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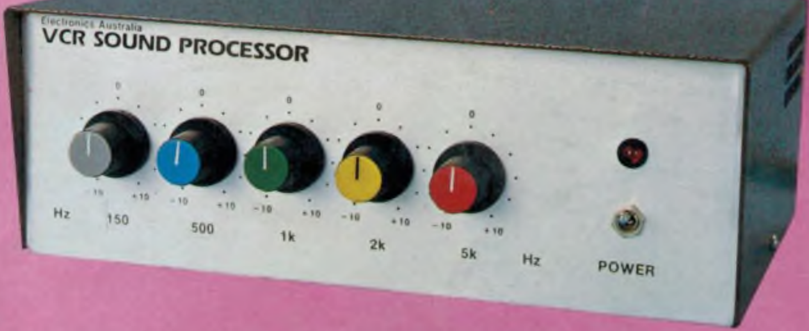
AUSTRALIA'S NUMBER ONE ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

APRIL 1984
AUST $2.30
NZ $2.75

VCR Sound Processor

Stereo simulator, plus 5-band graphic equaliser plus noise filtering



- What to do if your project doesn't work
- Flight simulators — the grand illusion
- Forum: when you can't find a job
- Phase Linear compact disc player reviewed

- Building the new LCR Bridge
- Li'l Pokey — an electronic poker machine
- High-power load box for amplifiers
- Op amps explained, Pt 2

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The audio giant scores 10 out of 10.

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8 3-way, 3 speaker systems each containing 25cm woofer, 10cm midrange and a 2.5cm dome tweeter.

9 Audio component rack with attractive wood-grain finish includes record storage facility. Castors for easy mobility, glass door and hinged glass turntable dust cover.

10 The tenth feature is the price and Sanyo has taken care of that too, but that's life.

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That's Life!

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7225

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE

ELECTRONICS AUSTRALIA

Volume 46, No. 4, April 1984

On the cover

Give the sound from your VCR a lift with this VCR Sound Processor. Features include a stereo simulator, noise filtering and a 5-band graphic equaliser.

Features

Hifi, Video and Reviews

Projects and Circuits

Personal Computers

Columns

Departments

LCR Bridge: construction

Our new LCR Bridge measures resistance to 11MΩ, capacitance to 11,000µF and inductance to 1100 Henries. The construction details begin on page 44.

Li'l Pokey: a one-button bandit

Here's a one-pushbutton bandit that definitely won't break the bank. It's battery-powered, easy to build and uses 7-segment LED readouts. Details on page 68.

Hong Kong airport — simulator style

Hong Kong airport from the flight deck of a 747. At least, that's what it looks like. In reality it is an image from a Qantas 747 simulator. Read all about it on page 12.

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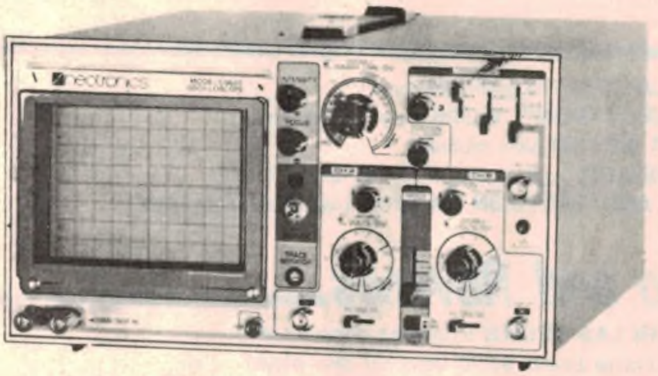

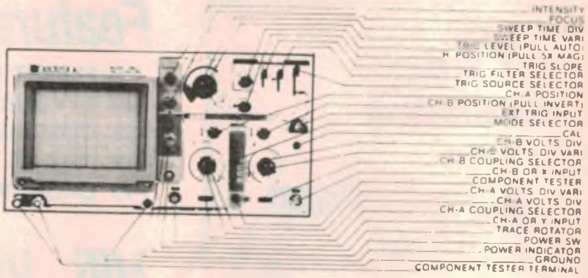

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Editorial Viewpoint

Museum industries are not a tourist attraction!

At a recent press conference, the Minister for Science and Technology Barry Jones stated that Australia has become an industrial museum. He went on to say that "this may have some value for tourism since our industries are in full working order". While this was clever and gained a laugh at the time it is not really a fair comment on most of Australia's industries.

True, some industries, notably those involved with car manufacture, footwear and textiles, are over-protected but even these are undergoing considerable rationalisation and modernisation. For the most part Australia's economy is very open and our industries are competing with overseas companies without much benefit from high tariffs, quota systems or other mechanisms designed to limit competition.

We realise that Barry Jones does have a purpose in making such uncomplimentary remarks. He is seeking to jolt Australians out of their complacency and to make a real effort to compete on world markets. It is not enough for Australian industry to survive in Australia — it must actively seek overseas markets.

Our immediate aim, if Australia is to become more competitive in future world markets, is to raise the skill base. With the erosion of employment in our electronics industry the reservoir of skill has become very small. So we have the paradox of a populace which is in love with all the latest technology but precious few people having any knowledge of how it works.

As an estimate, probably no more than 1 or 2% of the Australian population have any working knowledge of electronics, whether it is in computers, television, broadcasting and so on. And the number of people who are capable of useful design work is really small. In fact, quite a large proportion of our qualified engineers are useless in this respect. They're in administration, sales, insurance or whatever. Gone.

Moves to improve the skill base must start in the schools. More students should be steered towards subjects which will enable them to go on to do tertiary engineering courses. This means more emphasis on physics, chemistry and maths. Introductory electronics should also be featured, so that kids know something of the technology which is presently responsible for so much of their leisure activities.

As the years go past technology will become ever more pervasive in our environment. If no one can explain the environment we'll be back in the "dark ages".

Australian industries have a story to tell

While we realise that Australian industries may not be making the impression on world markets that they should, many companies are innovative and have a story worth telling. Too many organisations, whether in the private of public sector, tend to keep their light under a bushel.

"Electronics Australia" has a policy of producing feature stories which report on interesting technical developments in Australia. Recent examples are the story on heart pacemakers in June 1983, Televising the Bathurst 1000 in November 1983 and the Learmonth Solar Observatory in last February. We hope you have enjoyed these stories.

If you know of a technical development which is worth telling to our readers, why not drop us a line? We'd like to hear from you.

Leo Simpson

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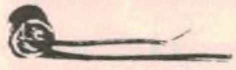

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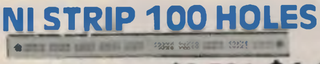

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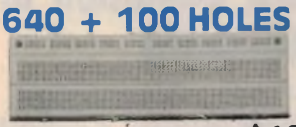

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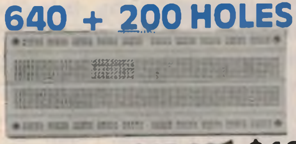

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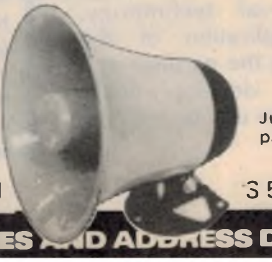

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News Highlights

Laser printing facility for CSIRONET

Users of the CSIRO's national computer network, CSIRONET, will now have available an advanced electronic printing facility as part of the basic service. Following an agreement between the CSIRO and an Australian company, Microsystems Pty Ltd, three laser printers will be available on the network.

The Xerox 9700 system used on the network combines laser, computer and xerographic technology to produce graphics and text of virtually unrestricted size and shape directly from digital information. Printed A4 size forms or letters, for example, can be produced at the rate of two per second, or up to 7200 per hour.

A minicomputer workstation is connected to the system for processing text and graphics images and allows the design of forms, type fonts and graphics, mixing of text and graphics and page composition before the information is transmitted to the laser printer. An Autokon Mk II Scanner is also linked to the workstation to scan and digitise original artwork and illustrations for use by the system.

Dr Peter Claringbold, the chief of the CSIRO's Division of Computing Research, stated "The new facility promises to favourably impact the publication of technical reports and papers being produced by CSIRO scientists. There are immediate and potential applications involving the integration of scanned, digitised graphics, multiple fonts, scientific notations, bar codes, OCR characters and international language character sets".

"Quite apart from offering an economically viable and speedy alternative to traditional time consuming and expensive publishing methods, the new Electronic Demand Printing Service allows CSIRONET customers to undertake tasks that were never before possible, or cost justifiable", he said.

Microsystems Pty Ltd and the CSIRO have entered a two year joint development program to expand techniques for graphics scanning, storage and retrieval technology. Australia's early application of the printing system places the partners in a prime position to develop applications software which can be sold internationally.

Cordless stereo system

An Australian industrial designer has patented what is believed to be the world's first cordless portable stereo system. The Transtereo system, developed by Stuart Saunders of Bracken Ridge, Qld, consists of a master control unit and two auxiliary receiver speakers. The main unit accepts signals from program sources such as a compact disc player, tuner or record player and provides equalisation and amplification before transmission to the powered loudspeakers.

Patents have been applied for in 25 countries which are either significant manufacturers or consumers of audio products. For further information contact Stuart Saunders, Esdesign, 249 Barrett St, Bracken Ridge, Qld. Phone (07) 261 3387.

New definition of the metre

As from December last year, Australia has a new definition of the standard metre. Following a recommendation by the National Standards Commission, Australian weights and measures regulations have been amended to incorporate the new definition agreed to in Paris at the 17th General Conference on Weights and Measures, held in October 1983.

The new definition is: "the metre is the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second". The previous standard defined the metre in terms of the wavelength of orange light emitted by atoms of krypton.

The CSIRO Division of Applied Physics, which is responsible for the maintenance of Australia's primary standards of measurement, made significant contributions to the international research collaboration which led to the new definition. The Division has already established a new primary standard of length based on a helium-neon laser emitted red light, the frequency and wavelength of which are stabilised by reference to the absorption spectrum of iodine vapour.

IBM funds Australian Research

An agreement between an Australian microelectronics research centre and IBM Australia which will ultimately benefit high technology industry was announced in Sydney recently at a news conference attended by the Minister for Science and Technology, Mr Barry Jones.

Through the agreement, the Joint Microelectronics Research Centre is to receive more than $1 million over four years from IBM in the form of scholarships, personnel exchanges and laboratory and computer equipment.

This will help the Centre expand its work in areas such as the design and fabrication of electronics chips, research into improved micro electronic materials and processes and the development of better solar cells.

Set up in February 1982 through a $2 million grant from the Federal Government, the Joint Microelectronics Research Centre combines the work of scientists at the University of New South Wales and the Royal Melbourne Institute of Technology. (The Centre is one of the Commonwealth Government's Special Research Centres).

It is vital to have interaction with industry, both in Australia and overseas, and this agreement is a link not only with a company in the forefront of its industry but also with one of the world's leading microelectronic research groups (at IBM's Thomas J. Watson Research Centre at Yorktown Heights, New York, one of the company's research laboratories).

Segmented mirror for solar research

Developed by Lockheed Research Laboratories, this segmented mirror assembly significantly improves the images produced by earth-based solar telescopes. The mirror is made up of 19 hexagonal segments, each mounted on three pistons that are controlled by special sensors. The sensors detect the incoming light and feed information to a computer to automatically adjust the mirror segments to reduce atmospheric distortion and blurring effects due to telescope jitter. Scientists claim that the new mirror will make possible more precise observations of the Sun and improve our understanding of its behaviour and influence on climatic conditions and radio propagation.

Philips Australia wins contract with China

Philips Australia has announced the sale of telecommunications products and manufacturing technology to the People's Republic of China. The contract is worth at least $A10 million and will extend over four years.

Following the visit of a Chinese Trade Delegation to Philips Australia in July, 1983, Philips Telecommunications Company received an invitation to visit Beijing in November 1983. The Philips delegation met senior members of the Chinese Ministry of Electric Industry, engineering staff of the Ministry, management and technical staff from the factories to be involved in the project, and officials of the China Electronics Import and Export Corporation.

The visit was to finalise negotiations on a contract for the sale of radio communications products and a licence agreement for the manufacture of at least 10,000 Philips Australian-designed 800 Series mobile radios in China.

The Australian delegation also conducted seminars and presented a series of technical papers on Mobile Automatic Telephone Systems (MATS) and other telecommunications topics.

The successful negotiation of this contract highlights the many opportunities for the export of Australian electronics technology and products.

News Highlights

Satellite communications for Australia's Antarctic stations

A satellite communications earth station has been set up at the Australian Antarctic base of Mawson in order to assess the potential of satellite communications to meet the needs of Australia's four Antarctic stations.

A recent investigation by the Antarctic Division has shown that existing communications networks between Australia and Antarctica are inadequate and unreliable. Most of the equipment currently used at the station will need replacement in two or three years, and an urgent assessment of future needs and facilities is urgently required, according to the study.

At present communications between Australia, Antarctic stations and expedition ships at sea use high frequency radio links which are often severely affected by disturbances in the Earth's ionosphere.

In order to evaluate the suitability of satellite communications, the Antarctic Division has purchased an Inmarsat ground station. The Inmarsat maritime satellite system includes three satellites in geostationary orbit over the Atlantic, Pacific and Indian Oceans. The Mawson tests will use the Indian Ocean satellite, which will be some 13° degrees above the horizon almost directly north of the station.

Communications traffic from Mawson travels to the satellite, down to the Inmarsat control station in Japan and then on to Australia either via an undersea cable or the Intelsat satellite system to a ground station at Ceduna, South Australia. It is then patched into the national communications network.

The Inmarsat facility will provide a single communications channel which can be used at any time for either telephone, telex, facsimile or data transmission to allow an adequate evaluation of satellite communications.

Probe to enter Jupiter's atmosphere

An interplanetary vehicle which will enter the atomosphere of Jupiter to make direct measurements has been built by the Hughes Aircraft Company and is scheduled for launch in May 1986.

Named the "Galileo Probe" the vehicle will be the first interplanetary mission to be carried into space by the shuttle, and its mission will be the first atmospheric probe of an outer planet.

The probe will be carried to Jupiter in a supportive "orbiter" spacecraft and will travel an estimated 1200 million kilometres to encounter Jupiter in August 1988. It will enter the gas giant's atmosphere at around 171,000 kilometres per hour. Six instruments inside the probe's descent module will assess the structure of clouds, calibrate a precise hydrogen/helium ratio, measure lightning and radio emissions and energy absorption.

All information will be relayed to tracking stations on earth and after the probe has completed its mission the orbiter component will spend a further 20 months circling Jupiter, returning about 50,000 high resolution pictures of the planet and its moons.

Business briefs

- Mr Michael Wilson has been appointed the new general manager of Dick Smith Electronics Pty Ltd. Previously the managing director of Data Terminal Systems Pty Ltd. Mr Wilson made his name in the provision of computerised check-outs and point-of-scale terminals.
- Dick Smith Electronics has also appointed a new marketing manager, Graham Foster, previously of Norman Ross. The previous marketing manager, Jim Rowe, is leaving to take up a position as managing editor with Federal Publications Pty Ltd.
- Dick Smith Electronics has opened a new store in Papatoetoe, in the southern suburbs of Auckland. Located at 26 East Tamaki Rd, Papatoetoe, the new store is managed by Richard Rowe, the previous manager of DSE's Avondale store. A full range of components, kits, computers, telephone accessories, audio equipment and books is stocked.
- Acme Electronics, a division of James Hardie Electrical, opened their own office and warehouse at 355 Motague Rd, West End, Queensland in March. Bob Hunt, previously the manager of the Acme agency for Actrol parts, has taken the position of Queensland Sales Manager for Acme Electronics. Further information on Acme Electronics product range is available from Acme Electronics, 2-18 Canterbury Rd, Kilsyth, Vic 3137 Phone (03) 729 8999.

ACTIVE ELECTRONICS

4 KING STREET SANDRINGHAM VICTORIA 3191 PH (03) 561 2103

10% DISCOUNT FOR 10 UP OR MORE OF ONE TYPE SEMICONDUCTOR

20% DISCOUNT FOR 25 UP OR MORE OF ONE TYPE SEMI-CONDUCTOR

7400

7400	.48
7402	.48
7403	.48
7404	.48
7406	.95
7407	.95
7408	.48
7410	.48
7411	.48
7414	.60
7416	.55
7417	.77
7420	.60
7421	.60
7425	.48
7426	.50
7427	.51
7430	.48
7432	.48
7437	.54
7438	.48
7440	.48
7451	.48
7454	.48
7472	.72
7473	.63
7474	.55
7475	.67
7476	.60
7483	.78
7485	.82
7486	.54
7489	4.50
7490	.67
7492	.66
7493	.70
7495	.75
7496	.96
7497	1.50
74107	.84
74123	.72
74125	.65
74154	1.82
74157	.65
74161	.88
74190	1.35
74191	.98
74365	1.20
74366	1.20
74367	1.20
74368	1.20

74LS00

74LS00	.58
74LS01	.48
74LS02	.48
74LS03	.46
74LS04	.48
74LS05	.48
74LS08	.50
74LS10	.46
74LS11	.46
74LS13	.42
74LS14	.65
74LS20	.42
74LS21	.43
74LS27	.46
74LS30	.50
74LS32	.58
74LS33	.42
74LS37	.60
74LS38	.48
74LS42	.67
74LS47	.72
74LS48	.98
74LS51	.48
74LS54	.48
74LS73	.60
74LS74	.72
74LS75	.77
74LS76	.72
74LS83	.78
74LS85	.84
74LS86	.53
74LS90	.72
74LS93	.72
74LS95	.75
74LS109	.74
74LS112	.64
74LS123	.95
74LS125	.67
74LS126	.72
74LS132	.78
74LS138	.82
74LS139	.82
74LS151	.75
74LS153	.72
74LS154	2.20
74LS156	.84
74LS157	.88
74LS160	.96
74LS161	.96
74LS163	.84
74LS164	.84
74LS165	.96
74LS173	.96
74LS175	.75
74LS190	1.30
74LS191	1.15
74LS192	.94
74LS193	.96
74LS194	.96
74LS195	.84
74LS221	.95
74LS240	1.50
74LS241	1.80
74LS244	1.80
74LS245	2.10
74LS251	.80
74LS253	.96
74LS257	.80
74LS258	.80
74LS259	1.80
74LS266	.80
74LS273	1.50
74LS279	.55
74LS283	1.10
74LS365	.75
74LS366	.90
74LS367	.65
74LS368	.65
74LS373	1.70
74LS374	1.70
74LS377	1.80
74LS390	1.10
74LS393	1.10
74LS629	5.50
74LS640	2.20
74LS670	1.70
81LS95	2.40
81LS97	2.40
81LS98	2.40

74F00

74F00	.79
74F02	.79
74F04	.79
74F08	.79
74F10	.98
74F11	.98
74F20	.88
74F32	.96
74F64	.96
74F74	.89
74F86	1.40
74F109	.99
74F138	1.80
74F139	1.90
74F151	1.90
74F153	1.80
74F157	1.90
74F158	1.90
74F175	2.90
74F181	4.50
74F182	3.00
74F189	7.00
74F190	4.20
74F191	4.20
74F194	2.60
74F241	3.50
74F243	4.20
74F244	3.72
74F251	2.35
74F253	2.00
74F257	2.40
74F258	2.40
74F352	2.30
74F353	2.40
74F373	4.20
74F374	4.20

74S00

74S00	.60
74S02	.72
74S03	.62
74S04	.60
74S05	.62
74S08	.60
74S10	.60
74S11	.65
74S20	.60
74S30	.72
74S32	.82
74S40	.90
74S51	.60
74S64	.66
74S74	.70
74S86	.85
74S112	1.10
74S132	.85
74S135	1.90
74S136	2.60
74S138	1.15
74S139	1.35
74S151	1.26
74S153	1.32
74S157	1.32
74S158	1.15
74S161	4.50
74S174	1.50
74S175	1.30
74S188	3.60
74S189	4.70
74S253	1.40
74S257	1.30
74S258	1.40
74S283	5.20
74S287	3.00
74S288	3.50
74S289	5.00

74C00

74C00	.60
74C02	.60
74C04	.60
74C08	.60
74C10	.58
74C14	.78
74C20	.60
74C30	.60
74C32	.58
74C42	2.00
74C48	1.65
74C73	.83
74C74	1.10
74C83	2.05
74C85	2.20
74C86	.60
74C89	5.50
74C90	1.75
74C93	1.80
74C95	1.60
74C107	1.20
74C150	5.50
74C151	4.20
74C154	5.40
74C157	3.10
74C160	1.80
74C161	1.50
74C163	1.50
74C164	2.00
74C165	2.00
74C173	1.50
74C174	1.50
74C175	1.50
74C192	1.70
74C193	1.50
74C195	1.65
74C221	2.55
74C240	3.10
74C244	2.90
74C373	3.60
74C374	3.20
74C914	2.20
74C920	7.50
74C922	5.40
74C923	7.20
74C925	7.80
74C926	7.90
74C927	7.20
74C928	9.00
74C941	2.50

4000

4000	.40
4001	.55
4002	.55
4006	.78
4007	.45
4008	.90
4009	.80
4010	.80
4011	.45
4012	.45
4013	.84
4014	.95
4015	1.10
4016	.60
4017	1.20
4018	.80
4019	.60
4020	1.40
4021	1.20
4022	1.00
4023	.50
4024	.95
4025	.60
4026	1.20
4027	.90
4028	.95
4029	1.20
4030	.60
4034	2.70
4035	1.10
4040	1.30
4042	.90
4043	1.10
4044	1.20
4046	1.50
4047	1.50
4048	.80
4049	1.00
4050	.70
4051	1.20
4053	1.50
4060	1.20
4066	.80
4068	.55
4069	.55
4070	.55
4071	.55
4073	.55
4075	.55
4076	.95
4077	.58
4081	.55
4082	.55
4093	.38
4411	15.00
4502	1.50
4503	1.00
4508	2.50
4510	1.20
4511	1.50
4512	1.50
4514	2.60
4515	1.95
4516	1.50
4518	1.50
4520	1.50
4521	2.60
4526	1.50
4527	1.70
4528	1.70
4538	1.50
4553	4.00
4569	2.70
4583	1.20
4584	.90
4585	1.05
9368	1.70
9370	3.40

LINEAR ETC.

ADC0800	19.50
ADC0804	5.50
ADC0808	15.00
AY 3-1015	6.50
AY 3-8910	10.00
BR1941	11.50
BR1943	12.00
CA3028	2.50
CA3039	2.10
CA3059	5.80
CA3081	1.50
CA3130	1.75
CA3130T	1.95
CA3140	.98
CA3140T	1.92
CA3146	2.70
CA3401	.99
DAC0800	3.95
DAC0808	4.50
DM8121	2.50
DM8130	5.20
DM8131	3.50
DS8869	1.80
DS75110	1.50
DS75150	1.80
DS75154	1.50
DS75451	1.10
DS75452	1.00
DS75453	1.00
DS75454	.66
FD1771	21.00
FD1791	37.00
FD1793	41.00
FD1795	41.00
ICM7555	1.85
L120	3.50
L121	3.50
LF347	2.20
LF351	.65
LF353	1.40
LF356	1.65
LF357	2.60
LF398	4.80
LM10CH	6.50
LM307	.65
LM310	3.60
LM311-14	2.70
LM318	2.70
LM319	2.90
LM322	2.50
LM325	4.80
LM329	1.10
LM334	2.00
LM3352	2.90
LM3362	1.80
LM349	2.16
LM358	.78
LM374	4.80
LM380-8	1.40
LM380-14	1.40
LM381	3.00
LM382	2.30
LM383	2.10
LM386	1.80
LM387	1.60
LM394CH	5.60
LM565	3.20
LM566	2.10
LM567	1.10
LM1830	3.20
LM2917-14	3.50
LM3080	1.30
LM3089	2.90
LM3900	.95
LM3905	2.00
LM3909	1.60
LM3911	2.00
LM3914	4.50
LM3915	4.50
LM3916	4.50
LM4250	2.90
MM5303	6.50
MM5837	3.50
MM58167	14.00
MN3001	13.90
MSM58372	15.00
NE530	2.30
NE558	2.30
NE571	2.80
NE5534	1.85
NE5534AN	2.60
OM321	12.00
OM350	9.30
SA80600	7.20
SN76477	7.50
SN76488	10.50
TL061	1.40
TL062	1.80
TL071	1.30
TL072	1.65
TL074	3.60
TL075	3.40
TL081	.60
TL082	1.30
TL084	2.70
TR1602	7.10
TR1863	6.70
TR1983	10.00
UA301	.65
UA301H	1.70
UA308	.77
UA311	.89
UA311H	1.50
UA324	.90
UA339	.82
UA348	1.40
UA393	.75
UA555	.55
UA556	1.20
UA710	.75
UA711	.90
UA723	.66
UA723H	1.20
UA725	2.90
UA739	1.20
UA741	.55
UA741H	1.15
UA747	1.40
UA1458	.55
UA1488	.96
UA1489	.96
UA2901	.96
UA3086	.75
UA4136	1.70
UAA180	4.30
ULN2003	1.45
WD1393	64.00
WD1691	17.50
XR2206	5.95
XR2207	5.28
XR2208	4.00
XR2211	6.80
XR2216	2.80
XR2240	3.00
XR2243	2.90
8T26	2.70
8T28	2.80
8T95	2.20
8T96	2.30
8T97	2.30
11C90	14.00
95H90	14.50

MICRO

2102	5.00
2112	8.50
2114	2.80
2532	10.20
2708	5.90
2716	4.40
27128	43.00
2732	6.95
2764	11.40
4116 150NS	3.50
4164 150NS	9.80
6116P3	9.90
6502	10.20
6502A	10.70
6520	4.20
6522	9.00
6522A	11.70
6532	11.80
6545	21.00
6551	17.00
6800	6.70
6802	9.60
6809	14.50
6810	4.20
6820	4.20
6821	3.70
6840	6.60
6844	15.50
6845	14.00
6850	3.50
6852	4.20
6854	10.30
6875	12.00
68B00	9.80
68B21	4.90
68B40	10.50
68B45	17.50
68B50	4.90
68B54	17.00
8080	6.90
8085A	10.90
8155	9.50
8202A	59.00
8203	65.00
8212	3.80
8214	9.50
8216	3.70
8224	4.90
8226	3.70
8228	8.90
8243	9.00
8251A	8.90
8253	6.50
8255A	6.20
8257	12.00
8259	11.00
Z80CPU	5.15
Z80ACPU	5.80
Z80BCPU	11.20
Z80PIO	5.15
Z80APIO	5.60
Z80SIO	14.50
Z80ASIO	15.00
Z80CTC	5.15
Z80ACTC	6.40
Z80DMA	14.60
Z80ADMA	16.00
8741A	39.00
8748-8	35.00
8749	54.00
8755A	39.00

VOLT REGS

LM337T	2.34
LM337K	6.80
LM338K	8.80
LM350K	6.30
LM350T	4.50
LM396K	18.90
LM79L05	.70
LM79L12	.72
LM79L15	.72
SH1605	19.80
UA317T	1.45
UA317K	4.25
UA309K	2.10
UA494	5.00
UA7805	.95
UA7805K	2.16
UA7806	1.00
UA7808	.90
UA7808K	2.40
UA7812	.94
UA7812K	2.50
UA7815	.90
UA7815K	2.40
UA7818	.90
UA7818K	2.40
UA7824	.90
UA7824K	2.40
UA78H05K	8.95
UA78H12K	9.90
UA78HGKC	10.80
UA78L05	.60
UA78L12	.60
UA78L15	.60
UA78P05K	15.70
UA78S40	3.50
UA7905	.95
UA7905K	2.35
UA7908	.96
UA7908K	2.40
UA7912	1.20
UA7912K	2.40
UA7915	1.30
UA7915K	2.40

OPTO

4N25	1.20
4N26	1.20
4N28	1.20
4N32	1.40
4N33	1.50
4N35	1.80
MCT6	1.90
MCT2	1.50
FND500	1.98
FND507	1.80
FND800	4.00
BPW50	2.00
CQY89	.85
MOC3020	3.10
MOC3021	3.10
MAN72A	1.70
MAN74A	1.70
FPT100B	3.40

LEDS

3mm GREEN	.15
3mm RED	.09
3mm YELLOW	.15
5mm GREEN	.15
5mm RED	.09
5mm YELLOW	.15
RECT RED	.25
RECT GREEN	.25
RECT YELLOW	.25

DIODES

1N4148	.04
1N914	.04
1N4002	.08
1N4004	.09
1N4007	.12
1N5404	.28
1N5408	.30
OA47	.43
OA90	.17
P600G	
6A400V	.35
OA91	.30
OA95	.32

BRIDGES

VJ448	
10A400V	2.16
BR154	
15A400V	8.40
BR254	
25A400V	3.80
BR354	
35A400V	4.30
PO4	
6A400V	1.50
RS204	
2A400V INLINE	.96
SB204	
2A400V	.75
W04	
1.5A400V	.50

ZENERS

5.1V 1 WATT	.22
5.6V 1 WATT	.22
6.8V 1 WATT	.22
10V 1 WATT	.22
12V 1 WATT	.22
12V 5 WATT	.75
75V 1.3 WATT	.90

TRANSISTORS

AC127	.70
AC128	1.20
AC187	.90
AC188	1.60
AD149	2.70
AD161	2.40
AD162	2.40
BC107	.40
BC108	.40
BC109	.40
BC177	.34
BC178	.34
BC179	.34
BC327	.29
BC328	.29
BC546	.20
BC547	.20
BC548	.20
BC549	.20
BC556	.20
BC557	.20
BC558	.20
BC559	.20
BC637	.45
BC639	.40
BC640	.40
BCY71	.80
BD139	.55
BD140	.55
BD233	.60
BD237	.60
BDV64B	2.80
BDV65B	2.80
BF115	.70
BF167	.75
BF173	.70
BF180	1.10
BF184	.80
BF198	.22
BF199	.22
BF337	.86
BF458	.72
BF459	.87
BF469	.97
BF470	1.20
BFY90	1.20
BU126	2.90
BU208	3.50
BU326A	2.90
BUX80	4.60
MFE121	2.00
MFE131	2.00
MJ802	6.50
MJ15003	5.20
MJ15004	5.20
MJ2955	1.65
MJ4032	9.50
MJ4035	11.20
MJ4502	5.20
MJE340	.80
MJE350	1.30
MJE700	.70
MJE800	.70
MJE2955	2.20
MJE3055	2.20
MPSA05	.22
MPSA06	.22
MPSA14	.24
MPSA56	.21
MPF102	.60
MRF901	3.20
TIP31C	.60
TIP32C	.75
TIP41C	1.10
TIP42C	1.25
TIP120	.84
TIP122	.90
TIP125	1.20
TIP2955	1.90
TIP3055	1.60
2N301	4.50
2N2219A	.60
2N2222A	.60
2N2646	.96
2N2647	2.80
2N2904	.73
2N2905A	.73
2N2906	.73
2N2907A	.60
2N3019	.78
2N3053	.65
2N3054	2.20
2N3055	1.30
2N3440	1.20
2N3441	2.60
2N3566	.20
2N3567	.20
2N3569	.20
2N3640	.20
2N3641	.20
2N3642	.20
2N3643	.20
2N3644	.20
2N3646	.20
2N3704	.25
2N3771	5.00
2N3773	5.50
2N3819	.80
2N3866	1.26
2N3904	.24
2N3906	.24
2N4032	.77
2N4033	.84
2N4250	.22
2N4355	.26
2N4356	.26
2N4360	.80
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.40
2N5088	.20
2N5089	.24
2N5179	1.60
2N5190	.90
2N5191	.90
2N5192	1.00
2N5193	.90
2N5195	.90
2N5245	.90
2N5303	4.70
2N5401	.40
2N5457	.80
2N5458	.80
2N5459	.80
2N5461	1.20
2N5485	.80
2N5486	.90
2N5590	16.50
2N5591	18.50
2N5770	.25
2N5777	1.30
2N5944	15.00
2N5946	19.50
2N6027	.80
2N6084	22.00
2N6121	.90
2N6123	.90
2N6125	.90
2N6126	.90
2N6129	1.50
2N6130	1.90
2SC1061	.80
2SD350A	5.00
2SJ49	6.50
2SK134	6.50

SCR & TRIACS

C103D	.85
C106D	.96
C122D	1.80
C122E	2.30
C230D	6.80
SC141D	1.40
SC146D	1.95
SC151D	2.85
ST4	.60

TANTALUM

.1UF/35V	.25
.22UF/35V	.29
.33UF/35V	.29
.47UF/35V	.29
1UF/35V	.29
1.5UF/35V	.32
2.2UF/35V	.34
3.3UF/35V	.78
4.7UF/35V	.60
10UF/35V	.80

ELECTRO PCB

1UF/50V	.15
2.2UF/25V	.15
4.7UF/25V	.15
10UF/25V	.15
33UF/25V	.18
47UF/25V	.15
100UF/25V	.20
220UF/25V	.27
330UF/25V	.40
470UF/25V	.50
1000UF/16V	.45
1000UF/25V	.60
2200UF/25V	1.20

ELECTRO AXIAL

.47UF/63V	.20
1UF/63V	.20
2.2UF/63V	.20
3.3UF/25V	.20
4.7UF/25V	.22
10UF/16V	.24
10UF/25V	.26
10UF/63V	.28
22UF/25V	.27
22UF/63V	.29
47UF/16V	.26
47UF/25V	.30
47UF/63V	.34
100UF/25V	.36
100UF/63V	.40
220UF/16V	.30
220UF/25V	.40
220UF/63V	.60
470UF/16V	.50
470UF/25V	.55
470UF/63V	.80
1000UF/16V	.65
1000UF/25V	.85
1000UF/35V	1.00
2500UF/16V	1.20
2500UF/25V	1.50
2500UF/35V	1.90
2500UF/50V	2.60
4700UF/35V	3.60

ELECTRO METAL CAN

2500UF/80V	3.50
4000UF/75V	6.50
5600UF/40V	4.50
8000UF/75V	9.00

ELECTRO BIPOLAR

2.2UF/50V	.35
4.7UF/50V	.38
6.8UF/50V	.39
10UF/50V	.40
22UF/50V	.46

GREENCAPS

.001UF/100V	.09
.0015UF/100V	.09
.0022UF/100V	.09
.0033UF/100V	.09
.0039UF/100V	.09
.0047UF/100V	.09
.0056UF/100V	.09
.0068UF/100V	.09
.0082UF/100V	.09
.01UF/100V	.09
.015UF/100V	.12
.022UF/100V	.12
.033UF/100V	.13
.039UF/100V	.13
.047UF/100V	.15
.056UF/100V	.16
.068UF/100V	.18
.082UF/100V	.18
.1UF/100V	.25
.15UF/100V	.26
.22UF/100V	.33
.27UF/100V	.34
.33UF/100V	.40
.47UF/100V	.72
1UF/250V	1.14
2.2UF/250V	2.10
3.3UF/250V	3.40
4.7UF/250V	2.80
6.8UF/250V	4.40
10UF/250V	5.90

GREENCAPS HIGH VOLTAGE

.01UF/630V	.27
.022UF/630V	.27
.033UF/630V	.27
.047UF/630V	.30
.1UF/630V	.56
.22UF/630V	.78
.33UF/630V	.98
.47UF/630V	1.30

CERAMIC

1PF	.08
1.5PF	.08
2.2PF	.08
2.7PF	.08
3.3PF	.08
3.9PF	.08
4.7PF	.08
5.6PF	.08
6.8PF	.08
8.2PF	.08
10PF	.08
12PF	.08

STYROSEAL

56PF/630V	.25
68PF/630V	.25
82PF/630V	.25
100PF/630V	.25
120PF/630V	.25
150PF/630V	.25
180PF/630V	.25
220PF/630V	.25

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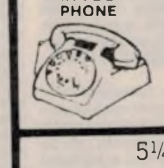

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JAYCAR - No.1 FOR LOW PRICES IN '84

SCOOP!

