BONUS: RAAF F/A 18 Poster

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THE WINNERS

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Best ☆ CD Player
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Best ☆ Loudspeakers

- How to use your CD player in your car
- Ultrasonic car burglar alarm
- Shure's Ultra D6000 CD player

it's a beauty!

SIEMENS

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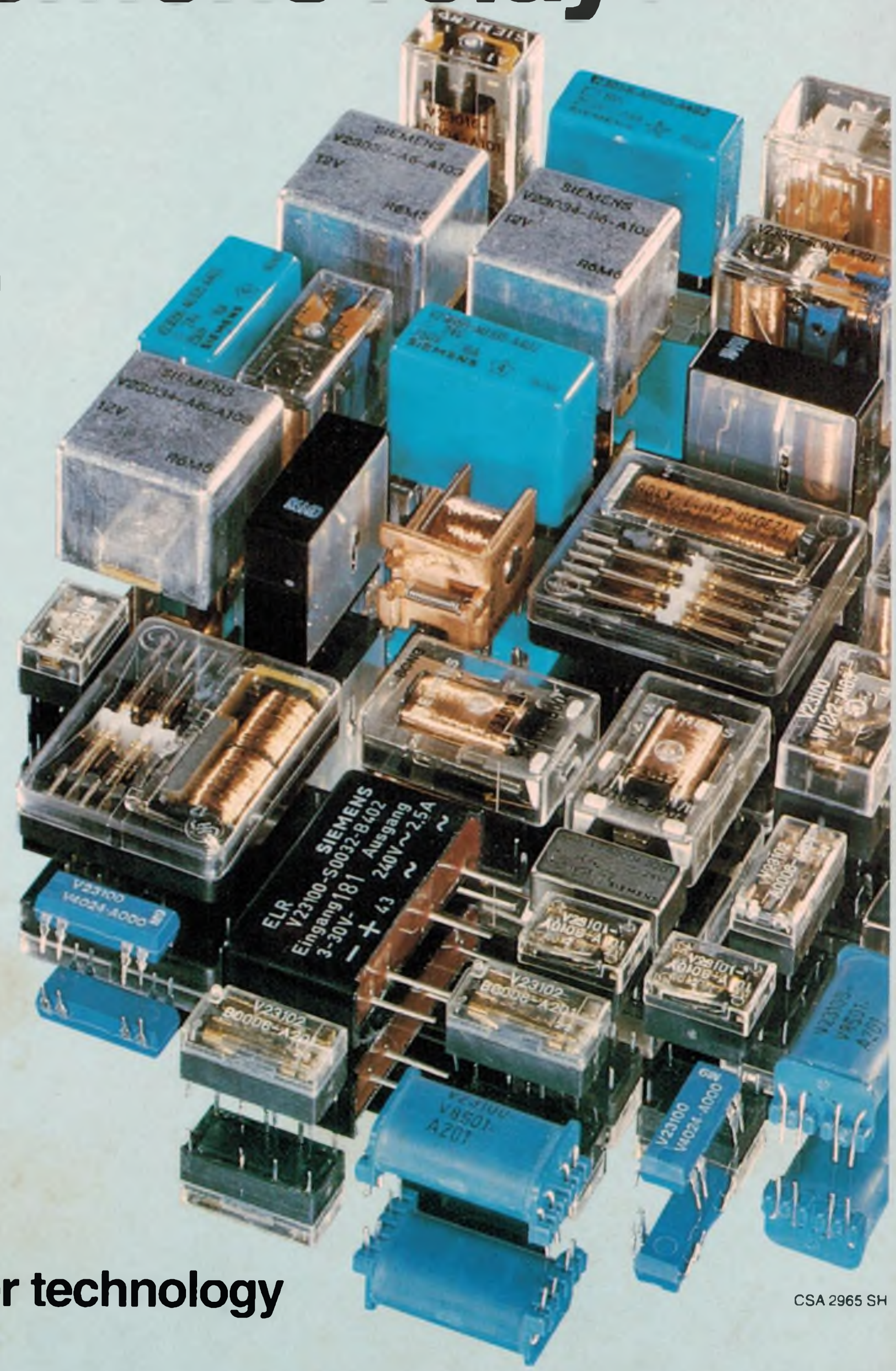

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Siemens. A higher technology

CSA 2965 SH

THIS MONTH'S COVER

Marantz's impressive PM94 stereo amplifier was one of the winners of this year's CESA hifi awards. What makes it so good? — we tell you on page 78.

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Electronics Australia

April 1987

Features

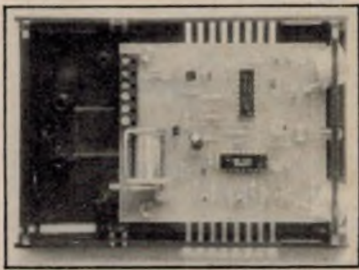
Entertainment Electronics

Projects and Technical

News and Comment

Departments

Ultrasonic burglar alarm



This inexpensive ultrasonic alarm can be used to protect your home or your car. It's also ideal for use with the remote control switch described in January. Details page 44.

RAAF Poster

This month's issue carries a bonus poster of the RAAF's new F/A18 fighter. Unfolded copies of this poster (sent in a mailing tube) are available from "Electronics Australia", PO Box 227, Waterloo, NSW 2017. Price $5.00 (incl. p&p).

12/240V inverter for portable CD players

Here's how to run your portable CD player from your car's cigarette lighter socket. This project converts the 12V DC battery voltage to 240V AC so that you don't have to rely on rechargeable nicad batteries. See page 28.

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Letters to the editor

Appreciates article on airship

I have just read the excellent article by Terry Ayscough entitled "A Ride the Bond Airship" (EA, February). Obviously, we are very happy for all the media exposure given for the utilisation of airships in the commercial world.

The Australian Airship Association (AAA) was set up as a platform for the exchange of ideas and information relating to the many aspects of lighter than air vehicles. As a service to your readers who may require further information on aerostats, we would gladly be of assistance. If you could publish our address it would be greatly appreciated.

Otto Lechner, President A.A.A.,
117 Bielby Rd, Kenmore,
Queensland, 4069.

Australian hobbyists better off

I've been following your comments and reader letters on supply of kits in Australia.

In my opinion, Australians are very fortunate to enjoy the availability and variety of relatively low cost kits compared to US enthusiasts. I am familiar with the Australian and American kit industry as I was Dick Smith Electronics' General Manager and Managing Director from 1972-84 in Australia and have been President of Dick Smith Electronics in California during the past two years.

I remember the first kit "assembler" I employed in 1973 at Gore Hill. I didn't know production technique so I sat him on the floor, surrounded him with ten small plastic containers and a parts list, and he sprinkled the required number of parts into each container. That is how primitive it was. When I left DSE Australia in 1984 that one man kit department had grown into a multimillion dollar operation employing 30 people.

There are a number of reasons kits have been so popular and successful in Australia and I believe a lot of this success has been due to the clever liasion between *Electronics Australia* and the parts supply companies. I know DSE would not have been as successful without EA and I also believe EA may not have been as successful without the commercial liasion with hobbyist suppliers like DSE.

Electronics Australia has it own design team and this, I believe, acts as a catalyst for ideas and creates a high degree of independence from having to rely solely on projects designed by readers and companies such as DSE. EA is able to "pick the eyes" out of projects offered by outsiders and develop their own unique designs at the same time.

This in-house technical expertise allows EA to test designs offered by others too. As far as I know, EA made sure all major projects worked to spec. before they were published.

By contrast, none of the electronics magazines in the USA design their own projects. As a result, they depend solely on readers and commercial suppliers to provide them with ideas and designs.

This makes it difficult for hobbyists. Pick up any US electronics magazine and try to find where you can buy a complete kit of parts for the project you are interested in building. If there is a supplier, it is usually the author. Problem is, a lot of authors are not businessmen. They don't know how to buy, supply and manage an efficient retail mail order business.

I've known hobbyists to place an order and wait months. Many hobbyists even told me that they gave up building kits because they never were able to get all the necessary parts together.

In Australia, the hobbyist in my opinion is much better off. Pick up EA and look at the number of reputable suppliers where you can buy your kit. If one supplier doesn't kit up for your project another one soon will.

In Australia, DSE used to take the EA article and spend sometimes weeks and thousands of dollars drafting enhanced kit instructions so that constructors wouldn't fall into traps. I always believed the more kits people got working the more excited they would be to continue their hobby. In 1977, I employed an engineer to draft special step by step style instructions for the EA CDI kit, of which we sold over 15,000.

DSE also came up with a "Sorry Dick It Doesn't Work" coupon: if you couldn't get your kit to go, we'd fix it for a fee and return it working. There was also a 7-day satisfaction guarantee: if you bought a kit, you had seven days to look over the instructions and if you thought it was too complicated you could return it for a refund. Before DSE opened in the USA, this service was unavailable for magazine kit projects.

In my opinion, the Australian electronics hobbyist is in Utopia. If you enjoy building, support EA and the kit suppliers. Sure the system has flaws but I think it is the best in the world.

Ike Bain,
Dick Smith Electronics,
Palo Alto, California.

Target areas of Radio Australia

I read with interest the problems faced by M.A. Young (January issue) in his attempts to listen to the English Language Service of Radio Australia.

As the writer correctly states, Europe is not one of Radio Australia's prime target areas although we often receive reports from our European listeners indicating good reception. We agree that the crowded shortwave spectrum in Europe is a contributing factor to reception problems, as are ionospheric conditions. It seems that a combination of these factors were responsible for your writer's lack of success.

Radio Australia's prime target areas are in Asia and the Pacific where we broadcast to a large and loyal audience in Indonesian, Standard Chinese, Cantonese, Thai, Vietnamese, Japanese, French, Neo-Melanesian Pidgin and basic English.

It is sometimes possible to listen to these programs within Australia, bearing in mind the fact that they are directed out of Australia and not aimed at an Australian audience. Travellers in Australia are able to hear our English service between midnight and dawn through ABC medium-wave transmitters in the Northern Territory.

Your readers will be only too aware of the financial restraints that the ABC is operating under and these are also limiting the service that Radio Australia would seek to provide for its listeners.

I might add that whilst Radio Australia provides the programs and studio facilities, the transmission side is handled

continued on page 110

Editorial Viewpoint

The Australia Card: we don't want a bar of it!

The heading of this editorial will surprise readers who saw my editorial of July 1985. In that issue I wrote supporting the general concept of identity cards. I took the view that tax evasion, social security fraud and law enforcement were serious problems confronting the Australian people and that the creation of a large database would go a long way to make the country less "ungovernable". It would be a good and desirable application of available computer technology. I also took the view that the average law abiding person had little to fear from the introduction of ID cards.

Well, dear readers, I was wrong. I have now seen the Australia Card Bill 1986 and I am horrified. If this bill ever becomes law we will have *Big Brother* with a vengeance. The proposed legislation is far more reaching and draconian than I had ever dreamt.

The Australia Card itself will have no information on it, apart from your name, photograph and your address. But it will be the key to a bank of information on births, deaths, marriages.

The Australia Card will need to be produced before any transactions can be made in any of the following categories: health insurance, social security, hospital admissions, Medicare claims, passport applications and immigration, accounts and deposits with all financial institutions, income from trusts, investments, real estate transactions (ie, leases and purchases), employment applications, safety deposit boxes, foreign remittances, shares in public companies, futures contracts, prescribed payments, rental income, and primary production income. The Australia Card will thus be a licence to perform virtually every essential activity, where no licence was required before.

Each transaction will be accompanied by your Australia Card number and will thus be the key to virtually all your life's activities. Many Government departments will inevitably have access to this information.

The proponents of this legislation will no doubt cite the provisions in the Bill to ensure privacy, notably the proposed Data Protection Agency but anyone with any knowledge of computers must know the difficulties of ensuring privacy when so many people will have access to the data.

The proponents can also point to the use of ID cards in many countries in the world but no country's card, to my knowledge, is backed by such a comprehensive store of data on each and every person.

There are clauses in the legislation which would easily enable any future totalitarian Government to withdraw your Card, which would be tantamount to removing your citizenship. And consider the Orwellian overtones of the legislation; throughout the Bill people are referred to as "Card-subjects".

The more you look at the legislation, the more you must conclude that it would be very bad for the rights and privacy of future generations. No or-

continued on page 110

News Highlights

Aussie robots for Ford factory

An Australian company, Machine Dynamics, has been commissioned by the Ford Motor Company of Australia to supply two robot assembly systems for Ford's Victorian operation.

The contract, which is worth more than $5 million, involves the design, manufacture and installation of 22 gantry robots with auxiliary gripping, tooling and positioning devices.

The project will take about twelve months to complete and the result will be two fully integrated production lines.

On one line, the robots will transfer door components for the 1988 Falcon and Fairlane ranges between robot spot welding stations, adhesive applications and a 200 tonne press.

On the other line, the Machine Dynamics robots will transfer front fender aprons during assembly. The robots will be capable of processing the left or right fender aprons individually or both simultaneously.

Ford has also recently placed an order with ASEA Pty Ltd for 76 robots to automate spot welding, arc welding and gluing of car bodies.

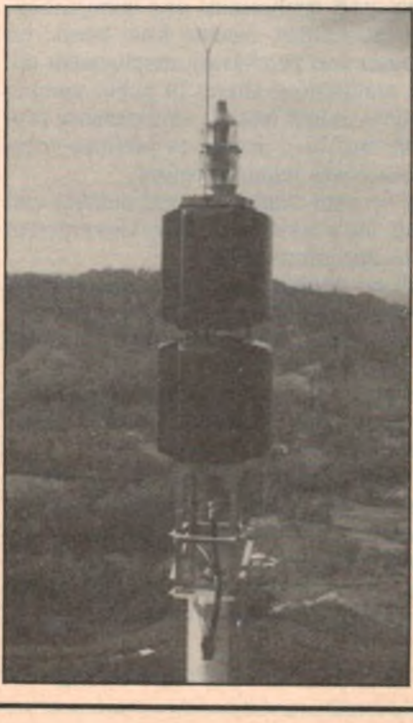
Speeding things up with Fastext

The Thorn-EMI Ferguson group in the UK is soon to release a new kind of teletext television set. This new system, called Fastext, has been jointly developed by TV set manufacturers and engineering staff at the BBC and ITV.

It is designed to overcome the current broadcast teletext bugbear of slow page selection — or at least provide a partial answer.

The system operates by linking four teletext pages together and equipping them with additional digital codes. These codes are recognised by additional circuitry in the receiver which then automatically stores the linked pages in memory.

What this now means is that the next page in a sequence can be quickly recalled from memory. By contrast, in the standard system, the selected page would not appear until it was the turn of that page to be transmitted. This could take around 20 seconds or more, depending on the number of page in the magazine.



UHF TRANSLATOR

SITTING HIGH above the surrounding countryside near Coffs Harbour in Northern NSW, this new UHF translator antenna is made up of eight panel arrays designed and manufactured by Antenna Engineering Australia Pty Ltd. According to AEA, the design covers the full UHF band and features excellent azimuth variation and VSWR.

AEA is a major antenna manufacturer and has recently also been involved in the installation of Band III VHF arrays for TVW7 Perth, HSV7 Melbourne, and QTQ9 Brisbane. Other recent contracts include the supply of antennas to the Broadcasting Corporation of New Zealand for FM services throughout that country and new arrays for Indonesian Television in Sumatra and Kalimantan.

Matsushita markets digital VCR

The Matsushita Electric Industrial Company has released its first digital VCR onto the Japanese market.

Called the NV-D21, it has an 8-event 4-week tuner and barcode scanner. Other features include a nine-window split-screen capability and nine 128K-bit RAMS, the largest memory capacity in the industry. This allows still motion for each window as well as strobe, rapid search and multi-tuning.

BWD takes over James Hardie Electrical

Ownership of the Electrical Division of James Hardie Industries Ltd was recently transferred to BWD Industries Ltd as an on-going concern.

An agreement between the two parties for the take-over had been settled prior to Christmas.

The Electrical Divison will be known as Wilco Electrical Pty Ltd and will continue to run as a wholly owned but autonomous company.

BWD Industries Ltd is an Australian owned technology and marketing based company. The inclusion of Wilco Electrical Pty Ltd into the group is seen as providing an excellent strategic fit between BWD Industries Ltd other subsidiaries and associated companies such as Swann Electronics, BWD Precision Instruments and ELPEC.

New owner for George Brown

The George Brown Group, a major Victorian component distributor, has been purchased by the Falkiner Group and has announced significant expansion plans.

Among several recent moves, the company has entered into a Volume Purchasing Agreement with Fairchild, which will offer the industry off-the-shelf, high end Fairchild products at competitive prices. The company will also be selling the NEC range of hard and floppy disc drives, and has entered into an agreement to distribute the new range of fibre optics equipment from Thomas & Betts, as well as an increased variety of IDC and surface mounted components. To accommodate the increased activity, George Brown has moved to larger more modern premises. The new address is Unit 7, 2-6 Apollo Court, Blackburn, Vic. 3130.

Big sales predicted for car telephones

Demand for car telephones is expected to increase significantly following the launch of the much-heralded cellular mobile telephone system.

Sydney and Melbourne were the first Australian cities to come on stream, with launches in February and March respectively. The system will be progressively introduced to other state capitals by year's end.

The new cellular telephone system is vastly superior to the two-way MTS (Mobile Telephone System) car radio network currently in use. It operates in the 800MHz band and is based on a series of transmitters which transmit and receive calls within set areas (or cells) varying in size from around 2km to 12km, depending on population density.

Each cell in the local network is tied into a central computer or Mobile Service Switching Centre (MSSC). Here the calls are automatically processed, the caller identification made and the call routed through the public telephone network.

As the car moves out of one cell and into another, the MSSC detects the fading signal and switches to the next cell with no perceptible interruption to the signal. Users can make or receive local, STD or ISD calls as if they were using a normal home or business phone.

The cellular system was first introduced in the United States four years ago and has proved so successful that sales have now reached 25,000 units a month. Australian predictions are equally impressive. Telecom expects 10,000 units to be in use after the first year of operation and 200,000 within five years.

The system is not exactly cheap, though. Prices start at around $3600 (includes installation) and users must may a network fee of $50 per month.

Double scanning for clearer TV pictures

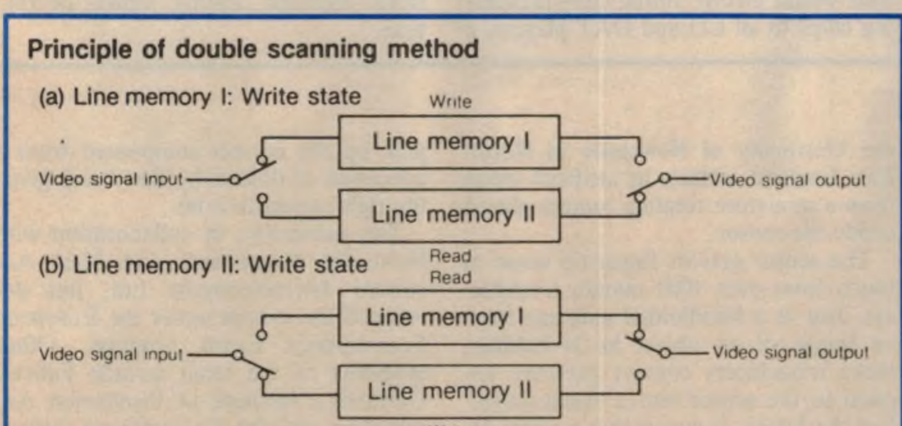
TV screens are being enlarged to enhance the enjoyment of not only TV broadcasting but various media such as video-cassette and videodisc programming. Along with this trend towards larger screens is a demand for better picture quality.

One Japanese company, Toshiba, has recently developed a new range of colour TV sets with high-quality picture resolution. The new sets employ a new double scanning method and a high-contrast, "full-square" picture tube. The result, according to Toshiba, is a much-improved picture.

Toshiba doubled the scanning lines by using two semiconductor chips called line memories in a digital memory circuit. In the double scanning method, each line is scanned twice to fill in the space which conventional TV leaves between the scanning lines as a gap.

As seen in Fig.1, while the line memory 1 is reading in the video signal of the scanning line at a given moment, line memory 2 reads out the previous line (a). And, while line memory 1 reads out the scanning line, line memory 2 reads in the next line (b). These functions are then repeated.

Although the number of the scanning lines in one field is twice as great with double scanning, the number of scanning lines in one frame remains 525 (NTSC system) because the two fields are overlapped to make one picture.



Supercomputer for CSIRO

The purchase of a Control Data 205 supercomputer has just been announced by the CSIRO. Costing some $3.7 million, the new machine has a 16 million byte memory and is able to perform 400 million calculations per second at peak operating speed.

Operation of the machine will be controlled by the CSIRO's independent computing company, CSIRONET, which has been renting the machine for the past two years. The supercomputer is used primarily by CSIRO and university researchers, government departments such as the Bureau of Meteorology and, increasingly, private companies.

News Highlights

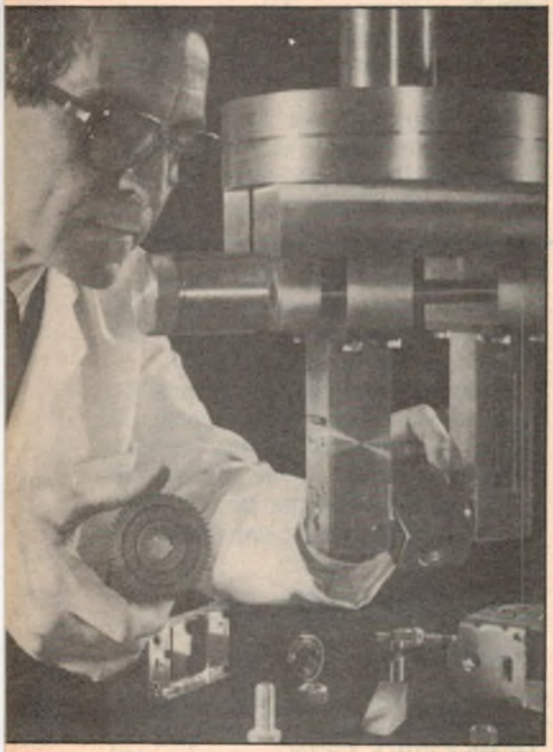
Remote-controlled vehicle for North America

The Minister for Defence, Mr Kim Beazley, recently announced that offsets would be used to boost marketing in North America of Australian-designed and built remote-controlled underwater vehicles.

As part of the offset obligation resulting from acquisition of 75 F/A-18 Hornets for the RAAF, the US-based McDonnell Douglas Corporation is to provide marketing support to the Western Australia company Underwater Systems Australia Ltd (USAL).

The initial marketing emphasis will be on the USAL designed C-Cat and Super C-Cat vehicles, which are fitted with video cameras and lights for relatively shallow water applications.

Under the arrangements established for the Hornet program, McDonnell Douglas has an obligation to place offset orders with Australian industry to the value of 30% of the project cost. The bulk of the offset program will be achieved through local production of F/A-18 components or work of similar technology.



DAT at conference table

The DAT (*D*igital *A*udio *T*ape) problem has all the makings of a major row. On the one hand, the audio equipment industry (read the Japanese) want to market DAT to open a new area of demand. On the other hand, the software industry wants to prevent copyright infringements by banning DAT if necessary.

A conference was recently held in Vancouver, Canada, to discuss both sides of the problem. The Japanese were looking for definite answers on such things as copycards, payment of copyright fees for dubbing of video or audio products, and the possibility of launching DAT in the near future.

At the same time, the Recording Industry Association of America (RIAA) has called for the banning of the DAT unless there is a recording spoiler to prevent recording from compact discs. This would involve fitting copy-preventing chips to all CD and DAT players, a proposal that is being strenuously resisted by equipment manufacturers.

One thing is certain — DAT cannot succeed without the cooperation of both industries.

Meanwhile, in anticipation of the release of DAT, companies such as TDK Corporation, Sony Corporation, Hitachi Maxell Limited, Fuji Photo Film Company, the Matsushita Electric Industrial Company, Victor Company of Japan and the Taiyo Yeuden Company are moving to commercialise the digtial audio tape cassette.

The cassette uses pure iron metal powder and the same tape width (3.81mm) as current compact cassettes. The recording system has a tape speed of 8.15mm per minute, sampling frequency of 48kHz, linear quantization of 16 bits, track pitch of 13.59 microns, and a line density of 64KB per inch.

Late news to hand is that Aiwa was planning to be the first to release a DAT recorder, during March of this year.

Robot with a human touch

A highly developed sense of touch and artificial vision enables this robot to choose any component it wants from among a collection of mixed objects.

When a human picks up and handles any object, his hand is guided nearly all the way by his sense of sight and the position of his arm. But the final approach and the actual grasping is guided by the sense of touch. The tactile sensor, developed by the Department of Electrical and Electronic Engineering at the University of Newcastle in North-East England, obtains its artificial vision from a miniature rotating camera placed inside the sensor.

The sensor gets its finger-tip sense of touch from over 1000 minute transducers. Just as a blindfolded man can form an image of an object he is holding, these transducers convert pressure applied to the sensor into a visual image. For the future, it means that a robot fitted with tactile sense can be taught to pick up the correct component from a collection of objects by first being given the right object to hold.

The university, in collaboration with Newcastle Polytechnic and Mari Advanced Microelectronic Ltd, has developed the system under the European Community's Esprit program. Other members of the team include Federal Germany's Institute of Production Automation and the Universtiy of Athens in Greece.

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AD149	[illegible]
AD161	[illegible]
AD162	[illegible]
BC107	
METAL	.53
BC108	
METAL	.50
BC109	
METAL	.40
BC177	.60
BC178	.37
BC179	.37
BC182	.34
BC212	.22
BC309	.12
BC317	.26
BC318	.14
BC321	.40
BC327	.21
BC328	.21
BC337	.21
BC338	.21
BC546	.16
BC547	.15
BC548	.15
BC549	.15
BC550	.15
BC556	.16
BC557	.15
BC558	.15
BC559	.15
BC560	.20
BC635	.48
BC636	.50
BC639	.37
BC640	.38
BCY70	.53

BCY71	.97
BD115	3.75
BD135	.71
BD136	.71
BD137	.65
BD138	.65
BD139	.75
BD140	.75
BD181	1.98
BD182	1.98
BD233	.82
BD234	.85
BD235	.82
BD236	.85
BD237	.95
BD238	.95
BD262	1.54
BD263	1.54
BD435	.62
BD437	.90
BD438	1.08
BD439	.68
BD647	1.12
BD649	1.12
BD675	1.03
BD676	1.03
BD677	1.03
BD678	1.03
BD679	1.12
BD681	1.34
BD682	1.34
BDV64B	3.16
BDV65B	3.16
BF115	.73
BF167	.64
BF173	.60
BF180	1.00
BF184	.65
BF198	.33
BF199	.33
BF337	1.24
BF457	.91
BF458	.56
BF458	.56
BF469	1.42
BF470	1.42
BF494	.21
BFY50	[illegible]
BFY90	2.00
BU126	2.09
BU208A	3.78
BU326A	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
BU426	[illegible]
[illegible]	[illegible]
MJ15003	[illegible]
MJ15004	[illegible]
MJ2500	5.90
MJ2500	2.92
MJ2955	[illegible]
MJ3000	5.00
MJ4030	[illegible]
MJ4035	[illegible]
MJ413	4.92
MJ4502	[illegible]
MJ802	[illegible]
MJE13007	[illegible]
MJE2955T	[illegible]
MJE2955	3.00
MJE3055T	1.34
MJE3055	3.00
MJE340	1.50
MJE350	2.75
MJE520	1.09
MJE521	1.09
MJE700	1.16
MJE800	1.02
MJE801	1.02
MJE802	1.29
MPSA05	.37
MPSA06	.37
MPSA12	.28
MPSA13	.27
MPSA14	.26
MPSA42	.30
MPSA56	.50
MPSA64	.95
MPSA70	.45
MPSA92	.35
MPSA93	.35
MPF102	.87
MPF105	.75
MPSL01	.35
MRF237	4.90
MRF454	43.00
MRF475	6.40
MRF901	3.12
TIP110	[illegible]
TIP112	1.03
TIP115	1.04
TIP117	.94
TIP120	.89
TIP122	1.10
TIP125	1.35
TIP126	1.10
TIP127	1.40

TIP132	1.75
TIP137	1.75
TIP2955	2.00
TIP3055	2.00
TIP29C	.71
TIP30C	.71
TIP31C	.71
TIP32C	.80
TIP34A	4.01
TIP41C	1.05
TIP42C	1.05
U310	3.05
2N1304	4.65
2N1306	4.00
2N1309	4.12
2N1613	1.20
2N2218A	1.20
2N2219A	1.20
2N2221A	.91
2N2222A	.82
2N2369A	.82
2N2484	.91
2N2646	1.55
2N2647	2.10
2N2894	.83
2N2904A	[illegible]
2N2905A	1.20
2N2906A	[illegible]
2N2907A	[illegible]
2N301	3.32
2N3019	1.20
2N3053	1.16
2N3054	2.78
2N3055	1.21
2N3107	1.20
2N3110	1.00
2N3440	2.23
2N3441	2.87
2N3442	3.53
2N3563	.32
2N3565	.26
2N3566	.29
2N3567	.21
2N3568	.17
2N3569	.21
2N3638	.20
2N3639	.38
2N3640	.38
2N3641	.21
2N3642	.21
2N3643	[illegible]
2N3644	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
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2N3771	4.10
2N3772	[illegible]
2N3773	6.55
2N3819	[illegible]
2N3866	2.30
2N3904	.20
2N3906	.20
2N4030	1.20
2N4032	1.20
2N4033	1.20
2N4036	1.20
2N4121	.21
2N4124	.25
2N4233	3.75
2N4236	[illegible]
2N4237	2.51
2N4248	.31
2N4249	.31
2N4250	.31
2N4255	.38
2N4258	.38
2N4356	.35
2N4401	.15
2N4402	.21
2N4403	.15
2N4427	2.70
2N5088	.31
2N5089	.32
2N5179	.98
2N5190	.66
2N5191	.80
2N5192	1.10
2N5193	1.50
2N5195	1.18
2N5210	.26
2N5245	.92
2N5303	5.40
2N5401	.79
2N5467	.79
2N5458	.57
2N5459	.57
2N5461	.75
2N5484	.58
2N5485	.80
2N5486	.65
2N5580	20.90
2N5590	21.60
2N5591	24.04
2N5770	.52
2N5777	1.25
2N5830	.32
2N5831	.32

2N5873	1.76
2N5874	1.40
2N5944	12.90
2N5946	25.00
2N5961	.36
2N6027	1.08
2N6028	1.00
2N6080	15.40
2N6083	18.25
2N6084	26.60
2N6121	.82
2N6122	1.05
2N6123	1.05
2N6124	.89
2N6125	.91
2N6126	.84
2N6129	.99
2N6130	1.35
2N6131	.90
2N6133	.90
2N696	1.03
2N697	.83
2N918	.26
2SC1061	.97
2SC1306	2.50
2SC1307	8.50
2SD325	.72
2SD350A	5.56
2SC353	3.90
2SJ49	10.36
2SJ56	16.56
2SK134	9.34
2SK176	13.46
CMOS-4000	
4000	.42
4001	.42
4002	.42
4006	1.42
4007	.42
4008	1.21
4009	.65
4010	.42
4011	.42
4012	.42
4013	.42
4014	[illegible]
4015	[illegible]
4016	[illegible]
4017	[illegible]
4018	[illegible]
4019	[illegible]
4020	[illegible]
4021	[illegible]
4022	[illegible]
4023	[illegible]
4024	[illegible]
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4028	[illegible]
4029	[illegible]
4030	[illegible]
4031	[illegible]
4032	[illegible]
4033	[illegible]
4034	[illegible]
4035	[illegible]
4040	1.10
4041	1.07
4042	1.25
4043	1.10
4044	1.16
4046	1.61
4047	1.00
4048	.89
4049	.53
4050	.83
4051	1.25
4052	1.25
4053	1.25
4055	3.25
4060	1.75
4063	1.66
4066	.75
4067	7.08
4068	.66
4069	.66
4070	.75
4071	.45
4072	.66
4073	.53
4075	.44
4076	1.79
4077	.66
4078	.44
4081	.45
4082	1.83
4085	1.83
4086	1.91
4089	2.85
4093	.75
4094	2.50
4098	2.41
4099	2.60
4104	4.58
4160	1.40
4161	1.37
4162	1.40

4163	1.64
4174	1.25
4194	1.62
4411	10.40
4419	2.87
4469	12.08
4495	3.29
4500	7.40
4502	1.42
4503	1.09
4507	.75
4508	3.39
4510	1.26
4511	1.37
4512	1.16
4514	2.42
4515	2.40
4516	1.37
4518	1.44
4519	.89
4520	1.37
4521	2.91
4522	1.68
4526	1.34
4527	1.93
4528	.95
4529	1.76
4531	1.37
4532	2.20
4534	7.40
4536	5.40
4538	1.55
4539	1.40
4541	1.45
4543	2.08
4553	4.55
4555	1.02
4556	1.04
4558	1.87
4560	3.12
[illegible]	[illegible]
4569	[illegible]
4572	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
4585	[illegible]
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4703	[illegible]
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4723	[illegible]
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40105	[illegible]
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40175	[illegible]
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40193	[illegible]
40194	[illegible]
CMOS 74C	
74C00	.58
74C02	.66
74C04	.66
74C08	.58
74C10	[illegible]
74C14	1.92
74C20	.76
74C30	.61
74C32	.76
74C42	1.63
74C48	2.47
74C73	1.07
74C74	.95
74C76	1.23
74C83	2.07
74C85	1.62
74C86	.75
74C89	7.40
74C90	2.40
74C93	1.72
74C95	1.91
74C107	1.10
74C150	4.62
74C151	2.89
74C154	4.55
74C157	3.53
74C160	1.13
74C161	1.37
74C162	1.50
74C163	1.64
74C164	1.05
74C165	1.72
74C173	1.79
74C174	1.25
74C175	1.21
74C192	1.80
74C193	1.65
74C195	1.62
74C200	9.03
74C221	2.42
74C240	2.72
74C244	2.72
74C373	3.19

Part	Price
74C374	2.91
74C901	1.06
74C902	.95
74C903	1.50
74C904	1.14
74C905	8.82
74C906	.96
74C907	.94
74C908	2.02
74C910	10.55
74C911	10.03
74C912	16.95
74C914	2.34
74C915	2.25
74C917	7.83
74C918	2.13
74C920	5.31
74C921	3.96
74C922	7.26
74C923	8.46
74C925	8.09
74C926	9.90
74C927	7.40
74C928	4.99
74C929	5.36
74C930	5.22
74C932	1.66
74C941	2.61
74C946	18.29
74C989	6.46
CMOS - 74HC	
74HC00	.50
74HC02	.50
74HC04	.50
74HC08	.53
74HC10	.53
[illegible]	[illegible]
[illegible]	[illegible]
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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74HC157	[illegible]
74HC158	[illegible]
74HC161	[illegible]
74HC162	1.58
74HC163	1.68
74HC164	1.61
74HC165	2.26
74HC173	1.38
74HC174	1.31
74HC175	1.31
74HC192	1.34
74HC193	1.35
74HC194	1.21
74HC195	1.18
74HC221	1.95
74HC240	2.36
74HC241	2.36
74HC242	1.86
74HC243	1.86
74HC244	2.31
74HC245	2.31
74HC251	1.34
74HC253	1.34
74HC257	1.19
74HC258	1.14
74HC259	1.50
74HC266	.87
74HC273	2.24
74HC356	3.28
74HC365	1.07
74HC366	1.34
74HC367	1.34
74HC368	1.34
74HC373	1.76
74HC374	1.87
74HC375	1.14
74HC390	2.58
74HC393	2.36
74HC533	2.36
74HC573	2.81
74HC574	2.81
74HC640	3.36
74HC670	1.84
74HC4002	2.00
74HC4017	2.00
74HC4020	2.00
74HC4022	1.64
74HC4024	1.89

Part	Price
74HC4040	2.39
74HC4049	1.70
74HC4050	2.98
74HC4051	1.37
74HC4052	1.77
74HC4053	1.77
74HC4060	2.36
74HC4066	1.15
74HC4075	1.15
74HC4078	1.15
74HC4511	2.50
74HC4538	2.76
74HC4543	3.05
74HCT240	2.63
74HCT244	2.63
74HCT245	2.31
74HCT573	2.31
74HCT574	2.17
74AC SERIES	
74AC00	.82
74AC04	.82
74AC08	.82
74AC14	.82
74AC32	.82
74AC74	1.05
74AC109	1.05
74AC138	1.05
74AC139	1.05
74AC153	1.40
74AC157	1.40
74AC158	1.40
74AC161	1.42
74AC240	[illegible]
74AC241	[illegible]
[illegible]	[illegible]
74AC245	[illegible]
74AC257	[illegible]
74AC258	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74AC373	[illegible]
74AC374	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74AC573	[illegible]
74AC574	1.34
74 SERIES	
7400	.75
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
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[illegible]	[illegible]
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7413	[illegible]
7414	[illegible]
7416	[illegible]
7417	[illegible]
7420	[illegible]
7421	[illegible]
7423	[illegible]
7425	[illegible]
7426	[illegible]
7427	[illegible]
7430	.89
7432	1.03
7437	1.12
7438	.98
7440	1.07
7441	1.43
7442	1.31
7443	1.93
7444	1.25
7445	1.86
7446	1.00
7447	1.25
7448	1.58
7450	.75
7451	1.00
7453	.71
7454	.60
7460	.60
7470	.60
7472	.98
7473	.79
7474	.95
7475	1.37
7476	1.31
7480	1.65
7482	3.15
7483	.75
7485	1.28
7486	1.05
7489	3.25
7490	1.21
7491	.83
7492	1.18
7493	.96
7494	1.25
7495	1.10
7496	1.12
7497	1.90

Part	Price
7410	.82
74109	.68
74121	1.24
74122	.84
74123	1.06
74125	1.16
74126	1.00
74132	1.10
74141	.91
74145	2.47
74147	1.62
74148	1.66
74150	2.05
74151	1.18
74152	6.83
74153	.91
74154	3.80
74155	1.42
74156	.99
74157	1.16
74160	.65
74161	1.24
74162	.71
74163	1.60
74164	1.31
74165	1.16
74166	1.21
74167	1.83
74170	[illegible]
74173	[illegible]
74174	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
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[illegible]	[illegible]
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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74221	[illegible]
74251	[illegible]
74279	[illegible]
[illegible]	[illegible]
74284	5.48
74285	4.58
74290	[illegible]
74293	[illegible]
74298	2.04
74365	2.02
74366	[illegible]
74367	2.02
74368	[illegible]
9316	1.65
9368	1.73
9602	2.08
9636	3.12
9637	4.38
9638	3.16
74LS - SERIES	
74LS00	.50
74LS01	.55
74LS02	.50
74LS03	.50
74LS04	.50
74LS05	.56
74LS08	.50
74LS09	.56
74LS10	.53
74LS11	.49
74LS12	.68
74LS13	.58
74LS14	.61
74LS15	.50
74LS20	.50
74LS21	.75
74LS22	.75
74LS26	.75
74LS27	.58
74LS28	.75
74LS30	.60
74LS32	.60
74LS33	.66
74LS37	.61
74LS38	.65
74LS40	.66
74LS42	.66
74LS47	1.40
74LS48	1.37
74LS49	1.60
74LS51	.56
74LS54	.62
74LS55	.54
74LS73	.58
74LS74	.50
74LS75	.61
74LS76	.48
74LS78	.68

Part	Price
74LS83	.80
74LS85	1.10
74LS86	.50
74LS90	.87
74LS91	.75
74LS92	.72
74LS93	.77
74LS95	.80
74LS96	.98
74LS107	.92
74LS109	.60
74LS112	.96
74LS113	.69
74LS114	.66
74LS122	2.10
74LS123	.86
74LS125	.63
74LS126	1.03
74LS132	.71
74LS133	.61
74LS136	.80
74LS138	.66
74LS139	.80
74LS151	.84
74LS152	1.60
74LS153	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74LS156	[illegible]
74LS157	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74LS161	[illegible]
74LS163	1.05
74LS164	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74LS173	[illegible]
74LS174	[illegible]
74LS175	[illegible]
74LS181	[illegible]
74LS190	[illegible]
74LS191	[illegible]
74LS192	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
74LS221	.86
74LS240	1.19
74LS241	1.62
74LS242	1.63
74LS243	1.40
74LS244	1.40
74LS245	1.71
74LS247	1.58
74LS248	1.25
74LS249	2.47
74LS251	.63
74LS253	.77
74LS257	.68
74LS258	.68
74LS259	1.08
74LS260	.76
74LS266	.79
74LS273	1.37
74LS279	.58
74LS283	.66
74LS290	1.03
74LS293	1.00
74LS295	.89
74LS298	.84
74LS323	5.49
74LS352	.82
74LS353	1.05
74LS365	.79
74LS366	.89
74LS367	.77
74LS368	.67
74LS373	1.33
74LS374	1.40
74LS375	.87
74LS377	1.40
74LS378	1.73
74LS379	.79
74LS386	1.45
74LS390	.79
74LS393	1.10
74LS395	1.55
74LS447	1.24
74LS490	1.00
74LS573	1.60
74LS574	2.29
74LS629	4.95
74LS640	2.90
74LS670	1.19
74F - SERIES	
74F00	0.88
74F02	.96
74F04	.95
74F08	1.08
74F10	.82
74F11	1.08
74F20	.82
74F32	.96

Part	Price
74F64	1.08
74F74	1.13
74F86	1.21
74F109	1.34
74F138	1.84
74F139	1.84
74F151	1.10
74F157	1.26
74F158	1.40
74F160	2.08
74F161	2.08
74F162	2.08
74F163	2.75
74F164	1.47
74F174	2.54
74F175	1.60
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74F189	3.52
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74F350	1.63
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74F353	1.19
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74S - SERIES	
74S00	.95
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74S11	.86
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74S30	.98
74S32	.95
74S40	1.03
74S51	.98
74S64	1.03
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74S109	1.79
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74S133	[illegible]
74S135	2.76
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74S140	1.82
74S151	1.73
74S153	1.29
74S157	1.68
74S158	1.61
74S161	4.95
74S174	1.73
74S175	1.66
74S188	3.40
74S189	7.08
74S194	3.08
74S241	5.75
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74S253	1.55
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74S283	6.58
74S287	4.08
74S288	3.68
74S289	5.79
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6808	9.58
6809	15.22
6810	4.81
6820	3.50
6821	5.60
6840	9.00
6844	14.49
6845	10.60
6847	7.08
6850	6.35
6854	13.44
6875	12.45
68B00	11.50
68B02	11.50
68B09	15.60
68B10	5.06
68B21	5.90
68B40	10.50
68B44	37.50
68B45	16.50
68B50	8.50
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HD6303R	19.80
6305 x 2	[illegible]
6321	[illegible]
[illegible]	[illegible]
63A03RP	[illegible]
63A21	[illegible]
63A50	[illegible]
63B09	[illegible]
63B50	[illegible]
[illegible]	[illegible]
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Z80A PIO	3.50
Z80 ATC	3.50
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LH0042CH	9.95
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TL062	[illegible]
TL064	3.90
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FD1791	16.50
FD1793	16.50
FD1795	25.00
FD1797	25.00
UAA180	3.12

Part	Price
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WD2795	57.50
WD2797	32.00
UA2902PC	1.10
LM2917N-8	3.16
LM2917N-14	1.00
MN3001	14.56
LM301AN	1.33
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CA3046	.50
CA3059	4.95
CA3080	1.57
CA3086	.60
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UA303TC	[illegible]
UA308HC	1.86
UA308ATC	3.08
UA308AHC	4.94
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LM319N	3.35
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LM335Z	2.22
OM335	18.30
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UA339ADC	3.10
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MC3470	5.95
UA348PC	2.02
LM349N	1.38
OM350	8.33
LF351N	1.20
LF353N	1.35
LF356N	2.87
LF357N	2.11
LM358N	.60
LM377N	3.76
LM378N	5.17
LM380N-8	1.48
LM380N-14	1.48
LM381N	3.97
LM382	3.22
LM383T	3.95
LM384N	2.95
LM386N-3	1.37
LM387N	2.22
LM388N-1	.85
LM389N	2.03
AY3-8910	12.05
LM3900N	1.18
LM3905N	1.80
LM3909N	1.67
LM3911N	2.87
LM3914N	3.85
LM3915N	3.23
LM3916N	3.78
LM391N-60	1.66
LM393N	1.03
LM394CH	5.60
LM398N	2.03
UA4136	1.40
ZN414	1.12
LM4250	2.87
4412	11.62
MM5303N	6.25
MM5309N	11.60

Part	Price
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NE5532AN	2.90
NE5534	1.80
NE5534AN	2.60
LM555N	.50
UA556PC	.92
NE558	3.50
NE565	1.33
NE566	2.25
NE567	1.58
NE570	4.91
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6551	14.50
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UA710PC	1.61
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TA7205	3.25
ICM7216B	55.62
ICM7217A	21.46
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LM711H	2.26
UA733PC	1.98
UA739PC	3.40
UA741TC	.41
UA741HC	2.60
LM747N	1.87
UA75107BPC	1.73
UA75110APC	2.04
75150	1.54
UA75154PC	1.54
UA75451BTC	1.49
UA75452BTC	1.49
UA75453BTC	1.49
UA75461TC	1.49
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DM8131N	4.50
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8155	5.40
8156	8.75
81LS95	2.38
81LS96	2.42
81LS97	2.51
81LS98	2.26
8202	2.83
8212	2.40
8214	1.20
8216	4.15
8224	2.90
8226	3.75
8228	4.50
8238	7.90
8243	6.60
8251	5.05
8253	4.95
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8304	4.58
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Technology from the good old days

Vintage radio restoration

There are many old-time valve radio receivers collecting dust in garages and antique shops. Collecting and restoring these old radios can be a rewarding and interesting experience.

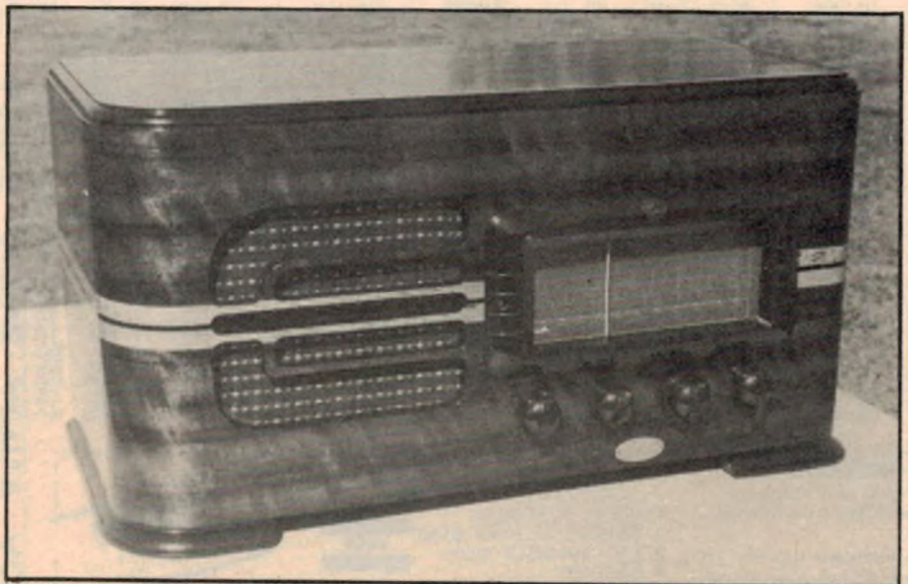
by JOHN HILL

Collecting and restoring various items from our past is a popular hobby for many. Typical collectors items include old cars, motor cycles, clocks, furniture — you name it and someone somewhere collects it.

Although I always considered myself immune to such childish behaviour, I now have to admit that I have been bitten by the collecting bug, with my particular interest centring around old valve radios. One of the most pleasing aspects of my new hobby is that it appears as though I have become interested in it at about the right time.

Unlike vintage motor cars (which are now almost impossible to find), there are stacks of old radios around and they are not only easy to locate, but relatively inexpensive to buy.

To give an example of old radio availability, I recently managed to obtain 32 complete sets during a two week holiday period. The average price was $8.00 which, as far as hobbies are concerned, isn't costly by any means. In some instances, people are happy to give away their old radios just to get rid of them.



A four valve battery operated Hotpoint. Battery sets offer special problems to radio restorers in that they require a 90-135 volt "B" battery.

