
* To write data from memory to tape use the W FILENAME command, where FILENAME is the file name.
* To read data from tape into memory use the R FILENAME command.



This is the MPF-IP EPROM programmer board.

Accessories for the MPF-IP

Accessories for the MPF-IP include a Basic interpreter resident in an 8K ROM which may be plugged into a spare socket on the PCB. This version of Basic included floating point arithmetic.

If you wish to use the MPF-IP as a dedicated controller, a ROM containing Forth programming language is also available. Forth provides the user an expandable, structured, stack-oriented language which is programmed in Reverse Polish Notation. Relative to other languages Forth is simple to use for control applications; even non-programmers can use it successfully.

A thermal printer capable of printing 20 characters a line is also available. Incorporated in the printer are several useful features, such as a memory dump utility and Z-80 disassembler listing utility.

An EPROM programmer board is available. This board is capable of accepting currently used 1K, 2K, 4K and 8K EPROMs which operate from a single +5V supply. The EPROM board allows you to read data from EPROM memory into a RAM buffer, then verify, display, list or modify the data. You can also write data from RAM to EPROM as required and delete or insert at will.

An input-output and memory expansion board is another accessory for the MPF-IP. Included on this board is a counter/timer chip (CTC), a communications interface chip (USART 8251) and a parallel I/O chip (PIO). Also included are 6K RAM and 4K ROM locations if extra memory is required.

Other accessories available for the MPF-IP are a speech synthesiser and a sound generator board.

Conclusion

When you consider all the features that have been mentioned above, the Micro-Professor is definitely good value for money. The quality of the construction and the performance are high. In fact there is only one noticeable short-coming in the Micro Professor and that is in the documentation. It appears to suffer from being translated from Chinese. Another small drawback is the requirement for a separate plugpack for each accessory board added to the MPF-IP.

Anyone who has an interest in either learning about microprocessors or has the need for a development system or a means of small scale process control in an industrial situation can make good use of the MPF-IP.

Prices for the MPF-IP and its accessories are as follows:

MPF-IP including manuals	$248.40
IOM-MPF-IP I/O & memory expansion board	$158.40
EPB-MPF-IP EPROM Programmer board	$190.80
SSB-MPF-IP TMS5220 based Speech Synthesis board	$190.80
PRT-MPF-IP Thermal Printer	$126.00
SGB-MPF-IP Sound Generation board	$126.00
SSB-VOC-IP 1,200 Word Vocabulary set	$672.00
BASIC-MPF-IP 8K Basic Interpreter ROM	$54.00
FORTH-MPF-IP 8K ROM	$54.00

Further information on the Micro-Professor range of products can be obtained from the Australian distributors, Emona Computers Pty Ltd, 720 George St, Sydney. Phone (02) 212 4599.

Books & Literature

Interfacing the Commodore PET

PET INTERFACING, by James M. Downey & Steven M. Rogers. Published by Howard W. Sams & Co, Inc, USA. Soft covers 135 x 215mm, 262 pages, illustrated with diagrams, pictures and tables. ISBN 0-672-21795-3.

This book has two authors, Dr James M. Downey, Professor in Medical Physiology whose work in this area involves the use of computers, and Steven M. Rogers, a technical representative for the Eastman Kodak Company, where his work involves high-speed computer controlled automatic photographic printers and negative handling systems for the photofinishing industry. Together, these two authors offer a great deal of practical knowledge on computer controlled systems.

As the title suggests, this text is aimed at Commodore Pet owners but it is so well written that it could be used as a general reference. Three types of interfacing are covered: the user port, memory expansion port and the IEEE 488 port.

The book opens with an introduction to the PET microprocessor hardware and guides you through the construction of a breadboard circuit. Next are interface experiments with the user port, interfacing the PET by using the memory expansion port and interfacing the PET to a IEEE 488 port.

Note that the experiments in this book can be used with all versions of the PET computer that have a 25-by-40-character video display, including some of the older PET computers that have been upgraded with new ROMs.

Our review copy came from Jaycar Electronics.

Applications for your Apple II

MOSTLY BASIC: APPLICATIONS FOR YOUR APPLE II (Book 1), by Howard Berenbon. Published by Howard W. Sams & Co, Inc, USA. Soft covers, spiral bound, 215 x 280mm, 158 pages. Illustrated with diagrams and tables. ISBN 0-672-21789-9. $14.95.

This book is written for the Apple II owner and contains 28 chapters filled with interesting and educational programs. Anyone who owns a different type of computer, provided it offers Basic, will more than likely still be able to use these programs, either with little modification or none at all.

The book is split into five separate headings which are as follows: Real-time Applications, Educational, Programs, Business and Investment, Home Applications, Utilities and The Unusual. For example under the first heading is a telephone dialler. The program accepts the name of the person to be phoned, searches for the number and on finding the number dials it. A simple interface circuit for dialing the phone number is provided.

Other chapters under this heading are entitled: Combination Lock, Digital Stopwatch and the Time Machine.

Each chapter of this book is devoted to one program, so the reader need only read that which is of interest. To make life even simpler for the reader, each chapter is kept short and to the point. Each chapter begins with a brief introduction as to what the program is for. Any interface required is also mentioned and finally the method of use is discussed.

In summary, this is a well-written and useful text. Our copy came from Jaycar Electronics.

projects & circuits Number 3

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Video Amplifier for Computers and VCRs; Video Enhancer; Vocal Canceller; Stereo Simulator for Tuners and VCRs; Guitar Booster for Stereo Amplifiers.

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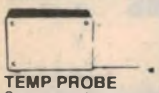

TEMP PROBE

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Cat. K41530 **$24.50**

ELECTRONIC WATT METER

This unit will measure the power consumption of any mains appliance with a rating up to 3 kilowatts. It makes use of a special op amp called an 'output transconductance amp' or OTA for short.
(EA Sept '83) 83WM8
Cat. 83082 **$89.95**

PH METER KIT

Build this pH meter for the swimming pool season is here again! From swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.
(EA Dec. 82) 82PH12
Cat. K82123 **$139**

50 W AMPLIFIER MODULE

Cat. K44880 **$24.50**

100 W AMPLIFIER MODULE

Cat. K44801 **$27.50**
(Heatsink optional extra)

ELECTRONIC MOUSETRAP

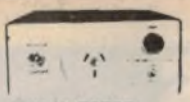
This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!
(ETI Aug. '84) ETI 1524
Cat. K55240 **$29.95**

1W AUDIO AMPLIFIER

A low-cost general-purpose, 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. 84)
Cat. K84111 **$9.95**

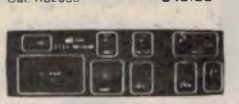
READY-SET-GO LIGHTS

A simple project for starting slot car races, etc. It provides the traditional Red/Amber/Green lights with a random delay between the amber and green. (ETI Oct. 84) ETI 277
Cat. **$24.95**



40 W INVERTER

This 12-240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May 82) 82IV5
Cat. K82050 **$49.50**

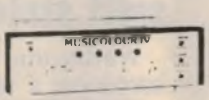


COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER

Here's what you've been asking for: a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Mircorbee, tips are available on interfacing the unit to other computers.
(ETI Nov. 84) ETI 755
Cat. K47550 **$139.00**

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automative ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additonally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept '82) 82EF9
Cat. K82092 **$19.50**

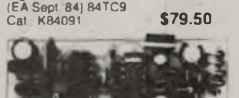


MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug. 81) 81MC8
Cat. K81080 **$84.00**

RAILMASTER PULSE POWER TRAIN CONTROLLER

Here's an up-to-the-minute train controller offering all the most desirable features including inertia, full overload protection, walk-around throttle and excellent low-speed running characters. Probably the best controller available, regardless of the cost!
(EA Sept. 84) 84TC9
Cat. K84091 **$79.50**

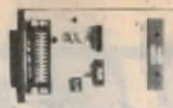


SOUND SIMULATOR FOR MODEL TRAINS

Fancy a diesel sound simulator for your model train layout? This circuit mounts inside the train for added realism and even varies its "speed" according to the throttle setting.
(EA Nov. 84)
Cat. K84110 **$18.00**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time and no more glow plug burnouts on your model engines.
(ETI June 83) ETI 1516
Cat. 55160 **$49.50**



MICROBEE SERIAL-TO-PARALLEL INTERFACE

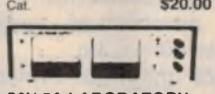
Most microcomputers worth owning have an "RS232" connector or port, through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel "Centronics" interface printers. Save money by building this interface. (ETI Jan. 84) ETI 675
Cat. K46750 **$59.00**

LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov. 81) ETI 158
Cat. K41580 **$34.50**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. 83)
Cat. **$20.00**

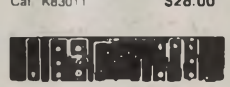


50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design.
(Ea May-June '83) 83PS5
Cat. K83050 **$149**

HEADPHONE AMPLIFIER

PRACTICE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb. 84) 83MA11
Cat. K83011 **$28.00**



150W BASS AMP

This guitar amp for impeccable bass players features many facilities found on expensive "commercial" ones. It delivers 150 watts into 4-ohms, has a 4-band graphic limiter, line out and bi-amp facilities.
(ETI Aug. 84) ETI 1410
Cat. K54100 **$299**

EFFECTS UNIT

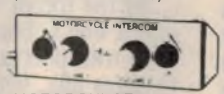
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.
(EA June '83) 83GA6
Cat. K83060 **$75.00**

LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.
(ETI May 83) ETI 163
Cat. K41630 **$175.00**

CAR IGNITION KILLER

Most car burgular alarms are easily circumvented, but not this cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterent to thieves! (EA Feb. 84) 84AU1
Cat. K84010 **$16.95**
(Our kit includes the box!)



MOTORCYCLE INTERCOM

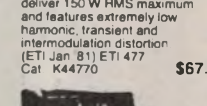
OVER 300 SOLD!
Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!
(EA Feb. 84) 84MC2
Cat. K804020 **$45.00**

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. 84) 84TP2
Cat. K84021 **$24.00**

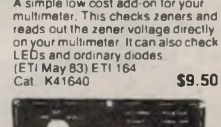
MOSFET POWER AMPLIFIER

Employing Hitachi Mosfets, this power amplifier features a "no compromise" design, and is rated to deliver 150 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion.
(ETI Jan. 81) ETI 477
Cat. K44770 **$67.50**



ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.
(ETI May 83) ETI 164
Cat. K41640 **$9.50**



SLIDE CROSS-FADER

Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. 81) 81SS11
Cat. K81110 **$85.00**

BIPOLAR PROM PROGRAMMER

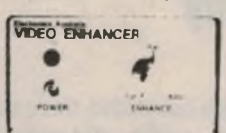
Every digital workshop should have one! Can be used to program the popular fusible-link PROMS like the 74S188/288, 82S23 & 82S123 etc.
(ETI June '83) ETI 688
Cat. K46880 **$49.50**

PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of componenets for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov. 83) 83MA11
Cat. K83110 **$15.00**

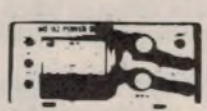
DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.
(EA March 82) 82PS2
Cat. K82030 **$87.50**



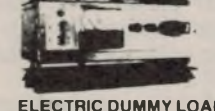
VIDEO ENHANCER

100's SOLD
Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct. 83) 83VE10
Cat. K83100 **$35.00**



30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec. 83) ETI 162
Cat. K41620 **$49.50**



ELECTRIC DUMMY LOAD

With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct '80) ETI 147
Cat K41470 **$109**

DIRECTIONAL DOOR MINDER

Most electronic door minders function by having a beam of light shinning across doorway interrupted, but are incapable of detecting whether the light beam is broken by a person entering or leaving the room. this project overcomes that problem with the aid of digital logic.
(ETI Nov. 84) ETI 278
Cat. K42780 **$29.95**

rie

Rod Irving Electronics

425 HIGH STREET,
NORTHCOTE VICTORIA.
Ph:(03)489 8866 489 8131
48-50 A'BECKETT STREET,
MELBOURNE VICTORIA.
PH:(03)347 9251
Mail Order and correspondance:
P.O. Box 235
NORTHCOTE 3070

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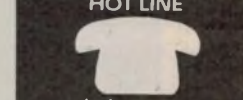
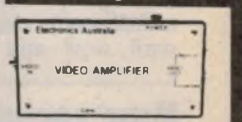
(03) 481 1436



POSTAGE RATES

$1-$9.99	$1.50
$10-$24.99	$2.00
$25-$49.99	$3.00
$50-$99.99	$3.50
$100-$199	$5.00
$200-$499	$7.50
$500 plus	$10.00

Comet road freight is extra.