8" CEILING GRILLES

Once again - a massive scoop purchase with a difference. We have purchased a very large quantity of 'reject' grilles. They are rejects because they have small flaws in the mouldings. Most people however cannot pick the flaws if allowed to examine the grille. Imagine what the flaws look like 9 feet up on the ceiling! Naturally we are offering a massive saving over normal units which we also sell. Exactly the same units (sans flaws) have been sold throughout Australia in the 10's of 000's. The perfect ones sell for around $2.95 - at least one company sells them for well over $3.00.
Cat AX-3560

1-4 UNITS
5-19 UNITS
20-49 UNITS
50 + UNITS

PRICES INCLUDE TAX
P.A INSTALLERS - GO FOR IT!

SILICON SOLAR CELL

★ Size: 12 x 20mm ★ Power 45V @ 20mA (min) ★
Cat. ZM-9001

NORMALLY $1.95
APRIL ONLY $1.50 ea

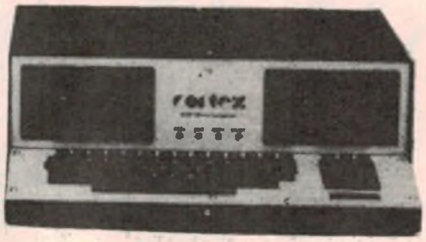
4th YEAR!!

This bag has become legendary in the value-for-money it provides as thousands of enthusiasts in Australia will testify. This year we are NOT SAYING what goes into the bag EXCEPT that it will have 50% MORE in it then last year - at NO extra cost!!!

HOW DO WE DO IT??

Once again, because of the tremendous amount of work in preparing the bags the quantities are strictly limited so be EARLY! Finally, we advise that not all bags are the same (like an Aussie meat pie) but each is outstanding value - we guarantee it!
Whoops sorry! Like last year p&p $2 - we can't do anything about the enormous WEIGHT of the bag!!

$5.50



KIT

WAS $1299 ORIGINALLY

Cat KJ-6630

uniden

SPECIFICATIONS:
- AM/SSB/CW/FM
- 150kHz - 29.999MHz (AM/SSB/CW)
- FM - 108MHz
- Triple superhet (AM/SSB/CW)
- 3-way power AC/Batts/DC (Car)
- Backup batteries for memory
- Will memorise up to 6 preset frequencies
- It's also a scanner! Will scan the HF band between pre-set limits, FM scan as well!
- Narrow band filter
- Facility for ext. antenna and earth
- Size: 320 x 155 x 65mm. Weight 2.1kg

Quite frankly we are astounded at the quality of this unit. It is one of the smartest looking modern radios around!
Each unit comes with an extensive manual which includes detailed info on Short Wave Listening as well as a comprehensive list of major Short Wave stations, their frequencies and their correspondence address.

HURRY STOCKS ARE STRICTLY LIMITED - SO ACT NOW!
Cat. DR-6010

MICROSYNTH

Equally suited to home, studio or stage use, the Microsynth has resulted from an extensive re-think of what is required from a synthesiser. Its compact and economic design achieves high performance at low cost without sacrificing versatility or musical stability.
A highly efficient switched routing system for signals and/or control voltages is capable of rapid operation for live work, yet unlike other small synthesisers does not restrict the possibilities for complex sound creation. Despite its small size, the Microsynth can produce startlingly rich sounds owing to the number of waveforms available, together with the sub-octave voices. It is capable of advanced effects such as Ring Modulation as well as rhythmic "staircase" or random patterns.
Operates in two modes depending on the configuration of the second oscillator (VCO2), which can either run at audio frequencies or as a voltage controlled low frequency oscillator (LFO). In audio mode, VCO2 will track VCO1 perfectly over its entire range. A thumbwheel allows manual control of oscillator pitch or filter cut-off frequency, depth of LFO modulation, etc., and internal power amplification will drive headphones or a monitor loudspeaker.

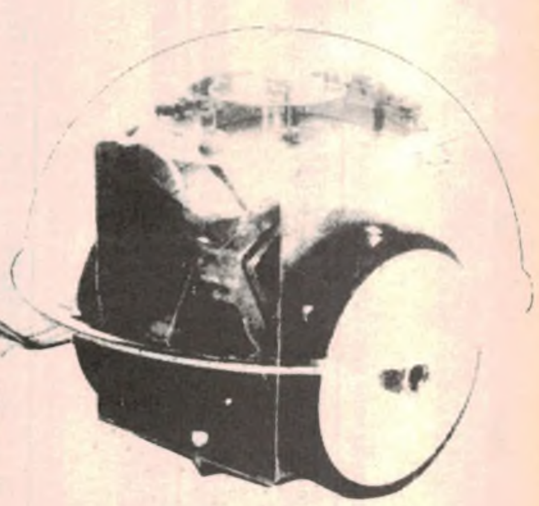
SEE ETI FEBRUARY 1983 FOR SPECS

NORMALLY $399
APRIL $349

KJ-6602

"HEBOT"

The HEBOT II Turtle is not just a fun device, it is a positive aid to education, it takes programming out into the real 3 dimensional world instead of the flat two dimensional world of the VDU. When connected to the I/O ports of your computer and given a DC supply of 9-15V the Turtle runs around under computer control moving backwards, forwards, right and left with independent control of each wheel, it has blinking eyes, will bleep with a choice of two tones and when ordered by the computer, presses down a pen to chart its progress and provide hard copy of the results of the program. When set free to run around the Turtle discovers its environment. When the Turtle shell bumps into an unmovable obstacle touch sensors send back data to the computer for it to calculate evasive or exploratory action.
If the computer has no I/O ports it doubtless has an expansion bus and the Turtle can be controlled and listened to using this bus together with the universal computer interface board (Cat. XR-1022 $39.50). This board enables the Turtle to be treated as a memory mapped I/O device. Complete HEBOT II kit including all hardware, dome, wheels etc.
Cat. XR-1020



UHF AMPLIFIER SENSATION

AMATEURS PLEASE NOTE!

NORMALLY $39.95

Jaycar has purchased a quantity of genuine Brand New MOTOROLA Brand MHW-710-1 UHF Power Amplifier modules. These units are designed for industrial and commercial FM transmitters!
The unit (pictured) is a rugged, tuned train of RF Power Amplifier transistors featuring thin film gold metal metallization, laser trimmed Nichrome resistors and MOS capacitors. The MHW-710-1 bolts to any flat surface (metal) to assist heat dissipation.

50% OFF!!

SAVE $20!!

ONLY $19.95

Includes FREE amateur TV transmitter circuit and full data on device!!

SOLDERING IRON TEMPERATURE METER

ENGINEERS & OTHER PROFESSIONALS PLEASE NOTE!
This compact, easy-to-read unit has a calibrated thermocouple to accurately measure the temperature of your soldering iron. Most adjustable temperature controlled irons don't have a readout so you don't know what the temperature is! Simply allow your iron to reach temperature and touch it to a point on the front of the meter. The movement is sensitive enough to be driven direct from the thermocouple junctions. No batteries are needed and the meters should last forever. The scale is easy to read, calibrated in °C and also gives coloured bands to identify correct soldering temperature. It is a must for the professional who cannot afford bad solder joints or overheated boards (especially plated-thru PCB's)
Cat. QT-2100

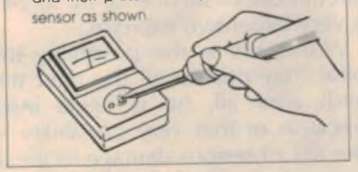
NORMALLY $29.95

APRIL ONLY $19.95

Quantities strictly limited!

EASY TO USE!

Apply solder to the tip of soldering iron and then press the temperature sensor as shown.



YELLOW LEDS

A Jaundiced View?

We're taking a jaundiced view of round yellow LED's in April. Catch us while we're weak and you'll save!!

Cat. No.	1-9	10-24	25-99	100+
3mm YELLOW LED				
ZD-1750	20¢(28¢)	18¢(25¢)	14¢(25¢)	13¢(25¢)
5mm YELLOW LED				
ZD-1720	20¢(30¢)	18¢(25¢)	15¢(25¢)	14¢(25¢)

Normal prices shown in brackets - check the savings!!

AC126 - *Collectors Item*

Will they ever be auctioned at Christies as an antique? We don't think so but they are the genuine TO-1 case PNP Germanium device.
Cat. ZT-2040

NORMALLY $1.20

APRIL ONLY ½ PRICE

60¢ each

IONISER KITS

COMPLETE KIT

- High efficiency emitter head - Fits completely inside a high quality ABS box (NOT a metal lid) - Only 2-core mains flex protrudes from the box - You can pay over $80 for a built-up inferior unit!

Cat. KJ-6511

NORMALLY $45
THIS MONTH ONLY

$29
SAVE $16

SHORTFORM KIT

- runs directly from 240V mains
- low power consumption
- produces high intensity electric field
- output around 7.5kV
- will not necessarily produce ozone in standard form
- ideal for those who wish to 'try' an ioniser at an economical price.

Cat. KJ-6510

NORMALLY $24.50
APRIL ONLY
$15.00

AM TUNER KIT

Ref: EA Dec/Jan 1982/1983

No room for specs. but they ARE magnificent

APRIL ONLY $20 OFF
NORMALLY $149
APRIL $129

KA-1498

30W + 30W Stereo pre-amp

STEREO AMPLIFIER

- Fully built and tested
- Separate bass, treble, balance and volume controls
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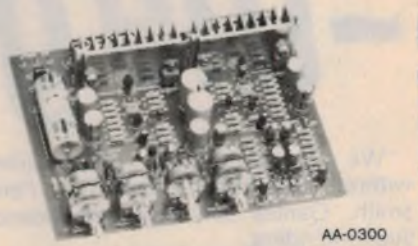
Back at last! No hassle amplifiers. Just connect a transformer, speakers, a signal and you're away!

ONLY $34.95



AA-0300

28 PIN IC SOCKETS

The Cheapest in the WORLD??

Well maybe, maybe not.
But we think - maybe! Quality production types.

Cat. No.	1-9	10-24	25-99	100-999	1000
PI-6507	40¢(50¢)	30¢(45¢)	25¢(45¢)	20¢(45¢)	15¢

Normal prices shown in brackets - check the savings!!

TO-3 TRANSISTOR COVERS

Quality UK-made by Jerinyn. Sold in Australia by McMurdo.
Normally fairly expensive but not in April!!
CHECK OUR PRICES
Cat. ZM-9902

1-9 30¢ ea SAVE 5¢
10-24 24¢ ea SAVE 6¢
25 UP 20¢ ea SAVE 10¢

CONDUCTIVE PLASTIC BAGS

Manufacturer's distress stock - you Reap the Benefit!

Jaycar has made a scoop purchase of heavy duty conductive plastic bags with inbuilt zipper closer.
Each bag measures a generous 280 high x 205 wide. They will accommodate complete S-100 boards, RAM cards etc. You can store your precious ICs in them safely. (The bag would hold hundreds of ICs)
Quantities strictly limited. First in first served.
Cat. ZB-9990

1-4 BAGS $2.00
5-9 BAGS $1.50
10 Up BAGS $1.00
(each)

10" ELECTRIC GUITAR SPEAKER

Quality Pioneer brand - check the specs! Check the price!!
HURRY

Impedance	8 ohms
Voice Coil dia.	1½"
Power Rating	60W (RMS)
Resonant Frequency	80Hz
Sensitivity	98(dB/W)
Response	80Hz - 7,000Hz
Total Flux	61,100 Maxwell
Flux Density	8,300 Gauss
Net Weight	1,540 grams

ONLY $29.95

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Flight Simulators –the grand illusion

A modern passenger airliner can cost up to $100 million. How do you train a pilot to fly one without serious risk? Or to cope with any likely emergency he may one day encounter? The answer is the flight simulator.

by PHILIP WATSON

Inside a 747 simulator. The captain's seat is on the left, the first officer's on the right, and the engineer's panel immediately behind it.

"We couldn't run a modern airline without simulators" enthused Peter Smith, Qantas Simulator Maintenance Superintendent.

That was the first thing I learned when I recently went to inspect the 747 simulators at the Qantas Industrial Complex adjacent to Sydney airport. A simulator is not simply a useful addition to a modern airline's stock-in-trade; it is an absolutely essential item – just as essential as the real aircraft on which it is modelled.

So just what is a modern simulator like, and what does it do? Inside, it is an exact replica of, in this case, a 747 flight deck. Every instrument and control is there, exactly as in the real thing and, as far as the user is concerned, they all work exactly as they would on a real aircraft.

This flight deck assembly is supported on a system of six hydraulic rams which can move it through a wide range of attitudes in all axes. The cabin can assume an attitude appropriate to the manipulation of the controls, engine status, prescribed wind conditions, etc.

And most importantly, there is the visual system; an optical arrangement which presents the pilot with a realistic moving image of the airport and its surroundings as he takes off or comes in for a landing. As with the cabin positioning system, the image generator responds to the supposed position and attitude of the aircraft, and varies the image accordingly.

To this is added sound effects; the whine of the engines increasing in pitch as they respond to the opened throttles, the rush of wind past the cabin, the sound of the landing gear being lifted or lowered, and the tyres on the runway as the aircraft puts down.

Advantages

One of the main advantages of the simulator over real flying is simply that of cost. It costs about 10 times as much to use a real aircraft for training as it does to use a simulator, taking into account the wear and tear on the aircraft, the cost of fuel, and the fact that the aircraft is out of revenue earning service. In its simplest role the simulator is used at basic instructional level, such as conversion from an older style aircraft to a more modern one. Typical would be 707 pilots converting to 747s. This involves about 44 hours of flight training and about 40 hours of this is done on a simulator.

Emergency procedures

But it is in the more advanced training exercises that the cost and other advantages of the simulator become most apparent. Take, for example, an exercise involving an aborted take-off. To stage this in a real aircraft would probably mean writing off a set of tyres and brake linings, as well as putting the aircraft out of service for up to 24 hours; a very expensive exercise.

Worse still is the possibility that the pilot may not do all the right things – and, after all, he is being instructed because of that very possibility – with the risk of serious damage to the aircraft or even more tragic results.

Other potentially dangerous exercises, in a real aircraft, would be landing procedures involving adverse wind and other weather conditions; fog, rain, etc. And quite apart from the risk involved there is the fact that these conditions will most likely not be available when wanted.

The simulator solves all these and

'The whine of the engines increasing in pitch as they respond to the opened throttles, the rush of wind past the cabin, the sound of the landing gear being lifted'

Six hydraulic rams support the simulator and produce all the effects of aircraft movement. ▶

similar problems. It can stage any number of aborted take-offs at no risk and no additional cost, and for any reason that the instructor likes to select. He can simply fail an engine, or set it on fire, or create any other likely take-off emergency, and note how each member of the crew reacts.

Alternatively, he may not plan for an aborted take-off but introduce an emergency after "V1" – the point where, according to aircraft weight, ambient temperature, runway length etc, there is no room to abort – and where a take-off must be continued. Again, the greatest risk in a simulator is that a crew member who does the wrong thing may have to undergo additional training.

An almost unlimited variety of adverse wind conditions, including severe turbulence, can be created by the simulator. In a landing sequence, for example, a pilot can be presented with a cross-wind which may vary both in strength and direction, and in virtually any combination the instructor cares to nominate.

Rain and fog or cloud can also be simulated. At appropriate altitudes the aircraft may be enveloped in cloud, or a runway may be shrouded in fog in varying degrees down to zero visibility. Rain impaired visibility can be simulated, including the fluctuating visibility caused by the windscreen wiper action, plus the sound of the windscreen wiper, and the rain on the aircraft skin.

In a cubicle adjacent to the simulator is an "air traffic controller", linked into the simulator's "radio" system. He's not the

Flight Simulator

A view from inside the simulator as it approaches Hong Kong airport, with the lighted runway visible through the left hand (captain's) window.

real air traffic controller, of course, and it's not a real radio link, but it is real enough to those in the cabin.

If all this creates the impression that the simulator's main role in life is to present flight crews with far more emergency situations than they are ever likely to experience in real life, then that is pretty close to the truth. After all, a qualified flight crew will gain little benefit from flying a mechanically perfect aircraft, in perfect weather, from point A to point B. Any crew can do that, to the point of boredom.

So the truth is that almost all simulator flying involves emergency routines, designed to continually reinforce crew members' ability to meet a crisis when it happens; to make them so familiar with the crisis – any crisis – that they will adopt the correct emergency procedure quite automatically.

A typical example of a real life emergency was the recent loss of all four engines, due to volcanic dust, in the vicinity of Indonesia, by a British Airways 747. According to Peter Smith this may have come as a suprise to the crew, at that particular moment, but not as a shock. Loss of all four engines, at high altitude, together with the correct re-start procedures, is a routine simulator exercise. They would all have been through it many times before.

The simulator

How is all this achieved technically?

The system is best thought of in two parts: the simulator proper, which consists of the flight deck and the hydraulics to control its attitude etc; and the visual system, which creates the image which the pilot sees through the cabin window. These two sections may, in fact, be supplied by separate makers, as in this case where the simulator is by Singer-Link and the visual generator by Redifusion. The simulator proper is controlled by a computer, called the "host" computer. (The image generator has its own computer.)

The host computer is programmed with all the aircraft's vital data; its weight, engine performance, rate of acceleration, aerodynamic characteristics, and so on, and the extent to which any of these may change in flight, with varying altitude, temperature, etc.

Output from the aircraft's controls – the throttles, the control column, etc – is fed into the computer where it is processed and emerges as instructions for the hydraulic system, cabin instruments, sound effects generators, and the visual generator computer.

How well the simulator responds to these inputs, compared with the real aircraft, depends largely on the program software, and a lot of effort goes into making this as accurate as possible. Such a program is suitable only for one version of the aircraft and a later version having, say, updated or alternative brand engines, would call for new software based on the altered performance.

All simulators must be approved and rated by the Department of Aviation, the highest rating being five. Qantas currently has two 747 simulators rated at five, and a third with a lesser rating. A fourth very early model is being taken out of service to make way for a 767 type.

All this is fairly basic and has been current practice for many years, differing only in mechanical and computer details. But, while the results were realistic enough as far as they went, there was still something missing.

Seat-of-the-pants flying

That "something" was the seat-of-the-pants sensation. Pilots complained that simulators were not convincing. In spite of the simulated rumble of the undercarriage on the runway, the whine of the engines, and the image of the moving runway, the simulator did not feel as though it was moving.

What was missing, in this case, was the nudge from the back of the seat as the aircraft started its run, and the continuing pressure as it accelerated. Similarly, on landing, the action of reverse thrust and braking has the opposite effect and, in an emergency stop, the pilot may find himself sliding forward against his safety harness.

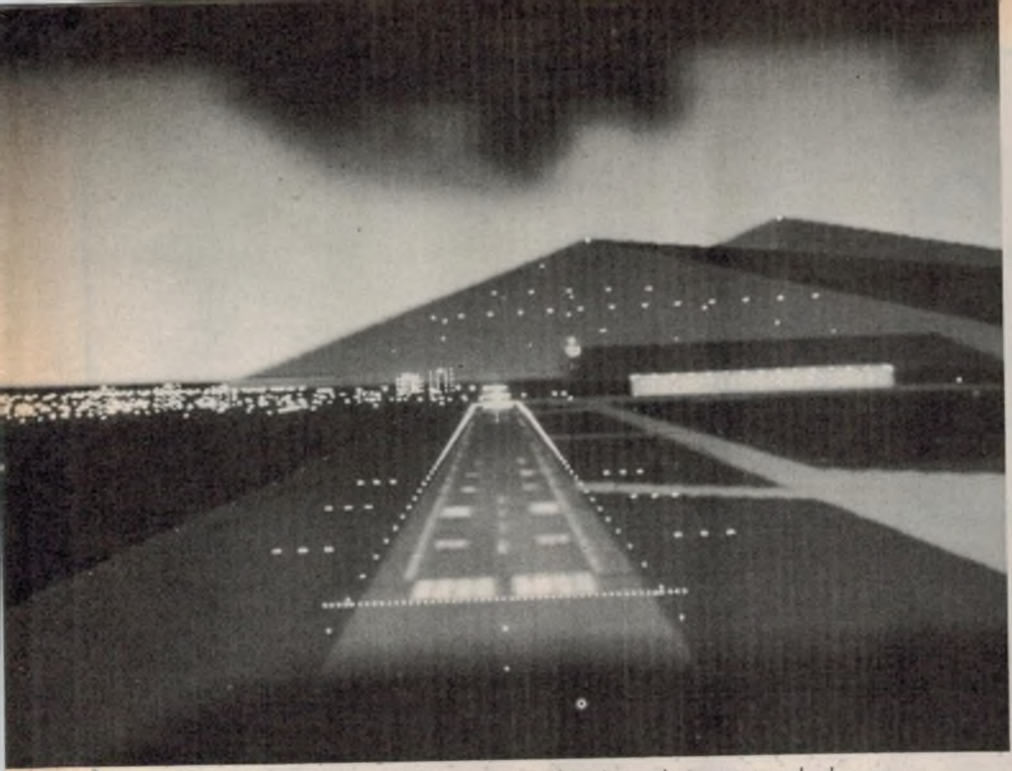
The modern simulator creates these effects very convincingly. At the start of a take-off run the simulator is first moved forward several metres, with appropriate acceleration, to represent the start of the roll. (The hydraulic rams can, if necessary, generate close to 1G of thrust, to simulate any likely 747 manoeuvre.)

However, this initial movement cannot be maintained, so the system resorts to another trick. The cabin is tilted upwards so that the occupants' own body weight creates an apparent pressure from the back of the seat appropriate to the rate of acceleration. At the same time the visual image cheats by pretending that the aircraft is still horizontal and travelling down the runway.

When the take-off point is reached the cabin is tilted still further, while the visual image presents the runway falling away to supplement the illusion. On landing, a similar, but opposite sequence is employed. On initial deceleration the cabin is moved backwards, then tilted downwards to maintain the illusion, while the visual image cheats as before.

Sound effects are created using oscillators, white noise generators, and appropriate filters. A quadraphonic amplifier is employed, with two of the channels feeding speakers mounted under the left and right hand sides of the simulator floor. These handle engine, undercarriage, and similar sounds.

The two other speaker systems consist of several small speakers concealed



Another view of the Hong Kong runway, this time closer to touch down.

behind the cabin lining, and are used to present wind and rain noises.

Image generation

Which brings us to the image generating process. Early image generators, such as those which Qantas introduced with the first 707s, used the "model board" technique. This consisted of a physical model of a runway, airport buildings, and surrounding countryside, on an appropriate miniature scale. It was set out on either a large board or a canvas belt, the latter supported vertically between two rollers about five metres apart.

A colour TV camera was mounted adjacent to the model and made to look parallel to it via a 45° mirror. The camera could be raised, lowered, turned and the mirror tilted through several degrees, to represent aircraft movement and altitude. Forward motion was created, in the case of the belt, by driving it at a suitable speed. For the fixed layout, the camera was moved across it.

The camera signals were fed to a colour TV projection system mounted on top of the cabin and projecting onto a screen in front of the windscreen. The whole system moved with the cabin.

Visually, the effect was very convincing and, by changing the lighting and other tricks, the scene could be varied from day to night, from fine to foggy, and so on. But the system had its problems. Being mechanical, a fair amount of maintenance was needed to keep it running. And the same applied to the colour TV projection system.

A more serious limitation was the high cost of the model layout. This was such that it was considered too expensive to make individual models of real airports, and all simulators were supplied with the same fictitious airport layout. Thus it could not provide practice with the various real airports a pilot would encounter on an overseas flight.

The development of computer graphic techniques provided the breakthrough. As all computer enthusiasts are aware, it is possible to start with a basic computer generated image which may then be programmed to appear as viewed from any angle or distance, and this is the basis of the modern simulator image generator.

So, in theory at least, it should be possible to construct a detailed image, in full colour, of any airport and as much of the surrounding countryside as desired. This would include well known landmarks, navigation lights, roads with moving traffic, and so on. In practice, the approach has to be a little more constrained. It is not so much that it can't be done, but the cost of doing it which is the limitation. Where the cost can be justified, as in military and space programs, results very close to this can be achieved, but it is difficult to justify such costs at a commercial airline level.

In practical terms, creating such detailed pictures involves a lot of data and, while it is not hard to provide enough memory to store it, the ability to update such large quantities rapidly enough presents the real problem. The image has to be updated 30 times a second (similar to US TV standards) and the "number crunching" ability to do this becomes very costly where a lot of detail is involved.

at the leading edge

SHARP ADDS 24 OPTO INTERRUPTERS AND 8 NEW PHOTOCOUPLERS TO RANGE

Already a leading light in opto devices, Sharp of Japan has launched a vigorous design effort to second source nearly all U.S. and European devices.

Recent releases include the OPIC range in which the receiving element incorporates its own voltage regulator, amplifier and Schmitt trigger. OPIC is available in Telecom approved optocouplers as well as transmissive and reflective photointerrupters.

WESTERN DIGITAL SLASHES WINCHESTER CONTROL COSTS

A revamp of the WD1000-05 dropped its 100 piece price to under $250 plus tax. Looking very much like the WD179X floppy interface, the WD1000-05 will make engineers feel very much at home with an old friend. The 5¼" drive form factor and its drive signals are based on the Seagate ST506, ST412 and other compatible drives.

BELL 103 FSK MODEM CHIP — FIRST IN G.I. FAMILY

Designated AY-7-1203 General Instrument's CMOS. 300 baud full-duplex modem abounds with features such as digital filtering, power down mode, single 5V Rail, self test and echo suppress or inhibit tone facility. Later devices in the family will include CCITT V.21, CCITT V.23 (Modes 1 and 2) and Bell 202.

The AY-7-1203 will be in volume production early in 1984 and predictions are that the product will be very cost effective.

10 MBYTE "SKINNY WINNIE" CHALLENGES 5 MBYTE PRICING

Volume production and high yields have given Miniscribe Series III half height drives a considerable cost benefit edge over their rivals.

Miniscribe's Model 3012 not only saves space and money but power requirements are also reduced to around 17 Watts which is well under the industry average. This solves two problems — Start-up surge and ongoing thermal regulation.

Seek times are kept to a respectable 155m/Sec and a microprocessor controller internal self diagnostic routine provides fast performance verification. Interface? ST412 Floppy look-alike!

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Flight Simulator

The compromise which has been almost universally adopted throughout the airline industry is settled for dusk or night time scenes. On this basis, buildings may be represented by simple silhouettes, perhaps embellished with a few lighted windows, a runway can be picked out in lights, and so on. Limited colour is available, but is usually used only for navigation and warning lights, or to portray vehicles.

Presenting the images to the simulator occupants is also quite different from the old colour TV projection system. The current approach is to build up the complete cabin presentation by means of several (typically five) 63cm TV picture tubes, the images being skilfully joined to create the impression of one wide angle scene.

The picture tubes themselves are also different. They are a special type of colour tube known as a beam penetration tube. They do not employ a dot structure, as in conventional tubes, but use several phosphor layers, each of a different colour. Colour selection is by varying the EHT voltage.

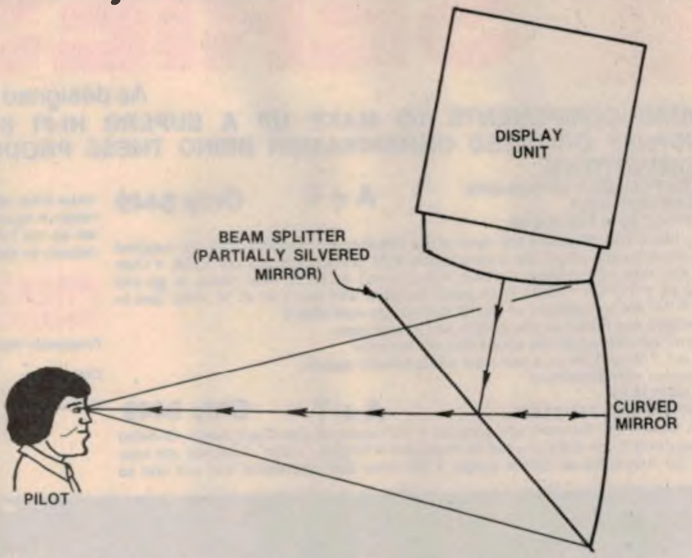
The colour range is restricted (no blue is available) and the tube has other limitations which exclude its use in more conventional roles, but they have several advantages in this application. One is simplified circuitry and deflection hardware, and another the sharper image possible with a continuous phosphor rather than a dot structure.

Each screen is mounted forward of, and above, the cabin window, and facing downwards. It is viewed by the occupant via a curved (spherical) mirror and beam splitter, or partially silvered mirror. The latter is mounted at an angle of approximately 45° to the tube face and projects the image forward to the curved mirror, which then reflects the image back to the viewer, through the partially silvered mirror.

Five such optical systems are used in the Qantas 747 simulator; two giving straight ahead views for the pilot and first officer, two giving left and right side views respectively, and the fifth giving an "aft window" image for the first officer.

All the images are derived from the one basic computer program, but varied electronically to conform to the various angles of view. In fact, some concessions have to be made and some tricks indulged in, but in spite of this, and the constraints on the computer graphic images, the end result can be very convincing.

Optical system for simulator visual display



This simplified diagram shows the optical path between the picture tube and the observer. Light rays are directed downwards from the picture tube, reflected by the partially silvered mirror onto the spherical mirror, then back to the observer through the partially silvered mirror. The spherical mirror allows the eyes to focus at near infinity, rather than on the picture tube face.

At the controls

Seated in the simulator for the first time I found myself looking at a row of runway lights, and a dashed centre line, extending into the distance. Against the dusk of an evening sky was the unmistakable outline of the Sydney control tower, off General Holmes Drive, and just to right of the runway. On its roof was the flashing red warning light.

Closer in, also on the right, was the outline of the International Terminal Building and, closer still, the ground lights marking the taxiway alongside the main runway.

Later, with Peter Smith at the controls, we took off from Avalon airfield, near Geelong, in Victoria (it takes only the flick of a switch!). As we sped down the runway, I felt the gentle pressure of the seat against my back. The effect was most convincing; it really felt as if the aircraft was moving. And even though I knew how the trick was being pulled, I was not conscious of the cabin being tilted. To me, the illusion was virtually perfect.

As we gained altitude and swung around to the left the lights of Melbourne appeared on the distant horizon. And immediately beneath us cars could be seen speeding along the Prince's Highway on the airfield perimeter. It was easy to forget that it was all make-believe. In fact I understand that some people have become airsick.

The foregoing emphasises a major advantage of the computer graphic system; its ability to provide a whole range of airport images, simply by changing the software. The current Qantas 747 system can store 10 such images, but is about to be expanded to take up to 24, if needed. Programs written to date are for Sydney, Melbourne, Avalon, Brisbane, Wellington (NZ), Hong Kong, San Francisco, and Frankfurt. Software for Los Angeles and London is being written.

There are a couple of other interesting tricks which the system can provide. One is to represent a typical airport service truck – or it could be another aircraft – on a runway as an aircraft is making a landing approach. The pilot would then be required to abort the landing, report the situation, and go around for another approach.

The other trick concerns those airports which have parallel runways, such as San Francisco. Here the system can present another aircraft taking off or landing at the same time, creating a distraction which, in real life, could be disturbing for an inexperienced pilot.

And so, the next time you see a Qantas 747 climbing out of an airport, or approaching for a landing, spare a thought for the vast amount of technology, most of it electronic, which is used simply to train the aircrew. Our national airline has a proud record of reliability, a fact which reflects credit throughout the whole organisation. And part of that credit goes to the Flight Training Centre, the simulators, and the technicians and operators who maintain, supervise, and update these systems.

Footnote: My thanks to Mr Peter Smith and Mr Bill Robertson for their very generous assistance in making this story possible.

SERIES 5000

SPECIAL PRICES THIS MONTH

As designed by ETI

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HI-FI SYSTEM. DIRECT IMPORT AND A MORE TECHNICALLY ORIENTED ORGANISATION BRING THESE PRODUCTS TO YOU AT LOWER PRICES THAN OUR COMPETITORS.

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KIT PRICE $319 P&P $12.00

A + T Only $449

• 1% Metal Film Resistors are used where possible • Prewound Coils are supplied • Aluminium case as per the original article • All components are top quality • Over 400 Kits now sold • We have built this unit and so know what needs to go into every kit • SUPER FINISH Front panel supplied with every kit at no extra cost to you. • We are so confident of this kit that we can now offer it assembled and tested so that people who do not have the time can appreciate the sound that this amplifier puts out. This is done on a per order basis delivery approx. four weeks after placement.

PREAMPLIFIER
KIT PRICE $289 P&P $12.00

A + T Only $449

• 1% Metal Film Resistors are supplied • 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes) • English "Lorlin" Switches are supplied no substitutes as others supply • We have built and tested this unit and so know what needs to go into every kit • Specially imported black anodised aluminium knobs • Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the power amp.

PREAMPLIFIER

Kit Price $289, P&P $12.00

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB
Distortion:	1kHz <0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N noise:	High-level input, master full, with respect to 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted MC input, master full, with respect to full output (1.2V) and 200 µV input signal: >71 dB flat >75 dB A-weighted

On Special at $259
Normally $289

All parts available separately for both kits.

POWER AMPLIFIER

On special this month $289

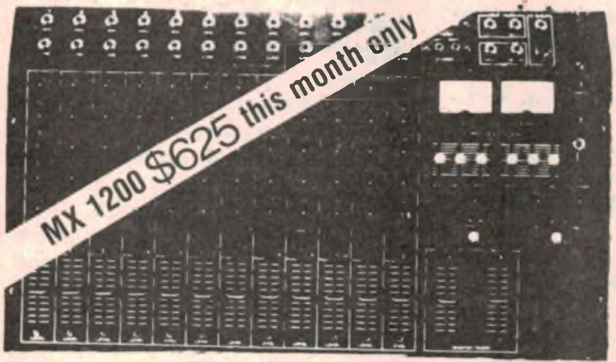
SPECIFICATIONS 150W RMS into 4Ohms

Power output:	100W RMS into 8 ohms (± 55 V supply).
Frequency response:	8 Hz to 20 kHz, +0 − 0.4 dB 2.8 Hz to 65 kHz, +0 − 3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ± 56 V supply rated at 4 A continuous. <0.003% at 10 kHz and 100 W
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound.

ON SPECIAL THIS MONTH $289

MX-1200 MICROPHONE/AUDIO MIXER



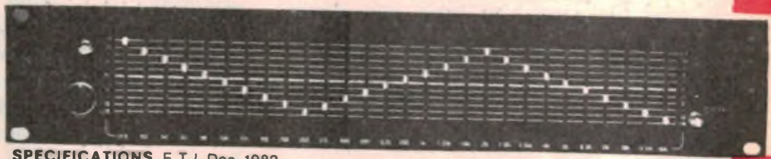
This unit features: 12 microphone line inputs with pan, bass, treble, effect and fold back controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc. • complete with carrying case.