The price of old radios is something that varies considerably. Radios in working order are worth more than those that aren't; wooden cabinets are more desirable than plastic; console models bring more than mantle models; while the true vintage radios of the 1920s are worth ten times as much as sets of the 1930s era or later.

Realistically, an old radio is only worth whatever someone is prepared to pay for it and, in the case of valve radios, not many people place much value on them at all. Many old radios, often in working order, are disposed of at the tip. Others find their way into the hands of dealers.

Dealer prices

Dealer prices are in accordance with demand and the guys I buy from don't seem to have much demand. Then again, I only buy sets that no longer work and most of these sell for around $10 or less. However, 20 years from now, the situation could change dramatically.

George is an antique dealer I buy a few radios from and a typical transaction goes something like this: "How much is the old radio, George?"

George rarely replies, but plugs the set into the power point to see if it goes. He never seems to find the time to do this until it looks as though someone might buy it. In most instances the radio fails to respond and appears to be quite dead.

"You can't ask much for them when they don't work, can you George?" is my standard remark after about a minute of silence from both George and the radio.

Eventually George finds his voice and mutters something like "How does five dollars sound?"

I buy a lot of radios from George because he is realistic with his prices and he is able to scrounge around at auctions and sales for me. Buying from the right antique dealer is perhaps the easiest way of getting onto old radio sets.

One striking aspect of valve radio is the quality of the sound. The cheap transistor radio has been with us long enough for most of us to forget just how good many valve radios were. Some of the larger console models have 25-30cm loudspeakers in them and the sound has to be heard to be believed.

Perhaps the tragic part of collecting these old radios is the constant reminder that the majority of them were entirely made in Australia. Like so much of Australian industry, radio manufacturers have gone down the gurgler and what was once a thriving industry has faded away to almost nothing. Sounds a familiar story, doesn't it? At least radio collectors are preserving a unique piece of Australian history.

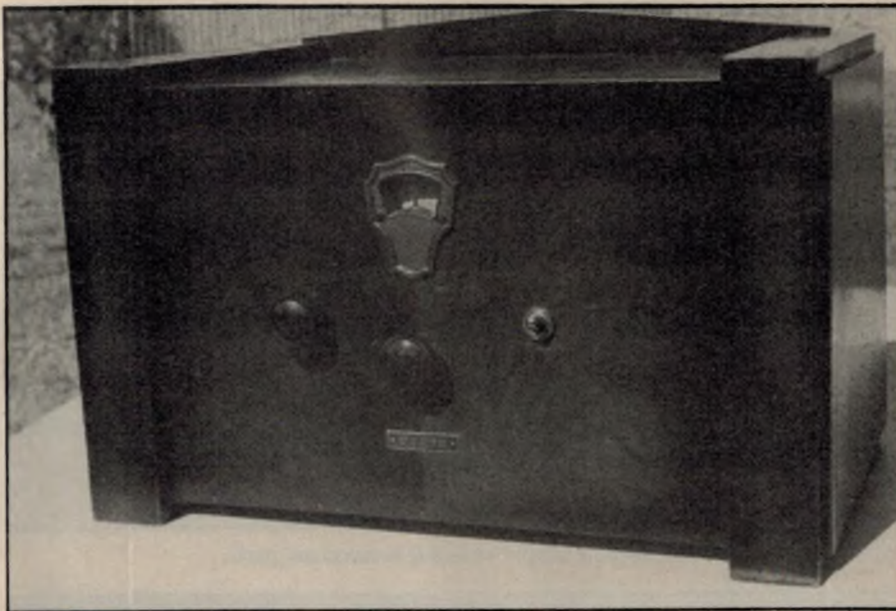
Anyone starting out on the radio restoration caper will find that they are pretty much on their own, unless they happen to have a few of the right contacts. It is most important that they will be able to do their own repairs, because most people in the trade don't want to see a valve radio, let alone repair it. The average radio-TV repair man has no valves, suitable spares or desire to work on old radios.

Radio restoration is similar to vintage car restoration in that the restorer has to utilise secondhand bits and pieces to best advantage. Not many modern components can be used in valve radios and one usually has to make do with cannibalised parts from other receivers.

Valves

Valves in particular present a major problem to restorers in that no-one makes, stocks or sells them any more. Some of the older repair places may have a few valves on a dusty shelf, but they are mainly TV valves and the old radio valves of the 1930s and 40s never seem to be there.

It is therefore important, when starting out, to buy up all the old wrecked sets one can lay hands on. Radios with smashed cabinets, broken dials and missing knobs can usually be bought for $2 or so and are an essential part of collecting. Wrecked and unrestorable radios are about the only supply of valves and other spare parts one is likely to find and as such are almost as

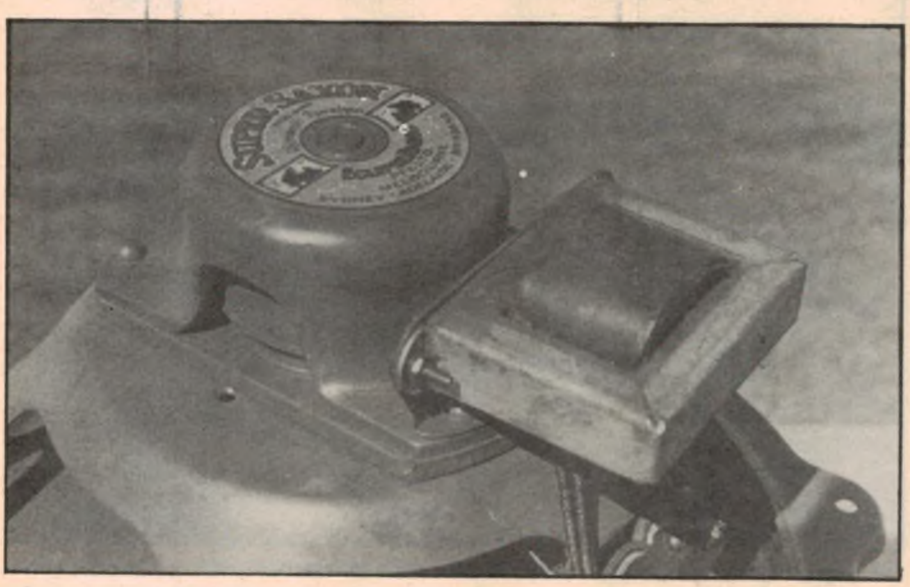


Vintage receivers like this late 1920s Seyon are few and far between. This one is a three valver with a separate loudspeaker.

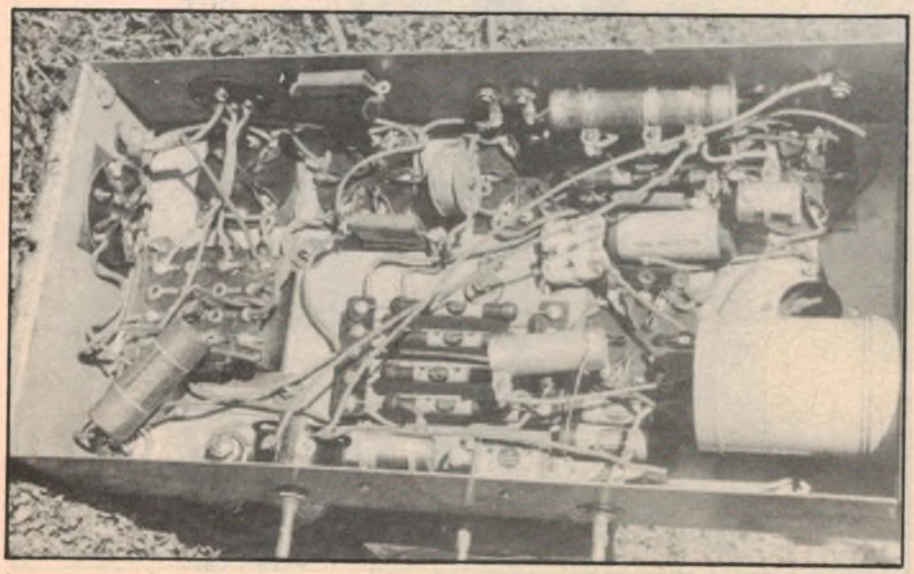
Old paper capacitors should be replaced with high voltage (400-630V) polyester equivalents.

Old valve manuals are an essential part of a restorer's equipment.

Radio wrecking is about the only supply of usable secondhand parts.



Double trouble with old radios. Both the loudspeaker field coil and loudspeaker transformer can burn out and give trouble.



It might look like a rat's nest. but it is accessable and easy to service.

valuable as restorable radios.

Secondhand valves can vary from totally useless to perfectly OK, with varying degrees in between. But while buying up wrecks is one way of obtaining valves, there are also other sources of supply.

Believe it or not, there are numerous people in the community with valve collections. Retired radio repairmen and others who have been in the trade sometimes have sheds full of bits and pieces and are glad of the opportunity to sell it or even give it away. They never thought they would meet anyone silly enough to actually want the stuff.

I have located and obtained three such valve collections and all were within one kilometre of where I live. If I can do that so close to home, then there must be other collections around just waiting for a bid. An advertisment in a newspaper could bring results.

Buying out a few valve collections can give one's own collection a considerable boost and increase the scope of restorations. To get properly organised, a valve collection needs to be tested, cleaned, sorted and cataloged. There is nothing worse than a great assortment of unknowns. My own valve collection numbers many hundreds and is still growing.

Testing valves is a problem and the best that the average restorer can do without a valve tester is to check the filaments or heaters for continuity, then plug the valves into a radio that is in good working order. If a valve works, well and good; if it doesn't, then discard it.

Unfortunately, if just starting out, one may not have many radios that can be used as valve testers. Collectors in this situation will have to do the best they can.

A supply of usable valves, whether new or secondhand, is of the utmost importance to the valve radio restorer. Without valves, valve radio ceases to exist.

Most old valve radios don't work when first salvaged and plugging them into the 240V power supply can do serious damage. In some instances, time and non-use have a bad effect on ageing components and it is advisable to give a set a thorough check out before plugging it in. Checking out the valves and cleaning the base pins and sockets is a good starting point.

Capacitors

One of the most common causes of trouble with vintage radios is with the capacitors. The two types that cause trouble are the paper capacitors (referred to as "condensers" in the good old days) and the electrolytics. Mica capacitors are unlikely to give trouble. Let's take a close look at these troublesome components and see what problems they cause and how these problems can be resolved.

Paper capacitors are so named because the dielectric insulating the two layers of foil is made of waxed paper (no fancy plastic in the early days of radio). Unfortunately, age and high voltage application causes the wax paper to break down and most old paper capacitors have serious leakage problems. In many instances they become resistors and allow sufficient current to flow to register on an ohmmeter. Readings of 500kΩ to 2MΩ are quite common when checking old paper capacitors.

Now if a capacitor leaks when a few volts from an ohmmeter is put across it, what's it going to do if put back into service with several hundred volts across it? That's right — ZAP!.

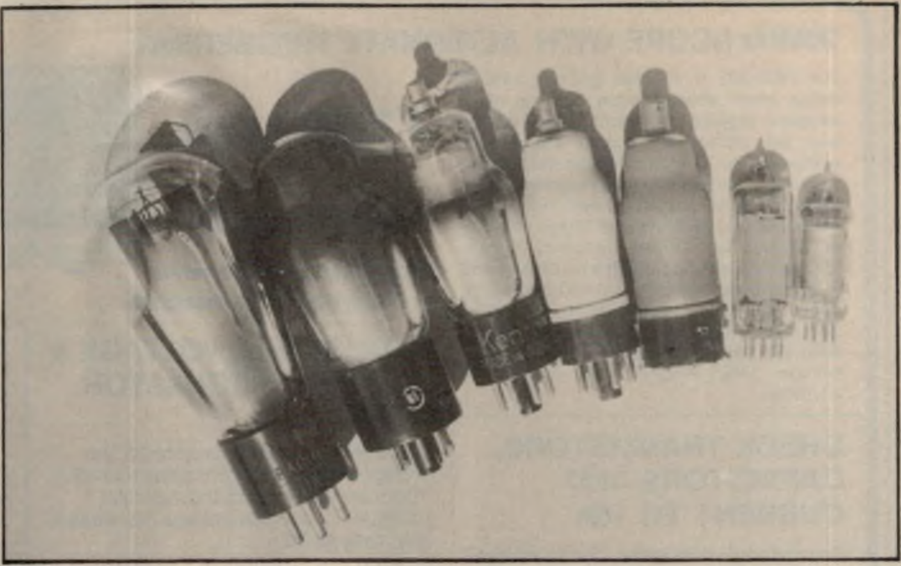
It is wise to replace paper capacitors with modern high voltage equivalents. If all paper capacitors are not replaced, then at least replace those with any measurable leakage. If one wishes, low voltage paper capacitors can be replaced with 100V capacitors which are cheaper to buy.

Another good reason for checking out the paper capacitors is that many of them have been chewed by rats and mice while the set spent 20 years or so in someone's shed. Vermin are quite fond of the wax coating on paper capacitors and it is not uncommon to find some capacitors have been eaten away.

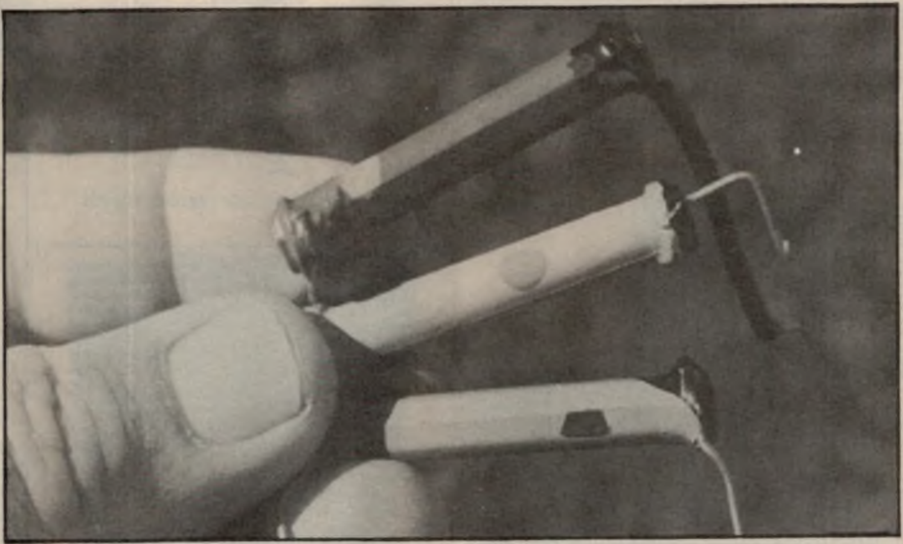
Electrolytic capacitors, whether vintage or modern, contain a fluid which eventually leaks away or dries out over a period of time, thus rendering the capacitor useless.

Old electrolytics are a mixed bag; some still work OK after 40 years, while others are completely clagged at half that age. Some become open while others short circuit. Once again, the replacement of old electrolytics is an excellent idea and can prevent a lot of trouble.

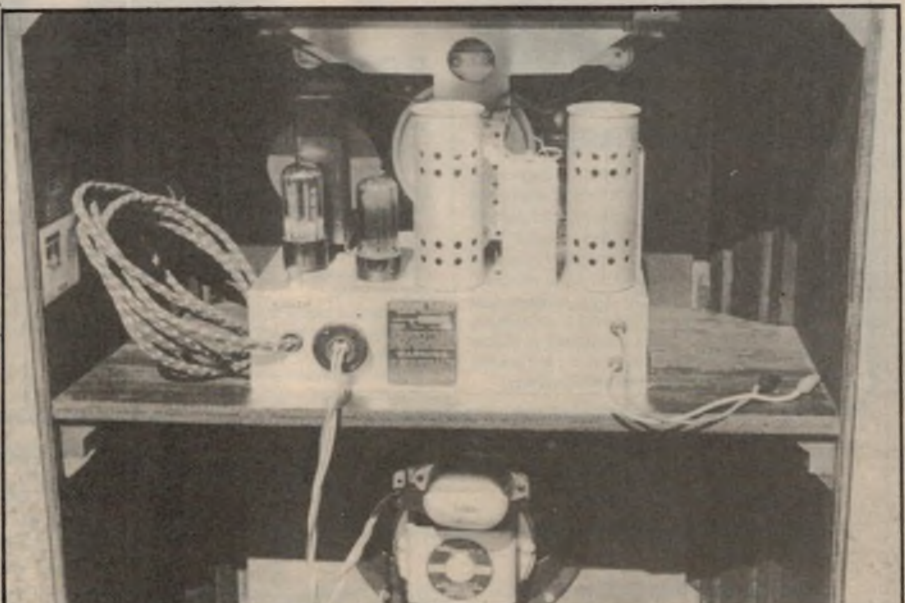
Unfortunately, old radios use different electrolytics to the ones usually encountered in modern circuits. Valve radios require electrolytics with voltage ratings ranging from 350 volts to 600 volts. Obtaining these high voltage electrolytics is a bit like trying to buy new valves, in that no one seems to manu-



Valves come in many shapes and sizes.



Old style body, end and dot resistors.



Back view of a 1937 Airzone after restoration.

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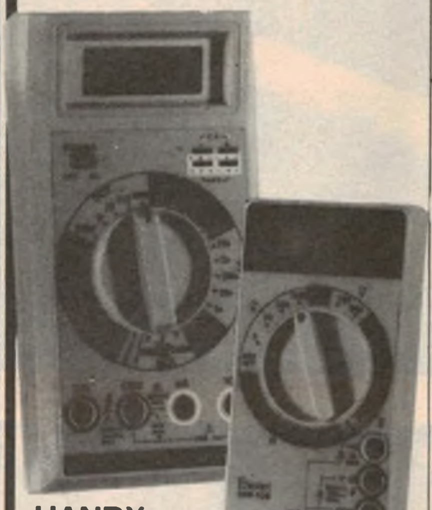

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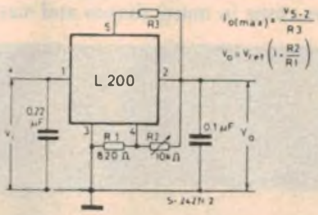

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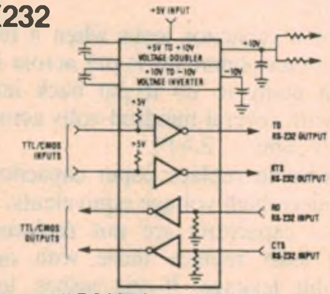

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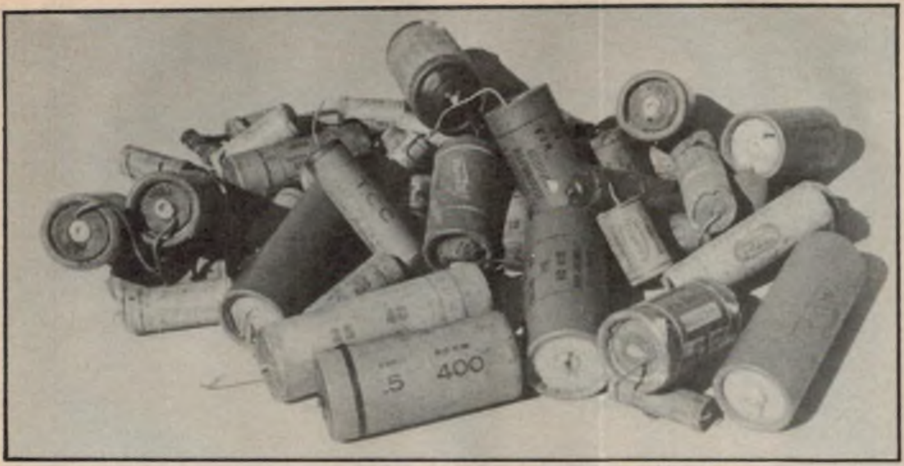


There are few things more useless than old electrolytics and paper capacitors.

facture or stock them any more. Shopping around may produce some, but they seem to be disappearing fast and are no longer listed in catalogs.

However, there is a solution. A 100uF 63V electrolytic is common and sells for 60 cents. If six of these are connected in series, one ends up with a 16μF electrolytic with a 380V rating. As the capacitance of an electrolytic used in a valve radio is not critical, such a set up would work with most old radios, thus getting the restorer out of trouble. The multiple series connected electrolytic may look a bit strange and will cost $3.60, but it's better than no electrolytic at all.

Seven and eight capacitor arrangements could also be useful, depending on the voltage rating required.

High voltage electrolytics are not the only electrolytics used in vintage radios. Some have quite low voltage ratings of 40 to 50V and are quite easily replaced with current stock.

The best advice one can offer regarding ageing capacitors in valve radios is to replace all the paper and electrolytic types. Making a clean sweep removes doubts, increases gain, improves sound clarity and eliminates many of the crackles, pops, hums and other strange noises that are common in old radios.

Resistors

Resistors, both fixed and variable, have always been part of the radio scene and there is little difference in today's resistors to those of yesteryear. There are physical differences, however, and these are in size and method of identification.

The old style resistor was quite large and the resistance value was clearly labelled. If a resistor was 1MΩ, it said so. None of those confusing bands of colour.

Actually, the old system seems like a good idea when you think about it. If one has to decode the colour bands to find out the resistance, why not write it in the first place?

However, this was not to be. In the years that followed, resistors where colour coded and are still that way today, although the method of colour coding has changed in recent times.

A modern resistor has three colour bands which indicate the resistance value in ohms. The first band from the end is the first figure of the reading, while the last band is the multiplier.

Colour coded resistors prior to the above sytem were based on the same colour values, but were read in a different order: body, end and dot. The body and end colours represent the first two significant digits while the dot defines the multiplier in powers of 10. If this type of resistor is not read in that order, the reading will not match up with the value.

Whilst the old system (which is common in valve radios) is known as "body, end and dot", often the dot is not a dot but a band. To add to this confusion, some resistors only have two colours: body and end — no dot. Actually, the dot is there but it can't be seen because it is the same colour as the body. In fact, it isn't even put on.

Fig.1 shows the basic scheme for the obsolete colour code. The areas marked "A" represent the body colour, area "B" the end colour, and area "C" the dot or band. Thus, if A is red, B is violet and C is yellow, the resistor value is 270kΩ.

Establishing the value of a resistor is important for two reasons. Firstly, if a resistor is burnt out it must be replaced with one of a similar value. Secondly, old resistors are inclined to go high and they should all be checked for value with an ohmmeter. The colour code may indicate that a resistance was 0.5MΩ when it was manufactured, but after 30-40 years it could rise to 1MΩ or even higher. Resistors that have gone high, beyond their tolerance, should be replaced.

It is advisable to check out the resistance of each resistor in order to establish that they are of the correct value or if they have burnt out. If a resistor measures considerably less than it is supposed to, the low reading may be caused by other resistances (not necessarily resistors) in the circuit that are in parallel with the resistor being checked. If doubt exists regarding any resistor, it should be disconnected at one end and its value checked again. Checking resistances whilst they are connected into the circuit may not give a true reading.

Finally, fixed resistors should always be replaced with a resistor that it an appropriate substitute. Don't replace a one watt resistor with a 1/2 watt resistor, although the reverse is quite OK. Always replace high wattage, wire wound resistors with similar wire wound replacements.

If all the resistors in a vintage radio are checked and suspect ones replaced, then that old set has a better chance of going when it is plugged in. A few other additional checks will increase the odds even higher.

The HT choke

Most of the older valve radios have a high tension choke. The purpose of the choke is to smooth out ripple in the rectified DC which substantially reduces 50Hz mains hum. The choke can be a transformer-style component bolted to the chassis, or it can be incorporated into the loudspeaker. A loudspeaker of this type is known an an electrodynamic loudspeaker and differs from more modern speakers in that it operates with

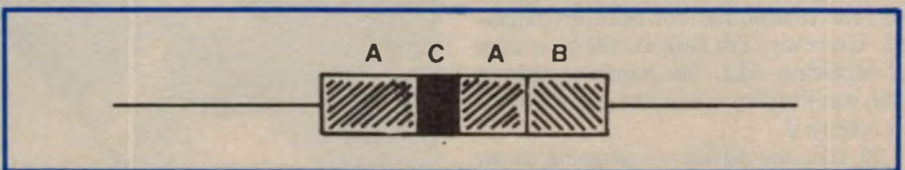


Fig.1: the obsolete resistor colour scheme. Area "A" represents the body colour, "B" the end colour, and "C" the dot or band.

an electromagnet, not a permanent magnet. The choke or field coil energises the magnet circuit.

Why this type of loudspeaker evolved is a bit of a mystery because permanent magnet loudspeakers were already in use at the time, yet the era of the electrodynamic loudspeaker lasted nearly 20 years.

The reason for mentioning this is because every now and then the choke or the field coil of a loudspeaker burns out (usually caused by a shorted capacitor or corrosion). This, in turn, effectively cuts off the high tension supply to the anodes and screens of the valves. Therefore, a routine ohmmeter check on the choke or field coil can save a lot of time in tracking down a problem. No high tension on the anodes or screens is a good indication of choke or field coil trouble.

It is interesting that later model valve radios dispensed with chokes and substituted a cheaper high wattage resistor instead. These can also burn out.

An ohmmeter check on the primary of the loudspeaker transformer is also advisable as these can give trouble too.

While some readers may consider so many checks and replacements to be unnecessary, keep in mind that most old radios were banished to the shed decades ago because something went wrong and the set stopped working. To plug such a radio into a power point and expect it to go some 20 years later is asking a bit much. On the other hand, a couple of simple checks and a few routine replacements will bring most valve radios back to life once again.

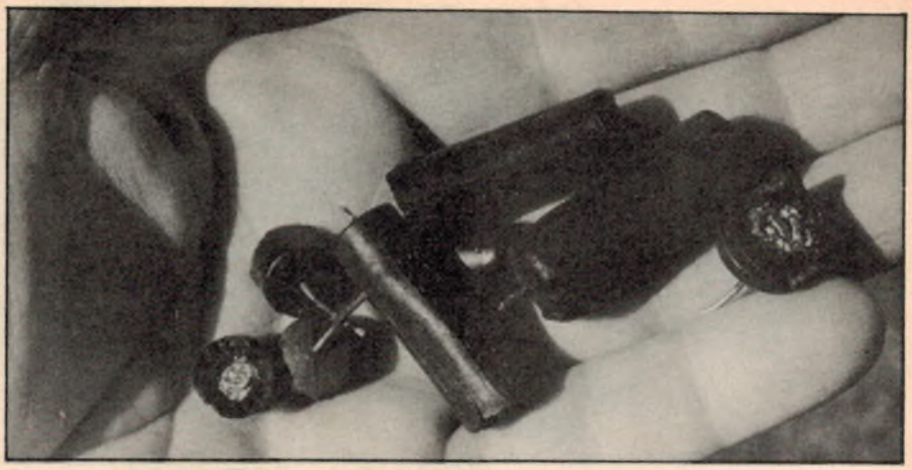
One of my own sets recently demonstrated the importance of this procedure when I chose to ignore my own advice.

This particular radio is an STC Console model with a "magic eye" tuning indicator. Having never seen a tuning indicator in operation, I switched on the set to see if it worked.

The dial lights came on which looked promising, but as no sound was forthcoming I peered into the back of the set to see if there was anything abnormal. Abnormal! The anodes of the rectifier valve were glowing red hot!

As you can well imagine, there was great haste to turn the set off and, as yet, the trouble has not been investigated. However, I'm sure it will be a case of replacing ALL the paper capacitors and electrolytics when the time comes to restore it.

So take my advice — plugging in an unchecked valve radio is asking for trouble.



Paper capacitors of AWA manufacture often split or blow their ends off when they short circuit.

Although restoring valve radios is an interesting and rewarding hobby, perhaps this article should close with a word of warning.

Always keep in mind that some of the voltages beneath the chassis of a valve radio are lethal and could result in some unsuspecting restorer's early demise. In other words: be careful or you may end up dead! There are even a few AC/DC sets around with live chassis — so beware!

In fact, it is a good idea to steer well clear of transformerless sets unless you know exactly what you are doing.

Remember, always switch off the power, pull the cord and discharge the electrolytics before working on a set. Simply switching off isn't good enough in some instances.

Normally, an electrolytic capacitor discharges itself within a few seconds of switching off, but if the high tension choke (or loudspeaker field coil) is burnt out, then there is nowhere for the charge to go until a path is provided for it to follow. As such, a capacitor could have a potential of around 400V, so it is wise to treat it with respect.

An insulated clip lead fitted with a series 10kΩ 5W resistor can be used to discharge the electrolytics. Do not directly short the capacitor terminals together with a screwdriver or clip lead — you could fuse the internal wires running to the terminals of the capacitor if you do.

This article on valve radio restoration has concentrated mainly on repairs of an electronic nature, but there are other problems facing the vintage radio restorer. Some radio components, such as dials, desperately need mechanical repairs, while the cabinets also require attention. More about such things in the next article.

Vermin, namely rats and mice, can do considerable damage to old radio components. A thorough checkout before plugging the set into the mains will detect such hazards.

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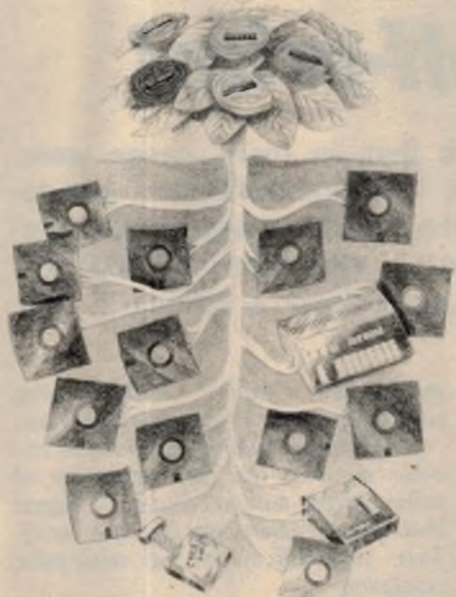

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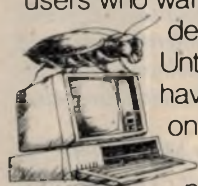

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FORUM

Conducted by Neville Williams

Audiophiles are not all half-wits!

Faced with quite a few letters that, in many cases were written during the holiday break, I am somewhat at a loss to know where to begin. Perhaps the logical starting point is one from a reader in Macgregor, ACT, who "blew his top" on Christmas eve when he saw Leo Simpson's editorial in the December issue.

As will be evident from the letter, I apparently compounded his black mood by remarks in the "Forum" column of the same issue, which tended to put the damper on claims dear to the heart of audiophiles in the "golden ear" set.

With some abbreviation to conserve space, the letter runs as follows:

Sir,

Having read the editorial by Leo Simpson in the December issue, I am appalled at the arrogance and the cavalier attitude displayed in his "truth about turntables" diatribe.

First, he (conveniently?) misrepresents the view of analog audiophiles, who have NEVER claimed turntable superiority in the areas of surface noise, feedback and other related afflictions; indeed, it is the very superiority of CD in these areas which makes its musical inferiority so frustrating!

Fair go — we're not all half-wits!

The area of audiophile contention concerns the audible effects of digital processing on the musical signal, particularly at high frequencies, which affect the harmonic content and spatial information.

Surely I do not need to explain all that here. It has been the topic of intensive investigation and debate for several years in the better specialist (ie, serious) audio publications — with considerably more competence in the field than an electronics magazine.

Elsewhere, in the same issue ("Forum") we find the implication that the enthusiast who spends large sums of money on "exotic" interconnecting cables is living in a land of self-delusion.

Rather than becoming involved in another argument on the inadequacy of some current test procedures, I suggest that, if you cannot hear any of these effects, your hifi system has inadequate resolution.

The editorial has caused considerable offence among local audio enthusiasts. Calling people stupid is hardly an objective comment. Calling people liars because they hold a viewpoint different from your own is an intolerable abuse of a privileged editorial position. I am diverting my magazine expenditure elsewhere.

My guess, on reading M.B.'s letter, is that he has lost patience, not just with Leo Simpson but with technical types generally who question his firmly held beliefs and, by implication, further investment in analog phono equipment. He was especially incensed, however, by what he regards as Leo Simpson's "arrogance and cavalier attitude".

On the other hand, I would interpret Leo's remarks as an indication that he had become no less exasperated by statements orchestrated by entrenched audiophile interests, which he judged to be inspired more by commercial expedience than technical accuracy. Perhaps Leo's main "sin" was that he expressed in such a forthright manner a viewpoint currently shared by most technically qualified audio professionals.

I say this because, over the years, I have found very little sympathy amongst academics and audio engineers for many way-out claims promulgated for — and by — the "golden-ear" fraternity. They tend to be dismissed in much the same way as the claims of the flat-earth group!

At the same time, I should perhaps make the point that technical qualifications and musically educated ears are not mutually exclusive.

The letter in close-up

I have no wish to get involved in a slanging match with M.B. but I do have some difficulty with the contents of his letter.

Analog audiophiles, he says, have NEVER (his emphasis) claimed turntable superiority in the areas of surface noise, feedback and other related afflications. I don't see how they could and I doubt that Leo intended to imply that they did. They tend, simply, to make ambit claims which (conveniently?) omit any reference to the abovementioned shortcomings.

I could quote, for example, from the articles on up-market phono players already mentioned in the February issue (David Frith, "The Guide", Sydney Morning Herald, Oct. 13 & 20):

"Most hifi specialists still insist that a well set-up analog LP system sounds better than the digital system".

"Any of the turntables mentioned in this column when properly set up with a quality cartridge, is capable of outperforming a compact disc player".

It so happens that the two articles appeared about the time Leo Simpson would have written his December editorial. Whether or not they helped to provoke it I wouldn't know but they apparently managed to provoke quite a few other SMH readers. David Frith mentions in the January 12 Pink Guide that he had copped a lot of flak because of what he had written. I quote:

"For days the phone didn't stop ringing, and bitter indeed were the denunciations from the CD fans . . . You're in the turntable manufacturers' pocket, &c".

He goes on to say that he doesn't retreat for one minute from the views previously expressed, but he does restate them in the following terms:

"A top quality turntable, well set up with a good quality cartridge and tonearm, playing an LP in good condition, can certainly extract finer musical detail than most CD players. If you doubt this, walk into any good hifi store and ask for a demonstration of one of the abovementioned turntables".

Definitely not a half-wit audiophile!

The modified statement parallels M.B.'s reference to the "musical inferiority" of the CD system which he attributes, in turn, to "the audible effects of digital processing on the musical signal, particularly the higher frequencies, which affect harmonic content and spatial information".

I find this very interesting because, from small beginnings in the late '70s, virtually all performances for CD, LP and tape alike are now recorded and processed on digital mastering equipment.

Curiously, this seems not to have rated a mention either by M.B. or any of the suppliers interviewed by David Frith. There is no hint that digitally mastered LPs are in any way suspect!

You can take your pick of the questions which would seem legitimately to follow:

- Why would the world audio industry, employing an army of musically informed engineers and producers, spend a fortune re-equipping with digital equipment, if they had reason to believe that it was likely to prejudice the intrinsic musical quality of all future recordings? Are they the real half-wits?
- If it is assumed that digital processing, per se, does compromise musical quality, as per M.B.'s letter, are we to believe that digitally mastered LPs somehow escape "musical inferiority" provided they are replayed on prestige analog equipment?
- If digitally mastered LPs are not musically inferior when played back on prestige analog equipment, is M.B.'s real quarrel with digital processing as employed in the CD format? If so, where lies the problem?

If there is a convincing positive answer to that last question, I have yet to see it. Mind you, if I were in M.B.'s shoes, I could contrive a suitably mischievous theory — without any known basis in fact, or even a conviction that there is a situation that needs to be explained!

How does this sound?

While the sampling parameters of hifi digital systems are all much of a muchness, the more ambitious record/playback equipment uses multiple tracks for each channel, with automatic switching in the event of a fault. (See DASH format, Nov. 1986 issue, p.78, col.1).

The CD system, however, has only one data stream to serve both channels, backed up by highly effective error detection circuitry capable of correcting or concealing disontinuities in the data stream that might otherwise be heard as clicks or plops.

Could it be that CD technology relies too heavily on correction circuitry, particularly in the case of discs and/or players with more than their fair share of data stream errors?

Could it be that, in the process of effectively concealing an excessive number of errors, it also conceals an excessive quota of high frequency signal information?

Let me repeat: I didn't read this anywhere; I dreamed it up for the occasion, but it's no more way-out than some other notions dreamed up by audiophile theorists.

And that brings me to the next point in M.B.'s letter.

"Intensive investigation"

He assumes that the alleged audible ill-effects of digital processing are so well documented as not to warrant further explanation. I quote:

"It has been the subject of intensive investigation and debate for several years in the better specialist (ie. serious) audio publications: publications with considerably more competance in the field than an electronics magazine."

Debate? Yes. Investigation? That's a matter of opinion!

My mind goes back to the late '70's when we began reviewing the first digitally mastered LPs to reach Australia. We were impressed and we said so. Many readers bought pressings and liked what they heard. Others were dubious about the whole idea, especially when that view was encouraged by some (not all!) of the so-called "specialist" audio magazines.

Some record and equipment vendors were so keen for me to get the anti-digital message that they sent me endless photostat copies of articles, clippings and circulars containing statements that were unsupported and, I suspect, unsupportable.

That has long been the problem for those "better (ie. serious) audio publications". They latch on to speculative ideas, which gain substance through literary feedback, until they are accepted as fact — often without a shred of objective evidence.

You may possibly have noticed a letter from R.S. of Lae, PNG (Forum, Feb) which made this very point. I quote:

"You must also have been amazed by the observations and reviews published in certain British audio magazines. In the period from the introduction of CD in 1983 to late 1984 there was a torrent of emotional opinion but, in the reviews, nary a measurement".

There is most certainly a place for speculation in hifi sound reproduction and for subjective reaction but, without reasonable checks or balances by way of basic theory or objective evidence, it/they can get completely out of hand. (Sotto voce): They can also be exploited!

"To be or not to be . . . "

Towards the end of his letter, M.B. criticises "Forum" in the December issue. In it, I referred to the fact that, in subjective A-B comparison tests, it was essential to ensure that the respective signals were at the same sound pressure level, otherwise there was a risk that the louder signal would be adjudged the better of the two.

I mentioned a recent finding that a difference margin of even 0.2dB was unacceptable. This was an interesting figure, because calculation showed it to be somewhat less than the difference in level to be expected between standard and super low-loss loudspeaker cables.

Unless it was taken into account when setting up a subjective test, the low-loss cables could be given the verdict simply because the marginal difference in loudness created an impression of better sound. As such, I suggested that it would be "a rather expensive alternative to an almost imperceptible clockwise nudge to the volume control".

To the best of my knowledge, that is a supportable statement. M.B. can reject it if he wants to; it's his money.

In the matter of syndromes, I too have been misrepresented but I can sug-

FORUM – continued

gest a compromise proposition to which I'd be willing to subscribe:

If you think that you can hear it,
It may be worth a shout;
But until it's been measured
There'll always be a doubt!

From West Malaysia

A reader, MOYK, from West Malaysia, whom I would take to be a professional engineer, also comments on the December Forum. However, he appears to have completely misread my remarks about special quality audio cables.

He says: "The concept you had was that a low loss cable will increase the output signal level arriving at the input of an amplifier which in return contributes to better sound."

In fact, the article had primarily to do with loudspeaker cables. The key paragraph in column 2 explicitly says:

"Calculations suggest that ordinary loudspeaker cables typically introduce a loss in level of about one quarter of a decibel in an 8-ohm circuit compared with nominally loss-free heavy duty cables."

The point being made was that in a subjective A-B test situation, using a common amplifier and common loudspeakers with inter-cable switching, the difference in sound pressure level could amount to 0.25dB or more — a totally unacceptable figure according to DLC Design Inc.

Small-signal amplifier input cables were mentioned once only, in column 3, in an entirely separate context.

While at odds over cables, the same correspondent "absolutely" supports my observations in the same issue on the subject of valve amplifiers. He concedes that valves have a "softer" overload characteristic than transistors but says that, in other respects, "valve amplifiers are no match for a modern, state-of-the-art solid-state amplifier."

Subjective frequency response

Getting back to the original theme, the stated subjective reaction to a loudness increment has been accepted as a truism worldwide and for decades. Curiously, however, I cannot recall ever having seen it explained in detail. To some degree, a least, it would appear to have its roots in the Fletcher-Munson equal loudness contours (Bell Laboratories, 1933) and subsequent parallel research, including work by Pollack using narrow band noise in lieu of discrete tones.

The curves all indicate that, at very low sound pressure levels (faint sound), human hearing is most sensitive in the 2-4kHz region. For equal loudness at other frequencies, the SPL (sound pressure level) needs to be increased by as much as 65dB as the frequency diminishes towards 30Hz. For the higher frequencies, the SPL needs to be increased by up to 20dB.

As the sound source becomes louder, the disparity between low/medium/high frequencies diminishes progressively, with aural response becoming reasonably uniform overall at sound pressure levels above about 80dB.

That it is essentially an acoustic/aural effect can be illustrated by reference to an outdoor brass band concert. From a distance, the sound is faint and "thin" but, as one walks towards the rotunda, the low frequencies and the higher order harmonics become progressively more evident until, close by, normal overall sonic balance is realised.

In the context of hifi sound systems, technical writers have commonly made the point that the most natural listening conditions obtain when the volume control is so adjusted that the sound pressure level at the listener's ears is similar to what it would be if he/she were seated in the audience at the original performance. Assuming that the amplifier chain has a substantially flat response, the subjective balance of the original and reproduced sound should then be similar.

If, on the other hand, the SPL at the listener's ears is substantially below optimum, the bass and to a lesser extent the upper treble will be subjectively weaker. Conversely, an unduly high level can have the reverse effect, with male voices in particular tending to sound unnaturally heavy.

The subjective frequency imbalance which results from an inappropriate SPL at the listener's ears has been described over the years in technical literature as "scale distortion"; eg, "Radiotron Designer's Handbook" (F. Langford Smith, 3rd. Ed., 1940); "Audio Cyclopedia" (H.M. Tremaine, 2nd. Ed., 1975). In his "High Fidelity Pocket Book" (Newnes, 1962), W.E. Pannet uses the term "volume distortion" to mean the same thing.

Scale (or volume) distortion becomes a fact of life in domestic listening situations, when the volume level needs to be severely restricted out of consideration for other members of the household.

To help compensate for the subjectively less vital sound, amplifiers often include loudness compensation circuitry, either integral with the volume control or controlled by a separate switch. Its purpose is to boost the bass response and to a lesser extent the treble whenever the equipment is operating, of necessity, at an unnaturally low volume level.

A-B test situations

Logically, any discrepancy in the SPL of two signals being subjectively compared must be responsible for some difference in the subjective bass and treble response — therefore in the potential quality of the two signals.

On the other hand, it could be argued that with an SPL discrepancy diminishing to a small fraction of a decibel, subjective frequency variations of the Fletcher-Munson kind would be microscopic.

Perhaps the most we can say is that any difference in frequency balance that might be picked up by an astute observer will be to the advantage of the louder signal.

Over and above that, the louder signal will have an advantage in terms of ambient noise, especially in respect to the fainter, more delicate stanzas. By ambient I am referring to the noise in the listening room and the physiological noise in the listener's own ears — especially where tinnitus may be present.

And, finally, there is the simple matter of magnitude of the sound, or the tendency for a larger sound to be more dominant, more arresting than a smaller one.

These statements don't sound very decisive? I agree. Under ordinary listening conditions a dB this way or that wouldn't matter two hoots. But remember that, under A-B test conditions, things are set up to expose the smallest differences. No less to the point, the participants are often under psychological pressure to record definitive verdicts — hopefully without inventing them!

I happen to know this from first-hand experience, having sat through quite a few such sessions, here and overseas, when my ears were younger and more acute.

Come to think of it: if you're on the lookout for an audio research project, this whole area could be worth considering.

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All that you ever wanted to know about professional video production but were afraid to ask! Divided into 4 parts - preproduction, production, post production plus other important topics i.e. editing - you are guided slowly thru each phase of the art.
Approx 400 pages.
Cat. BS-0727 **WAS $39.95**

NOW $19.98

ATARI GAMES & RECREATIONS

For beginners and advanced programmers as well.Learn to program in BASIC while you work with your own Atari 400 or 800. Play many challenging educational games and learn to create programs of your own.
338 pages
Cat. BS-0656 **WAS $23.95**

NOW $11.98

HOW TO MICROCOMPUTERISE YOUR BUSINESS

This book takes the mystery and technicality out of computers - making your decisions about computerisation as rational and intelligent as any other business decision you make. Explains how computers can help you run a more efficient, more profitable business.
182 pages.
Cat. BS-0680 **WAS $15.95**

ONLY $7.98

INTRODUCTION TO THE NEW TECHNOLOGY

144 page book describing subjects such as teleshopping, telebanking, electronic mail and many more forms of electronic communication. There is also a section on lasers.
Cat. BU-1200 **$9.95**

CABLE TV

Designed for the engineer or technician wishing to improve his knowledge of cable TV. Component testing, troubleshooting, noise reduction, and system failure are discussed. Contains valuable information on the relatively new areas of fibreoptics and communications satellites.
392 pages.
Cat. BS-0560 **WAS $21.00**

ONLY $10.50

MICROCOMPUTER FOR BUSINESS APPLICATIONS

This book describes different types of micros, highlights pitfalls and explains computer related terms. If you are the potential buyer of a business computer system, this booko will prove invaluable in helping you select the best system. A must to read before "plunging".
256 pages
Cat. BS-0602 **WAS $15.95**

ONLY $7.98

INTRODUCING THE APPLE MACINTOSH

Introduces you to the design philosophy and physical structure of the Mac, and explores its displays, keyboard, mouse, software and accessories. Covers graphics, word processing, spreadsheets, BASIC and windowing and discusses how the Mac fits into an office system.
192 pages.
Cat. BS-0714 **WAS $21.95**

ONLY $10.98

HOW TO READ SCHEMATICS

4th Edition

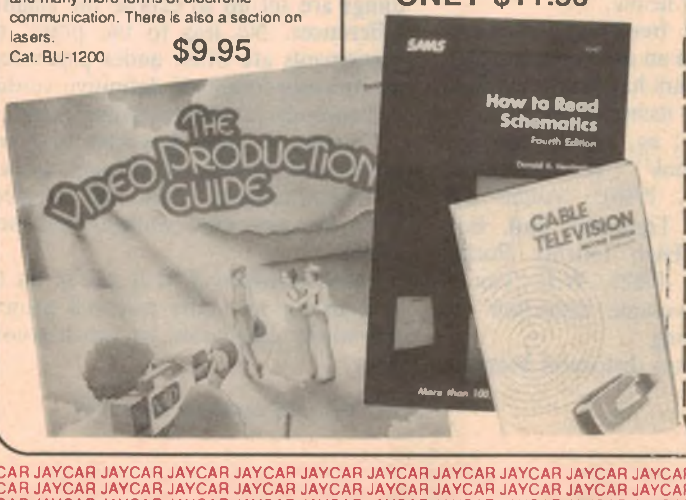
Explains circuit components and how they are represented in schematics. Then explains common circuit configurations such as emitter-followers, basic common circuits, etc. Essential if you want to understand schematics.
258+ pages
Cat. BS-0730 **WAS $27.50**

NOW $13.75

VIDEO FUNDAMENTALS

This book is for all who want to learn about video taping. Topics covered include: How a recorder works; How to choose a VCR; How to playback videotapes; Sound advice; How to add a camera; Lighting techniques; How to make your own videotapes; How to add a second VCR; How to take care of your equipment & Video formats.
186 pages
Cat. BS-0646 **WAS $22.95**

ONLY $11.50



TO CELEBRATE the RELEASE of our BRAND NEW CATALOGUE we have SLASHED the PRICES of many of our BEST SELLERS - but ONLY for APRIL, SO BE QUICK

NEW 1987 CATALOGUE

The new Jaycar 114 page Engineering Catalogue was released last month in Electronics Australia and Electronics Today.
If you don't have one yet there are two things you can do.
(1) Call in to any one of our retail showrooms and pick one up, they are only $1.00.
(2) Send $1.00 plus $1.00 for P&P to Jaycar Electronics, P.O. Box 185 Concord 2137 and we'll post you a copy.

YOU WON'T BE SORRY!