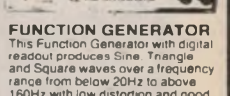


VIDEO AMPLIFIER

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead - it's much better! The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugpack supply.
(EA Aug. 83) 83VA8
Cat. K83081 **$15.00**

TRANSISTOR TESTER

1000's SOLD
Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. 83) 83TT8
Cat. K83080 **$15.00**



FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April 82, 82AO3A/B)
Cat. K82040
Cat. K82041 **$84.50**

EPROM PROGRAMMER EP1

No need for a Micro with EA's great Eprom Programmer suitable for 2716/2758 Eproms.
(EA Jan. 82) 82EP1
Cat. K82013 **$47.50**
With Textool Sockets **$59.95**

Errors and Omissions Excepted

NEW PRODUCTS

Teac's new cassette decks

The latest Teac decks have just been released. Ranging in price from $219 for the V-306C to $549 for the R-666X, the machines have many impressive features.

The least expensive machine features a frequency response of 30-16,000Hz, with wow and flutter of .06%. The V-430X and V-530X include dbx, with logic transport control for the 530 and one program skip for the 430.

At the top of the range are the R-555 and R-666X, both with auto reverse and logic transport control. The R-666X also features dbx, with both models boasting frequency response from 30-20,000Hz.

Teac Australia Pty Ltd, 115 Whiteman St, South Melbourne 3205. Phone 699 6000.

New security devices

GRM Wholesale has added three new products to its range of security equipment. From FM Security (UK) comes the IFM 120 passive infrared detector. This unit is a high-performance, versatile detector which is easy to use. It has a 12m range over a full 90° field of view.

C & K Systems (USA) have supplied the Dualtec II which combines microwave and passive infrared detectors within a single unit. This improves the system immunity to false alarms. It is available in a number of range configurations up to 60m x 3m.

A stereo Doppler unit from Protech (USA) has two receiving channels, allowing it to sense distance moved rather than speed. The critical distance is preset at installation — any target which moves further than this distance will trigger the alarm.

GRM Wholesale Pty Ltd, 15-19 Boundary St, Rushcutters Bay.

Latching EPROMs from Intel

Built-in address latching is featured in the 87C64, a new 64K EPROM from Intel. This is an enhanced version of Intel's 27C64 EPROM.

The internal latching capability means that external latches — normally needed to interface the CPU to memory devices — can be eliminated from the circuit. This leads to a reduction in chip count and board size.

The 87C64 is the first in a series of latched memory products which Intel plan to release.

Intel Australia Pty Ltd, 200 Pacific Highway, Crows Nest 2065. Phone (02) 957 2744.

New range of solid state relays

Warburton Franki has recently introduced a new range of DC power solid state relays from the International Rectifier CRYDOM series. The devices can be driven from most logic circuits as they require less than 1.6mA at 5VDC. By means of an internal oscillator, the DC control signal has transformer isolation of 2500V from the output.

Warburton Franki are stocking 100 and 200 VDC versions ex-stock with 400 and 500 VDC versions available.

Warburton Franki, 199 Parramatta Rd, Auburn 2144. Phone (02) 648 1711.

New Philips CD player

Philips has announced the launch of a new audio CD player, the CD104. The compact dimensions of the unit are designed to fit in with the new Philips Midi range of hifi systems.

Main features of the CD104 include front loading (with a motorised loading drawer) and a liquid crystal display which can indicate the total number of tracks available and the total playing time. During play mode, the display indicates the track number and the elapsed time.

The CD104 has skip forward and reverse functions, both of which can be operated at three different speeds.

Philips Industries Holdings Ltd, 15 Blue St, North Sydney 2060. Phone (02) 925 3281.

Australian-made head cleaner

A revolutionary new cassette head cleaner has been unveiled by Goldring Audio Industries of Sydney. The Australian designed and manufactured head cleaner, called the FlexiBar, is a mechanical (non abrasive) type cleaner.

It is the first mechanical type designed to clean the erase head. In fact the FlexiBar head cleaner is capable of cleaning up to seven points of the cassette mechanism automatically. These include the play head, record head, erase head, single capstan and pinch roller and dual capstans and pinch rollers in auto reverse machines.

The head cleaner requires just 15-20 seconds of operation to complete the cleaning process. Replacement cleaning felts are readily available at reasonable prices.

The FlexiBar head cleaning cassette is available throughout Australia from selected record shops and hifi stores for $9.95.

For further information contact Goldring Audio Industries, 89 Chandos St, St Leonards, 2065. Telephone 439 3100.

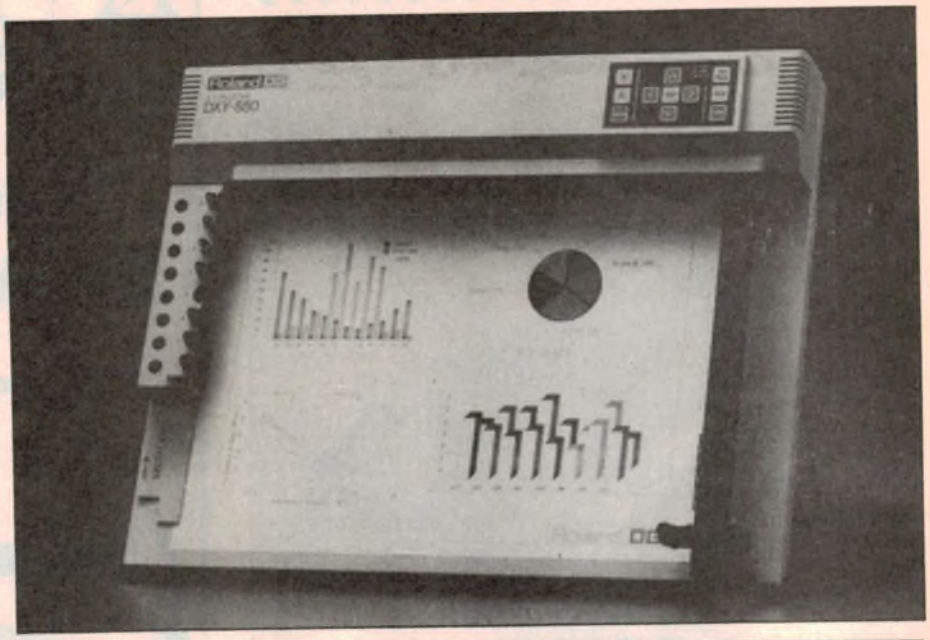
Stepper motor driver circuit

Motorola has announced immediate availability of a new stepper motor driver circuit — the MC3479P. The new driver is especially optimised for two phase stepper motors commonly used in disk drives and robotics. It allows either forward or reverse rotation to be selected. Additionally, it permits full step or half step rotation, depending on the logic input.

The MC3479P is supplied as a high thermal dissipation 16-pin DIL package, permitting sustained motor currents of up to 0.25A. Features include motor braking for high speed microstepping, TTL compatible inputs and a single supply voltage of between 7.2V and 16.5V.

Motorola Semi Conductor Products, 250 Pacific Highway, Crows Nest, 2065. Phone (02) 438 1955 or (03) 561 3555.

Computer plotter from Roland



Roland, a name well known for musical equipment, is likely to become equally well known for computer plotters. The company's recent release of the DXY880 has helped to take their share of this market to just over 40%.

The DXY880 is an A3, eight-pen plotter. It joins the DXY100 single-pen and DXY800 eight-pen plotters in the Roland line up. It includes drivers for all the common business software such as Lotus 1-2-3, high resolution, increased speed and Hewlett-Packard compatibility.

The DXY880 is priced at $1795, which is claimed to be $1000 to $1500 below that of comparable products.

Roland Corporation, 39 Victoria St, Fitzroy, Vic 3065. Phone (03) 417 1800.

Appliance control by microcomputer

Lemic Advanced Electronics has released an Australian-designed system that enables a wide range of control applications for microcomputers. The system uses the existing mains wiring as a communications link throughout the house, permitting the computer to control virtually any outlet.

The appliance to be controlled must be connected to the mains socket by means of the receiver unit. This is available in five different configurations, including a two-way outlet and a 300W 12-step control.

A transmitter unit must be used in conjunction with the computer to permit control of the receiver units. This unit is available in four configurations, including two and three-line serial, Centronics and RS-232.

The LAE Power Control is a practical low cost system that can be used in numerous industrial, commercial and home applications.

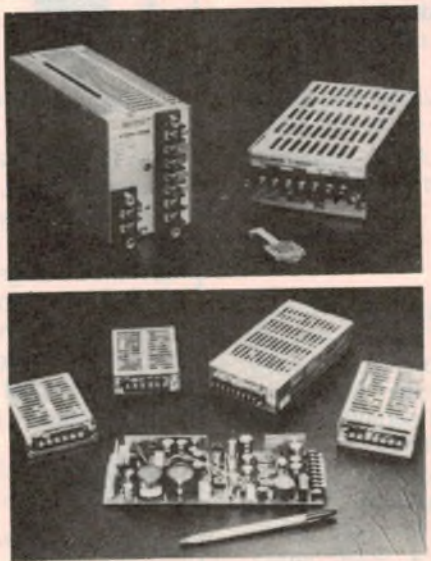
LAE Advanced Electronics Pty Ltd, 135 Roseneath St, Nth Geelong, Vic 3215. Phone (052) 78 4254.

Switch mode power supplies

Semiconductor Circuits Inc has added new models to its range of switching power supplies. The units are available in three output power ranges: 10 to 75W single; 100 and 150W single; and 12.5 to 50W multiple.

There are 28 new models in the 10 to 75W range, with voltages of five, 12, 15 and 24VDC. Output protection is in the form of foldback over-current limiting and overvoltage clamping.

There are also 16 new 100 and 150W units (five, 12, 15 and 24V) and 21 multiple output models. All 65 units are designed to comply with UL1012 and are suited for a wide variety of applications such as process control, computer peripherals and test equipment.



George Brown Electronics Group, 174 Parramatta Rd, Camperdown 2050.

Eurocard Connectors

Intended for PCB applications, TRW Eurocard Connectors offer high reliability and low cost. The connectors are easy to assemble, feature dual spring socket design, and meet performance criteria for the appropriate DIN, VG and MIL standards. They are available in straight or PC-mount termination styles.

Total Electronics, 9 Harker St, Burwood, Vic 3125. Phone (03) 288 4044.

Travelling wave amplifier

Logimetrics has introduced a new microprocessor-based travelling wave tube amplifier. It is intended for ATE test systems, laboratory use and component testing.

The new amplifier, Model A339/IJ, is a microprocessor based instrument and includes the latest technology in mini-TWT tubes. It offers a digital readout displaying helix voltage and current, collector voltage, RF power output in dB and watts, fault indication and operational mode.

The A339/IJ is intended for use in the frequency range 7GHz to 18GHz at 20W, with similar models available for frequencies from 1GHz to 18GHz in power ratings of 10 and 20W.

Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW 2137. Phone (02)736 2888.

ELECTRONICS GALORE

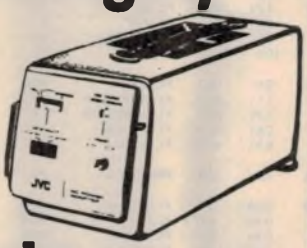
'OPEN SESAME' TO A 1001 STUPENDOUS BARGAINS

100's OF OTHER BARGAINS FOR CALLERS

Scoop Purchase

Limited stocks

JVC Battery Charger/ Power Supply



Combined battery charger and fully regulated power supply unit
(Model AA-P41EA)
Input: 240VAC 50Hz
Output: 12VDC 2.3A

Has built in over-charge prevention and automatic change over from nicad to power supply.

Ideal for use as a computer power supply

All brand new and cartoned with instruction book. Normally around $150 but from us a silly

only $60 plus P&P certified post $8.00

Huge scoop purchase of Plessey plugs and sockets

Knockout prices on the 159 series of plugs and sockets from Plessey. The range uses very effective locking devices, excellent contact areas and gold flashing for low contact resistance. The cover allows top or side entry. An extra contact on one row allows for polarisation.

Working Voltage:
350V DC or AC (peak)

Current rating:
5A DC or AC (RMS) Max operating temperature 70 degrees C

Flashover voltage
4kV between contacts and to case

Sockets with mounting brackets and retainers

Number of ways	Cat Number socket	Dim (inch)	Plugs with cover Number of ways	Cat Number
11	32841	.99	11	324967
23	324847	1.88	23	324973
31	324851	2.47	31	324977

31 way plug with cover & panel socket **$6 a pair**

23 way plug with cover & panel socket **$4.75 a pair**

11 way plug with cover & panel socket **$3 a pair**

Microswitch Bargain

Top quality Cherry brand. 15A/250VAC rating. Normally open contact with lever.