SPECIFICATIONS:
INPUTS
Level Impedance Mic 46 db 1K
Line 22 db 16K x 12
Phono 52 db 50K STEREO x 2 (2mv) at 1KHz
Effect Return (Aux) 20 db 50K x 1
OUTPUTS
Level Impedance L & R 0 db 2K
Effect Send 0 db 2K F B Out 0 db 2K
Head phone Stereo +10 db 600 (100 1K)
EQUALISATION
Channel
Bass ±15db
Treble ±15db
Master
Bass ±12db
Treble ±10db
Middle ±12db

FADER & CONTROLLERS
12 channel fader Slide 60m/m LOG 25%
2 Master fader Slide 60m/m LOG 15%
12 F/B Volume 300 LIN
1 F B Master level 300 LIN
12 Effect Send 300 LIN
1 Effect Return 300 LOG 15%
2 Phono 300 LOG 15%
1 Head Phone 300 LOG 15%
S N 58DB
FREQUENCY RESPONSE 20-20 KHz
TOTAL HARMONIC DISTORTION Less than 0.1%
METER 2 illuminated VU Meters 0db = 0.775V
PEAK INDICATON 12 LED Peak Indicators
VOLTAGE 240 VAL 50Hz
POWER CONSUMPTION 7.2 watts
DIMENSIONS 620 (W) x 386 (D) x 108 (H) mm
(supplied complete with carrying case)

NORMALLY $799

THIRD OCTAVE GRAPHIC EQUALIZER



SPECIFICATIONS E.T.I. Dec 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB).
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0 max 0.01%, sliders at minimum
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat
Boost & Cut:	14 dB

1 unit $189

2 units $359

SERIES 4000 SPEAKERS.

• 8 speakers with crossovers	$499
• Speaker boxes (assembled with grill and speaker cutout)	$299
• Crossover kits	$199
• Complete kit of parts (speakers, crossovers, screws, innerband, boxes)	$799
• Assembled, tested, ready to be hooked up to your system	$849

WE BELIEVE THAT WE ARE NOW THE ONLY ONES TO SUPPLY COMPLETE SPEAKER KITS ASSEMBLED AND TESTED FOR THOSE WHO HAVEN'T GOT TIME $849 EX STOCK.

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"BIG BOARD II"

Over 1,000 sold

Jim Ferguson, designer of the "Big Board" distributed by Digital Research Computers, has produced a stunning new Computer, "Big Board II". It has the following features:

4 MHz Z80-CPU AND PERIPHERAL CHIPS

The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM

"Big Board II" has the three memory banks: the first memory bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two SKx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 static RAMS, or pin-compatible E(E)PROMs, the third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, or assembled and tested, it comes with a 450nS2732A EPROM containing the monitor.

MULTIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS

The new Ferguson single-board computer has a multiple-density disk controller, it can use 1793 or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY

The new Ferguson SBC uses a 6845s CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5 x 7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.

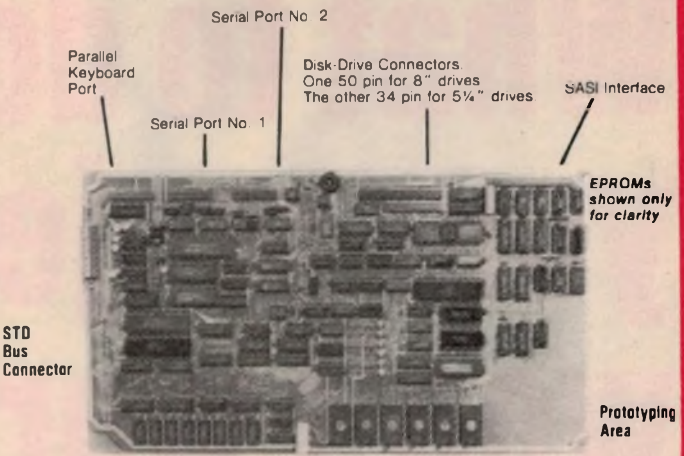
STD BUS CONNECTOR

The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder a DSTD, bus cards can be plugged directly into it, and It can as well be connected by bus cable to industry-standard card cages.

A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS

TWO Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS

The new Ferguson computer has two Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use



PROM PROGRAMMING CIRCUITRY AND SOFTWARE

The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E) EPROMs. Software $25 extra.

CP/M

CP/M with Russell Smith's CB10S for the new Ferguson computer is available for $230. + TAX
The CB10S is available separately for $65. + TAX
Actual board size: 39.6cm x 22.2cm. 5 inch B10S being developed. Approx price $95 + TAX

Kit Price

$695 inc tax Less 10% for 3+

$895 Assembled and Tested

NEW SINGLE BOARD PRODUCTS AND PRICING

THE 6809 "UNIBOARD"™

SINGLE BOARD COMPUTER KIT

PERFECT FOR COLLEGES, OEM'S, INDUSTRIAL AND SCIENTIFIC USES!

64K RAM! DOUBLE DENSITY FLOPPY DISK CONTROLLER!

FEATURES THE POWERFUL, THIRD GENERATION, MOTOROLA 6809 PROCESSOR!

Many software professionals feel that the 6809 features probably the most powerful instruction set available today on ANY 8 bit micro. Now, at last, all of that immense computing power is available at a truly unbelievably low price.

FEATURES:

- ★ 64K RAM using 4116 RAMS.
- ★ 6809E Motorola CPU.
- ★ Double Density Floppy Disk Controller for either 5-1/4 or 8 inch drives. Uses WD 1793.
- ★ On board 80 x 24 video for a low cost console. Uses 2716 Char Gen Programmable Formats. Uses 6845 CRT Controller.
- ★ ASCII keyboard parallel input interface. (6522)
- ★ Serial I/O (6551) for RS232C or 20 MA loop.
- ★ Centronics compatible parallel printer interface. (6522)
- ★ Buss expansion interface with DMA channel. (6844)
- ★ Dual timer for real time clock application.
- ★ Powerful on board system monitor (2732). Features commands such as Go To, Alter, Fill, Move, Display, or Test Memory. Also Read and Write Sectors. Boot Normal, Unknown, and General Flex™.

PC BOARD IS DOUBLE SIDED, PLATED THRU SOLDER MASKED, 11 x 11-½ IN.

BLANK PC BOARD $199.95 + tax WITH PAL'S, AND TWO EPROMS.

FOR 5-¼ OR 8 INCH SOURCE DISKETTE ADD $25 + tax

$599.00 incl tax COMPLETE KIT! FULLY SOCKETED.

ALL OPTIONS ARE STANDARD. NO EXTRAS TO BUY!

YOUR CHOICE OF POPULAR DISK OPERATING SYSTEMS:

FLEX™ from TSC	$209
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Specify 5-¼ or 8 Inch

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Mail Order Delivery Instructions: Minimum Pack and Post $3.00 for Australia Post. Please allow extra for bigger orders and Certified, Airmail or Registered Post. Minimum order is $5.00. Please address orders to Mail Order Department, PO Box 235, NORTHCOTE, 3070, VICTORIA. PHONE (03) 481 1436.

What to do if your project won't work

-don't stomp on it

by LEO SIMPSON

Many readers build EA projects and are pleased with the results. But some projects don't work at switch-on and cause a lot of frustration. What is the answer?

Among the many hundreds of letters we receive each month from our readers there are inevitably a few that go like this:

"I built your XYZ project described in month, year and it doesn't work. I have carefully double-checked all my work and so has a mate of mine who is a technician with a large organisation. He can't find anything wrong with my work and reckons there is probably a design fault in the project. In desperation I have even replaced all the CMOS ICs and now write to you as a last resort. Can you help me?"

Such letters usually make us shake our heads in resignation. Here we have a situation that is difficult for us to retrieve. The reader wants to keep faith with EA but has had the nasty suspicion placed in his mind that the project is a lemon. After all, EA does regularly admit its mistakes in the "Notes & Errata" section in most months. Is it likely that this poor reader has copped one of EA's as yet undiscovered mistakes?

All right let's face it, we do make some mistakes and some of these take a while to come to light. But eventually mistakes that are brought to our notice are published in "Notes & Errata".

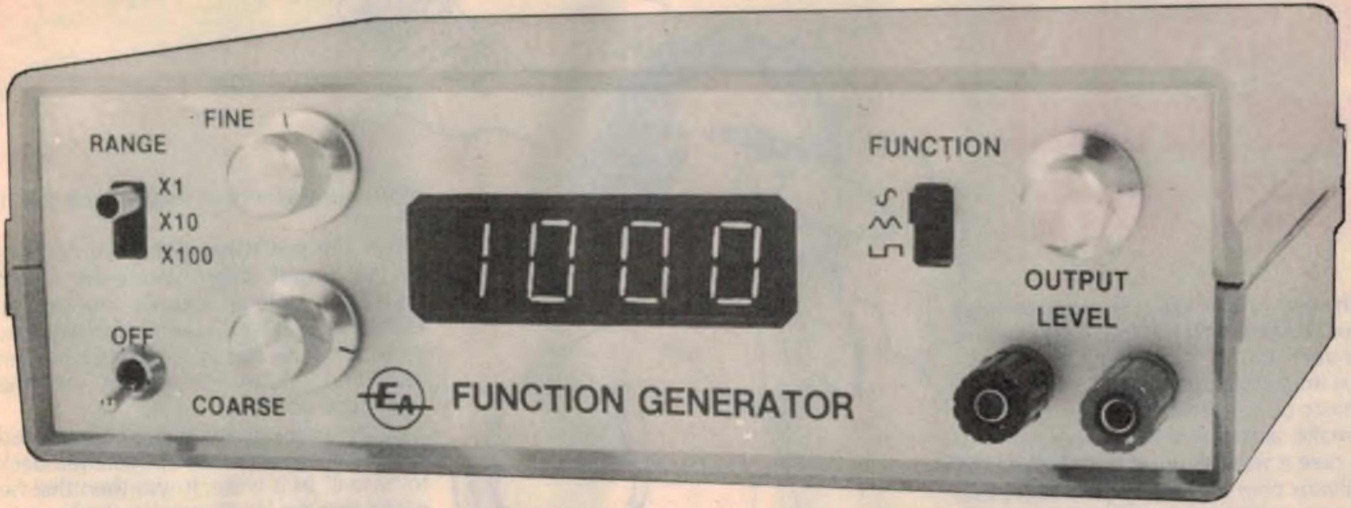
Kitset suppliers often become aware of errors in parts lists or diagrams before we do. They make the necessary correction and then sometimes neglect to tell us about it. So whatever happens, the fact that a project is available as a kit is a good indication that it will be a "goer".

That is not to say that EA projects which are not available in kit form are no good. Kitset suppliers necessarily have to make decisions about which kits they will carry and those they will not. They can't do them all. There are just too many, as far as they are concerned.

More often than not though, the poor distraught reader is referring to a kit that has been built by the thousands. Kitset suppliers often like to refer to such kits as "chestnuts" meaning that they are ever popular, reliable and importantly to the kitset supplier, good money spinners.

So how do we go about answering such a letter? All letters that we receive are answered or acknowledged by the way, provided that the sender has remembered to include his address.

The main problem in answering the above letter is that the reader has provided us with absolutely nothing to go on. No voltages, no symptoms, nothing. So all we can do is write back and ask. Does it do such and such? Is the whatnot hot? and so on. Which means that our thoroughly discouraged reader has to go back to the forlorn little pile of bits sitting at the back of workbench, under his bed or where ever and try once again, to make some sense of it.



Many hundreds of this project have been built but if not assembled correctly it does not work.

So if you do get to the stage of desperation where you consider writing to EA as a last resort, please tell us as much as you can. Which voltages are correct and which are not? Are ICs getting hot? What are the readouts? What noises is it making?

Paradoxically, if you take the trouble to find out all this information you may solve the problem yourself and not have to write to us after all. And strangely, the fact that you have solved the problem yourself, by delving a bit deeper into it, will probably give more satisfaction than if the project had immediately worked at switch-on.

A practical example

As might be expected, the stimulus for this article has come from a number of recent experiences in the EA editorial department. One of these involved a long-time acquaintance of one of our staff members. This reader had been an amateur radio operator for many years but it had been some time since he last built anything. In fact, the last project he built had used valves!

And so he had come to our staff-member asking for reassurance about one of our projects and whether we thought he could put it together. He wanted to build the Function Generator described in April 1982. Naturally our collective response was along the lines of, "Give it a go. She'll be right" and "Why not" and other such remarks intended to bolster this frail body once more venturing into the joys of electronics.

Having psyched himself up, our newly enthused constructor went out and bought the full kit for the Function Generator. In no time at all he had it all put together.

Well, you guessed it. It didn't work. It wasn't quite dead but it certainly was not in first class health either. "Please help" he said "I'm desperate. I've checked everything several times and everything looks right". It did too. The kit was from Dick Smith Electronics and had gone together very well. What was wrong?

I suppose that this is where EA staff have a very large advantage over typical readers. In the first place we designed it. Second, we know it works. Large numbers of this kit have been built. Third, and perhaps the most cogent, we are quite confident of being able to fix it. If all our readers were in the same position they would have little use for EA.

Having said that, our staff member still started out in the same position as any reader confronted with a non-working project. He did not know why it was not working. What was the evidence? There must always be symptoms even if they are of the catastrophic smoking kind.

The symptoms

First, the four digit counter was not working correctly and permanently displayed "7777" regardless of how the frequency controls were varied. Second, it was quickly discovered that there was no audio output from the front panel terminals. Oh, and the readout was quite dim and appeared to flicker sequentially across the four digits.

This was discouraging perhaps but at least part of the circuit was working because the displays were alight. That would probably mean that the relatively expensive 74C926 counter chip was not dead. That much could be surmised from those few symptoms.

Let us now follow through the steps taken by our staff member to discover where the fault lay.

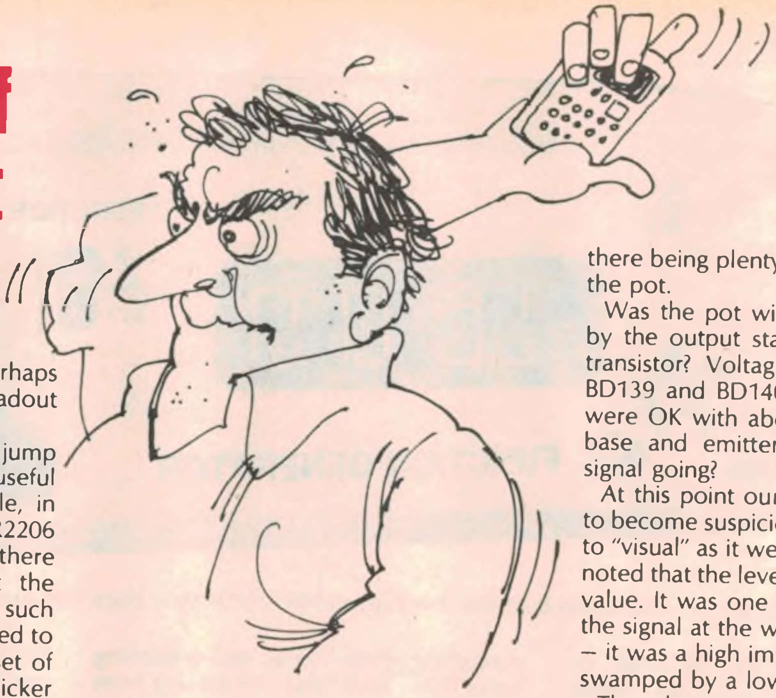
First step was to take the PC board out of the case and give it a thorough visual examination. On the whole it looked very good. There appeared to be no solder bridges or missed joints. A couple of the PC pin solder joints had not really tinned well so these were touched up. But nothing untoward was really obvious.

At this stage of the game, the visual inspection was really more cursory than thorough. Our staff member really only concerned himself with the orientation of all the semiconductors and electros. Individual resistor and other component values were not checked. It was assumed that these were all correct.

Next, the voltages at the outputs of the three-terminal regulators were checked. There are three such regulators in this circuit, one positive 5V and two negative 5V. Only the positive regulator was correct. The negative regulators were

Don't cry . . . measure the voltages

What to do if your project won't work



both very low in output which perhaps would explain why the four digit readout was very dim.

It is important at this stage not to jump to hasty conclusions but it can be useful to make assumptions. For example, in this case it was assumed that the XR2206 oscillator chip was faulty (because there was no audio output) and that the 74C926 was OK. In making such assumptions you have to be prepared to admit that a completely different set of assumptions might lead to a quicker solution. In other words, you might be wrong.

On the basis of the above assumptions our staff member further surmised that the XR2206 or its output stage was somehow loading down the output of the associated 7905 regulator. Accordingly, he proceeded to cut links on the board until the output of that regulator was isolated.

We should mention that this was a trial and error process with the power being re-applied after each link was cut to check the result. When you have a fault condition it is not wise to leave the power applied for a long time while you fiddle about. Components might burn out.

There was also the odd symptom whereby the DC input to both negative regulators was quite low at about -3 volts, indicating that there was a fairly serious overload somewhere in the circuit. Nothing seemed to be getting "red in the face" though, as he touched each of the major components in turn.

As is always the case with these trial-and-error processes, it was the last link to be cut that isolated the problem. (When you think about it, this must be the case.) We now had the negative regulator (7905) on the lefthand side of the board isolated and it was giving its specified -5V. The other was OK too. And there was now a bright and cheery 4-digit readout, indicating "0000".

This was evidence that the counter section was functioning properly, as far as it could with no input signal.

The last link to be cut was that which supplied the negative rail to the 74C14 (IC7) and associated components. So that was where the overload problem lay. Was it simply a matter of a short between tracks or was it something more devious?

Being completely open-minded about it, our staff member closely examined the underside of the board, in the vicinity of the 74C14, for evidence of shorts. None was found. Then another look at the top of the board around IC7. Compare board with wiring diagram. Uh huh, there it is. The two diodes associated with IC7d were the wrong way around. This was placing a short, via two diodes, across the ±5V supplies but the negative rail appeared to be affected more.

Without stopping to analyse the situation, our staff member quickly swapped the offending diodes around, patched up the broken links and re-applied power. Voila!

It was now evident that the display readout could be varied by rotating the coarse and fine frequency controls. The XR2206 chip was working so that nothing had been really wrong with the unit.

It seemed a little odd that those two low current diodes had not been damaged but why worry. The unit was now functioning. Not quite, as it happened.

While the XR2206 chip was evidently working there was still no output from the front panel terminals. Time to trundle out the CRO and have a look see. But a CRO was not essential here. A multimeter switched to a low AC voltage range would have done the job.

We found that there was now plenty of signal across the output pot but it was clipping severely because trimpots R2, R3 and R4 had not been adjusted. These were quickly set to give reasonable output and a rough sine wave.

But there was still no output from the front panel terminals. Another check showed that there was no signal at the wiper of the level control in spite of there being plenty of signal at the top of the pot.

Was the pot wiper being shorted out by the output stage? Was there a dud transistor? Voltage checks around the BD139 and BD140 confirmed that they were OK with about 0.8 volts between base and emitter. So where was the signal going?

At this point our staff member started to become suspicious and switched back to "visual" as it were. It was then that he noted that the level pot was not the right value. It was one megohm. No wonder the signal at the wiper was disappearing – it was a high impedance source being swamped by a low impedance load.

Then the penny dropped. Our intrepid constructor had inadvertently swapped the 1MΩ coarse frequency control pot for the 22kΩ level pot. Twiddling the coarse frequency control also revealed a lack of control range, as might be expected.

So. Two mistakes produced the problems. The reversed diodes had the most dire consequences but the swapped pots produced strange symptoms too.

Perhaps the most important lesson is that these faults could easily have been found by careful visual inspection. Our constructor swore on a "stack of data books" that he had closely checked his work. We took his word for it and then went through the rigmarole just described.

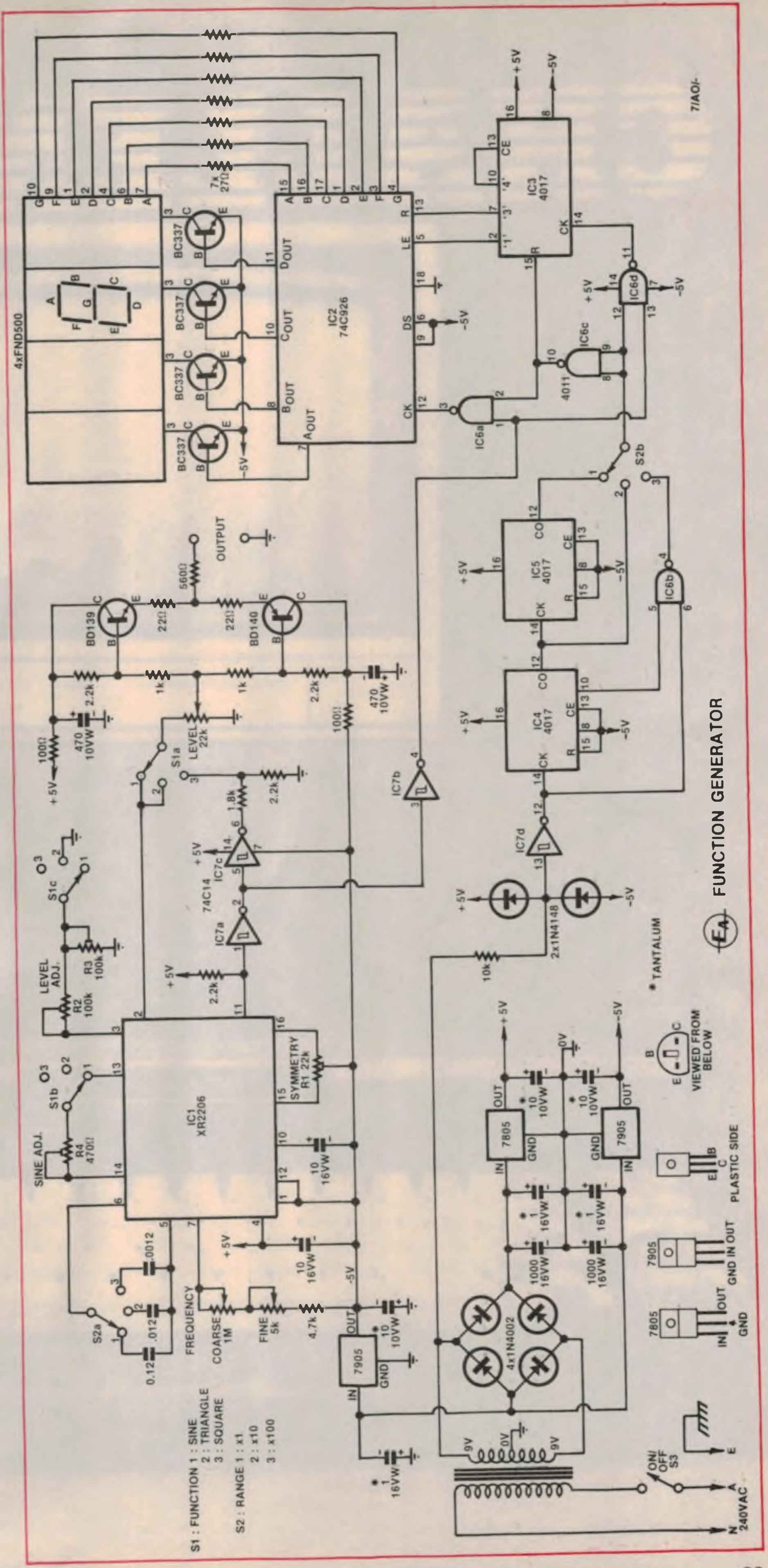
We are not saying that visual inspection will cure all problems but it will probably solve most. You should proceed on the basis that a mistake in assembly has been made.

Defective components are relatively rare and few components are ever damaged during soldering, which brings up another important point.

Many constructors are frightened of soldering ICs and transistors. Instead of soldering the joints properly they merely wave the iron somewhere in the vicinity of the joint and hope that it'll be okay. It won't.

Look. ICs and the majority of semiconductors are designed for the rigours of flow soldering. They are rated for soldering at 300°C for 10 seconds. How many people hold the iron on the joint for 10 seconds? None. It would be silly. Normal soldering will not damage components.

Here's how to do it. Make sure the iron is hot, clean and well-tinned. Shove it firmly on the joint for a second or so and make sure the joint is good and hot.



The circuit of the Function Generator which was originally published in April 1982.

Then tin both the copper pad and the component lead and make sure the solder flows evenly over the whole joint. Don't use too much solder.

If the joint looks messy after the first attempt leave it a minute or so and then have another go. Reheat the joint and then a touch of solder, to provide the necessary flux, will make a clean job of it. (And don't take that remark about "necessary flux" as being a suggestion to use any sort of solder paste. The ordinary resin-cored solder is all that is required.)

Remember that you are most unlikely to damage an IC because of overheating while soldering. The most likely damage, if you are too heavy handed or using too large an iron, is that the copper pad and track on the PC board will lift. This sometimes happens if you are desoldering components without the aid of a solder sucker or solder-wick.

Of course you still have to take precautions against static damage when soldering MOS components. But CMOS ICs are pretty rugged. As long as you solder the two supply pins first and use a jumper lead to connect the metal shaft of your iron to one of the supply tracks on the PC board there is little chance of damage.

Those who know better

While the vast majority of constructors do try and follow our articles closely in building their projects there are some who reckon they know better. And do they "come a gutser". These people don't like certain aspects of a project design so they change it. In this category our friends the amateurs figure strongly I'm afraid. They tend to take liberties.

The classic example of this concerned the UHF transceiver project described in our September, October and November issues last year. By all accounts this project has been very successful and many hundreds have been sold by Dick Smith Electronics. But there have been problems brought about by the constructors simply not following instructions.

At the extremely high frequencies used on the UHF bands it is absolutely critical that all component leads be as short as possible. Coils must be wound exactly as specified. But we have seen non-working transceivers that looked like birds' nests rather than the neat and tidy design presented on our September 1983 cover. Needless to say, when all the components were shortened back, coils correctly wound and inserted, the units operated correctly.

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Apart from being manufactured in an automated factory with the consistency of quality that entails, every Dick Smith Challenger undergoes rigorous and thorough automated testing – and comes with its own test certificate! So the quality and reliability are outstanding.

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This is the basic computer, which can be used by itself for hobby computing. It offers much more than other machines – at a very attractive price!

Specifications:
CPU: 8086 full 16-bit processor running at 4.77MHz.
RAM: 128K internally expandable to 256K, 16K video RAM.
ROM: 64K including Microsoft GW BASIC, diagnostics, cassette operating system.
KEYBOARD: Separate unit with 84 keys including numeric/cursor control group, 10 function keys.
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RESOLUTION: 320 x 200 or 640 x 200.
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The IBM PC with equivalent features would cost you at least $1700 – if they'd sell you one!

YOU SAVE OVER $700!!

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Add this expansion unit, and the basic Challenger computer becomes more than equivalent to a fully expanded IBM PC – PLUS a complete set of disk software and manuals.

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Yet the expanded Challenger costs only $2990.

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PERFECT WRITER/SPELLER – one of the most popular word processing systems in the world. Worth at least $790 alone!
PERFECT FILER – lets you design your own filing systems and mailing lists. Worth over $675!
PERFECT CALC – the electronic spreadsheet to beat them all. Worth over $330 as well!

DICK SMITH Electronics

A726

See page 98 for full address details.

From a young reader: What do you do

A young Queensland reader invites us to open up a debate on a subject which is of major concern to many in his age group: How can a young person build a career in electronics when no one appears willing or able to help them get started? To give them that vital first job?

FORUM

Conducted by Neville Williams

Well, we are perfectly willing to talk about job opportunities in the electronics industry but, in so doing, we have to be realistic. We can highlight the problems but we can't hope to come up with instant answers. The article will have served a useful purpose, however, if it induces some prospective employers and some prospective job applicants to re-think their attitudes – and their aptitudes!

But, first, let's look at the reader's letter. As you will see, he is keen to obtain a sales position with an electronic component or computer supplier but it may be more helpful to discuss job opportunities generally in the electronics industry. The letter is reproduced exactly as written, omitting only the name and address.

Dear Sir,

promted by the Editorial in the November issue, I would like, on behalf of other unemployed people with a hobby back-ground to propose a knew topic of debate for your excellent column.

'Should the Electronics component and Hobby computer retailers hire hobbyists and others with an understanding of the field, or professional sales-people, trained in all the tricks of selling 'optional extras!'

My own experience, seeking both assistance and employment, has not boded well for 'consumer' retailers. Perhaps it is only Brisbane, but applying for a position produces the opening question, 'How much sales experience have you had?' A typical telephone interview runs:–

"J. Jones Electronics"

"Hello, I'm calling about the position you advertised this morning."

"Have you had any sales experience?"

"No, but I've. . ."

"Thank-you but we require sales experience, 'Thank-you, call us for all your hobby needs' Good-bye"

The above little fiction sums up the average interview, though some, omitting the advertisement, are shorter.

Sad, from my piont of view as a job hunter, but sadder still is the plight of someone seeking information, of a technical nature from a well-meaning ex-used-car-salesman.

In closing, I am 18 years old, and am seeking employment, prefently in electronics or micro-computing. I find the attitude of the industry in this regard most disapointing.

(From Eagleby, Qld)

It may come as a surprise to our correspondent to know that the situation which he describes has a familiar ring for members of my particular generation. We went through school during what became known as "the great depression" and did so, in many cases, with parents unemployed and fortified by dole-queue food. When we left school, it was a case of joining more queues in the hope of picking up a job.

On the strength of an intense hobby interest, a leaving certificate pass and a good school report, I did ultimately manage to find work in a wireless factory but it was a hand-to-mouth existence. In those days, assemblers and wirers were paid about £1 ($2.00) per week, plus occasional overtime – during the winter months. In the warmer weather, when sales of wireless sets declined, production lines often worked part time and factory hands were paid part wages!

> **"The survivors were those who maintained an interest in what they were doing and displayed initiative"**

I can say with some conviction that it was no fun trying to live on that kind of money, with no further help from what passed at the time for social services. But, still, I must concede that even a tenuous job in a wireless factory was a better start to a career in electronics than no job at all – which is what our correspondent says he is up against.

Looking back over those years, however, one lesson stands out very clearly: the last people to be stood down, the first to be re-engaged, the survivors, those who made it through the ranks to responsible positions, were people who maintained an interest in what they were doing, learned as they went along and displayed initiative of one kind or another.

That lesson remains as valid today as ever it was. When jobs are scarce, they tend to go selectively to those who exhibit the right training and attitude, plus a degree of sincerity, interest, involvement and initiative. They are old-fashioned values but I don't apologise for naming them. What's more, they are attributes which cannot be donned like a set of new clothes; they have to be cultivated, encouraged and worked at over a period of time.

Have in mind that I am talking primarily about the electronics industry, in which the work force is broken up into relatively small units, where individual initiative stands a better chance of being noticed. Unfortunately, there are many industries in which initiative and performance tend to be obliterated by industrial codes and attitudes.

In writing the letter reproduced above, our correspondent from Eagleby in Queensland has shown a certain degree of initiative. It may not produce direct results but it is indicative of a young person who is not content simply to grumble and give up. He wants to initiate debate about his problem in the hope that good may ultimately flow from it. It's a healthy reaction.

But, having said that, I must also observe that the impact of the letter is lessened, to a significant degree, by unfortunate errors in its composition. (I am hoping that the magazine typesetters will not correct the spelling and punctuation, thereby negating the point I am trying to make).

It would appear that our correspondent, like many in his age group today, has paid less attention than perhaps he should to spelling, punctuation and the use of capital letters. It is true that these matters have been emphasised less in recent years than once they were but,

when you can't find a job?

even so, an element of carelessness is suggested by phrases like "a knew topic", "my piont of view" and "prefently in electronics".

In a job application, as distinct from an ordinary letter, such phrases could be a liability. If an employer has to make a final choice from a "short list" of two applicants, that choice may well hang on a hunch and a hint of carelessness — or a lack of attention to detail. It could easily influence the decision in favour of the other person.

At this point, it may be helpful to run through the procedure (as I remember it!) for filling a position on the technical staff of "Electronics Australia". It should be typical enough of the procedure generally.

The first step would be to identify the position to be filled, nominate the range of duties and prospects for advancement, specify experience and/or qualifications required, the starting salary range, &c. A suitable advertisement would then be compiled requesting initial application by letter, giving details of training, experience, &c.

Why by letter?

Because it affords the prospective employer the opportunity to observe the number of applicants, their possible suitability for the position and their overall expectations. Those who, for any reason, are plainly unsuitable can be advised accordingly, obviating pointless expenditure of time and money for all concerned.

The remainder are requested to phone for an appointment at a mutually convenient time.

But a letter of application is significant for another reason, particularly if a successful applicant would be required to write articles (as for a magazine) or, in other situations, to originate laboratory reports or initiate correspondence. An employer would be diffident indeed about a native-born Australian who has yet to learn how to spell and to write reasonable English!

At the actual interview, first impressions are important. Allowance can be made for circumstances but some applicants virtually disqualify themselves by appearing to be chronically slovenly. That is scarcely a desirable quality where a person may have to meet the public on occasions, talk to sales/technical representatives of other companies, or be identified with their own company at exhibitions, lectures, &c.

I am not talking about collars and ties; simply about tidiness and personal hygiene! There's no getting away from it — some interviewees stink!

At a technical level, the interviewer (or interview group) has to assess the range and depth of the applicant's knowledge and whether it matches the claims in the letter of application. Is that knowledge purely a recital of what they have read or do they give evidence of thinking things through independently?

Practical and hobby-level experience would also be considered, partly as a back-up for theoretical study and partly as tangible evidence of the applicant's involvement in the subject. As a hobbyist from way back, I must confess to reservations about the commitment of anyone who can spend years studying a subject like electronics, without ever generating an unstoppable urge to follow up some of those ideas at a practical level!

> ***"Some applicants disqualify themselves by appearing to be chronically slovenly"***

School-leavers may wonder what it's like to be on the other side of the interview table, asking the questions and having ultimately to make a decision. In over 40 years in an executive role with "Electronics Australia" I was in that situation on many, many occasions.

I can't say that it's been one that I've particularly enjoyed. In some interviews, for sure, the result has scarcely been in doubt; the applicant has either been so obviously suitable, or so obviously unsuitable for the position, that a "yes" or "no" answer has been almost automatic. Interviews like that are the easy ones.

More commonly, however, the interviewer ends up having to make a value judgment between a number of applicants, each with good points and not-so-good points, and each with the potential to succeed or to fail. The interviewer's prime responsibility is to identify the applicant most likely to succeed but, in so doing, he has no option but to reject the rest — and that is always an unpleasant task, no matter how elaborately one tries to embroider the word "no".

The most helpful advice I can offer to an unsuccessful applicant is not to regard the interviewer as some kind of an ogre but to work out, if you can, why he (or she) gave the nod to someone else. Do that successfully and you may be able,

Master the Microprocessor

Learn how Microprocessors really work ...the practical way.

The Purpose of this Course

There is a considerable, expanding and world-wide demand for people with a real knowledge of microprocessors and general computer technology. Such people are needed to design and evaluate systems and to assess and develop the enormous range of possible applications, both present and future, of microprocessors and to understand the installation and servicing of the main types of equipment of which they may form the most vital component.