Giant EASTER SHOWBAG

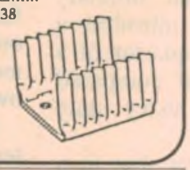
Back again for the 6th year! Once again we have a JUMBO bag weighing an average of 2.5kg! Each bag is slightly different but certainly contains an unbelievable assortment of electronic components, electronic hardware and much, much more!
We are certain that you will be absolutely delighted with this incredible addition to your junk box!
Cat. XB-9000 **$12.95**
Quantities strictly limited - personal shoppers only due to heavy weight.

TO-3 HEATSINK *Special*

Usually $1.95

We have made a bulk purchase of TO-3 minifin heatsinks. Size 38 x 38 x 26mm(high)
Cat. HH-8509
APRIL ONLY

1-9	$1.25
10-99	$1.10
100 up	$1.00

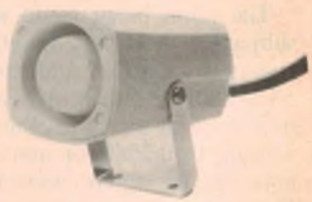


EVER POPULAR TWEETY PIE DISCOUNTED

This incredibly little piezo screamer measures 57(L) x 33(H) emits a 116dB wail. It's deafening! As used in the screamer car alarm kit.
Cat. LA-5255

Usually $16.95

APRIL ONLY **$15.00** SAVE $1.95



TURN YOUR SURPLUS STOCK INTO CASH!!

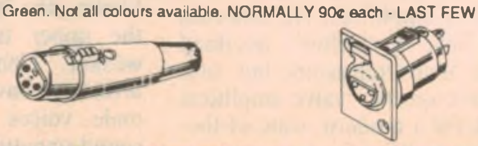
Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.
CALL GARY JOHNSTON OR BRUCE ROUTLEY NOW ON (02) 747 2022

GENUINE CANNON — *At 1812 Prices*

SAVE ON CANNON CONNECTORS

Description	Cat. No	Normally	Special	10 UP
3 pin Chassis Male	PP-1020	$4.25	$3.25	$3.00
3 pin Line Male	PP-1024	$5.25	$4.00	$3.75
3 pin Chassis Female	PS-1030	$5.95	$4.75	$4.50
3 pin Line Female	PS-1032	$5.50	$4.50	$4.25

We also have a quantity of Cannon coloured boots. Available in Red, White, Yellow, Blue and Green. Not all colours available. NORMALLY 90c each - LAST FEW at 40c each.



ETI 684 INTELLIGENT MODEM

Ref: ETI most of 1986
This is a full blown auto dial - auto answer - full duplex intelligent modem.
The Jaycar kit for the complete project comes as two components viz:

Modem	Cat. KE-4715	$379.00
Power Supply	Cat. KE-4716	$ 49.95
	TOTAL	$428.95

BUY BOTH FOR $379.00
SAVE ALMOST $50.00

For full specifications see the Jaycar 1987 Catalogue

CONCORD OPEN SATURDAYS 9am - 12 NOON

SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE

WORLD CLASS ADCOLA SOLDERING DESOLDERING STATION

See our new catalogue for full details

POWER CONTROLLER
Cat. TS-1475
(no iron or desolderer supplied)

$139.50

40 WATT SOLDERING PENCIL CT-6 Cat. TS-1478

$39.95

80 WATT SOLDERING PENCIL CT-7 Cat. TS-1480

$42.50

DESOLDERING TOOL
Cat. TS-1476

$59.95

BONUS: Purchase this soldering station in April and receive 2 rolls of solder FREE.

JAYCAR JVE-1 VIDEO DETAIL ENHANCER

MADE IN AUSTRALIA

Connects between 2 VCRs to improve the quality of a recording of an original tape. 625 line PAL-D 50 frame unit. Can be used as a distribution amplifier.
Cat. AV-6501
FULL DETAILS IN 1987 CATALOGUE.

APRIL SPECIAL
FREE PLUGPACK WORTH $12.95
(Cat. MP-3020)

ONLY $79.95

ECHO CHAIN

NEW FOR '87

Also known as a keyfinder. Put it on your keyring and when you want your keys - just whistle and it will whistle back to you. These were selling for as much as $15. We have a limited quantity to clear out for only $3.95 each.
This is less than half what you would expect to pay.
Cat. XM-0900

$3.95 each

METEX BARGAIN

10 AMP DIGITAL MULTIMETER + TRANSISTOR TESTER + CAPACITANCE METER

LOOK AT THESE FEATURES:
0.5" high digits ■ high quality probes supplied ■ LED and buzzer continuity test ■ precision thin film resistors used for long term stability ■ CMOS logic ■ 1,000 - 2,000 hours battery life ■ fuse protection ■ Complete with battery and spare fuse ■ floating decimal point ■ auto polarity ■ impact resistant case

FOR FULL SPECS SEE THE JAYCAR 1987 CATALOGUE Cat. QM-1540

SAVE $20.00
APRIL ONLY
ONLY $109.00

SOLAR POWER 150 EXPERIMENTS

This experimenters kit enables the enquirer to verify many of the fundamental physical aspects of solar energy. The 150 experiments include: solar furnace, stroboscope, electroplating, electronic thermometer, solar powered fan, etc. Includes all necessary components for all experiments. Does not require batteries. Gift boxed - measures 410(W) x 305(D) x 85(H)mm. For ages 10+.
Cat. KJ-6692

USUALLY $39.95
NOW ONLY $29.95
SAVE $10.00

SAVE ALMOST 50%

ALARM STICKERS

Large 125mm x 75mm
Suitable for house, factory, caravan, etc. Will stick on the outside, i.e. sticky on the back.
Cat. LA-5102

NORMALLY $1.95 ea

SPECIAL 5 for $5.00
SAVE $4.75

SMALL 73mm x 33mm
Specifically designed for cars. Sticky on the front so you can stick them on the inside glass. Thieves will not know whether you have an alarm or not!
Cat. LA-5100

NORMALLY 95¢ each

SPECIAL 10 for $5.00
SAVE $4.50

WE'RE OVERSTOCKED MAGNAVOX 8MV-003

8/30 replacement

Update your 8/30 speaker boxes today and turn them from 30 watt rms system speakers into a 120 watt system!
These are direct replacements and fit into the 8/30 cutouts.
Resonant frequency 31Hz; range from fo to 4kHz. Sensitivity 95dB.
Cat. CW-2110

NORMALLY $89.50

SAVE $20.00
ONLY $69.50 ea

LIGHT DEPENDENT RESISTORS

$8.50 ea
10+ $8 ea

Quality Philips brand.
Epoxy housed, vertical or horizontal mount.
Dark resistance min 10M ohm
Light resistance 30-300 ohms
Cat. RD-3480
FULL SPECS IN CATALOGUE

AUSTRALIAN MADE MAGAZINE BINDER NOW IN STOCK!

Re-designed to really hold your magazines in comfort. Uses holes instead of slots to hold your mags. Will easily hold 12 issues of your magazines but can accommodate more if necessary.
SEE OUR NEW CATALOGUE FOR MORE DETAILS
Cat. BB-7000

$7.95 ea
10+ $7.50 ea

ATTENTION ✸ ✸ BONAX WIRELESS ALARM SYSTEM OWNERS

We have a small quantity of components left to suit the Bonax Alarm system.
This is an ideal time to add that other siren. All you need do is plug it in the mains and mount it somewhere. Normally $99, we have 11 only at $50 each. We also have two control panels reduced from $299 to $100. This stock is available only through Mail Orders. Phone (02) 747 1888

SOLDER REEL

200 gram reel. 1mm universal gauge. Suitable for all types of electronic soldering.
Resin cored and includes bit saving additive.
Cat. NS-3010

NORMALLY $7.95 reel

$6.50 reel
$5.50 ea 5 reels

SAVE UP TO $2.45

SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE

JAYCAR FOR CLASS 1 KITS

FIBRE OPTIC EVALUATION KIT

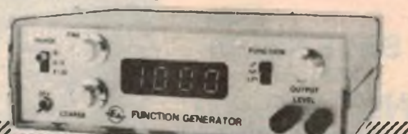
The EDU-LINK kit is a fibre-optic evaluation system consisting of TTL compatible transmitter board IR LED, one metre of fibre optic cable, photodiode and TTL compatible receiver board. The fibre optic connectors are also included. Full instructions - Ideal for engineers, students and hobbyists as a learning aid.
Cat. KJ-6520

ONLY $49.95

FUNCTION GENERATOR with DIGITAL READOUT

Ref: EA April 1982
This attractive unit produces sine, triangle and square waves over a range of 160kHz to below 20Hz. Low distortion and good envelope stability. Built-in 4 digit frequency counter for ease and accuracy of frequency setting.
Cat. KA-1428

ONLY $119.50



ETI TEMPERATURE PROBE FOR MULTIMETERS

Ref: ETI June 1983
Simple add-on device extends your multimeters capability to measure temperature. Ideal for digital meters. Range from -55 to +150 degrees C or better.
Cat. KE-4033

ONLY $27.95

DIRECT INJECT BOX

Ref: "Sonics"/ETI Sept 1985
This unit transforms an unbalanced signal to a balanced one.
Full specs 1987 Jaycar Catalogue.
Cat. KE-4708

ONLY $42.50

8 SECTOR BURGLAR ALARM

Ref: EA Jan/Feb 1985
Costs a lot less than often inferior units. A unique feature is its ability to have N/O and N/C sensors on the same line.
All parts supplied including 4 bonus deterrent stickers.
Cat. KA-1582

ONLY $135.00

THE 'LISTENING POST'

Ref: AEM July 1985
This device attaches between the audio output of a shortwave receiver and the input port of a computer. It allows decoding and printing out of morse code, radioteletype (RTTY) and radio facsimile (FAX) pictures.
Cat. KM-3015

$39.95

STEREO LOUDSPEAKER PROTECTOR

A must for all high power amplifiers. Measures 85(W) x 55(D) x 35(H)mm and draws very little current at 12V DC.
Cat. AA-0320

ONLY $22.95

"SCREECHER" CAR ALARM

SCARE THE PANTS OFF WOULD BE THIEVES!

This unit is fitted under the dash-board of your car. When a thief breaks in (after entry delay) an unbelievably shrill alarm goes off - INSIDE THE CAR.
The thief will be scared witless by the deafening noise of a demented 110dB monster canary - exit thief!
The Jaycar kit includes the special high power piezo siren, dash lamp, etc.
Cat. KA-1675

ONLY $32.50 - 1,000's sold

ETI 1406 PARAMETRIC EQUALISER MODULE

Ref: ETI August 1986
This individual module can be used on its own or ganged to equalise a whole system. 'Parametrics' can be made to tune around a centre frequency.
For specifications see kit section of Jaycar's 1987 Catalogue.
Cat. KE-4724

ONLY $23.50

ETI 1532 SOLDERING IRON TEMEPRATURE CONTROLLER

Ref: ETI September 1986
Save the cost of buying an expensive temperature controlled iron by building this kit. Simply plug your iron into the unit and you're into TC soldering!
The Jaycar kit includes all parts and the case.
CatKE-4725

ONLY $35.00

UPGRADED DIGITAL CAPACITANCE METER

Ref: EA August 1985
This is the improved version of the very popular March 1980 design. The new high impact plastic case, 4 digit display and ability to realistically measure from 1pF to 99.99uF. No adjustments are necessary, you simply connect the capacitor to the input terminals.
Cat. KA-1595

ONLY $85.00

AEM 4600 DUAL SPEED MODEM

Ref: AEM December 1985
This project enables you to construct a modem that operates at either 300 Baud full duplex or 1200/75 Baud half duplex (i.e. CCITT V.21 Orig; CCITT V.21 Ans; CCITT V.23 (mode 2) Orig & CCITT V.23 back) for a fraction of the cost of equivalent built units.
Cat. KM-3040

ONLY $169.00

30+30 WATT STEREO AMP

Includes pre-amp. Fully built and tested.
Transformer to suit MM-2010 $22.50
Cat. AA-0300

ONLY $49.95

80+80 WRMS PRE-MAIN AMP

Complete pre-amp and high power amp. Size: 245(W) x 240(D) + heatsink 130(W) x 75(D) x 70(H)mm.
Cat. AA-0310

SAVE $25

ONLY $124.95

SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE

PASSIVE INFRA RED DETECTOR

WITH PULSE COUNT TRIGGERING

NEW FOR '87

The absolute latest technology is used in this PIR. It employs a pulse count triggering circuit which virtually eliminates false alarms. The circuit first senses an alarm (pulse 1) and then goes into an alarm standby mode for 30 seconds. If during this period a second alarm event occurs (pulse 2) the unit goes into alarm mode and the standby period is extended a further 30 seconds. If there is no alarm pulse during this 30 seconds the unit returns to normal condition. Also suitable for single shot triggering. FOR FULL TECHNICAL DETAILS SEE THE NEW JAYCAR 1987 CATALOGUE - AVAILABLE NOW

Cat. LA-5019

$139.00

TELEPHONE CALL DIVERTER

ONLY $199

This unit enables you to divert an incoming phone call to another location. The diverter will divert either line (2 lines required) or will divert only one incoming line. There are many other features which you will find out about this unit in THE BRAND NEW JAYCAR 1987 CATALOGUE - OUT NOW.

Cat. YT-6510

NEW FOR '87

BRAND NEW DPM's

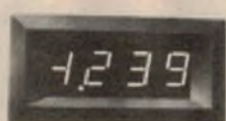
SEE THE JAYCAR 1987 CATALOGUE FOR FULL SPECIFICATIONS

DPM 40
3 1/2 DIGIT LED DPM
Cat. QP-5542
$79.95

DPM 125
3 1/2 DIGIT ULTRACOMPACT
Cat. QP-5500
$75.00

NEW FOR '87

DPM 600
3 1/2 DIGIT BANDGAP REFERENCE DPM
Cat. QP-5516
$89.95

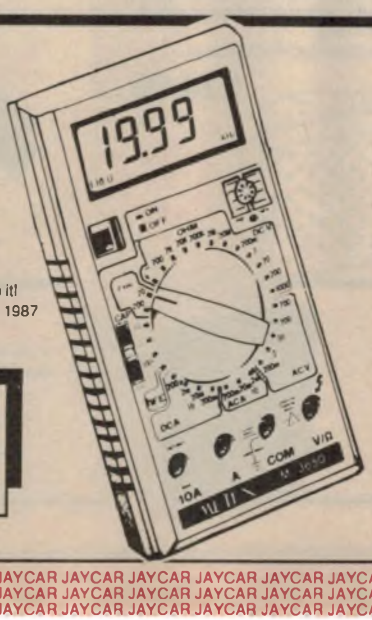


FREQUENCY COUNTER DMM + CAPACITANCE METER + TRANSISTOR TESTER +20 AMP CURRENT + HIGH IMPACT CASE

Bright yellow case so you won't lose it! Fantastic specifications (see Jaycar 1987 catalogue) and a delight to use.

Cat. QM-1555

ONLY $169.00

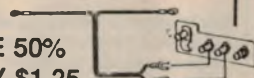


FM INDOOR ANTENNA

Simple ribbon type antenna for strong signal areas. 300 ohm termination.

Cat. LT-3002

NORMALLY $2.50
SAVE 50%
ONLY $1.25

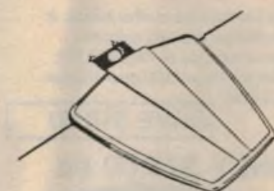


CARAVAN TV AERIAL

Suitable for car, caravan, boat. Designed for UHF, VHF and FM. Built-in masthead amplifier. Complete with cable and plug.

Cat. LT-3120

SAVE $30.00
NOW ONLY $69.50



PENLIGHT NiCads

Don't waste money - buy rechargeable NiCads.

SUPERB ROCKET BRAND AA PENLIGHT 450mA

Cat. SB-2452

$3.50 ea OR
4 for $12.00

STD/ISD PHONE CALL PREVENTION MODULE

Connect in series with your phone turn the keyswitch and you can make STD/ISD calls - turn the key and remove to prevent unauthorised calls.

Cat. YT-6540

$29.95

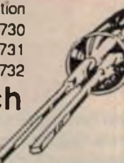
NEW FOR '87

FLASHING LEDs

all 5mm, 5 volt operation

RED	Cat. ZD-1730
GREEN	Cat. ZD-1731
YELLOW	Cat. ZD-1732

$1.50 each
10 or more
$1.35 each



LED MOUNTING CLIPS

Hewlett Packard Brand Black with interlocking collar. Suit 5mm LEDs.

PACK OF 20
Cat. HP-1102
$1.50

PACK OF 100
Cat. HP-1103
$5.00

IC SOCKET PACKS

The economical way to purchase quality tinned IC sockets.

ALL PACKS OF 100 UNITS

	Pins	Price
PI-6478	8	$15.50
PI-6480	14	$16.95
PI-6482	16	$19.95
PI-6484	18	$23.95

MIXED PACK OF IC SOCKETS

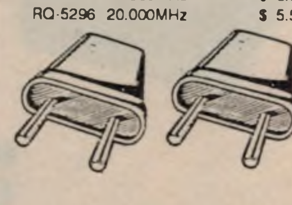
Consists of:
15 x 8 pin
20 x 14 pin
20 x 16 pin
10 x 18 pin
5 x 20 pin
10 x 22 pin
5 x 24 pin
5 x 28 pin
10 x 40 pin

Cat. PI-6490

PACK OF 100 UNITS
$37.00 VALUE FOR $25.95
APRIL ONLY TAKE 20% OFF ALL IC SOCKET PRICES SHOWN ABOVE

NEW LOWER PRICES ON CRYSTALS. . .

RQ-5260	1.000MHz	$14.95
RQ-5264	1.8432MHz	$ 9.50
RQ-5268	2.000MHz	$ 8.50
RQ-5269	2.4576MHz	$ 8.50
RQ-5271	3.000MHz	$ 5.50
RQ-5272	3.5795MHz	$ 4.00
RQ-5274	4.000MHz	$ 5.50
RQ-5277	4.433619MHz	$ 5.50
RQ-5280	4.9152MHz	$ 5.50
RQ-5283	5.000MHz	$ 5.50
RQ-5285	8.0000MHz	$ 5.50
RQ-5286	8.867238MHz	$ 5.50
RQ-5289	10.000MHz	$ 5.50
RQ-5291	10.695MHz	$ 1.95
RQ-5292	12.000MHz	$ 5.50
RQ-5294	16.000MHz	$ 5.50
RQ-5296	20.000MHz	$ 5.50



SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE SALE

Speaker Prices Slashed

5" MIDRANGE POLYPROPYLENE

Power handling 80 watts rms system into 8 ohms. Resonant frequency 600Hz and a sensitivity of 90dB/W @ 1 metre.
Cat. CM-2085

SAVE $9.50

ONLY $20.00 ea

FOSTER 8" WHITE CONE

Best 8" woofer we've seen. Looks great - sounds great. Ferrofluid 30 watts rms. Frequency response 50 - 3000Hz. Resonant frequency 50Hz. 99dB/0.5 metre SPL.
Cat. CW-2111

SAVE $7.00

ONLY $19.95 ea

FOSTER DOME TWEETER

DO25N25 model. System power 150 Watts rms. Resonance frequency 1.2khz. Frequency range 3kHz - 30kHz. 91dB/W @ 1 metre SPL.
Cat. CT-2018

SAVE $8.00

ONLY $24.50 ea

FOSTER HORN TWEETER

This tweeter is brilliant. It is very bright and crisp. Frequency range 5kHz - 40kHz. System power 100 Watts rms. 96dB/W @ 1 metre sensitivity.
Cat. CT-2016

SAVE $8.00

ONLY $24.50 ea

GRILLE CLOTH

High quality, acoustically transparent. Is ideal for all speaker cabinets. 1.5 x 1 metre roll. Colour black.
Cat. CF-2752

SAVE $3.00

ONLY $8.50

SPEAKER SEALANT

Special non-hardening sealing compound. Ideal for airtight seal between speaker drivers and cabinet. Essential for acoustic suspension designs. 2 metre roll.
Cat. CF-2762

SAVE $1.00

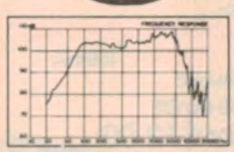
ONLY $1.95

PIONEER 12" GUITAR SPKR

Around half the price of other makes. A superb Pioneer unit. 100 watts rms, frequency response 80 - 4000Hz, SPL 100dB/0.5m. Huge 4,002 gram magnet.
Cat. CG-2380

SAVE $14.50

ONLY $75.00 ea

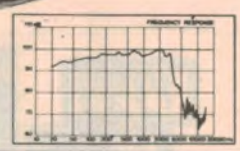


PIONEER 418 12" WOOFER

White cone and chrome surround with superb specs. A winner. 65 watts rms, frequency response 25 - 2500Hz, resonant frequency 25Hz. SPL 97dB/0.5m
Cat. CW-2121

SAVE $10.00

ONLY $39.50 ea



10" POLYPROPYLENE

Handles 70 watts rms system into 8 ohms. Resonant frequency 24.3Hz and frequency response of 24Hz - 6kHz. 91.9dB/W @ 1 metre. Electromagnetic Q = QES 0.398 and a peak cone excursion of 2 x/max 1.25mm.
Cat. CW-2116

SAVE $14.50

ONLY $55.00 ea

NEGATIVE AIR IONISER

The Country Air negative air ioniser was advertised extensively around a year ago for $200. We have bought the manufacturers distressed stock and can pass on massive savings to you! A high quality product.
Cat. YX-2902

SAVE A FURTHER $20 APRIL ONLY

ONLY $49.95

QUARTZ CRYSTAL CLOCK MOVEMENT

SUPPLIED WITH 3 SETS OF HANDS

Very compact unit (56mm square x 15mm deep) that can be used in your own design of clock face. Self starting one second stepping motor has strong torque. Powered by 1 x 1.5V AA battery that lasts around one year. Accuracy is ±15secs/month.
Cat. XC-0100

ONLY $12.95

FRIGI-FRESH

ELECTRONIC REFRIGERATOR DEODORISER

This unit automatically circulates the air in your fridge after each door opening. A special filter removes odours and circulates a fresh smell through your fridge. The unit turns off after 12 seconds. Uses 4 x AA cells (not supplied).
Size: 100(W) x 90(H) x 88(D)mm. Simply sits at the back of your fridge on a shelf.
Cat. YF-5522
Spare filters Cat. YF-5523 $3 ea

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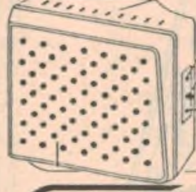

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Run your CD player from your car battery

12/240V inverter for portable CD players

Here's how to use your portable CD player in your car without having to rely on the limited capacity of rechargeable nicad batteries. This small 12/240V inverter has been specially designed to power portable CD players but can also be used for other mains powered devices which draw 15W or less.

by JOHN CLARKE

There is no denying it. Portable CD players are fantastic. They represent a mind-boggling concentration of high technology into a very small package. And even though their performance might not be up to the ultimate standards of conventional CD players, they are still streets ahead of any other hifi program source.

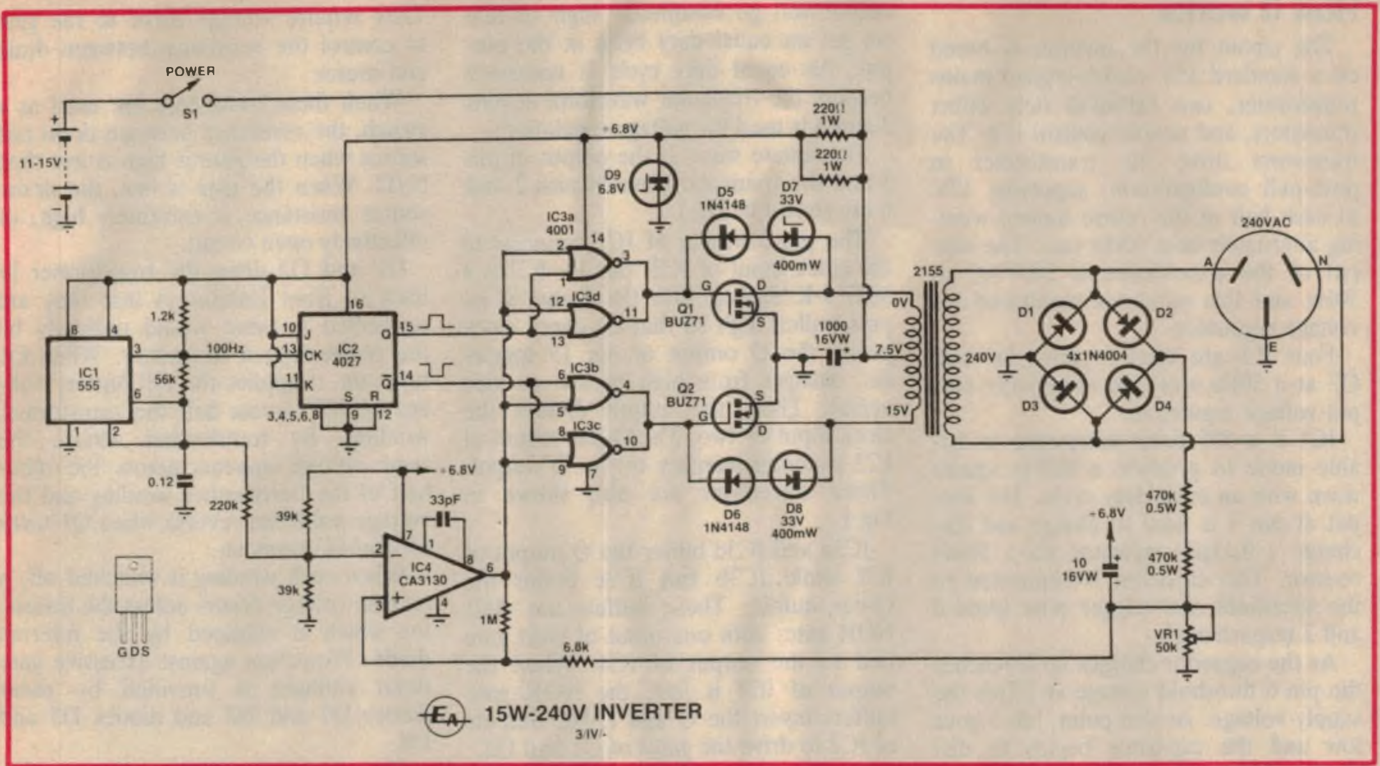
So it is not surprising that portable CD players are becoming so popular. They can be used virtually anywhere, on the run using headphones or at home, connected to the hifi system. However, their potential for use in the car has yet to be fully realised.

There are a number of problems in using a portable CD player in a car. First, unless you are a passenger, you can't use headphones. If you are the driver you could not even consider using headphones because you would be too isolated from the sounds of the road and surrounding traffic.

Second, there is the question of how you connect the CD player into your car's existing sound system. Unless they are new models, most systems make no provision for portable CD players. In the near future, more and more radio/cassette players will be fitted with jacks for connection of CD players.

Although the player can be operated using the internal rechargeable batteries of the CD player, it is far more practical to provide power via the car battery.

The new inverter can be used to power any portable CD player which has a plugpack adaptor and draws up to 15W.



The circuit employs field effect transistors Q1 and Q2 to drive a transformer in push-pull configuration. The output voltage is sampled and fed to IC4 which controls the "dead" time of each transistor during every half cycle.

This will provide unlimited playing time from the player.

Powering a CD player directly from the car battery is not as simple as it may appear. There are several safeguards necessary to ensure sound quality and to protect the CD player from the voltage transients common to a car electrical system.

First, the negative return of the DC supply should be isolated from the signal output ground to prevent the possibility of a current loop (ie, equivalent to an earth loop in an audio system). If this is not done, noise and distortion could well prove a problem. In addition, the DC supply to the player needs to be regulated and must incorporate transient suppression.

Some CD players are much more difficult than others to power from a car's electrical system. Whereas the Sony players need only a single 9V supply, others such as the Technics SLP-X7 require ±6V. This is very awkward as it requires the use of a DC-to-DC inverter. We could have designed such an inverter but then we had to face the fact that these players have a special DC power socket which would be hard to obtain.

12/240V AC inverter

Since all portable CD players are supplied with a 240VAC plugpack adaptor, we realised we could meet all the above problems with one solution — a 12V DC to 240VAC inverter circuit. The resulting inverter will power any portable CD player which has a plugpack AC adaptor and draws up to 15W. It will also run any other mains-powered appliance with a rated power consumption up to 15W.

Incidentally, we are indebted to Sean McCarthy of Swindon, UK for this project idea. Sean was a visitor to Australia during 1986.

As shown in the photographs, our new inverter is housed in a compact steel box with a sloping front panel. It has a mains socket mounted on the front lid and an on/off switch. A twin lead from the rear of the case is fitted with a plug which plugs into the car's cigarette lighter socket.

Alternatively, readers may wish to install the unit beneath the dash and permanently connect the unit to the vehicle 12V supply via the accessory fuse.

Although the inverter is only a low power unit, its line regulation is impressive. For an input voltage range of 11VDC to 15VDC, the output voltage changes from 240VAC to 249VAC. Load regulation at 12V input is equally impressive, changing from 242VAC at no load to 241VAC at 15W load.

The efficiency at full load (15W) is 82% with the current drain just on 1.5 amps DC. Standby current at no load is 120mA.

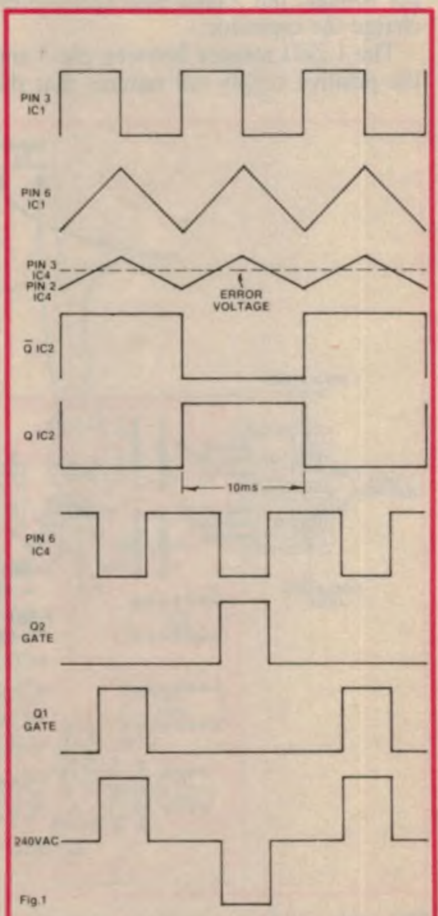


Fig.1: this diagram shows the waveforms at various points on the circuit.

How it works

The circuit for the inverter is based on a standard 15V centre-tapped mains transformer, two SIPMOS field effect transistors, and several control ICs. The transistors drive the transformer in push-pull configuration, supplying 12V to each half of the centre tapped winding alternately at a 50Hz rate. The output of the transformer is 240VAC at 50Hz and this output is monitored for voltage regulation.

Four ICs are used to drive Q1 and Q2 at a 50Hz rate and to provide output voltage regulation.

IC1 is a 555 timer connected in astable mode to produce a 100Hz square wave with an even duty cycle. The output at pin 3 is used to charge and discharge a 0.12μF capacitor via a 56kΩ resistor. This capacitor is connected to the threshold and trigger pins (pins 6 and 2 respectively).

As the capacitor charges up it reaches the pin 6 threshold voltage at 2/3rds the supply voltage. At this point, pin 3 goes low and the capacitor begins to discharge. When the voltage reaches the pin 2 trigger voltage at 1/3rd of the supply voltage, pin 3 goes high again to recharge the capacitor.

The 1.2kΩ resistor between pin 3 and the positive supply rail ensures that the output will go completely high so that we get an equal duty cycle at the output. An equal duty cycle is necessary because the triangular waveform at pins 2 and 6 is used for voltage regulation.

The square wave at the output of pin 3 and the triangular wave at pins 2 and 6 are shown in Fig.1.

The pin 3 output of IC1 connects to the clock input of IC2, pin 13. IC2 is a 4027 J-K flipflop with the J and K inputs pulled high so that on every clock pulse, the Q output at pin 15 toggles (ie, changes from high to low or vice versa). Thus, the output divides the clock input by two. The Q-bar output of IC2 is complementary to the Q output. These waveforms are also shown in Fig.1.

IC3a and IC3d buffer the Q output of IC2 while IC3b and IC3c buffer the Q-bar output. These buffers are 4001 NOR gates with one input of each gate tied to the output of IC4. When the output of IC4 is low, the NOR gate buffers invert the Q and Q-bar outputs of IC2 to drive the gates of Q1 and Q2.

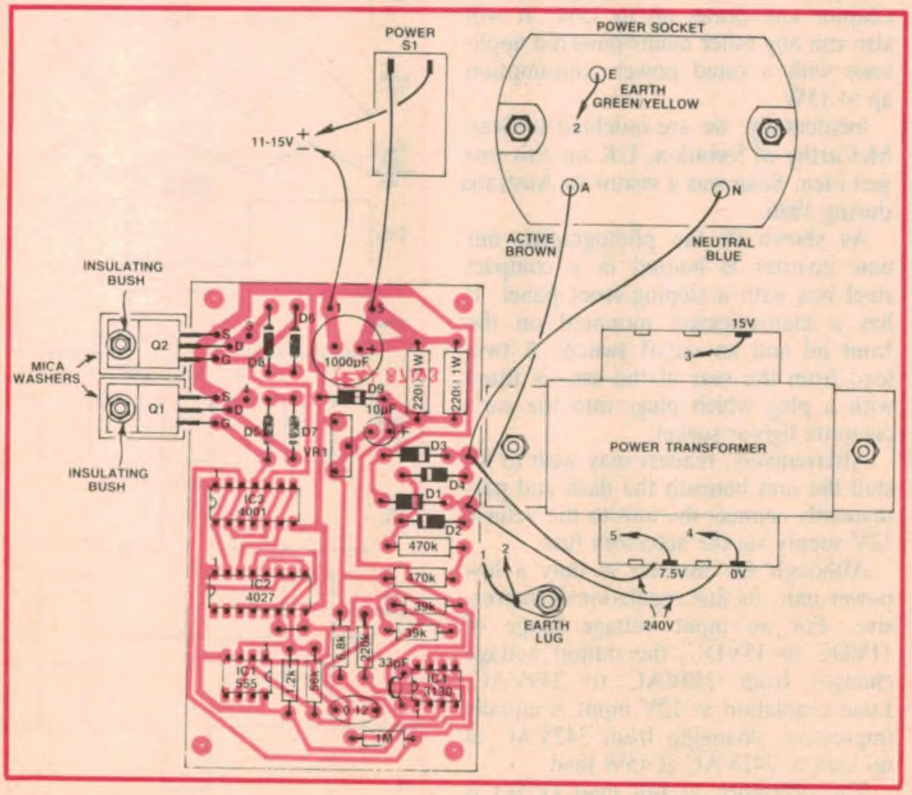
Q1 and Q2 are Siemens Power Metal Oxide Semiconductors, or SIPMOS for short. They can be regarded as conventional power field effect transistors with an integral reverse protection diode between the drain and source electrodes. They require voltage drive to the gate to control the resistance between drain and source.

When these transistors are used as a switch, the resistance between drain and source when the gate is high is less than 0.1Ω. When the gate is low, the drain-source resistance is extremely high, or effectively open circuit.

Q1 and Q2 drive the transformer in back to front fashion so that they are connected to what would normally be the centre-tapped secondary. When Q1 turns on, it applies the full battery voltage of 12V across half the transformer winding. By transformer action, the same voltage appears across the other half of the transformer winding and the voltage polarities reverse when Q1 turns off and Q2 turns on.

When each winding is switched off, a reverse voltage occurs across the transistor which is clamped by the internal diode. Protection against excessive gate drain voltages is provided by zener diodes D7 and D8 and diodes D5 and D6.

The above description of operation applies to a simple push-pull inverter but our circuit also has regulation. This is obtained by having a certain amount of "dead" time between Q1 turning off and Q2 turning on, and vice versa.



The parts can be mounted in any order on the PCB. Note that the metal tabs of the two transistors must be isolated from the metal case using mica washers and insulating bushes.

Regulation

A full wave rectifier consisting of diodes D1 to D4 is connected across the transformer output winding. The resulting rectified output is attenuated using the two series 470kΩ resistors and a 50kΩ trimpot. A 10μF capacitor filters the signal to provide a smooth DC voltage which is proportional to the peak-to-peak output voltage from the transformer.

This sample DC voltage is applied via a 6.8kΩ resistor to the non-inverting input of IC4, which is an op amp connected as a comparator.

The other (inverting) input of IC4 is fed an attenuated version of the triangular waveform from pin 2 of IC1 via a 220kΩ resistor. This input (pin 2) is also referenced to half supply by the 39kΩ voltage divider resistors connected between the positive supply rail and ground.

The waveforms at pin 6 of IC1 and those at pins 3 and 2 of IC4 are shown in Fig.1. The output of IC4 (pin 6) is high whenever its pin 3 voltage is higher than its pin 2 voltage and vice versa. Therefore, the output of IC4 changes each time the voltage at pin 2 flicks above or below the voltage at pin 3.

As previously mentioned, the IC3

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8228	5.50
8237	19.50
8238	9.50
8243	8.50
8251	6.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8272	33.00
8273	65.00
8274	42.50
8275	38.50
8276	28.50
8279	8.50
8282	6.50
8283	6.50
8284	6.50
8286	6.50
8287	6.50
8289	73.00
82S23	5.95
82S123	5.95
8303	5.50
8304	6.95
8311	5.95
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8741	57.50
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8755	33.50
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
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8T13	2.75
8T14	2.95
8T26	3.00
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LM358	2.40
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BC338	.40
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BC548	.20
BC549	.20
BC550	.40
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2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
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2N3702	1.20
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Errors & Omissions Excepted

12/240V inverter

NOR gates invert the Q outputs from IC2 whenever pin 6 of IC4 is low. When pin 6 is high, both transistors are switched off due to the low output of each NOR gate. Thus, IC4 controls the "dead" time of each transistor during every half cycle.

The resulting 240VAC waveform from the output of the transformer is shown in Fig.1.

So voltage regulation is obtained as follows: If the output from the transformer is too high, then the voltage at pin 3 of IC4 rises relative to the triangular waveform of pin 2 and this increases the "dead" time of the transistors.

If the output voltage drops, the voltage at pin 3 of IC4 is reduced relative to the triangular waveform at pin 2, reducing the "dead" time of the transistors and so increasing the drive to the transformer.

The gain of this feedback system is very high to keep the output voltage relatively constant. Note the 1MΩ resistor between the non-inverting input and output of IC4. This in conjunction with the 6.8kΩ resistor at the non-inverting input sets a small amount of hysteresis for IC4 to prevent high frequency oscillations.

Power for the ICs is derived from the 12V supply and regulated using a 6.8V zener diode fed by the two 220Ω paralleled dropping resistors. The regulation isolates the ICs from the supply to the transformer to prevent false triggering. In addition, a 1000μF capacitor connected to the positive supply of the transformer helps reduce the transients and supply drop as the transformer primary winding is switched on and off.

Construction

Our prototype inverter was housed in a case measuring 150(W) x 103(D) x 70mm (H) at back and 35mm (H) at the front. Most of the components are installed on a small printed circuit board (PCB) coded 87iv3 and measuring 97 x 58mm. The power switch and mains socket are mounted onto the top lid while the remaining components are mounted on the base of the case.

Start construction by installing the parts on the PCB. Make sure that all the diodes are oriented correctly and note carefully the diode to be used at each location. For example, diodes D7 and D8 are zeners and are different from small signal diodes D5 and D6. Zener diode D9 should have a stress relieving loop in the lead to allow for expansion.

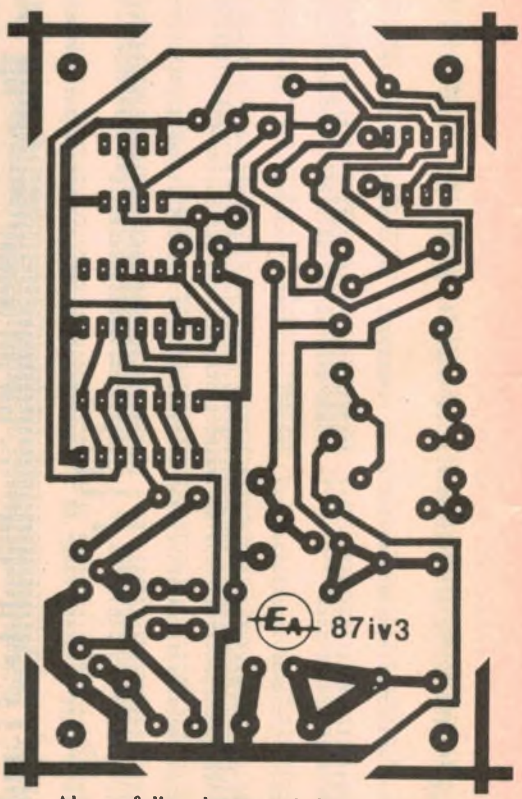
We used PC stakes to terminate the external connections since this helps with the wiring at a later stage.

Note that IC1 is oriented differently to the remaining ICs. The two electrolytic capacitors should be oriented as shown on the overlay diagram. The resistors and remaining capacitors can be inserted any way around.

The leads for the BUZ71 transistors should be bent so that the devices mount perpendicularly and to the left of the PCB. This will allow the transistors to be bolted to the side of the case for heatsinking.

Once the PCB is complete, work can begin on the case. The transformer mounts in the rear right hand side of the case (the deep end) to allow clearance for the lid. The PCB mounts close to the left hand side of the case and is mounted on 9mm standoffs.

If you have purchased a kit with drilled metalwork, some of the following steps will not be necessary. Otherwise, drill holes in the base of the case for mounting the PCB, transformer and earth lug. The holes for securing the transistors to the case can be drilled after temporarily mounting the PCB on the standoffs and marking the hole positions.



Above: full-scale artwork for the PCB.

PARTS LIST

1 PCB, code 87iv3, 97 x 58mm
1 sloping front metal cabinet, Jaycar Cat. No. HB-6080
1 Arlec 2155 transformer, 15V 1A centre tapped (or equivalent)
1 flush-mounting 3-pin mains panel socket
1 2A SPST toggle switch
1 cigarette lighter plug
4 12mm spacers
1 earth lug
1 cord clamp grommet
2 sets of insulating hardware for T0-220 package (mica washer, bush, screw and nut)

Semiconductors

1 555 timer IC
1 3130 CMOS op amp
1 4001 quad 2-input NOR gate
1 4027 dual J-K flipflop
2 BUZ71 SIPMOS transistors
4 1N4004 1A diodes
2 1N4148, 1N914 diodes
2 33V 400mW zener diodes
1 6.8V 1W zener diode

Capacitors

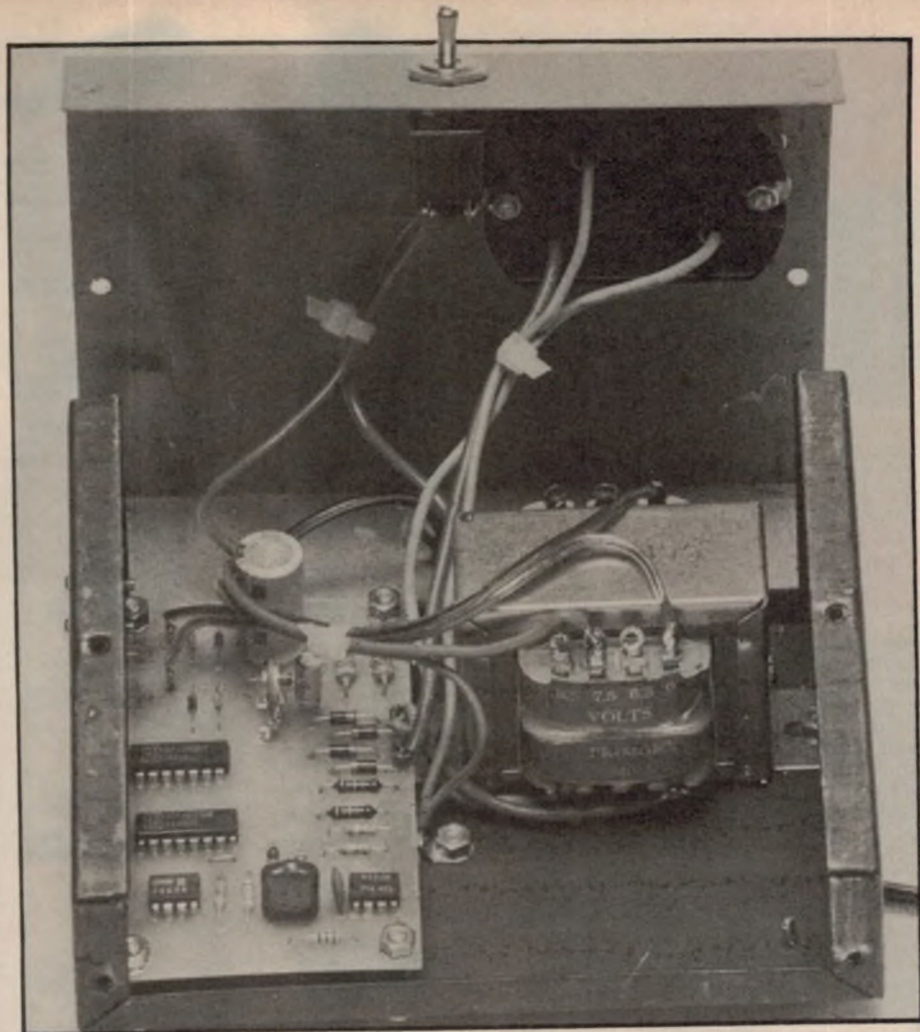
1 1000μF 16VW PC electrolytic
1 10μF 16VW PC electrolytic
1 0.12μF metallised polyester
1 33pF ceramic

Resistors (0.25W, 5%)

1 x 1MΩ, 2 x 470kΩ 0.5W, 1 x 220kΩ, 1 x 56kΩ, 2 x 39kΩ, 1 x 6.8kΩ, 1 x 1.2kΩ, 2 x 220Ω 1W, 1 x 50kΩ miniature vertical trimpot

Miscellaneous

Screws, nuts, shakeproof washers, heatsink compound, solder, mains wire, cable ties, heavy duty hookup wire.



You will have to follow the layout shown here to get the parts to fit into the recommended case. Take care to ensure that leads carrying 240V AC don't short to adjacent connections.

Holes are also required in the lid for the mains socket, power switch S1, and the cord clamp grommet. The mains socket mounts on the top of the lid very close to the front. It should be located as far to the front and as far to the right as possible without fouling the sides of the case. The switch mounts alongside the socket on the front of the lid. The cord clamp grommet mounts on the rear of the lid.

To make the round hole for the socket, drill a number of holes around the circumference of the required hole and knock out the centre piece. The hole can then be filed to a smooth finish. This done, bolt the transformer, PCB and earth lug to the case.

The two transistors must be insulated from the case using mica washers and insulating bushes. Smear heatsink compound on each of the mating surfaces before bolting the transistors to the case. This done, check that each transistor case is indeed isolated from the case by testing with a multimeter (switched to the "ohms" range).

Be sure to use mains-rated cable for the 240V wiring. This includes the leads from the 240V output of the transformer to the PCB and all leads to the mains socket. The earth wire should also be mains rated and should have the standard green with yellow stripe insulation.

The remainder of the wiring can be run using medium-duty hookup wire. This wiring includes the leads between the low voltage terminals of the transformer and the PCB, and between the PCB and the switch. Figure eight twin cable can be used for wiring the ground and +12V wires to the cigarette lighter plug.

Once construction is complete check your work carefully for possible wiring errors. In particular, make sure that all the parts on the PCB are correctly positioned and oriented. It is also a good idea to recheck the isolation of the two switching transistors.

Testing

To test the inverter, connect a multimeter set to 1000V AC to the output socket and plug the inverter into the cigarette lighter socket of your car. Alternatively, you can use a 12V DC bench supply capable of supplying 2A. Measure the output from the inverter and adjust VR1 for a reading of 240VAC.

You can test the regulation by connecting up your CD player and again measuring the AC voltage. It should still be very close to 240V AC.

Note that for accurate setting of the output voltage, it is necessary to use a moving iron meter or true RMS meter. However, for this inverter application, the actual voltage is not critical and a conventional analog or digital multimeter will be adequate.

12 months warranty!

HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- Wide bandwidth and high sensitivity
- Internal graticule rectangular bright CRT
- Built in component tester
- Front panel trace rotater
- TV video sync filter
- Z axis (Intensity modulation)
- High sensitivity X-Y mode
- Very low power consumption
- Regulated power supply circuit

COMPONENT TESTER is the special circuit with which a single component or components in circuit can be easily tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to troubleshoot solid state circuits and components with no circuit power. Testing signal (AC Max 2 mA) is supplied from the COMPONENT TEST IN terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT
CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule
Effective display area: 8 x 10 div (1 div = 10 mm)
Acceleration potential: 2KV

VERTICAL
Operating Modes: CH-A, CH-B, DUAL, ADD (CH-B can be inverted.)
Dual modes: Alter: 0.2uls - 0.5ms/div. Chop: 1ms - 0.5s/div
CHOP frequency 200KHz approximately
Deflection factor: 5mV/div 20V/div +/- 3%, 12 ranges in 1-2-5 step with fine control.
Bandwidth: DC, DC - 20MHz (-3dB). AC; 10Hz - 20MHz -3dB).
Rise Time: Less than 17ns.
Overshoot: Less than 3%.
Input Impedance: 1M ohm +/-5%, 20pF +/-3pF
Maximum Input Voltage: 600Vp-p or 300V (DC+AC Peak).
Channel Isolation: Better than 60 dB at 1KHz.

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

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

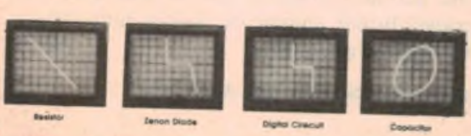
X-Y OPERATIONS
X-Y Operations: CH-A: Y axis. CH-B: X axis Highest Sensitivity: 5mV/div.

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

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

Cat. Q12105 .... **only $849**
(tax exempt only $695)

Bulk orders, schools, please phone (03) 543 2166 for special low pricing



METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

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

METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

Features
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- 1/2" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Capacitance measurements to 1pF
- Diode testing with 1 mA fixed current
- Audible Continuity Test
- Transistor hFE Test

SPECIFICATIONS
Maximum Display: 1999 counts 3 1/2 digit type with automatic polarity indication
Indication Method: LCD display
Measuring Method: Dual-slope in A-D converter system
Over-range Indication: "1" Figure only in the display
Temperature Ranges: Operating 0-C to +40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

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

PRINTER LEAD FOR IBM*

- Suits IBM* PC XT and compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug
- Length: 2 metres

Cat. P19029

1-9	10+	100+
$19.95	$17.95	$15.95

(R.R.P. $44.95)

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Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).

Features include:
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

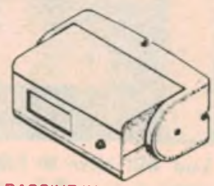
WITHOUT TIMER
Cat. X14950 **Normally $119**
Special, $89

WITH BUILT-IN TIMER
Cat. X14955 **$139**
Special, $119

CODE KEY PAD

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

Cat. A13014 **R.R.P. $79.95**
SPECIAL, ONLY $69.95



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Compact P.I.R. with adjustable corner or wall mounting bracket, dual pyroelectric infra red sensing element gives a coverage 2 x 14 zones 2m high and 10m wide.
- Sensitivity adjustment control
- Detecting range 12-15 metres at 90 degrees
- Detecting zones 9 long (up), 5 short (down)
- LED indicator for walk test (can be disabled)
- Shielded against RF interference
- Relay output NC or NO at 30V (AC-DC) 0.5A max
- Integral NC tamper switch
- Operating voltage 10.5 - 16V DC
- Current 20mA with LED 25mA

Cat. S????? **$145**

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250 x 300mm (10 sheets)	$39.95	
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A versatile 12V electric tool for:
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Features:
Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor, 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee

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

Cat. T12300 .... **$59.95**

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These superb rack mount cabinets will give your projects a real professional appearance!
Just look at these features
- All dimensions conform to the International Standard
- All aluminium construction
- Choice of black or natural finish
- Deluxe brush finish anodised front panel
- Removeable top and bottom lid
- Ventilated lid

A = Internal Height mm
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A	B	C	Finish	Cat.No.	Price
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82	430	254	Natural	H10402	$59.50
126	430	254	Natural	H10403	$69.50
38	430	254	Black	H10411	$59.95
82	430	254	Black	H10412	$69.95
126	430	254	Black	H10413	$79.95

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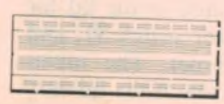

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The WTCPN Features:
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having.

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SPECIAL, ONLY $129

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W11251	13/.12 TND BLK
W11252	13/.12 TLD BROWN
W11253	13/.12 TLD ORANGE
W11254	13/.12 TLD YELLOW
W11255	13/.12 TLD GREEN
W11256	13/.12 TLD BLUE
W11257	13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

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

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W11268	14/.20 WHITE

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W11274	24/.20 GREEN

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$12.60	$10.80

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

PRICES PER 100 METRE ROLL

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Q10504	MU45 0-100uA	12.50
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Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMetre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
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DPM-200 PANEL METER

- Ultra Low Power
- Separately Addressable Annunciator
- 15mm Digits
- Bandgap Reference

A low profile LCD DPM with a range of useful symbols as shown. The DPM 200 features 15mm 3 1/2 digit display and ultra low current consumption and a bandgap reference for high stability. It also features Auto-zero, Auto-polarity, 200mV fsd. It may be used in single-ended, differential or ratiometric modes. The fsd can be easily changed by the user to indicate any other units. The decimal points and symbols can all be driven from an internal source. Wide supply rail symbols can all be driven from an internal source. Wide supply rail (5-15V DC) with a variable threshold low battery warning indicator. Supplied with mounting clips and comprehensive data sheet.

SPECIFICATIONS
Accuracy: 0.1% + -1 digit
Linearity: + -1 digit
Samples/sec: 3
Temp. Stability: 50 ppm typical
Temp. Range: 0 - 50-C
Supply Voltage: 5 - 15V DC
Supply Current: 50uA typical
Max DC Input Volts: + - 20V

Cat. Q15510 **$99.95**

ROD IRVING ELECTRONICS
N°1 FOR COMPONENT SPECIALS!

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Cat.No.	Description	Price
R16124	16V 4.7uF	$0.48
R16125	16V 10uF	$0.52
R16126	16V 15uF	$0.75
R16128	16V 22uF	$0.85
R16216	25V 2.2uF	$0.40
R16220	25V 4.7uF	$0.70
R16222	25V 6.8uF	$0.70
R16224	25V 10uF	$0.60
R16228	25V 22uF	$2.40
R16300	35V 0.1uF	$0.30
R16302	35V 0.15uF	$0.30
R16304	35V 0.22uF	$0.30
R16306	35V 0.33uF	$0.30
R16308	35V 0.47uF	$0.30
R16310	35V 0.68uF	$0.35
R16311	35V 0.82uF	$0.35
R16312	35V 1.0uF	$0.30
R16314	35V 1.5uF	$0.50
R16316	35V 2.2uF	$0.50
R16318	35V 3.3uF	$0.35
R16320	35V 4.7uF	$0.70
R16322	35V 6.8uF	$0.80
R16324	35V 10uF	$0.80
R16326	35V 15uF	$1.40
R16328	35V 22uF	$3.50

SEMICONDUCTORS!

Always check our prices before you buy!

	1-9	10+	100+
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2732	$8.95	$8.50	$7.95
2764	$7.95	$7.50	$6.95
27128	$6.95	$6.50	$6.25
27256	$11.50	$10.50	$10.00
4116	$3.95	$3.50	$2.95
4164	$2.95	$2.75	$2.50
41256	$4.95	$4.50	$3.95
5558pin	$0.50	$0.40	$0.35
6116	$3.95	$3.75	$3.50
6264	$6.50	$5.50	$5.25
6802	$5.00	$4.00	$3.75
6821	$2.00	$1.80	$1.70
6845	$5.00	$4.00	$3.75
7406	$0.40	$0.30	$0.25
8250	$29.95	$27.95	

NE5534AN

SCOOP PURCHASE!!

1-9	10+	100+
$1.95	$1.85	$1.75

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Cat. U21614 Normally $49.50

Save $25, SPECIAL $24.95

MEL9501

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SPECIAL, ONLY $29.95

8087

Genuine Intel chips with manual and data sheets packed in boxes!

8087-3 (4.77MHz)	$279
8087-2 (8MHz)	$399
8087-1 (10MHz)	$649
80287-3 (6MHz)	$499
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Description	Cat.No.	1-9	10+
1MHz	Y11000	$7.50	$7.00
4.433618MHz	Y11023	$2.95	$2.75
8.867238MHz	Y11055	$2.95	$2.75
12MHz	Y11070	$2.95	$2.75
14.31818MHz	Y11072	$2.95	$2.75

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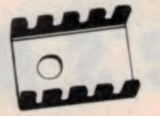
36 WAY MALE (P12200)

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



MINIATURE HEATSINK!

A great little fellow if you are short of space. Great price too, because we import direct so you save!

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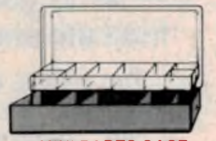

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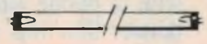

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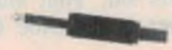
6672 240V 15-30V 1A tapped Cat. M16672	$14.95	$13.95



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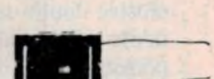

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MODEL 15-1-11

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

Cat. R14405 .... $45.95

MODEL 16-1-11

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

Cat. R14400 .... $26.95

MODEL 21-1-11

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

Cat. R14410 .... $46.95

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Designed to transmit at 40kHz (L19990) and receive at 40kHz (L19991) with up to 20V I/P on the transmitter. These units can't be heard and so are ideal for TV remote controls, water level detectors, burgalar alarms, motion detectors and information carriers as they can be either pulsed or used in the continuous wave mode.

Full specifications below for design purposes.

Maximum Input Voltage: 20V rms
Centre Frequency (kHz): 40 ± 1.0
Sound Pressure Level 10V RMS: 110dB min.
Sensitivity (dB/v/ubar) min: -65 min.
Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at -73dB)
Impedance:
Transmit: 500
Receiver: 5000

Cat. L19990 (Transmitter)	$4.75
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20 Pin Cat.	29c	28c	27c	26c
24 Pin Cat.	35c	33c	32c	28c
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QUALITY LEDS

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

HIGH INTENSITY RED LED BAR GRAPH

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

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

½" HIGH INTENSITY RED LED DISPLAYS

(Available in Common Cathode and Common Anode)

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

COMMON CATHODE:

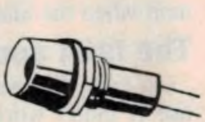
Pin 1 Segment E Pin 6 Segment B
Pin 2 Segment D Pin 7 Segment A
Pin 3 CC Pin 8 CC
Pin 4 Segment C Pin 9 Segment F
Pin 5 Segment Dp Pin 10 Segment G

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

COMMON ANODE:

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

Cat.No.	1-9	10+	100+
Z10191	$1.95	$1.75	$1.50



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S14034	Yellow	$1.45

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- Gold plated

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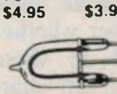

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Cat. No. Description	Price
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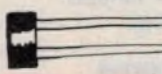

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The Serviceman

There's no profit in crook joints

In spite of the vast improvement in component quality which has characterised the electronics industry over the last couple of decades, one consistently weak area remains. We've thrown away our paper capacitors, ditched our horrible carbon resistors, and banished our thermionic devices to the museum — all to good effect — but the faulty joint remains to harass, frustrate and impoverish us.

The truth is, the faulty joint is like no other fault. For one thing, finding such a fault seldom teaches us anything, for the simple reason that the chances of that particular fault appearing again in that model set are about one in a million. So, while the time wasted finding elusive faults involving specific components can usually be written off to experience — "I'll know that one when I see it next time" — time wasted finding a faulty joint is time wasted — period.

There is also the frightening realisation that the number of distinct faults and symptoms which the faulty joint can create is almost infinite. Look at any chassis, make any estimate you like as to the number of joints it contains, then try to visualise the likely symptoms which the failure of any one of them might produce.

Some could be relatively easy, like those causing total and permanent failure, but a significant number can create symptoms the like of which no-one has ever seen before. Then, to round off these pleasant thoughts, multiply that situation by the number of different models likely to pass across your bench in the course of a few months.

As I said: frightening.

Strange symptoms

Naturally, these philosophical musings were prompted by a couple of real life situations which caused me a certain amount of head scratching at the time. The first one, in particular, set me back because it produced a set of symptoms which I had never seen before and, I'm prepared to wager, have been seen by few, if any, of my readers.

I bet that'll get a bite!

The device in question was a National 48cm colour set and the story started with a phone call from the lady of the house. She was not one of my regular customers but had been directed to me because I am authorised to service National sets under warranty, and this set was only a few months old. That much established I asked her to describe the set's behaviour.

"Well", she said, "the set went very well for the first few months, then occasionally the picture would suddenly contract and become small."

So what did she mean by "become small"? Was it loss of height? Loss of width? Or both? Exercising a certain amount of discretion I endeavoured to clarify these points. (It is easy to offend some people by questioning in a too abrupt manner. What seems like a reasonable question to us can often "throw" a customer, and get them offside.)

As it happened, the lady was anxious to be as helpful as possible and her description turned out to be quite accurate, even if I did have my doubts about it at the time.

"The picture appears in the top left hand corner and covers about a quarter of the screen. At first it happened only occasionally, but now it happens quite often. Oh, and another thing. There's no colour when this happens."

Well, that set me back on my heels for a few moments. So much so that I asked the lady to repeat the bit about the top left hand corner. But there was no mistake; that was what she meant. Then, as a final attempt to make sense of the description, I asked her whether the picture that appeared in these conditions was simply the top left quarter of the full picture, or was it a shrunken version of the whole picture. Again the lady was quite definite; it was the whole picture squeezed into the top left hand corner.

Doing my best to keep the amazement, and even some incredulity, out of my voice I advised the lady that, under the terms of the warranty, it would be necessary to bring the set to my shop, to which she readily agreed. In any case, I didn't fancy tackling a set of symptoms like that in the customer's lounge room.

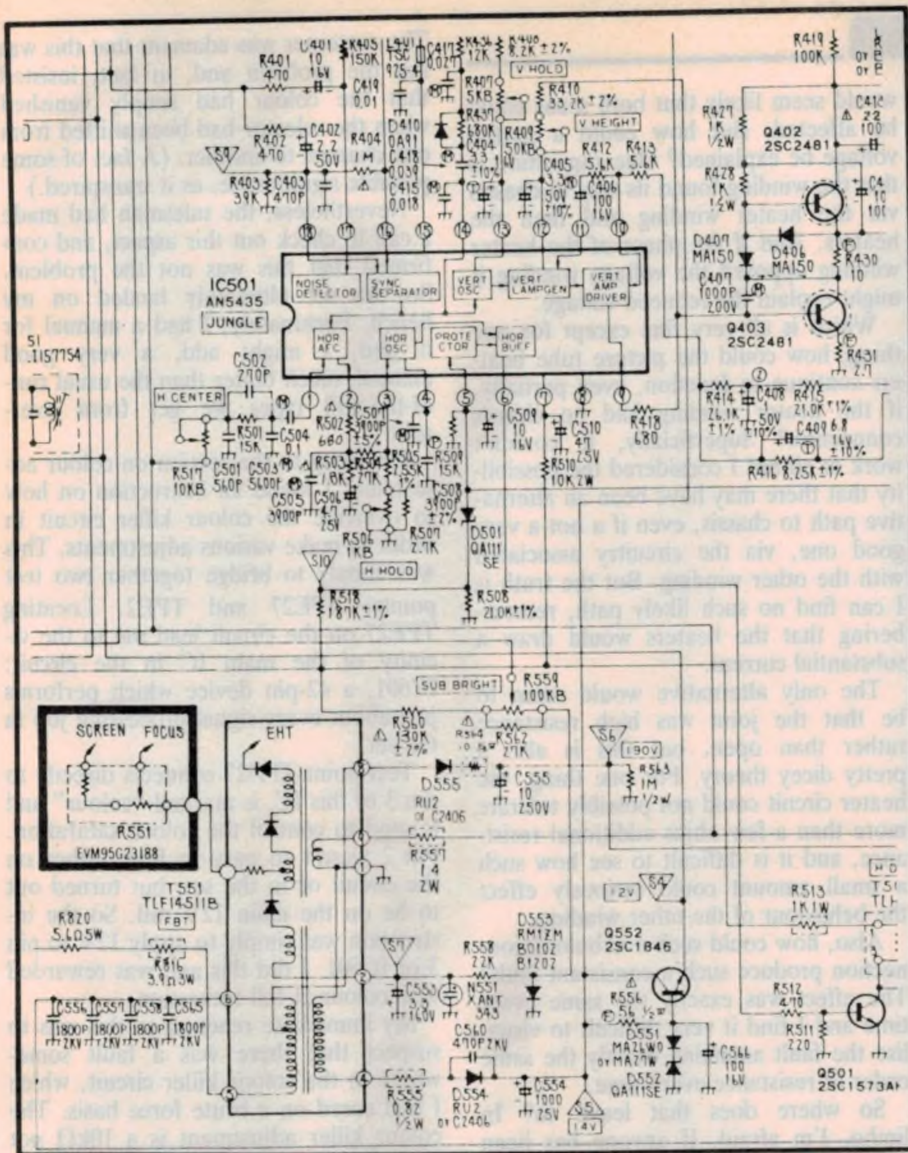
And so, in due course, the lady turned up with the set. It turned out to be a model TC-2035 which was the first setback because I realised that I didn't have a manual for it. This fact assumes some importance later on, not so much in regard to finding the fault, but in explaining the symptoms. However, more of that later.

I turned the set on as soon as the lady brought it in, but I need hardly add that it performed perfectly. The lady was somewhat embarrassed by this, and went to some lengths to assure me that the effect she described really did happen. I reassured her this situation was quite common, due to Murphy's Law. I'm not sure whether she really knew what I meant, but she seemed to accept my reassurance.

Naturally, the first thing I did was put in an order for a manual, but was advised that this might be delayed a few days, due to some kind of stock hassle. In the circumstances, there was little I could do except run the set, check the symptoms if and when they appeared, and perhaps make some preliminary tests which would hopefully prove pertinent when the manual arrived.

The fault appears

At least that was the theory: in practice it didn't work out that way. I left the set running and after a few hours the picture started to jitter slightly, as though it couldn't make up its mind what size it wanted to be. It then suddenly collapsed into the top left quarter of the screen, in monochrome, with the rest of the screen completely black, exactly as the lady had described. I offered a silent apology for any doubts I may have had in my own mind, and



Line output and horizontal and vertical oscillator circuitry for the National TC-2035.

reckoned I had now seen everything.

Quite obviously I didn't have a clue at that stage as to what could possibly cause such an effect, but I did have a gut feeling that it would involve the horizontal output stage in one way or another. There seemed little doubt that the scan was extending only halfway across the screen while, at the same time, the vertical stage was extending only halfway down the screen. And, since many of the operating voltages for the set would almost certainly be derived from the horizontal stage, a fault there could produce more than one symptom.

At least, that was the theory; I would need the manual to confirm it. In the meantime I decided to make whatever preliminary observations I could. The set was still in the cabinet at this stage — a deliberate routine on my part in case an intermittent is heat sensitive — so I turned it off and withdrew it from the cabinet. And I need hardly add that, when I turned it on again, it was back to a normal picture.

I was still thinking in terms of the horizontal output stage, with the added possibility of a dry joint in that area. I set the chassis on its side and made a visual inspection of the suspect area, using a jeweller's loupe to examine each joint as closely as possible. But I found nothing suspicious; as far as I could see every visible joint was above reproach. So I switched the set on again and let it run.

To be honest, I wasn't persuing the fault very vigorously at this stage. I was waiting on the manual before getting stuck into it properly. On the other hand, intermittent faults need to be attacked as and when they appear so I decided to press on, at least superficially, whenever the fault appeared.

In fact, it showed up again a couple of hours later and I speculated as to whether I should go all scientific with meters and a CRO, or whether I should resort to the primitive and attack it with the butt end of a screwdriver. The absence of a manual decided me; I reached for the screwdriver.

Thus I began a systematic pattern of gentle tapping around the horizontal output stage. Nothing happened until I moved into the area of the line transformer when a moderately gentle tap suddenly brought the picture back to normal. I continued tapping in the hope that I might recreate the fault, but to no avail. Performance was back to normal and nothing was going to upset it. This turned out to be something of a pattern.

So the set was left running for the few remaining hours of the day, but without result. The next day it ran for a couple of hours then failed again. This time I went straight to the suspect area around the transformer, particularly where it was soldered into the printed board. I also reduced the vigour of the tapping, the better to isolate the sensitive area. Again, I was rewarded. A very gentle tap in one spot and the fault disappeared. But again, no amount of tapping, however vigorous, could recreate it.

In fact, there appeared to be only one way to produce the fault; simply let the set run for several hours until it made up its own mind. And so I went through the same routine several more times, except that I had replaced the screwdriver with a lighter, plastic alignment tool, and had reduced the tapping force to a mere flick and, eventually, simple pressure.

And this paid off. I narrowed the area down to a small group of line transformer pins where they were soldered to the copper pattern. Thus alerted, I went over them again with the jeweller's loupe, hoping to find some evidence of a dry joint or cracked pattern. But again, I drew a complete blank.

Nevertheless, I was highly suspicious of these few pins, and one in particular which was obviously a chassis connection. It looked perfect and so did the adjoining pattern, but I reasoned there was nothing to lose by unsoldering these joints and remaking them. So I reached for the iron and attacked the chassis pin.

And what a surprise! The solder came away from the pin so completely that it was obvious that it had never "wet" the metal in the first place. It had adhered to the copper pattern OK but, as far as the pin was concerned, it was as dry a

The Serviceman

joint as I have ever seen. Yet it was visually perfect. So much for the value of visual inspection; while useful, it can be misleading.

I remade the joint and then reconsidered whether I should check the adjacent pins at the same time. After some thought I decided against this, at least for the moment. I wanted to be sure that this fault was the one I was seeking, and not a red herring which Murphy had thrown in just to make it hard.

But that was it all right. The set ran all day for several days after that and never missed a beat. Comparing it with its previous performance I was convinced that I had found the cause. Thus satisfied, I went over the other pins with the iron, but found nothing suspicious.

And that, from a practical point of view, was really the end of the story. I called the customer, advised them it was ready, and it was duly collected. As with any intermittent fault, I impressed upon the lady, the possibility, slight though it was, that the fault may be laying dormant, and that she should contact me immediately at the first sign of repeat performance. That was several months ago and, at last check, all was well.

The explanation

But why did the fault cause the symptoms it did. The manual arrived about the time I was returning the set to the customer, and I gave the circuit only a casual glance. It wasn't until some time later that I sat down and studied it in detail in an attempt to make sense of the cause and effect. The faulty joint was on pin 1 of the transformer and provided the chassis connection for two windings; the winding supplying the picture tube heater (pins 1 and 9) and another low voltage winding (pins 1 and 4) providing, first, a 14V unregulated rail and, from this (via Q552 etc), a 12V regulated rail.

Now this poses a number of questions and I don't pretend to have the answers. At first glance it would appear that the failure of the 14V supply winding to connect directly to chassis might explain the reduced scan in both directions. Both the 14V rail and the 12V rail supply one of the main ICs (IC501) which contains both the vertical and horizontal oscillators and associated amplifiers.

So if this voltage was reduced — rather than removed completely — it would seem likely that both scans could be affected. But how could a partial voltage be explained? One suggestion is that the winding found its way to chassis via the heater winding and then the heaters. And if the phase of the heater winding opposed the voltage winding it might explain the reduced voltage.

Which is all very fine except for one thing; how could the picture tube heaters continue to function, even partially, if the heater winding had no chassis connection? Superficially, it couldn't work at all but I considered the possibility that there may have been an alternative path to chassis, even if a not a very good one, via the circuitry associated with the other winding. But the truth is I can find no such likely path, remembering that the heaters would draw a substantial current.

The only alternative would seem to be that the joint was high resistance rather than open, but this is also a pretty dicey theory. For one thing, the heater circuit could not possibly tolerate more than a few ohms additional resistance, and it is difficult to see how such a small amount could seriously effect the behaviour of the other winding.

Also, how could such a nebulous connection produce such a consistant fault? The effect was exactly the same every time and I find it very difficult to visualise the fault assuming exactly the same order of resistance every time.

So where does that leave us? In limbo, I'm afraid. If anyone has been there before me, and can offer an explanation, I would be happy to pass it on. In the meantime, if ever I get my hands on that set again, or one like it, I have a feeling that I will be opening that chassis connection and making some pertinent measurements.

Another warranty job

My next story also involves a National 48cm set which was also still under warranty. But that's about where the similarity ends. It wasn't intermittent, and it was a relatively common "no colour" situation. The set came to me via a local retail outlet for whom I do warranty work, and the salesman advised me that the set was only a couple of months old.

His first reaction, when the customer complained, was to query the setting of the fine tuning control. This is a common cause of nuisance calls, particularly where there are children in the house who tend to fiddle with the controls. The customer was adamant that this was not the problem and, in fact, insisted that the colour had simply vanished when the selector had been shifted from one channel to another. (A fact of some possible significance, as it transpired.)

Nevertheless, the salesman had made a call to check out this aspect, and confirmed that this was not the problem. So the set ultimately landed on my bench. Fortunately, I had a manual for it and, I might add, a very good manual; much better than the usual run-of-the-mill types we get from overseas.

Referring to the section on colour adjustment I found an instruction on how to override the colour killer circuit in order to make various adjustments. This was simply to bridge together two test points: TPE27 and TPE2. Locating TPE27 on the circuit lead me to the vicinity of the main IC in the circuit: IC601, a 42-pin device which performs just about every signal processing job in the set.

Test point TPE27 connects directly to pin 3 of this IC, is marked "colour" and is used to control the colour saturation. Pin 2 wasn't so easy to find, either on the circuit or in the set, but turned out to be on the main 12V rail. So the instruction was simply to apply 12V to pin 3 of IC601. I did this and was rewarded with colour at full saturation.

My immediate reaction to this was to suspect that there was a fault somewhere in the colour killer circuit, which I had cured on a brute force basis. The colour killer adjustment is a 10kΩ pot (R616) between the 12V rail and chassis, with the moving arm going to the colour killer pin (pin 12) of IC601. Thus, this pin can be varied from zero to 12V but, according to the manual, normally sits at about 4.4V. In fact, it was virtually spot on.

So was there a fault in the chip, whereby the colour killer function was permanently locked on? With 42 pins involved I wasn't going to be panicked into any thoughts along those lines at this stage. Instead, I turned my attention to pin 3. It was all very well to brute force it with 12V but what were its normal operating conditions?

Tracing the circuit from pin 3 lead me to a 27kΩ resistor (R619), then a long run to a 7-pin chassis socket, E12. This socket mates with a plug (E12 again) which connects via a cable to the "M-board". The M-board mounts behind the front of the cabinet and carries the tuner, with the channel selector buttons, and the other controls such as volume,

Weller Cordless Pyropen.

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The Weller Pyropen is operated with butane gas and has been developed mainly for field and service jobs. The reservoir in the handle of the soldering pencil contains up to 27.5ccm of butane gas (as used in cigarette lighters) which is sufficient for 3-4 hours of soldering. Heat-up time is 30 seconds.

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Hot air tip 0·22in/5.7mm Ø
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Spanner
Tool support clip
Cleaning sponge
Operation manual

Tips and Parts

CooperTools

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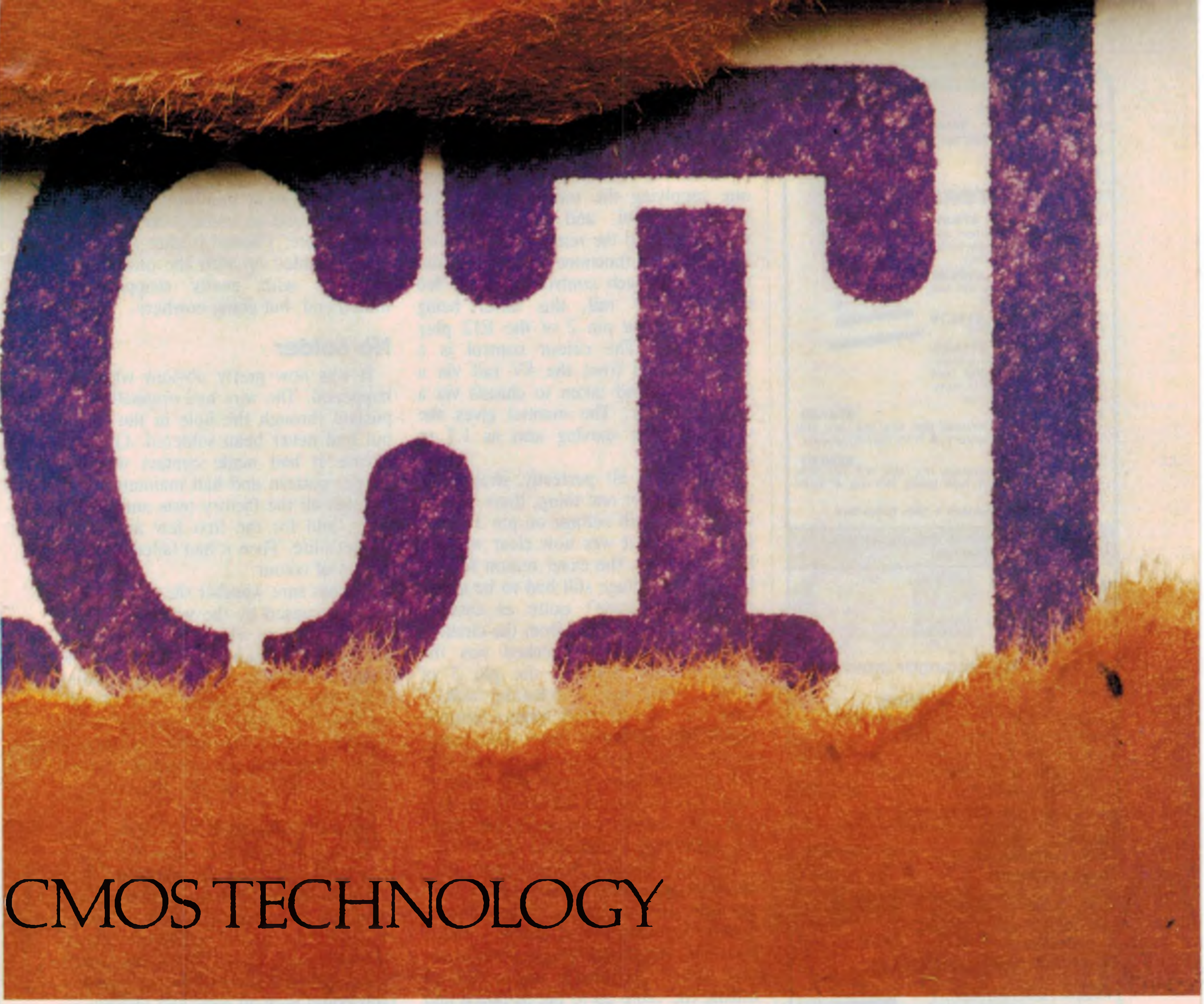

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brightness, contrast, picture, and the non-functioning colour control.

There were three cables altogether; one supplying the tuner, one for the volume control, and the E12 cable which provided the remaining functions. Each of these functions are voltage controlled and each control is a pot fed from the 5V rail, this latter being brought up via pin 2 of the E12 plug and socket. The colour control is a 10kΩ pot fed from the 5V rail via a 1kΩ resitor and taken to chassis via a 5.6kΩ resistor. The manual gives the voltage at the moving arm as 1.7 to 3.8V.

Which was all perfectly straightforward except for one thing; there was no sign of any such voltage on pin 3 of the IC601. While it was now clear why we had no colour, the exact reason for the loss of this voltage still had to be determined. This wasn't quite as easy in practice as it appeared from the circuit.

The first thing I checked was the 27kΩ resistor adjacent the pin 3 of IC601. While not a common fault, I have had several cases where virtually brand new resistors have gone completely open circuit for no obvious reason; a nasty trap if you take them at their face value. In this case all was well; the resistor was intact, but there was no voltage on the other side of it.

The next check was the socket, E12, and its mating plug. There was no voltage here either, while a visual inspection — for what it was worth — failed to reveal any faulty connections to either device. So now it was a case of tracing the cable up to the M-board and it was immediately obvious that the only way to do this properly was to remove the board itself.

This was fairly straightforward, but involved undoing various nuts, screws, cable ties etc, which took some time. When it was finally freed I could see that the wires in the E12 cable — plus the other cables — were all terminated along the edge of the board by being fed through holes from the component side and then soldered to the copper pattern.

I checked the 5V rail as a matter of course, even though a failure here would have disabled the brightness, contrast, and picture controls as well as the colour. As I expected it was intact. What was more it was being applied to the 10kΩ pot and appeared at the moving arm with approximately the range quoted in the manual. So where was it going astray?

I traced the copper pattern down to the "M1" position on the edge of board — and looked in vain for the cable that was supposed to connect to it; it just wasn't there. I found it after a few moments, cabled up with the other wires, complete with neatly stripped and tinned end, but going nowhere.

No solder

It was now pretty obvious what had happened. The wire had originally been pushed through the hole in the board, but had never been soldered. Quite by chance it had made contact with the copper pattern and had maintained this through all the factory tests and inspections, and for the first few months of the set's life. Then it had failed, robbing the set of colour.

I'm not sure whether the original failure was caused by the wire coming out of the hole, or whether it was simply due to a slight movement. I suspect the latter and that it was my manhandling of the board which pulled it out. Recalling that the colour had vanished as the channel selector was being operated, it seems likely that this vibration was the last straw that broke the tenuous connection.

Naturally, the fault was easily fixed and, overall, it hadn't been that much of a hassle; at least the symptoms were conventional and consistent. But it had all taken time and the blob of solder which wasn't applied would turn out to be quite costly. And, I must confess, I found it quite surprising that such a fault could pass all tests and inspections and get into the field.

So there it is; a couple of faulty connections which caused quite a lot of inconvenience and expense. I wonder if we will ever solve this problem.

Finally, I expect that some of you are wondering about that "picture" control. This is a term somewhat loosely used, sometimes for the contrast control and sometimes for the brightness control. But since this set carries both these controls what does the picutre control do? It appears to be a video "sharpness" control which can vary the picture outlines from "hard" to "soft".

This is not a new idea. Some of the early European monochrome sets featured such a control. It was intended to provide a degree of high frequency boost in the video amplifier for use when the program material lacked sharpness; ie. poor quality films. On the other hand, such boosting could lead to ringing on good quality program material, so the control was provided to allow it to be reduced.

Technically, the idea is quite sound but I do have doubts as to the average viewer's ability to use it intelligently. Having seen what most people do to contrast, brightness and colour setting, I hate to think what they could do with a control as subtle as this.

Still, it's a good idea for those who can manage it.

Squaring off

And now some more comments on the matter of wire sizes. I thought I had heard the last of this when I made some comments, and expressed some confusion, in the December notes. As it turned out, it seems that I upset Mr G.C. of Mt. Burrell, NSW, whose letter I quoted in those notes. The EA office has passed another letter on to me from this reader and he writes as follows.

I write in reference to the matter of naming wire sizes. Perhaps I am mistaken in my memory but in the letter to you I believe I wrote "10mm²". This is a recognised metric abbrieviation of "ten square millimetres", the unit being "mm²". The cubic unit is written "mm³".

This is the measurement system used throughout the electrical trade in reference to power transmission cables! I refuse to accept that the solar trade has formed "a cult".

What is this normal metric wire gauge 30 AWG = 10 thousandths of an inch diameter? This gauge system makes it necessary to have on hand a table to find the resistance of a cable. Yes I know a 10 AWG wire has a resistance of about one ohm per thousand feet and three gauge sizes alters this by a factor of two. However this seems unnecessarily clumsy when a simple formula exists as:

$$\text{Resistance (ohms)} = \frac{\text{length (m)}}{\text{area (sqmm)}} \times 0.017$$

or less accurately but more usefully:

$$R = L/A \times 1/60$$

Furthermore, the gauge system becomes technically inappropriate for a multi-stranded wire.

There is somewhat more to G.C.'s letter, dealing with the metric system in general and, as nearly as I can make out, endeavouring to convince me that it is superior to the imperial system. (My apologies if I read you incorrectly, G.C.). He finishes by suggesting that I need to study the metric system and also develop some humility.

Be that as it may, it would appear that, in summary, the following points need to be clarified:

(1) Whether the expression "mm²" is a recognised abbreviation for "square millimetres" and whether G.C. used this in his original letter.

(2) Whether electrical cables are now universally designated by area rather than diameter.

(3) How did the AWG system get into this? (What's this Chinaman doing in a Welsh pub?).

In regard to (1), yes G.C., you did use this expression in your letter and, OK, let's accept that it means "square millimetres" (Humble enough for you G.C., or must I prostrate myself and bash the skull three times upon the ground? If so, consider it done!)

But at least we are agreed on one thing; we are talking about "square millimetres".

Item (2) is not quite so clear cut. Prompted by G.C.'s letter I wandered through the electrical section of a nearby large hardware store and took note of the labels on a wide range of cable drums, carrying various manufacturers' names. Strange to relate, with only one exception — which I will deal with in a moment — they all designated the cable size by diameter in millimetres in the first instance, but followed by an area value in brackets.

For example, what used to be 1/.004 (inch) lighting cable is now 1/1.13mm (1mm²), and what used to be 1/.064 power cable is now 1/1.78mm (2.5mm²). (These are not exact equivalents, but are very close.) These were by no means the only sizes in stock, which was quite extensive, but I quote them as being most familiar to readers.

Now maybe I'm biased but it seems to me that these several manufacturers prefer to use the diametric measurement as the primary one, with the area being provided purely as additional information which may be useful — even essential — in some circumstances. Nor is there anything new about this approach. For as long as I can remember the better wire tables have listed such additional data, including area, weight, turns per unit area, etc, to assist users with their design problems. (A typical example is the *Radiotron Designer's Handbook*, circa 1942).

Now what about the exception I mentioned. This presented the measurements in the opposite order; area first, with the diameter following in brackets. But while this appeared to support G.C.'s approach, it was not this fact which really caught my attention. Far more important, I feel, is their manner of designating the area. I quote exactly from the label: "2.5mm sq. (1/1.78)"

Now I think even G.C. would have to admit that that description is mathematically incorrect. But, for the benefit of any readers who may have been lost along the way, let me spell it out. There is no way that a wire of 1.78mm diameter can have an area of 2.5mm square, ie. 6.25 square millimetres. In fact it will have an area of 2.5 square millimetres.

All of which seems to suggest that there is a certain amount of confusion in the trade and a need for them to get their terminology right.

Incidently, I have raised this whole subject with several people in the trade and from what I can determine, the majority of electricians and not a few engineers regard "square millimetres" and "millimetres square" as meaning exactly the same thing. In fact, most of them tend to express the abbreviation "mm²", verbally, as "millimetres square" and, when tackled on the correctness of this, shrug their shoulders and claim "they both mean the same thing".

(Did I misinterpret G.C.'s abbreviation through ignorance, or was I simply being hard to get on with?)

As to item (3) I must confess to being totally confused. Nowhere did I mention the AWG system and, while I am well aware that it provides a much more logical progression of sizes than the SWG system, I would never describe it as a metric system. When I mentioned the "normal metric system" I was referring to the metric system of wire sizes which, in fact, replaced the old B&S (AWG) and SWG system. A table listing these metric sizes and comparing them with the imperial systems was published in the 1976/77 EA Yearbook and is reprinted in the back of the Dick Smith Catalog.

And finally, G.C., if you are trying to convince me of the superiority of the metric system over the imperial system, forget it; you're about 50 years too late — in a manner of speaking. Suffice it to say that I was an advocate of the metric system long before the powers that were even thought about it. Moreover, I have had many a verbal fisticuff with those diehards and professional protesters who opposed its introduction. (Ask Mrs Serviceman!)

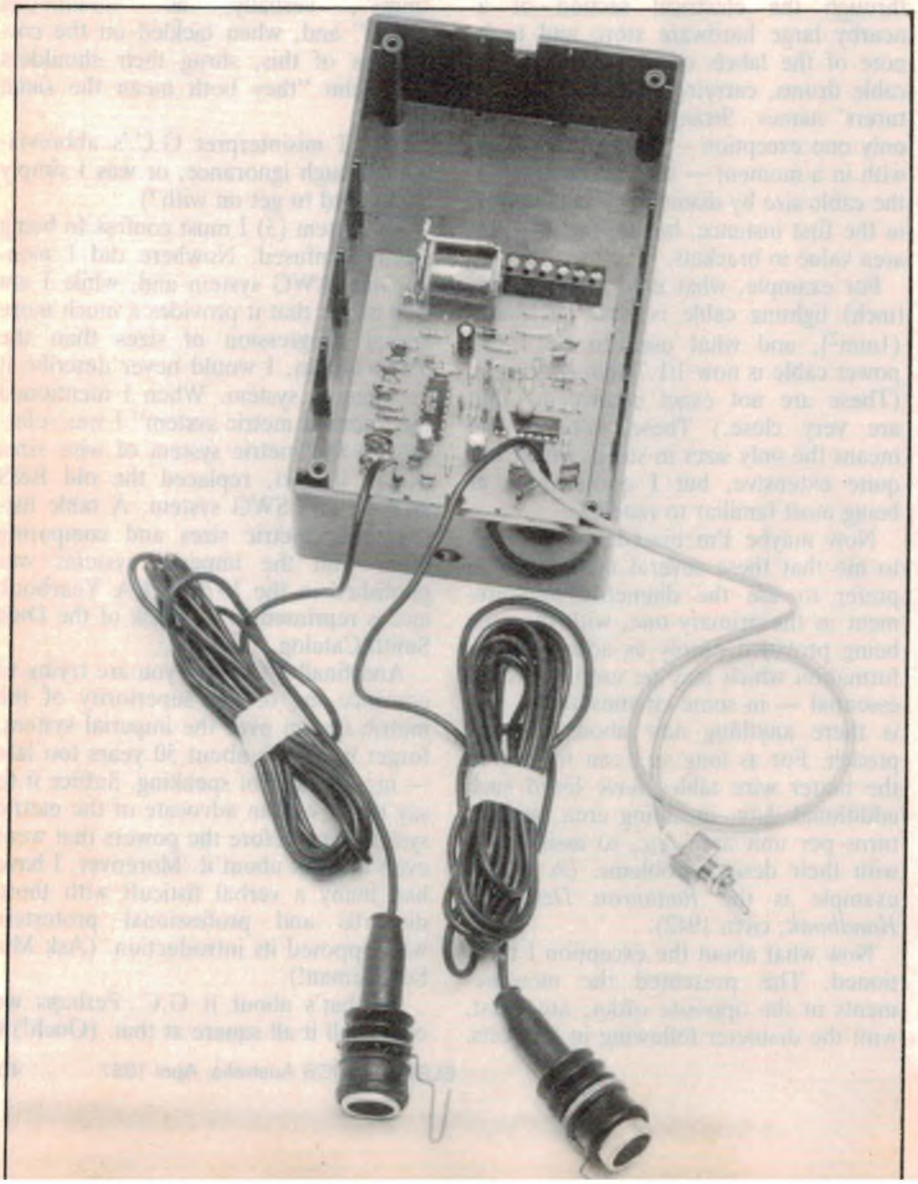
So that's about it G.C. Perhaps we could call it all square at that. (Ouch!)

Protect your home or car with this

Ultrasonic burglar alarm

Here is an inexpensive and self-contained ultrasonic burglar alarm which offers excellent performance for your car or home. It can be activated by either a mechanical switch or the remote control switch described in January.

by BRANCO JUSTIC



Ultrasonic movement detectors are not new — in fact, probably the largest percentage of all movement detectors are ultrasonic. When properly installed and adjusted they provide a reliable and cost-effective burglar alarm in most situations.

Apart from ultrasonic movement detection, this unit also has provision for "hard wired" switches, making it much more versatile. For example, in the case of a vehicle, switches which are operated by the bonnet, boot etc can be wired in, making it extremely difficult to break in without instantly setting off the alarm.

This alarm is designed to be activated by either a switch or, in the case of a wireless remote switch, by relay contacts. If a simple mechanical switch is used, it will have to be located outside the protected area in order to prevent false triggering when you want to go in or out.

Hidden switch or remote control?

For simpler installations, an effective and economical solution would be to have the required switch hidden out of sight. In a vehicle, the switch could be hidden in the boot, under the fenders, or behind a bumper bar. In the home, the switch could be hidden outside the protected area.

In both cases, several switches wired in series could be used in order to improve security, or you can use "barrel key" switches.

The car burglar alarm version was built into a plastic case and the ultrasonic transducers connected to the PCB via long shielded leads. The transducers are mounted on opposite ends of the car dashboard and can be clipped to the trim on the windscreen pillars.

A somewhat classier solution to the switch problem is to use a wireless remote control switch, such as the one described in the January 1987 issue. Note that there is sufficient space inside the plastic case of the alarm to accommodate the UHF Remote Switch circuitry. The resultant alarm system is very easy to install — only two connections have to be made to your car's electrical system (+12V and ground).

Let's now take a look at the circuit and see how the alarm works.

Transmitter

The transmitter section of the circuit is very simple and is based on CMOS inverter stages IC2c-IC2f. A three gate oscillator (IC2c-IC2e) is used to generate a 40kHz square wave at the output of IC2e. The frequency of operation is mainly determined by C10 and the total resistance of R18 and trimpot VR2. VR2 is used to adjust the transmitter frequency to exactly 40kHz.

The output of IC2e drives one side of the transducer (Tx) and inverter IC2f, the output of which drives the other side of the transducer. Thus, by adding IC2f, the drive voltage to the transducer is doubled. Capacitors C11 and C12 (100pF) equalise the loading conditions for the outputs of IC2c and IC2f and thereby ensure that they produce waveforms which are exactly complementary.

Receiver

The 40kHz signal from the transmitter is picked up by the receiver transducer (Rx) and fed via a low pass filter section (R1, C1) to sensitivity control VR1. This allows the sensitivity to be adjusted to suit different applications. From there, the signal is AC-coupled via C2 and R2 to the inverting input of quad op amp stage IC1a. IC1 is a Norton amplifier, type LM3900 or LM3401.

IC1a and IC1b form two identical amplifier stages, each having a gain of approximately 20 at 40kHz as set by R4/R2 and R7/R5. Thus, the overall gain is approximately 400. Capacitors C3 and C5 (in parallel with the feedback resistors) roll off the response of the amplifiers above 70kHz.

The amplified output signal appears at pin 9 of IC1b and is fed to a detector-cum-filter stage consisting of D1, R8, R9 and C6. Thus, in the absence of amplitude changes in the received 40kHz, a steady DC signal appears on the positive terminal of C7.