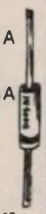
only 65c
10 for $5.50

150 ohm/25W Wire Wound Rheostat

Going at absolutely giveaway prices for New Year. Ceramic body. ¼" shaft. Perfect for speaker attenuators, power supplies etc.

only $1.00

Money Savers



A14A Glass Diodes 100V 1A
10 for $1
A15A Glass Diodes 100A 3A
10 for $1.50
IN914 (IN4148) Diodes
100 for $2.50
IN4004 Diodes
50 for $2.50
BC548 Transistors
10 for $1.40
BC549 Transistors
10 for 90c
BC559 Transistors
10 for 90c
BC547 Transistors
10 for 90c
BC557 Transistors
10 for 90c
BC332 Transistors
10 for 90c
BC109/BC337 Transistors
10 of each (20) $3.00
TIP29B Transistors
10 for $3.50
4001A CMOS
10 for $1.50
4020A CMOS
10 for $2.50
Crystal 6MHz
$2.50 each
Crystal 32.768 Clock Xtal
$1.25
Crystal 4433.619KHz Colorburst
$2.00

400m Roll Twisted Pair Bell Wire

fire proof

Top quality single strand pairs. Perfect for burglar alarm systems, intercoms etc, etc. 400m rolls. Limited quantity to clear.

only $25

A Mile of Wire

Limited quantities. Single strand. Priced to clear. 1650 metre roll.

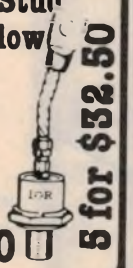
only $30.00

Resettable Counter ALL NEW

Fantastic resettable 12V counter. 4 digits 50mA, 10cps. Thousands of uses.

only $10

300V/150A Stud Rectifiers below wholesale



Astounding savings on these 300V rectifiers. 300V forward or reverse voltage (please specify). All brand new current stock.

only $7.50

5 for $32.50

Give away specials Limited stocks only

2764 8Kx8 EPROM was $13.00 **now $8.00**
6116-P3 150nS Static RAM was $9.95 **now $6.50**

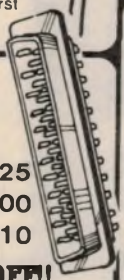
Tuning Gang Bargain

We have limited stocks of these rare beasties! 10-150pf air spaced/ ceramic insulated tuning capacitors from Jackson.

Normally selling for $8.00 This month

only $3.50

Super-Dooper Clearance



RS232 Type "D" connectors
Superior "Cannon" type

25 way Plug was $3.00	**Now $2.25**
25 way Socket was $4.00	**Now $3.00**
25 way Cover was $3.00	**Now $1.10**

Buy 10 or more and take 10% OFF!

BARGAIN PACS

1 **Component Pacs.** 1½kg's of useful components, including switches, capacitors, slide pots, relays, tagstrips, resistors etc. Worth at least $20. Yours for only. **$6**

2 **Fuse Pacs.** 50 assorted 3A & 2AG glass fuses in fast-acting & slow blow, all useful values. Normally 25¢ each. Our special price only **$6**

3 **Relay Pac.** 30 assorted types from 12 to 48 volts. Cradle, mini and mercury wetted etc. $60 value for only $10. Limited stocks ...only Rush your order NOW. **$10**

4 **Disk Ceramic Pac.** 60 assorted values. From 10pf to 1uF. 100 to 630V. Here's value for money ... $6 value for only **$3**

5 **Polyester Capacitor Pac.** 60 assorted types from .001uF to .22uF. 100V. Only **$6**

6 **Electrolytic Pac.** 55 assorted high grade electros. Radial and Axial types. 2.2uF to 470uF. 10 to 25V. $10 value for only **$5**

7 **1% Resistor Pac.** High grade Takman ¼ watt type. 300 mixed types that would normally cost you around $22, but for only a measly **$12**

8 **Connector Lead Pac.** Look what you get here. Talk about value
1 x 5 pin DIN plug to 4 x 6.5mm Mono Plugs.
1 ditto to 1 x 3.5mm plug
2 x 6.5mm line socket to 1 x 6.5mm stereo plug
1 x 3.5mm plug to 1 x RCA Line Socket. **4 for $5**

9 **Monolithic Cap Pac.** Now here's value. Mini Bypass caps manufactured by Emcon USA. 50 assorted from 12pf to 270 pf 100V In radial and axial. Worth at least $15. Our special price **$7**

SHERIDAN ELECTRONICS PTY LTD

164-166 Redfern Street, Redfern, NSW 2016.
Phone (02) 699 5922, 699 6912

Mail Orders to:
PO Box 229 Redfern NSW 2016

Mail Charges:

$5.00-$9.99	$3.50
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$50.00-$99.99	$7.00
$100 and over	$8.00

Large and overweight items sent Skyroad Freight Forward

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Mon-Fri	9am-5.30pm
Thurs.	9am-7pm
Saturday	9-12pm

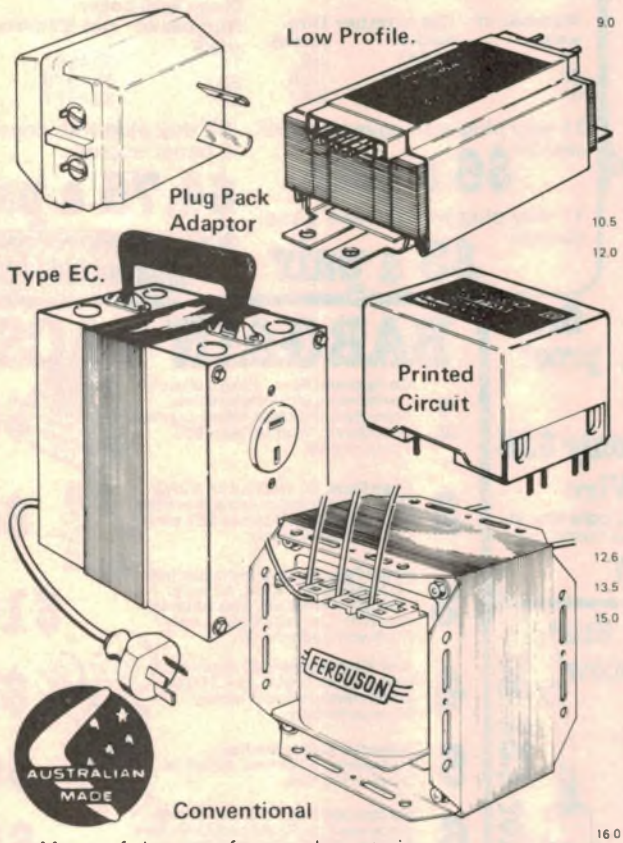
Note: We accept Bankcard and American Express. However we cannot provide quantity discounts on credit card purchases or account orders. Minimum for account orders is $50.00. Minimum order is $10.00 **exclusive** of postage and packing.

All prices include sales tax.

KEEP THIS HANDY

TRANSFORMER SELECTION GUIDE

This selection guide covers transformers for connection to 240V, 50Hz mains with secondaries from 1.5 to 115V.
All are designed to Australian Standard 3126 or the relevant clause of that standard as applicable.
They are all manufactured in Australia.
Prefixes indicate the method of construction – popular types being illustrated.



Many of the transformers have twin secondaries enabling different voltages/currents to be obtained from the same transformer. Many are also suitable for centre tapped configurations and these are denoted by an asterisk. The column headed VA relates to total VA of the transformer concerned and should not be exceeded.
If no suitable transformer is listed, we would be pleased to discuss your requirements and quote.

- Battery Chargers & Eliminators.
- Power Supplies.
- Constant Voltage Transformers.
- Motor Starters.
- Discharge Lighting Control Gear.
- Emergency Control Gear.

VOLTS	AMPS	TOTAL V.A.	TYPE NO.	CONSTRUCTION
1.5	1.11	20.0	PL1.5-18/20VA	LP
	2.22	20.0	PL1.5-18/20VA	LP
3.0	1.11	20.0	PL1.5-18/20VA*	LP
	2.22	20.0	PL1.5-18/20VA	LP
	8.0	120.00	PF3788	C
4.0	1.0	6.0	PPB4/1000	PA
4.5	1.11	5.0	PL9/5VA	PCB
	1.11	20.0	PL1.5-18/20VA	LP
	2.22	20.0	PL1.5-18/20VA	LP
6.0	0.4	2.5	PF2851	C
	0.83	5.0	PL12/5VA	PCB
	1.11	20.0	PL1.5-18/20VA*	LP
	2.22	20.0	PL1.5-18/20VA	LP
	3.33	20.0	PL12/20VA	LP
	4.0	120.0	PF3788*	C
	6.67	40.0	PL12/40VA	LP
	10.0	60.0	TS6/60EC	E
7.5	0.67	5.0	PL15/5VA	PCB
	1.11	20.0	PL1.5-18/20VA	LP
	2.22	20.0	PL1.5-18/20VA	LP
	2.67	20.0	PL15/20VA	LP
	5.33	40.0	PL15/40VA	LP
8.0	1.0	6.0	PPB8/1000	PA
9.0	0.28	2.5	PL18/2.5VA	PCB
	0.56	5.0	PL9/5VA*	PCB
	0.56	5.0	PL18/5VA	PCB
	0.83	7.5	PL18/7.5VA	PCB
	1.11	20.0	PL1.5-18/20VA*	LP
	1.33	12.0	PL18/12VA	PCB
	2.22	20.0	PL1.5-18/20VA	LP
	2.22	20.0	PL18/20VA	LP
	4.44	40.0	PL18/40VA	LP
	6.67	60.0	PL18/60VA	LP
	10.00	120.0	PF4405	C
	20.00	210.0	PF4354	C
10.5	1.11	20.0	PL1.5-18/20VA	LP
12.0	0.2	2.5	PF2851*	C
	0.21	2.5	PL24/2.5VA	PCB
	0.42	5.0	PL12/5VA*	PCB
	0.42	5.0	PL24/5VA	PCB
	0.5	6.0	PPB12/500	PA
	0.63	7.5	PL24/7.5VA	PCB
	0.67	8	PPA12/670	PA
	1.00	12.0	PL24/12VA	PCB
	1.11	20.0	PL1.5-18/20VA*	LP
	1.25	15	PPC12/1250	PA
	1.67	20.0	PL12/20VA*	LP
	1.67	20.0	PL24/20VA	LP
	3.33	40.0	PL12/40VA*	LP
	3.33	40.0	PL24/40VA	LP
	5.0	60.0	PL12/60VA	LP
	5.0	60.0	PL24/60VA	LP
	5.0	60.0	TS12/60EC	E
	8.0	120.0	PF3788	C
	10.42	125.0	TS12/125B	E
12.6	1.0	12.5	PF2565	C
13.5	1.11	20.0	PL1.5-18/20VA	LP
15.0	0.17	2.5	PL30/2.5VA	PCB
	0.33	5.0	PL15/5VA*	PCB
	0.33	5.0	PL30/5VA	PCB
	0.50	7.5	PL30/7.5VA	PCB
	0.8	12.0	PL30/12VA	PCB
	1.11	20.0	PL1.5-18/20VA*	LP
	1.33	20.0	PL15/20VA*	LP
	1.33	20.0	PL30/20VA	LP
	2.67	40.0	PL15/40VA	LP
	2.67	40.0	PL30/40VA*	LP
	4.0	60.0	PL15/60VA	LP
	4.0	60.0	PL30/60VA	LP
	8.0	120.0	PF3788	C
16.0	18.0	300.0	PF4244	C
16.5	1.11	20.0	PL1.5-18/20VA	LP
18.0	0.12	2.5	PF3787	C
	0.14	2.5	PL18/2.5VA*	PCB
	0.28	5.0	PL18/5VA*	PCB
	0.42	7.5	PL18/7.5VA*	PCB
	0.45	8	PPA18/450	PA
	0.67	12.0	PL18/12VA*	PCB
	0.83	15	PPC18/830	PA
	1.11	20.0	PL18/20VA*	LP
	1.11	20.0	PL1.5-18/20VA*	LP
	2.22	40.0	PL18/40VA*	LP
	3.33	60.0	PL18/60VA*	LP
	4.0	120.0	PF3788	C
	10.0	210.0	PF4354*	C
20.0	0.25	5.0	PL40/5VA	PCB
	1.0	20.0	PL40/20VA	LP
	2.0	40.0	PL40/40VA	LP
	3.0	60.0	PL40/60VA	LP
	3.0	60.0	PF3993	C
24.0	0.10	2.5	PL24/2.5VA*	PCB
	0.21	5.0	PL24/5VA*	PCB
	0.31	7.5	PL24/7.5VA*	PCB
	0.5	12.0	PL24/12VA*	PCB
	0.83	20.0	PL24/20VA*	LP
	1.67	40.0	PL24/40VA*	LP
	2.5	60.0	PL24/60VA*	LP
	2.5	60.0	TS24/60EC	E
	4.0	120.0	PF3788*	C
	5.2	125.0	TS24/125B	E
	5.2	125.0	TS24/125VA	C
	8.33	200.0	TS24/200B	E
	8.33	200.0	TS24/200VA	C
	12.5	300	TS24/300VA	C
	12.5	300	TS24/300B	E
	20.8	500	TS24/500VA	C
25.0	0.5	12.5	PF2565*	C
26.0	10.0	350.0	PF3783	C
27.0	4.0	120.0	PF3788	C
28.0	4.0	112.0	PF3577	C
	10.0	350.0	PF3783	C
30.0	0.08	2.5	PL30/2.5VA*	PCB
	0.17	5.0	PL30/5VA*	PCB
	0.25	7.5	PL30/7.5VA*	PCB
	0.4	12.0	PL30/12VA*	PCB
	0.67	20.0	PL30/20VA*	LP
	1.33	40.0	PL30/40VA*	LP
	2.0	60.0	PL30/60VA*	LP
	4.0	120.0	PF3788*	C
31.0	5.0	200.0	PF4361/1	C
	8.0	300.0	PF4362	C
32.0	1.88	60.0	TS32/60EC	E
	3.9	125.0	TS32/125B	E
	3.9	125.0	TS32/125VA	C
	6.25	200	TS32/200B	E
	6.25	200	TS32/200VA	C
	9.4	300.0	TS32/300VA	C
	9.4	300.0	PF4244*	C
	9.4	300.0	TS32/300B	E
	15.6	500	TS32/500VA	C
	15.6	500.0	TS32/500EC	E
	31.55	1000.0	TS32/1000EC	E
32.5	10.0	350.00	PF3783	C
33.0	5.0	200.0	PF4361/1	C
	8.0	300.0	PF4362	C
35.0	5.0	200.0	PF4361/1	C
	8.0	300.0	PF4362	C
	10.0	350.0	PF3783	C
36.0	0.06	2.5	PF3787*	C
40.0	0.13	5.0	PL40/5VA*	PCB
	0.5	20.0	PL40/20VA*	LP
	1.0	40.0	PL40/40VA*	LP
	1.5	60.0	PL40/60VA*	LP
	1.5	60.0	PF3993*	C
	5.0	350.0	PF3783	C
42.0	5.0	350.0	PF3783	C
	6.0	300.0	PF4363	C
44.0	6.0	300.0	PF4363	C
47.0	6.0	300.0	PF4363	C
52.0	5.0	350.0	PF3783*	C
56.0	2.0	112.0	PF3577*	C
	5.0	350.0	PF3783*	C
58.5	5.0	350.0	PF3783	C
62.0	2.5	200.0	PF4361/1*	C
	4.0	300.0	PF4362*	C
63.0	5.0	350.0	PF3783	C
65.0	5.0	350.0	PF3783*	C
66.0	2.5	200.0	PF4361/1*	C
	4.0	300.0	PF4362*	C
70.0	2.5	200.0	PF4361/1*	C
	4.0	300.0	PF4362*	C
	5.0	350.0	PF3783*	C
84.0	3.0	300.0	PF4363*	C
88.0	3.0	300.0	PF4363*	C
94.0	3.0	300.0	PF4363*	C
110.0	0.55	60.0	PL110/60VA	LP
115.0	0.43	50.0	TS115/50G	E
	1.09	125.0	TS115/125B	E
	1.09	125.0	TS115/125VA	C
	1.74	200.0	TS115/200VA	C
	1.74	200.0	TS115/200B	E
	2.61	300.0	TS115/300B	E
	2.61	300.0	TS115/300VA	C
	4.35	500.0	TS115/500EC	E
	8.7	1000.0	TS115/1000EC	E
	17.4	2000.0	TS115/2000EC	E