(A microcomputer has already been produced to replace the mechanical programmer on a domestic washing machine, for example.)

This Course provides the necessary basic information to enable a student to really understand the functioning of microprocessors and their supporting circuitry, usually referred to as the "hardware". This is backed up by showing how to program a microcomputer (or produce its "software") in the most fundamental form of computer language called "machine code".

No previous knowledge of computers is necessary, though a little basic knowledge of electronics plus digital and logic circuits will be found helpful.

A special introductory short course is available to provide this back-ground information, if required by an individual student on the course without extra fee.

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A qualified Tutor is available to every Student throughout this Course in order to deal with any queries which may arise and to assess certain questionnaires which are issued to Students throughout the period of training.

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Issued to all Students completing the Course successfully. Course covers main requirements of the City and Guilds Certificates in Computers.

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EA 4/84

How the Course is organised

The basis for the practical work in the Course is the Microcomputer.

This is supplied completely assembled and ready to use.

The Course text is carefully arranged in sequence so that each new section follows logically from previous work. Hardware description and programming technique progress together, so that the Student is discouraged from treating them as distinctly separate subjects. Following each section of descriptive text, detailed instructions are given in order to use the Microcomputer to provide a practical demonstration of each new function or technique. This provides a very powerful way of learning precisely how the system operates, and enables any possible ambiguities in the Student's mind to be quickly resolved.

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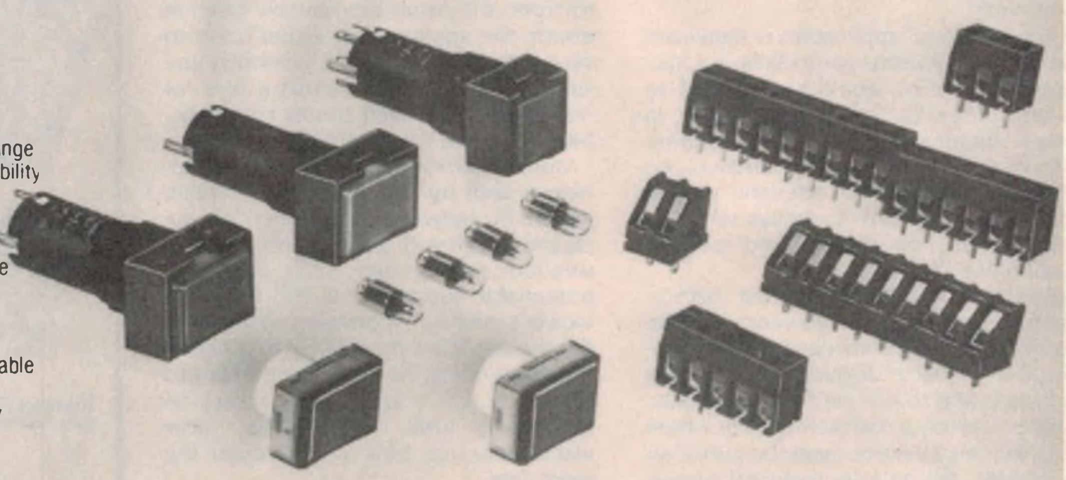

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Phone now for free, comprehensive technical literature!

FORUM — continued

next time, to present yourself to better advantage.

The nature of the job opportunities in electronics has changed radically over the years and, in some respects, "Electronics Australia" might be seen as a microcosm of the Australian electronics industry as a whole.

During the '40s, the design and construction of consumer type equipment was fairly static – kept that way by preoccupation with the war effort and limitations on the production and sale of non-essential components. Manpower was short and the emphasis was on practical skills, with old-time hobbyists much in demand – for the magazine and for industry.

The '50s provided more of the same, with the ranks of old-time hobbyists swollen by forces-trained technicians and licensed amateur operators. Radio stores were awash with new components and ex-disposals equipment. Radio factories were busy and gearing up for television. For the magazine, the most likely candidate for a job was a person with a wide range of electronic interests and skills, a reasonable grasp of supporting theory, an amateur licence if possible but no rigid requirement for formal qualifications.

New technology

Then came the '60s, with transistors, new concepts, new theory and new constructional methods. Generations of servicemen, hobbyists and amateurs found that their acquired expertise was rapidly becoming obsolete. They either had to start again or be left behind by a new generation of technicians and engineers trained from the outset in solid state technology.

That situation has been accentuated by the emergence of many other components based on solid state technology, by enormously complicated integrated circuits, by "little black box" design methods, by the adoption of digital circuitry for a whole range of complex functions and, of course, by microprocessors, computers and all their assorted paraphenalia.

Nowadays, for the industry as a whole, and certainly for this magazine, a certificate or degree, or formal training towards that end is almost a prerequisite for a career in electronics. A parallel hobby interest is valuable in imparting practical depth to the theory but a hobby interest alone is a very tenuous basis for technical advancement.

When young people ask me, these days, about getting into the electronics industry, there can be no equivocation: do your best to emerge from secondary school with a good pass, in the hope of being accepted for a position in the industry. Make up your mind that you will take up a course in a technical college, institute or university, keeping your options open for further studies. By all means pursue the subject at a hobby level but don't rely on hobby learning, no matter how rewarding it might seem in the short term.

And that brings us, in a full circle, back to our correspondent from Eagleby. He refers quite vaguely to "hobbyists and others with an understanding of the field" and implies that they should be given preference for sales positions over people whose only qualification is that they have had sales experience (eg in selling used cars).

I agree that a used car salesman would be completely out of his depth in an electronics component store, trying to identify funny little things with difficult names and confusing type numbers. But, in reality, I do wonder how many sales persons for used cars or other unrelated products ever do find themselves selected to sell ICs, LEDs and electronic whatnots! Has the notion any basis in fact?

If a retailer had to choose between such a person and a technically informed hobbyist, they would probably choose the latter, providing they were satisfied that he/she would also prove to be honest, reliable, tidy, courteous and not likely to spend half their time (or more) magging to talkative customers.

Perhaps the real objective of the aforesaid advertisements would be to lure not used-car-salesmen but partly trained people from other retailers, thus bypassing the "breaking-in" phase. Let someone else have that dubious pleasure!

Whether it's valid for our correspondent to lump together electronic component retailers and computer/peripheral retailers is open to question. While there is an obvious overlap, computers and peripherals are "big ticket" items, where the wrong approach could lose sales and have a serious effect on profitability. Selling computers, printers and disc drives isn't quite the same as selling ICs.

But, while a computer/peripheral retailer might not be willing to employ a complete sales novice, they might be favourably disposed to someone who could say: I've had two years experience with Dick Carr or Jaysmith!.

The next step

But something else concerns me about all this, which isn't hinted at in the letter:

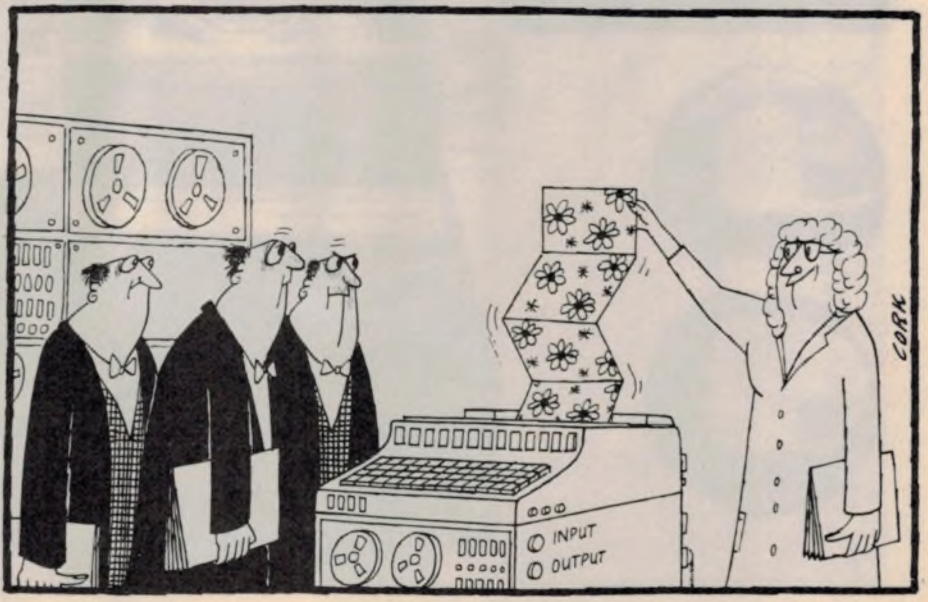
A hobbyist gets a job at Dick Carrs, Jaysmiths of Microwotnots but where is it supposed to lead to? A technical career? Marketing? Management?

We've already said that, these days, a technical career in electronics has to be based on formal training, not simply on hobby interest.

Perhaps the same remark should apply to these other areas, leading hopefully from the sales counter to an executive position. But what incentive or what opportunity is there for sales staff to pursue a course in advertising, marketing or management?

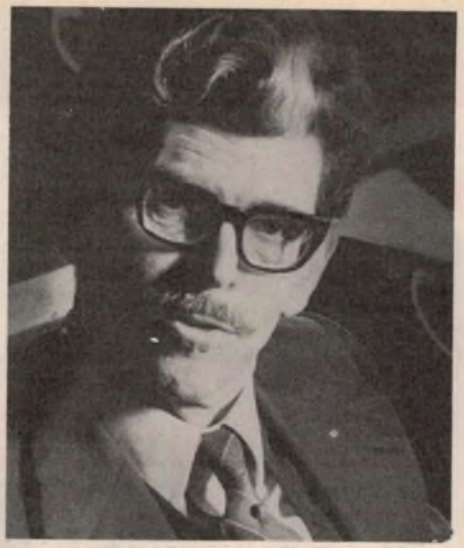
What "next step" would be open to our young reader if he did manage to get the kind of job which he seeks?

Consider the subject open for discussion!



Philips Compact Disc.

If you can't believe your ears, believe John Cargher's.



For eighteen years John Cargher, author, critic and broadcaster, has been presenting two weekly radio programmes for the ABC. He is also the Managing Director of the Australian National Theatre in Melbourne.

Recently he heard a performance of La Traviata with Joan Sutherland and Luciano Pavarotti on a Philips Compact Disc Player.

"It did not take me long to realise that the compact disc Traviata sounded better than the original records. It also reminded me of my huge collection of 78's of Caruso, Melba and the rest which is resting in peace, now unplayed.

Is history about to repeat itself? Should I now replace umpteen thousands of records with Compact Discs which sound better than my best digital records?

It makes me want to cry, but I long for the day when all my Traviatas will be duplicated on Compact Disc. Not only is it quicker to put a Compact Disc into its player, but – an incredible blessing for a broadcaster – the Philips Player selects individual tracks automatically and in any predetermined order.

Take Violetta's death scene in the last act. There is little more than a whisper from her, yet it is impossible to hear anything but Sutherland on the Philips Compact Disc Player. Surface noise and tape hiss are not minimal; they are non-existent. The silence during pauses is deafening!

As for the balance between voices and orchestra at the other extreme of the dynamic level, as in the Brindisi of the first act, the Compact Disc wins hands down over the traditional LP.

Pavarotti may as well be standing there in the flesh, with a crystal clear background of instruments in perfect balance.

The sound produced by this player tolls the death knell for quadraphonic or any other sound. Never again will singers have to compete against wow, flutter, inner-groove distortion and the like.

I knew the Sutherland-Pavarotti was a good recording. I did not know that it would be enhanced by the Philips Player to this extent – or that the Compact Disc is immune to the effects of dust or scratches or the accidental bounce while playing."

COMPACT disc DIGITAL AUDIO

This superb Sutherland/Pavarotti performance is only one of many hundreds of titles already available on Compact Disc. New ones are added every month.

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Music that will last forever. Because the disc will last forever. The music is stored in digital form and protected by a layer of transparent material.

No wear, no scratches, no deterioration.

Furthermore, no rumble, no wow and flutter because there is no stylus.

All thanks to this remarkable creation of Philips. A player with a high precision laser beam which focuses through the transparent layer to read the encoded music.

So every note is perfect, from the subtlest pluck of a pizzicato to the full fortissimo of an orchestra.

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PMP V 428

Video and compact disc dominate the Winter CES in Las Vegas

by **NEVILLE WILLIAMS**

Video and Compact Disc were the two main thrusts of the Winter CES in Las Vegas. Acceptance of the compact disc is clearly growing while the video scene was stirred up by the announcement of 8mm gear from Kodak.

The latest CES (Consumer Electronics Show) was held from January 7 to January 10 at the Las Vegas Convention Centre and, simultaneously, at the Hilton, Riviera and Sahara Hotels. In American terms, the exhibition occupied a total of 725,000 square feet of floor space, reflecting an overall US industry size of $20 billion. Something like 500 industry meetings and press conferences were scheduled during the 4-day event, along with technical and business-orientated workshops.

What the records don't show is the number of informal discussions which took place, as distributors and retailers tried to work out what was going on in the video industry! More importantly how it might affect their own planning for the coming year.

THE VIDEO SCENE

Towards the end of '83, the home video industry appeared to have sorted itself out remarkably well. The VHS and Beta groups had carved up the home video cake between them – or so it seemed – without needing to worry too much about the European Video-2000 system or Technicolor's quarter-inch format. VHS had its compact variant, Beta had Betamovie, both had hifi-stereo sound, and both could afford to push the new 8mm format back under the rug for the time being.

With a good year behind them, video distributors and dealers had every reason to expect more of the same in '84 – until a number of pre-CES announcements threatened to turn the whole US video scene on its end.

One was the announcement by Zenith that it would abandon the Sony-developed Beta system in favour of VHS – a decision that posed a potential threat to the precarious market balance between the two. Nor was it a long-term plan. With stocks already run down, Zenith were all set to effect the switch during the first quarter, drawing supplies of VHS and VHS-C hardware from JVC.

Sanyo's version of Betamovie, said to be doing well in the marketplace. Reports from CES suggests that Sanyo will drop its two-unit portables to concentrate on Betamovie.

At the CES, there were rumours about other possible defections from the Beta camp and speculation that some manufacturers might see it as the ideal moment to move directly into 8mm home video, winding down their dependence on Beta in the process. Sony sought to counter this by issuing a statement which minimised the significance of the Zenith move, pointed to continuing improvement in Beta technology and promising that the company "would continue to supply Betamaxes as long as the half-inch format exists."

Some saw in the situation the seeds of a possible price war in the US home video market later in the year. Beta manufacturers might decide to cut prices and margins to support their market while, within the VHS group itself, a vigorous sales campaign by Zenith could step up the rivalry between competing brands.

The American video industry was looking forward to a happy and prosperous new year until Kodak took the wraps off their "Kodavision" camera/recorder using new format 8mm tape.

In the meantime, Sony is reportedly happy with the reception afforded its Betamovie combination camera-recorder, as also are NEC and Sanyo. In fact, NEC and Sanyo have decided to discontinue their two-piece portable systems to concentrate on Betamovie, with Sanyo tagging their version at a going price of $1595. Sony will continue to push Betamovie but plans to retain a two-piece portable system for the sake of those who want the extra facilities it offers.

As an answer to Betamovie, JVC has been demonstrating its "VHS-C Movie",a single-unit camera-recorder using VHS-C cassettes and weighing in at just under 2kg. JVC expects it to supplement but not supplant two-unit portables but they do expect it, along with Betamovie, to delay any substantial move towards the 8mm format, for perhaps two or three years.

Things may not work out that way, however, in the face of a further pre-CES announcement, this time from the photographic giant, Kodak. In a statement which really rocked the video boat, Kodak announced the release, later this year, of their state-of-the-art Kodavision 8mm camera-recorder.

As if that wasn't sufficient, both GE and RCA made almost simultaneous announcements of their intention to adopt the same format, although RCA did add that a couple of years might elapse before it made any real impact on the market. With a strong grip on the current portable video market, RCA is probably hedging its bets, determined to be on the spot whichever way it goes.

In the background to all these moves is the giant Matsushita (National Panasonic). While a dominant force in the existing 12.7mm (half-inch) market, it has remained strangely silent about single-unit camera-recorders, leaving it to its subsidiary JVC to make the running in the field.

The likely reason for their reticence is not hard to suggest now, because it is Matsushita which will manufacture the new 8mm portable equipment for Kodak and possibly for the others as well. Preliminary specifications hint strongly of the very latest Matsushita technology, including three-head jitter-free playback, on-tape date recording, and provision for both metal particle and metal evaporated tape – the latter a Matsushita development, which is currently being licensed out to other tape manufacturers such as BASF and TDK.

Other provisions include video quality equal to the existing format, hifi-stereo sound, auto focus on the top model, fully automatic white balance, electronic viewfinder, visual search, fade-in and backlight controls and a record/play time variously reported as 60 and 90 minutes. For use in the home, a mains-operated cradle has been developed, providing charging facilities, provision for dubbing to standard VHS, and RF output to feed a TV receiver. An off-air TV tuner-timer is a further option.

Provisional prices quoted by Kodak were $1599 for the basic camera/recorder, $1899 for the deluxe auto-focus model, $199 for the playback/charger cradle and $300 for the tuner/timer.

As large as they are, Kodak, RCA and GE would find it difficult to launch a new format on their own, and to impose a set of standards on Japanese manufacturers, many with their own 8mm prototypes and ideas. But when Kodak, RCA and GE have the implied backing of Matsushita – and maybe JVC – it becomes a different matter.

The Kodak/RCA/GE announcements certainly put the cat among the video pigeons at the CES. A front-page article in the "Show Daily" on day two of the CES had this to say:

"Call it running scared or call it schizophrenia, leading video suppliers hit the CES Show floor on opening day with an aggravated case of 8mm nerves. Not since the half-inch VCR burst on the scene has an issue generated the controversy triggered by Kodak's entry into the 8mm video arena.

"Many leading video executives angrily denounced efforts to introduce 8mm at a time when half-inch sales are booming.

"Hitachi's Bob O'Neil set the tone: 'At an explosive growth position in its life cycle, industry management should take responsible and prudent action not to interfere with the high sales rate currently being enjoyed'.

"O'Neil's speculative scenario for 1984 sees Kodak and others capturing only about 5% of the total VCR business, but generating enough consumer confusion to cut half-inch sales back by up to 15%"

VIDEO SNIPPETS

Cheaper TV sets: 33cm to 48cm TV receivers, favoured by US video dealers as "leader" lines to sell up from, received quite a hammering at the CES. Taiwanese and Korean companies were on the job offering receivers at $20 to $40 below prices from established suppliers.

Hifi about face: In the '70s, when it proved no longer profitable to compete with Japanese suppliers, major US companies like RCA, GE and Zenith pulled out of the domestic hifi field to concentrate on video. Now, with video sources offering vastly improved sound quality, the companies are being forced to look again at high quality audio supplements to their video equipment. If they don't, and perhaps in any case, they will find themselves outmanoeuvred by Japanese hifi companies diversifying into video!

Winter CES in Las Vegas

A photo finish? Recording tape is no longer the preserve of traditional suppliers like BASF, TDK, 3M, Maxwell, &c. Photographic companies are well aware that magnetically-based photography may cut deeply into traditional methods, making it essential that they re-position themselves. What better point of entry than through magnetic tape, which they can market easily through existing outlets — to the dismay of electronic suppliers. Fuji, Agfa-Gevaert and Konica, already in the business, are being joined by Canon, Minolta, Polaroid and Kodak. Who's next and will they stop at video tape? What about computer software?

Cheaper movies? For the first time in the US, current hit movies are being offered to consumers on videodisc for under $20 — $19.95 to be precise. This is less than half the cost of almost any movie on video cassette, although some non-theatrical releases have a price tag of $29.95. With the supply of theatrical films dwindling, software companies are having to rely more on made-for-video productions.

The Mitsubishi prototype in-car CD player exhibited in Chicago last June. The company now plans to market up-dated custom kits for selected prestige cars by the end of this year.

CD PLAYERS

After about six months exposure on the US market, compact disc players were on display at Las Vegas as an accepted item of domestic hifi hardware. Dealers and the public alike were more comfortable about them and ultimate purchase was not so much a question of "if" as "when". Gone was the speculation about whether or not the format was even viable. It most certainly was.

Visitors to the CES were treated to two reassuring sights: CD players from brand suppliers who had held back from an earlier commitment, and second-generation models from others who had been part of the initial launch. Nor were there any major hang-ups about supply, the usual response being: available now, in quantity.

Prices quoted at the CES appeared, for the most part, to have settled between about $500 and $1000, with some realignment likely after dealers and customers had had a chance to compare them on a features-for-money basis.

At the low end, $499 would buy a Sherwood no-frills player using digital filtering.

For twice that figure, $1000, Denon were offering their model DCD-1800, a 16-bit player, using a separate Denon-developed digital/analog converter for each channel, with a combination of digital and analog filtering. It features oversampling and a laser-tracking mechanism which Denon claim to be impervious to vibration and shock.

Most other models fall between those limits — a mix of established models at reduced prices, and completely new models with some surprises. The new, compact Sansui PV-V500, for example, offers most of the features provided in their earlier PC-V1000, including infrared remote control. But, whereas the earlier model sold for $1000, the new model is ticketed at $649. It will almost certainly be an option in Sansui's compact rack systems, as well as being marketed separately.

According to most observers, the range of models now available and the price options open to purchasers is helping positively to boost the sales of compact disc players. Customers can settle for a no-frills economy model, if they so wish, knowing that it will still bring them superb sound quality, superior to any source they have owned to date. But, if they are inclined to spend more, they have the satisfaction of consciously moving up-market and selecting the styling and features they really want.

Sales of compact disc players in the USA for 1983 were estimated at between 35,000 and 50,000 units but the figure being bandied around at the CES was an additional 200,000 sales in 1984, leading to a steep increase in the demand for discs to play on them.

Most of the early problems in the production of compact discs appear to have been sorted out and they are flowing off the production lines (CBS/Sony, Matsushita, Sanyo) routinely and with very few being returned by customers as defective.

About 500 different titles were on sale in the US by the end of '83, although their distribution was patchy and confined mainly to specialist outlets.

Predictions for '84 suggest about 1200 new titles by the end of the year,with larger numbers of individual titles and a broadening of the sales base to smaller and less specialised outlets.

Price-wise, compact discs are retailing for between $15 and $22, depending on the supplier and the brand. This is too high, according to hardware retailers, especially now that economy models are appearing on the market. Cheaper discs would mean more hardware sales.

Software suppliers, on the other hand, maintain that there is little chance of substantial price reductions until demand pushes up production runs of individual titles to around 30,000. This would swamp overheads and the cost of mastering, setting up, &c. At present, the costs are being loaded on to much smaller runs – typically 3000 or less.

Most software interests at the CES agreed that compact disc prices would come down in 1984 but only gradually, as the market expanded and as increased competition induced retailers to accept smaller margins.

IN-CAR CD PLAYERS

Determined not to miss out on a possible future market, Panasonic (National), Mitsubishi, Fujitsu TEN and Philips were among those exhibiting prototype or pre-production automotive compact disc players at the CES. It is unlikely, however, that any of them will be on sale before the end of the year or into 1985 at the earliest – and then only if a number of difficulties are overcome.

If an in-car CD player is to be an acceptable alternative to the popular cassette-radio, it would have to include provision for AM/FM-stereo, leading to problems with overall size and lack of compatibility with the space normally provided in modern compact cars. Options might include suspending the player beneath the dash, putting some of the electronics in the trunk, or confining the use of such units to large cars or to those designed to take them.

Significantly, Fujitsu TEN developed its CD/radio in conjunction with Toyota of Japan. Fujitsu TEN managed to get its player down to dimensions reported as 178 x 178 x 76mm and left the rest up to Toyota.

In the USA, Delco is working in conjunction with General Motors to develop a mutually practical design for their range of vehicles. How it is working out is unclear.

Another problem has to do with vibration and bumping at high speed or on poor roads. With a cassette player, a bump or two may produce transistory wow and flutter but, if the tracking of a laser head is interrupted, it is possible to lose snatches of music or whole slabs of it!

In a vehicle, a player would also have to be able to withstand extremes of temperature, and temperature cycles from well below freezing point to around 50°C. And, of course, dust-laden air has to be taken into account.

Engineers and marketing executives concerned with in-car CD all admit to the problems but they are somewhat evasive on the subject of their solution. Some imply that the problems have been solved but others suggest that there is still work to be done. A spokesman for Philips said that his company was pursuing the development of an adequate suspension system.

A great deal would seem to depend on the interpretation of the word "adequate"!

Mitsubishi exhibited an under-dash prototype CD player at the Chicago CES in June last year and plans to market actual product by the end of this year. It will be in the form of custom kits for specific models of the more expensive cars, with prices getting up to around $900.

Fujitsu TEN was also making noises about a possible release date for the USA towards the end of the present year.

Philips, too, may have something to offer by the end of the year but, again, it may not happen until 1985.

Panasonic had an AM/FM radio CD player on display separately and in a vehicle but insisted that it was a prototype only but would make no statement about release date or price.

The Sony group, who exhibited a prototype in Berlin in September last, is similarly non-committal about a release date.

Dealer attitude to automotive CD installations reflected no impatience. Demand is not likely to build for such a product, they say, until CD hardware and software is fully established and accepted in the home. Initial demand will be confined to purchasers who simply must have the latest hifi toy, even if it costs them $1000 to have it installed!

But, as others pointed out, that may not be the end to it. Road noise would mask the excellent signal/noise ratio of compact discs, while a couple of hundred watts would be necessary to take advantage of the dynamic range – if customers could afford it and put up with it in those circumstances!

A ROAD MAP THAT YOU PLAY

According to a spokesman for Philips, a compact disc player in a car could have a role beyond the mere provision of entertainment. A great deal of the information normally presented in local street directories could be encoded into a compact disc and readily accessed, provided the vehicle was equipped with a suitable video display system. (The CD format will accommodate still-picture video information but detailed system standards have not yet been adopted by the industry.)

Invasion of the electronics industry by the photographic giants was a hot subject at Las Vegas. Diversification and the subsequent release of Polaroid video cassettes was announced in Australia last July.

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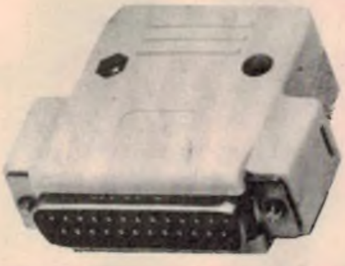

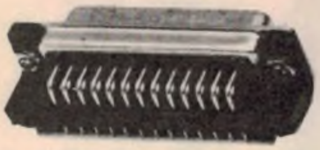

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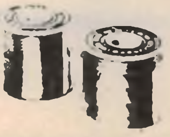

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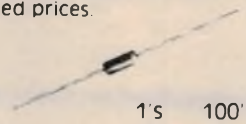

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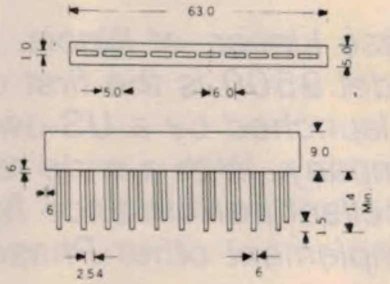

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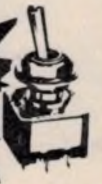

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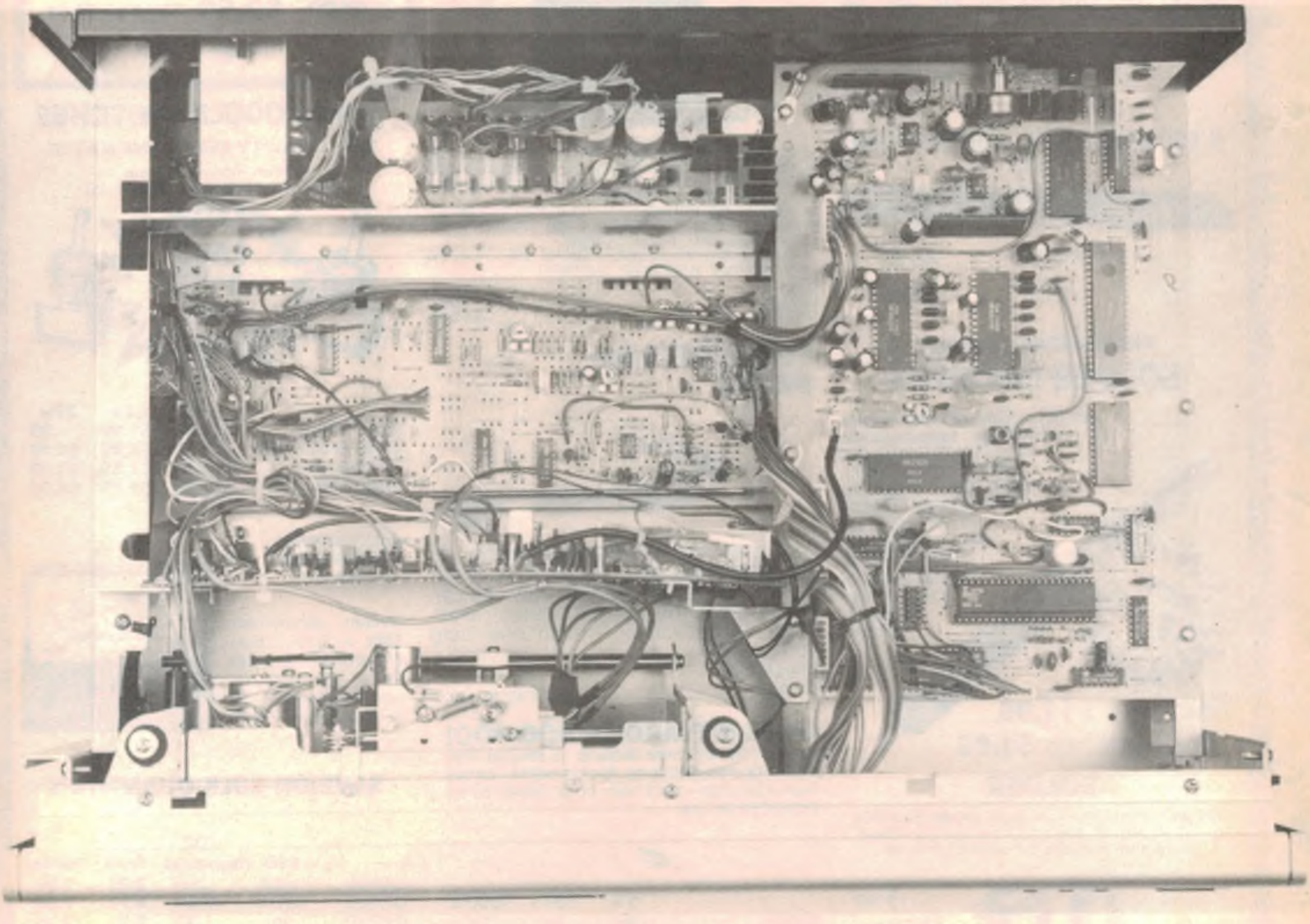
Electronics Australia reviews

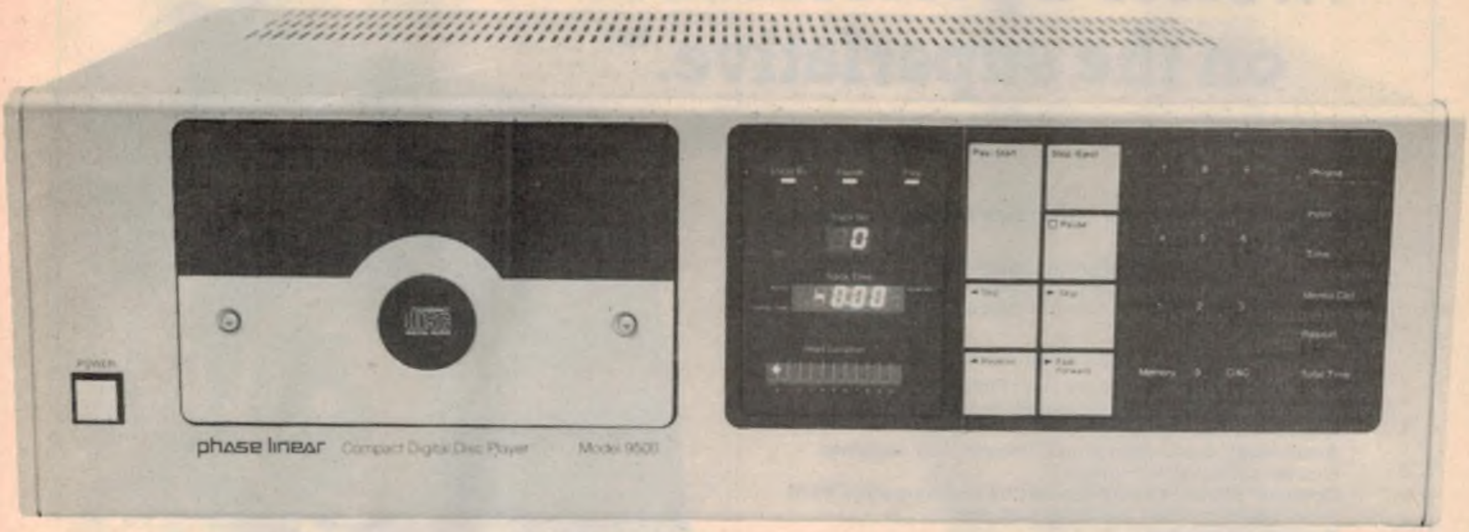
Phase Linear 9500 compact disc player

Phase Linear, of Illinois, USA, claim that their model 9500 is the first compact disc player to be launched by a US-owned and US-based company. With a wide range of facilities and excellent performance figures, it is intended to complement other Phase Linear hifi components.

Originally well known for their high quality power amplifiers, Phase Linear was just one of many US companies which fell victim to financial recession and to competition from overseas. After a period of uncertainty, the company became part of the Esmark Group, which also owns the Jensen Sound Laboratories and the Advent name – both notable in their own right.



This inside view of the Phase Linear player shows the very compact disc transport mechanism.



Phase Linear's continued involvement in high quality amplifiers is apparent in the user manual which comes with the 9500 CD player. It contains a basic explanation of the CD system, placing considerable emphasis on the increased dynamic range which it offers. Their advice: increase the dynamic range of your hifi system to match it by using a Phase Linear DRS amplifier.

Phase Linear admit to the fact that the 9500 is manufactured "off-shore" (Japan) but say that they nominated the user-features provided on the front panel and had a hand in some of the internal engineering.

Intended, possibly, to be in keeping with the big-and-tough image of high-powered amplifier systems, the 9500 CD player is noticeably larger, plainer and more subdued than most of its Japanese or European counterparts. It measures 443(W) x 139(H) x 320(D) and weighs 7.7kg. The body shell is a mid grey-brown and the front panel a slightly brownish-silver matte, with a dark perspex disc compartment and information window.

As such, it's a rather sombre brute, with virtually twice the cubic volume of (say) the Philips slimline CD-3. It will win friends – or fail to win them – on this score alone, tending to select itself for the big-is-beautiful (macho?) hifi market.

As with other CD players, the 9500 has provision for locking the disc tracking mechanism during transport – in this case involving five small screws and two small plates. As I removed them, I could not but wonder how one would keep track of them against the day when they might be needed again. Even as it was, one of the screws was missing when I lifted the player from its box and was found later amongst the packaging!