If, however, there are sudden amplitude changes in the received signal (ie, when there is an intruder), the detector output level varies accordingly. These

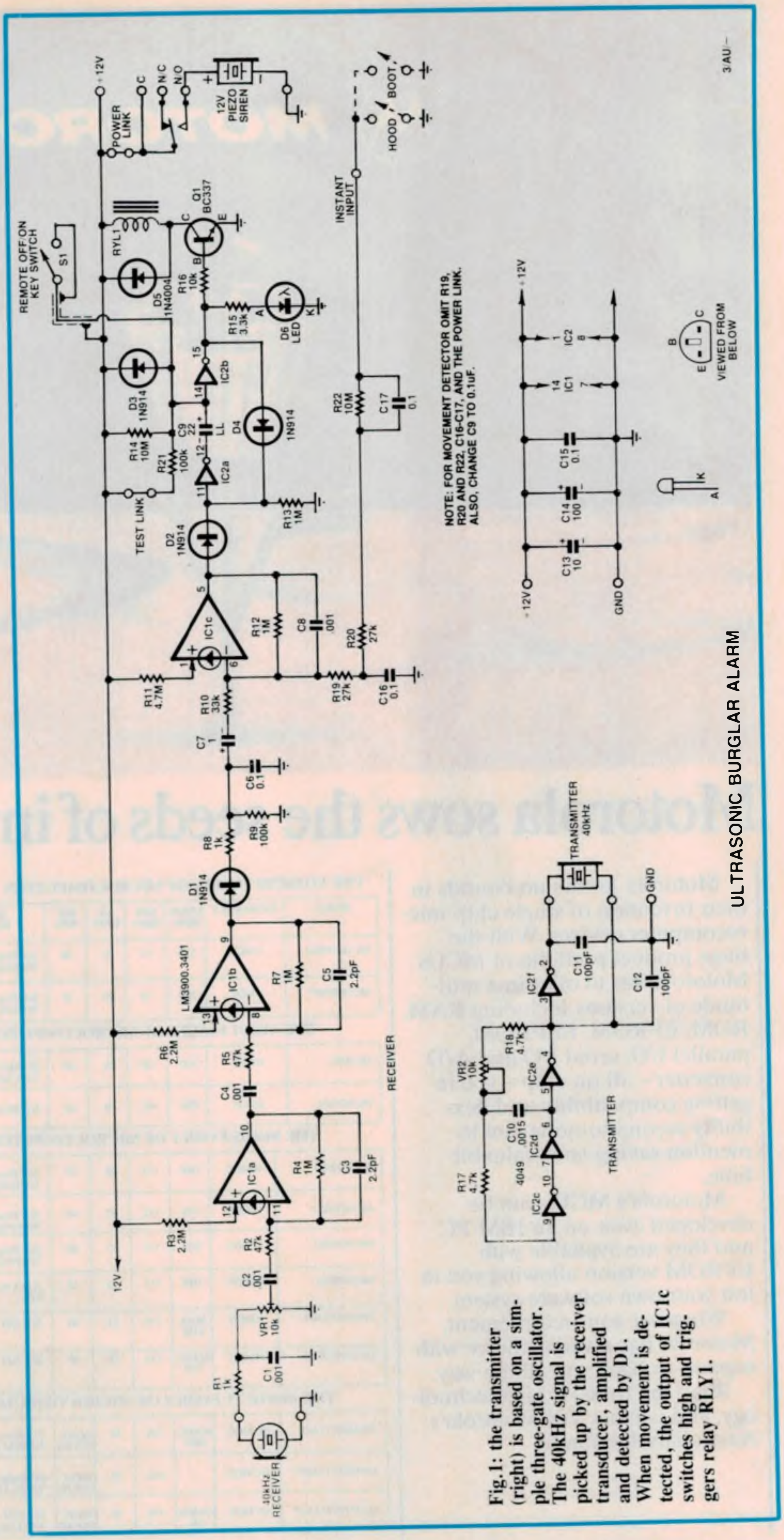
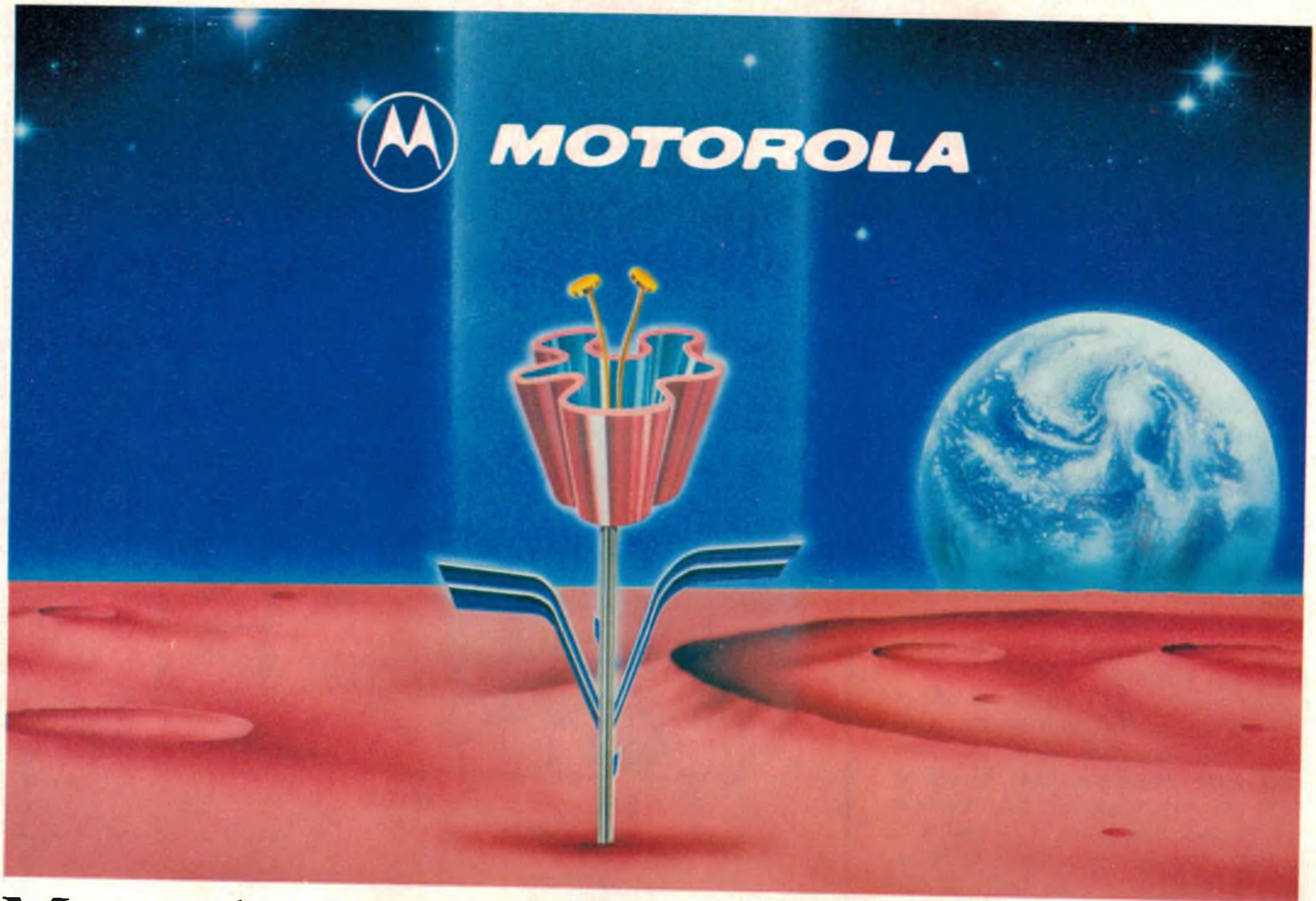


Fig.1: the transmitter (right) is based on a simple three-gate oscillator. The 40kHz signal is picked up by the receiver transducer, amplified and detected by D1. When movement is detected, the output of IC1c switches high and triggers relay RLY1.



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• **QUEENSLAND** (07) 52 5022 • **VICTORIA** (03) 543 6445 • **SOUTH AUSTRALIA** (08) 267 4848 • **WESTERN AUSTRALIA** (09) 328 8499 amplitude variations are coupled via C7 to low frequency amplifier stage IC1c, the output of which is normally biased low. This stage has a gain of approximately 30 and its output is used to trigger a monostable via isolation diode D2.

The monostable consists of inverter gates IC2a and IC2b and their associated components. The "on" time for the monostable, as determined by the values of R14 and C9, is approximately two minutes (no test link). When the test link is included, the "on" time is reduced to approximately one second.

The test link is used when adjusting the sensitivity of the unit during the initial installation. It reduces the waiting time between adjustments from two minutes to one second.

The alarm on-time (without the test link) can easily be extended or shortened by using a different capacitor value for C9 (RBLL or tantalum). For example, a 10μF capacitor gives an alarm time of one minute, while a 47μF capacitor gives an alarm time of four minutes.

Normally, C9 is charged to the positive supply rail and the output of the monostable (pin 15 of IC2b) is low. When an intruder is detected, pin 5 of IC1c goes high and pulls pin 11 of IC2a high via D2. Thus, pins 12 and 14 go low, pin 15 switches high, and the monostable latches up via D4.

C9 now charges towards the positive supply rail via R14 and, after about two minutes, pin 15 switches low again to turn the alarm off. This also effectively resets the alarm so that it will be instantly retriggered if further movement is detected. D3 is included to ensure that the input of IC2b can not go more than 0.6V above the positive supply rail.

The output from the monostable is used to operate a relay via R16 and

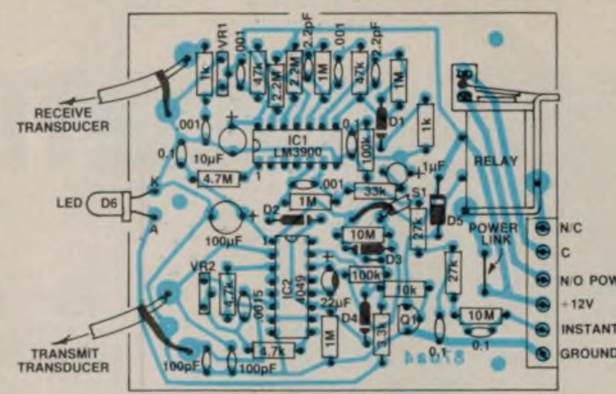


Fig. 2

Fig.2: the parts can be installed in any order on the board but take care with the polarised components. Shielded cable is used to connect the transducers and the remote switch (or relay) terminals.

transistor switch (Q1). A LED indicator (D6) in series with a 3.3kΩ resistor is wired across the monostable output to indicate the "alarm on" condition.

The alarm is turned on and off by a switch wired in parallel with the 10MΩ timing resistor in the monostable circuit. When the switch is closed, pin 14 of IC2b is held high and thus Q1 and the relay are off. As mentioned previously, this switch may be either a keyswitch, a simple toggle switch or a set of relay contacts from the UHF Remote Switch.

Note that the on-board relay contacts of the UHF Remote Switch cannot be used directly as the project was originally described, since the relay wiper was permanenly connected to the +12V rail. Fortunately, this potential problem was recognised in time for the PCB to be modified such that all commercial versions of the board include provision for a power link (just like the present project).

So the solution is quite simple. If you want to use the relay contacts on your remote receiver to switch your ultrasonic alarm on and off, just delete the power link on the receiver PCB. The on/off switch contacts of the ultrasonic alarm are wired across the normally open (N/O) contacts of the relay (ie, between N/O and COM).

Finally, a normally open (N/O) instant trip input is coupled via C17 and a low pass filter network (R19, R20 and C16) to the inverting input of IC1c. Shorting this input to ground instantly triggers the alarm, so it is ideal for protecting the bonnet and the boot. R22 discharges C17 so that the alarm can be instantly retriggered from other instant trip inputs.

C17 ensures that the ultrasonic movement detection circuitry can retrigger the alarm regardless of the status of the instant trip switches.

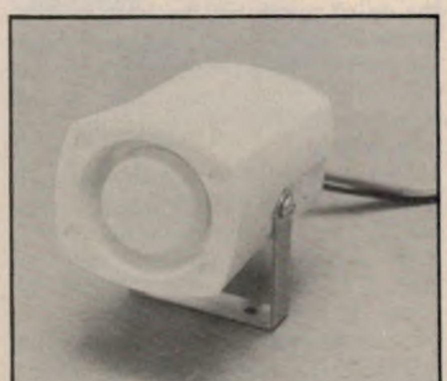
Construction

We built up two versions of the Ultrasonic Burglar Alarm, one for use in a car and the other for use as a movement detector to go with a home burglar alarm system.

Most of the parts are mounted on a printed circuit board (PCB) coded

The alternative movement detector version was built into a clip-together plastic case from Dick Smith Electronics.

The transducers are fitted into rubber spark plug covers. The wire clip enables attachment to the car windscreen pillars.



This compact piezoelectric siren can be hidden under the bonnet or inside the car and emits an ear-splitting modulated tone.

as soon as the Government completes its deliberations with all concerned parties.

While there has been no official government announcement, it is also intended that a 10-day week be introduced in 1988, leaving Sunday where it is. The new week would thus run Sunday, Monday, Blueday, Tuesday, Sicday, Wednesday, Pieday, Thursday, Friday and Saturday (alternatively, Sundie, Mundie, Bludie, Tuesdie, Wensdie, Piedie, Thursdie, Fridie and Satdie).

When this happens, the month will be deemed unwieldy and will be withdrawn.

A particular advantage with metric time is that there is no longer any AM or PM, so there can be no more confusion. The fortnight has been withdrawn. Provision for flexitime has been referred to a 10-member standing committee on which the ACTU will have representation.

Digital clock

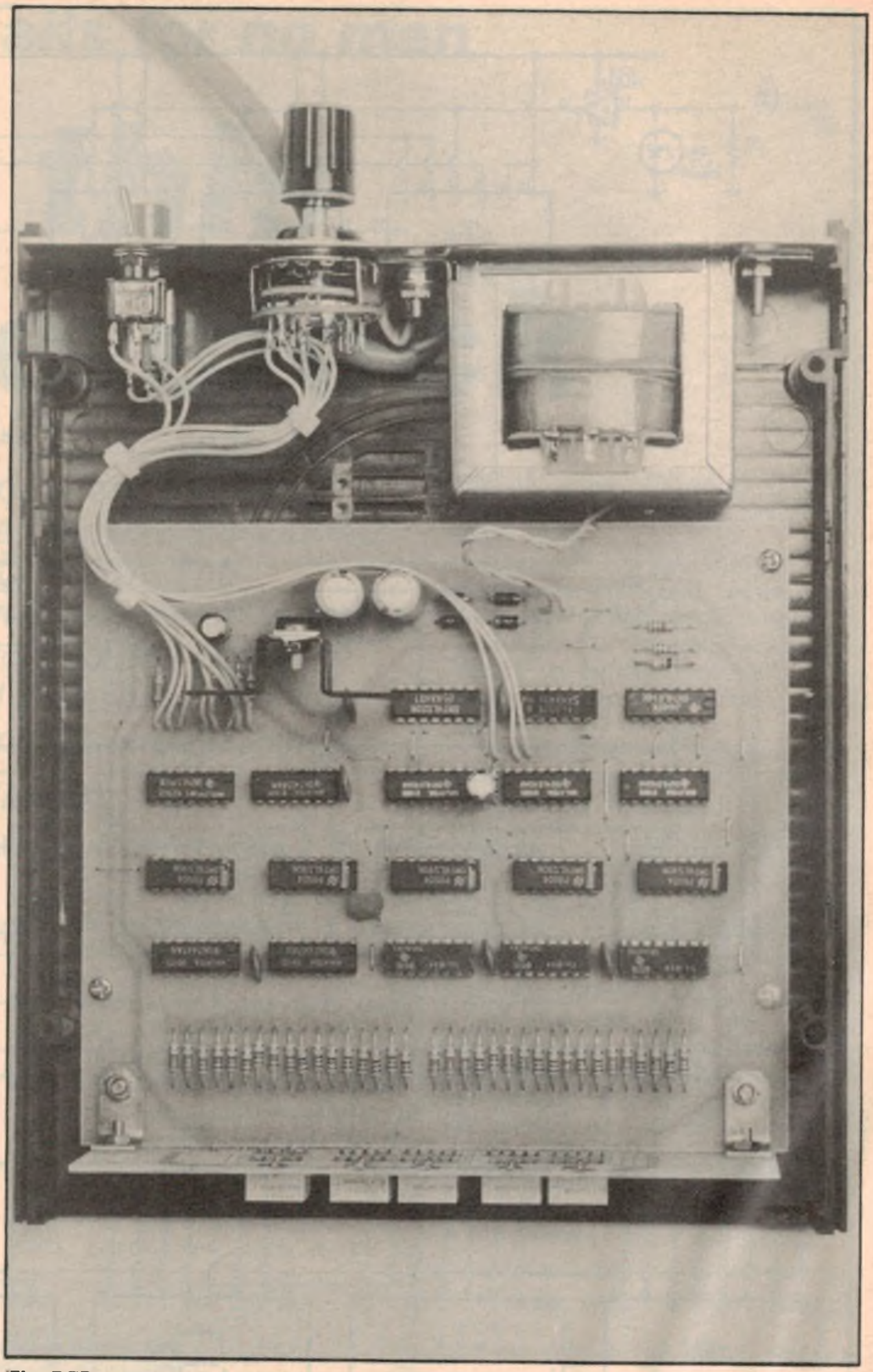
Now all the above may be very straightforward but how do we now tell the time? That's where this new project comes into the picture.

In view of the fact that all existing clocks will be obsolete, we have decided to be the first with the introduction of a metric digital clock (or MDC). We're very proud of the device because its the first metric clock design that we know of. Let's take a closer look at this new marvel of logical thought processes.

The first thing to note is that our new MDC has a 5-digit LED readout that counts up to 9 hours, 99 minutes and 99 seconds. The device is mains operated, is accurate to about ±5 metric seconds per metric day and should only take you about 1.26785 metric hours to build.

All controls are mounted on the rear panel. These consist of a Run/Halt switch, a Reset switch and a Pulse switch. All three are used for setting the time.

The prototype clock was designed and built by Dick Smith Electronics and they have a kit available at $59.95.



The PCB assembly fits neatly inside the DSE H-1895 instrument case. Note that the heatsink supplied with kit versions differs from that shown here and is soldered to the two holes in front of the regulator.

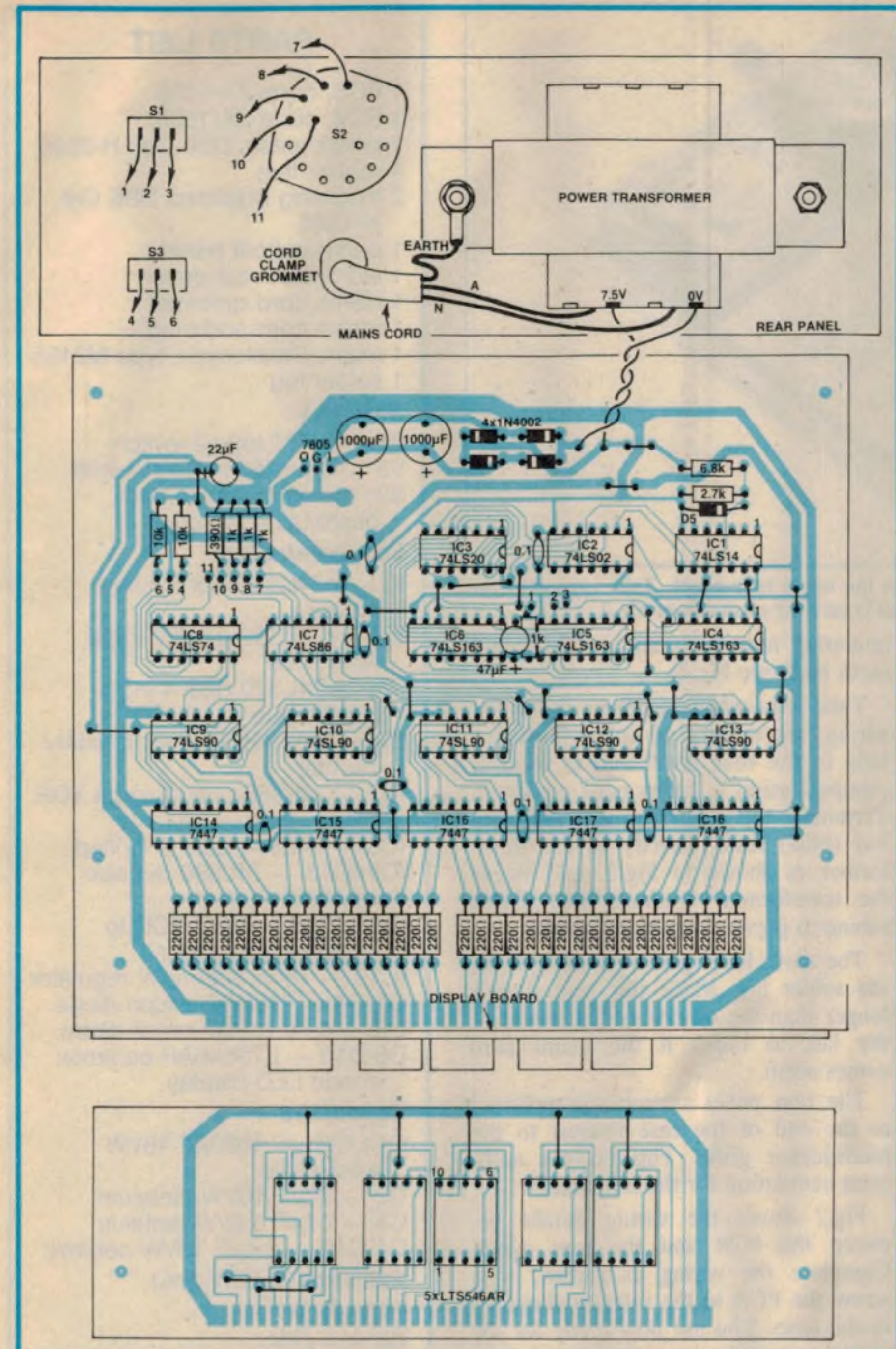
The circuit

Fig.1 shows the circuit of the MDC. It can be broken into three sections: a power supply, a timebase divider (IC1-IC6), and a 5-digit decade counter IC7-IC18. The circuit uses lots of ICs for a very simple reason — proprietary LSI chips for digital metric clocks are not yet available! However the ICs specified can be easily purchased and are reasonably cheap.

Power for the circuit is derived from the 7.5V secondary of mains transformer T1. Its output is rectified using diodes D1-D4 and filtered by two 1000μF electrolytic capacitors (C1a and C1b). The resulting DC is then applied to 3-terminal regulator IC1 which provides a regulated +5V rail to power the TTL ICs.

The 9.5V secondary of the mains transformer also provides the timebase signals for the clock. These pulses do not drive the counter circuit directly, however. Instead, the 50Hz mains pulses are divided by 43.2 to produce a 1.157Hz timebase so that the clock will correctly count in metric time.

This job is performed by the timebase divider circuitry which consists of ICs 1-6. The 50Hz mains pulses picked up from the transformer secondary are first attenuated by a voltage divider (R1,



You can mount the parts in any order on the PCB but take care to ensure that all polarised parts are correctly installed. The two PCBs are soldered together at right angles.

Where to buy the kit

This project was commissioned by the Research and Development Department at Dick Smith Electronics Pty Ltd. It is available as a kit of parts only and can be purchased by mail order or from your nearest DSE store.

The kit comes complete and includes fibreglass PCBs, predrilled metalwork, and screen-printed front and rear panels. The price is $59.95.

Mail orders should be addressed to: Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde 2113. Phone (02) 888 2105.

Note: copyright of the PCB patterns for this project is owned by Dick Smith Electronics.

R2) and then squared up by Schmitt inverter stage IC1a. Diode D5 clips the negative voltage swings of the transformer and ensures that the input to IC1a cannot go above 4.7V.

The output from IC1a is fed to the clock inputs of IC4 and IC5 which are 4-bit synchronous counters. These ICs, together with IC1b, IC2, IC3 and IC6, effectively divide by 43.2 to produce the desired 1.157Hz timebase at the output of NOR gate IC2a. It is this timebase signal which is used to drive the counter circuit.

ICs 9-13 are TTL decade counters arranged in cascade fashion to produce a maximum BCD count of 9.99.99. This is achieved by connecting the Q_D output of each counter to the A input (pin 14) of the following counter. Note that for ICs 9-11, the signal from the preceding counter is gated through an exclusive-OR (XOR) gate (IC7a,b,c).

The counters automatically return to 0.00.00 (ie, metric midnight) after the maximum count of 9.99.99 is reached. ICs 14-18 are BCD to 7-segment decoders which decode the counter outputs. These, in turn, drive the five common anode LED displays via current limiting resistors R10-R44.

Switches S1, S2 and S3 are for time setting. Normally, S1 is in the Run position to enable the timebase divider circuitry, while S2 can be in either position 1 or position 2. S3 is a normally closed (NC) pushbutton switch.

When S1 is set to Halt, the timebase is disabled and the display remains static. To reset the display to 0.00.00, the R0(2) input of each decade counter must be pulled momentarily high. This is done by setting S2 to position 3 and pushing Pulse switch S3.

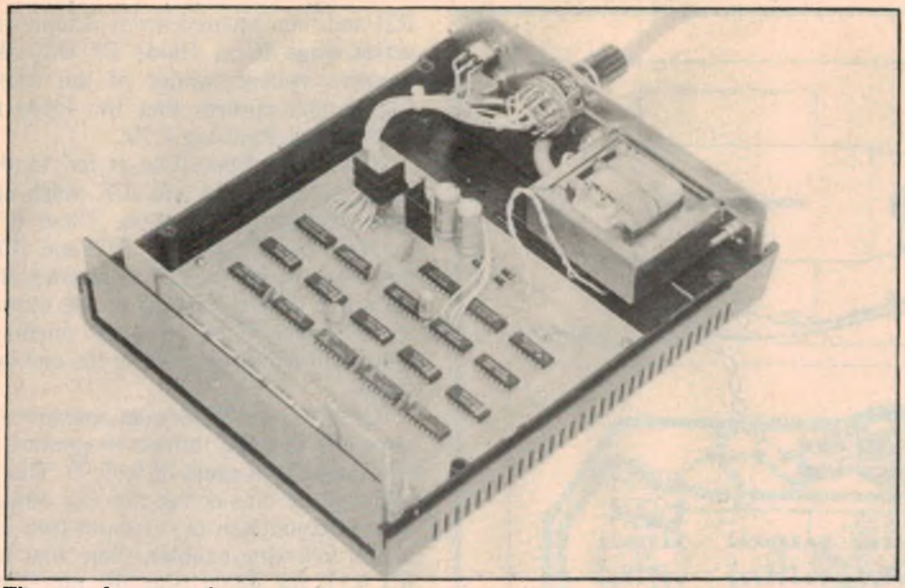
The hours, tens of minutes, and minutes are set by respectively selecting positions 4, 5 and 6 on S2 and repeatedly pushing S3. This clocks the A inputs of ICs 9-11 via the remaining inputs of the X-OR gates.

RS flipflop IC8 (74LS74) debounces the output of S3. Its Q output (pin 9) is normally low but goes high whenever S3 is pressed.

Construction

Most of the parts are mounted on a printed circuit board coded ZA-1555. A separate display board coded ZA-1556 accommodates the LED readouts and is soldered at right angles to the main board.

Begin construction by installing the parts on the main PCB as shown in Fig.2, but do not mount the regulator at this stage. The main thing to watch here



The transformer and switches are mounted on the metal rear panel. Take care with the mains wiring and make sure that the rear panel is earthed as shown in Fig.2.

is the orientation of the polarised components. These include the ICs, diodes and electrolytic capacitors.

Now for the regulator. Before mounting it on the board, it must first be bolted to its heatsink. This done, the assembly can be installed on the PCB as shown in Fig.2. Watch the orientation of the regulator — the metal tab goes towards the front of the PCB.

Note that the heatsink to be supplied with kits differs from that used in the prototype. It is soldered directly to the PCB via two mounting holes directly in front of the regulator.

The display PCB should only take a few minutes to assemble. Install the wire links first, then mount the five LED displays. Make sure that you install the displays the right way round, with the decimal point towards bottom right.

When the board assemblies have been completed, the two can be fastened together using the right angle brackets supplied with the kit. Next, carefully check that the solder pads along the edge of each PCB are correctly aligned. Adjust the two boards as necessary, then solder the matching pads together.

Hardware

The transformer and the three switches are all mounted on the aluminium rear panel of the case. In kit versions, this panel will be supplied predrilled and will feature screened lettering, so the job of mounting the hardware is really easy. Install the three switches first, then bolt the transformer into position.

Note that a solder lug must be secured under one of the transformer mounting nuts to terminate the mains earth lead (see Fig.2).

Take care when installing the mains wiring. The mains cord enters through a hole in the rear panel and is securely clamped using a mains cord grommet. Terminate the active (brown) and neutral (blue) leads directly to the transformer as shown in Fig.2, and sleeve the transformer terminals with plastic tubing to prevent accidental contact.

The earth lead (green/yellow) goes to the solder lug. Make this lead slightly longer than the others so that it will be the last to break if the mains cord comes adrift.

The rear panel assembly is mounted in the end of the case nearest to the loudspeaker grille. This ensures sufficient ventilation for the transformer.

Fig.2 shows the wiring details between the PCB and the rear panel. Complete the wiring as shown, then screw the PCB to the integral standoffs in the case. You are now ready for the smoke test.

Testing

Plug the clock into the wall, switch on and check for +5V at the output of the regulator. If this output is incorrect, switch off immediately and check for wiring errors.

Assuming all is well, you can now check the clock for correct operation. Set S1 to Run and S2 to position 1 (or 2) and check that the clock counts up correctly (it will initially display a random reading). The display should "freeze" when S1 is set to Halt.

Finally, check the timesetting switches (S2 and S3) for correct operation. First, set S2 to position 3 (Reset) and press the pulse switch — the display should reset to 0.00.00. It should now be possible to set the time by selecting the remaining positions on S2 and repeatedly pressing the pulse switch until the correct reading appears.

That's it — your metric digital clock is completed. Next April, we might describe a metric alarm to go with the new clock, but then again we might not.

PARTS LIST

1 PCB, code ZA-1555
1 PCB, code ZA-1556
1 plastic case, DSE Cat. H-2520
4 rubber feet
2 mounting brackets, DSE Cat. H-1895
1 perspex front panel
1 aluminium rear panel
1 mains cord grommet
1 mains cord and plug
1 mains transformer, type M2155
1 solder lug

Switches

S1 — SPDT toggle switch
S2 — 6-position rotary switch
S3 — momentary contact pushbutton switch

Semiconductors

IC1 — 74LS14 hex Schmitt trigger
IC2 — 74LS02 quad 2-input NOR gate
IC3 — 74LS20 dual 4-input NAND gate
IC4-IC6 — 74LS163 4-bit binary counter
IC7 — 74LS86 quad 2-input XOR gate
IC8 — 74LS74 dual D flipflop
IC9-IC13 — 74LS90 decade counter
IC14-IC18 — 7447 BCD to 7-segment decoder
IC19 — 7805 3-terminal regulator
D1-D4 — 1N4002 silicon diode
D5 — 4.7V 0.25W zener diode
D6-D10 — LTS546AR common anode LED display

Capacitors

C1a,C1b — 1000μF 16VW electrolytic
C2 — 22μF 16VW tantalum
C3 — 47μF 6.3VW tantalum
C4-C10 — 0.1μF 16VW ceramic

Resistors (0.25W, 5%)

R1 — 6.8kΩ
R2 — 2.7kΩ
R3, R5-R7 — 1kΩ
R4 — 390Ω
R8-R9 — 10kΩ
R10-R44 — 220Ω

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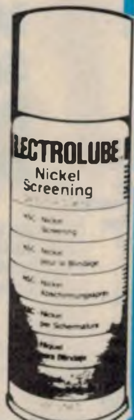

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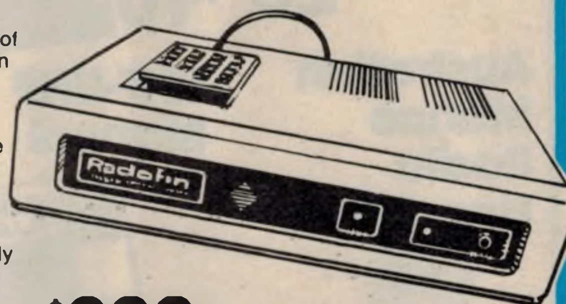

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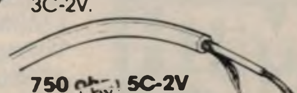

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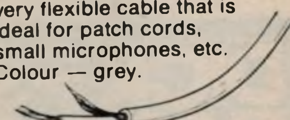

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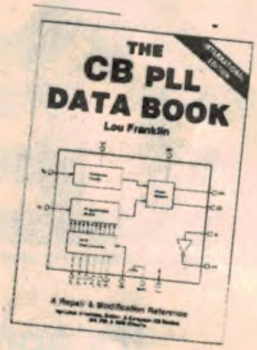

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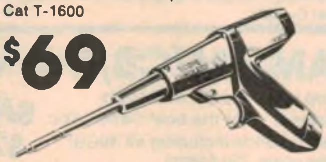

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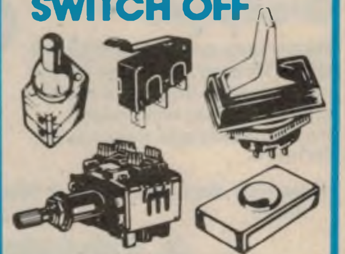
SWITCH ON TO DSE BEFORE THE BARGAINS SWITCH OFF



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Heavy duty grommets made of Black Rubber. Essential when cable passes through a metal chassis as they will prevent frayed cables and live chassis. Cat H-1719

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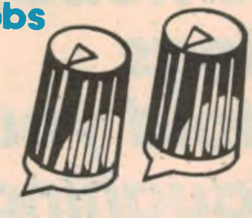

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87¢ each

Orange Cat H-3802, Red Cat H-3800, Green Cat H-3806, Blue Cat H-3804.

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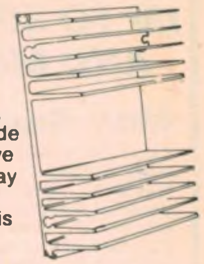
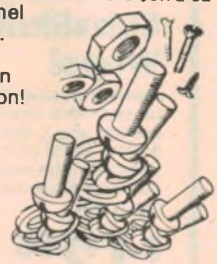


The ingenious design of this heatsink makes it possible to mount it either flat on a panel, or at right angles to it (eg inside a case). The side fins also have tongue and groove so they may be joined sideways. Drilled version takes 2x TO-3's. Size is 78 x 110 x 33mm. Cat H-3460
Undrilled 1-4 $6.36 ea
5 or more $5.72 ea



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50 and 25 years ago...

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

Wireless Weekly 3d

April 1937

Oscillograph: We recently received for inspection the latest product of the Paton Electrical Instrument Company, namely, the highly interesting Model M1 "Palec" Cathode Ray Oscillograph, which incorporates the new one-inch 913 tube.

The specifications of the instrument as supplied by the manufacturers are as follows:

The instrument is equipped with horizontal and vertical shifts to enable the picture to be positioned to any part of the screen. Focus and intensity controls are provided for sharp definition.

Both plates, horizontal and vertical, have independent amplifiers which enable very small EMFs to be viewed. These special amplifiers are "flat" from 50 cps to 100,000 cps.

Radio men go hunting: (caption) On a recent rabbit shooting trip — Ronnie Bell, of RCS Laboratories, tries to skin a rabbit whilst Rae Weingott of Kriesler, supervises the job.

Half-an-hour's hard work and you get one leg nearly out of the skin, and then appreciating the smell you throw the carcase away — that's how to skin a rabbit.

RADIO, TELEVISION and HOBBIES

April 1962

FM Smokescreen: The very large group of listeners who were dismayed, some months ago, by the termination of FM broadcasting, ground their teeth in further frustration at a statement by the Postmaster-General, Mr Davidson, on March 8. Replying in Parliament to a question by Mr Enfield, the Minister said " . . . space would be made available in the ultra-high frequency band for a continuation of frequency modulation broadcasts, if a fairly general desire to have such a service reinstated were indicated by listeners generally . . . as yet I have not been informed of any such general desire."

What kind of double-talk is this? If only a fraction of those listeners who expressed their intention of doing so, actually wrote to their local member, then a very considerable number of letters must have reached Canberra. Did the Minister, by some strange circumstance, not hear of these letters or were the people who wrote them written off as "hifi cranks" whose opinions didn't count?

Ultrasonic camera: Ultrasonics, that is sound of frequencies high above the range audible to the human ear, behave just like x-rays in that if they are made to pass through the human body they will produce a shadow pattern corresponding to areas of greater or lesser absorption by bone or soft tissue respectively.

This property has been put to use in an ultrasonic viewing device. In a tank full of water or other transfer medium a point source of ultrasonics, which is a single piezoelectric cystal, emits a beam of sound waves which pass through an object in the tank. They are then focussed by an acoustic lens to give an intensity distribution image on an electromagnetic transducer plate. This plate forms the end-window of a high-vacuum electron tube and is continuously scanned by an electron beam.

Applications suggested include biological studies, non-destructive testing of bonds between surfaces of various compositions, tests on resistance-welding and examination of materials which are highly absorbent to x-rays.

Ultra D6000 CD player from Shure

For at least 50 years, Shure has been a manufacturer of fine magnetic cartridges and microphones and it continues to be so. But now it has moved into the digital age with the introduction of its own compact disc player which is a very refined machine indeed.

The Ultra D6000 is a fairly large machine, as CD players go, meauring 430mm wide, 75mm high and 325mm deep. Its mass is 5kg. As with the vast majority of hifi equipment today, the D6000 is finished in black with the control legends in gold. A good point here is that the labelling is quite legible which is a different story to some hifi equipment.

The display is a greeny-blue fluorescent panel which is also highly legible as well as being attractive. It displays the playing mode, time from the beginning of the program being played, the track number and index and the memory and repeat modes.

As far as the control features are concerned, the player itself is not overloaded with control buttons. Besides those for power and open/close buttons, it has buttons for stop/clear (clears memory), audible fast forward and reverse, skip forward and reverse, play/pause, repeat, A-B (for repeating a musical phrase) and memory (for programming). The remaining front panel features comprise the headphone socket and associated level control.

On the rear panel, the D6000 has two pairs of RCA sockets, for the fixed and variable audio outputs. It also has a 5-pin DIN socket for video image subcode output, if and when this facility becomes available, plus a mains voltage selector.

Remote control

The deluxe feature of the D6000 is the comprehensive remote control. This actually provides more features than are available via the front panel controls. It has a numerical keypad to select track for immediate play or programming and it has two buttons for volume control. This last feature takes the D6000 into a very select group of CD players. The volume up and down buttons actually cause the front panel volume control knob to rotate clockwise or anticlockwise, respectively.

Using a mechanically rotated volume control in this way may seem a little inelegant but it is one way of being certain that the performance of the output amplifiers is not degraded by electronic volume control circuitry. In practice too, having the volume control visibly rotate is useful because it gives a simple and unambiguous indication of the volume setting, so that you do not blast yourself and your loudspeakers, or worse, your headphones.

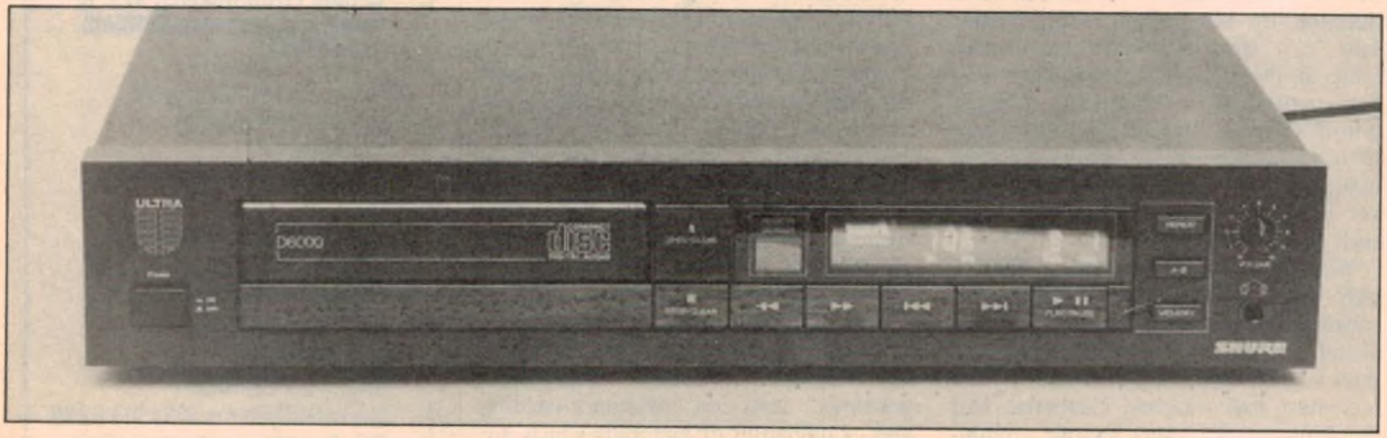
We found the remote control to be very effective, out to at least five metres from the machine. One could argue that it is not necessary to have the CD drawer open and close under remote control but what the hell, it stops you putting fingerprints on the player, doesn't it?

Inside the large chassis, the D6000 has one large printed circuit board and a number of smaller boards to accommodate the circuitry. One of those boards accommodates the motor-driven volume control.

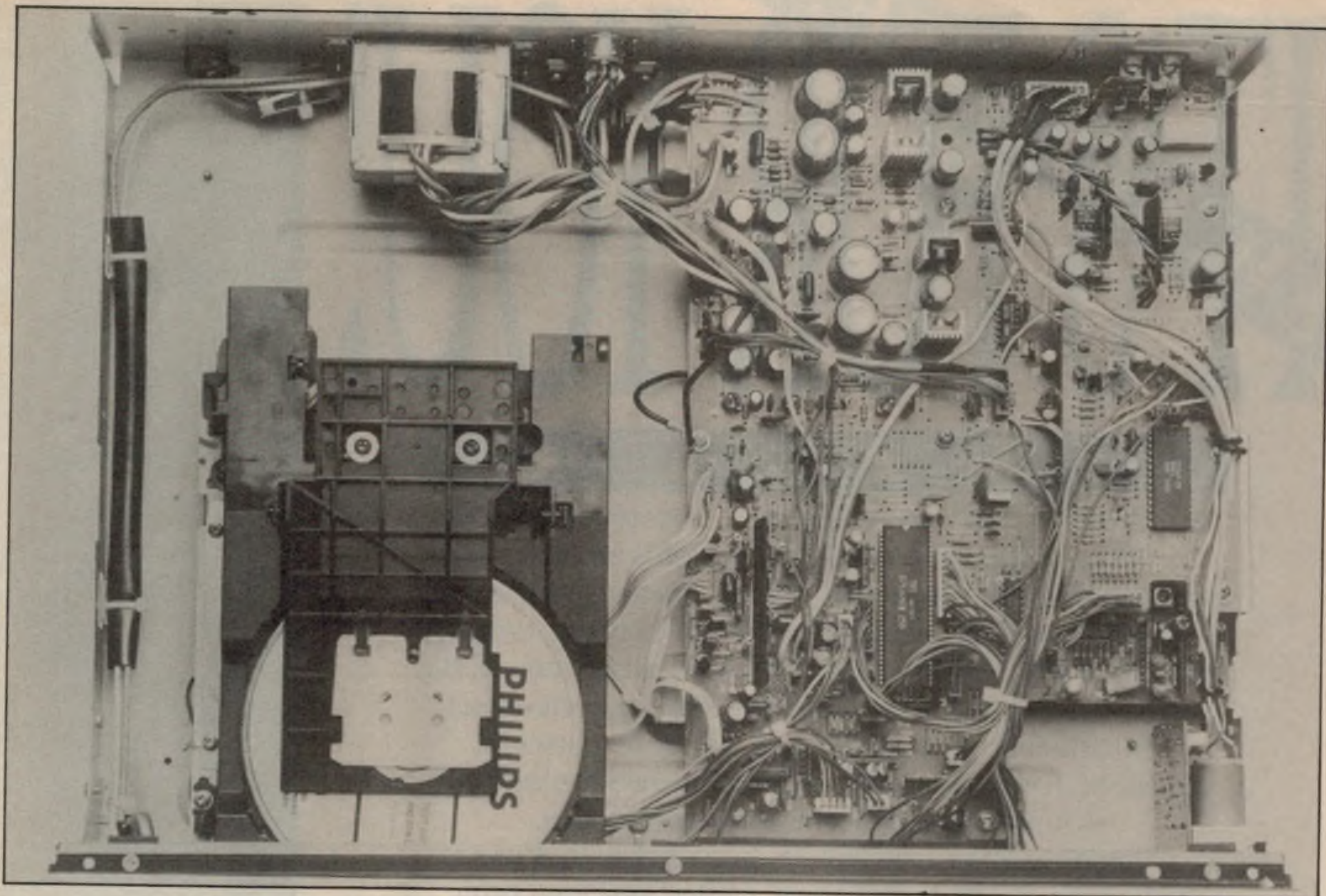
While manufactured according to Shure's specifications, the D6000 is made in Japan and the principal parts appear to be mostly sourced from NEC.

Shure's D6000 uses a 16-bit digital-to-analog decoder and two-times oversampling.

Interestingly, as with most Japanese-made consumer electronic equipment, the PC boards are single-sided instead of double-sided, use lots of wire links and have lots of interconnecting cables. Apparently, the Japanese take the attitude that this approach is cheaper and



Shure's front-loading D6000 CD player has infrared remote control of all functions, including volume.



View inside the chassis of the Shure D6000. The linearity of this player is one of the best we have seen to date.

more reliable than using the more elegant approach of double-sided boards with almost no additional wiring.

With the steady evolution of CD player design, it is apparent that the circuitry is becoming much simpler due to the increasing use of ever more complex VLSI chips. At the same time, the player mechanisms are becoming smaller, lighter and physically simpler. While this is happening, the operational aspects of the players are tending to improve.

The major improvements have been in the laser tracking which means that the later CD players are generally better in their handling of CD defects such as scratches, warps and eccentricity. These new players also are less susceptible to shock and vibration.

Shure's CD transport mechanism, which has a linear tracking laser pickup, is certainly elegantly simple in appearance. However, it has two mechanism locking screws which must be removed from the underside before the deck can be played. As we have remarked in previous reviews, we would like to see these screws either eliminated or have alternative storage holes in the chassis so that they won't be lost.

In use, the D6000 operates a very refined way. The disc drawer opens and closes smoothly and quietly, without hesitation. Tracks are accessed quickly, typically under three seconds, and mechanical noise is quite low.

Performance measurements

Measuring the performance of CD players can be a jading experience since so many decks have so little to distinquish them — they are all good — but few are outstanding. In this case though, the D6000 stands out. Its frequency response was unusually flat from 20Hz to 18kHz and was then only 0.25dB down at 20kHz.

Linearity tests also gave some of the best results measured to date. There was only -1dB error at a level of -80dB, and only —1.5dB at 90dB. Many decks have linearity errors much greater than this.

Results for total harmonic distortion and separation between channels were more or less standard though, and in line with Shure's conservative specifications of 0.01% and -80dB at 1kHz respectively.

Signal-to-noise ratio was very good with a result of -103dB and intermodulation distortion was very good with a result of 0.0036%.

Tracking tests generally gave good results too. On the Philips No 4a defect disc, the D6000 got the all clear apart from some intermittent faint mistracking on the 900μm interruption. It easily played a badly warped disc which has fazed other decks, with the laser pickup actually periodically bumping the underside of the disc in some cases. And on our badly scratched disc it managed to load and play all tracks except two.

The D6000 is also very good as far as susceptibility to shock and vibration is concerned and it seems quite insensitive to bumping and jarring. So on the whole, the D6000 turns in a very good tracking performance.

The performance summary is therefore good: excellent sound quality, good measured results, good tracking and refined operation, especially with the remote control. What more could you want? Recommended retail price is $1899.00.

For further information regarding the Shure Ultra D6000 contact the Australian distributors, Audio Engineers Pty Ltd, 342 Kent St, Sydney, 2000. Phone (02) 29-6731. (L.D.S.)


microbee

A simple temperature-controlled crystal oven

Does your frequency meter drift as it warms up and as the ambient temperature changes? Unless it has an oven-controlled crystal oscillator it will drift quite a lot. Here is a simple, easy to make, crystal oven which controls the crystal temperature within close limits.

by IAN POGSON, VK2AZN

These days, many people have a seven or eight digit frequency meter in their workshop. Such an instrument is vital for frequency measurements but the accuracy of many DFMs is often questionable in spite of the fact that they have so many digits.

There are two problems to be overcome in ensuring that the best possible accuracy is obtained from a frequency meter. The first is calibration and the second is overcoming drift in the crystal oscillator timebase due to temperature changes. The problem of calibration can't really be addressed until drift is fixed.

What is drift?

All frequency meters have a crystal oscillator timebase which provides the reference frequency against which the frequency to be measured is compared. In the best of worlds, the crystal oscillator reference would be "absolute", dead on frequency to within ±1Hz and unchanging in value regardless of time, temperature or any parameter.

Unfortunately, that is not the case. The typical 10MHz crystal found in most digital frequency meters is nominally only within about ±1kHz of its designated frequency, although when calibrated it is usually within about ±10Hz at a particular temperature. Here is where drift comes into play.