** Centre Tapped Secondary*
LP Low Profile
C Conventional
E Enclosed
PCB Printed Circuit Board Mounting
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Bubble memory module from Fujitsu

IRH Components are now distributors for Fujitsu bubble memory modules. The modules, in addition to the memory devices, have peripheral linear ICs. With the addition of control ICs the modules can be used for reliable, maintenance-free file memory.

All components operate at TTL I/O level, with up to 4MB of memory directly addressable. Access time for stored data is 12.5ms, permitting a data transfer rate of 100K bits/s. The modules are supplied in 40-pin DIP configuration.

IRH Components, 53 Garema Circuit, Kingsgrove, NSW 2208. Phone 750 6444.

New family of compact RAMs

Texas Instruments has released a new family of low cost, high density dynamic RAM modules. The new TM4164EC4 (64K x 4) modules are single in-line packages, providing up to 3.5 times as much memory in the same board space as conventional dual-in-line packages.

Other ICs in the new family include the TM4164FL8 (64K x 8) and TM4164FL9 (64K x 9). Each device is available with either 120, 150 or 200 nanosecond maximum access time. One-off prices range from $56 to $97.

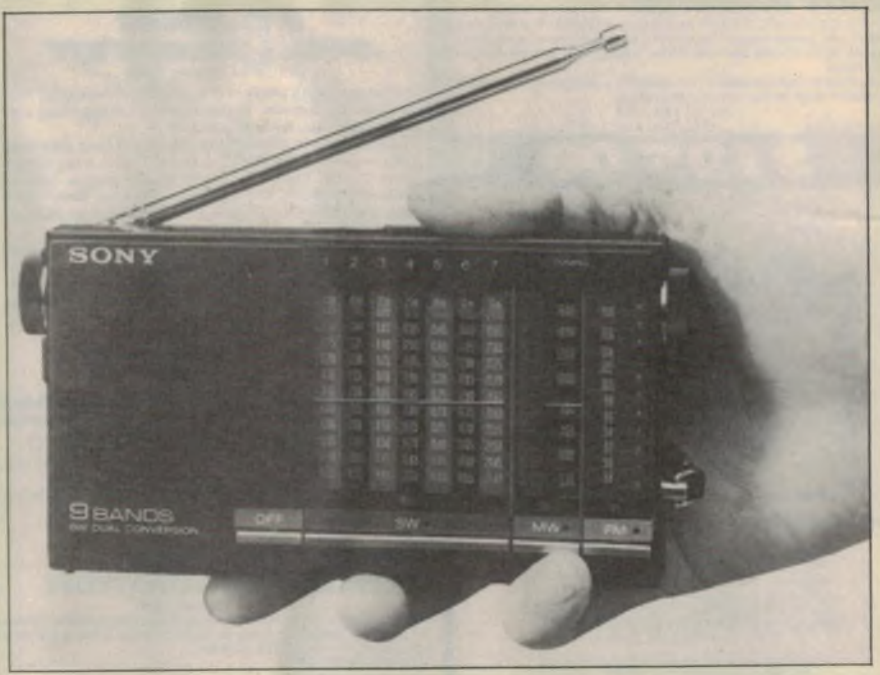
Texas Instruments Aust Ltd, 6 Talavera Rd, North Ryde 2113. Phone (02) 887 1122.

Adjustable A/D converter

The Teledyne Semiconductor TSC5000 A/D converter allows engineers to instantly select a desired combination of accuracy and speed. Designed to work in tandem with a microprocessor, the IC is a dual slope integrating converter that can operate anywhere from 14-bit resolution at 5Hz to 8 bits at 400Hz. Maximum resolution is 4½ digits.

Fabricated in CMOS, the TSC5000 includes an input buffer and an integrator with controllable parameters. Supply is ± 5V and inputs within the range ± 4V are acceptable.

Promark, PO Box 115, Nunawading, Vic 3131. Phone (03) 878 1255.



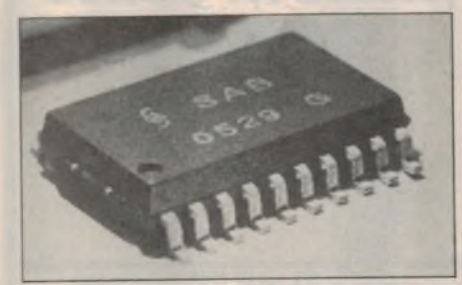
Pocket-size shortwave receiver

Single chip design has enabled Sony to develop a nine-band receiver measuring only 134 x 74 x 23mm. Weighing in at only 235g, including batteries, the receiver is virtually pocket-size.

A separate crystal is used for each of the seven shortwave bands. These cover the range 5.85 to 21.9MHz — separate bands are provided for normal MW and FM broadcasts. The Sony receiver also features touch tuning.

Sony (Aust) Pty Ltd, 33 Talavera Rd, North Ryde 2113. Phone (02) 887 6666.

Surface-mounted IC timer



The locally stocked SAB 0529 IC timer from Siemens is now also available in the compact SO package. Designed for delay times ranging from one second to 31.5 hours, the device derives its timing from the mains.

The new SAB 0529G is only 2.65mm high — an important consideration when space is at a premium. It can operate on 4.5-5.5V DC at (typically) 1.4mA current consumption. Triacs or relays can be connected to the output and the user has the choice of eight overlapping time periods and two function modes (on-time and turn-off delay).

Potential applications include industrial controllers and all equipment required to operate for a limited period of time: cookers, stoves, coffee machines, hand driers, stairwell switches, alarm systems, battery chargers, etc.

Siemens Ltd, 544 Church St, Richmond, Vic 3121. Telephone 429 7111.

Low-voltage tuner modules

Ellistronics now has available two low voltage tuner modules. The TDA7211 is an FM tuner featuring low oscillator radiation, 30dB conversion gain and good signal to noise ratio.

The TDA7220 is an AM/FM radio module, offering AM reception up to 30MHz and a low external component count. Both modules will operate reliably down to 1.4V.

Ellistronics Pty Ltd, 797 Springvale Rd, Mulgrave 3170. Phone (03) 561 5844.

GREAT KITS FOR '85

12/230V · 300 WATT INVERTER

This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output voltage is regulated and gives a precise 50Hz. The kit also has current limiting with ultimate thermal shutdown.
The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.
Ref: EA June 1982
Cat. KA-1574

$195.00

RAILMASTER KIT

Ref: EA September 1984
This is the most up-to-date train controller kit that we have seen. It offers all of the most wanted features including inertia, full overload protection etc. The kit includes front panel, correct console box and all parts.
Cat. KA-1560

ONLY $79.95

DIESEL SOUND SIMULATOR

Ref: EA November 1984
You'll be amazed how authentic this kit sounds. The kit includes PCB and all parts as well as all of the components for the lighting circuit.
Cat. KA-1561

INCLUDES LIGHTING CIRCUIT

ONLY $19.95

STEAM SOUND SIMULATOR

Ref: EA December 1984
This kit will make your model steam train sound like the real thing! Includes infra red optical switch to synchronise the "chuffs" to the wheel rotation. Includes all parts plus 32 ohm headphone type transducer.
Cat. KA-1562

ONLY $15.95

MOTORCYCLE INTERCOM

Ref: EA February 1984
What a great kit! This full duplex unit enables you to talk to your pinion passenger whilst driving with your helmets on! Powered by the bikes battery - you can both talk at the same time if you wish as there are no switches to activate. The Jaycar kit includes the special headphone inserts and all parts.
Cat. KA-1533

ONLY $39.95

UTILITY AMPLIFIER · 20 WATT

Ref: EA November 1984
A great low-cost, easy to build amplifier that gives Hi Fi performance. All components mount on the PCB which is supplied.
Frequency response is from 45Hz to 68kHz and this unit can be used with speakers from 4 ohms up, on voltages from 20 to 35. A great kit for the person who requires low cost Hi Fi.
Cat. KA-1567

ONLY $17.50

5 (6.5)MHz OSCILLOSCOPE KIT

Ref: EA October 1984
Over the years many people have asked, "Do you have a CRO kit?" Our answer - up until now - has been that built and tested units were no dearer than kits, if you get a kit at all.
The Jaycar KJ-7050 Cathode Ray Oscilloscope kit has a guaranteed 5MHz bandwidth but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz scope is usually adequate to troubleshoot most microprocessor and other digital circuitry as well!
This is a wonderful opportunity to learn electronics AND end up with a valuable piece of test equipment as well.
The Jaycar KJ-7050 kit is absolutely complete. The chassis is pre-punched and every component including nuts and bolts are provided, along with instructions.
Cat. KJ-7050

ONLY $249

☆ OPENING SOON! ☆

Call in to our brand new store at 188 Pacific Highway GORE HILL. You can't miss it, just a few doors up from Dick Smith.
We hope that all JAYCAR patrons on the North Shore will look us up. You're more than welcome!