Full marks to those players where the locking screws merely need to be slackened off, being retained automatically by the metalwork.

The power switch is at the bottom left-hand corner of the panel and pushing it on brings up a sufficient number of figures in the information window to confirm that the player is responding.

Adjacent to the switch and occupying the left-hand side of the panel is the disc compartment. Press a "Stop-Eject" pad elsewhere on the panel and the compartment door tilts outwards, revealing a slot into which the disc can be dropped, label side out. To load, the disc must be pushed down and the compartment closed manually – a simple enough procedure but a little less elegant from a consumer point of view than motor-driven self-loading.

More to the point, the user is virtually obliged to grip the exposed edge to withdraw the disc, with the distinct possibility of leaving behind a finger mark. Dutifully, however, Phase Linear's own user manual illustrates the preferred way of handling a compact disc – except "when putting a disc into . . . or removing the disc from the disc compartment!"

The information window, which occupies most of the right-hand end of the front panel, is divided into two sections by a vertical group of microswitch type function pads, operating in conjunction with internal control logic. The largest of the pads, as normal, is for "Play/Start".

The "Stop/Eject" pad alongside it has a triple role: (1) To open the disc compartment for initial loading; (2) To interrupt the Play cycle and bring the disc to a stop; (3) To initiate the Eject function by pressing the pad twice in succession.

To interrupt and re-start play at the same point on the disc, use can be made of the "Pause" pad which, sensibly, does not appear to follow the VCR convention of automatically reverting to Stop after a few minutes. There is really no reason why it should in a CD player, because the disc is not subjected to wear.

Next come two "Skip" pads, with appropriate arrow heads, which allow the user to skip to the next track or revert to the previous one, with the player automatically indicating the new number and commencing play at the exact start point of the signal.

The two remaining pads are for Fast Forward and Reverse, allowing the laser head to be cycled or merely nudged either way, as desired, the player again automatically amending the track number and time readout to correspond.

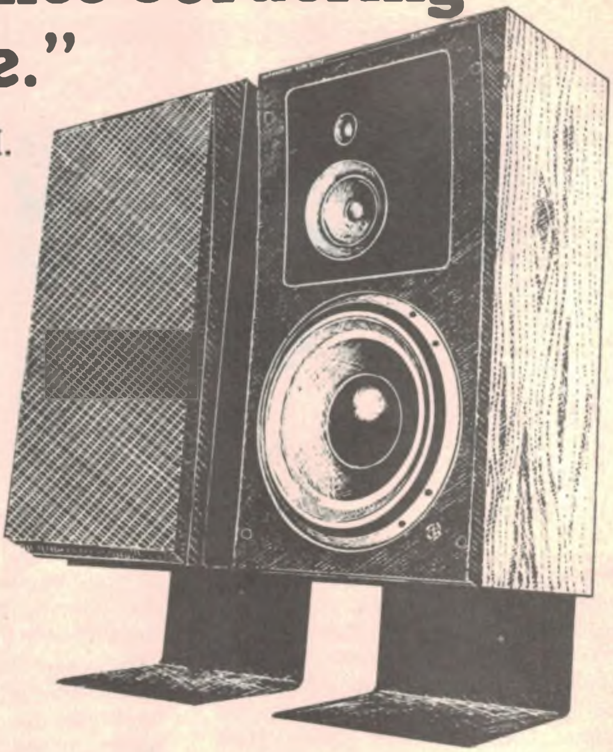
At switch-on, indicators and readouts appear only in the left-hand portion of the information window and relevant to normal manual play. At this level, the 9500 could be treated as a basic player, presenting the fewest possible difficulties to the newcomer. It's just a pity that Phase Linear did not make the legends a little larger and thereby more readable in subdued light.

At the top of the window are three LEDs indicating "Standby" (red), "Pause" (yellow) and "Play" (green). Below them is a group of figures which normally display the number of the track being played and, below them again, other figures showing the elapsed time of the particular track in minutes and seconds. (Both readouts have other functions in other play modes).

Along the bottom of the panel is an arbitrary 0-10 scale with a moving red dot pointer indicating the approximate position of the laser head relative to the

"...offer a performance bordering on the superlative."

Louis Challis, ETI.



This statement, made by one of Australia's highly respected hi-fi critics, is no exception.

The Danish JAMO Loudspeakers are acclaimed world wide. Their unique way to solve the problems which plague ordinary speakers have made JAMO one of Europe's best speakers today.

No other speakers on the market feature all these benefits:

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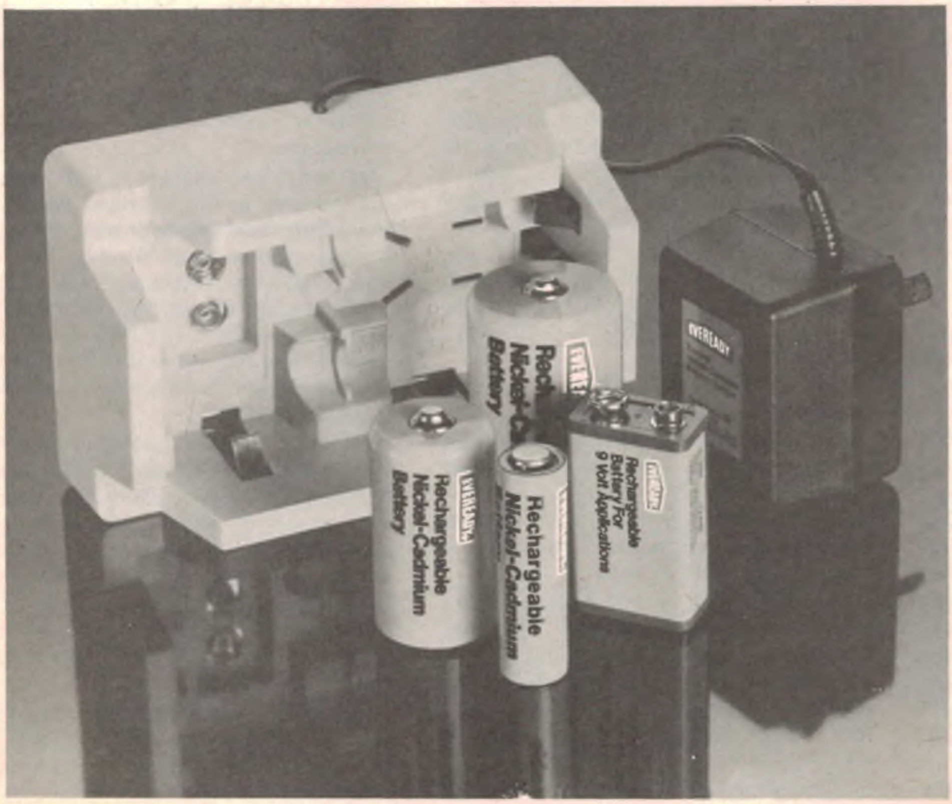

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Phone: 321 2926.

UNION CARBIDE

'Eveready' and 'Union Carbide' are registered trade marks. 085.P834A

Phase Linear 9500 compact disc player

surface of the disc. It provides some guidance when using the Fast Forward and Reverse functions but is interesting to watch anyway!

While the 9500 could be used indefinitely at this basic level, it is in its programmed or automated modes that it impresses most. Sensibly, the more "technical" facilities are grouped to the right of the control pads, quite separate from the manual play functions already described. They can thus be ignored by the uninitiated although, in the longer term, a few minutes learning about the extra functions would be time well spent.

Adjacent to the pads is a group of numeric buttons, 0-9, similar to those on a calculator and complete with a "C/AC" (Clear/All Clear) function. The user can punch in any desired track number, followed by a Play instruction, and the deck will immediately commence play of the nominated track, irrespective of whether it was in Standby, Pause or Play mode: a quick and easy way to play a wanted track.

In this context, it is interesting to punch in a number greater than the number of tracks on the particular disc and to watch the player go through its paces, as evidenced by the head position indicator. The head will be seen to move to the outer edge of the disc, search back and forth, give up in disgust and revert to the start of track one!

As an alternative to playing a nominated track immediately, the user can store a series of track numbers in memory, in any order and including repeats if desired. The 9500 will play them in that order and, in fact, repeat the program unless the cycle is interrupted. The memory can accommodate up to 24 track numbers.

A "Memory Call" button allows the contents of the memory to be checked at any time by displaying the stored numbers in sequence on the track number readout – one of the additional functions mentioned earlier.

In addition to nominating complete tracks, the numeric pad can be used in conjunction with a "Time" button to nominate a starting and/or finishing time for replay within any given track. The facility can be used manually but up to eight such timed requests can be assembled in memory for automatic replay. (A track number plus start and finish times counts as three "insertions", permitting eight such segments in the 24-insertion memory).

An extension of this facility in the 9500 could be of enormous value in music or language study. During normal play, the exact starting point of an interesting phrase or stanza can be stored in memory by merely touching a "Phrase" button. At the end of the wanted segment, touching the Phrase button again records the finish point and initiates automatic repeat. The player continues to repeat the phrase or stanza until instructed otherwise by pressing the "C/AC" memory clear button.

(Lacking any immediate need for the facility at the time of test, this reviewer merely set up to repeat the first four words of a song lyric. The 9500 thereafter proclaimed to all and sundry: "You're marvellous, you're wonderful . . . You're marvellous, you're wonderful . . . You're . . . etc"!

The 9500 also includes an "Index" function which enables it to respond to, read out, or be programmed for index reference points planned into the compact disc system. Index points, encoded into the disc and listed in the jacket notes could be of particular value in long classical works but, to date, the facility has not been exploited to any extent. If and when it is, the 9500 can handle it.

If the front panel of the 9500 is taken up with numerous facilities and controls, the rear panel is equally bare: a mains cord, a pair of gold-plated RCA-type output sockets and an output level control knob. This last is a useful inclusion, having in mind the occasional complaint being voiced that the output from some CD players is uncomfortably high for the AUX input terminals of some amplifiers.

A twin audio lead, 150cm long (approx) and terminated in gold-plated RCA-type plugs is supplied with the 9500, together with a 40-page brochure explaining in detail the operation of the player. Performance specifications as quoted in the brochure are shown in the panel below.

Specifications

Dynamic range	92dB
Frequency resp.	20Hz to 20kHz
Signal-noise ratio	92dB
Channel sep.	92dB
Total harm dist.	.005%
Intermodulation dist	.005%
Output impedance	10 ohms
Wow and flutter	too small to measure
Audio output	2.0V RMS 100% modulation

Lab tests produced results which either confirm the specifications or substantially bettered them. In the latter category was signal-to-noise ratio which proved to be 102dB, some 10dB better than specified.

Harmonic distortion was also remarkably consistent over the full audio range and at maximum signal level it varied from a low of .004% to a high of .0078% at 20kHz.

Other players we have seen recently have tended to have a rising distortion/frequency characteristic which means that the Phase Linear gets top marks in this department.

The player is also one of the quietest we have tested, in the mechanical sense. You have to listen fairly close to it to perceive that is running. And it does not emit any spurious high pitched tones from the transport mechanism.

Sensitivity to vibration was another matter. We found that it could be hassled by the slightest of knocks to the cabinet and these would mean that the machine would abruptly jump forward by one or two seconds, as indicated by the digital readout. Naturally, an interruption of this magnitude was very noticeable. So it isn't perfect.

On the other hand, it does not seem to be unduly fazed by discs which are dirty or scratched. However, without having carried out careful comparison tests we are not prepared to say that it is discernibly different in this respect from other current players.

A look inside the machine shows that it is no more complicated than other models although the bigger case does give somewhat better access. And note how compact is the vertical player mechanism itself – many cassette mechanisms are more bulky than this.

The 9500 is double-insulated and has a sheathed two-core flex fitted with a standard three-pin plug.

Conclusion

As mentioned earlier the Phase Linear is a bulky machine which may or may not appeal to everyone. Its control legends could have been made more legible but it does have some nice features. Its sound quality is certainly above reproach and it works well.

Recommended retail price of the 9500 is $1400 including sales tax. For further information see hifi retailers or contact the Australian distributors for Phase Linear products, PC Stereo Pty Ltd, PO Box 272, Mount Gravatt, Qld 4122. Phone (07) 343 1612. (WNW).

STRONGEST KIT LINEUP FOR '84 - JAYCAR!!

REF: ETI APRIL 1984

NEW!!

ETI 340
CAR ALARM/MONITOR SYSTEM

Moving on from our very popular '330 (MkII) alarm, this system does not rely on interior lights to turn to trip the alarm, it uses low cost resonance sensors. It features three delays - entry, exit and alarm length before resetting. In addition, 'immediate-trip perimeter alarm' sounds the alarm if a thief attempts to disconnect the battery, steal tyres, lights etc. This alarm is armed in an unusual way - by pressing its 'arming' button when you turn off the ignition - which means you can leave it armed in a parking station when you have to give the keys to the attendant.

As is usual, the Jaycar kit for this project is complete and original. All parts necessary to build the standard kit are included, as well as two alarm stickers.

KE-4670 **P.O.A.**

"ELECTRIC FENCE"

REF: EA SEPTEMBER 1982

Mains or battery powered, this electric fence controller is both inexpensive and versatile. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian Standard 3129.

(Kit does not include the automotive ignition coil which is required)

Cat. KA-1109

$15.00

DRUM SYNTHESISER
JOIN THE DRUM REVOLUTION

Original design from the UK magazine "Electronics and Music Maker" April 1981. This self-contained unit can produce a variety of fixed and falling pitch effects triggered either by tapping the unit itself or striking an existing drum to which the unit is attached. The Jaycar "SYNTOM" Drum Synthesiser comes complete with a high quality pre-drilled moulded all ABS box 152 x 80 x 47mm with professional silk screened front panel.

FEATURES:

Decay from less than 0.1 second to several seconds - Pitch Control - Sweep Control and Volume ON/OFF.

AS USED BY WARREN CANN OF "ULTRAVOX"

Cat. KJ-6502

$36.50

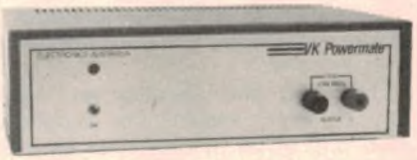
VK POWERMATE

REF: EA DECEMBER 1983

This kit enables you to build a power supply that will give 13.8 volts at up to 10 Amps! (8A continous). Ideal for running mobile transceivers at home. Kit is complete with box and front panel.

Cat. KA-1120

ONLY $89.95



12/230V - 300W INVERTER

REF: EA JUNE 1982

This unit provides up to 300VA of power @ 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output is voltage regulated, gives a precise 50Hz and has current limiting with ultimate thermal shutdown.

The Jaycar kit features quality, conservatively rated components and is complete down to the case and front panel. "C" core transformer supplied.

Cat. KA-1114

$195

TRANSISTOR ASSISTED IGNITION $35

REF: EA JANUARY 1983

Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and diecast box - as used in the original EA unit.

Beware of flimsy kits that use sheetmetal boxes!

This kit is designed to be used with contact breaker points, if you want Hall-Effect breakerless option may we suggest the KA-1505 version of this kit shown elsewhere on this page.

Cat. KA-1506

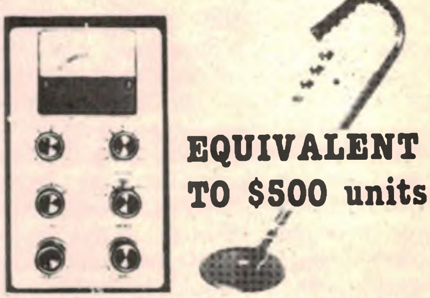
ETI 1500
METAL DETECTOR

The performance of a $500 metal detector - for $219! This is a fully discriminating VLF T/R instrument (yes, the same principles as those expensive American ones) with ground balance. Control facilities are comprehensive - including an 'auto-tune' button. The kit includes all parts including a fully built search head and handle assembly and special meter and case.

REF: ETI DEC/1980 - JAN/FEB 1981

Cat. KE-4015

$219.00



EQUIVALENT TO $500 units

MUSICOLOR IV

REF: EA AUGUST 1981

The ultimate in lighting controllers. Combines a brand new four channel version of the famous EA Musicolor sound-to-light effect with four channel chaser. This new Musicolor has a host of features rarely seen even on expensive commercial units: ★ Front panel LED display ★ four different chaser patterns ★ auto and manual reverse chase ★ sound-triggered chase ★ inbuilt electret microphone ★ safe, opto-isolated circuitry. And just look at the price!

Cat. KA-1010

$89.90

"SUPER SIREN"

REF: EA NOVEMBER 1982

Earsplitting sound from a CMOS that only draws 5maA on average.

NEW LOW PRICE

NORMALLY SELLS FOR $22.00

New low price with powerful imported piezo siren

$14.95

Cat. KA-1055

Short Form Kit (electronics only) $5

Cat. KA-1484

DIGITAL DELAY LINE KIT

COMPLETE 400MS VERSION ONLY $449

The Digital Delay Line is designed to produce a huge variety of electronic effects. It works very well but the amazing thing is the low, low price! The effects depend on the time delay selected and some of those included are: Phasing, Flanging, Chorous, ADT (Automatic Double Tracking), Echo, and Vibrato. The delay time can be varied from 0.32ms to 1.6 seconds! Because the signal is stored in digital form there is, unlike analog systems, no degeneration of the signal with time and unlimited repetition is provided by use of the freeze control. All the controls mount directly upon the PCB's to eliminate wiring and to further simplify construction the main board is 'plated-thru' i.e. there are no wire links or link-thru pins. The whole of the memory whether for the basic 400ms machine or the fully expanded 1.6 second model all fits on the main board. The cabinet which is free standing but also suitable for 19" rack mounting, is fully finished to a very high. The panel is deep blue whilst the cover is sprayed with a durable black enamel. The kit is available for only $449 - compare with inferior units that can cost over $2000!! Cat. KJ-6621

VOCAL CANCELLER

REF: EA APRIL 1982

Do you think you can sing? How would you like to be the lead singer in a famous rock (or any) band? You can cancel out the lead singer from almost any stereo record and substitute your own voice or musical instrument. Complete with case.
Cat. KA-1430

$19.50

GUITAR BOOSTER

REF: EA JUNE 1982

This inexpensive preamplifier enables you to use your guitar at home with the lounge room Hi Fi. It has treble and gain controls and runs from an inexpensive 9V battery. Super performance specs. All parts supplied including box, controls etc.
Cat. KA-1450

$17.50

MICROWAVE LEAK DETECTOR

If you own a microwave oven, your peace of mind is worth the price of this kit. Extremely simple and foolproof to build and use. Gives a positive indication of the security of your oven's seal.

REF: ETI 724

Cat. KE-4013

$14.95

BBD EFFECTS BOX

Fantastic low-cost instrument using the versatile MN3001 Bucket Brigade Delay Line to achieve brilliant sonic effects. Now you can emulate the commercial rock groups with Phasing, Flanging, Reverb and Echo. The Jaycar kit includes all components INCLUDING IC sockets and the TU-04 box. (Not cut down but this is easily done) Jaycar has a specially built cabinet for this kit with all holes pre-punched etc. at only $10 extra but only if you buy the original kit from us. Available as a separate item for $29.50. When the kit is purchased with the de-luxe case the TU-04 case will not be supplied.
Cat. KE-1522

COMPLETE KIT

$79

Special cabinet to suit
Cat. HB-6445

$10.00

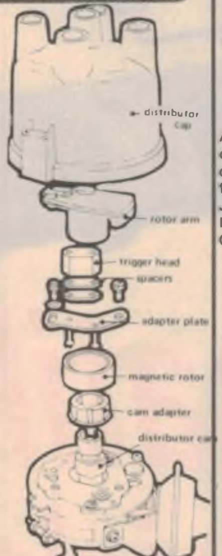
SEE EA Dec '83

IT HAD TO HAPPEN!

A professionally engineered electronic ("breakerless") contact breaker system.
Yes, only Jaycar has a complete Hall-Effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:

- HALL EFFECT TRIGGERHEAD
- MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS
- OVER 6 CAM-LOBE ADAPTORS
- OVER 12 DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
- OTHER HARDWARE (i.e. SCREWS etc.)
- YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL BREAKER POINTS WHEN YOU SELL THE CAR!!
- AS EASY TO INSTALL AS A SET OF POINTS!
- INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list. Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts you don't need to use! (Perhaps for the next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOR EVER.
Cat. KJ-6655
PLEASE NOTE: This system must be used in conjunction with an electronic ignition. The Hall-Effect device will not switch enough current to replace the contact breaker points on their own!



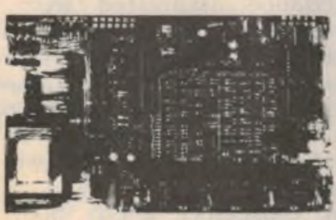
ONLY $29.95

ETI644A

See ETI Jan '83!!

DIRECT CONNECT MODEM

Ref: ETI October 1982



NEW MODEL

Two models (i) Short form which contains ALL PCB components as specified by ETI (BEWARE!!) The genuine ETI PCB with plated-thru holes, solder mask and component overlay is supplied. We also supply at NO EXTRA CHARGE a full set of quality IC sockets. A must with plated-thru PCB - remember this when making comparisons.
(ii) Full kit. Includes: all of the above plus 12V plug-pack, case, switch and LED bezel and Cannon DB-25 RS-232 connector. Makes a complete stand-alone modem ● Capable of a range of Answer/Originate operating modes ● Selectable Baud rate ● Software controlled ● Uses new patented technique ● More reliable and faster than most acoustic modems.
Arlec transformer as used in this project only $22.00

SHORTFORM KIT
Cat. KE-4600
ONLY $169

COMPLETE KIT
Cat. KE-4601
ONLY $199

STEREO SYNTHESISER

REF: EA SEPTEMBER 1982

This unit basically is the same as the KA-1510 simulator, but does a better job with more sophisticated circuitry. By employing a "Bucket Brigade" IC and Comb filtering, very realistic stereo sound spatial effect is evident. Ideal for VCR's and other mono sources that would benefit from stereo.
The circuit, though sophisticated is easy to build. Two versions of this kit are available, a shortform for people who want to build into equipment and a full kit which includes box, power supply and case.

SHORTFORM
Cat. KA-1476
$39.50

FULL KIT
Cat. KA-1478
$57.50

ETI 340

REF: EA JUNE 1982

This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output is voltage regulated, gives a precise 50Hz and has current limiting with ultimate thermal shutdown.
The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.
Cat. KA-1114

$195

150W MOSFET AMP MODULE

REF: ETI MARCH 1982

At last, a high power amplifier with the stability and reliability of MOSFETs. Genuine 150 watts r.m.s. with power supply components on board. You only need to connect a power transformer (4361 type Cat. MM-2015) and heatsink. The Jaycar kit includes a magnificent jig drilled EXTRUDED heatsink bracket for greater thermal efficiency.
Cat. KE-4220

$79.50

TRANSISTOR ASSISTED IGNITION HALL-EFFECT "BREAKERLESS" VERSION

REF: EA DECEMBER 1983

This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ-6655 Hall-Effect triggerhead.
Cat. KA-1505

$36.95

VIDEO AMPLIFIER/-BUFFER

REF: EA AUGUST 1983

The answer to a maidens prayer?
This device can be made to fit inside a TV set (or in a separate box if necessary). It basically enables you to connect straight into the video drive of your TV turning it into a colour monitor. This means that the video signal from your computer, VCR, Tv game etc., does not need to be converted to RF and go through the TV IF strip. You will be amazed by the clearer, sharper signal that has less interference! Notes on how to fit to various TV sets are included.
Cat. KA-1527

$14.95

Jaycar Incorporating **ELECTRONIC AGENCIES**

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TELEX: 72293
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Cnr. CARLINGFORD & PENNANT HILLS ROAD - PHONE: (02) 872 4444
CONCORD
115 - 117 PARRAMATTA ROAD - PHONE: (02) 745 3077
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$100 - $198 ($8.00)	Over $199 ($10)

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All heavy or bulky items (over 20kg.) sent Comet Road Freight $12.00 anywhere in Australia.
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by JEFF SKEEN
& LEO SIMPSON

A versatile LCR Bridge

PART 2

—for laboratory & workshop

Last month we presented the basic circuit concepts behind our all new LCR Bridge design. This month we present the full circuit and the construction details.

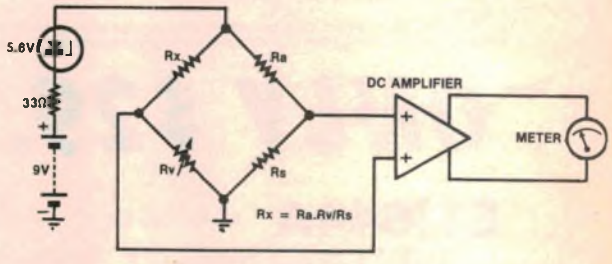


Fig. 1c

Five variations of the basic Wheatstone Bridge configuration are used in our new LCR Bridge, as discussed last month. While each of these variations in themselves represent a simple circuit, when you tie them all together it starts to become a trifle complicated. Add in the range switch wiring and you have the potential for a real bird's nest.

This raises two problems. First, there is the tedious job of wiring up the switch banks and second, there is additional wiring and contact resistance and stray capacitance associated with the switches. The contact and wiring resistances cause measurement errors on the low resistance ranges so there is provision in the circuit to take these residual resistors into account in the calibration procedure which will be discussed later.

Stray capacitance affects both the capacitance and inductance ranges so it must be kept to an absolute minimum. Fortunately, the stray capacitance in the circuit is due more to the interwinding capacitance of the transformer than to the wiring. This means that we have to specify a transformer with a low value of interwinding capacitance.

At the same time, the wiring layout has been arranged to keep stray capacitance

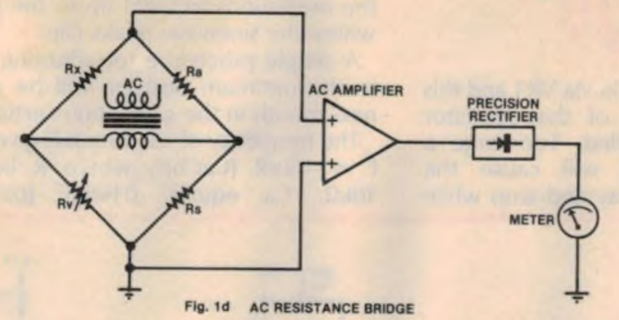


Fig. 1d AC RESISTANCE BRIDGE

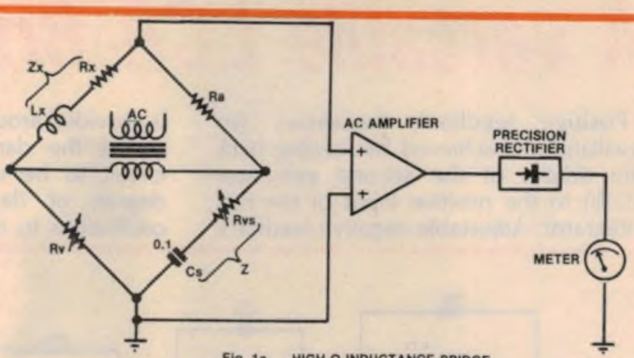


Fig. 1e HIGH Q INDUCTANCE BRIDGE

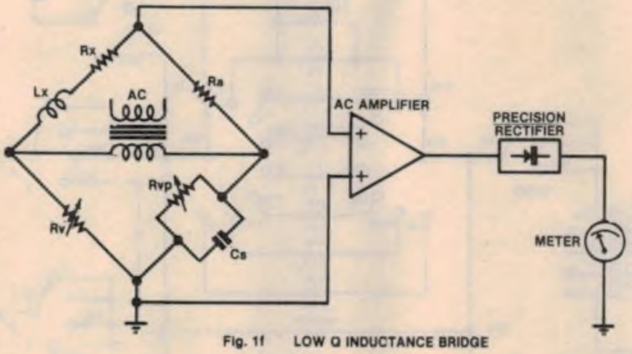


Fig. 1f LOW Q INDUCTANCE BRIDGE

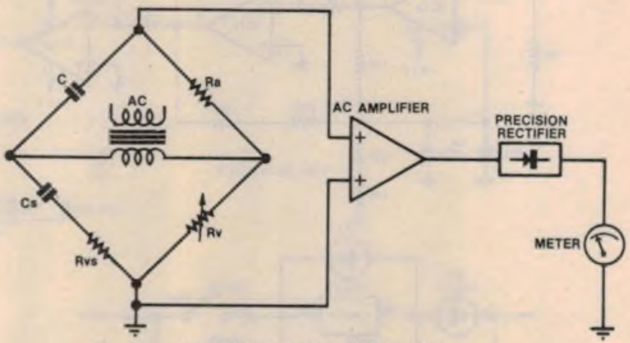


Fig. 1g CAPACITANCE BRIDGE CONFIGURATION

to a reasonable minimum. In fact, while our initial remarks may give the opposite impression there is not a great deal of wiring in this project but the complete circuit does look a bit of monster.

Incidentally, if you haven't already perused last month's article on this project you would be wise to do so. If you don't you probably won't make a great deal of sense out of the circuit description.

Circuit Description

Having put you on notice that you should read last month's article, let's recap on the five basic configurations used and then see how they are brought together in the main circuit diagram.

We have reproduced the five configurations again this month for handy reference and used the same diagram numbering as for last month.

Fig. 1c is the configuration used for DC resistance measurements. It uses DC energisation for the bridge itself and a DC amplifier to measure the null condition. Rx is the unknown resistor, Rv is the 10-turn pot with three-digit readout, Rs is the standard resistor and Ra is the range multiplier.

All five of the bridge configurations utilise the same components for Rv (ie, there is only one 10-turn pot) and Ra, the range multiplier. Similarly, the configurations used for measuring inductance and capacitance all use the one standard, a close-tolerance 0.1μF capacitor.

Of the five configurations, Fig. 1c is the odd one since it uses DC energisation. The other four configurations use AC energisation via a transformer and an AC null indicator.

Fig.1e and 1f are essentially the same with the only difference being the provision of Rvs or Rvp. Fig.1g, for capacitance measurement, has the bottom legs of the bridge swapped over, to take care of the fact that the impedance of a capacitor is in inverse proportion to its actual value.

Now let's take a look at the complete circuit diagram and how it relates to the five basic bridge configurations. First of all note S2, the range multiplier switch. S2a and S2b, the two poles of S2, switch in the multiplier values for Ra. As might be expected, these values increase from one range to the next by a factor of 10.

S1 is the selector switch. Various parts of S1 seem to be all over the circuit. It has a messy job to do and so has a lot of poles. In fact it has 12 poles, labelled S1a to S1l, all accommodated on three double-sided wafers. S1 has four positions, Rdc for DC resistance measurements, Rac (yep, you guessed it, for AC resistance measurements), L and C. Each one of the switch pole positions is labelled with one of these four legends, to make the function clear.

Have a look at S1a and S1c for example. They switch the meter between the DC and AC modes. At the same time, S1i and S1k change the configuration of the metering circuit from a differential amplifier to a single-ended input amplifer followed by a precision rectifier.

Note that one of the poles, S1j, is not used and so is not shown on the circuit.

S3 is the D.Q switch. It switches either of two legs of a dual gang pot into the circuit to provide Rvp or Rvs, depending on the particular measurement being performed. The 5kΩ track of the pot covers the D and Q ranges while the 50kΩ track covers the D × 10 and Q × 10 ranges.

Finally, there is S4 which is the "+1" switch. It connects a close tolerance 1kΩ resistor in series with the vernier drive pot. Rv, to increase the scope of any range from 10.00 to 11.00. This allows the ranges to overlap which is essential when measuring values at the top of a range.

So when you account for all the connections provided by the four switches there is really not all that much circuitry in the LCR bridge. Even so, there are some unusual circuit features. The first of these is the oscillator.

Two-phase oscillator

This is an interesting configuration which is not often used but which has the desirable features of low distortion, high output and very good amplitude stability. It's surprising that it is not used more often. It uses two op amps, Ic1a and Ic1b.

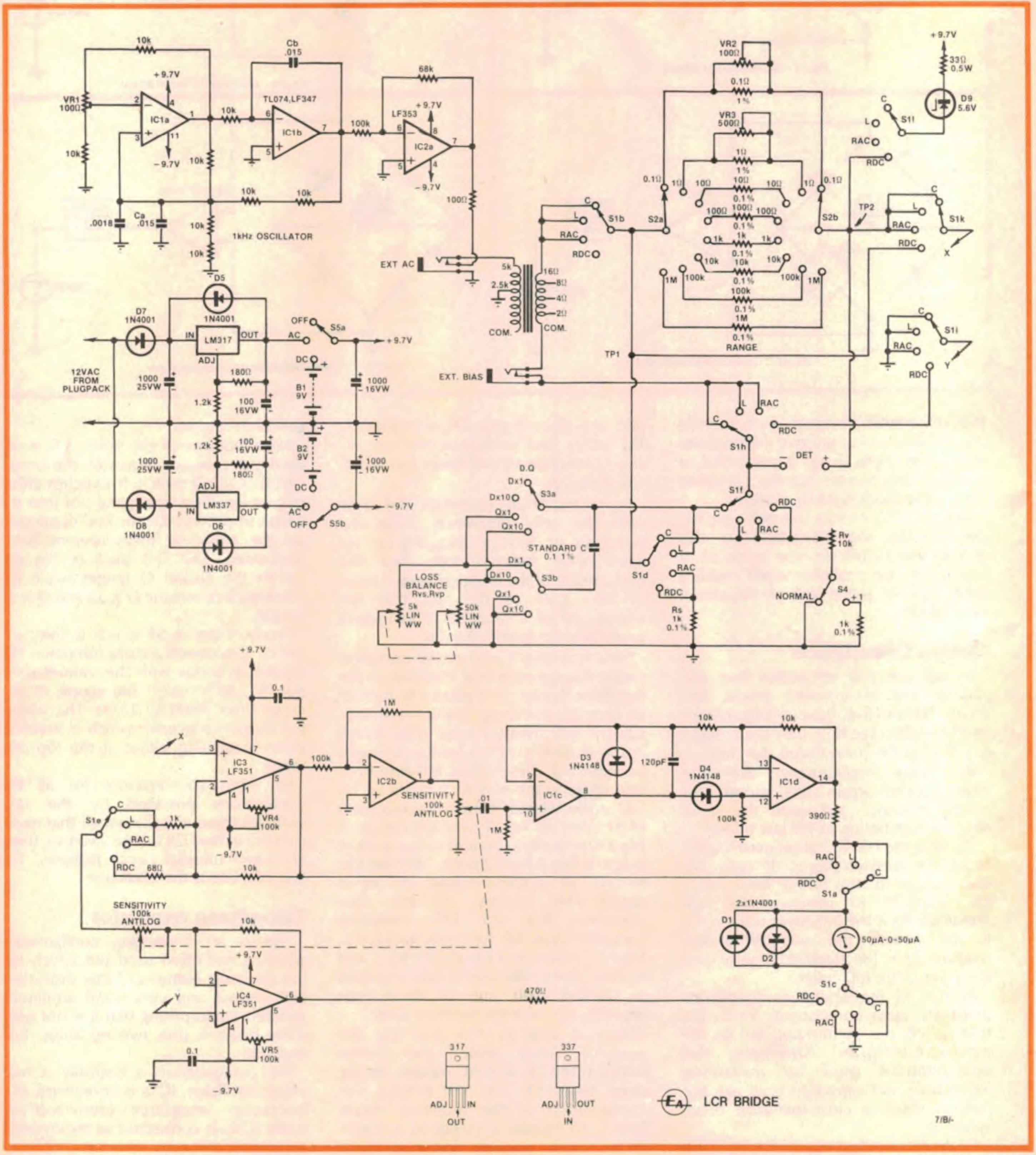
The configuration is basically a two-phase oscillator. IC1a is connected as a bootstrap integrator (non-inverting) while IC1b is connected as an inverting integrator.