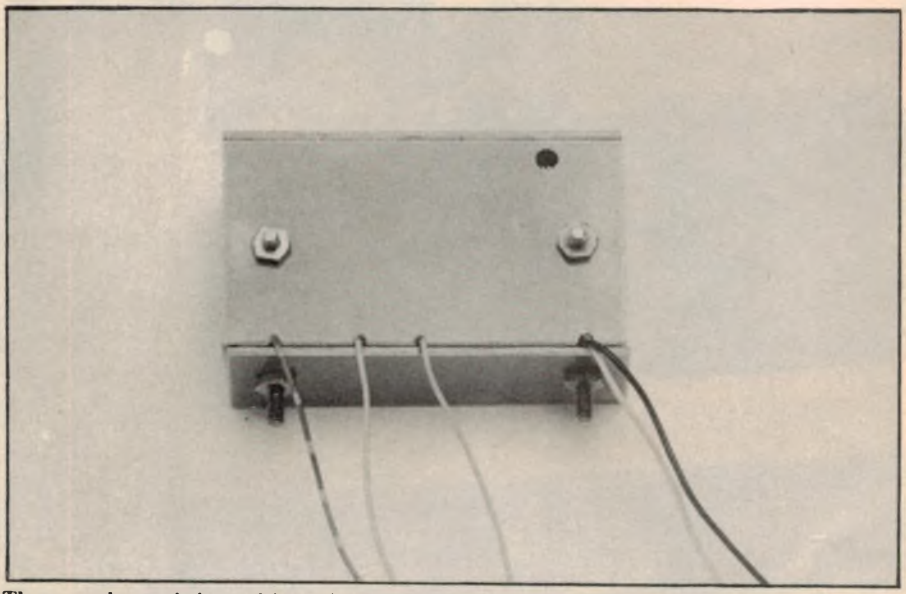
All oscillators drift, which is to say that their operating frequency changes with temperature. In LC or RC oscillators, the drift is due to the temperature coefficients of capacitance, inductance and resistance of the frequency determining components. In crystal oscillators, temperature has less effect but it is still quite marked and needs to be compensated if the best accuracy is to be obtained.

Fig.1 shows the drift of typical AT-cut crystals. In order to make the graphs as general as possible, the frequency axis is labelled in parts per million so if we are considering a 10MHz crystal, we could multiply all the values on the vertical axis by 10 to obtain the exact frequency variation in Hertz.

Fig.1 shows three curves. These are just three examples of a large family of curves for 10MHz AT-cut crystals. The variation in curve shapes is a result of very small differences in the angle at which the particular crystals are cut from the mother quartz. As can be seen, these small differences lead to quite large variations in the crystal's temperature performance.

Notice that all the curves have a common crossover point, corresponding to a temperature of 27°C. Curves A and B each have turnover points while curve C has no turnover points at all. (A turnover point is where the curve gradient goes from positive to negative or vice versa.)

The upper turnover point of curve A is at about 53°C, while the upper turnover point for curve B is at about 88°C.



The crystal oven is housed in an insulated box made from PCB laminate.

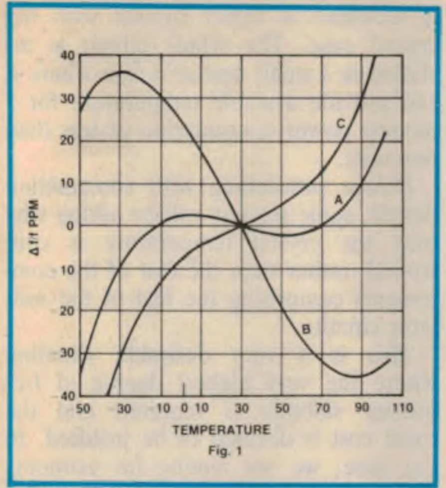
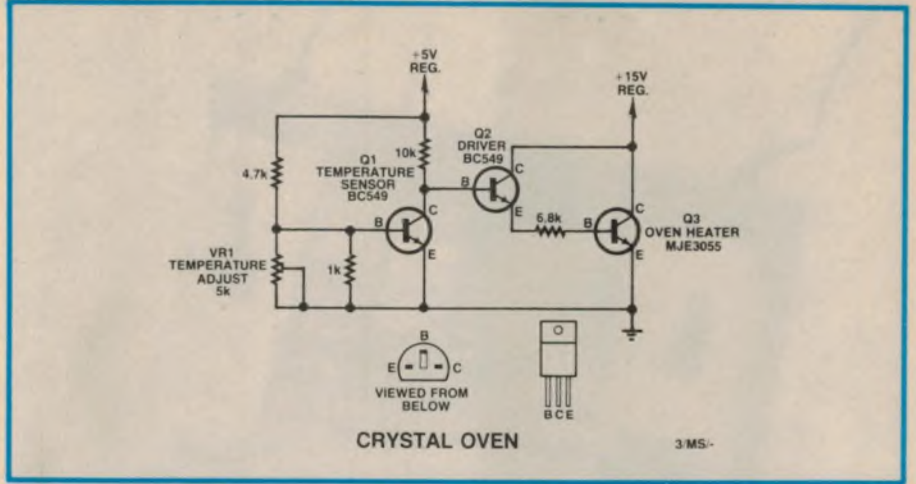


Fig.1: typical drift vs. temperature curves for 10MHz AT-cut crystals.



The circuit uses just three NPN transistors. Q1, in direct contact with the crystal, serves as the temperature sensor and controls the current through Darlington pair Q2 and Q3.

Note that these three curves are typical but there are whole families of curves for crystal performance, depending on the way in which they are cut. Pick a curve, any curve.

The task of determining the best curve to use depends on the circuit. For a simple circuit designed for ambient temperature conditions, a crystal with curve A would be close to ideal. Note that it has very little variation in frequency between about –10 and +70°C.

On the other hand, where a crystal is to be used in a temperature-controlled oven, curve B might be selected. This has a turnover which is safely above any expected ambient temperature maximum. Fairly obviously though, there is little point in selecting a higher temperature of operation than is necessary.

Curve C, on the other hand, being fairly linear with temperature, might be selected for crystals to be used in temperature-compensated circuits, which is a more economical approach to the temperature problem. Unfortunately, satisfactory compensation is not easy to achieve.

The foregoing gives a general indication as to the best choice to be made for the most desirable operation of a crystal with regard to temperature. This means that a crystal would be ordered with the required specifications.

Reality recovered

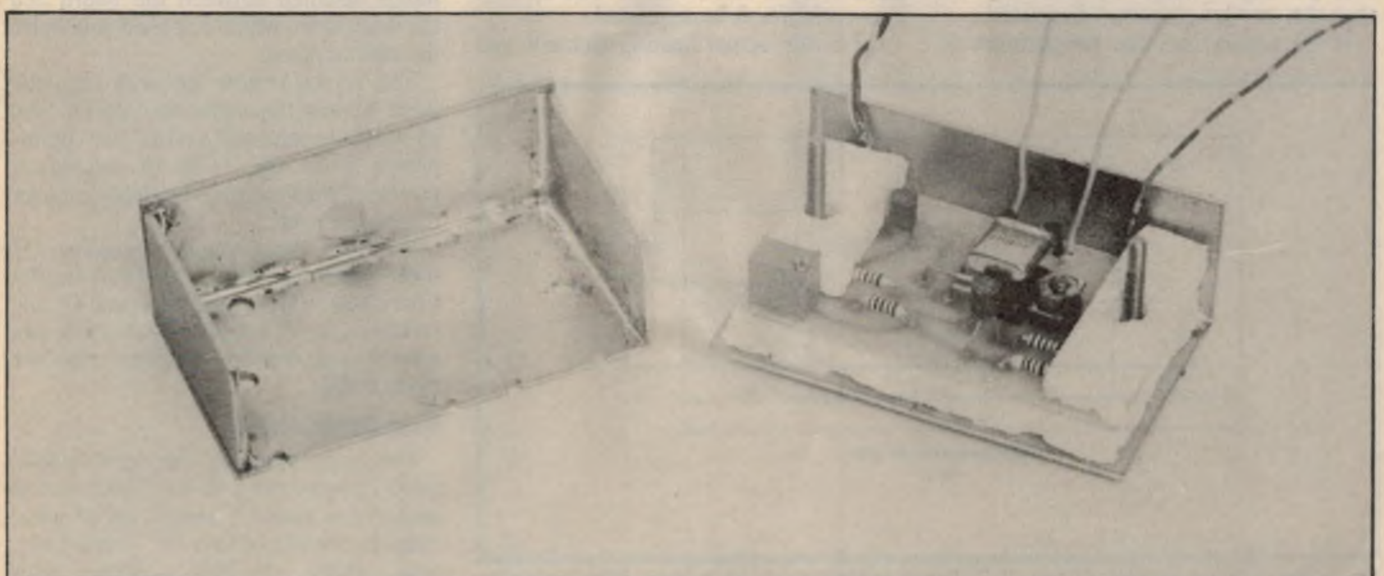
So much for the most desirable situation. Let's now get our feet firmly back on the ground. There are many off-the-shelf crystals available today at quite reasonable prices and which may be used with satisfactory results. Most commonly, these crystals are intended for non-critical applications and have a temperature characteristic similar to that of curve C.

These can be operated in the oven to be described and the combination is very satisfactory. Astute readers will already be asking the question, "What about the non-existent turnover point where it is desirable to operate an ovened crystal?" The simple answer is that we ignore this ideal and do the next best thing.

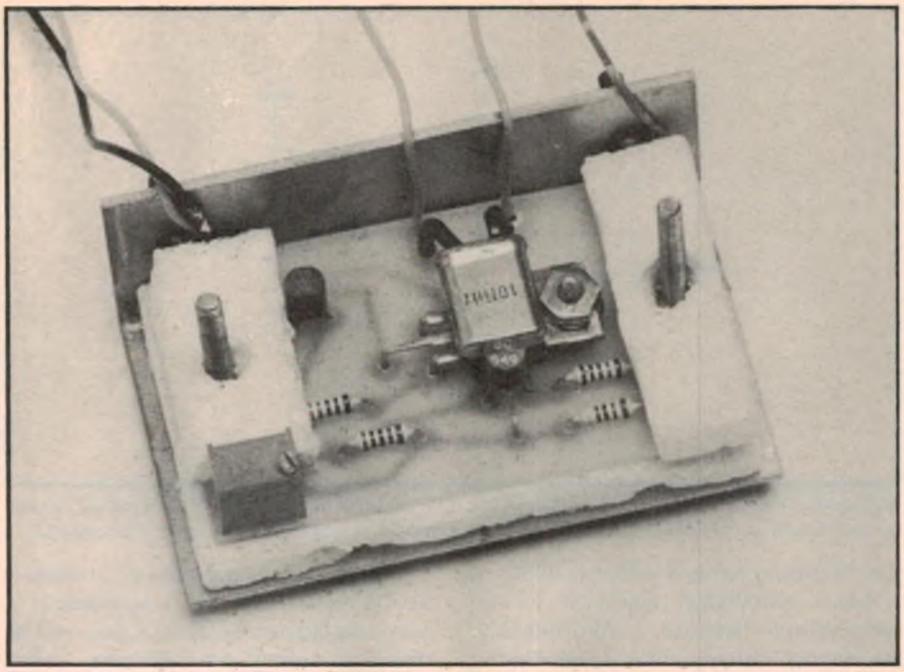
Good performance can be obtained by operating the crystal at a temperature between about 45°C and 50°C. If operation is considered in the tropics, then the temperature of the oven will have to be increased to, say, 60°C or more.

It must be admitted that a crystal similar to curve C does not give the best possible frequency stability but it is a whole lot better than lesser measures.

So much for the reasons why it is so desirable to control the temperature of



How the oven assembly goes together. Note that the top piece of foam insulation is missing from this photograph.



Close-up view of the PCB assembly. The crystal is held firmly against the temperature sensing and heating transistors (Q1 and Q3) by a top layer of foam insulation (see text).

a crystal. Let's now have a look and see how this may be achieved.

The circuit

The essence of the circuit is very simple. It uses a small signal NPN silicon transistor as the sensing element followed by a Darlington transistor pair as the heating element.

This is how it works: The temperature sensing transistor (Q1) is in direct contact with the case of the crystal. Q1 is biased on, as set by the 5kΩ trimpot connected between its base and emitter. The voltage at the collector of Q1 therefore determines the amount of current passing through Q2 and Q3 and thus the amount of power dissipated.

If Q1 senses that the temperature is reducing, its collector current will be reduced accordingly and the base voltage of Q2 will rise. This will increase the conduction of Q2 and Q3, raising the power dissipation and bringing the temperature back up to the required value.

Alternatively, if Q1 senses that the temperature is rising, it will tend to reduce the conduction of Q2 and Q3, to bring the temperature back down to par.

In practice, the 5kΩ trimpot is used to set the operating temperture of the oven. The 5V supply to Q1 should be well regulated, as from a 3-terminal regulator (eg, 7805). The 15V supply to Q2 and Q3 is not a critical value, nor is it essential for it be regulated.

Q3 is the actual heating element and is mounted in direct contact with the crystal case. The whole circuit is installed in a small insulated case where it can provide a stable temperature for a modest power consumption of less than one watt.

Before proceeding with construction details, some readers will be asking why only the crystal temperature is controlled, rather than the rest of the components comprising the rest of the osillator circuit.

This is a very desirable situation where the very highest degree of frequency stability is required and the extra cost is deemed to be justified. In our case, we are aiming for economy and ease of implementation (ie, taking the easy way out).

Construction

All of the components for the circuit and the crystal are mounted on a printed circuit board coded 87ov4 and measuring 61 x 36mm. As noted above, only the crystal is controlled, so none of the other oscillator circuit components are mounted on the board. A pair of flying leads from the printed circuit board connects the crystal to the relevant oscillator circuit.

As such, the circuit could be used for timebase temperature control in frequency meters, synthesised tuners and computer equipment.

Mount the four resistors first, then Q2 and the 5kΩ trimpot. Q3 is installed with the back (metal side) uppermost. The three leads are bent to fit the board and the transistor is set so that its hole is in line with the matching hole on the board. A 3mm screw is used to firmly hold the transistor. Note that a spacing nut is installed between the board and the transistor, while a second nut holds the unit in place.

The crystal is now laid with one side flush against the metal face of Q3 and its leads terminated at the two points provided on the PCB. A couple of pieces of sleeving may be used to cover the crystal leads.

With the above items in position, Q1 should now be installed so that its flat side rests firmly against the end of the crystal case. Assembly of the PCB can now be completed by attaching the five flying leads.

Insulated box

The box containing the oven components measures 69 x 38 x 25.4mm and is made from printed circuit copper laminate. It consists of two "L" shaped sections which are held together with screws and nuts.

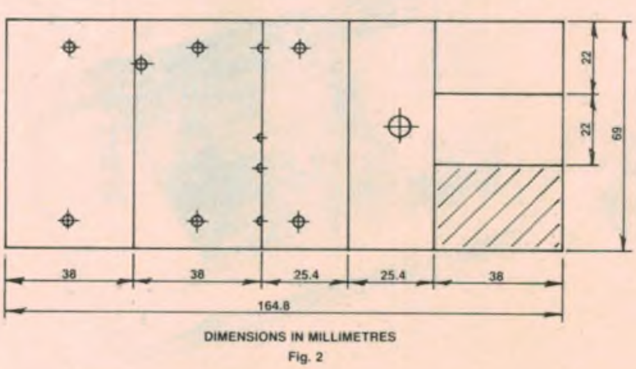


Fig.2: the oven box consists of two "L" shaped sections made from blank PCB laminate. This drawing shows the dimensions of the various sections.

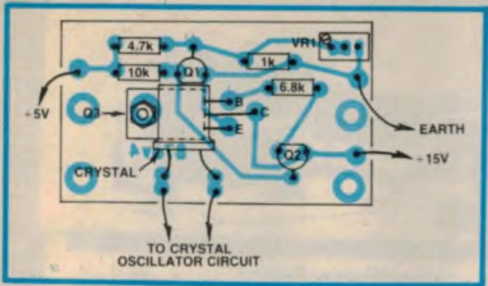


Fig.3: it's vital that Q1, Q3 and the crystal are installed in contact exactly as shown.

The drawing shows how a blank may be guillotined with a minimum of waste. If the board is to be cut with a hacksaw, then due allowance will need to be made for this. To make life just that much easier, Geoff Wood Electronics has agreed to make a set of guillotined panels available.

Several holes need to be drilled in the panels. One is to allow access to the temperature setting trimpot after assembly. A somewhat larger hole is provided on the top panel to allow a thermometer to be inserted to check the crystal temperature. In addition, there are four notches to be filed out along the bottom edge of one panel to provide exits for the flying leads.

You will need a fairly robust soldering iron to solder the panels together. The copper cladding is just like a heat sponge and an iron of about 60W rating will be needed. When soldering the pieces together, care must be taken to make straight and square joints.

Having made the box, we are now ready for the final assembly. From a piece of polystyrene foam (used for packing in cartons), 6mm thick, cut two pieces that will fit neatly inside the two large panels. Two more small end pieces will be required later but these may be dictated by the assembly as it progresses.

Now take two 3 x 32mm screws and push them through the two holes from the outside on the large panel and screw a nut on each. Pierce two holes in one piece of foam, push it over the screws and up to the panel. Screw two more nuts on firmly so that the foam is flat against the panel. The nuts will then be bedded into the foam.

Now push the PC board over the screws, copper side first and firmly fix with two more nuts. On the bottom panel, drop two 9mm long screws through the two holes provided and run a nut on each. These screws are for subsequent mounting of the oven inside the chassis of your chosen piece of gear.

Using the same technique as before, pierce two holes in the other piece of foam. Also, with a sharp knife, cut a small rectangle out of the appropriate corner of the foam so that it will clear the 5kΩ trimpot.

At this stage it will be obvious where two more small pieces of foam can be cut and fitted at the ends. (The top and bottom edges were left uncovered with foam). Assemble the pieces of foam such that the large piece is in contact with the crystal case.

To complete the assembly of the crystal oven, the other half of the box is slipped into place over the screws and the five leads carefully guided into the four notches along the bottom edge of the panel. This done, the two nuts are added to the screws and lightly tightened to hold the assembly together.

Temperature adjustment

We are now in a position to power up the oven and make the necessary temperature adjustments. You will need a power supply with a very well regulated 5V source and another supply of between 12 and 20V.

The following procedure is suggested for setting up the oven. Set the temperature adjusting trimpot to maximum resistance. Connect the 5V and 15V leads to the power supply, the latter via a mA meter set to the 500mA range.

Switch on. All being well, the meter will only indicate a very small amount of current, as the MJE3055 transistor will not be conducting. Now rotate the trimpot screw until the current starts to rise on the meter and continue until about 200mA is reached.

It is possible that you may not be able to get the meter reading up to 200mA. If it reaches about 150mA, then this will usually be quite sufficient. When the meter fails to rise further, do not continue to rotate the trimpot screw.

If you wish to increase the current flow through the MJE3055, this may be done by reducing the value of the 6.8kΩ resistor feeding its base. Alternately, if you wish to reduce the maximum current, then the reverse will apply.

Having set the maximum current, wait for a couple of minutes and the current will slowly fall to quite a low level, about 20mA or so. Temperature measurements may now be taken, either with a suitable glass thermometer or a probe. Either can be inserted through the hole provided and the thermometer bulb or probe must be in contact with the side of the crystal case.

Over a period, continue to advance the trimpot until the required temperature is reached. Temperatures between 45 and 50 degrees Celsius should be obtained with a current of the order of 40mA or so. This will vary according to ambient temperature and the value of supply voltage used.

A reasonable time should be allowed for the temperature to stabilise. This should be achieved in an hour or so. When the temperature setting has been finalised, the thermometer should be removed and the hole covered with a small piece of masking tape. The unit is then ready to be connected into the oscillator circuit and put into operation.

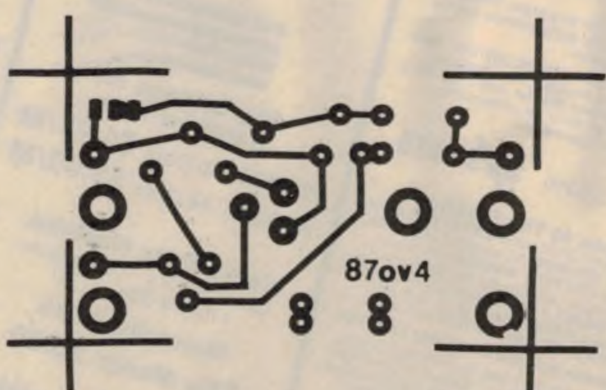


Fig.4: actual size reproduction of the PC artwork.

PARTS LIST

1 PCB, code 870v4, 61 x 36mm
1 insulated box (see text)
2 BC549 NPN transistors
1 MJE3055 NPN power transistor
1 10kΩ 0.25W resistor
1 4.7kΩ 0.25W resistor
1 5kΩ trimpot, Bourns 3299 or equivalent
1 crystal (for external circuit)

Miscellaneous

Polystyrene foam, copper laminate, screws, nuts, hook-up wire, solder

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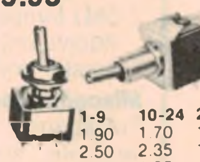

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S 1027	SPDT centre off PCB	2 75	2.50	1 80
S 1030	DPDT centre off	2.75	2 50	1.79
S 1035	DPDT PCB	2.75	2.50	1 79
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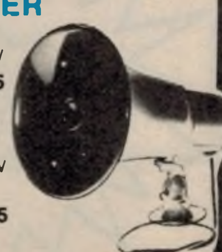

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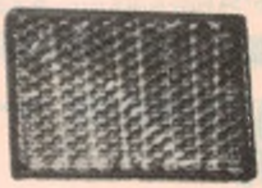

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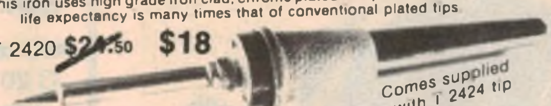

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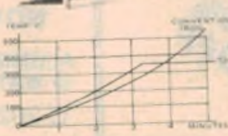

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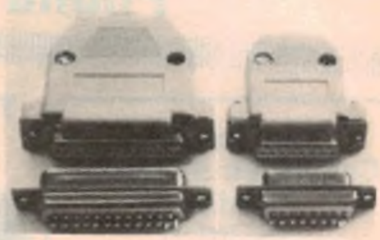

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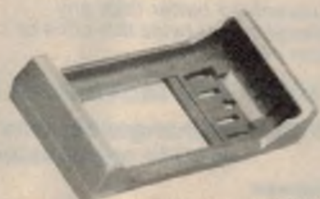

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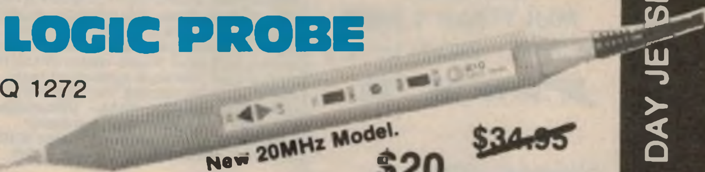

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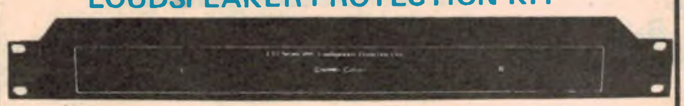

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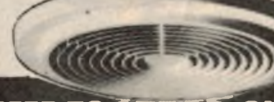

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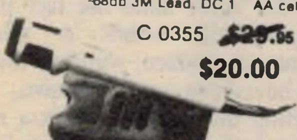

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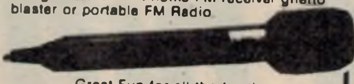

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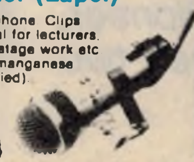

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CESA Hifi Grand Prix Awards

The best hifi products for 1986

The third year of the Australian hifi awards resulted in awards in all but two categories: tuners and turntables. The winning brands were all Japanese: JVC, Marantz, Pioneer, Technics and Yamaha which received two awards.

by LEO SIMPSON

The third year of the CESA Grand Prix awards, Australia's own hifi awards, reflected the tough nature of the hifi market in recent times. There were less products entered in most categories and some categories did not have many entries at all.

Disappointingly perhaps, the closing date for entries prevented a number of manufacturers from presenting products which might have altered the outcome in some categories, or at least, stiffened the competition. Still, that means an interesting round in the awards for next year.

On being confronted by all the entries for this year's awards, the judges' first reactions were that there were just not enough entries. Closer examination revealed that there were indeed some good products but that in one or two categories the number and quality of entries might not be enough to give a good result.

The overriding concern of the judges of these awards was that they maintain a high standard. If there was any suggestion that winners in some categories were not really up to par, the whole award concept would be jeopardised. With this in mind, the judges considered all the entries very closely and deliberated at some length before coming to their conclusions.

As a point of interest, the prices of some hifi products have increased markedly since the entries for this year's awards closed, at the end August 1986. In one or two cases the price increases have been as high as 30%.

This has been due to the considerable appreciation of the Japanese yen against the Australian dollar. Most of this appreciation occurred in late 1985 and early 1986 but the effect on prices was delayed as long as possible by the hifi importers and distributors. Prices quoted throughout this article are those effective in February 1987.

Amplifiers

In many ways, amplifiers still present the greatest interest to informed high fidelity enthusiasts. It is in the category of amplifiers that the technology is perhaps best understood and the greatest refinement has taken place. In spite of that, the introduction of compact disc technology has caused a re-examination of amplifier design with a view to improving the overall dynamic range, both by increasing the available power output and by improving the overal signal-to-noise ratio.

At the same time, there has been a trend in recent years, especially in amplifiers produced in Europe, to reduce the number of controls and facilities available to the user. The reasoning behind this is that the extra controls and circuitry can have a deleterious effect on the music reproduction and therefore should be left out.

Indeed, some amplifiers from Britain have had virtually no controls at all apart from a volume control and input selector. And never mind the fact that this simplification means a much cheaper unit to produce; some of these amplifiers have been very expensive.

Considering that this has been a noticeable trend, there were not many amplifiers of this design philosophy entered in the awards. There were eleven entries in total, with all except one being integrated models. In alphabetical order, the entries were:

JVC AX-900B integrated stereo amplifier, 120 watts per channel .... $1599.00.

Luxman LV102 "Brid" integrated stereo amplifier, 70 watts per channel ... . $1299.00.

Luxman LV105 "Brid" integrated stereo amplifier, 80 watts per channel ... . $1995.00.

Marantz PM94 integrated stereo amplifier, 140 watts per channel .... $3299.00.

NAD 3130 integrated stereo amplifier, 30 watts per channel .... $499.00.

Rotel RA840BX integrated stereo amplifier, 40 watts per channel ... $569.00.

Sharp 207XBK integrated stereo amplifier, 40 watts per channel system .... $1799.00.

Technics SUV60 integrated stereo amplifier, 90 watts per channel .. $1069.00.

Yamaha C-2x preamplifier and B-2x power amplifier, 170 watts per channel .. .. $5598.00.

All the above power figures represent the rated power into 8-ohm loads for the amplifiers concerned; ie, they are the continuous power output ratings for the frequency range from 20Hz to 20kHz without exceeding the rated distortion.

However the bald figures do not necessarily represent a fair comparison.

JVC's feature-laden and powerful model R-X500B was the clear winner in the receiver category.

Some amplifiers, such as the Yamaha, have much lower rated distortion than others and some amplifiers have much greater headroom so that they can deliver considerably more power on short musical transients.

In a similar vein, some of the amplifiers can drive very low impedance loads and hence can deliver much higher output currents than otherwise might be expected.

For example, the NAD 3130 looks, on the face of simple power figures, to be a fairly modestly powered model. It has a rated power of only 30 watts per channel but it has a generous headroom figure of +3dB. This means that it is able to deliver 60 watts per channel into 8-ohm loads on a short term basis. Furthermore, into a load impedance of only 2 ohms, it is able to deliver 85 watts per channel under the same conditions.

Another amplifier which has generous headroom and output current capability is the Rotel RA840BX. While rated at 40 watts per channel it will deliver about 95 watts into 8 ohms on a short term basis and has an instantaneous output current capability of 29 amps. (Incidentally, an article on the requirements for output current capacity was published in the November 1986 issue of EA.)

The largest and most expensive amplifier among the entries is the Yamaha C-2x/B-2x combination. The power amplifier is rated at 170 watts per channel but once again has a good headroom figure of 1.88dB for 8-ohm loads and 2.7dB for 4-ohm loads. This means that it can deliver over 260 watts per channel into 8 ohms and over 440 watts per channel into 4-ohm loads. And with an instantaneous current capacity of 25 amps it can deliver no less than 625 watts per channel into a 2-ohm load on a short term basis.

Pioneer's PD-M6 multiplay CD player has a cassette loading system which lets it handle up to six compact discs.

Power is not the end of the story though and the Yamaha combination has excellent figures for harmonic distortion, signal-to-noise ratio and separation between channels, as you might expect.

Another interesting innovation in the newer amplifiers is the inclusion of a "CD direct" facility whereby the signal from the CD player inputs is coupled directly through to the power amplifier via the volume control. Thus, the tone control stages and balance control are completely bypassed, which should (but

Yamaha's winning K-540 cassette deck has Dolby HX-Pro, B, and C noise reduction and is good value at $599.00.

does not always) lead to an improvement in signal-to-noise ratio, channel separation and harmonic distortion.

In theory, with today's power amplifiers it should be possible to obtain a signal-to-noise ratio of better than 110dB with respect to a 2-volt input signal for such a direct connection.

Those amplifiers which included this feature were the Technics SUV60, Marantz PM94 and Luxman LV-102.

For the judges though, the newest and most interesting amplifier of the group was the Marantz PM94. In some ways, this amplifier represents a return to the Marantz design philosophy of old. It is large, heavy and no expense has been spared to make it a very fine amplifier.

Just how large and heavy it is is indicated by the physical measurements. Its dimensions are 416 x 146 x 410mm (W x H x D) and mass is a solid 25kg.

The PM94 has very flexible controls and features which can be used or ignored. Some of its features include: transformers for the moving coil cartridge inputs, to gain better signal-to-noise ratio; very large toroidal power transformer for low hum radiation; hifi VCR inputs; large ceramic-damped electrolytic capacitors (27,000μF) in the power supply; and a copper-plated chassis.

The last two features certainly border on the esoteric. The ceramic damping of the electrolytic capacitors is claimed to eliminate "vibration at high current and high sound levels" while the copper plated chassis is said to provide "full non-magnetic screening to minimise induced currents in the chassis. Result: lower distortion".

We can accept the first concept but have difficulty accepting the second, especially since a number of Japanese manufacturers (including Sony) are promoting the desirability of a non-magnetic chassis but giving different garbled explanations of why it is necessary.

Apart from any reservations that at least one judge may have had about justifications for a copper plated chassis, the judges were unanimous as far as the amplifier category was concerned. The Marantz PM94 was the winner by a fair margin.

Receivers

Surprisingly, there were only three entries in this category. They were:

JVC R-X500B, 105 watts per channel .... $1549.00.
NAD 7130, 30 watts per channel .... $699.00.
Technics SA-290, 50 watts per channel .... $629.00.

In many ways this was an uneven contest; two modestly powered receivers against JVC's hi-tech battle-cruiser which has lots of power and abounds with more features than most people will ever use.

Naturally, the former receivers are much cheaper than the JVC but while they are undeniably good products with the NAD featuring +3dB of headroom (giving it the same performance as the NAD 3130 described above) they offer fairly routine performance standards and nothing in the way of extra user convenience. They are simply outgunned by the JVC R-X500B.

Many of the features of JVC's R-X500B stereo receiver will probably be dismissed as gimmicks by the audio purists who prefer spartan simplicity.

Features that might be rejected on this basis might include the JVC's flashy seven-band graphic equaliser and analyser which is computer-controlled and the fully electronic controls — there are no knobs on this receiver. But consider that it has moving coil and moving magnet cartridge inputs, tape dubbing for two cassette decks, high power at very low distortion and infrared remote control for all the major functions, including volume. It was the winner.

Tuners

There were four entries in this category, all of which were fully synthesized tuners. They were the JVC T-X900B at $949.00, the Marantz ST64 at $699.00,

The Yamaha DSP-1 digital signal processor reproduces the acoustic environment of large and small concert venues.

the NAD 4130 at $399.00, and the Sharp ST207 which is part of a rack system at $1799.00. Not an exciting line-up at all although there are some good tuners there.

The judges decided to make no award in this category since there were no really outstanding models submitted and none included AM stereo reception. Let us hope there is a better line-up next time.

Turntables

There were only two entries in this category, with one not being eligible since it is only available in a complete rack system, the Sharp R-207X. That left the Dual CS 5000 semi-automatic turntable which comes in two versions: the classy walnut veneer job with Ortofon OMB-20E cartridge at $1099.00 and the sombre black version without cartridge at $950.00.

A semi-automatic turntable, by the way, is one in which the tonearm must be manually started but which has automatic lift-off of the tonearm at end of play.

Now make no mistake, the Dual CS5000 is a very fine turntable. It has a microprocessor-controlled DC motor with belt drive at speeds of 33, 45 and 78 rpm and has excellent figures for rumble, signal-to-noise ratio and wow and flutter. It also has an optical sensor for end-of-play detection which means that there are no extra side forces on the stylus.

The problem with the Dual was that it was the only entry and the judges therefore felt that they could not justify an award. This is a great pity since there are other good turntables in the market although admittedly it does seem as though the Japanese manufacturers are abandoning the turntable scene.

Cassette decks

This was a most interesting category with seven entries:

Akai GX-R70	$849.00
JVC DD-VR77	$1099.00
Marantz SD-74GL	$769.00
NAD 6155	$799.00
Sharp RT-207XBK	$1749.00
Technics RS-T80R	$1179.00
Yamaha K-540	$599.00

By contrast with the above categories, competition in the area of cassette decks was, and is, intense. There are decks with Dolby B, C and HX PRO plus dbx noise reduction. Some models were double cassette decks with comprehensive dubbing facilities and quick auto-reverse.

The Akai GX-R70, for example, is a single front-loading deck with quick auto-reverse, Dolby B, C and dbx noise reduction and computer control of the recording level. The quick-reverse facility, by the way, uses a head assembly which can be swapped around very rapidly so that there is almost no interruption during recording of lengthy broadcasts or lectures.

Similarly, the JVC DD-VR77 is another quick reverse deck with Dolby B and C with music scan, editor and optional infrared remote control. By contrast, the Technics RS-T80R is a dual deck with all three noise reduction systems, quick reverse, versatile editing, parallel and series recording. In the latter mode, using two C-90 tapes, you can make a continuous three-hour recording. With all these features, the Technics deck was a strong contender for an award.

Marantz's SD-74 is a single deck with dbx, Dolby B and C noise reduction systems, quick auto-reverse and peak-hold fluorescent meters which makes it also an attractive package. But as far as the judges were concerned, the Yamaha K-540 was the winner. It was regarded as having the best combination of performance and features for a reasonable price.

Compact disc players

This was another category which was strongly contested with eight entries, as listed below:

Akai A-70	$699.00
dbx DX3	$1995.00
Marantz CD-65	$599.00
Pioneer PD-M6	$999.00
Sharp DX120HBK	$999.00
Technics SLP-500	$999.00
Toshiba XR-P9RC	$449.00
Yamaha CD 2000	$1499.00

As far as user convenience is concerned, six of these players come with infrared remote control as a standard feature, with the exceptions being the dbx and Marantz models. Only three have over-sampling, being the dbx, Marantz, and Yamaha models. In other respects, all but two of the entries offer fairly standard features and performance. The exceptions are the dbx DX3 and the Pioneer PD-M6 multiplay CD player.

The dbx DX3 is the first to incorporate a compression facility. This is not surprising really since the dbx company has been a specialist in audio compression and expansion techniques since its inception. The compression feature is incorporated so that CDs can easily be transferred to cassette for listening in a car or in a portable player.

The reduction of dynamic range by using compression also makes it easier to use CDs for background listening where the pianissimo (soft) passages would otherwise be lost and the fortissimo passages would be overbearing.

As well, the dbx incorporates two other unusual features, digital audio impact recovery (DAIR) and an ambience control. The latter control can be used to add or subtract high and mid-frequency difference information from both channels to increase or decrease the perceived spaciousness of the sound.

The DAIR control is a more radical feature which is supposed to compensate for the inevitable peak compression of CDs which have been reprocessed from analog master tapes. It can also add another 10dB to existing 96dB dy-

Marantz's impressive PM-94 amplifier puts out 140 watts per channel.

The Technics SB-RX50 is the first new coaxial system for many years.

namic range of CDs to augment the impact of percussion instruments.

All the judges concerned agreed that the dbx player was an innovative product but there was a general leaning towards Pioneer's multiplay CD player with its cunningly designed magazine which holds six compact discs. It also has the ability to play up to 32 selections from the six loaded discs, in any order or alternatively, play all disc track selections in random order. The Pioneer is the only domestic CD player which can play six discs (the only other non-professional player is the Sony Disc-Jockey for cars).

The combination of multiplay and a reasonable price was a winning one for Pioneer. It will be interesting to see how many other manufacturers introduce multiplay machines in the future.

Loudspeakers

There were five entries in the loudspeaker category and they were surprisingly diverse, embracing the price range from $450 a pair to $3999.00 a pair.

Kef C40, 2-way sealed box $949.00
Mordaunt Short MS-10,
2-way vented box $450.00
Sharp CP207XBK, (rack system) $1799.00
Technics SB-RX50,
2-way vented box $749.00
Yamaha NS1000x,
3-way sealed box $3999.00

The tiniest of the entries was Mordaunt-Short's teensy little MS-10 which has an enclosure volume of less than seven litres but still manages to put out a commendable volume of sound.

It manages to do so, in spite of having a very small woofer, by combining a quite reasonable efficiency together with an elegant system of overdrive protection using positive temperature coefficient thermistors. (These loudspeakers were reviewed in our September 1985 issue and the use of PTC thermistors was discussed in an article in our July 1986 issue.)

The Kef C40s are a very popular module in the mid-priced bracket and combine relatively high efficiency (91dB/W/m) with excellent power handling and extended bass response from a 30 litre cabinet. It is unusual in that it has two low frequency drivers, with one being used to augment the very low bass.

Yamaha's NS-1000x was the dearest entry and is essentially a refined and upgraded version of the NS-1000M, which was introduced about a decade ago and has always been very highly regarded.

However, the system of most interest was the Technics SB-RX50 which is a technological tour-de-force. It is the first new coaxial speaker system to be introduced for over twenty years. Both the tweeter and woofer have rigid, flat diaphragms and the tweeter has a high-energy samarium-cobalt magnet. The tweeter diaphragm is made of mica while the woofer's is reinforced with carbon fibres.

Add to that the additional magnet on the rear of the woofer housing to cancel stray magnetic fields (which can affect picture purity when close to video monitors), the rear mounted reflex port, a nominal impedance of 6 ohms (to extract 50% more power from the driving amplifier) and excellent power handling capacity, and you have a system which deserves a second look.

Very well received by reviewers both here and overseas, the Technics SB-RX50 was a clear winner, for innovation, sound quality and value for money.

Technological development

Interestingly, this category had the most entries, with some companies have a second attempt at an award, by entering a product in both this and another category.

JVC HR-D725 hifi VCR $1849.00
Kef 107 3-way
loudspeaker system $7500.00
Luxman LV102 stereo amplifier $1299.00
Luxman LV105 stereo amplifier $1995.00
NEC AV-300E Home
Theatre Sound System $2344.00
Shure HTS-5000 Home
Theatre Sound System $2600.00
Sharp WQ-CD15H
CD/radio/cassette player $999.00
Technics SB-RX50
two-way loudspeaker system ... $749.00
Yamaha DSP-1
digital sound processor $1349.00

There are some expensive products in that line-up and most are pretty interesting in their own way. Take, for example, Kef's 107 loudspeaker system which is a considerable refinement of their multi-award winning 104.2 model. Or the two Home Theatre Sound sytems from NEC and Shure. Both these decode the Dolby Surround information on stereo videotapes to provide spectacular surround sound from four channels.

But there is one product which is really new and which stands out as the winner for technological development: the Yamaha DSP-1 Digital Sound Processor. This uses up-to-the-minute digital circuitry to greatly modify the perceived acoustics of the listening room. It can change both reverberation and decay times to simulate a large auditorium, concert hall, cathedral, or other venue — you name it, you can be there. We'll see a lot more of this product and others like it in years to come.

Post mortem

Well, what conclusions can be drawn from these latest awards. For a start, there really were not enough entries. That is hard to understand since the industry is supposedly going through a really tough time and hifi distributors would probably wish for as much exposure as they could get.

Second, while it might be expected that the smaller companies who have less personnel would be less able to enter the awards, it is less understandable as far as the larger players are concerned. What happened to the distributors of brands such as Sony, Nakamichi, B&W, Kenwood, Onkyo, Proton, Perreaux and virtually all the brands sourced from Europe and the UK? There are some very fine products being missed out here and some would certainly have been in the running for an award. Let's hope they wake up next year.

The judges for this year's awards were: Greg Borrowman, editor of Australian Hifi; David Frith, audio writer for the Sydney Morning Herald; Louis Challis, acoustics consultant and audio reviewer for *Electronics Today* and Leo Simpson, Managing Editor, *Electronics Australia*.


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New Products...
Product reviews, releases & services

Cellular telephones from Mitsubishi

Mitsubishi Electric has released its Telecom-endorsed cellular telephone range. As a mobile system for vehicles and boats the cellular system offers greatly improved performance without the limited availability and shortcomings of the existing mobile system.

The Mitsubishi system also provides a choice of a vehicle installation or portable unit and either unit can be upgraded when required.

Call diversion, a network function, makes the new mobile telephone even more effective and Mitsubishi's "hands free" remote microphone ensures safe driving.

For further information, contact Mitsubishi Electric Australia Pty Ltd, 73 Epping Rd, North Ryde, NSW 2113. Phone (02) 888 5777.

Printer buffer

The printer Qr is an intelligent data buffering and queuing device designed to organise your computers, printers and plotters into one co-ordinated system.

Connected between your computers and printers/plotters, the Printer Qr allows all users to be permanently on line to the shared printing resources. The printer Qr will accept data simultaneously from all inputs at high speed, check for software commands, then spool to the appropriate printers at a rate they can accept.

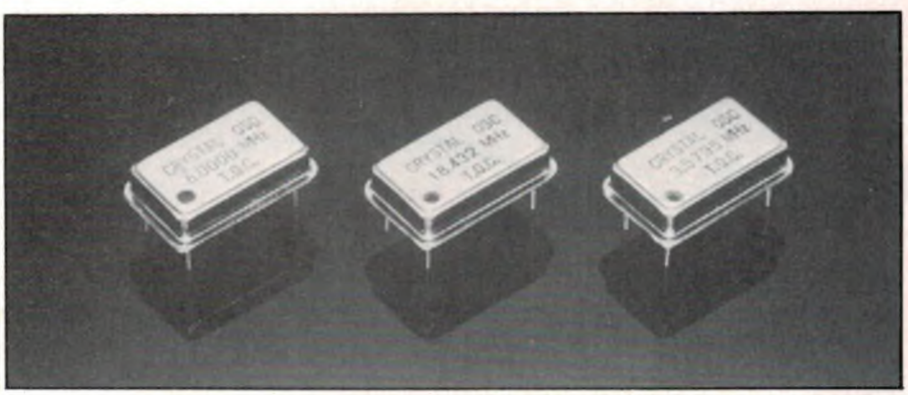
Four or five computers can share two or three printers. For larger installations the special cascade feature can be used to connect two or more Printer Qrs together, to increase the number of ports and amount of buffer memory available.

The buffer offers up to 512K with dynamic allocation to each user. Sophisticated character compression techniques are used on all repeated characters, greatly increasing the effective buffer size (eg, a 750K dot matrix plot file is compressed to 120K in the buffer).

The Printer Qr can be operated transparently, or a comprehensive set of commands are available giving the user full control over each print operation. Temporary or permanent printer selection can be made, copies specified single sheet feed control and more. Also included are commands for more specialised applications.

The Printer Qr is manufactured in Australia by Diamond Systems.

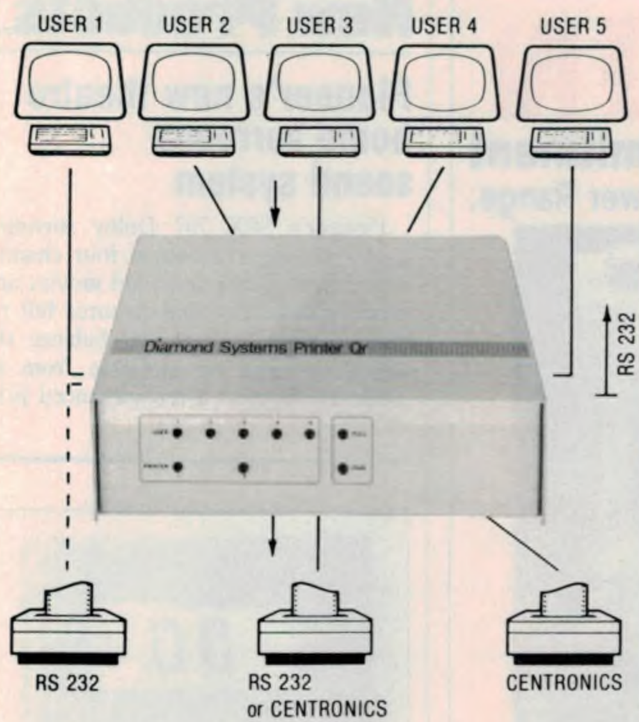
For further information contact Diamond Systems, PO Box 105, Hurstbridge, Vic 3099. Phone (03) 714 8269.

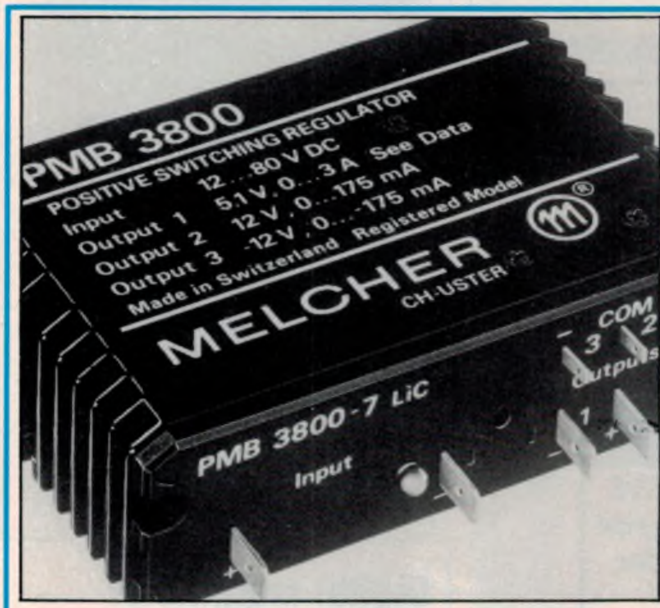


Crystal clock oscillators

Alfatron has announced the availability of the TQC crystal oscillator series. The series comprises a C-MOS crystal oscillator with specified frequency from 3.2MHz to 26.999MHz and two TTL crystal oscillators with specified frequencies from 1MHz to 3.199MHz and 27MHz to 70MHz respectively.

For further information, contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully, Vic. 3156. Phone (03) 758 9000.





New switching regulators from Melcher

Melcher Switzerland has introduced a range of switching regulators with several outputs. The PMB series offer an exceptionally large input voltage range: 12-38V DC and 12-80V DC with output power from 20-25 watts.

These units are small in size and are a very compact design.

Melcher products are available from: Jessec-Switches Plus Components, 569 Hampton Street, Hampton, Vic. 3188. Telephone: (03) 598 2333.

New Products...

Pioneer's new theatre home surround sound system

Pioneer's SPX 707 Dolby surround sound processor produces four channel sound from Dolby recorded movies and music videos. The unit features full remote control to vary and balance the sound and will be available from selected retailers at a recommenced price of $595.

Digital multimeter

Neotronics has announced the release of the HC 5000 digital multimeter which has voltage ranges from 200mV AC and DC to 1kV DC and 750V AC. The AC and DC current ranges are from 200 microamps to 10 amps and up to 20 amps via a separate jack, while the resistance ranges are from 200 ohms to 20 megohms. The meter comes complete with test leads.

For further information, contact Neotronics Pty Ltd, 37 Ryedale Rd, West Ryde, NSW 2114. Phone (02) 807 2642.

Miniature microphones from Crown

A new series of miniature microphones from Crown, released by Magna-Techtronics in Australia, provides the on-set and studio user with the sound of larger, expensive condenser microphones in a remarkably small and durable housing.

Less than half the diameter of a two-cent coin, the Crown GLM mini microphones are particularly suitable for filming and studio recording where placement of larger mics would be physically or visually undesirable.