ETI 342 CDI Type ELECTRONIC IGNITION

Ref: ETI February 1985
This brand new design virtually eliminates the controversial problems of past CDI designs. Probably its biggest feature is that it has all but eliminated the CROSSFIRE problem.
OTHER FEATURES:

- High reliability
- Runs from 2-25V supply
- Doesn't create high coil current
- Hall-Effect Trigger compatible
- Die cast box
- Will work on virtually any type of ignition (i.e. boats, planes etc)

A REAL WINNER!!
Cat. KE-4690

$55.00

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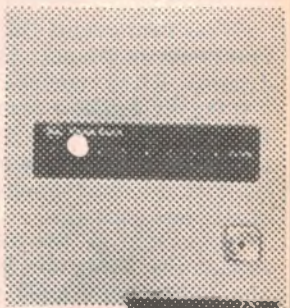

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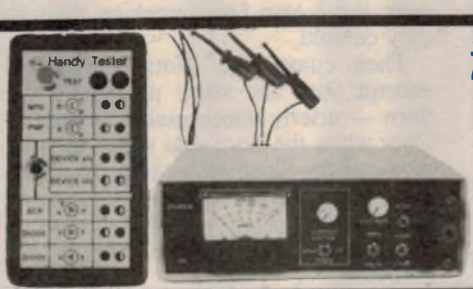

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REVIEWS OF RECENT RECORDS AND CLASSICAL • POPULAR • SPECIAL

WEILL

Rise the Fall of the City. Mahogonny Lotte Lenya, Heinz Saverbaum, Gisela Litz and others with the Chorus and Orchestra of the North German Radio. CBS Masterwork Mono Disc CBS77431.

The performance was first issued over 20 years ago, in mono, of course. Now electronically reprocessed it is still in mono but much of the sound has been tidied up and is quite presentable today. I found it just as moving as when I first heard it many years ago and more recently a performance in the Sydney Opera House.

The recording has benefit of the great Lotte Lenyam, the widow of the composer, in the leading role. She is no less than magnificent, and impressive too is Gisela Litz as Widow Begbick. The rest of the cast is excellent and the playing fine. If you don't already have it, don't miss it this time. (J.R.).

THE RING

Der Ring des Nibelungen. Excerpts by Sir Georg Solti and the Vienna Philharmonic Orchestra. Decca Digital Disc SXDL7612.

Solti conducts this music with all his usual flair — and sometimes flare. My reservation about the set up is that many of the excerpts are torn bleeding from their context. This is all the more noticeable because they are all taken from the Ring of the Nibelung, a series of musical dramas which runs with magical seamlessness through the four nights it takes to perform.

Some of the items end on the leading note leaving the music up in the air. A full close, however anomalous, would be better than this. Another fault is the substitution of the vocal line to an orchestral instrument. The most inept of these is Votan's Farewell to Brunnhilda in Act 3 of The Valkyrie where a melancholy French horn busks its way through the score. The result is dismal in the extreme and has a depressing effect on the rich orchestral sound in the background music.

This opinion voiced I have nothing but praise for the rest of the disc. Polygram recently issued a brochure of Solti's many recordings up till roughly the end of 1984. I did a "Freddy Blanks" and adding them up arrived at a total of 32 covering an enormous range of composers of many nationalities from the 18th to the 20th centuries. I chose four, selected with an eye to show the width of Solti's score from time to time.

The sound throughout the disc has a well controlled dynamic range. The recital starts with the Ride of the Valkyries without voices and has the surprising effect of stopping in the middle of a phrase. Next comes The Entry Of The Gods Into Walhalla — the Entrance Theme seems a little slow. Perhaps out of its context Solti takes it thus to emphasise a point.

But here it is too slow to sound at all triumphant and reminded me vividly of a Bayreuth performance where at this point a beautifully contrived curtain fall left one with a final image, not of stately gods, but a lean Loge mocking them as they entered.

Then comes the Wotan's Farewell excerpt with the voice played by the horn — utterly unacceptable nowadays. Only when the horn solo stops does the magic of the Sleep Music take over. The great crescendo comes off excitingly, and later in the Fire Music a flickering piccolo rides sparkling on the top of the orchestra.

And there is the stupendous first utterance of the Siegfried theme, much too noble for such an oaf — Wagner's misinterpretation of his friend Nietzsche's Superman idea. The hapless horn solo competely distorts Wagner's intention in this fine coda to the second section of the four part work. The ending is disturbingly abrupt.

On the reverse one has a beautifully done Forest Murmurs from Siegfried in which the wonderful Vienna Philharmonic strings play a peerless part. This has a real ending. Siegfried's Funeral March is also nobly performed despite some slightly portentous hesitations unnoticeable in Solti's complete recording of the Ring. It strides majestically across death with trumpets.

The final item — you might have noticed that they are in chronological order of composition — is the Closing Scene from Gotterdammerung which starts where Brunnhilda's solo ends. It also has an inconclusive ending. I think a tendency to over-interpret occasionally is used by Solti to underline a point not necessary in a complete recording, four sets of which are still available by Solti, and are still warmly recommended.

BARTOK

Violin Concerto No. 1 (1908). Isaac Stern (violin) with the Philadelphia Orchestra under Eugene Ormandy. Piano Concerto No. 1 (1926). Rudolf Serkin (piano) with the Columbia Symphony Orchestra under George Szell. CBS Masterwork Series Analog Disc MP39057.

These concertos come from different ends of Bartok's creative career. The violin concerto is an early work which despite some formal uncertainties shows limitless promise. It was written for and dedicated to a young violinist, Stefi Geyer, with whom Bartok was deeply in love. It made a brief premiere in Hungary but was afterwards shelved and forgotten. Just why still remains a mystery. It was obviously the most important work the composer had as yet produced yet it didn't receive public performance until five years after his

death. It has therefore been numbered as a posthumous opus.

Readers are warned that though it has strong romantic links they are not to expect a Tchaikovsky-Rachmaninov type of work. Early though it is, it is still a difficult nut to crack for newcomers to Bartok. Things are made easier by Stern's sweet tone and effortless accuracy and authority.

The fine stranded first movement is slow and yearning with a beautiful lyrical change towards the end. Then comes a fast and final movement — its dance-like violin solo needing all Stern's nimbleness to enunciate every note as clearly as he does. It slows down to a beguiling barcarolle-like sequence. The happy ending breathes fulfilment. Though the analog sound is generally good the orchestra under Ormandy sometimes fades a little in favour of the soloist, who uses it very much to his advantage.

The piano concerto is a mature work written when the composer was 45 years old. It is an angry, bitter work in which the piano gnashes its percussive dissonant chords at you. These are used rhythmically rather than harmonically and could easily frighten a newcomer away.

I know it fairly well but have never got around to liking it very much though it contains a lot that earns my deepest respect. It was not welcomed at its New York premiere and has never since won popularity with pianists. Serkin plays it very well here. Sound is uneven with here and there a tendency to reverberate.

BRAVURA

Violin Recital by Cho-Liang Lin of short pieces by Sarasate, Falla (Suite Populaire Espagnole), Rachmaninov, Mozart, Schumann, Kreisler and Wieniawusky. Accompanist, Sandra Rivers. CBS Digital Disc IM 39233.

Cho-Liang Lin is undoubtedly a fine fiddle player. He has a brilliant technique, dead centre intonation, a sweet tone and an assured manner. The questions of repertoire and taste are another matter.

In this, the first recital by him that I have heard, is choice of items tends towards that of a restaurant violinist who goes from table to table "beguiling" embarrassed diners whom he expects to receive his attentions rapturously. On the rare occasions it has happened to me I have asked him politely to go away.

Overriding everything is Soulful Expression. Every phrase is lovingly caressed and over-interpreted. This becomes all the more difficult to understand when you learn that the recording is dedicated to his former teacher, the late Rober Pikler. I knew Pikler well and respected him as a first-class musician with classical taste. I doubt if Cho-Liang learned his present style from him. He seeks, at any rate in this recital, the very cheapest form of popular approval.

In this aim he is partnered by an excellently equipped but flashy styled accompanist Sandra Rivers who, however, sticks to him as closely as a stamp to an envelope. Even turn of the century virtuoso violinists had the grace to include some tribute to the classics, even a baroque sonata by some bore like Tartini or Corelli. Nothing of that kind is included in Cho-Liang's recital.

True it is labelled Bravura, so you are warned about what to expect. Most of his items might be used as encores today. Otherwise the days of such self-indulgence are over, thank heavens. The well-worn survivors of yesteryear nowadays only appeal to the lowest common denominator of musical taste. The sound is patchy, occasionally so reverberant that there is a haze on the edge of it. Some pieces, on the other hand, come off perfectly.

If you like all this sort of thing here is what might probably be one of the best examples you're likely to meet for some time. If you're like me you'll just get impatient. It is a good example of almost intolerable brilliance.

BACH MOTETS

Motetten: J. S. Bach. Singet dem Herrn ein neues Lied, BWV225. Jesu, mein Freude, BWV227. Windsbach Boys Choir, directed by Karl-Friedrich Beringer. Compact disc, Bellaphon 690.01.005. [From PC Stereo Pty Ltd, PO Box 242, Mt Gravatt 4122. Phone (07) 343 1612].

Essentially a polyphonic, choral form of liturgical music, the motet, from the French "mot" (word or saying) dates back to Limoges around the year 1000 — followed by centuries of gradual development, especially in the Notre Dame School. For a while, the motet

gravitated into a distinctly secular role, with instruments replacing some vocal parts, only to revert to its original religious/liturgical character in the mid 16th century.

In Bach's lifetime, the Motet had come to be associated mainly with funerals and memorial services and this was certainly the case with "Jesu, meine Freude" (BWV 227). But, curiously, the atmosphere of BWV 225 is far more suggestive of a celebration or an occasion of thanksgiving.

Both are presented here by the Windsbach Boys Choir, founded in 1946 and so called because it originated in a small German town by that name. Thanks largely to its founder, the late Hans Thamm, the Windsbach choir soon built up an enviable reputation, leading to concert engagements, radio broadcasts, recordings and international tours.

Directed now by Hans Thamm's successor Karl-Friedrich Beringer — an experienced musician in his own right — the choir sings without instrumental accompaniment (a capella) in accordance with the original intention of the composer.

Professional as it may be, however, the presentation is likely to have a somewhat sectional appeal — mainly to students and to those with a personal interest in music of this kind.

In terms of quality, the digitally sourced recording is technically good, except for a somewhat "papery" edge to the massed high soprano voices — a variant of the effect that I complained about in the February issue: ("Why the distortion on orchestral strings?"). Maybe it's an acoustic/aural effect, and it will pass unnoticed by listeners interested primarily in the music, but hifi fans may have reservations about it. (W.N.W.)

CONCERT AT THE "MET"

Leontyne Price, Marilyn Horne in Concert at the Met. With the Metropolitan Opera Orchestra conducted by James Levine. Digitally mastered stereo LP, double album, RCA CRL-24609.

It may never have been your good fortune to attend a concert at the famous New York Metropolitan Opera House but this recording should come as close as any to conveying the atmosphere of a major occasion in that venue.

This particular "all American" performance took place on the afternoon of March 28, 1982, as a full public concert, but one which was also videotaped for subsequent simulcast presentation over the US Public Broadcasting Service.

As indicated in the title, it features Leontyne Price, lyric soprano, and Marilyn Horne, who has a somewhat deeper voice variously described as "coloratura mezzo soprano" or "mezzo to contralto".

In the course of the program, Leontyne Price presents arias from "le Nozze de Figaro" (Mozart) and "La Forza del Destino" (Verdi). Arias by Marilyn Horne are from "Rodelinda" (Handel) and "L'Assedio di Corinto" (Rossini). The two artists also combine magnificently in duets from "Cosi van Tutte" (Mozart), "Rinaldo" (Handel), "Aida" (Verdi) and "Norma" (Bellini).