A versatile LCR Bridge

Positive feedback (necessary for oscillation) is achieved by feeding back the output of the second integrator (IC1b) to the positive input of the first integrator. Adjustable negative feedback is provided around IC1a via VR1 and this allows the damping of the oscillator circuit to be controlled. Too large a degree of damping will cause the oscillations to die away and stop while too small a degree of damping will cause the oscillations to build up to the point where the sinewave peaks clip.

A simple procedure for adjusting VR1 to the optimum position will be given next month in the calibration section.

The frequency of oscillation is given by F = $1/2\pi R\ (CaCb)^{\frac{1}{2}}$, where R equals 10kΩ, Ca equals .0168μF (parallel



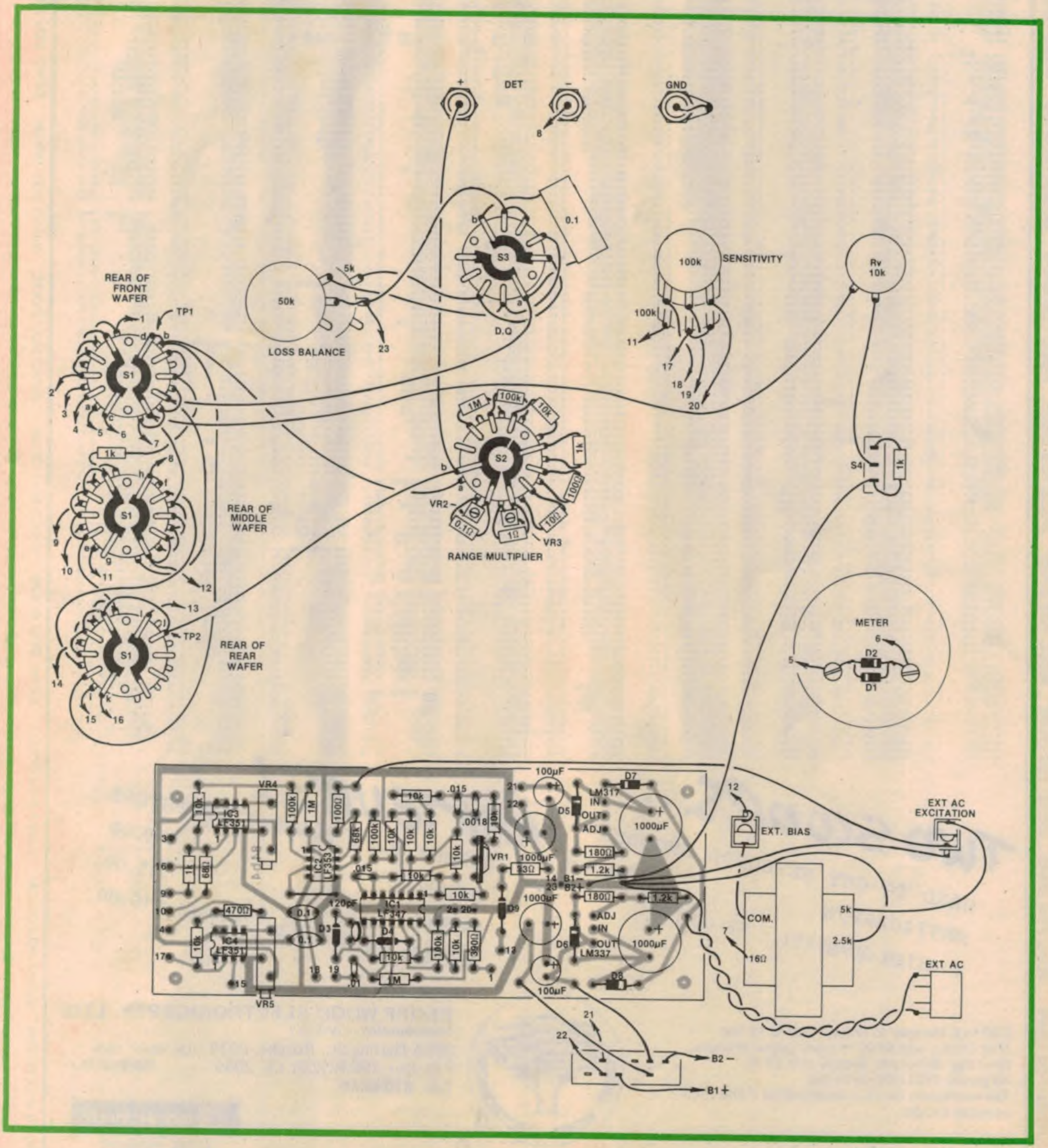
combination of the .015μF and the .0018μF capacitors) and Cb equals .015μF.

The output of IC1b is buffered by IC1c which has a gain of less than unity so that the output amplitude is reduced. This is done because the transformer load driven by IC1c is a low impedance and if maximum drive was applied the output would be clipped due to current limiting.

Only part of the transformer primary winding is used which means that the effective turns ratio is increased and a higher voltage is developed across the secondary. The jack socket in series with the transformer primary allows an external oscillator to drive the bridge.

The insulated socket labelled "external bias" is a further refinement on the basic bridge circuit and allows the connection of either polarising voltages when measuring electrolytic and tantalum capacitors or DC bias currents when measuring iron cored inductors.

This allows components to be measured under conditions approximating normal circuit operation.



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

MICROPROCESSOR

COM5016P	23.74
COM8116P	18.56
DP8212N	4.00
DP8216N	3.74
DP8224N	4.80
DP8226N	3.74
DP8228N	8.67
DP8303N	5.34
DP8304BN	5.34
ICL7209IPA	2.47
ICL8052ACP	3.47
ICL8053ACP	3.47
ICL8250CPE	2.47
INS1771N	40.02
INS2651N	12.67
INS8073N	61.48
INS8080AN	7.47
INS8250AN	18.97
INS8255N	6.83
MM52116FDW	10.67
MM5303N	7.45
MM5307AA	12.89
MM57409N	21.49
MM57499N	10.41
NSC800N-1	12.62
NSC810N-1	15.15
NSC831N-1	11.38
NS160KIT	151.73
P8085A	12.63
P8155	11.85

CMOS

CD4000BCN	0.48
CD4001BCN	0.48
CD4002BCN	0.48
CD4006CN	1.45
CD4007CN	0.48
CD4008BCN	1.52
CD4009CN	0.80
CD4010CN	0.80
CD4011BCN	0.48
CD4012BCN	0.48
CD4013BCN	0.72
CD4013CN	0.80
CD4014BCN	1.59
CD4015BCN	1.35
CD4016BCN	0.87
CD4017BCN	1.45
CD4018BCN	1.33
CD4019BCN	0.80
CD4020BCN	1.64
CD4021BCN	1.52
CD4022BCN	1.52
CD4023BCN	0.48
CD4024BCN	1.04
CD4025BCN	0.48
CD4027BCN	0.68
CD4028BCN	0.95
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CD4031BCN	4.05
CD4034BCN	2.75
CD4035BCN	2.17
CD4040BCN	1.64
CD4041BCN	1.69
CD4042BCN	1.16
CD4043BCN	1.21
CD4044BCN	1.38
CD4046BCN	1.91
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CD4049CN	0.79
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CD4094BCN	3.09
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CD4511BCN	1.52
CD4512BCN	1.28
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CD4515BCN	3.52
CD4516BCN	1.64
CD4518BCN	1.64
CD4519BCN	0.80
CD4520BCN	1.64
CD4521BCN	0.94
CD4522BCN	2.40
CD4526BCN	2.17
CD4527BCN	1.93
CD4528BCN	2.17
CD4529BCN	2.41
CD4538BCN	2.07
CD4541BCN	1.81
CD4543BCN	2.38
CD4553BCN	2.50
CD4555BCN	2.90
CD4556BCN	2.50
CD4583BCN	0.48
CD4584BCN	0.65
CD4723BCN	2.00
CD4724BCN	2.00
MM74C00N	0.48
MM74C02N	0.48
MM74C04N	0.51
MM74C08N	0.48
MM74C10N	0.48
MM74C14N	0.89
MM74C20N	0.48
MM74C30N	0.48
MM74C32N	0.48
MM74C42N	1.77
MM74C48N	2.53

CMOS

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MM74C74N	0.93
MM74C76N	1.14
MM74C83N	2.40
MM74C85N	2.40
MM74C86N	0.51
MM74C89N	10.31
MM74C90N	1.18
MM74C93N	1.68
MM74C95N	1.87
MM74C107N	1.20
MM74C150N	4.83
MM74C151N	3.34
MM74C154N	5.12
MM74C157N	3.15
MM74C160N	1.71
MM74C161N	1.60
MM74C162N	1.60
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MM74C165N	2.00
MM74C173N	2.13
MM74C174N	1.52
MM74C175N	1.52
MM74C192N	2.13
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MM74C195N	1.87
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MM74C903N	0.93
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MM74C905N	13.75
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MM74C911N	13.87
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MM74C922N	6.32
MM74C923N	6.67
MM74C925N	9.34
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CMOS

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TTL LOGIC

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TTL LOGIC

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DM74LS93AN	0.76
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DM74LS173A	1.12
DM74LS174N	1.00

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DM74LS175N	1.00
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DM74LS191N	1.14
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DM74LS193N	1.09
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DM74S133N	0.66
DM74S135N	1.43
DM74S136N	2.18
DM74S138N	1.72
DM74S139N	1.72
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DM74S151N	1.72
DM74S153N	1.72
DM74S157N	1.72
DM74S158N	1.72
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DM74S162N	4.30
DM74S163N	4.30
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DM74S175N	2.01
DM74S181N	6.30
DM74S182N	2.58
DM74S188N	2.84
DM74S189N	4.30
DM74S194N	2.58
DM74S195N	2.72
DM74S196N	2.87
DM74S197N	4.15
DM74S240N	3.29
DM74S241N	3.29
DM74S242N	4.01
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DM74S251N	1.86
DM74S253N	1.86
DM74S257N	1.72
DM74S258N	1.72
DM74S262N	1.72
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DM8121N	1.43
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DM8131N	4.73
DM8136N	4.73
DM8160N	4.73
DM81LS95AN	2.00
DM81LS96AN	2.00
DM81LS97AN	2.00
DM81LS98AN	2.00
DM8219N	2.43
DM8220N	4.72
DM8223N	2.36
DM8288N	2.66
DM8312N	2.60
DM8334N	5.16

TTL LOGIC

DM8520N	14.68
DM8542N	8.32
DM8544N	1.50
DM8552N	9.42
DM8553N	9.42
DM8601N	1.07
DM8602N	1.91
PSC 4096SD	7.67
PSC 9301PC	2.87

CONVERTER

ADC0800PC	18.21
ADC0804LCN	5.20
ADC0808CC	14.50
ADC0816CC	19.90
ADC0817CC	12.89
ADC0831CCN	5.04
ADC1001C-1	27.94
ADC1021C-1	29.65
ADC1210HC	68.03
ADC3511CC	14.67
ADD3501CC	14.67
ADD3701CC	16.68
AM3705CN	8.31
DAC0800LCN	3.60
DAC0808LCN	2.13
DAC0831LCN	6.06
DAC1000LC	11.27
DAC1006LC	12.06
DAC1020LC	11.21
DAC1021LCN	9.34
DAC1022LCN	7.47
DAC1203N	148.39
DAC1220LC	12.99
DAC1221LC	10.99
DAC1222LCN	8.99
DAC1230LC	19.85
DAC1231LC	16.92
DAC1280HC	36.02
HA 2-2502	2.87
LF398H	6.94
LF398N	5.47
LF13006N	6.06
LF13201N	5.71
LF13202N	5.71
LF13331N	5.71
LF13332N	5.71
LF13333N	5.71
LF13508D	12.81
LH0023CG	54.74
LM2907N	3.34
LM2907N-8	3.20
LM2917N	3.34
LM2917N-8	3.20
LM331AN	7.20
LM331H	9.74
LM331N	5.60

LINEAR

DT1050	66.70
DT1057	45.36
LF311H	6.15
LF347N	2.27
LF351H	1.47
LF351N	0.85
LF353H	1.89
LF353N	1.16
LF355H	2.13
LF355N	1.60
LF356H	2.13
LF356N	1.52
LF357H	2.13
LF357N	1.52
LF411CH	1.86
LF411CN	0.99
LF412CH	2.87
LF412CN	2.13
LF441CH	1.86
LF441CN	0.93
LF442CN	1.60
LF444CN	2.67
LF13741H	0.75
LF13741N	0.75
LH0002CH	15.57
LH0002CN	11.90
LH0022CH	21.74
LH0024CH	33.81
LH0032CG	38.48
LH0033CG	41.06
LH0036CG	50.23
LH0038CD	88.87
LH0042CH	10.07
LH0044CH	23.18
LH0086CD	63.43
LH740ACH	31.78
LM10CH	8.00
LM10CLH	6.00
LM10CLN	4.00
LM11H	4.67
LM11CH	7.45
LM11CLH	5.16
LM11CLN	2.55
LM11CN	2.72
LM1304N	4.36
LM13080N	1.60
LM13600N	1.55
LM13700N	1.55
LM1414N	1.97
LM1458H	2.15
LM1458N	0.56
LM1496H	3.60
LM1496N	1.60
LM1818N	3.72
LM1886N	5.73
LM1889N	4.30
LM301AH	1.60
LM301AN	0.67
LM306H	6.67
LM307H	1.60
LM307N	0.75
LM308AH	5.34
LM308AN	4.00
LM308H	1.73
LM308N	0.94
LM3080N	1.31
LM3089N	2.80

LINEAR

LM310H	3.07
LM310N	3.16
LM311H	1.73
LM311N	0.80
LM312H	4.67
LM316AH	14.94
LM316H	8.00
LM318H	3.41
LM318N	3.58
LM319H	4.00
LM319N	3.07
LM321AH	22.14
LM321H	8.00
LM324AN	3.34
LM324N	0.93
LM339AN	1.87
LM339N	0.93
LM344H	8.09
LM346N	3.52
LM348N	1.33
LM349N	1.73
LM358AN	2.19
LM358H	1.39
LM358N	0.80
LM359N	2.29
LM360H	7.16
LM360N	6.73
LM360N-14	6.73
LM361N	3.60
LM363D	26.28
LM363H-100	16.68
LM363H-500	16.68
LM372H	5.74
LM377N	3.20
LM378N	4.14
LM379S	13.34
LM380N	1.33
LM380N-8	1.33
LM381AN	4.27
LM381N	2.80
LM382N	2.27
LM383AT	3.60
LM384N	2.67
LM386N-1	1.07
LM387N	2.15
LM388N-1	1.72
LM389N	1.92
LM390N	2.87
LM391N-80	1.58
LM392N	0.96
LM393N	0.72
LM3900N	1.07
LM4250CH	3.15
LM4250CN	2.40
LM565CH	4.30
LM565CN	2.40
LM566CN	2.40
LM567CN	1.87
LM709CH	1.73
LM709CN	0.93
LM710CH	1.33
LM710CN	0.93
LM711CN	1.20
LM725CH	8.00
LM725CN	5.16
LM733CH	1.87
LM733CN	0.99
LM741CH	1.20
LM741CN-14	1.06
LM741CN	0.51
LM747CH	1.47
LM747CN	1.07
LM748CH	1.47
LM748CN	0.80
MM5824N	3.87
NE501-SIG	2.47
NE510-SIG	2.47
NE515-SIG	2.47
NE536-SIG	2.47
NE543-SIG	2.47
NE553-SIG	2.47
RC3403N	2.87
RC4739N	2.87
TBA1205	1.86
XR1310	2.67
XR2216	2.67
XR2240CP	3.38
XR2567	3.68

CLOCKS

MA1003	36.62
MA1010E	23.00
MA1026ALR	33.51
MM5309N	9.31
MM5314N	9.31
MM5318N	11.17
MM5369AA/N	2.87
MM5387AA/N	8.60
MM53107N	2.87
MM5865N	11.17
MM5871AA/	11.17
MM58167AN	16.01
MM58174AN	14.67

DATA

DATA ADV LOG	6.25
DATA AUDIO	6.25
DATA CMOS/81	9.00
DATA HYBRID	8.75
DATA INTFAC	17.50
DATA LINEAR	15.00
DATA LIN AP	20.00
DATA LOGIC	11.25
DATA 8070	20.00
DATA TRANS	7.50
DATA V.REG	6.25

DIODES

1N60	POA
1N914	0.05
1N3070	POA
1N5626	POA
701PBS	POA
701PES	POA
PK40F	2.51
SB2	0.74

OPTO

FOR261F-2	21.72
LH0082CD	51.68
LM3914N	3.34
LM3915N	3.34
LM3916N	3.34
MM5451N	5.60
MM5453N	5.60
NSB3881	10.12
NSB5382	11.13
NSB5388	10.87
NSB5881	10.87
NSB5882	10.87
NSB5917	14.54
NSB7382	12.14
NSB7881	12.14
NSB7882	12.14
NSC003	0.06
NSL4550	0.35
NSL4550•CL	0.48
NSL4555•CL	0.56
NSL4855	0.15
NSL4944	0.83
NSL4944•CL	1.04
NSL4955	0.15
NSL4955•CL	0.56
NSL5053	0.35
NSL5053•CL	0.43
NSL5056	0.23
NSL5056•CL	0.43
NSL5086	0.16
NSL5253A•CL	0.83
NSL5353A•CL	0.83
NSL6754	0.20
NSL52124	0.64
NSL53124	0.69
NSL57124	0.67
NSM1416	24.01
NSM3914	8.00
NSM39142	10.31
NSM39146	10.31
NSM39152	10.31
NSM39158	8.40
NSM3916	8.00
NSM39168	9.74
NSM4000A	12.01
NSM4005	12.94
NSN334	5.06
NSN373	5.73
NSN374	5.73
NSN381	5.73
NSN382	5.73
NSN534	5.73
NSN581	5.73
NSN583	5.73
NSN584	6.30
NSN782	6.40
NSN783	6.40
NSN784	6.40
XC209-G	0.33
XC209-Y	0.33
XC-500B	0.71
XC5491	1.14

HARDWARE

BEZEL	2.65
KBD 3149	24.40
KBD 3150	24.40
KBD 3200	18.01
KBD 3201	18.01
KBD 3203	15.36
KBD 3204	15.36
DUN 3253	12.40
DUN 4219A	26.45
DUN 4219LK	26.45
DUN 4415AK	27.80
DUN 4415LK	27.80
DUN 62 DIAL	18.18
DUN 82 DIAL	26.44
DUN KNOB	2.23
PAN MU2A1 1	23.00
PAN MU3A1 2	20.00
PAN SU2A1 1	25.00
PAN SU3A1 2	23.00
PAN WR3A1 2	27.00
SOCKET-8 PI	0.32
SOCKET-14 P	0.28
SOCKET-16 P	0.28
SOCKET-18 P	0.30
SOCKET-20 P	0.35
SOCKET-22 P	0.35
SOCKET-24 P	0.60
SOCKET-28 P	0.60
SOCKET-40 P	0.87
SPEC 008T00	2.59
SPEC 13P SER	1.79
SPEC 63P SER	1.42
SPEC 64Y SER	3.40

INTERFACE

DP8310	4.73
DP8311	4.73
DS0026C	2.44
DS1488	1.26
DS1489A	1.26
DS1489	1.26
DS16913	8.82
DS26LS31C	3.79
DS26LS32C	3.79
DS26LS33C	3.79
DS26S11	4.15
DS3245	7.07
DS3486	4.00
DS3487	4.00
DS3605	5.02
DS3611	1.66
DS3612	1.66
DS3613	1.66
DS3614	1.66
DS3625	4.30
DS3630	2.58
DS3631	2.72
DS3632	2.72
DS3633	2.72
DS3634	2.72
DS3640	2.35
DS3644	6.88

INTERFACE

DS3648	3.58
DS3649	2.29
DS3662	5.47
DS3675	4.01
DS3686	5.73
DS3687	5.73
DS3692	4.94
DS36149	2.46
DS7524	2.87
DS75107	2.05
DS75108	2.05
DS75121	2.13
DS75124	2.13
DS75125	4.00
DS75150	2.93
DS75154	2.45
DS75160A	7.27
DS75161A	7.93
DS75324	2.19
DS75450	0.88
DS75451	0.92
DS75452	0.90
DS75453	0.93
DS75454	0.93
DS75461	1.01
DS75491	1.12
DS75492	1.12
DS75494	1.68
DS8T26A	3.34
DS8T28	2.53
DS8629	7.16
DS8640	5.55
DS8641	3.58
DS8664	8.35
DS8692	6.45
DS8800H	8.60
DS8812	1.76
DS8820A	2.15
DS8820	1.90
DS8822	6.66
DS8830	1.90
DS8831	4.00
DS8832	4.30
DS8833	3.58
DS8834	2.15
DS8835	3.58
DS8836	1.43
DS8837	2.87
DS8838	2.44
DS8839	3.58
DS8853	3.58
DS8859	2.58
DS8861	2.58
DS8864	4.45
DS8867	2.87
DS8868	2.47
DS8869A	2.29
DS8871	2.72
DS8872	2.87
DS8877	1.86
DS8880J	4.73
DS8880	2.55
DS8881	8.60
DS8885	3.72
DS8887J	4.73
DS8889	3.87
DS88C20	5.73
DS88C120	5.73
DS88LS120	4.15
DS8963	5.87

REGULATORS

LH0070-0H	10.63
LH0070-1H	16.42
LH0071-0H	10.63
LH1605CK	20.75
LM113H	14.24
LM217H	14.41
LM2930T-8	1.61
LM304H	4.00
LM305AH	3.60
LM305H	1.33
LM309H	3.92
LM309K	2.78
LM309K-STL	4.94
LM313H	8.94
LM317H	5.20
LM317HVH	8.00
LM317HVK	8.00
LM317K	4.94
LM317KC	3.34
LM317LZ	0.93
LM317MP	1.47
LM317T	1.87
LM320H-15	7.47
LM320H-5.0	7.47
LM320K-12	7.34
LM320K-15	7.34
LM320K-5.0	7.34
LM320KC-12	4.68
LM320KC-15	4.68
LM320KC-5.0	4.68
LM320LZ-12	1.26
LM320LZ-15	1.26
LM320LZ-5.0	1.26
LM320MP-12	2.40
LM320MP-15	2.40
LM320MP-5.0	2.40
LM320T-12	3.29
LM320T-15	3.29
LM320T-5.0	3.29
LM323K-STL	8.67
LM325AH	6.94
LM325H	4.67
LM325N	4.40
LM326H	4.67
LM326N	4.40
LM329BZ	2.67
LM329CH	4.27
LM329DZ	0.80
LM334Z	1.93
LM336Z-2.5	1.43
LM336Z-5.0	1.43
LM337H	6.27
LM337HVH	10.27
LM337HVK-ST	12.94

REGULATORS

LM337K-STL	[illegible]
LM337LZ	1.20
LM337MP	1.60
LM337T	2.53
LM338K-STL	9.23
LM340K-12	4.80
LM340K-15	4.80
LM340K-6.0	4.45
LM340K-8.0	4.45
LM340KC-12	1.97
LM340KC-15	1.97
LM340KC-8	2.09
LM340T-12	0.93
LM340T-15	0.93
LM340T-5	0.93
LM341P-12	0.83
LM341P-15	0.83
LM341P-5.0	0.83
LM342P-12	0.86
LM342P-15	0.86
LM342P-5.0	0.86
LM350K-STL	7.08
LM350T	5.39
LM3524	3.95
LM368H-10	8.00
LM368H-5.2	8.00
LM368H-6.0	8.00
LM376	0.75
LM385Z-1.2	3.29
LM396K-STL	20.23
LM399H	6.67
LM3999Z	3.44
LM723CH	1.04
LM723CN	0.59
LM78L05ACZ	0.53
LM78L06ACZ	0.53
LM78L12ACH	1.60
LM78L12ACZ	0.53
LM78L15ACH	1.60
LM78L15ACZ	0.53
LM78L18ACZ	0.46
LM78L24ACZ	0.46
LM7905CK	2.24
LM7905CT	0.99
LM7912CK	2.24
LM7912CT	0.99
LM7915CK	2.24
LM7915CT	0.99
LM79L05ACZ	1.26
LM79L12ACZ	1.26
LM79L15ACZ	1.26
RC4195	2.87
SR1605	54.54

SUNDRY

LH0091CD	60.12
LH0094CD	88.87
LM1014	1.60
LM1801	4.30
LM1812	10.94
LM1830	3.34
LM1871	5.73
LM1872	5.73
LM322H	2.67
LM322	2.13
LM375	5.74
LM3905	1.72
LM3909	1.33
LM555C	0.93
LM556C	1.21
LU316-SIG	2.65
MM53200	6.02
MM54240	10.41
MM5837	3.58
N1013AN-SIG	2.65
N2501N-SIG	2.65
N2509N-SIG	2.65
N2521N-SIG	2.65
N2527N-SIG	2.65
N5880BN-SIG	2.65
N8244N-SIG	2.65
N8252N-SIG	2.65
N8269N-SIG	2.65
N8273N-SIG	2.65
N8274N-SIG	2.65
N8284N-SIG	2.65
N8285N-SIG	2.65
N82S10N-SIG	2.65
N82S21N-SIG	2.65
N8815N-SIG	2.65
N8824N-SIG	2.65
N8825N-SIG	2.65
N8226N-SIG	2.65
N8840N-SIG	2.65
N8875N-SIG	2.65
N8T04BN-SIG	2.65
N8T09BN-SIG	2.65
N8T35BN-SIG	2.65
N8T36BN-SIG	2.65
N8T363N-SIG	2.65
N9314N-SIG	2.65
N10101BN-SIG	2.65
N10106BN-SIG	2.65
N10112BN-SIG	2.65
N10114BN-SIG	2.65
N10115BN-SIG	2.65
N10125BN-SIG	2.65
N10131BN-SIG	2.65
N10231BN-SIG	2.65
NE592-SIG	2.47
ULN2208	1.15
ULN2209	1.15
VELOSTAT	11.73
XR2206CP	6.60
XR2211CP	6.77

TEMPERATURE

LM135H	10.14
LM335H	2.90
LM335Z	2.24
LM350H	4.32
LM350Z	3.31
LM3911N-46	4.50
LM3911	2.42

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A versatile LCR Bridge

Nulling amplifier

As noted before, the nulling amplifier configuration is changed depending on whether DC or AC measurements are being performed.

In the DC mode, only IC3 and IC4 are involved. They function together as a true differential amplifier and drive the meter via S1a and S1c. IC2b is also connected to the output of IC3 but this is of no consequence in the DC measurement mode.

Now comes the fiddle. In the AC measurement modes, the input of IC4 is grounded by S1i which effectively disables it, as far as AC signals are concerned. So for AC signals, the signal chain is via IC3, IC2b, IC1c and IC1d.

Going back to the DC measurement mode again, IC3 and IC4 can be regarded as non-inverting amplifiers which share a common 100kΩ gain control. The gain is given by the expression G = 1 + Rf/R where Rf is the 10kΩ feedback resistor and R is the series combination of the 100kΩ potentiometer and 68Ω resistor (selected by S1e).

This gives a minimum gain of 1.1 and a maximum gain of about 148.

In the AC mode, IC3 has a variable gain set by the combination of the 100kΩ potentiometer and the 1kΩ resistor (again selected by S1e). The range of gain is from 1.1 to about 11 times.

IC2b is an inverting amplifier with a gain of 10. It feeds a 100kΩ potentiometer which is ganged with the 100kΩ pot in the feedback circuit of IC3 and IC4. Output from the wiper of the pot is then coupled via a .01μF capacitor to IC1c and IC1d which together form a precision full-wave rectifier. The way in which the two op amps work is interesting.

Consider a positive going signal (eg, the postive excursion of a sine wave) applied to the input of IC1c. This is connected in non-inverting configuration and so the output signal from IC1c is also positive going which forward-biases D4 and reverse-biases D3. So the signal is also applied to IC1d which works as a non-inverting voltage-follower.

Since D3 is reverse-biased, the feedback network for IC1d also applies feedback to IC1c with the result that for positive-going signals the circuit has a gain of unity.

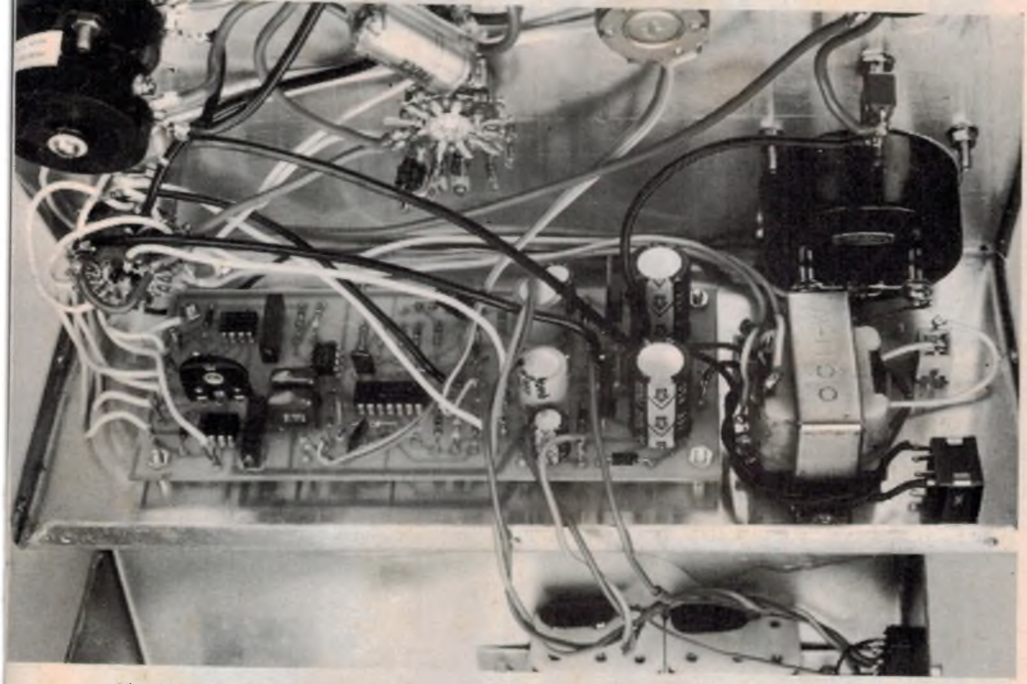
For negative-going signals, the mechanism is different. Here, because D3 is forward-biased and D4 is reverse-biased, IC1c acts as a unity gain follower while IC1d acts as a unity gain inverter.

Hence, the two op amps form a full-wave rectifier. The 120pF capacitor across D3 is added to ensure RF stability.

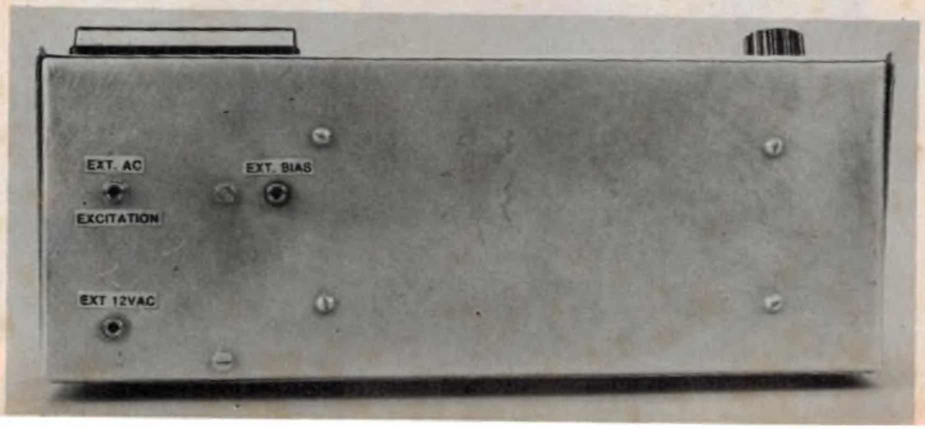
We estimate the cost of parts for this project to be approximately

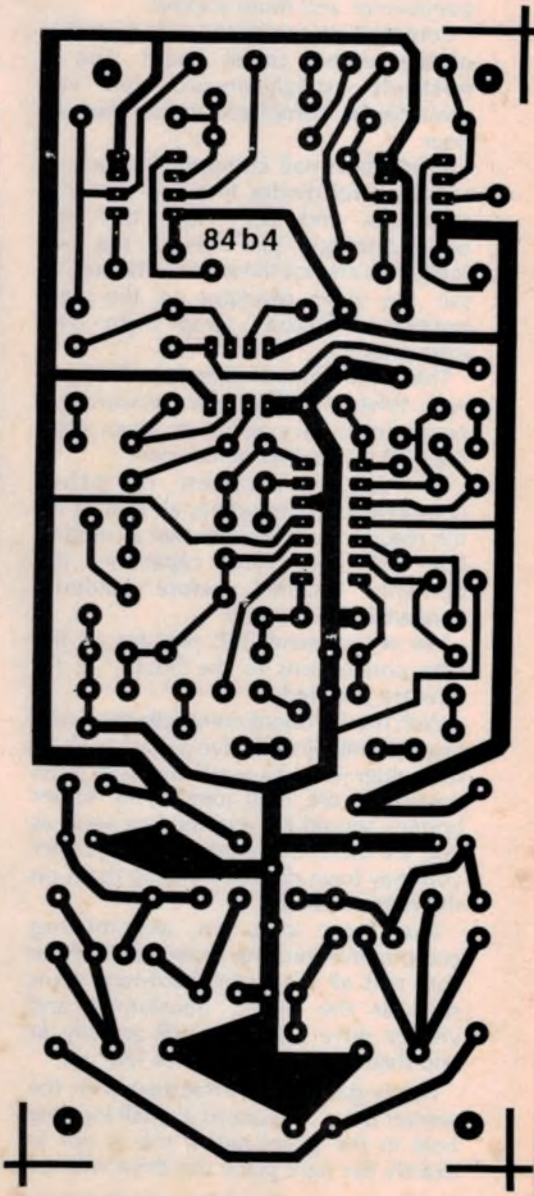
$149

This includes sales tax.



Above: view inside the prototype. Note that a few minor changes were made to the PCB after this photograph was taken. Below is a view of the rear panel. The external bias socket must be isolated from chassis.





A versatile LCR Bridge

The output of IC1d drives the meter via a 390Ω resistor and S1a (and S1c).

Power supply

If other parts of the circuit are unusual, the power supply is strictly conventional. It uses an external AC plugpack to provide 12VAC. This is applied to two half-wave rectifiers to provide positive and negative DC rails. These are filtered and then regulated to ±9.7V by adjustable 3-terminal regulators.

Construction

A sloping front metal case houses the new LCR bridge. Measuring 260 × 173 × 103mm, it is designed for easy viewing of the controls and good access to the internal wiring. The printed circuit board, measuring 151 × 64mm (code 84b4), is mounted vertically inside the back panel of the case, together with the audio transformer and three sockets.