Available in both omnidirectional condenser and hypercardiod condenser versions, the GLM microphones are entirely self-contained, with no extra equaliser or interface box needed for operation.

The series can be powered from an unusually wide voltage range of 12 to 48V and offers a smooth and wide frequency response which has been optimised with a specially-designed beveled acoustic port.

The series also has significantly less mechancial noise than other small microphones. Crown claims to have successfully minimised low-frequency pickup and clothing noise interference and have selected cabling with the lowest mechanical noise conduction.

For further information, contact Magna-Techtronics, 9 George Place, Artarmon, NSW 2064. (02) 427 0666.

Stereo phase monitor

B&B systems have released the new AM-3B Phase Monitor for all stereo audio applications. The unit provides real time visual and audible monitoring of stereo audio phase, program VU levels, and peak threshold levels, including L+R or AUX, in one system.

The AM-3B features dual three-channel inputs (selectable A/B), a separate level control for an isolated power amplifier and loudspeaker, and a headphone output which is selectable for stereo, L+R, or AUX and follows the A/B input selection.

Other features include a CRT X-Y phase monitor, with calibrated graticule for phase, and three ANSI calibrated VU meters with peak overload LED indicators for each channel. The AM-3B is self contained in two EIA rack units.

For further information contact Radio Manufacturing Engineers Pty Ltd, Unit A, 30-32 Skarratt Street, Auburn 2144. Telephone: (02) 648 2531.

Software debugger for IBM PC/XT

Macro Dynamics has announced the release of the Atron PC Probe. The PC Probe is a real-time hardware-assisted software debugging aid that plugs into a PC/XT slot. It has 128K bytes of hidden write-protected memory on board for storage of symbol table and debugger, leaving the system memory free for the program being debugged.

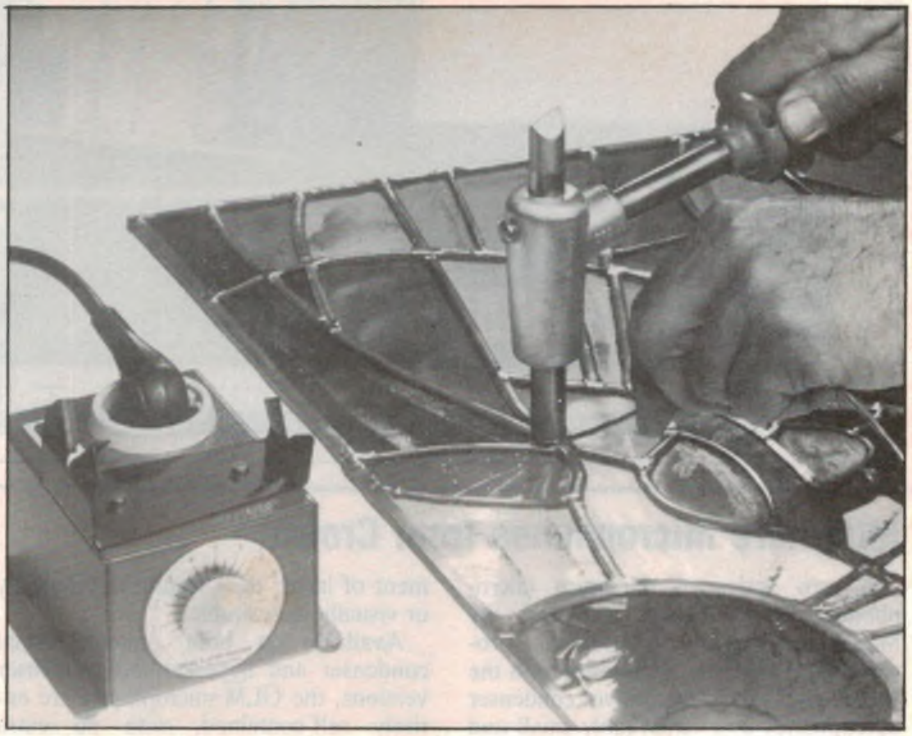
PC Probe has hardware-assisted break points that can trap on reading, writing, executing, input and output on single or a range of addresses, and can include particular data values. The history of the program is saved on-board, in real time. Once a hardware trap has occurred the program history can be displayed in detail, including symbols and the user's source code. Source Level Debug is supported for C, Pascal, Fortran and Macro Assembler.

The PC Probe family includes software performance and timing analysis tools. These can measure the duration time of procedures and measure the relative amount of program execution time spent in user-defined address ranges.

For further information, contact Macro Dynamics Pty Ltd, 80 Lewis Road, Wantirna South, Vic. 3152. Telephone: (03) 220 7260.

New Products...

Zeva hatchet soldering irons



Zeva's range of hatchet type soldering irons is now available through Alfatron. Like other Zeva hand tools, these irons feature a heating element protected inside a cast aluminium sheath. This protects the element from shock and corrosion.

The aluminium casing is also an excellent heat reservoir which prevents rapid cooling when an iron is applied to a large surface.

Hatchet type irons are extremely well balanced in the hand and reduce operator fatigue. It also makes them very useful for hard to get at jobs.

For further information contact Alfatron Pty Ltd, 1761 Ferntree Gully Road, Ferntree Gully, Vic. 3156. Phone (03) 758 9000.

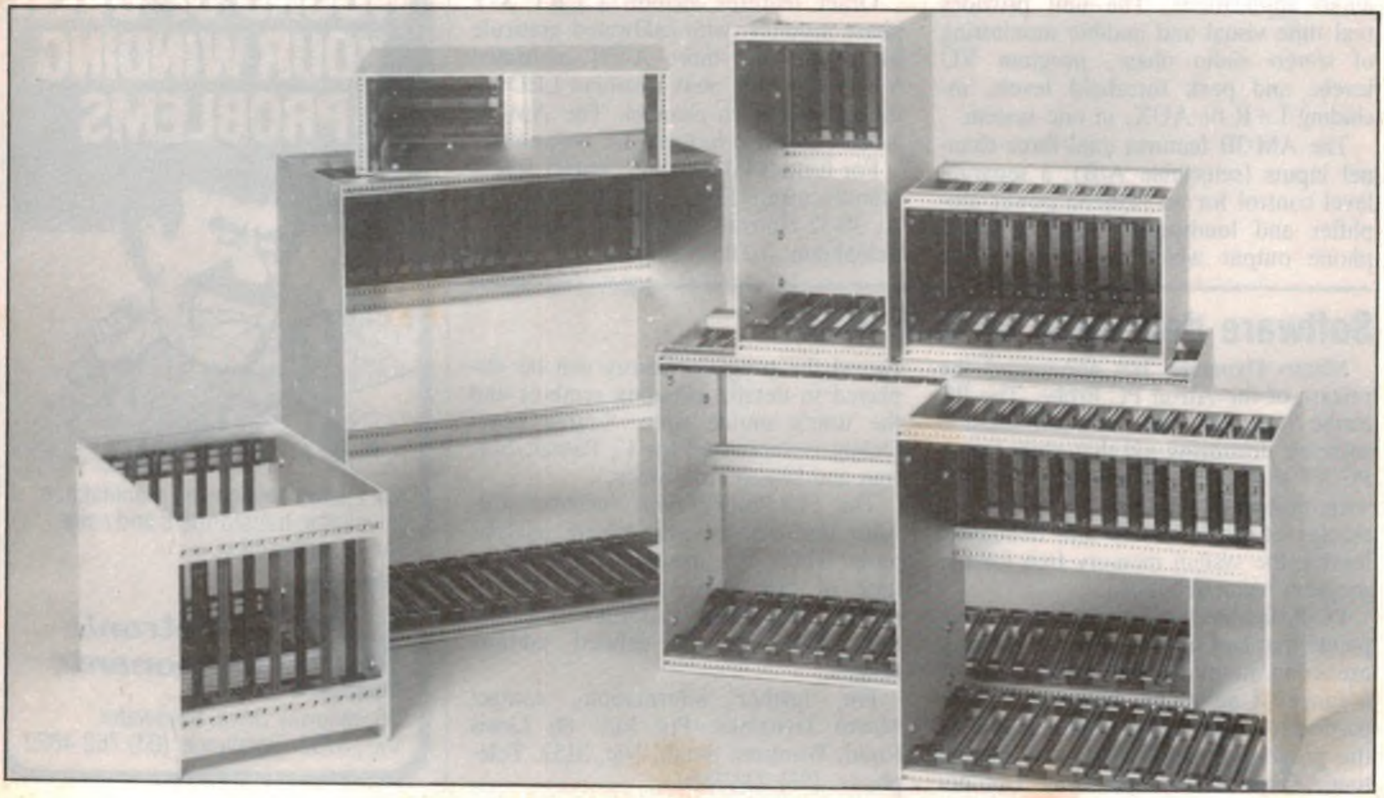
Deluxe card cages

Electronic Solutions has just released the V-800 series of card cages. The backplanes are designed for high performance and have low crosstalk figures which are achieved by generous ground planes and the use of guard earth tracks around the clocks. Heavy-duty copper clad power planes ensure low losses and high current carrying capability.

A special centre adaptor converts any double or triple size slot to a single height slot. This allows mixing of cards of different heights. The adaptor module installs or relocates in seconds.

The cages may be mounted in any axis and have special aircraft-type fasteners to ensure positive grip. A corrosion resistant aluminium finish is employed to add to their durability.

For further information, contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully, Vic. 3156. Phone (03) 758 9000.



Fluke breaks the old mold.

The Fluke 37. A bold new shape emerges with more features for the money than any other bench DMM.

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- ***TASMANIA*** George Harvey (003) 31 6533 (002) 34 2233
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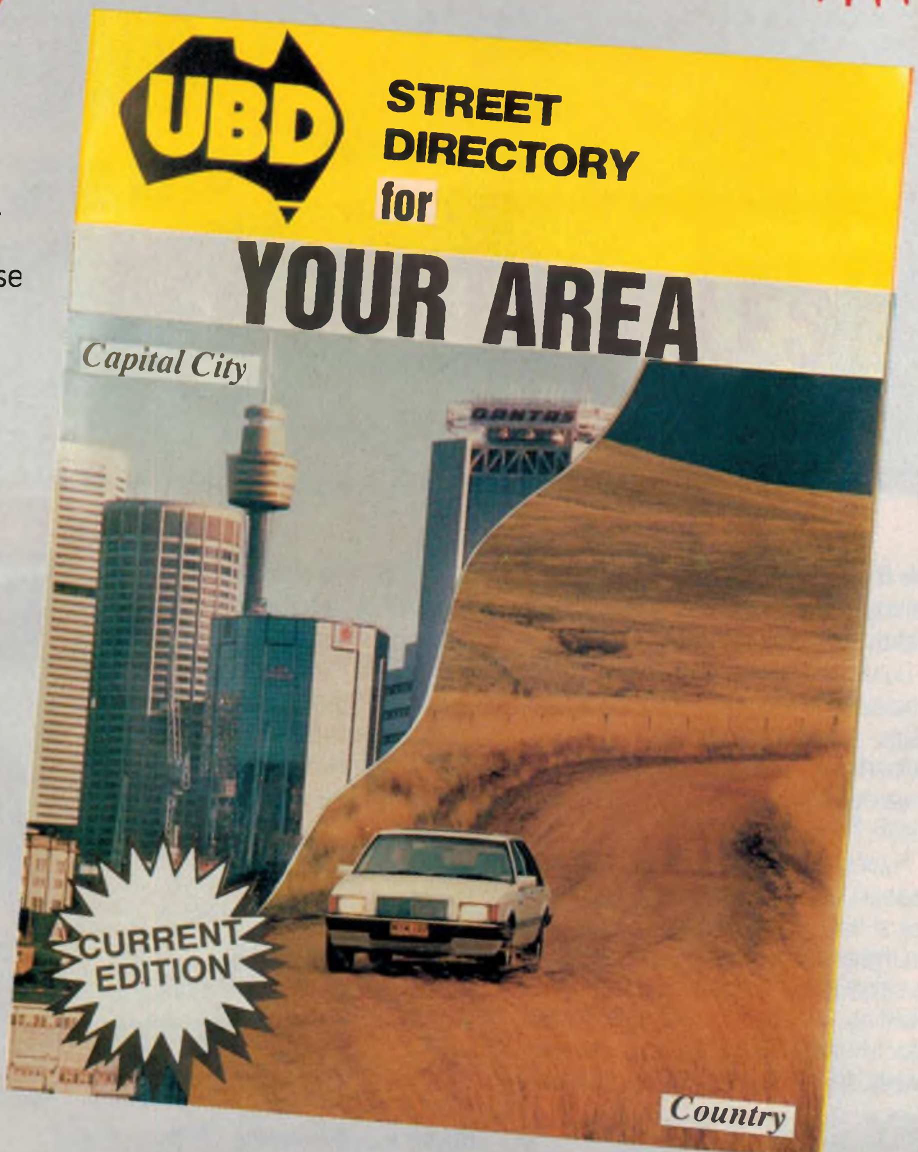

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New Products...

Mobile converters for Midland Syn-Tech portables

Midland LMR has introduced Mobile Converters for the Midland Syn-Tech portable radios that convert them into efficient mobile installations. When inserted in the Mobile Converter, a Syn-Tech portable instantly becomes a high-capability synthesised "mobile" with automatic connection to power supply, microphone, antenna, 5W audio amplifier, loudspeaker and (in Models 70-H30/70-H40) to a high-performance RF amplifier.

A fast-release lever permits the user to quickly extract the unit and exit the vehicle with a fully functioning portable. A key lock secures the unit if the operator wants to leave the portable in vehicle. The converters accept Syn-Tech portables with any standard rechargeable battery pack.

Model 70-H40 for high-band Syn-Tech portables has 25W RF output and 5W audio; Model 70-H30 for UHF Syn-Tech portables has 25W RF and 5W audio; and Model 70-CH05, without RF amplifier, accepts either VHF or UHF portables and provides 5W audio. The converters are interchangeable with Syn-Tech underdash mobiles in most vechicle installations depending on model and depth available.

For more information, contact Codan Pty Ltd, PO Box 227, Chatswood, NSW 2067. Phone: (02) 419 2397.

New VCRs from National Panasonic

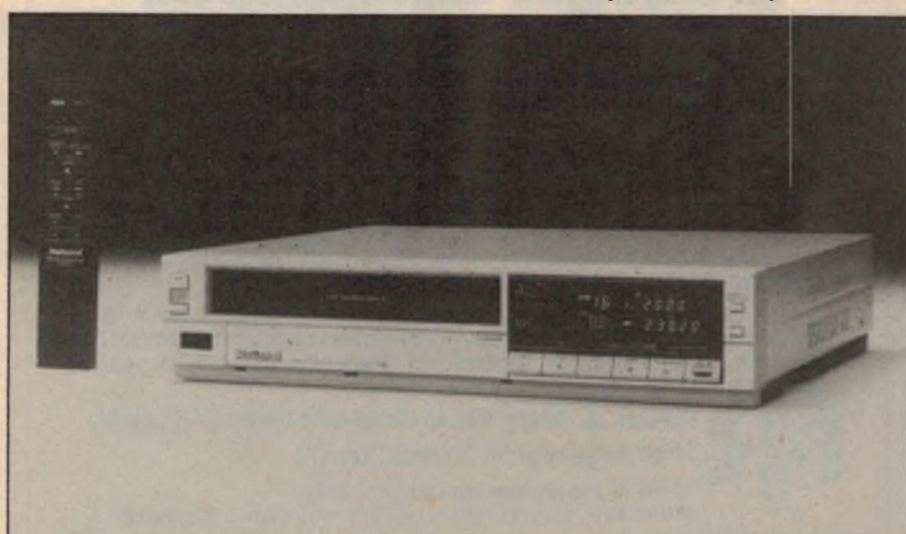
National Panasonic has recently released a new videocassette recorder, the NV-G20A, featuring refined slow motion and HQ circuitry for much improved picture quality.

Included in the list of features is one-touch recording (OTR) and a one-month, 8-program timer which allows the user to preset timer recordings as much as a month in advance.

The new rewind auto shut off allows the NVG20A to automatically eject the cassette and turn itself off when rewinding is completed. Combined with the infrared remote control, this further adds to the convenience of this VCR.

The NVG20A also includes a newly designed mechanism and direct-drive cylinder motor with oil film suspension system. This suspension system floats the DD cylinder on a thin film of oil during rotation, virtually eliminating friction and vibration, to give a much smoother operation than possible with conventional bearings.

Recommended retail price is $1029. For further information, contact your nearest video retailer.



New Products...

PAL860 low cost PAL programmer

The PAL860 is a companion product to the popular PROM8500. It is a compact, economical and effective programming tool for the development of 20 and 24-pin programmable array logic devices.

As a stand-alone unit it is able to load fuse data into its buffer, verify fuse patterns, write and secure PALs and do function testing after programming. An RS-232 interface allows connection to a host computer for remote control. The PAL860 is JEDEC format compatible and can be used together with commonly used Boolean data entry packages.

An integral two-line alphanumeric display enables easy control of the unit. Only three keys are required for stand-alone operation. Non-volatile memory retains data for manufacturer, device type, fuse maps and test vectors.

For further information contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully, Victoria 3156. Phone (03) 758 9000.

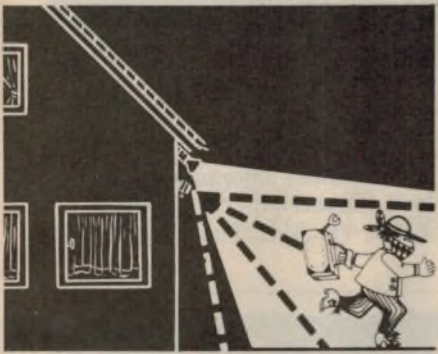
Moving message sign display

Novatech Controls has released a new range of stationary and moving message displays with 50mm high LED characters for industrial and commercial applications.

The displays are inexpensive and can be programmed from a computer or from a keyboard supplied. Their normal colour is red but green and yellow multicolour are also available.

16 alphanumeric characters are displayed at any one time and the memory can store up to 3768 characters. When set to moving mode, several speeds are available.

For further information contact Novatech Controls Pty Ltd, 8 Knox St, Belmore, NSW 2192. Phone (02) 758 1122.



Automatic lighting control

There are many passive infrared devices in use for intrusion alarm systems, but few that can be used for directly switching lighting.

Utilux has recently introduced their Scanelite which is suitable for both indoor and outdoor use and capable of switching up to 2kW (resistive) loads. The detection unit is small, about 75mm square and has a range up to approximately 15 metres.

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For further information contact the Scanelec Division of Utilux Pty Ltd, 14 Commercial Road, Kingsgrove, NSW 2208. Phone (02) 50 0155.

New Products...

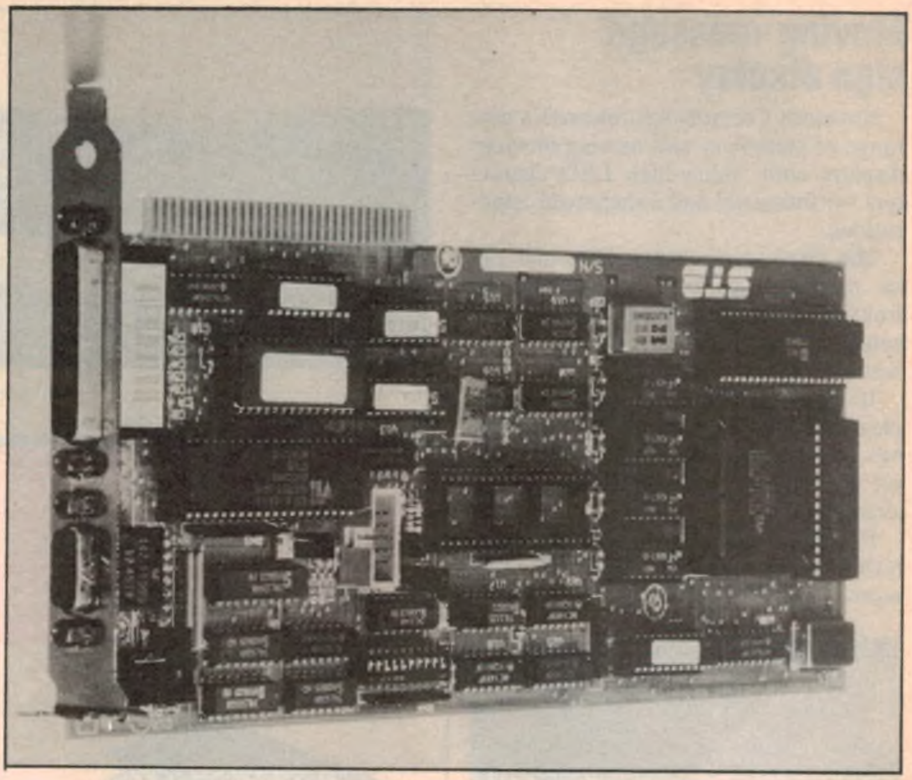
New PC video boards

Roland Corporation has released what the company describes as "the ultimate" in IBM compatible graphics boards.

The product, the STB Chauffeur HT (Hi-tech), is designed to overcome the main PC hardware and software "mismatches" and finally enable spreadsheet users to display a full 132 columns on a standard IBM monochrome or colour monitor.

The STB Chauffeur incorporates all the features of IBM's Mono/Printer Display Adapters, the Hercules Graphics Card, the STB Super-Res 400, and Tseng Labs' UltraPAK-S and the Chauffeur cards, and will drive all software written for these cards.

It also provides 1052 x 352 bit-mapped graphics accessed through window drivers and CAD/CAM users, without the need to change monitors. The PC accelerator on the Chauffeur's accompanying disc provides 64K-bytes of printer buffering and up to 10 RAM disks.



For further information contact Roland Corporation, 50 garden St, South Yarra, Vic. 3141. Phone (03) 241 1254.

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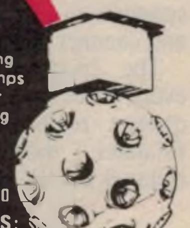

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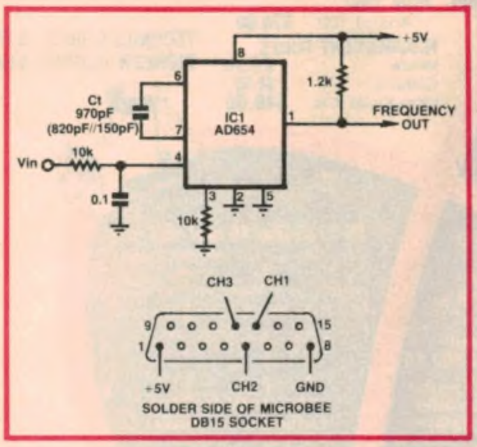
Circuit & Design Ideas

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




```
00100 READ X,Y:REM START,SIZE
00110 PRINT "@ ",X,Y," BYTES"
00120 FOR Z=1 TO Y:READ W:POKE X+Z-1,W:NEXT Z
00130 DATA 0,40,245,213,229,62,255,211,1,211,1,6
00140 DATA 0,17,0,112,33,0,0,219,0,230
00150 DATA 1,184,1,0,0,203,17,9,71,27
00160 DATA 122,179,32,239,68,77,225,209,241,201
00170 REM -----------------------------------------
00180 INPUT "DO YOU WANT TO CALIBRATE Y/N?",Q1$
00190 IF Q1$="Y" OR Q1$="y" THEN GOTO 200 ELSE GOTO380
00200 INPUT "PROBE ON REF 1.000V <RET>",I2$
00210 R=USR(0): PRINT "FREQ ";R;" HZ = 1.000V"
00220 REM -----------------------------------------
00230 PRINT"CH 1 ";
00240 T1=FLT(USR(0))/FLT(R)
00250 PRINT [F6.1 T1],"DEG C"
00260 POKE 20,2:PRINT "CH 2 ";
00270 T2=FLT(USR(0))/FLT(S)
00280 PRINT [F6.1 T2],"DEG C"
00290 POKE 20,4 : PRINT "CH 3 ";
00300 PRINT [F6.1 FLT(USR(0))/FLT(T)],"VOLTS"
00310 REM -----------------------------------------
00320 FOR J=1 TO 46
00330 FOR I=1 TO 1016 : NEXT I
00340 NEXT J
00350 REM -----------------------------------------
00360 POKE 20,1:REM BACK TO THE FIRST CHANNEL MASK
00370 PRINT:GOTO 230
00375 REM -----------------------------------------
00380 R=7000 :S=6980:T=6990: GOTO 230
00390 END
```

Precision V/F Converter

Here is an inexpensive method of implementing a multi-channel data aquisition system with high accuracy for the Microbee computer.

It uses an Analog Devices AD654 voltage to frequency converter which converts a 0 to 1V analog signal to a 0 to 10kHz frequency. The frequency range is set by capacitor C_T across pins 6 and 7 of IC1. The necessary connections for three such channels to the Microbee DB15 socket are shown in the accompanying diagram; ie, channel 1 connects to pin 13, channel 2 to pin 5, and channel 3 to pin 12.

The program reads each channel every three minutes and provides a frequency reading from the converter. Channel 1 data is printed at line 250, channel 2 data at line 280, and channel 3 data at line 300.

Note that the data can be scaled so that, for example, if a 10mV/°C source is used for channel 1, then the value can be scaled for a direct °C reading by multiplying T1 in line 250 by 100. In other words, T1 in line 250 is replaced by 100*T1.

For calibration, a 1.000V source is applied to the input of each converter in turn and the calibration program run starting at line 180. To access each channel, the POKE 20,1 statement at line 360 is changed. Use POKE 20,1 for channel 1, POKE 20,2 for channel 2 and POKE 20,4 for channel 3.

The frequency for the 1.000V input will be printed as shown in line 210. The calibration frequency should be entered at line 380. R is the calibration number for channel 1, S for channel 2 and T for channel 3.

G. Guttridge,
Wanniassa, ACT. **$15**

Nicad Charger with Auto Float Charge

This charger is designed to operate from 12VDC, making it suitable for recharging batteries or cells from a boat or car battery. Up to six cells can be charged in series. When charging is complete, the charger stops the cells from self-discharging by supplying a trickle charge to the nicads.

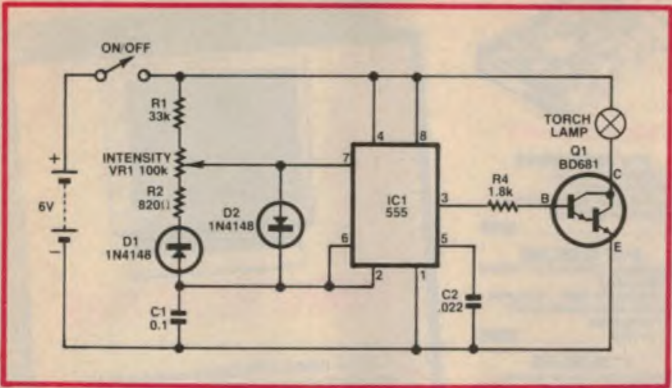
Initially, with the 12V battery connected and no nicads connected, the yellow trickle LED will light. Once the nicads are inserted, the red charge LED will light and extinguish after the nicads are charged. The yellow LED will again light to indicate that charging has ceased and that trickle charging has begun.

Q1, R1 and LED 1 form a constant current source supply for charging. It operates as follows: LED 1 is lit via the current through R2, providing a 2V drop across the LED. The voltage across the base emitter junction of Q1 is 0.6V and this leaves 1.4V across R1.

Thus, when R1 is 27Ω, the current through Q1 is 1.4/27 = 52mA. Similarly when R1 = 12Ω, the current is 116mA. These two currents correspond to the 14-hour charge rate for AA cells and C and D cells respectively.

IC1 is used to switch off the charger once the nicads are charged. It does this by monitoring the nicad voltage at the inverting input, pin 2. The non-inverting input is connected to a reference voltage set by 10V zener D2 and trimpot VR1. VR1 is set to the fully charged potential of the cells.

When the nicads are charged, the output of IC1 goes low and switches on the yellow LED (LED 2). The resulting 2V across LED 2 turns on transistor Q2 via R3 and turns off LED 1. With LED 1 off, the voltage across R1 is reduced, limiting the charging current to about



Brightness control for torches

Here is an efficient method for controlling the brightness of an Eveready Dolphin hand-held torch.

The circuit uses a 555 timer with adjustable duty cycle to drive the torch light bulb. The range of dimming is from about 99% duty cycle for full brightness down to about 30% duty cycle. By using the lower settings, you can dramatically increase the life of the battery.

IC1 is connected as an astable oscillator with two separate paths for charging and discharging the timing capacitor C1 at pins 2 and 6. When C1 is charging, diode D2 conducts and charging is via R1 and the top portion of VR1. Conversely, during the discharge cycle, D1 conducts and discharges C1 through R2 and the bottom portion of VR2.

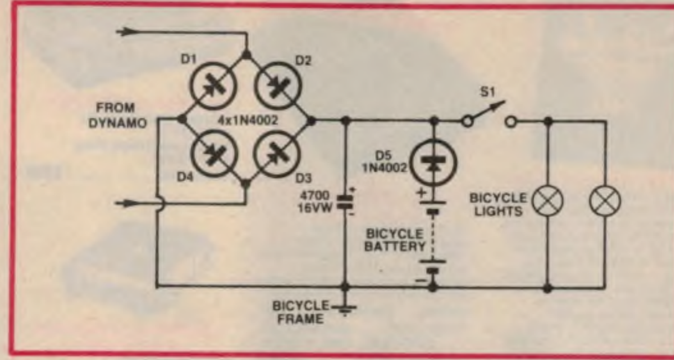
When the wiper of VR2 is toward R1, the pin 3 output of IC1 is high for about 30% of the time and when the wiper of VR1 is toward R2, the pin 3 output is high for about 99% of the time. VR2 allows adjustment between these two extremes.

The pin 3 output of IC1 drives NPN Darlington transistor Q1. Thus, when pin 3 is high, Q1 switches on the torch lamp.

Some modifications are required to the torch in order to mount the controller. A lead for the positive rail can be soldered to the lamp side of the on/off switch while the other side of the lamp needs the connection broken between it and the battery negative. Q1 connects across this break, with the emitter to the negative side of the battery.

T Hand,
Bentleigh, Vic.

$10



Battery Backup for Bicycles

Lighting for bicycles which are powered from a dynamo are liable to vast variations in lamp brightness, especially at slow speeds. At standstill, the lights go out completely and this lack of visibility can be dangerous, particularly in a poorly lit street.

The alternative is to use batteries for lighting so that the lamps remain lit even when stopped. The problem with this is that the batteries require frequent replacement.

This battery backup circuit combines the advantages of both battery and dynamo lighting. The lights are normally powered from the dynamo, with battery power taking over only when the bicycle is stopped or moving at slow speeds. This conserves the batteries.

Diodes D1 to D4 full wave rectify the AC output from the dynamo and this is smoothed to DC using a 4700μF capacitor. The bicycle battery is isolated from the dynamo supply using D5. The diode only conducts and powers the lights when the generated DC voltage falls 0.6V below the battery voltage.

Installation involves insulating the dynamo from the frame of the bicycle using a rubber or plastic bush around the frame before clamping the dynamo in place. A wire connection is needed from the dynamo body as well as from the normal dynamo screw terminal. These two leads connect to the D1 to D4 bridge rectifier.

A standard battery-powered front lamp can be used to hold the battery and this should be modified to include diode D5. Similarly, a battery-powered rear light can be used to hold the 4700μF capacitor and bridge rectifier.

G. Reeve,
Craigie, WA.

$10

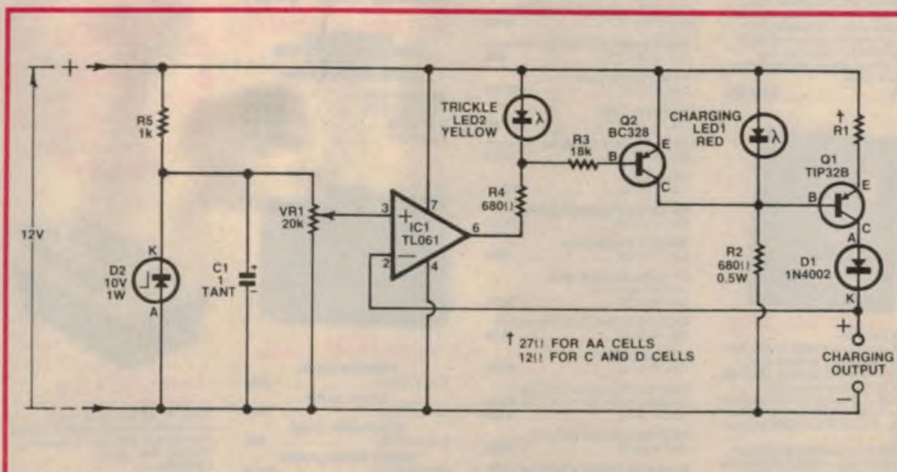
60% of normal. This trickle charges the nicads.

To adjust VR1, initially turn it fully in the direction of the zener diode cathode. Now charge the nicads for 14 hours and turn VR1 back until the yellow and red LEDs are both just lit. With VR1 left in this position the red LED will extinguish after several minutes.

Note that VR1 will require readjustment if more or less cells are to be charged.

P. Boyle,
Edithvale, Vic.

$20



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Estimating noise in op amp stages

Estimating the noise performance of an op amp stage is easy with a little circuit analysis and a short BASIC program to take care of the maths. The program requires only two resistance values and a figure for bandwidth to compute the noise levels for six popular op amps.

by PHIL ALLISON

There are several sources of noise in an op amp stage which together account for the total background hiss level. These are the op amp itself (particularly the active devices employed in the input stage), the resistors used for gain setting, and the noise generated by the resistance of the signal source.

It must be appreciated that any resistor has a self noise level caused by thermal agitation of its free electrons. This noise, commonly known as white noise, is random and spreads across the whole frequency spectrum. Its magnitude is given by a simple formula:

where

En = RMS noise voltage

L = Boltzmann's constant 1.38×10^{-23}

T = temperature in degrees K (degrees C + 273)

B = bandwidth of measurement

R = resistor value in ohms

For example: a 10kΩ resistor at room temperature and measured with a 20kHz bandwidth will generate a noise voltage of 1.8μV. (Try some other values on your calculator to get a feel for the quantities involved).

The program presented here can be used to select the best op amp for a given application or to examine the effect on noise performance of design changes to a circuit.

Before the program can be used, two resistance values must be derived from the circuit of the op amp stage in question. These I have called *source resistance* and *input resistance*. The first is just the value in ohms of the internal resistance of the device generating the input signal.

For example, for a 200-ohm microphone use a value of 200 for the source resistance, and for a high impedance microphone (internal step-up transformer type) use a value of 50,000. If noise testing is to be done with the input shorted then use a value of 1 (one ohm) as the program will not accept a value of 0.

Input resistance

The input resistance has to be determined from the circuit of the gain stage in question and here a little analysis is needed. Note that the input resistance is not the same as the input impedance for the circuits of Fig.1 and Fig.2.

There are two common types of op amp gain stages: (1) the inverting stage as shown in Fig.1; and (2) the non-inverting stage as shown in Fig.2. The input impedance of the inverting type is equal to R1, while the input impedance of the non-inverting type is equal to Rin and may be almost any value. The signal gains of these two stages are given by the formulas beneath each diagram.

Don't worry if your circuit has capacitors in series with the input or feedback ground (Fig.2) as normally these can be neglected.

In Fig.1, the input resistance is equal to R1 in parallel with R2. If R2 is more than ten times R1, then just use the value of R1.

For Fig.2, the input resistance is the same as for Fig.1 (ie, R1 in parallel R2), but if Rin is less than ten times R1 then calculate Rin in parallel with R1 and R2 as well. If there is a resistor in series with the input, add this to the input resistance.

The figure for bandwidth can be any value up to the circuit bandwidth. For audio purposes, a figure of about 16kHz is commonly adopted for specifications.

The program will, in a couple of seconds, compute the *equivalent input noise* (EIN) and noise figure for six op amps. Other op amps can easily be added to the list.

The EIN is a standard way of specifying input stage noise as it is independant of the overall gain. If you multiply the EIN figure by the gain of the stage, then you will have the noise voltage expected at the output.

The noise figure is also calculated so that the standard of performance of a circuit can be seen at a glance. It compares the stage in question with an imaginary noiseless stage and quotes the difference in decibels. A figure of 1dB would be very good and hardly worth trying to improve upon. This figure is

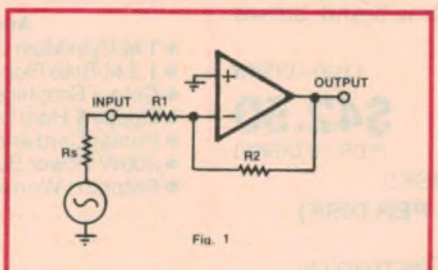


Fig.1: inverting op amp stage. Gain = R2/R1.

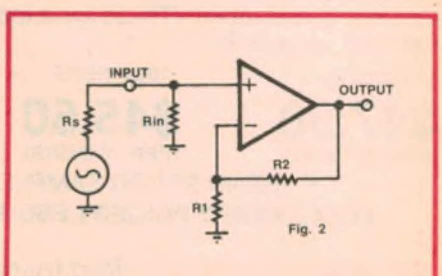


Fig.2: non-inverting op amp stage. Gain = (R1 + R2)/R1.

```
10 CLS:PRINT
20 PRINT"   PROGRAM TO CALCULATE NOISE"
25 PRINT"          IN OP AMPS"
30 PRINT"   **************************"
40 PRINT
50 INPUT" SOURCE RESISTANCE    ";RS:PRINT:IFRS=0THEN50
60 INPUT" INPUT RESISTANCE     ";RI:PRINT:IFRI=0THEN60
70 INPUT" NOISE BANDWIDTH KHZ ";BW:PRINT:IFBW=0THEN70
71 PRINT
100 DATA 3.5E-9,4E-13,1E-8,5E-13,1.8E-8,1E-14
110 DATA 1.5E-8,1.7E-13,2.2E-8,6E-13,4.7E-8,1E-14
115 RESTORE
120 FORI=1TO6:READ EN,IN
140 KT=4.1E-21
150 ET=((EN^2+IN^2*(RS^2+RI^2)+4*KT*(RS+RI))*BW*1E3)^0.5
160 IFI=1THENPRINT"   NE5534 ";:GOTO300
170 IFI=2THENPRINT"   RC4558 ";:GOTO300
180 IFI=3THENPRINT"   TL071  ";:GOTO300
190 IFI=4THENPRINT"   LM301A ";:GOTO300
200 IFI=5THENPRINT"   UA741C ";:GOTO300
202 IFI=6THENPRINT"   TL081  ";:GOTO300
300 PRINTUSING"###.##";ET*1E6;:PRINT" UV ";
310 NS=(4*KT*BW*1E3*RS)^0.5
320 NF=20*LOG((ET/NS))/LOG(10)
330 PRINTUSING" ##.#";NF;:PRINT"  DB"
340 NEXTI
350 PRINT" =========================="
360 INPUT"RTN";A:IFA=0SOUND21,1:GOTO10
```

Left: this program was written for the VZ300 computer but should work with little alteration on almost any computer running BASIC. The program runs each time return is pressed, so that you can enter new values.

Below: these sample screen printouts show the results for six common op amps for various circuit conditions. The program calculates both the equivalent input noise (in microvolts) and the noise performance (in dB).

```
S A M P L E   S C R E E N S

SOURCE RESISTANCE     ? 200

INPUT RESISTANCE      ? 47

NOISE BANDWIDTH KHZ ? 16


  NE5534    0.51 UV    7.0   DB
  RC4558    1.29 UV   15.0   DB
  TL071     2.29 UV   20.0   DB
  LM301A    1.91 UV   18.4   DB
  UA741C    2.79 UV   21.7   DB
  TL081     5.95 UV   28.3   DB
============================

SOURCE RESISTANCE     ? 7000

INPUT RESISTANCE      ? 1000

NOISE BANDWIDTH KHZ ? 16


  NE5534    1.56 UV    1.2   DB
  RC4558    1.97 UV    3.3   DB
  TL071     2.70 UV    6.0   DB
  LM301A    2.39 UV    4.9   DB
  UA741C    3.18 UV    7.4   DB
  TL081     6.12 UV   13.1   DB
============================

SOURCE RESISTANCE    ? 1E5

INPUT RESISTANCE      ? 1E4

NOISE BANDWIDTH KHZ ? 2.5


  NE5534    2.93 UV    3.2   DB
  RC4558    3.33 UV    4.3   DB
  TL071     2.31 UV    1.1   DB
  LM301A    2.41 UV    1.5   DB
  UA741C    3.85 UV    5.6   DB
  TL081     3.17 UV    3.9   DB
============================
```

independent of gain, bandwidth and signal level.

Low noise tips

To optimise a design, the value of input resistance must be kept as low as possible. For an inverting stage, this is limited by the minimum acceptable input impedance. There is no such problem with the non-inverting stage, making it the preferred type for low noise stages. Most op amps will drive loads down to 1000 ohms or so, hence R1 plus R2 can equal this. The NE5534 can drive loads down to 600 ohms.

Don't worry about using expensive "low noise" resistors as these make no difference in an op amp stage where there is little or no DC across the resistors. Noise caused by a large voltage across a resistor is called excess noise and varies widely with resistor type.

Using the program

The formula for noise in the program appears in line 150. This sums all the noise sources involved using the published data for each op amp in turn and the result is quoted in microvolts. This data appears in lines 100 and 110 as EIN voltage and EIN current figures in volts and amps per Hz respectively. Line 320 computes the noise figure by dividing the result of line 150 by the noise of the source resistance and converting this to decibels.

When return is pressed the program runs again so that you can enter new values.

Due to device variations and the use of averaged values in the EIN data, the computed figures are not precise but are close enough to measured results to allow valid comparisons between circuits and op amps.

The program was written for a VZ300 computer but should work with little alteration on almost any computer running BASIC.

References

R.A. Fairs, Resistor Survey. *Wireless World*, October 1975.

Walter G. Jung, *IC Op Amp Cookbook*.

An introduction to hifi, Pt.12

AM radio tuners

Background, fidelity, problems, stereo

While radio may be seen by many as a utility service for a non-critical mass audience, it has the potential to deliver better than average quality sound to listeners who are prepared to install a better than average quality tuner or receiver. In this chapter, we look particularly at stereo AM broadcasting.

by NEVILLE WILLIAMS

A radio frequency carrier may be "modulated", or have an audio signal imposed on it in a variety of ways, the original and most common method being amplitude modulation (AM) as illustrated in Fig.1. When an audio signal (a) is amplitude modulated on to a radio frequency carrier (b), the modulated carrier takes on the form depicted in (c), its amplitude varying in sympathy with the instantaneous amplitude of the audio waveform.

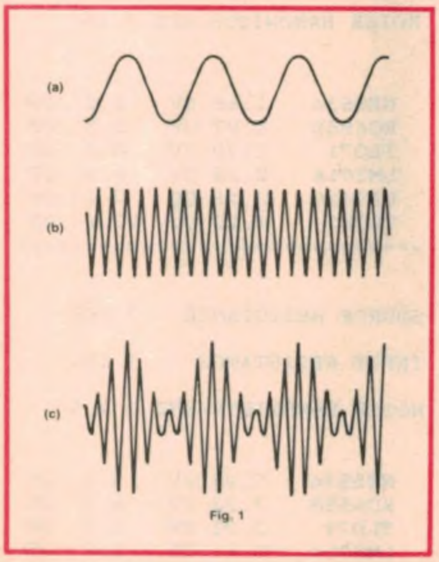


Fig.1: when an RF wave (b) is amplitude modulated by an audio signal (a) the modulated waveform mirrors the shape of the audio envelope, as shown in (c).

While most readers will be familiar with Fig.1, not everyone may realise that, by its very nature, the process of modulation generates additional high frequency signal components distributed (usually) on either side of the original carrier frequency.

In the case of normal amplitude modulation, every frequency component in the audio waveform generates a pair of these so-called "sidebands", one to either side of the carrier and displaced from it by an increment equal to the particular modulating frequency (Fig.2).

A bass note of, say, 64Hz would produce a pair of sidebands respectively 64Hz to either side of the carrier. With a 4096Hz treble note, the sidebands would be displaced to either side by 4096Hz or 4.096kHz. In practice, with a complex music signal, there will be a similarly complex pattern of sidebands present, extending out to 10kHz or more on either side of the carrier and occupying a total bandwidth of (typically) 20kHz.

To receive the total signal being radiated by an amplitude modulated broadcast transmitter, the tuning circuits in a receiver should be so designed that they will accept the full spectrum of sidebands. At the same time, however, they are expected to discriminate against unwanted signals being radiated from other stations broadcasting on adjacent carrier frequencies.

Here lies a problem. Only so much spectrum space is available for use by "medium wave" broadcast stations in the allotted frequency range from (approx.) 525 to 1600kHz. Over 250 stations have to be accommodated in this space in Australia (in other countries, the situation is similar) operating on channels only 9kHz apart, with many geographically isolated stations actually having to share channels.

Particularly at night, with medium-wave transmissions tending to spread across the continent — and the Tasman — distant signals can interfere with anything but strong local stations, particularly with wideband receivers.

As well, adjacent carriers tend to beat or heterodyne, to produce a continuous 9kHz whistle. To overcome this problem, wideband receivers need to be fitted with a special 9kHz whistle filter. (In the USA, AM stations are still 10kHz apart, so that their tuners need 10kHz filters).

As far back as the 1930s, with the number of AM broadcast stations just

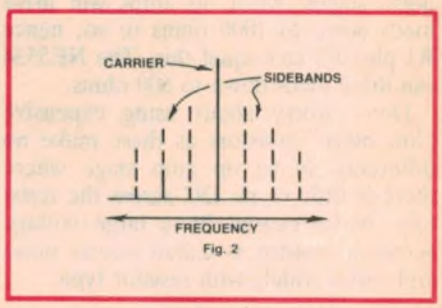
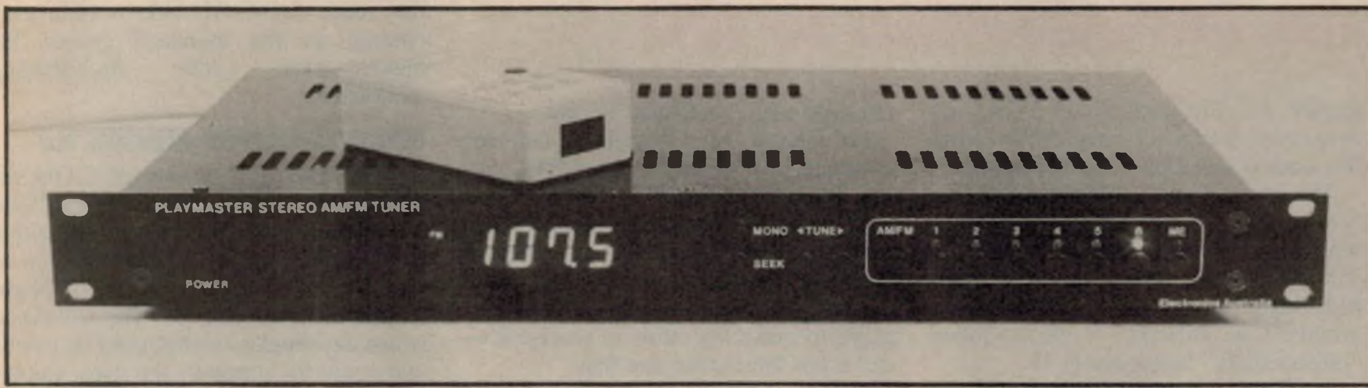


Fig.2: unlikely as it may seem an amplitude modulated waveform is made up of the original carrier plus pairs of sidebands, one pair for each frequency component in the audio signal.



This high performance Stereo AM/FM Tuner from *Electronics Australia* features wideband stereo AM reception, 12-station memory, remote control and synthesised tuning.

beginning to multiply, listeners were demanding more "selective" receivers to ensure freedom from inter-station interference and inter-carrier whistles – irrespective of the fact that it meant attenuating the outer sidebands of the wanted station and thereby sacrificing treble response.

And that's the way it still is, with the vast majority of AM broadcast band receivers and tuners cutting heavily into sidebands beyond about ±3kHz, with a consequent loss of treble response above that figure.

But, back in the 1930s, there was also a genre of more discerning listeners who preferred non-selective receivers, reckoning wideband reception of local broadcasters to be more important than the ability to receive distant stations that were seldom listened to anyway!