There are two orchestral interludes: the overture to Verdi's "I Vespri Siciliani" and Sinfonia from Bellini's "Norma". They provide a good opportunity to assess the technical quality of the recording, which stands up very well to such scrutiny. Indeed, RCA's account of the digital technology used for the recording would be entirely in character on a Telarc jacket!

At the end of the official program, by way of encore, Marilyn Horne and Leontyne Price sing arias, respectively from Meyerbeer's "Les Huguenots", and Puccini's "La Rondine" — the latter notable for a high-C cadence in which the voice is so pure and true that it takes on an almost "electronic" quality. The program concludes with the Flower Duet from Puccini's "Madame Butterfly" and thunderous applause from the audience.

A word about the applause: While the recording is of a "live" performance, it has been suitably edited to retain the atmosphere, without subjecting the listener to tedious, and often noisy delays between items.

If you like opera, you should find much in this record to interest and enjoy. Even if you're only half-hearted about the music, the sense of occasion is quite compelling. Well worth a hearing. (W.N.W.).

POPULAR VOCAL

TIM CONNOR

Tim Connor: One More Road. Stereo LP. Powderworks POW-4035 (cassette POWC-4035). Distributed by RCA.

Readers in Western Australia will probably remember Tim Connor as a young Irishman, a friend of Dave Allen, who began his career in Australia hosting his own show on Channel 9 in Perth. Personally, I remember him as a typical and pleasantly listenable young Irish singer-entertainer.

Since then, his native Irish background has taken quite a beating from ocker acquaintances like Paul Hogan (who contributes warmly to the jacket notes). So the Tim Connor you

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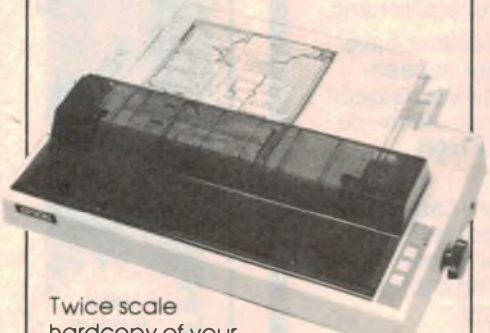

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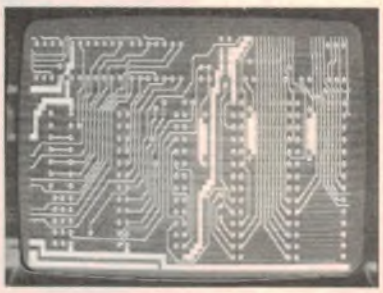

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meet here is Tim Connor, a "conditioned" singer and song writer, who is more concerned with social comment and the local scene. There's not one word about the Emerald Isle!

Most, if not all of the songs here are Tim Connor's own compositions, although you would scarcely gather that from the notes; he seems intent on crediting others with the ideas and the inspiration. The titles:

One Woman Older — You Are a Woman — Laugh Like a Gypsy Violin — Her Song — Keep the Clouds off My Baby — Look Inside — Long Distance Runner — Brisbane Town — Boggo Road — Johnny — How Are You Dancin' Will Gaines? — One More Road.

It's a varied program, with a mix of styles from sentimental, through bluegrass to soft rock, with full lyrics provided on the jacket, good diction, good production and good/average technical quality. Fine, if the contents appeal. (W.N.W.).

DEVOTIONAL ALBUMS

Best Loved Inspirational Hymns, Volume One. "A String Symphony of Praise" by Kurt Kaiser. Stereo LP, Word SPCN-7-01-892210-0. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.]

While, in general, Word do an excellent job with their devotional records, they seem somehow to run into problems with orchestral recordings, such as this one, featuring massed strings.

Time and again, the strings end up with a congested, "edgy" sound — and this latest album is no exception. The problem may be acoustic in origin, it may result from over-dubbing, or it may be due to intermodulation in the mastering process. But whatever the reason, it negates any appeal the album may have for listeners who are sensitive to sound quality — particularly in this era of digital mastering.

It's a pity, because Kurt Kaiser has chosen hymns which are apt to the title and which have been skilfully arranged for orchestra: Morning Has Broken — Precious Lord — Take My Hand — It Is No Secret — Let Us Break Bread Together — I'd Rather Have Jesus — The Lord's Prayer — Softly And Tenderly — Goin' Home & Steal Away — Precious Memories — Beyond The Sunset.

If the frequency range of your equipment is limited, or you're prepared to turn down the treble control, you may still enjoy these "Best Loved" hymns, but I wouldn't recommend it as hifi fare. (W.N.W.)

DEVOTIONAL SONGS

By My Spirit. Stereo LP, Myrrh SPCN-7-01-677806-1. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont Vic, 3135].

I guess one would have to describe this as a sampler disc, although the Word organisation does appear to be issuing more albums than usual containing tracks contributed by various artists. Maybe they sell well as such, thus achieving a double purpose.

First impression, based on the opening tracks, is that the album is intended to cater primarily for the under '30s but some of the tracks which follow would have more general appeal. But there are certainly no old-time hymns among them. For your guidance, I list the titles and artists:

By My Spirit (Leslie Philips); Live On in My Love (Tom Franzak); Spirit Wings (Joni Tada); These Things Were Done by You (Benny Hester); Baruch Hasham Adonai (Kelly Thompson); Psalm 103 (Brush Arbor); We Give You Praise (Morris Chapman); I Dedicate All My Love to You (Teri DeSario); Go (Leon Patillo).

Some of the artists may already be known to you but they are all accomplished in their own way. Technically, the quality of the disc is well up to standard and you can buy with confidence if the contents appeal. (W.N.W.)

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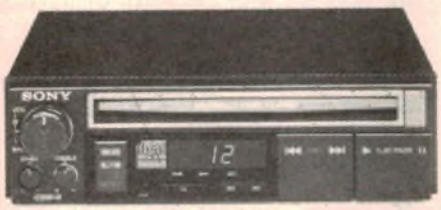
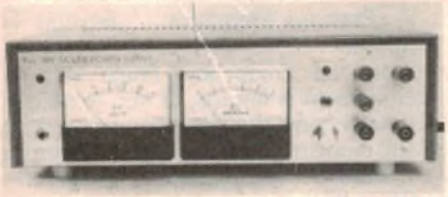


Sony CDX-5 car audio CD player.



50V/5A switchmode power supply.

Next month in Electronics Australia

Playmaster Amplifier

A last minute technical hitch forced us to hold over the Playmaster Series 200 amplifier from this issue. We've now solved the problem and will bring you the constructional details next month. See also page 49.

Sony Car CD Player

Sony is the first audio manufacturer to market with an in-car CD player — the model CDX-5. We take a close look at this brilliant new product in May *Electronics Australia*.

50V/5A Power Supply

Our 50V/5A Lab Power Supply featured in July 1983 has been upgraded to provide substantially improved ripple performance. The original front panel, case and transformer have been retained but inside there's a new PC board.

True RMS-DC Adaptor

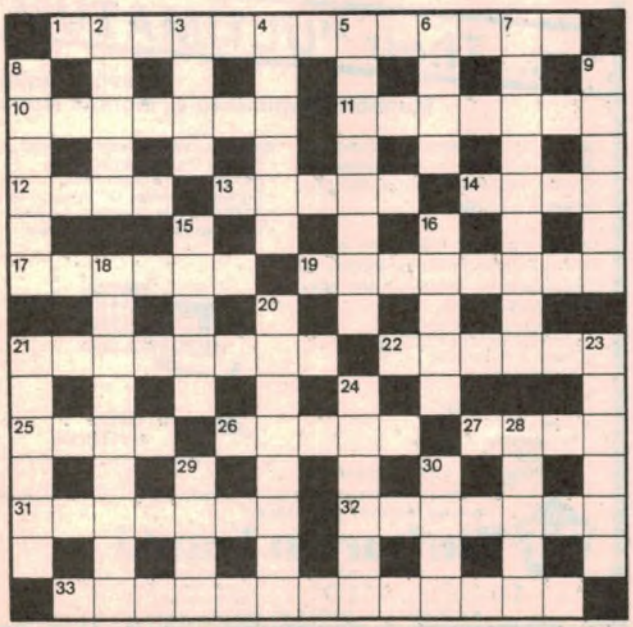
This low-cost adaptor plugs into your digital multimeter and provides true RMS voltage measurements at frequencies up to 100kHz. May *Electronics Australia* has the construction details.

* *Although these articles have been prepared for publication, circumstances may change the final content.*

APRIL CROSSWORD

ACROSS

1. Circuit connector. (9,4)
10. Energises a battery. (7)
11. Type of scrambler. (7)
12. What a computer can draw. (4)
13. Magnetic unit. (5)
14. Contracted term for certain controls. (4)

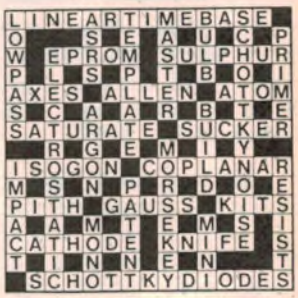


17. Turntable fault. (6)
19. Radio circuit. (8)
21. Losing charge. (8)
22. Physicist who solved the black body problem. (6)
25. Programmable read-only memory. (4)
26. A telephone line. (5)
27. Reduce signal amplitude. (4)
31. Adding inductances, etc. (7)
32. Loss of charge. (7)
33. Characteristic of certain displays. (5,8)

DOWN

2. Inductors do it. (5)
3. Wire screen, or Faraday ----(4)
4. Shape of some antennas. (6)
5. Type of programming language. (3-5)
6. Term formerly used for memory. (4)
7. This sort of gain seems low! (3-6)
8. Counting device. (6)
9. Possible functional description of a head. (6)
15. Operates a tape deck. (5)
16. Inventor of the AC induction motor. (5)
18. Radiation with wavelength usually expressed in cm. (9)
20. Neon may be described as such. (5,3)
21. Type of antenna (6)
23. Magnetic accessory. (6)
24. Type of computer. (6)
28. Suitable position of voltaic cell electrodes. (5)
29. Early recording medium. (4)
30. Remove insulation. (4)

SOLUTION FOR MARCH



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.

April 1935

Baby passifier: after car radio comes perambulator radio; American manufacturers claim that a restive child makes no further trouble when dance music is switched on.

Unstable busses: London trolley busses carry heavy copper coils on their roofs to prevent static which might interfere with broadcast reception. Now the trolley bus company is complaining that the copper coils upset the balance of the buses, especially on steep cambers, and the post office is making tests to find some more suitable preventative.

Standard equipment: two million USA cars are equipped with radio receivers, and now American car manufacturers all consider radio standard equipment, or make provision for car radio connections.

Thoroughly modern: the electric oven and refrigerator shown at the Electrical and Radio Exhibition is perhaps one of the best examples of how home equipment is being designed for the modern flat.

Another new notion is a range with an element which takes the place of the hot plate and gives rapid heat. The utensils rest directly upon the glowing coils, so that there is no intervening space to reduce efficiency.

Also calculated to delight the modern housewife is an electric casserole which boils, bakes and stews. There's also an electric toaster which you regulate according to whether you require the toast light, dark or burnt.

Then the new washing machines. One machine boasts a new vacuum cup which draws the water through the clothes instead of the agitator method. Other washing machines had an electric wringer.

Having electrically washed, you can now complete the job on an electric ironing machine.

Light powered motor: another step forward in the search for machines which can harness the natural energy of sunlight was demonstrated recently by Dr C. W. Hewlett.

The model, which used unusually sensitive light cells of the selenium type, derived sufficient energy from sunlight or even artificial light to run a small motor.

Four of the cells connected together operated a small motor rated at four ten millionths of a horsepower. No practical applications for the sun driven motor have been undertaken, for its power, which might be likened to one flea-power or less, is too low to be of any immediate practical value.

April 960

Flying telescope: a telescope that ill be mounted in the nose cone of a ylark rocket to take pictures of the y and measure the intensity of ultravic t light has been developed at the ondon University College.

It will be flown in the Skylark at the Woomera range in South Australia shortly. Skylark is purely a research rocket, originally designed for carrying instruments into the upper atmosphere.

Gas turbines: a large American aircraft manufacturer believes that gas turbine engines will eventually power radically different earth moving tractors, fire engine pumpers, a highway freight tractor and an air cushion vehicle.

The company is the Boeing Airplane Company, which is currently engaged in a vast gas turbine development program. US developed gas turbines may take to the air in the spring of 1960 in both a helicopter and a turboprop executive plane. Both planes will probably be production models of big American aircraft manufacturers.