Construction can begin with assembly of the printed circuit board. This is relatively straightforward and can probably be completed in less than an hour.

Install the small components such as resistors and diodes first and then the regulators and ICs. Note that the orientation and pin outs of the two regulators are not the same so be sure to put the right regulator in the right position and don't swap them over inadvertently.

The two multi-turn pots. face the same way. While this may look awkward it is necessary to give access to them once the PCB is installed in the case.

Correct orientation of other components is important, as well as for the regulators. Make sure that all diodes, ICs and electrolytic capacitors are correctly installed before soldered connections are made.

We recommend PCB pins for all the wire connections to the board. 22 PC pins are required.

With the PC board complete check the layout carefully and have a close look at the solder joints to see if any have been missed or are cold joints. Any solder bridges should be removed as soon as you see them. If you leave them till later you may have difficulty finding them on the next occasion.

The first step in assembling components into the chassis is to make sure that all the major hardware items such as the meter, transformer and vernier drive assembly will actually fit and that the mounting holes line up.

This is particularly important with the vernier drive. It requires a small locating hole in the panel and if this is not in exactly the right place the drive will not run freely. On the other hand, if the hole is too large, the vernier drive will tend to wobble from side to side. Having said this, it would be a good idea to do a "dry run" with all the front panel hardware before the front panel is affixed.

If the front panel is a Scotchcal it should be sprayed with a clear lacquer and allowed to dry before affixing. Note that the external bias socket on the rear panel must be isolated from chassis.

Special components

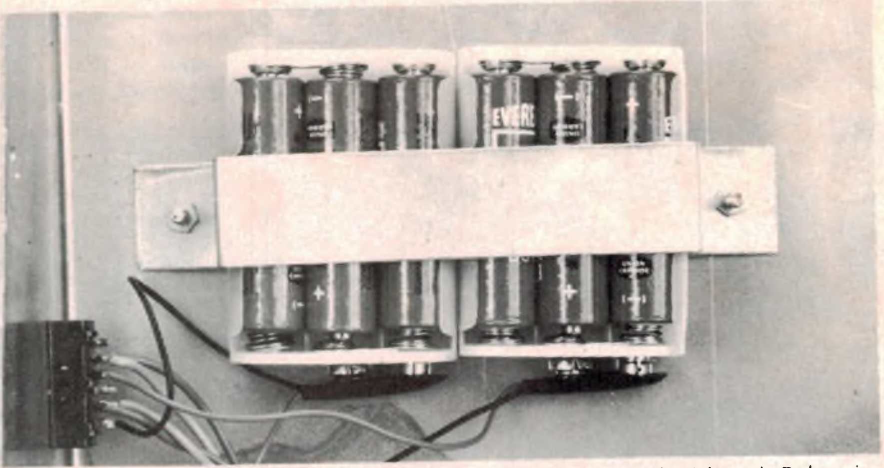
The transformer has been specially selected for its low interwinding capacitance and good frequency response. It can be purchased from Jaycar as part number MM-2001 or from Altronics as M-1105 (although the one used in our prototype had M-1100 stamped on it). At the time of writing we know of no suitable substitutes for this transformer.

Another special component is the D.Q potentiometer which is a 5kΩ + 50kΩ ganged type made by A. G. Naunton & Co Pty Ltd, Melbourne. We obtained our prototype sample from Watkin Wynne Pty Ltd, 68 Alexander St, Crows Nest, NSW 2065. The D.Q dial is intended for use with this pot so substitutes may not be suitable.

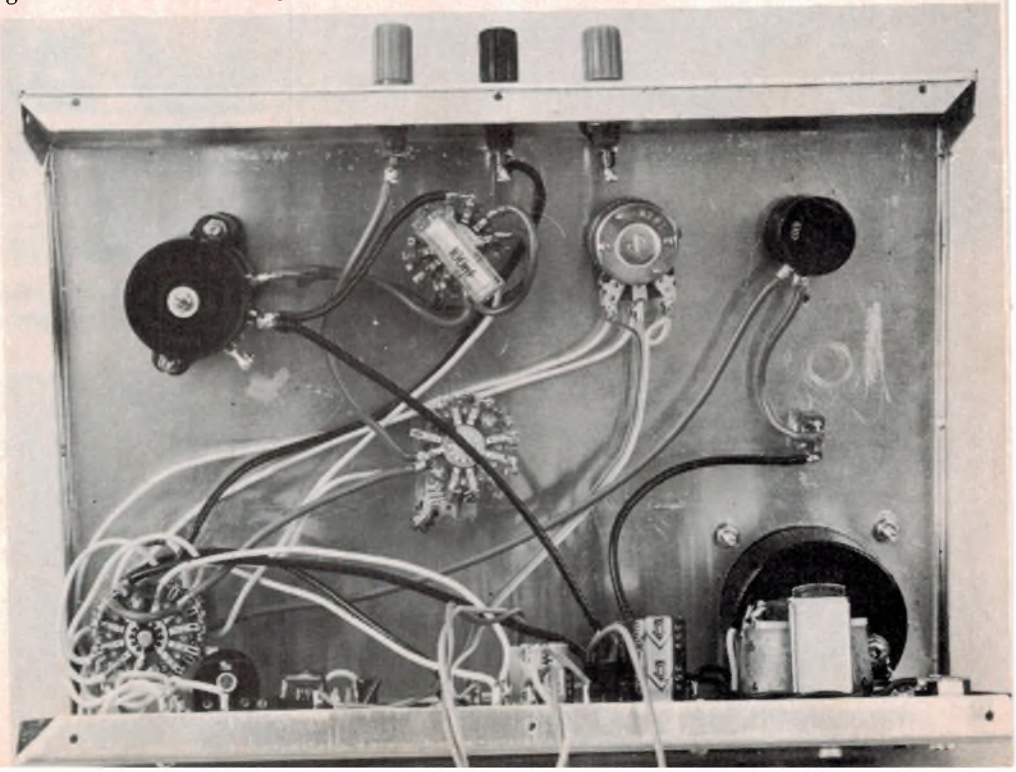
The 10-turn vernier dial is made by Copal and is distributed by Mayer Kreig & Co, 49/51 Brodie St, Rydalmere, NSW 2116.

The 10-turn pot that goes with it is a standard item with 0.25% linearity. It is made by a number of manufacturers such as Bourns.

The 0.1μF 1% standard capacitor is installed across the D.Q switch S3. The capacitor is a polystyrene. It is labelled 100nF/100V and is made by Rifa Pty Ltd. The code number on the capacitor is



An aluminium clamp is used to secure the optional battery packs (above). Below is a general view of the wiring to the front panel controls.



PFE216F. Other 0.1μF polystyrene capacitors of 1% or closer tolerance may be substituted for this unit.

The three multi-position switches, S1, S2 and S3, are made by Lorlin and distributed by C&K Electronics (Aust) Pty Ltd, 15 Cowper St, Parramatta, NSW 2150. We purchased switches for our prototype from Radio Despatch Service, 869 George St, Sydney.

Most of the wiring between the internal hardware components is centred around the multi-wafer switch S1. No matter which way you approach this job it will be tedious. Some of the wiring will have to be done with the switch out of the chassis.

Perhaps the best way to approach it would be to do all the wiring between the switch terminals first as this can be done with the switch out of the chassis. We suggest you start with the wafer closest to the front panel, S1a, and work back from there.

Ordinary hookup wire should be used for the wiring between the terminals of S1. Do not use shielded cable. All other wiring, with the exception of that to the gain control, should be run in heavy duty hook-up wire such as 24 × 0.2mm. This is to keep the resistance of the wiring between the switches as low as possible.

Note that all the multiplier resistors associated with the range multiplier switch S2 are wired on the switch itself. The 0.1Ω multiplier posed a problem. Where do you get it? We used ten 1Ω 2% resistors wired in parallel. Two multi-turn pots are wired to S2 as well.

Follow the wiring diagram and check your work against the wiring diagram and circuit, to make sure you know what you are doing.

Next month we shall complete this series on the LCR bridge by giving the calibration procedure and instructions on how to use the bridge to best advantage.

(To be continued).

PARTS LIST

1 sloping front metal case, 260 x 173 x 103mm.
1 printed circuit board, code 84b4, 151 x 64mm.
1 Scotchcal front panel to suit.
1 50μA centre zero meter, Standard ST-670 or equivalent.
1 12-pole, 4-position rotary switch, Lorlin RA style.
1 2-pole, 8-position rotary switch, Lorlin RA style.
1 2-pole, 4-position rotary switch, Lorlin RA style.
1 4W speaker transformer, Jaycar cat. No. MM-2001, Altronics cat. No. M-1105 or equivalent.
1 10-turn drive mechanism with digital readout, Copal model CD-10 (see text).
3 21mm wing knobs.
1 28mm wing knob.
1 21mm plain knob and matching 63mm clear plastic dial.
2 battery holders (six AA size batteries, optional).
2 battery clips to suit holders.
1 small strip of scrap aluminium for battery bracket, 186 x 20 x 1mm.
1 12VAC plugpack transformer, Ferguson PPB/500 (optional).
1 3.5mm stereo jackplug.
1 SPST toggle switch.
1 2-pole, 3-position slide switch.
2 3.5mm mono jackplug sockets.
1 3.5mm stereo jackplug socket.
3 binding post terminals, one red, one black, one green.
1 3m length heavy duty hook-up wire, 24 x 0.2mm.
22 PC board stakes.
4 6mm PC board spacers.
4 stick-on rubber feet.
8 sets 12mm x 1/8 inch nuts and bolts.

SEMICONDUCTORS

1 LF347 quad operational amplifier.
1 LF353 dual operational amplifier.
2 LF351 operational amplifiers.
1 LM317T positive voltage regulator.
1 LM337T negative voltage regulator.
6 1N4001 diodes.
2 1N4148 diodes.
1 5.6V 1W zener diode.

CAPACITORS

2 1000μF 25VW PC mount electrolytics.
2 1000μF 16VW PC mount electrolytics.
2 100μF 16VW PC mount electrolytics.
2 0.1μF greencaps.
1 0.1μF polystyrene, 1% or better, Rifa type PFE216F (see text).
2 .015μF greencaps.
1 .01μF greencap.
1 .0018μF greencap.
1 120pF ceramic.

RESISTORS (¼W, 5% unless stated)

2 x 1MΩ, 3 x 100kΩ, 1 x 68kΩ, 12 x 10kΩ, 2 x 1.2kΩ, 1 x 1kΩ, 1 x 470Ω, 1 x 390Ω, 2 x 180Ω, 1 x 100Ω, 1 x 68Ω, 1 x 33Ω½W, 1 x 1Ω 1% ½W, 1 x 0.1Ω 1% ½W.

RESISTORS (½W, 0.1%)

1 x 1MΩ, 1 x 100kΩ, 1 x 10kΩ, 3 x 1kΩ, 1 x 100Ω, 1 x 10Ω.

POTENTIOMETERS

2 100kΩ 10-turn trimpots.
1 100kΩ dual gang antilog taper.
1 50kΩ/5kΩ dual gang wirewound linear taper. [Manufactured by A. G. Naunton & Co., Melbourne (see text)].
1 10kΩ 10-turn, 0.25% linearity wirewound.
1 500Ω 10-turn trimpot.
1 100Ω 10-turn trimpot.
1 100Ω large vertical mount trimpot.

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VCR Sound

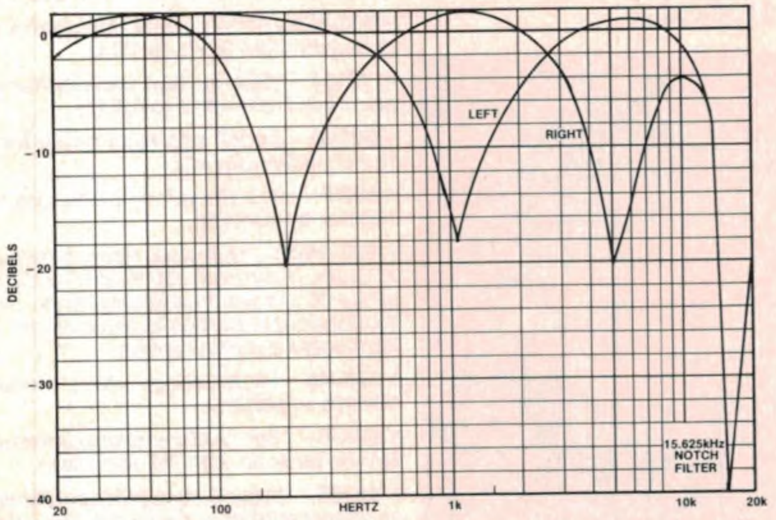
Give the sound from your VCR a lift with this new VCR Sound Processor. Main features include an effective stereo simulator circuit, a 5-band graphic equaliser, and noise filtering.

by JOHN CLARKE and GREG SWAIN

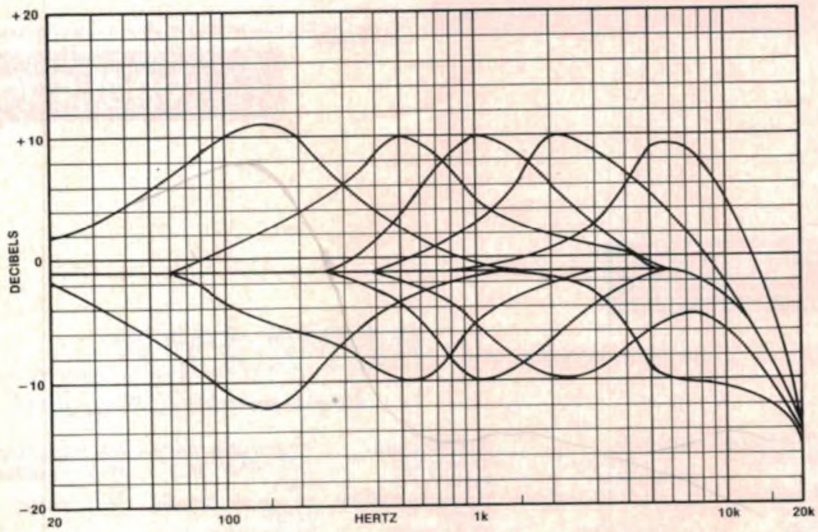
There's no denying that the sound produced by most VCRs is barely adequate for the job. By the time the sound signal is extracted from the tape, modulated along with the video signal onto a spare TV channel, and fed to a typically modest TV-set speaker, any pretence to high-fidelity has been well and truly lost.

In an effort to overcome this problem, most VCR manufacturers include an audio output socket on the rear panel. The user simply turns down the volume on the TV set and feeds the audio direct to a high-quality stereo system. Because hifi loudspeakers are used instead of the TV set's internal speaker, the improvement in sound quality is often quite dramatic.

But this approach does have drawbacks. The sound is mono only and there is usually a fair amount of good old-fashioned tape hiss to boot. On top of that, it's possible for the 15.625kHz TV line frequency to find its way into the audio chain, resulting in a low-level whistle from the tweeters. When added to the 15.625kHz "garbage" already radiated by the TV set, this whistle can be very annoying for those with keen ears.



Graph 1: left and right channel response with equaliser controls set flat.



Graph 2: frequency response curves for the 5-band graphic equaliser.

Part of the answer to improved TV sound lies with the new stereo VCRs now on the market. But while these provide an extra dimension if the soundtrack is in stereo, most current VCR tapes are only recorded in mono. In addition, they generally have a poorer signal-to-noise ratio than comparable mono VCRs since each channel occupies only half the audio track width.

It was with these thoughts in mind that we recently decided to develop an add-on sound enhancer. The result is this new VCR Sound Processor. It is designed for use with an existing stereo system and boasts a 5-band graphic equaliser, an effective stereo simulator, and in-built noise reduction circuitry.

To use the unit, all you have to do is feed the VCR audio to the input socket and connect the left and right channel outputs to the auxiliary inputs of your stereo amplifier. After that, it's just a matter of adjusting the various controls and enjoying the vastly improved sound quality. No longer will you have to put up with tape hiss or boring mono sound. And with the 5-band equaliser, you can tailor the sound to your personal tastes.

For example, the midrange controls of the equaliser can be adjusted to enhance dialogue or to reduce harshness in a particular voice. Or you can roll off the high frequency response even further if you wish, or perhaps boost the bass. The controls provide up to 10dB of boost or cut at nominal centre frequencies of 150Hz, 500Hz, 1kHz, 2kHz and 5kHz.

The in-built noise reduction circuitry consists of a fixed 10kHz low pass filter. This is effective in reducing tape hiss and other unwanted high frequency noise but has little effect on the wanted sound. Also provided is an optional 15.625kHz

Processor

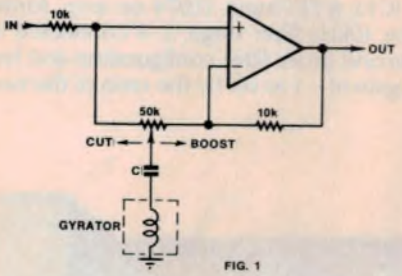


FIG. 1

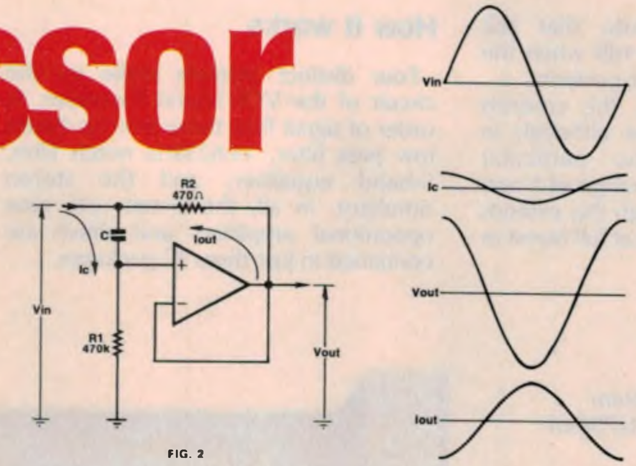
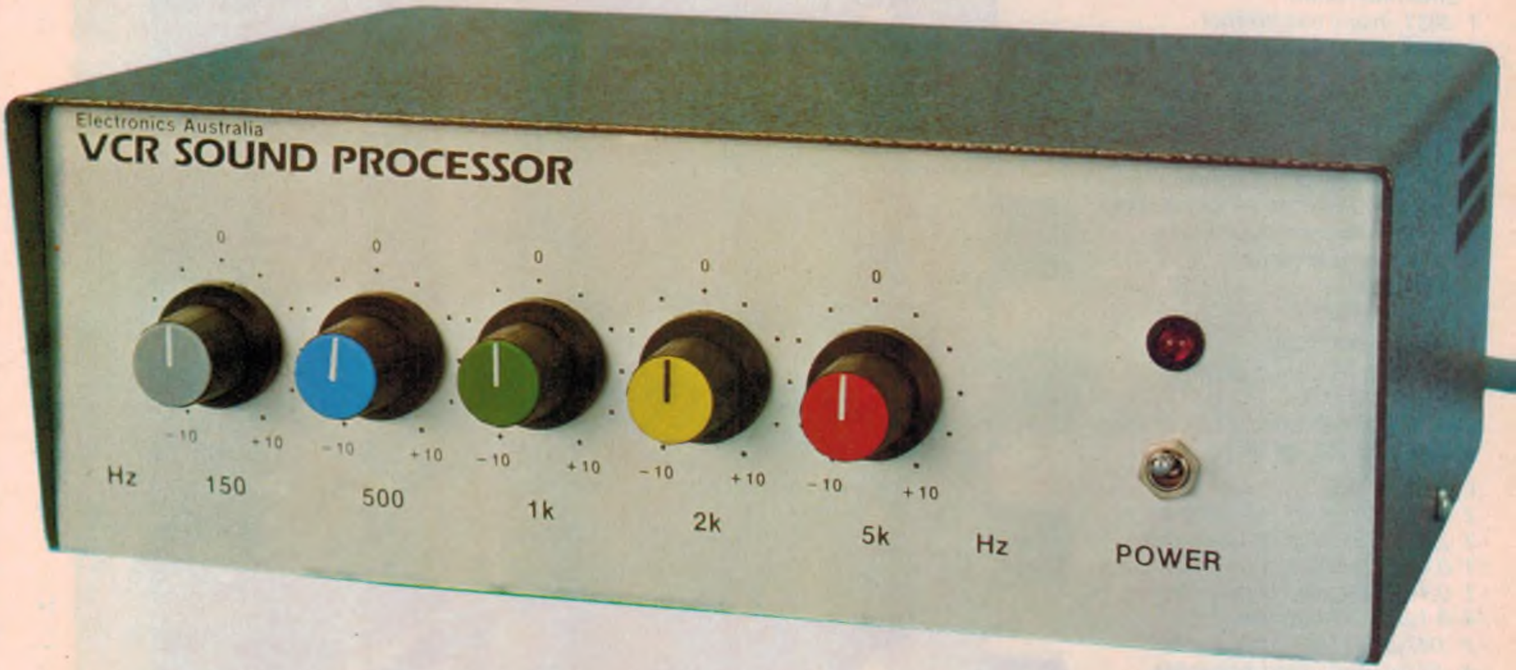


FIG. 2

We estimate that the cost of parts for this project is approximately

$57

This includes sales tax, but not the optional whistle filter circuit.



notch filter circuit which can be added if the TV line frequency proves troublesome.

Stereo simulator

One particularly attractive feature of the unit is the stereo simulator. This processes the mono signal into separate left and right channels, although it must be realised that it is incapable of producing genuine stereo. What it does do is create a certain amount of artificial separation between the left and right channels, thus diffusing the "point source".

The result is a much more interesting signal which sounds as though it could be stereo – hence the term "stereo simulator".

The way in which the simulator circuit works is both interesting and straightforward. Two twin-T filters are used to create notches in the frequency response at 200Hz and 5Hz and this filtered signal forms the right channel. The left channel then becomes the difference between the right channel and the mono input.

This is a fairly effective approach since the sum of the two outputs gives the original mono signal, yet the left and right channel signals are quite different.

Performance

No apologies need to be made for the performance of the unit. As the specification panel shows, the signal-to-noise ratio is a very good 65dB or more while the distortion is comparable with that of a good stereo amplifier, even with the equaliser controls at full boost. Maximum input signal before clipping is 4V RMS, which is more than adequate.

The accompanying graphs show the frequency response curves for various circuit stages. Graph 1 shows the left and right channel response with the equaliser controls set flat. Note that the 10kHz filter rolls off the response at 40dB/decade while the notch filter has a deep null of 40dB at 15.625kHz. Also shown are 20dB notches in the right channel response at 200Hz and 5kHz, and the complementary notch at 1kHz in the left channel.

The second graph depicts the equaliser response. For clarity this shows the response of the equaliser and 10kHz low pass filter only (the left and right channel and notch filter responses would only

VCR Sound Processor

confuse the result). Note that the equaliser has a gain of −1dB when the controls are set to the flat position.

As with all equalisers, the controls interact to some degree although in practice this is of no particular importance. The normal range of boost and cut is ±10dB, although this extends to ±12dB with all controls at full boost or cut.

How it works

Four distinct sections make up the circuit of the VCR Sound Processor. In order of signal flow these are: the 10kHz low pass filter, 15.625kHz notch filter, 5-band equaliser, and the stereo simulator. In all, the circuit uses nine operational amplifiers and these are contained in just three IC packages.

Note that both the filter and equaliser stages go before the stereo simulator. If they had been placed after the stereo simulator we would have had to double up on much of the circuitry. And that would have been expensive.

IC1a, a FET-input TL074 op amp, forms the 10kHz filter stage. It is connected in second order filter configuration and has a gain of −1 as set by the ratio of the two

PARTS LIST

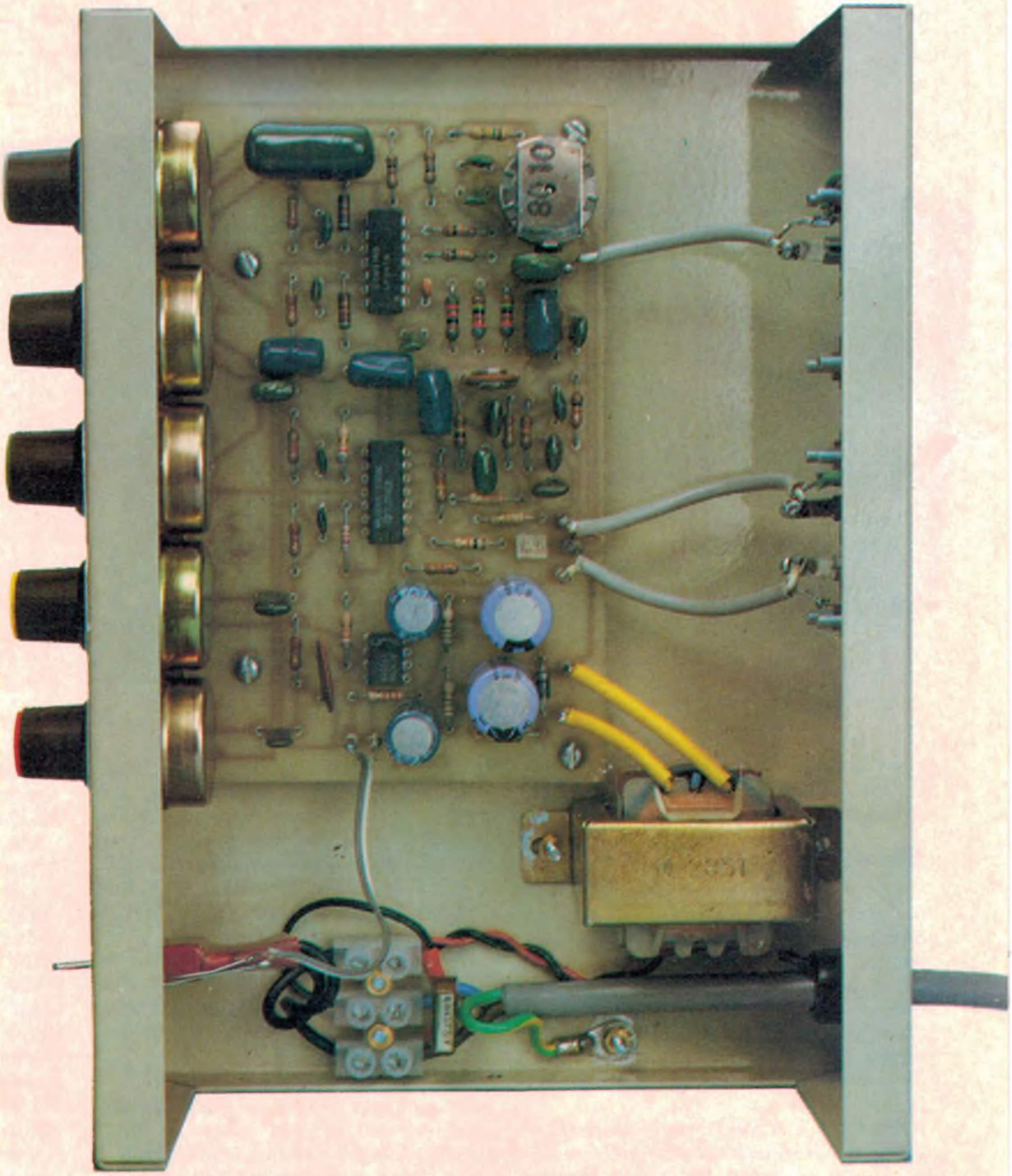
1 PCB, code 84sp3, 80x130mm
1 Scotchcal front panel, 201x79mm
1 Betacom case, E-IC2/2, 200x140x70mm
1 2851 mains transformer
1 SPDT mains switch
5 knobs
1 mains cord and plug
1 Jabel 8010 whistle filter coil (optional, see text)
1 stereo RCA socket panel
1 mono RCA insulated socket panel
1 3-way mains terminal block
1 mains cord grommet
1 earth lug
4 9mm spacers

SEMICONDUCTORS
2 1N4002 1A silicon diodes
1 5mm red LED
2 TL074, LF347 quad JFET op amps
1 TL071, LF351 op amp

CAPACITORS
2 470μF/16VW PC electrolytic
2 220μF/25VW PC electrolytic
1 0.47μF metallised polyester
1 0.12μF metallised polyester
4 0.1μF metallised polyester
2 .047μF metallised polyester
4 .022μF metallised polyester
2 .015μF metallised polyester
1 .012μF metallised polyester
1 .0068μF metallised polyester
1 .0047μF metallised polyester
1 .0047μF 250VAC polyester
3 .0022μF metallised polyester
1 .0018μF metallised polyester
1 .001μF metallised polyester
1 560pF ceramic
1 470pF ceramic

RESISTORS (¼W, 5%)
1x220kΩ, 1x150kΩ, 1x100kΩ, 5x82kΩ, 2x33kΩ, 2x22kΩ 1x15kΩ, 1x12kΩ, 2x10kΩ, 9x2.2kΩ, 2x1kΩ, 2x180Ω, 2x100Ω, 1x100kΩ large vertical trimpot, 5x47kΩ linear potentiometers.

MISCELLANEOUS
Screws, nuts, solder, shielded audio cable, hook up wire, mains wire, insulated sleeving etc.



View inside the prototype VCR Sound Processor.

22kΩ resistors. The response of this stage is 3dB down at 10kHz and the rolloff above this frequency is at the rate of 12dB per octave.

The 0.12μF capacitor at the input provides low frequency rolloff below 20Hz.

Following the 10kHz filter stage is the notch filter. This consists of an 8010 whistle filter coil connected in a bridged-T network. As used here, the bridged-T network is essentially a parallel-tuned circuit. At resonance, the parallel-tuned circuit is a very high impedance and this results in a deep null in the response at 15.625kHz.

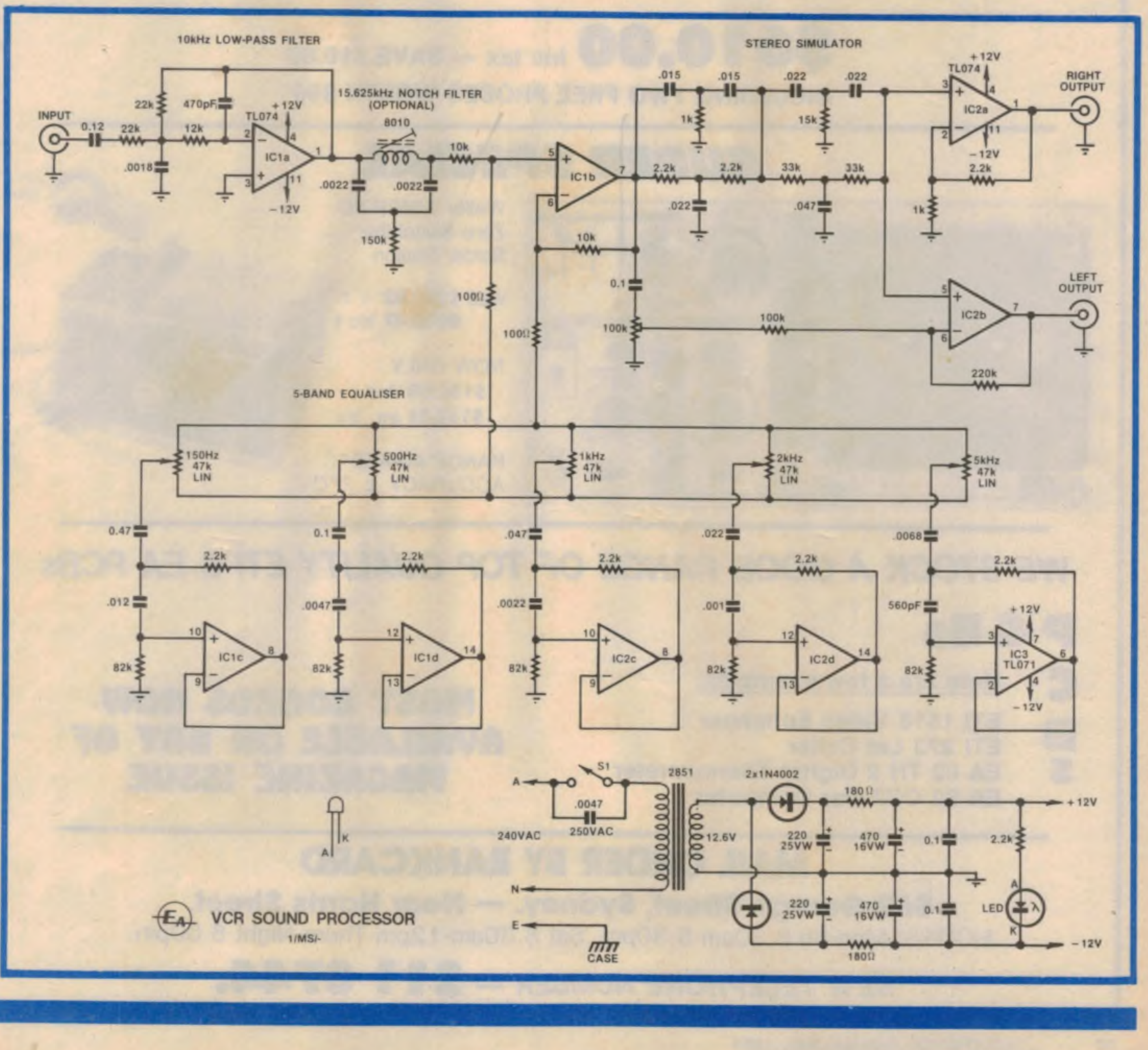
The inductor has a nominal inductance of 100mH and is adjusted to give resonance at precisely 15.625kHz by rotating the top section of the potcore. This has the effect of adjusting the air gap between the core sections, and thus adjusts the inductance. Since the null is very sharp, the adjustment is quite critical.

The output from the notch filter is fed to the non-inverting input of IC1b which, together with IC1c, IC1d, IC2c, IC2d and IC3, forms the 5-band graphic equaliser. Notice that the filter circuits IC1c-IC3 are connected in parallel between the inverting and non-inverting inputs of IC1b.

Fig. 1 illustrates the basic circuit principle. This shows an operational amplifier connected in the non-inverting mode, with negative feedback to the inverting input. The circuit is considerably simplified in that it shows only one of the five potentiometer controls.

The circuitry connected to each pot acts like a series tuned circuit, so that is how it is shown in Fig. 1. With the slider control centred, the op amp provides unity gain and the tuned LC circuit has negligible effect. When the slider pot is set to the boost end, the negative feedback signal tends to be shunted to ground by the tuned LC circuit which increases the gain at the resonant frequency. With the slider set to the cut end, the negative feedback is at a maximum and the gain is at a minimum at the resonant frequency.

But instead of using inductors the circuit employs gyrators. As used here,



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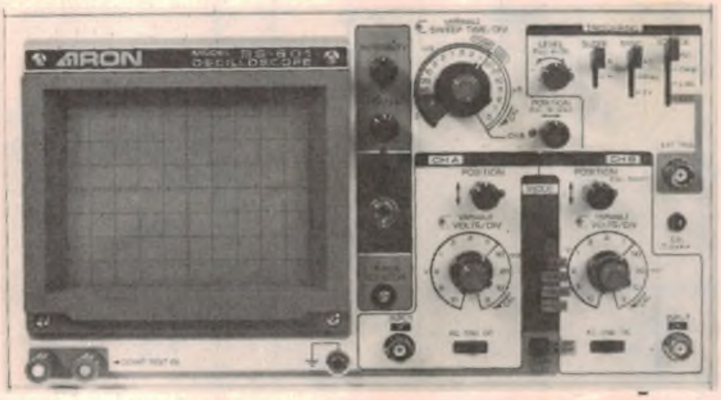

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the word "gyrator" refers to an op amp circuit which effectively transforms a capacitor into an inductor. This is illustrated in Fig. 2.