Early receivers — the TRF

A type of receiver much favoured for this purpose was the so-called TRF (tuned radio frequency) design, as illustrated in Fig.3. It most commonly involved two RF amplifiers, followed by a detector, with the inputs to all three stages being tuned to the frequency of the desired station by means of matched tuning coils and a 3-gang variable capacitor.

While TRF receivers gave a wider bandwidth of sorts, the basic selectivity curve was of questionable shape (solid curve, Fig.4). The "nose" of the curve was often sufficiently peaky to prejudice the sidebands while, at the same time, the wide "skirts" could let strong interfering signals through that would otherwise not be a problem.

To make matters worse, the tuning circuits invariably tended to exhibit a narrower bandwidth at the low frequency end of the band, where most major national stations were to be found, and a wider bandwidth at the high frequency end, where greater selectivity would have been more appropriate!

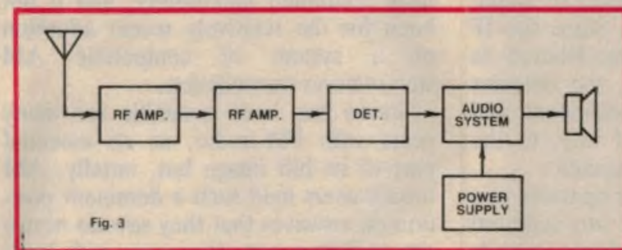


Fig.3: popular in the 1930s, a simple TRF receiver offered wideband reception under favourable conditions but was unduely prone to interference from strong signals on nearby channels.

Even so, TRF receivers generated a cult following and there were countless arguments in the technical press as to their merits. However, their inadequacies became more apparent as the number of stations increased. Nowadays, the principle is seldom mentioned.

Superheterodyne receivers:

A more practical and now universal type of receiver is the superheterodyne — or "superhet" — configuration as illustrated in Fig.5. The incoming signal passes through a tuned RF amplifier or, more simply, through a simple tuned circuit to a frequency changer or converter section.

Here, it is heterodyned or mixed with a locally generated signal from an inbuilt oscillator stage. The circuitry controlling the oscillator frequency is so ar-

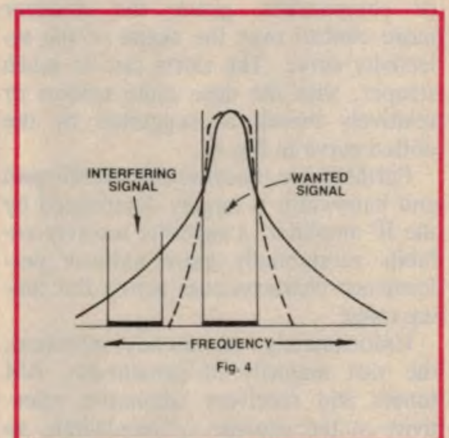


Fig.4: the selectivity curve shown solid is doubly unacceptable. Its sharp "nose" seriously attenuates the outer sidebands but, at the same time, the wide "skirts" invite interference. A blunt, more rectangular curve (dotted) is much better in both respects.

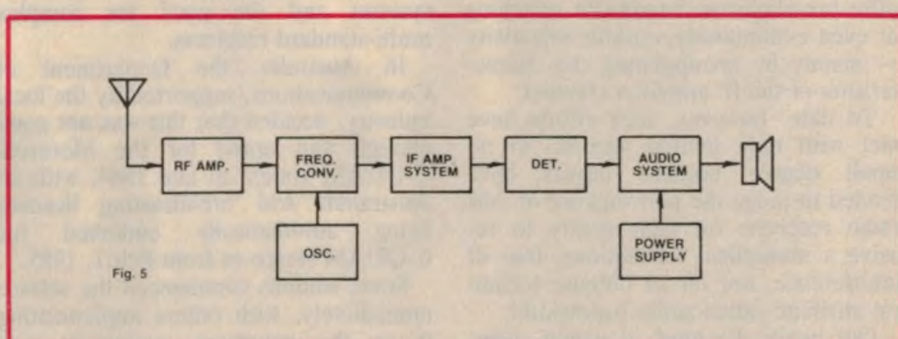


Fig.5: virtually all tuners and receivers produced during the past 40 years or more have used the superheterodyne principle, although the execution of the circuit looks very different in the modern crystal-locked synthesised form.

ranged that the local signal fed to the frequency changer always differs from the wanted signal by a specific figure.

The convention in AM broadcast receivers is to run the oscillator above the selected incoming frequency by around 455kHz so that, when the two signals heterodyne or "beat", a resultant is produced at 455kHz — the so-called "intermediate" frequency or IF.

In effect, a superheterodyne receiver changes each incoming signal, as it is selected, to the intermediate frequency, passing it through a pre-tuned IF amplifier system to a detector. Since the IF signal carries the same modulation as the original radio carrier, the detector can isolate the audio component and pass it on, in the normal way, to the audio amplifier and loudspeaker.

Because the IF amplifier operates at a fixed frequency, it can use any required number of pre-tuned resonant circuits or components, giving the designer more control over the shape of the selectivity curve. The skirts can be much steeper, with the nose quite narrow or relatively broad, as suggested by the dotted curve in Fig.4.

Furthermore, because the overall gain and bandwidth is largely determined by the IF amplifier, a superhet receiver exhibits substantially more uniform performance characteristics across the tuning range.

Unfortunately, as already indicated, the vast majority of present-day AM tuners and receivers emphasise selectivity at the expense of bandwidth, so that they are rather good at receiving stations under difficult reception conditions but rather poor in terms of high frequency audio response.

Efforts have been made, from time to time, to promote designs with the emphasis the other way round, or which offer broad/narrow bandwidth switching or even continuously variable selectivity — mainly by manipulating the characteristics of the IF amplifier channel.

To date, however, such efforts have met with only limited success, in no small degree because buyers have tended to judge the performance of AM radio receivers on their ability to receive a multiplicity of stations, free of interference, not on an obscure technical attribute called audio bandwidth!

Old habits die hard, it would seem. Fifty years on, AM radio has still to shed its utility image as a vehicle for instant news, information, sport, entertainment and "wallpaper" music.

Fortunately, even though the majority of tuners and receivers have been narrow-band designs, AM radio stations have continued to radiate program material extending out to a nominal 10kHz, so that better quality AM sound has long been accessible to anyone prepared to make the effort to receive it — and a few have done just that!

Stereo AM radio

This general situation could well have continued indefinitely, had it not been for the relatively recent adoption of a system of compatible AM stereo/mono transmission.

Stereo has been available for many years with FM radio, as an essential part of its hifi image but, initally, AM broadcasters held such a dominant position on airwaves that they saw no necessity to follow suit. However, with leading FM stations clawing their way to the top, in terms of audience share, the AM stations obviously had to polish up their act.

With the AM system, compatible mono/stereo posed considerable difficulty at both the transmitting and receiving end but, in the mid 1970s, when the FCC (the US Federal Communications Commission) addressed itself to the matter, no less that five rival systems were available for evaluation: Harris, Kahn/Hazeltine, Magnavox, Motorola and RCA/Belar.

After due consideration and testing, the FCC designated the Magnavox system as the provisional standard for the USA. However, faced with possible legal challenge by the losers, it set aside the decision in March 1982, leaving the matter to be determined by market forces — a non-decision that could have led to multiplicity of transmission systems and the need for complex multi-standard receivers.

In Australia, the Department of Communications, supported by the local industry, decided that this was not good enough and opted for the Motorola C-QUAM system in late 1984, with all Australian AM broadcasting licences being automatically endorsed for C-QUAM stereo as from Feb.1, 1985.

Some stations commenced the service immediately, with others implementing it as the necessary equipment was installed. It appears to have been a technically sound decision, subsequently endorsed by New Zealand, and setting the scene for C-QUAM to ultimately emerge as the standard system for medium-wave AM broadcasting worldwide.

What C-QUAM stands for

The "QUAM" portion of C-QUAM stands for *QU*adrature *A*mplitude *M*odulation and refers to a technique involving the use of two sub-carriers of the same frequency but with a phase difference of 90 degrees. The technique is broadly similar to that used in colour television to transmit the two chominance signals.

In the context of AM stereo, the main sub-carrier would typically be modulated by the L+R (left + right) "sum" signal, while the derived (90° phase lag) sub-carrier would accommodate the L-R "difference" signal. After summing, the sub-carrier components would be modulated on to the main carrier for transmission.

In practice, the QUAM system, as such, is not suitable for use by medium-wave broadcast stations because it would demand greater bandwidth than is available. Moreover, the transmission would not be truly compatible, because the detector in mono AM tuners would see and respond only to the vector sum of the two modulating envelopes, having a value of:

$$(1 + L + R)^2 + (L - R)^2$$

The recovered audio would be mono of a kind but characterised by gross distortion and totally unacceptable on that account. The prefix "C" in C-QUAM, signifying compatible quadrature amplitude modulation, is therefore of particular significance.

In C-QUAM there is no sub-carrier as such, the L+R and L-R components being quadrature modulated directly on to the main carrier, which is then amplitude modulated in the normal way by the L+R signal.

As indicated in Fig.6, the sum and difference signals are fed to two balanced modulators, along with a direct and a phase shifted feed from the main carrier generator, the respective outputs being combined in a summing circuit.

To overcome the stereo/mono compatibility problem, indicated above, each carrier axis is electrically multiplied by the cosine of the angle theta, representing the instantaneous vector sum of the L+R and L-R components (Fig.7).

What ultimately emerges from the summing circuit can be interpreted mathematically either as the sum of two

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An intoduction to hifi

separately modulated carriers or as a single carrier with complex phase and envelope modulation. A limiter removes the envelope variation, leaving only a phase modulated signal, which can be fed to the exciter input of an existing transmitter.

The result is that, as seen by the detector in a conventional mono tuner, the resultant from a C-QUAM modulated stereo carrier cancels down to:

1 + L + R

which is precisely what a mono AM tuner expects to receive from a mono transmission of a summed stereo signal from tape, disc or other source (see Fig.7). Proponents of C-QUAM point out that it is the only system in those listed that offers mathematically precise mono compatibility.

A C-QUAM stereo tuner or receiver, on the other hand, can react to the phase components and, by reversing the transmission encoding, recover the original L & R audio signals. But more about that later.

Note also that Fig.6 shows a 25Hz pilot tone being fed into the (L-R) channel, at a 4% modulation level. It serves to alert tuners to the fact that they are receiving an adequate stereo transmission and that the appropriate decoding circuitry should be activated.

Problem areas

Because, like other AM stereo systems, C-QUAM involves additional and critical modulation components, along with the likelihood of wideband reception, some of the liberties which can be taken with narrow-band mono broadcasting are no longer acceptable.

At the transmitting end, care must be taken to minimise random or incidental phase modulation (IPM) because it could be interpreted by tuners as an audio signal. In addition, the amplitude modulation of the carrier must be symmetrical, as also the amplitude and phase characteristics of the sidebands.

This calls for careful assessment and adjustment of the transmitter, consideration of the antenna feedlines and filters and of the antenna system itself. Very real problems have had to be faced by station engineers with directional and shared transmitting antenna systems, involving filters and configurations worked out before stereo was even to

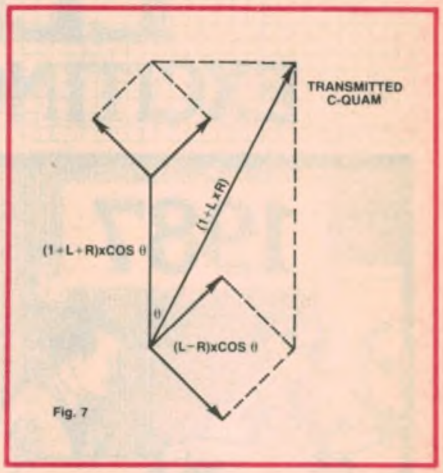

Fig.7: this vector diagram shows the sum and difference information as transmitted for stereo reception and compatible vector sum received by existing mono tuners.

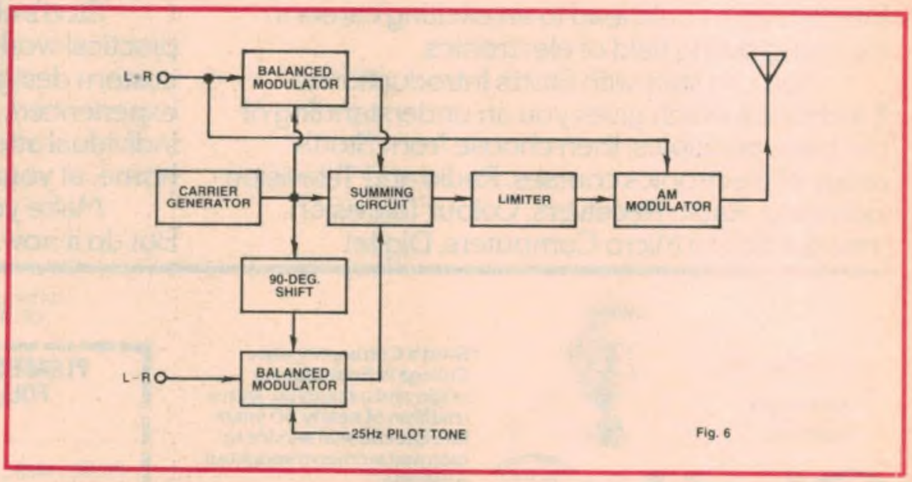

Fig.6: for C-QUAM transmission the AM transmitter remains basically intact but the carrier is effectively phase modulated in terms of (L+R) and (L-R). C-QUAM can claim complete stereo/mono compatibility provided good practice is preserved.

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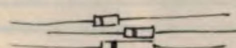

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Q10510	MU45 0-5A	7.50	6.95	6.75
Q10518	MU45 0-1A	7.50	6.95	6.75
Q10520	MU45 0-20V	7.50	6.95	6.75
Q10535	MU45 VU	8.50	7.75	7.50
Q10530	MU52E 0-1mA	9.95	8.35	
Q10533	MU52E 0-5mA	9.95	8.35	
Q10538	MU65 0-50uA	11.50	9.35	8.95
Q10540	MU65 0-1mA	11.50	9.35	8.95
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PN2222A	.10	.08	PN2907A	10	.08
PN3463	.15	.13	PN3565	.12	.11
PN3566	.15	.13	PN3567	10	08
PN3569	.18	.16	PN3639	.18	.16
PN3640	.18	.16	PN3641	.10	.08
PN3642	.10	.08	PN3643	.10	.08
PN3644	.15	.13	PN3645	15	.13
PN4250A	.15	.13	PN4355	.16	.14
PN4356	.16	.14	MPSA42	.23	20
MPSA43	.23	.20	MPSA55	.15	.14
MPSA56	.15	.14	MPSA92	22	20
MPSA93	.22	.20	SC1410	.85	.75
BU126	1.50	1.25	BUX80	2.75	2.55
BU208	2.50	2.20	2SD350	2.75	2.40
BU326	1.75	1.60	BC547	.07	.06
BC548	.07	.06	BC549	.07	.06
BC557	.07	.06	BC558	.07	.06
BC559	.07	.06			

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R15140	.0022uF	0.06	0.04	.03
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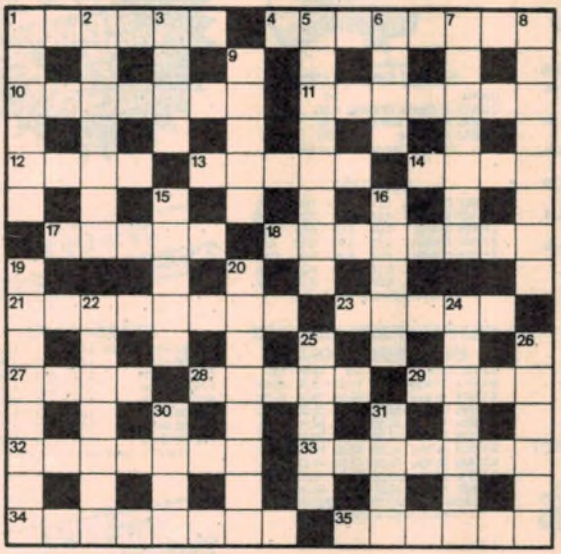
R15145	.0047uF	0.06	0.04	.03
R15146	.0056uF	0.06	0.04	.03
R15147	.0082uF	0.06	0.04	.03
R15148	.01uF	0.07	0.05	.04
R15150	.015uF	0.07	0.05	.04
R15152	.022uF	0.07	0.05	.04
R15154	.033uF	0.07	0.05	.04
R15155	.039uF	0.07	0.05	.04
R15156	.047uF	0.08	0.06	.05
R15157	.056uF	0.08	0.06	.05
R15158	.068uF	0.08	0.06	.05
R15159	.082uF	0.08	0.07	.05
R15160	.1uF	0.09	0.08	.07
R15162	.15uF	0.11	0.10	.09
R15164	.22uF	0.15	0.14	.13
R15165	.27uF	0.16	0.15	.14
R15172	1uF	0.70	0.55	0.50
R15176	2.2u	1.20	1.10	1.00
R15178	3.3uF	1.50	1.20	

Plus 30% tax where applicable

APRIL CROSSWORD

ACROSS

1. Device triggered by microwaves. (5,8)
8. Phenomenon affecting radio reception. (7)
10. Said of a number with a radix of three. (7)
11. Useful place for a magnetic plug. (4)
12. Type of wing used on F/A18. (5)
13. Applied to a pinball machine. (4)
16. Effect of troposphere on radio beams. (7)
17. Type of diode. (6)
20. Symbol used for wavelength. (6)
22. Accurate measuring instrument. (7)
26. Hyperbolic function. (4)
27. What EFTS can do to your account. (5)
28. Sixth letter of Greek alphabet. (4)
31. Part of automotive traffic indicator circuit. (7)
32. Type of potentiometer. (7)
33. Male-to-female D-type adaptor. (6,7)



DOWN

1. Substance used to prevent etching in PCB manfacture. (6)
2. Said of a non-static characteristic. (7)
3. Twisted cable of natural fibres. (4)
4. Elevate retracted antenna. (6)
5. Doughnut-shaped rings. (4)
6. Adjust relative position. (7)
7. Used in CB radios. (8)
9. Inventor of the maser, and proponent of the laser. (6)
14. Etude. (5)
15. Possible results of severe electric shock. (5)
18. Electronic device with unknown contents. (5,3)
19. Sequential connection of components. (6)
21. Pattern substrate etching. (7)
23. End of the day. (7)
24. Unit of phase difference. (6)
25. Possible indication of a siren. (6)
29. Conductors at high frequencies exhibit a — effect. (4)
30. Type style for a printer. (4)

SOLUTION FOR MARCH

be considered.

AM broadcasters are also having to rethink certain practices which have grown up over the years. To achieve a subjectively louder signal, for example, peak limiting has been freely exploited and modulation "fiddled" to increase the amplitude of positive excursions without cutting the carrier on negative excursions. C-QUAM calls for substantially symmetrical modulation and a certain minimum limit to carrier amplitude.

Again, to ensure a brighter sound with indifferent, narrow-band receivers, the stations have commonly applied boost to audio frequencies in the upper middle register. As heard on wideband tuners, this can exaggerate sibilants in speech and impart an obvious "edginess" to music. The problem can be alleviated by use of treble cut in wideband receivers but AM stereo broadcasters will obviously need to agree on a uniform amount of pre-emphasis.

C-QUAM stereo tuner

Fig.8 illustrates the sequence of stages in a C-QUAM stereo tuner. The front end designated as "Tuner and IF Amp." is a superhet system as outlined in connection with Fig.5. However, an old-style superhet front-end with a manually tuneable oscillator is not desirable for a stereo AM tuner or receiver for a variety of reasons:

(a) It may be difficult to ensure that it is tuned to the exact centre of the channel, resulting in a non-symmetrical recovery of sidebands and degraded results.

(b) Even if correctly tuned initially, old-style tuners are subject to drift during operation, which may be sufficient to prejudice stereo reception.

(c) Conventional oscillators may also prove to be microphonic in a stereo tuner because any repetitive variation in frequency — therefore phase — can produce spurious audio output.

(d) Most existing tuners exhibit too narrow a bandwidth to permit the full benefit of the stereo facility.

For these and other reasons, the idea of adding stereo to existing tuners, by way of a C-QUAM adaptor, is debatable. The best candidates for modification are undoubtedly good quality tuners with synthesiser front ends or logic controlled varactor tuning but, even with these, precautions may be necessary to limit hunting effects in the phase locked loop.

(For further information on this subject, see "Add-On Decoder for AM Stereo" in the October 1984 issue of this magazine and recent correspondence in the Information pages).

With very few exceptions, new-generation C-QUAM tuners and receivers can be expected to incorporate modern crystal-locked synthesiser front ends and to include all necessary precautions against IPM effects from any source.

Pressing the appropriate station selector button brings up the precise local oscillator frequency, usually 450kHz above the wanted signal which as displayed on the digital readout. The 450kHz heterodyne resultant appears in the IF channel accurately and rigidly on frequency and ready for amplification and processing.

Setting up AM stereo

When the time comes to invest in a stereo AM/FM tuner, there is every reason to select a model which offers wide/normal bandwidth switching. While the actual bandwidth figures may vary somewhat from model to model, a new stereo tuner, when switched to narrow-band mono, should exhibit much the same gain and selectivity as an existing mono tuner or receiver.

This being the case, it should still be possible to listen to those weaker or more distant signals, if that desired. It may even be possible to tune some of them in stereo.

The real bonus, however, is the ability to hear the local AM stations in wideband stereo and this can be quite an experience the first time around, especially as heard through headphones. We have become so used to listening to cricket and other sport broadcasts in mono that it is quite startling to hear the voice of a commentator against the stereo ambience of a large, vociferous crowd.

With music, of course, it's more a matter of AM radio catching up — almost — with everything else. For sure, the figures are not as good but, subjectively, the sound is way ahead of the "wireless" we've grown accustomed to.

In areas of high signal strength as, for example, Sydney's mid-western suburbs, clean stereo sound should be virtually routine. On the north, east and southern fringes, electrical noise could become a probelm, especially in homes where light dimmers have been fitted and where aluminium foil under the tiles tends to shut the interference in and keep the signals out!

If noise is noticeable on a mono tuner, it will increase by 3dB when switched to stereo, and by a few more dB in the wideband setting. This isn't a reason to abandon wide-range stereo, however; it should provide the incentive to take more care with the placement of the loop antenna provided, or to look into the possiblity of installing a large noise cancelling loop or a modest outdoor antenna.

And if a light dimmer is all that stands between you and good stereo AM, maybe it's time to disconnect it!

One final point: stereo AM can provide a very acceptable alternative for in-car listening in those situations where stereo FM is being chopped up by multipath or the "picket fence" effect. AM signal quality varies in a much less disconcerting fashion and stereo should be all that it needs to make it competitive once again.

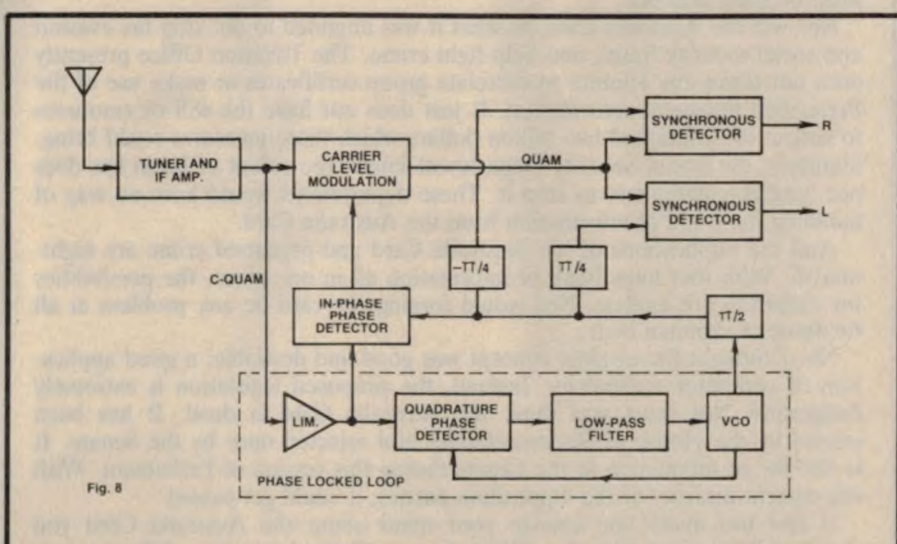


Fig.8: the main body of the tuner is contained in the box marked "Tuner and IF Amplifier". All the rest is concentrated, in practice, in a single dedicated IC and a modest handful of peripheral "bits".

Letters to the Editor . . . ctd from page 5

by Department of Communications and Telecom staff. It is their professional expertise that helps to make Radio Australia the success it is.

N. Deer,
A/Controller Resources and Services,
Radio Australia.

CD has earned its popularity

I was most interested in your "The truth about turntables" editorial (December 1986) and the predictable reply from Thorens.

Before valid comparisons can be made, it is essential that the difficulties of optimising vinyl record playback systems as well as the cost of CD are considered.

Outside of a laboratory, it is virtually impossible to optimise a vinyl record playback system. The following factors must be considered:

(1). Matching stylus compliance with tonearm mass.

(2). Optimising, in four directions, the mounting of the cartridge in the arm.

(3). Ensuring the arm is mounted correctly, in three directions, on the turntable.

(4). Tuning the turntable suspension to the correct resonance.

(5). Levelling of the turntable.

(6). Matching the capacitance and impedance of the preamplifier input to the requirements of the cartridge.

To anyone who has tried to do the above with any degree of accuracy, the task is well nigh impossible. In addition, the phono preamplifier is inevitably the Archilles heel of any preamplifier.

The CD overcomes all the above problems, including the phono input stage.

The vinyl record protagonists invariably pit a $5000 turntable against a $500 CD player. They also choose from a very small range of specially selected records to do their demonstrations. Most of these records have been digitally recorded!

History has shown us that when any technological breakthrough occurs, the old system is relegated to the lower end of the market. This was so with the change from cylinders to discs, acoustic to electrical recording, shellac to vinyl, mono to stereo, analog to digital, and now vinyl to CD.

One only has to visit a major record store to see the range of CDs against the range of vinyl records, most of which are of the cheap "television special" variety.

The reason the esoteric magazines rave on about exorbitantly priced cartridges, tonearms and turntables is that they have to. CD has simplified hifi to the point where its use can be understood by the layman, and it is philosophically impossible for the magazines to support mass produced products made by giant multinational companies.

No one would suggest that CD is perfect, but it solves so many problems that it certainly deserves its huge popularity.

John D. Browne,
Alfred Cove, WA.

Those plastic credit cards

Mr Y.Z.'s letter on plastic credit cards (December 1986, page 19) reminds me of a story that I heard some years ago.

A man in Florida inserted his card into an automatic telling machine, which duly digested his card but refused to return it and also refused to give him any money. At this the man whipped out a gun and shot the machine. I have much sympathy as one who has been cheated countless times by automatic ticket machines (an article on what sort of kicks to give these machines would, I am sure be useful).

The court treated this case with great solemnity. After all, the automatic telling machine was worth $75,000, whereas the value of the contents of a mere person, according to the latest estimate and allowing for inflation, is around $3.50. Furthermore, the automatic telling machines have an even more valuable database to support.

Y.Z. is certainly justified in feeling uneasy in the light of these relative values. However, I am sure that the incident in Florida will imbue us all with a correct sense of priorities and with a dutiful humility.

M. Gamble,
South Yarra, Vic.

Editorial Viewpoint . . . ctd from page 5

ganisation that has considered the legislation has pronounced itself in favour of it. The organisations actively against the Australia Card legislation include: The Joint Parliamentary Committee, Law Council of Australia, The Confederation of Australian Industry, NSW Privacy Committee, Real Estate Institute of Australia, Federated Clerks' Union, NSW Council of Australian Small Business Association, Australian Associated Stock Exchanges, Victorian Teachers' Union, Victorian Chamber of Commerce, NSW Anti-Discrimination Board, International Commission of Jurists, Australian Catholic Welfare Commission, Administrative & Clerical Officers' Association and last, but probably the most relevant as far as I am concerned, The Australian Computer Society. If they don't like the security of the proposed system, there must be great concern.

Nor will the Australia Card do what it was intended to do: stop tax evasion and social security fraud, and help fight crime. The Taxation Office presently does not make any attempt to correlate group certificates or make use of the Prescribed Payments information. It just does not have the will or resources to collect the estimated two billion dollars which these measures could bring. Similarly, the Social Security Department knows the extent of fraud but does not have the manpower to stop it. These departments would have no way of handling the flood of information from the Australia Card.

And the implications of the Australia Card and organised crime are nightmarish. With that huge bank of information all in one place, the possibilities for extortion are endless. Nor would forging the card be any problem at all for those of criminal bent.

No, I thought the original concept was good and desirable, a good application of computer technology. Instead, the proposed legislation is extremely dangerous. Nor must you think the Australia Card is dead. It has been passed by the House of Representatives and rejected once by the Senate. It is due for re-submission to the Senate during this session of Parliament. With the current disarray of the Opposition parties, it could get passed.

If this has made you change your mind about the Australia Card you should take immediate action. Write to your Federal member of Parliament. Say that you don't want a bar of it.

Leo Simpson

Compact Disc Reviews

MENDELSSOHN

Overtures and Symphony No. 3
The London Symphony Orchestra conducted by Claudio Abbado
Deutsche Grammophon 415 973-2 DDD
Playing time: 65 min 42 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Written when the composer was 17 years old the music to "A Midsummer Nights Dream" has a very pleasant, airy and youthful character to it, like many of his other compositions. It was intended as a concert overture and not for the theatre, yet 17 years later Mendelssohn added a set of incidental music for accompanying a play.

The 3rd symphony is very characteristic of Mendelssohn with its dance-like 2nd and 4th movements and a somewhat melancholic 1st movement. It was inspired by a trip to Scotland when the composer visited the ruins of "the place where Queen Mary lived and loved". This obviously conjured up ideas of sadness as evidenced in the "flavour" of the 1st and 3rd movements.

Overall the work is a real gem and I find it strange that it is not featured more often in concerts and on radio.

The overture "The Fair Melusina" is a rarely performed work but nevertheless very worthwhile. It was written as an example of how this work should be after hearing a composition of the same title by Conradin Kreutzer whom he disliked.

Whilst the music on this disc is excellent, the sound quality is a little disappointing. To some it may sound fatiguing but if you enjoy Mendelssohn, that will keep you listening. The string tone has a hardness about it and is almost overpowering.

This is disappointing for such great music. The playing time is very generous at nearly 66 minutes and there are good notes on all the works. (R.L.C.)

MENDELSSOHN

Violin Concerto, Octet OP.20
Pinchas Zukerman, soloist
St. Paul Chamber Orchestra
Philips 412 212-2 DDD
Playing time: 61 min 59 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

Maybe this is Mendelssohn month for here is a superb performance of his most famous work. It was first performed on March 13th, 1845 in Leipzig when the composer was 36 and just two years before his death.

The performance here, by Zukerman, is frankly flawless — superlatives are unnecessary. One point easily missed is that there is no formal conductor here, just the soloist directing, although noone would ever know.

The octet in E flat is a well established work and explores some unusual musical form, yet is so appealing and friendly, especially the popular scherzo. Written when the composer was a mere 16 years old, I feel it is chamber music at its best and performed here extremely well.

The sound quality just borders on excellent — maybe slightly dull but only slightly. Nothing appears to excel — probably the mark of a perfect balance yet somehow I think I may have heard better so I have given it a reluctant 8 where it may deserve a 9. Remember this is chamber music, not a rousing romantic symphony, so don't expect any sonic booms.

This music is more fully appreciated if you can get away from interruptions and listen with the lights out. Great stuff! (R.L.C.)

CHARLES DUTOIT

Scheherazade, Op.35
Capriccio Espagnol, Op.34
Richard Roberts, solo violin
Orchestre Symphonique de Montreal conducted by Charles Dutoit.
Decca 410 253-2 DDD
Playing time: 61 min 11 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

This work, I am sure most will agree, is a foot tapper if ever there was one. If you're not familiar with classical music but would like to be enlightened then here is a work that will get you going and give your hifi something to do.

It was written around the story of a thousand and one nights by a composer by RON COOPER

so gifted in exploiting such a tale! The extremely rythmic tonal hues throughout this work I find most fascinating. There seems to be an endless melodic flow, almost to tease, as you are allowed just a little of each before an equally exciting new one emerges with its tantalising oriental rhythms.

As a bonus there is also the Spanish Caprice which is nearly as colourful as Scheherazade and also superbly played.

So you won't be disappointed with this disc. The playing is excellent, the tempos as they should be, and there is a good clean sound with accoustic ambience just right for a large orchestra. I would have preferred perhaps a little more body in the lower bass but I have to concede that this is a desirable version.

One point worth noting is the virtual lack of any program notes on these works or the composer. (R.L.C.)

RACHMANINOFF

Piano Concertos 1 & 2
Zoltan Kocsis, piano
San Francisco Symphony conducted by Edo de Waart
Philips 412 881-2 DDD
Playing time: 55 min, 44 sec

PERFORMANCE
1 2 3 4 5 6 7 8 9 10

SOUND QUALITY
1 2 3 4 5 6 7 8 9 10

The 1st concerto here could be regarded as Rachmaninoff's debut as a composer. Commenced when he was 17, it is an interesting work but what we always hear is the revised version of some nine years later. It has a magnificent opening but I feel the 1st movement lacks something, particularly when compared with the magnificent No. 2 concerto.

However, this is merely a personal opinion and the playing of Zoltan Kocsis of this work is extremely good. Tempos are on the brisk side but I don't mind that at all. The 2nd movement is skillfully played and the last movement seems to benefit from the lively tempo.

The 2nd concerto was written after

the composer had recovered from a mental depression following the unjustifiably critical reception of his 1st symphony. Obviously, he must have recovered well, for the 2nd concerto is probably his most famous work and one that you never seem to tire of.

The recording I feel, is not up to the usual standard we have come to expect from Philips. Possibly it is an acoustic problem as there is a certain boomy quality to the upper bass although the overall balance is quite good with excellent sonic impact from the brass. This boomy quality seemed to be much less noticeable in the 2nd concerto than the 1st. In fact, the 2nd sounds excellent and on it's own would rate a 9 in this regard.

This seemed strange to me so I looked for a possible reason and found that there is a two year gap between the recordings as mentioned on the cover notes, which give excellent accounts of these concertos.

I would have preferred a little more feeling from the performer in the 1st movement of the 2nd work but this does not apply to the 2nd or 3rd movements which were magnificently played. (R.L.C.)

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AERIALS

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Chapter 2 deals with linear analogue circuits and also covers the use and construction of a signal injector/tracer which can be used to locate and isolate the faulty areas in a project.
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Information centre

Parts for Playmaster 60/60 amplifier

I am writing in regards to the Playmaster 60/60 amplifier. While reading your article I thought it would be a good kit to build as it seems to be an excellent amplifier.

However, a friend of mine enquired at one of Melbourne's smaller kitset suppliers and was turned away by one of the sales representatives because of things like the printed circuit board is apparently 3mm too big for the cabinet to go over it and also some problem about the toroidal transformer. I would like your views on this. (R.G., West Footscray, Vic).

• Complete kits of parts for this amplifier are available from at least two sources: (1) Jaycar in Sydney and (2) Altronics Pty Ltd in Perth. We also understand that Dick Smith Electronics is currently in the process of kitting up for this project.

The kitset supplier in question, who is not an advertiser in this magazine, has not made the effort necessary to be able to supply the kit. Hence, they have poured cold water on it.

It is utterly ridiculous for them to suggest that the PCB is too big to go into the cabinet. The board was specially designed to fit into a standard rack mounting cabinet and the photographs published with the articles should prove that there are no problems in this regard.

It is true that the toroidal transformer has been in short supply but an approved locally-made substitute transformer which works just as well is now available and is presently being supplied by Jaycar Electronics.

Modifying a Pioneer tuner for AM stereo

I incorporated the AM stereo decoder published in the October 1984 issue of EA in a six year old Pioneer TX-5300 tuner, and encountered and resolved the following problems:

(1) The decoder would not remain locked to the 25Hz sub-carrier on all stations. The stereo indicator LED (which lights when the decoder is locked) would reliably light on only two of the four local stations. Lock was difficult to achieve with 6IX and 6KY and would drop-out after a few minutes operation. I am told that both these stations use the same encoding equipment.

A check on pin 14 of the MC13020 showed that the recovered 25Hz subcarrier voltage was less than half (about 300mV p-p) that of the stations which produced reliable lock. This voltage is proportional to the modulation depth of the 25Hz subcarrier as the RF carrier is subject to AGC. Thus, if the Motorola circuit was thoroughly tested (and it's odds on that it was), then I suspect that at least two of the stations are transmitting less than the recommended 4% subcarrier.

The solution is to increase the recovered level of the subcarrier by:

(a) removing the 7.5kΩ resistor on pin 11.

(b) short the 430Ω resistor on pin 11.

(c) reduce the 4.7μF capacitor on pin 11 to 1μF.

The 7.5kΩ resistor is an attenuator, whilst the other two components form a low-pass filter, which has its cutoff frequency raised by the above modifications. The following active bandpass filter provides adequate filtering. The result is a doubling of the recovered 25Hz subcarrier signal at pin 14. Greater than 500mV p-p provides reliable lock, and 400mV p-p minimum was required.

(2) Tantalum capacitors must be used in lieu of electrolytic capacitors on pins 11, 12, 13 and 14 as the capacitance spread (tolerance) of electrolytic capacitors is too large.

(3) The three oscillator capacitors on pins 17 and 18 must be low temperature coefficient NPO types (I used Philips miniature square ceramic plate types) to prevent the VCO from drifting off frequency. The disc ceramic types provided in my kit were useless for this application. This modification allows stable locking from cold to normal temperatures.

The above modifications are considered essential and the following are specific to the tuner mentioned:

(4) The local oscillator/IF/detector stage (HA1138 IC) power rail was regulated by the addition of a 9V 400mW zener diode between pin 12 and ground (pin 16). This reduces distortion due to phase modulation of the IF signal caused by large changes in signal level modulating the Vcc rail. An existing 47Ω resistor (R23) between pin 12 and Vcc limits the current, and forms part of an RC decoupling network.

(5) The IF feed is from pin 13 of the HA1138 IC, via an added 500kΩ trimpot used as a variable resistor, and adjusted for 500mV p-p into the decoder. A x10 probe should be used to minimise loading effects while measuring this signal.

(6) The 2.2kΩ resistor on pin 10 (R26) was removed to disable the mono AM output, and the selector switch rewired to provide stereo AM switching to the output.

(7) The tuner bandwidth is set by a ceramic resonator to about 4.5kHz and limits the tuner performance in the AM mode. This can be improved marginally by loading the primary winding of the transformer feeding the resonator with a 10kΩ resistor, and slightly detuning (stagger tuning) the transformer, at the expense of reducing selectivity and sensitivity.

The overall result of these modifications is a stable, reliable tuner with reasonable performance, limited by bandwidth, which is better than mono AM but not as good as stereo FM. I cannot detect any change in the distortion level between AM mono and stereo with ears.

Twenty years ago, I wrote to your magazine and asked you how to dim interior lights in an FB Holden with a resistor, which you kindly explained. I have written the above in a expanatory style for use as you wish. It is my pleasure to return the favour. (A.L. Darlington, WA)

• Thanks for taking the trouble to write and return the favour.

Can't calibrate capacitance meter

I recently completed the Digital Capacitance Meter (described August 1985) and found that I was unable to carry out the calibration procedure until

I had changed trimpot VR3 to 2kΩ and the associated 2.2kΩ resistor to 1kΩ.

I allowed one hour before completing calibration so that the instrument might reach a steady temperature. Before using it for making any measurement I leave it switched on for at least an hour.

The problem is that when I use the original calibration capacitors I find that the readings vary by one or two units; ie, the 47μF may read between 45μF and 49μF. This occurs over the three ranges. The further the capacitor is from any of the three calibration values the greater the problem becomes. The variation in this case might be 15 or more units and I have yet to see the reading stabilise as even at its steadiest, it still varies over two or three units.

I believe the instrument is capable of better performance than I have experienced and any advice you can give will be greatly appreciated. (D.P., Tamworth, NSW).

• Because you have found it necessary to change some of the resistor values around the reference oscillator, we suspect that you are not using a 74C14 or 40106 Schmitt trigger IC as specified in the parts list.

In fact, we have become aware of at least one retailer who has been substituting an MC14585 Schmitt trigger for IC1. Please note that this IC is quite unsuitable as its hysteresis levels are quite different to those of the ICs specified.

The answer to bad cases of display jitter is to use a separate IC for Schmitt trigger oscillator IC1c. This is done by mounting a second 74C14 or 40106 on top of the existing IC in piggyback fashion, and soldering their supply leads (pins 14 and 7) together. It's then simply a matter of running connections for the gating oscillator directly to the pins of the piggyback IC.

Polyswitch protectors for loudspeakers

I refer to the article by Leo Simpson on "Foolproof Loudspeaker Protection" in your July 1986 issue where particular reference was made to polyswitch protectors.

I have a Sansui R-30 receiver purchased around 1978 (minimum 25W RMS per channel into 8Ω) playing into two Wharfedale Super 10RS/DD loudspeakers dating from around 1967 (actual resistance 10Ω, maximum input 10W RMS). I realise that these loudspeakers represent outmoded technolgoy but they are more than OK for my needs. They replaced the original pair of similar loudspeakers I purchased in 1965, one of which blew last June when the receiver developed a fault which apparently resulted in a relatively large DC voltage at the output.

There are no built-in speaker protection devices in the receiver but I have since installed 250mA fuses in the positive leads to the loudspeakers at the amplifier end.

For various reasons I took six months to get the receiver repaired satisfactorily and I now want to ensure, if feasible, that the speakers won't be similarly damaged in the event of a further amplifier fault. I understand fuses aren't very reliable and I regard them only as an interim measure .

When I enquired at Jaycar Electronics about the polyswitch devices in your article I was told they would not be appropriate because of the low power ratings of the equipment involved. However, I noticed that in your article on page 61 under "other applications" it mentioned that such devices are available in a large range of ratings. Could you therefore please advise whether there is a polyswitch protector available to protect my loudspeakers and where I might be able to get them. (H.D.W. Kenmore, Qld).

• Although units in other ranges are manufactured, they are unavailable in small off quantities. Unfortunately though, the people at Jaycar arc wrong. As we explained in our July 1986 article, the RDE 115A is suitable for systems *up to 100 watts*. Therefore, the RN3415, now sold by Jaycar, would be quite suitable for protecting your loudspeakers.

Alternatively, you could incorporate relay protection for your loudspeakers. A suitable loudspeaker protector was described in the November 1975 issue of EA (File No 1/MS/13) and could be built into your Sansui receiver. Photostat copies of this article are available from our Information Service at $4, including postage.

Solar powered motor boat

In your November 1986 issue an article appeared concerning a solar powered bilge pump for a boat. Although a solar powered small craft has already crossed the Atlantic Ocean between the UK and the USA I am intrigued by the solar powering possibilities for a small craft which would need:

(1) A suitable number of high power solar panels for battery charging or direct motor drive.
(2) Say four 12V 6-cell lead-acid heavy-duty automotive batteries.
(3) A suitable electric motor able to produce up to 0.25-0.33BHP.
(4) Simple reduction gearing to provide one BHP at the propellor with a propellar speed of 300-600rpm (not too low with suitable pitch).
(5) With such a set up a maximum boat speed of between four and six mph should be possible in a suitable hull of half tonne displacement.

I am not conversant enough with either electronics or electrics to go into further detail, but would be interested to read other reader's comments or concept. (D.C., Auckland, NZ)

• Your idea is interesting but appears to have a number of drawbacks. First, you only obtain maximum output from the cells in bright sunlight and with the cells oriented for maximum illumination. On a boat, these conditions would be seldom attained.

Second, you would need large battery storage if you needed to keep going at night and this would necessarily increase the hull weight considerably. Third, the use of reduction gearing from a third horsepower motor will not yield one horsepower. Under ideal conditions it will yield around 90% of the motor's rating. With these things in mind, you might be wise to take along a few sails.

Lack of bass in Playmaster amplifier

I have recently constructed the Playmaster 60-60 amplifier and also the Vifa 60-60 kit speakers.

In the time between completion of the speakers prior to building the amplifier, I used a low-cost low power (15W per channel) amplifier of some vintage to tide me over, and was quite impressed with the results, having not owned a pair of high quality speakers before.

After building the 60-60, I was very impressed with the clarity and purity of the sound, but a little disappointed with what seems to be a reduction in bass response, particularly at low output levels. The cheap amplifier seems a long way in front in this sense.

Is there a problem with my particular unit, or could a modification to the tone control circuitry be worthwhile? The bass control knob is always fully clockwise and I would be interested in your comments. (R.S., Stawell, Vic.)

• First of all, we would like to assure you that when it is working correctly, there is nothing wrong with the bass response of the Playmaster 60-60. If your particular amplifier lacks bass response, the most probable cause is a faulty or incorrect value component.

To troubleshoot the problem, try rotating the bass control backwards and forwards. If there is a marked variation in the bass level, then the amplifier is probably perfectly OK. It could be that your low-cost amplifier lacks high-frequency response or has an inbuilt bass boost circuit, thus giving the impression of better bass.

If this is the case, the Playmaster amplifier will eventually sound much more natural after further listening.

You haven't told us whether the problem occurs on all inputs or only on the Phono input. If the problem only occurs on Phono, carefully check the 220μF capacitors on the base of Q2 in each channel.

On the other hand, if the problem occurs on all inputs, check the values of the coupling capacitors in the preamplifier and tone control stages. These include the 0.22μF capacitor in series with the volume control wiper, the 22μF capacitor at the output of IC2 and the 6.8μF capacitor at the balance control.

In addition, you should also check the value of the bass control pot and the 0.01μF capacitor across it.

Finally, we suggest that you check the 1μF capacitor on the balance control wiper and the 47μF capacitor connected to the base of Q7 via the 1kΩ resistor.

UHF remote control switch

I am rather perturbed with a paragragh on page 25 of the January issue concerning the UHF remote control switch. It states that the loudspeaker or horn and side lights sound for approximately 0.2 seconds when the alarm is turned on and approximately 0.5 seconds when the alarm is turned off.

This would be unacceptable if this is the case and would be a complete give-away to a professional thief. It would be very embarrassing and a bonanza to a professional in an enclosed carpark. (J.T., Bilinga, Qld).

• You are quite correct in assuming that the loudspeaker (or horn) sounds for approximately 0.2 seconds when the alarm is switched on and for 0.5 seconds when the alarm is switched off. This is in line with standard commercial practice and is quite acceptable in view of the very brief time periods.

Note, however, that you don't have to operate your horn or the blinker lights if you don't wish to — this feature is entirely optional. Instead, you may wish to mount a small 8Ω loudspeaker inside the vehicle and to use this for audible on/off indication.

Wants Band V version of UHF antenna

I am interested in the UHF TV antenna described in the May 1986 issue of EA. It was for band IV. In Adelaide, all five TV stations broadcast in UHF in band V on channels 43, 46, 49, 52 and 55. (SBS also broadcasts on channel 28 with the other four stations on VHF from Mt Lofty.)

Can you please advise what modifications should be made to the antenna described in EA to give good reception on channels 43 to 55, or for band 5?

• Essentially, redesigning the antenna to suit the channels you want would be a matter of scaling the dimensions to suit the higher frequencies. Our antenna was cut to favour channel 28 in band 4. To make it work to suit your purpose, all the antenna dimensions would all have to be reduced by a factor of 0.78, to favour channel 49.

We must emphasise that we have not tried making the antenna work at these higher frequencies and could not guarantee the results. Having said that, such a design could be expected to work well when modified. Have any readers tried modifying the design along these lines?

Notes & Errata

DIGITAL SOUND STORE (February 1987, File 1/MS/34): There is an error on the circuit diagram on page 94. The connection from pin 10 of IC2b to pin 5 of IC6b should in fact go to pin 4 of IC6b. The printed circuit board is correct.

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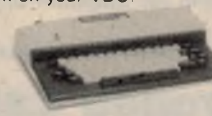

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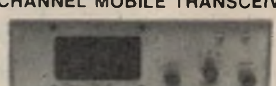

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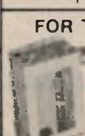

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Plus:

An op amp tester to build, an Omega derived frequency standard, part two on restoring vintage radios, the story of Aussat, a car battery voltage monitor, and radar during WWII.

**Note: although these articles have been prepared for publication, circumstances may change the final content.*

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