Automatic power control: the Electricity Commission of NSW will place in service during 1960 a comprehensive computing and control installation to regulate power interchange between its own system and the systems of the Snowy Mountains Authority and the State Electricity Commission of Victoria.

In addition, the equipment will automatically load and unload generating units in seven power stations with a total capacity of one million kilowatts, to achieve greatest efficiency of operation.

The power interchange control section of the equipment is of a type widely used on the huge interconnected systems of the USA, and similar equipment is being installed by the Victorian and Snowy Mountains authorities.

Lighting the canal: for the first time in its 45 year history, the Panama Canal will bear ships from ocean to ocean by night as well as by day. The darkness that up to now has prevented the operation of its three locks after nightfall will be dispelled by 750W GE fluorescent lights currently being installed.

The six foot, two lamp units, normally used for street lighting, are being mounted atop the walls of the locks on 20 foot aluminium towers. The poles are hinged at their bases to enable them to be swung outward for the passage of especially wide vessels.

TV remote controller: recent television receivers released in Australia incorporate a remote tuning control system in which a non-electrical remote control unit is employed.

The system uses ultrasonic audio waves to act as the connecting link in the control circuit. The ultrasonic waves, far higher in frequency than sound waves, are generated in the hand control unit and are used to control relay circuits in the receiver.

The "Son-R" control unit, used with the Admiral set, contains two short brass rods which are machined so that they vibrate at above audio frequencies when struck. The unit has two push buttons and, when each is pressed, it causes a small hammer to strike the appropriate rod. The rods used are tuned to frequencies of 38.285Hz and 39.285Hz.

Information centre

Comments on CDI crossfire

I have read a reply to a letter from L.H. of Concord West in the Information Centre columns of the December issue of EA. Part of the reply deals with crossfire problems associated with capacitor discharge ignition. One sentence of the reply is open to challenge; ie, "probably the worst car in this respect was the VW Beetle but it only had four cylinders!"

I have been running Beetles with CDI for about 20 years with no crossfire problems. My first Beetle, a 1962 model with a 6V system, really benefited from CDI. So much so, that when I replaced the car with a new model in 1972, I built and installed a 12V CDI within a few weeks of taking delivery! The old Beetle still had plenty of life in it when I sold it after 75,000 miles; the engine had certainly not been damaged by crossfire.

Of course, with all the fuss about crossfire, I did take the precaution of separating the plug leads on the new car when I installed the CDI. Also the distributor cap on the VW is fairly large, so this is unlikely to be a source of trouble. In any case, I believe I could recognise crossfire if it occurred.

The lid has been off the CDI once in 14 years to glue a crack in the potcore encapsulation; the inverter whistle was a source of annoyance. The main ignition problems that I have had relate to the short life of carbon cored plug leads. These were eventually replaced with copper cored cables and separate suppressors.

The new car is still going strong after 14 years and 78,000 miles. Barring write offs, it should be good for at least another five years. (B.D., Magill, SA.)

● Thank you for relating your experiences with capacitor discharge ignition systems in VWs. We note with interest that you took the precaution of separating the plug leads when installing the CDI. If this is not done, crossfire can certainly be a problem.

Proximity detector for cars

Recently, a situation arose whereby a man in a delivery van reversed into the front of my parked car. Following the subsequent altercation and the financial settlement for the damage caused, it occurred to me that a warning device to indicate the proximity of a rearward vehicle would be a boon.

I visualise a device capable of emitting an infrared or ultrasonic pulsed signal from the rear of the driven vehicle, and a companion receiver to pick up the reflected signal. The time difference would be decoded and interpreted as the range between the two vehicles. This information would control a beeper such that the beeper would beep at a frequency of say 1Hz when the range is two metres, progressively increasing up to a continuous note when the range is say 25cm. (R.P., West Ryde, NSW.)

● While such a device would be relatively easy to design, it's not worthwhile as there is already a commercial unit available. Dick Smith Electronics advertised an ultrasonic range sensor in our November issue for $59.

Questions on the Ignition Killer

I am a student at the NSW Institute of Technology. As a project, my course requires that I build a simple circuit and write a technical report on it. I chose the Ignition Killer which was described in the February 1984 edition of your magazine.

A few questions: why have you used a 15V zener diode, not a different size? What voltages are we to expect and how are they caused? Why has the capacitive filtering used a 22Ω resistor and a 1000μF capacitor? Why has the 555 been connected up the way shown when there are many other ways to connect this IC? What improvements have been suggested for the circuit and why? (G.B., Homebush, NSW.)

● Let's consider your questions in the order raised.

First, the function of the 15V zener diode is to clamp supply line transients to 15V and thus protect the 555 from excessive voltages. To explain, an automobile electrical system is quite "noisy." Large voltage spikes of the order of several hundred volts superimposed on the main 12V DC rail can occur. These voltage spikes are produced by switching transients, as when a solenoid turns off. Also, ignition spikes can be capacitively coupled into the circuitry.

By including the 15V zener, any large voltage spikes are clipped to the zener voltage and thus effectively eliminated.

TV Interference from Stereo Synthesizer

I have recently purchased and constructed the Stereo Synthesizer which was featured in EA for September, 1982.

The unit operates normally in the audio field on any of the Sydney channels and on playback of prerecorded material. However, I have one problem which I cannot overcome. When the unit is functioning and the TV set is on Channel 0 or 2, an irregular interference pattern appears on the screen.

I have checked the circuit and it appears to be OK. I have also removed both the input and output connections but this does not make any difference. It appears it may be the transformer which is different from the one specified. Also two 1000pF/6kV ceramic capacitors were substituted for the 470pF/2kV capacitor across the power switch.

These are the only modifications to the original circuit. Can you please help me? (B.M., Sylvania Waters, NSW.)

● It is doubtful whether the transformer is at fault. Nor is your substitution of 1000pF capacitors, although you could have made do with just one capacitor rather than putting two in series as the value is not critical.

Unfortunately, you have not given a precise definition of the video interference so it is a little hard to make a diagnosis of the problem. However, we are inclined to the view that it is the internal clock for the bucket brigade device which is causing the interference. As such, it is difficult to suggest a cure apart from keeping the TV set and its antenna lead as far away as possible from the synthesizer unit.

The 22Ω resistor and 1000μF capacitor provide supply line isolation and filtering. The resistor value is something of a compromise. It is made as high as possible in the interests of supply line isolation, but must also be low enough so that there is only a small voltage drop across it when the relay pulls in.

The capacitor value is not all that critical. 1000μF just happens to be a good practical value, both in terms of cost and physical size.

The 555 IC has been wired in a standard astable oscillator configuration. In other words, the oscillator "free-runs" when triggered, thereby continually turning the relay on and off until power is removed from the circuit. Resistors RA and RB, together with the 2.2μF timing capacitor, set the frequency of oscillation. The capacitor voltage varies between ⅓ Vcc (Vcc is the supply voltage) and ⅔ Vcc as described in the article.

Of course, it's also possible to wire a 555 for monostable operation (ie, the pin 3 output goes high for a set time after triggering before switching low again). For a more detailed explanation on how the 555 works, we suggest that you get hold of an IC data book.

The circuit can be improved by adding a 15Ω 10W resistor in series between the relay contacts and the ignition coil. This is designed to prevent possible damage to the coil during extended operation.

Auxiliary battery for car burglar alarm

I am concerned about the auxiliary battery for this alarm which is charged via D25. It has been pointed out to me that if this battery was to become flat, a high-charging current would result which could cause damage.

In the July, 1984 issue a reader suggested an additional diode and 39Ω resistor to cure the problem. Could you please explain where these components should be placed and whether you agree with this modification? (J.G., Thornbury, Vic.)

● As we explained in the July, 1984 Information pages, the auxiliary battery should never become heavily discharged since it is on permanent floating charge. The only way it can happen is if it was disconnected from the vehicle battery for some time. Only if this did happen would it be necessary to recharge the battery via a suitable current limiting resistor.

If you want to install the suggested 39Ω resistor and diode, they could be connected in parallel with the 3A fuseholder (the fuse should be omitted), with the anode of the diode connected to the battery.

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Railmaster Train Controller

Being both an electronics and model railways enthusiast, I was delighted with the Railmaster train controller and the two sound effects circuits that you recently published. I have just constructed the Railmaster and would appreciate your comments on the following problems I experienced.

(1) Overload protection: pin 14 of IC1d is supposed to go low when the voltage across the 0.1Ω resistor is sufficient to cause pin 13 to be at a higher voltage than pin 12. The problem is, it does not go low, but merely reduces proportionally to the width of the output pulses.

With the unloaded output showing about 8V on a DC meter, a short circuit will pull pin 14 back to about 5V. This reduces the pulse width fractionally, lights the overload LED (not very brightly) and causes pin 8 of IC2c to go low and energise the buzzer. If the unloaded output is increased to maximum (12V DC as averaged by the meter), the voltage at pin 14 of IC1d drops to about 3V, but the effect on the pulse width is no greater.

I have tried varying the value of the 3.9kΩ resistor on pin 12, as well as the .01μF capacitor on pin 13. Neither made any difference; nor did replacing D8.

I examined the voltage at pin 13 of IC1d with a CRO and found that it was peaking above the 0.31V on pin 12, which explains why the output of the op amp was reducing — the lower voltage was the average of the output of IC1d. I would have thought that increasing the value of the .01μF filter capacitor would have solved the problem, but even a 0.1μF made no difference.

I solved the problem by connecting another 1N4148 diode in series with a 5.6kΩ resistor from pin 3 of IC2a to pin 8 of IC2c (cathode to pin 8). When pin 8 goes low, which it always does reliably, the pulse width is greatly reduced and the maximum short circuit current is about 800mA.

The overload does not trigger until the current exceeds 2A. It is then held at 800mA until the short circuit is removed. Incidentally, the short circuit current can be varied by changing the value of the 5.6kΩ resistor in series with the diode.

(2) Speed monitoring: I also had a problem with this part of the circuit. Transistor Q4 is supposed to be turned hard off during pulses to the motor. In its original form, the circuit did vary the pulse width as the motor speed changed with load, but so little it wasn't really effective.

A check with the CRO revealed that Q4 was only just turning off, resulting in an initial spike of the output pulse reaching pin 12 of IC2d. This spike was being seen as part of the back-EMF voltage. Because the voltage of the spike always remained constant, a falling back-EMF voltage had a greatly reduced effect on the output of IC2d pin 14.

I increased the 470Ω resistor on the base of Q4 to 2.2kΩ and that completely solved the problem.

I trust that you will find the above information to be of some use. In particular, I would appreciate your comment on the problem I encountered with the short-circuit protection. As I have modified it, the controller works extremely well, its smooth low-speed performance being a delight to experience. (J.K., Blackburn South, Vic.)

● The overload protection circuitry in your Railmaster was functioning correctly in its original form.

What happens is this: if an overload

occurs, the increased voltage across the 0.1Ω resistor is detected by pin 13 of IC1d, and the output of IC1d switches low. This in turn switches off the output voltage to the track. The voltage across the 0.1Ω resistor now drops to 0V and the output of IC1d switches high again, and so on indefinitely.

Thus, in the overload condition, the output of IC1d switches rapidly between high and low, thereby reducing the pulse width of the track output voltage and limiting the short circuit current to about 3A.

Your modification to the circuit is a form of foldback current limiting which detects the maximum current and then limits the current to a lower level (800mA). It can be regarded as something of an improvement on the method we used in that the dissipation will be reduced.

The necessity to increase the resistor value at the base of Q4 suggests that this transistor was not fully saturating (possibly due to low gain). An alternative would be to reduce the value of the 15kΩ base driving resistor.

Problems with the brake lamp flasher

I built the Brake Lamp Flasher featured in the November, 1983 issue of EA, using unknown brand ICs. Some modifications had to be made in order to get the circuit working properly. The "CMOS Cookbook" suggests that some brands of IC produce peculiar results when used in oscillator circuits because of internal zener diodes.

The clock rate was found to be far too high. Changing the 4.7μF capacitor to 10μF and the 330kΩ resistor to 470kΩ put this right. Consequently, the initial start up period was too long, requiring the 150kΩ resistor be changed to 56kΩ.

The repeat delay was found to be one minute, again far too long. This was remedied by adding an 82kΩ resistor across the 22μF capacitor.

Since I wanted to utilise the rear fog lights, as used on some European cars, I decided to change the output to a PNP 2955 type and drive it with a Darlington NPN, type MJE800. This would probably be better for local cars with four stoplights, since the lamp base earth circuit is not disturbed. To isolate the two different supply circuits to the lamps, I included two five-amp diodes. The circuit works well. (G.T., Murrumbeena, Vic.)

● It is true that the internal protection diodes do affect the frequency when inverters are used in oscillator circuits. However, that does not apply with the Brake Lamp Flasher circuit which uses a Schmitt trigger (IC1a) for the oscillator. The problem of hysteresis was alluded to briefly in the article and is the cause of the variation in oscillation frequency you have noted.

While we do not disagree with the changes you have made or suggest, we find it surprising that the repeat delay could have been as much as one minute and that it could be reduced back to the correct five-second period by adding the 82kΩ resistor across the 22uF capacitor. It sounds as though this capacitor was well out of tolerance.

Notes & Errata

DOORWAY MINDER (February, 1985, File 3/MS/114): The inverting and non-inverting inputs to IC1 have been transposed on the circuit diagram. The wiring diagram is correct.

GUITAR TUNER (CDI, February, 1985): The author has advised that the supply pins to IC1 are shown transposed on the circuit.

EPROM COPIER (December, 1984, File 2/CC/92): This device is suitable for programming 2532 EPROMs, but cannot be used to program 2732 devices unless some of the pin connections are changed.

The 2732 has pin 21 as A11, pin 20 as Vpp and pin 18 as CE-bar. The remainder of the pins are compatible with the 2532. Note that the pinout data provided on p57 of the December, 1984 issue is correct only for the 2532.

Readers are also advised that the Texas Instruments TMS2716 is not compatible with other 2716 devices.

Hitachi VT-88E hifi stereo VCR . . . . cont. from p. 27

was −5dB at 20Hz and flat up to 10kHz, where it began to roll off to −0.5dB at 15kHz and −1.5dB at 20kHz. At half speed the signal was −4dB at 20Hz, −1dB at 15kHz and −2dB at 20kHz.

Again, this drop in frequency response, 1dB less for the full speed at 20Hz and 0.5dB less for the half speed above 15kHz, is academic and unnoticeable under listening tests.

Linearity was also tested at half speed. This involves recording a 1kHz signal at decreasing signal levels and noting the playback reponse. The VT-88E was 2dB high at −60 and −70dB, and linear at signals above this — a very reasonable result.

Signal to noise ratio was measured as 80dB with respect to a +5dB signal level. This is a very good result and equals its claimed specification. Crosstalk between left and right channels with respect to a +6dB signal level was 56dB at 100Hz, 60dB at 1kHz and 61dB at 10kHz. These results are very good.

For both of the above measurements, the results were virtually the same for both full and half speed operation.

How it sounds

On listening tests we found it difficult to distinguish between the recording and the source signal, which was from a CD player. Clearly the levels of distortion measured on these VCRs is not audibly apparent. The most impressive feature when comparing the recorded signal with the original source is the lack of rise in background noise and retention of the high frequency response. In short, the sound quality is excellent.

However, as with other video recorders, the transport mechanism leaves a lot to be desired when recording and during playback. The main problem is the slow response time of the tape mechanism. It is necessary to wait for the tape to spool itself around the tape head before play or recording can begin.

Similarly, on stop, it is necessary to wait for the tape to unspool itself from the drum before rewind or fast forward functions operate. So there is some sacrifice in operating convenience, compared with a normal audio cassette recorder.

The Index feature which allows the tape to move forward or in reverse to an indexed location is an excellent feature, although only operative in the half speed mode. The indexing can be set at any and at as many positions on the tape as desired. This helps negate the tape transport objections. In fact the Hitachi VT-88E is a major competitor with standard audio cassette recorders, with the added bonuses of full-function video recording and infrared remote control as well.

Recommended retail price of the Hitachi VT-88E is $1450.

In summary, a most impressive and versatile performer in terms of both video and audio. (J.C.)

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6BQ5	$4.00	EL37	$12	6BA8	$4
6K8	$10.00	ID8	$4	6GW8	$5
6K7	$7.00	41	$6	6BD6	$4
5AS4	$4.00	42	$6	6AM6	$4
6V6	$10.00	6B7	$6	6BF5	$4
6AL3	$4.00	80	$6	QQV03	$6
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6SA7	$5.00	6BX6	$4	12AN7	$5
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½ Meg	50c	10K Switch	50c
1 Meg	50c	250K	30c
100K	30c	50K	30c
100K Switch	50c	20K	30c
50K Double Pole Switch	50c	10K Min Pots	25c
7.500	30c	50/ohm	50c

Extra Pots ¼meg LIN 50c
½ or 1 Meg Switch 50c
½ 1 meg dual Concentric tapped at 100K $1
2 meg ganged double pole switch $1
1 5 meg dual ganged 50c 2 meg ganged log $1
1 meg dual ganged $1 ½ meg dual ganged LIN 75c
25K 50K dual ganged Concentric double switch $1
100K dual ganged linear pots 75c
200K single line 30c 10K sub min log pots 50c
20K wire wound 75c 250K ganged pots 75c
dual log 10K 75c 25K in ganged pots 75c

SUPER SPEAKER SPECIAL

15/ohm 2¼ inch four for $1 P.P. $1.40

MICRO SWITCHES
5A 250V 50 cents

SLIDE POTS

½ meg dual	$1	1K dual	$1
1 meg dual	$1	50K single	50c
2 meg dual	$1	250K single	50c
25K dual	$1	10K single	50c
250K dual	$1	2 meg single	50c

TOUCH MICRO SWITCHES
As used in front control panels in colour TV sets.
4 FOR $1

SPEAKER
2-way crossover networks
30 WATTS RMS $2

CRYSTALS for colour TV $1 each

AM FM TUNING CAPACITORS
$7

4 PIN SPEAKER SOCKETS
4 for $1

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8in x ½in with coils $1.50

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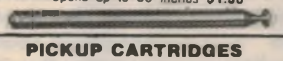
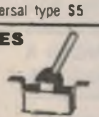


PICKUP CARTRIDGES
Ceramic BSR Turnover Stylus universal type $5

TOGGLE SWITCHES
4 FOR $1



Capacitors ELECTROS

2500 16V	4 for $1	22 UF 16V	10 for $1
220 16V	4 for $1	330 UF 63V	each 50c
1000 UF 50V	each $1	1 MFD 50V	10 for $1
1000 UF 63V	each $1	33 UF 10V	10 for $1
22 UF 160V	3 for $1	33 UF 10V	10 for $1
1000 UF 16V	each 50c	1 MFD 50V	10 for $1
63 UF 25V	5 for $1	33 UF 10V	10 for $1
470 UF 63V	each 50c	0.0039 1500V	
47 UF 160V	3 for $1	8 MFD 350 V	each 50c
470 UF 25V	4 for $1	6N8 1500V	each 50c
40 UF 25V	5 for $1	220 UF 35V	4 for $1
470 UF 40V	3 for $1	1000 UF 25V	each 50c
47 UF 10V	10 for $1	680 UF 50V	each 50c
100 UF 25V	5 for $1	22 UF	10 for $1
25 UF 25V	10 for $1	100 UF 6.3V	10 for $1
470 UF 16V	5 for $1	330 UF 25V	3 for $1
220 UF 50V	each 50c	2000mfd 25V chassis mount	$1
47 UF 200V	each 50c	50mfd 400V chassis mount	$1
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2.2 UF 200V	4 for $1	450V chassis mount	$1

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DS150A	75c	IN5059	10 for $1	BY188A	3 for $1
BA244	4 for $1	IN4001	10 for $1	AT324	4 for $1
DS230	$1	OA645	50c	AT347	4 for $1
BA219	6 for $1	BAX18	10 for $1	AT322	4 for $1
DS130	4 for $1	BA217	4 for $1	C1051H	each $2
0404	4 for $1	AN755	10 for $1	2SB405	50c
BAV18	10 for $1	B279	10 for $1	2SB303	50c
DS130Yb	30c	OP478	10 for $1	IN4001	10 for $1
		646	50c	OA626	4 for $1

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3.5mm	4 for $1
6.5mm	3 for $1

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OC988	50c	BS14E	50c	BD202	50c
OC968	50c	D330D	50c	BD139	50c
OC967	50c	D33E	50c	2SB186	50c
OC9304	4 for $1	B514D	50c	25C154B	$1
AC128	50c	BD202	50c	AS128	50c
608DK	4 for $1	BC548	50c	BF494	50c
BF469	50c	OA626	4 for $1	A437	50c
AC187	50 cents	OA662	4 for $1	2SB77	50c
Sanyo DS18	$1	BY188	3 for $1	2SB75	50c
C1048C	$1	AT324	4 for $1	BP559	50c
BC559	50c	AT347	4 for $1	BE549	50c
2SB274V	$2	AT322	4 for $1	A209D	50c
0400	75c	C1051H	each $2	106F1	50c
RD516	$2	2SB405	50c	2SA15	50c
C875F	$1	2SB303	50c	2350	50c
OC9524	$1	OC955	75c	2SA351	50c
OC9524	$1	OP57	50c	B544	50c
C106F1	50c	2N1111	50c	C1048P	$1
OC957	75c	BP139	50c	2N2175	50c
BA2622	50c	2SB407	$2	B1135	50c
				BF245A	50c

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117V	$10

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Delta 11270 $5

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3102-108-50301

$7

$6

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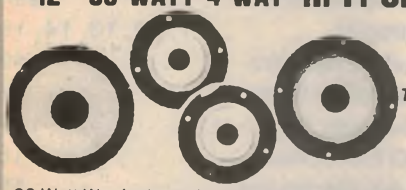

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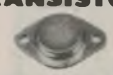

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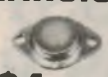

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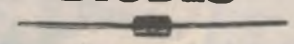

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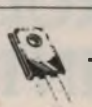

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• 3½ digit • 0.25% basic accuracy • Diode test • Continuity beeper (8021B only)

4 8024B
• 3½ digit • 0.1% basic accuracy • 11 functions including temperature with K type thermocouples • Peak hold on voltage and current • Logic detection and continuity testing • Audible and visible indicators

5 8026B
• 3½ digit • 0.1% basic accuracy • True RMS to 10kHz • Conductance to 10,000Mohm • Diode test and continuity beeper

6 8062A
• 4½ digit • 0.05% basic accuracy • Similar to 8060A without counter and dB • Relative reference • True RMS to 30kHz

7 8060A
• 4½ digit • 0.05% basic accuracy • True RMS to 100kHz • Frequency counter to 200kHz • dB and relative dB • Microprocessor self diagnostics • Relative reference for comparing values • Direct resistance to 300Mohm

LOW COST 70 SERIES WITH ANALOG & DIGITAL DISPLAY

3 YEAR WARRANTY

8 73
• 3200 count display • 32 segment bar graph • 18 ranges • Automatic power down • 10A current range • Autorange • 0.7% basic accuracy • 2000 hour battery life

75
All the features of the 73 plus:
• Audible continuity tester • Autorange/ Range hold • 0.5% basic accuracy • Low mA range

77
All the features of the 75 plus:
• Touch Hold function • 0.3% basic accuracy • Multipurpose protective holster

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It's more than an editor. More than an image enhancer. More than a duplicator. More than a mixer and more than a special effects generator.


VERTICAL WIPE


CORNER WIPE


3 SIDED WIPE


HORIZONTAL WIPE

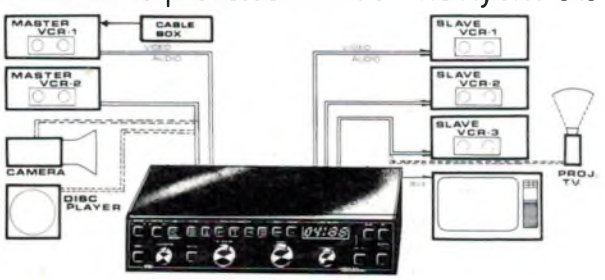

CONVERGING FROM 4 SIDES


CONVERGING FROM 2 SIDES


CORNER WIPE FROM TOP


FADE TO BLACK

Before the Hybrid 8 was created you needed several separate components strung together with a lot of connector cables to do just some of what this remarkable multi processor can do. The Hybrid 8 is a complete video editing, viewing and duplicating system that gives home video the quality than normally comes from expensive studio equipment. Here are just a few of the system's capabilities.



Add fades, wipes, credits, special effects to home movies. Eliminate snow and static. Make dubs as good as (and sometimes better than) the original.

Make up to 3 stereo dubs at one time. Works with both VHS and Beta. 12 months warranty. Edit from 2 video sources. Add music to your movies. Fade in pictures and sound with total control. A fraction of the cost of a system built up of separate components. **$998**

Leads not included.

The Hybrid 8 home video master control.

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