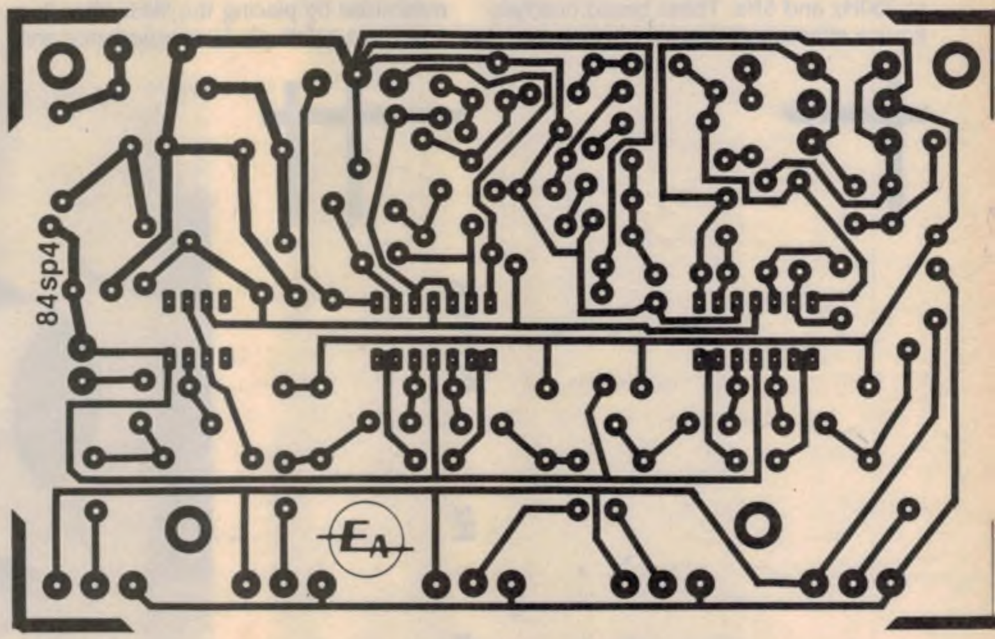
Consider an AC voltage source, Vi, connected to the op amp circuit of Fig. 2. This forces a current Ic through the capacitor, which develops a proportional voltage across R1. The voltage across R1 is reproduced at the output of the op amp. The voltage across R2 is equal to the difference between Vi and Vo and this causes current Io to flow through R2 and into the input voltage source!

An analysis of the phases of these currents and voltages will show that while Ic leads the voltage Vi, as would be expected for a capacitive circuit, the net input current, which is the vector sum of Ic and Io, actually lags the voltage Vi. So, in effect, capacitor C has been transformed into an inductor by the op amp. The inductance is given by the formula:

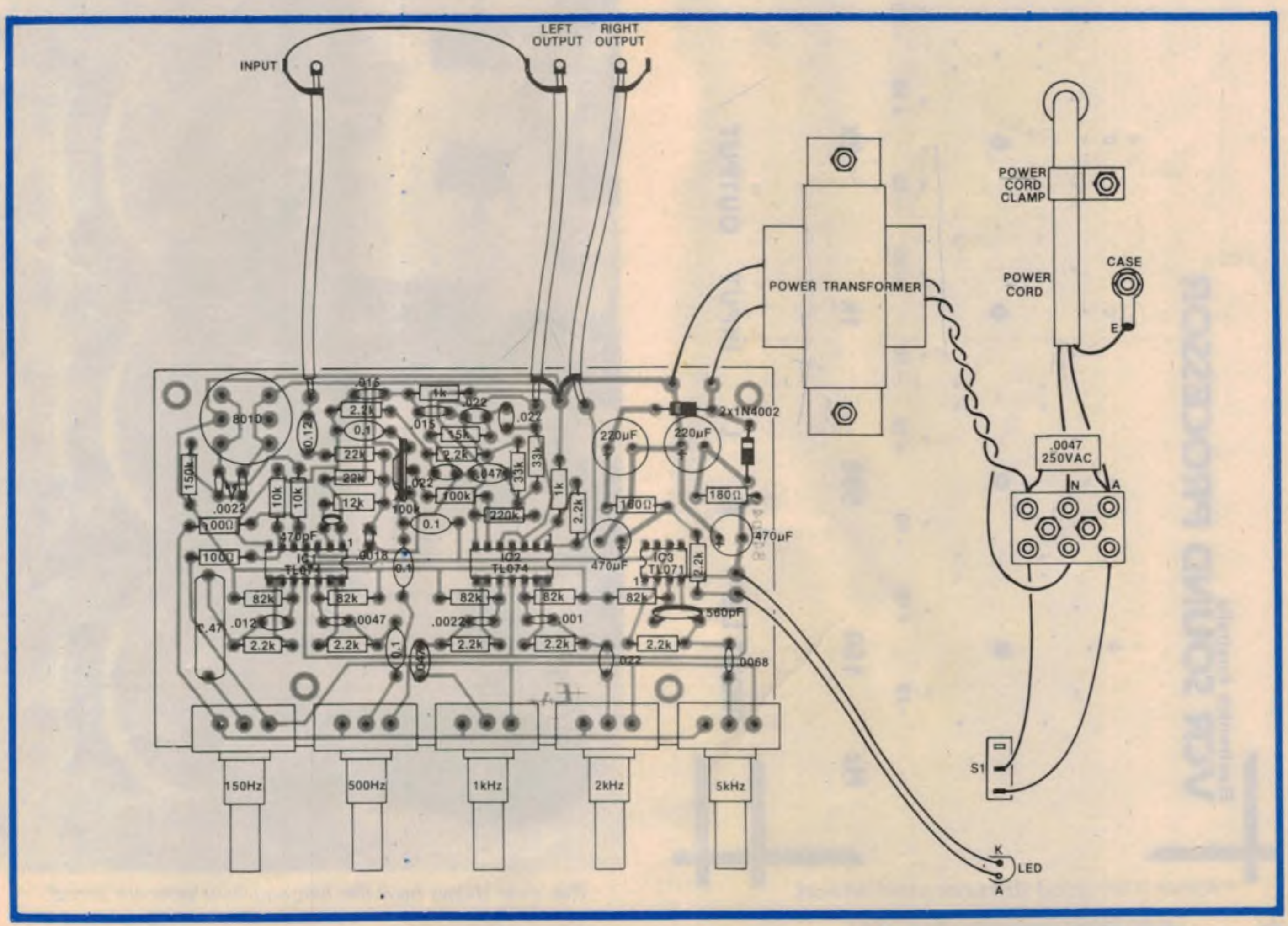
$$L = R1 \times R2 \times C$$

where C is in Farads, R is in ohms and L is in Henries.

We now come to the stereo simulator circuit which consists of op amp IC2a and IC2b and two twin-T filter networks. Twin-T filters are so named because they consist of two T sections. One section uses an R, 2C network and the other an R/2, C network. When the values are chosen precisely, the filter gives a narrow notch with almost total



Here is actual size artwork for the printed circuit board.



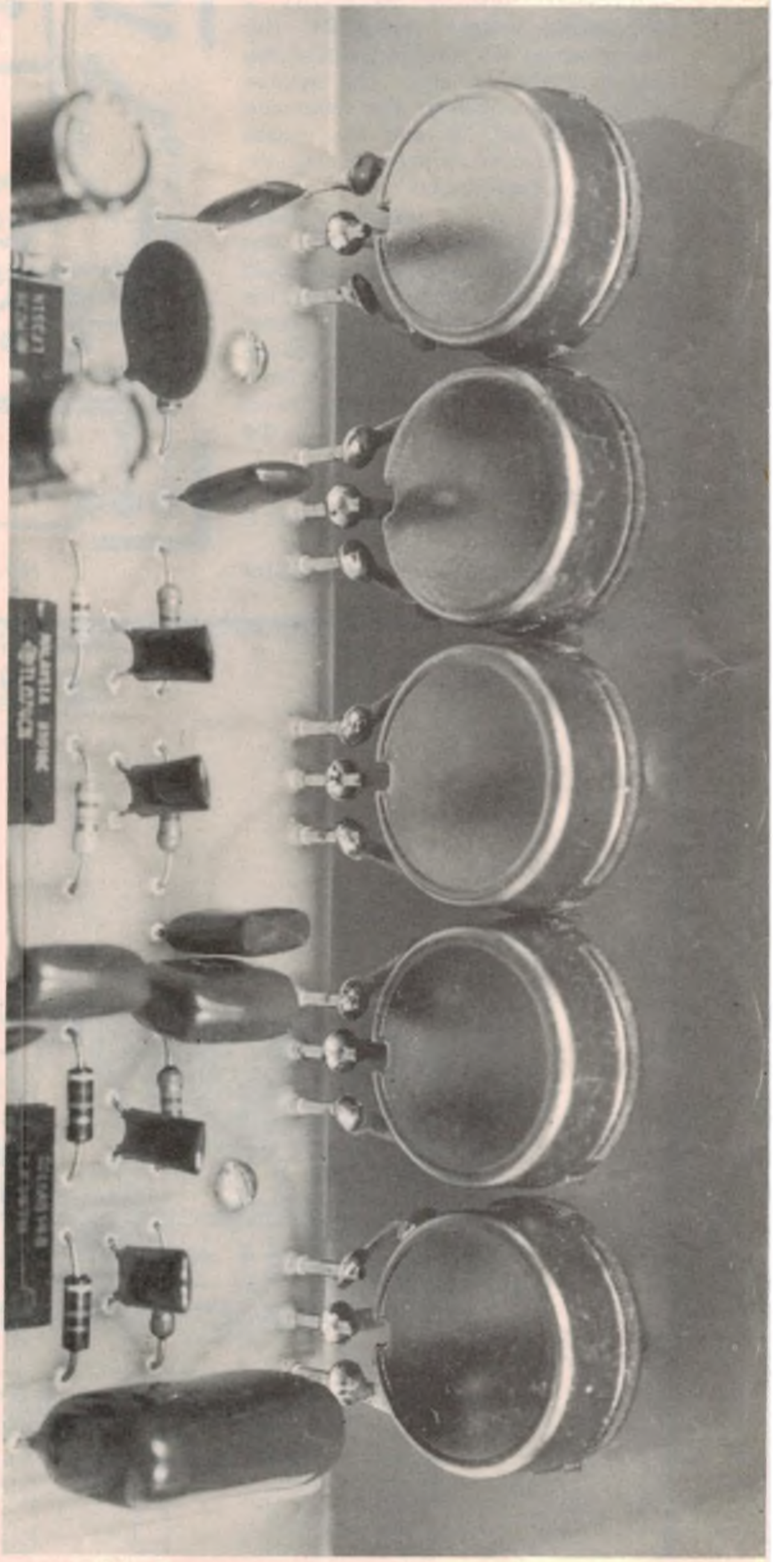
cancellation at its centre frequency.

In this circuit, however, the values used are deliberately off value and this has resulted in broad notches of about 20dB at 200Hz and 5Hz. These broad notches ensure effective stereo simulation.

The response of the filters has also been modified by interaction between the two stages since they are direct coupled. This interaction has been minimised by placing the 5kHz filter first – it has a relatively low impedance and is thus not unduly loaded by the higher impedance of the following 200Hz filter.

As we have seen, IC1b forms part of the equaliser circuitry. Its output feeds directly into the twin T filter network and also, via a 0.1μF capacitor, to one side of

Above is an actual size front panel artwork.



This view shows how the five equaliser pots are wired.

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Super quality 3mm LEDs from Stanley at clearout prices. Only in bags of 100 at this mad price.

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We now have the latest databooks form National, Motorola and Texas. Call and check our massive range

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- ★ Pushbutton Keyboard
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Very few left at this price

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Note: not Telecom Approved.

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Top quality Cherry Brand Microswitches at giveway prices. 15A/250V AC rating. Normally open contact with lever.

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Get your hands on these top quality AMP low profile IC sockets at a fraction of their normal price.

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Grab these top quality resistors. Great for power supplies, amps etc. Fraction of the normal price, while they last

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100 mixed values and types. Normally selling for 30 to 50¢ each! Grab a pack or two and save!!

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Low loss R.F. switching—allows inputs for:- VCR, video disc, antenna, cable TV, home computer and video games.

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VIDEO ENHANCER

Bargain Price **$75.00**

Detail Enhancer VP5030 is another important contribution to the world of video accessories. The lightweight Detail Enhancer has been particularly designed to rectify loss in detail derived from VCR tapes and picture impairments. With simple adjustments for more or moderate detailing, the detail enhancer can also overcome such picture impairments as loss of detail and disappearance of verticle lines.

Specifications:

1. Power requirement: 12V DC 110mA
2. Input: 1 Video (RCA connector)
3. Outputs: 3 Videos (RCA connectors)
4. Output lever: Video outputs: 1.0Vp-p, 75 Ohm unbalanced below 1Vp-p out
5. Enhance: Enhance 9dB (Reference 1.0Vp-p)
6. Signal-to-noise ratio: Greater than 50dB below 1Vp-p out

WE HAVE A GREAT RANGE OF VIDEO CONNECTORS AND CABLES FOR VIDEO TO VIDEO DUBBING.

Cables

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5 pin 180 degree dubbing adaptor—Reverse pins for video use **$6.95**

VC-14
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6 pin DIN plug to 6 pin DIN plug. Cable leng . 5m **$4.95**

VC-1
BNC plug to BNC plug Impedance-75Ohm. Cable length 1.5m **$6.50**

VC-2
BNC plug to PL259 plug Impedance-75Ohm. Cable length 1.5m **$6.75**

VC-3
PL 259 plug to PL 259 plug Impedance-75Ohm. Cable length 1.5 **$4.95**

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PL 259 plug to RCA plug Impedance-75Ohm. Cable length 1.5m **$4.95**

VC-5
RCA plug to RCA plug Impedance-75Ohm. Cable length 1.5m **$5.95**

VC-6
BNC plug to RCA plug Impedance-75Ohm. Cable length 1.5m **$5.95**

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VP-8
8 pin square video connector plug **$7.50**

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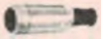
8 pin square video connector inline socket **$7.50**

VP-10
10 pin male video plug. Used in J.V.C., Panasonic, Sharp and other VHS machines **$11.50**

VS-10
10 pin female inline socket. Used in J.V.C., Panasonic, Sharp and other VHS machines **$11.50**



VP-14
14 pin male video plug. Used in Sony, Sanyo, Toshiba and other Beta machines **$16.50**

VS-14
14 pin female inline socket. Used in Sony, Sanyo, Toshiba and other Beta machines **$16.50**

VIDEO STABILIZER

VP-5010

Image stabilizer — ensures no vertical roll or blackout occurs. With slight adjustment immediately stabilises picture of pre-recorded tapes — removing the copyguard signal, which tends to upset video recorders

Power Requirement	9VDC negative earth*
Input	2 video (RCA connectors)
Output	1 video (RCA connector)
Oscillator Freq.	3590Hz
Output Level	Video out 1.0V P.P. 75 ohm unbalanced
Gain	1 (0dB)

*PP300 recommended power source

$79.50

DM726L LOW IMPEDANCE — OMNI DIRECTIONAL $11.95
DM726H HIGH IMPEDANCE — OMNI DIRECTIONAL $12.50

Impedance:	L = 500 ohm H = 20K ohms
Freq. response:	40-14KHz
Cord/Plug:	1.5 metres/6.5mm plug
Dimensions:	500 × 272mm
With on/off switch	

Errors and omissions excepted.

VIDEO HEAD CLEANERS

HC-1 V.H.S. Video head cleaner
HC-2 Beta Video head cleaner

A professional head cleaner—employs new "double sided" cleaning action—no need to "operate" on your machine. Just insert the cassette, play for 30 seconds and the job's done. Effective for 100 operations

HC-1 $17.50 HC-2 $17.50

WIRELESS MICROPHONE

Tunable	88-108MHz
Freq. Response	100-10KHz
Battery	1.5V UM3/AA
Type	Electret condenser

$11.95 THIS MONTH ONLY

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Impedance: 200 ohm
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Sensitivity: −74dB
2.5 and 3.5mm plugs

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Battery life: 600 applications
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Circuit: 4 transistor — 4 diode

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A15035	BETA	$2.75	$2.25
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D 46	2.64	1.93
D 60	2.86	2.09
D 90	3.08	2.31
D 120	5.23	3.85
AD 60	3.47	2.86
AD 90	4.29	3.30
AD 120	6.49	5.39
ADX 60	4.46	3.30
ADX 90	5.28	4.18
SA 60	4.68	3.74
SA 90	5.28	4.29
SAX 60	5.78	5.06
SAX 90	6.38	5.72
MAC 60	10.45	9.35
MAC 90	11.28	8.75
MAR 60	13.42	10.95
MAR 90	17.29	15.35

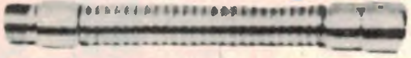
TDK VIDEO TAPES

60	12.50	11.00
120	14.00	13.00
180	15.00	14.50
240	25.00	23.50

GN15

Goose neck 5/8" male to 5/8" female 15cm long

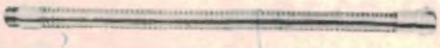
$4.95



GN33

Gooseneck 5/8" male to 5/8" female 33cm long

$6.95



48-50 A'BECKETT ST, MELBOURNE 3000 VIC PHONE (03) 347 9251

Mail Order Delivery Instructions: Minimum Pack and Post $3.00 for Australia Post. Please allow extra for bigger orders and Certified, Airmail or Registered Post. Minimum order is $5.00. Please address orders to Mail Order Department, PO Box 235, NORTHCOTE, 3070, VICTORIA. PHONE (03) 481 1436.

SPECIFICATIONS

SIGNAL-TO-NOISE RATIO
66dB (left channel); 65dB (right channel)
unweighted with respect to 100mV at 1kHz.

DISTORTION
.035% (left channel); .05% (right channel) at 1kHz and 100mV;
.03% (left channel); .04% (right channel) at 10kHz and 100mV;
.06% (right channel) at 1kHz with full equaliser boost.

MAXIMUM SIGNAL INPUT
4V RMS before clipping with maximum equaliser boost.

FREQUENCY RESPONSE (see graph).

EQUALISER
Cut and boost of ± 10dB for each band: 150Hz, 500Hz, 1kHz, 2kHz, 5kHz.

a 100kΩ trimpot. The other side of the trimpot is grounded and the signal available on its wiper used to drive the following left channel output stage.

Op amps IC2a and IC2b form the output stages. The filtered signal from the twin T network is applied to the non-inverting input in each case. IC2a applies a gain of about two to this signal which subsequently becomes available as the right channel output.

IC2b is wired as a differential amplifier and functions somewhat differently to IC2a. In this case, different signals are applied to the non-inverting and inverting inputs — the output from the twin-T filter network appears at the non-inverting input, while the signal on the inverting input is derived from the 100kΩ trimpot. The output of IC2b represents the difference between these two signals.

Thus, when the signals on pins 5 and 6 of IC2b are common (ie, have the same phase and amplitude), they are cancelled and IC2b has no output. When the signals are no longer common (as at the twin T notch frequencies), only partial (or nil) cancellation occurs depending upon the relative phase and amplitude differences between them.

Note that the gain of IC2a compensates for the "lossy" nature of the twin-T filter network, at least as far as the right channel is concerned. The 100kΩ trimpot adjusts the gain of IC2b in the left channel and functions as both a depth of stereo control and a balance control. In practice, the actual setting tends to be a compromise between these two functions.

Readers who built the stereo simulator described in our April 1983 issue will note the similarity of the present circuit to the earlier version.

Power for the circuit is derived from a 12.6V transformer, the output of which is half-wave rectified and filtered to provide ±12V supply rails. The 0.1μF capacitors across each rail improve supply line rejection while the .0047μF capacitor across switch S1 minimises switching transients. A red LED wired in series with a 2.2kΩ resistor across the supply provides power on/off indication.

Construction

Most of the parts are mounted on a printed circuit board (PCB) coded 84sp4 and measuring 80 x 130mm. Begin construction by installing the parts according to the overlay diagram, taking care to ensure correct orientation of the ICs, diodes and electrolytic capacitors. PC stakes are used to terminate all external wiring connections and these should also be installed at this stage.

You will need 23 PC stakes in all, of which 15 eventually provide direct connections to the terminals of the five equaliser control pots.

The 15.625kHz filter can be considered optional, as not all VCRs will have a problem in this regard. We suggest that you initially purchase the kit without the notch filter components and only install them later if the 15.625kHz whistle proves a problem. For the time being, the whistle filter coil should be replaced by a wire link.

The remaining notch filter components (2 x .0022μF and 1 x 150kΩ) are simply left off the board.

Once the PCB assembly has been completed, attention can be turned to the metalwork. The circuitry is housed in a Betacom metal case measuring 200 x 140 x 70cm (W x D x H) and coded E-IC2/2. A Scotchcal front panel gives the unit a professional finish.

The Betacom IC2/2 case is part of an attractive new range of cases recently made available in Australia. Of New Zealand manufacture, it features a folded aluminium base finished in beige enamel and fitted with small rubber feet. The wraparound cover has a contrasting dark brown crinkle finish and is secured to the base by two self-tapping screws.

Spray the Scotchal front panel with a hard-setting clear lacquer (eg, "Estapol"), then carefully affix it to the front panel and drill mounting holes for the front panel hardware. You will also have to drill holes in the rear panel to accept the RCA socket panels and mains cord, and in the base to accept the power transformer and other hardware items (see wiring diagram).

Note that the PCB must be positioned so that the PC stakes along the front edge of the board line up directly beneath the pot lugs. It is secured on 9mm spacers using machine screws and nuts.

All that remains now is complete the internal wiring. The mains cord passes through a grommeted hole in the rear panel and is anchored with a cord clamp. Terminate the mains active (brown) and neutral (blue) leads to the insulated terminal block and solder the earth lead (green/yellow) to a solder lug bolted to chassis.

Make sure that you scrape away the paint under the solder lug, otherwise you will not get a good chassis connection.

The wiring to switch S1 must be mains-rated. Before you actually solder the switch connections, slip a short length of heatshrink tubing over the two wires. Then, when the switch wiring is completed, the heatshrink tubing can be slipped over it to shroud the mains terminations.

Use the barrel of your soldering iron as a heat source for the heatshrink tubing.

Connections between the PCB and the RCA sockets are run using shielded audio cable, while light-duty hook-up wire is used for the LED connections. It is important that you make all connections exactly as shown in the wiring diagram, otherwise you could get a hum loop. Note that there is no connection between the circuit earth and chassis.

Testing

Testing the unit involves little more than connecting it up and trying it out. Connect the unit between your VCR and stereo amplifier, switch on and try adjusting each of the equaliser controls in turn. If you strike problems, switch off immediately and check for wiring errors.

Now adjust the 100kΩ trimpot for the best compromise between overall balance and stereo spread. A half-way setting should be about right.

Finally, check for the presence of 15.625kHz whistle. If this proves to be a problem, the whistle filter components will have to be installed and the filter adjusted for a null by rotating the top section of the coil potcore.

The Serviceman

TV reception problems on a fishing trawler

Life on a fishing trawler is no holiday for the crew, and a less than perfect environment for electronic equipment, particularly TV sets. Here is a story about one such situation, where there was definitely something fishy about the whole set-up.

My story this month concerns the problems of keeping a TV system operational in the salty, rough and tumble conditions aboard a fishing trawler. It comes from my colleague on the NSW south coast, who I have mentioned many times previously in these notes. As readers may realise, his district ranges from inland rural settings, to the coastal fishing ports. This is how he tells it.

The trawler in question is a quite reasonable size, being some 30 metres long, and is used exclusively for tuna fishing. Its home port is Ulladulla and it cruises down the coast, through Bass Strait and west to Port Lincoln in South Australia. In fact, over the period of this story it sailed as far west as Western Australia.

The boat is about three years old and has logged over 56,000 nautical miles, with some 9000 hours logged for the main diesel engine plant. It probably cost in the neighbourhood of $1.5 million when new. (And a very nice neighbourhood to be in, too!)

So that's the general background. The vessel is very well equipped with modern navigational and communications equipment, including satellite navigation, depth sounders, HF and VHF two-way radio and so on. And at creature comfort level there are two colour TV sets, one in the skipper's cabin and one in the saloon for the crew. Which, of course, is where our story starts.

The two sets are fed from the one antenna which is on top of a 20 metre mast. This feeds a masthead amplifier, the signal then passing via coax cable to a splitter in the cabin. From there, the two sets are fed via separate cables.

The antenna is a rather strange animal, and worthy of some comment. Although it appeared to be a commercial unit I had never seen anything like it before and I imagine it was probably a one-off or special of some kind. It is in the form of crossed, horizontal, folded dipoles, the dipoles being mounted on a heavy block of perspex, which also served as an insulator to terminate the active ends of the dipoles and connect them to the coax terminals.

The philosophy behind the design appeared to be to produce what is virtually an omnidirectional TV antenna; which is almost a contradiction in terms at first glance. However, it is not as silly as it sounds. Because of the constantly varying direction in which the boat points, relative to the TV station, a directional antenna could be worse than useless.

On the other hand, the directional characteristic is far less important at sea, where there are few objects, apart perhaps for a passing supertanker now and then, to create ghosts. Granted, some ghost may still be created by land based objects, but it is doubtful whether many of these could be eliminated by a directional antenna, even assuming it could be kept correctly orientated.

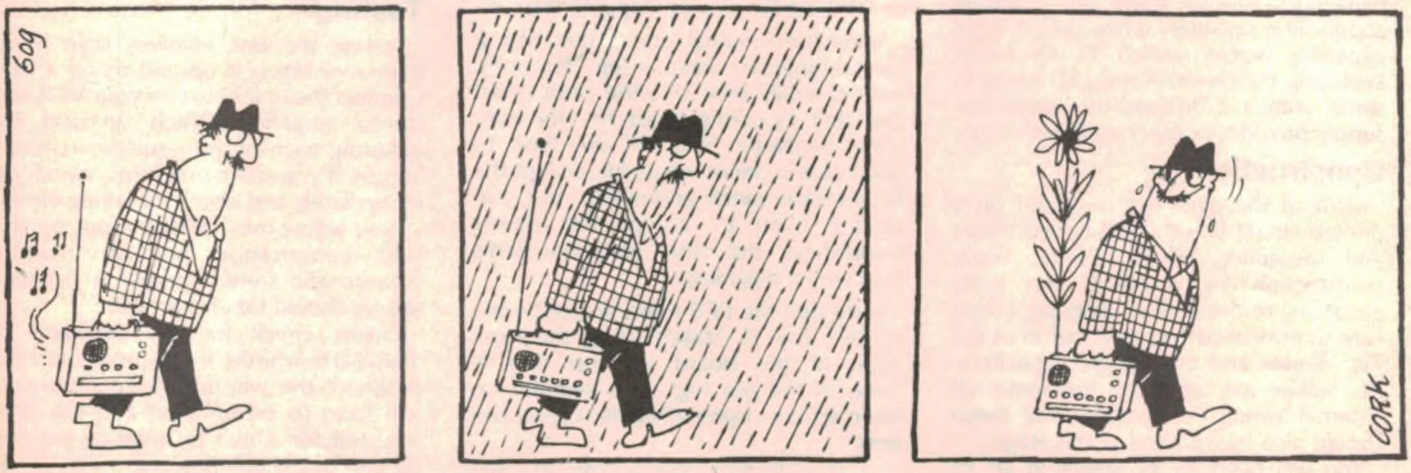
Naturally, the gain of such an antenna would not be high and I imagine that this was the reason for the masthead amplifier, particularly as it had to feed two sets.

TUNA BUT NO PICTURE

My first encounter with the system was some two years previously, about a year after the boat had been commissioned, when the skipper called me in because, as he put it, "the TV reception's a bit crook". That was the understatement of the year – hopeless would have been a more appropriate term.

In fact, one could say that they couldn't "tuna" it in properly, but I wouldn't stoop so low.

After a few preliminary checks, suspicion fell on the antenna and I found . . .



myself climbing up the ratlines to a small platform below the antenna, then shinning up the remaining distance to the antenna and, not without some acrobatics, finally managing to unbolt it and lower it to the deck. (Ever since the days of long wire radio antennas, strung up gum trees, antenna installation has been an occupational hazard. Serviceman.)

One glance at it on the deck was enough. It was a hopeless mass of corrosion around the support screws and terminals and was clearly a job for the work bench. In fact, I finished up virtually rebuilding it, at least around the perspex block. The effect of the salt atmosphere had been aggravated by the presence of three different metals: the aluminium elements, steel self-tapping screws, and the copper feeder wire.

Granted, the makers had avoided a direct copper/aluminium contact, but there was still enough galvanic action beween those metals in contact to create havoc in such an environment. At the same time, I couldn't think of any other practical combination which would avoid the problem.

I finished up adopting a different approach. For some time prior to this I had been experimenting with a commercial product designed to minimise this very problem, and which is serious enough in any seaside suburb to cause a few headaches. The product is "Alminox" electrical jointing compound which, according to the literature, is designed, among other things, to "... simplify aluminium to copper connections".

Up until that time I had not been using the material long enough to form any firm opinion about it. The best I could say was that I had not found anything to disprove the maker's claims. So I thought this might be a good chance to give it the ultimate test. Besides I had to make some attempt to solve the problem.

So I applied a liberal coating of the substance over all the critical points, took it back to the trawler, repeated my death defying act up the mast, and finally fitted everything back together. The result was completely satisfactory, with good pictures in both the skipper's cabin and the saloon. Everybody was happy.

And that was the last I saw of the system until a few weeks ago, near enough to a two-year period. From what I subsequently pieced together it appears that the system worked perfectly for about 12 months after I overhauled it, which included a trip to South Australia and back.

On the next trip, which ultimately took the ship to Western Australia, the system failed not long after leaving port. So when the ship put into the next port, which was well down the NSW coast, the skipper called in the local TV serviceman to have a look at it.

His immediate reaction was to condemn the antenna out of hand (presumably because he had never seen one like it before) and to disconnect it – but leave it in place – and fit a conventional TV antenna. Apparently this performed well enough while the ship was in port and the antenna was pointing to the local stations, but became hopelessly inadequate when it was at sea.

But over and above that the crew complained that, even on the few occasions when a reasonable signal was available, the picture on the saloon set was not as good as the picture on the skipper's set. As a result, another serviceman was called in, this time when the ship was at Port Lincoln in South Australia.

Following its return to home port, after some 10 months at sea, the ship was treated to a major overhaul; everything from the diesel engine to the outside of the hull and from the navigation and radio systems to the winches was given a birthday. And, of course, the TV system, which was where I was called in again.

PATHETIC PERFORMANCE

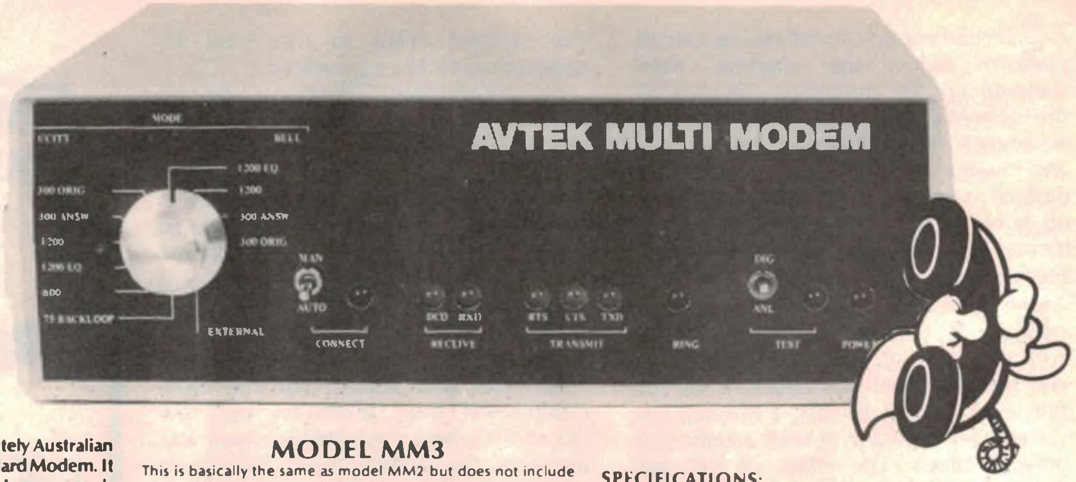
The only word for its performance at this stage was pathetic; it was virtually unwatchable. This wasn't surprising considering the substitute antenna, and the direction in which it happened to be pointing, but I still feared that the rejection of the original antenna might have been justified; after all, the protective coating could well have broken down after 12 months, allowing corrosion to again take over.

So the first thing was to get the antenna down and onto the bench. (More death defying activities!) But when I did get it on the bench and tackled the coating I was in for quite a shock, albeit a pleasant one. The coating was still intact, with a hard skin or crust on the outside. And when I scraped this away I found that all the metal under it was in absolutely immaculate condition, not the tiniest spot of corrosion anywhere.

And that, I consider, is the toughest test this material is ever likely to encounter; two years at sea in every kind of weather, with every indication that it would be good for another two years or even longer. I will have more to say about this material at a later date.

So, back went the antenna to the top of the mast and I checked the system out again. Results were a good deal better, at least in the skipper's cabin, though I was not completely happy. On the other hand, I had to make some allowance for the ship's present location and my own recollection of the previous performance.

AVTEK MULTI MODEM



The AVTEK MULTI MODEM is a completely Australian Designed and Manufactured Multi Standard Modem. It has been designed to meet current Telecom specifications (approval pending) and will be available in 4 different styles.

KIT FORM

This is for the hobbyist and is not approved for connection to Telecom lines. It is ideal for private line use and for the Amateur Radio operators for Packet Radio (See review Electronics Australia January 1984). Complete kit to the last nut and bolt including pre-punched and silk screened front and back panels.

ONLY

$249.00

(This price will increase to $249 shortly)

MODEL MM2

This is a completely assembled and tested unit with a telephone hard wired into the Modem. It can be plugged legally into any phone socket to replace your standard phone.

INTRODUCTORY PRICE

$329.00

MODEL MM3

This is basically the same as model MM2 but does not include the telephone but comes fitted with a data Telecom plug which means a dedicated socket must be installed by Telecom.

CONTACT AVTEK FOR PRICE

MODEL MM4

This unit is basically the same as model MM3 but does not have externally selectable Baud rate. The mode of operation is factory set. This is ideal for dedicated dial-up lines. This model also has hardware Auto Answer included.

CONTACT AVTEK FOR PRICE

NOTE: Models MM2, MM3 and MM4 will not be available until Telecom approval has been obtained.

COMING SOON
MINI MODEM

Possibly the smallest Telecom approved (pending) Mode the Australian market - includes phone. 300 Baud CCITT ans or originate (switchable), plugs into standard telephone socket and replaces standard phone. So small it can be mounted on your skirting board near phone socket.

SPECIFICATIONS:

☐ 300 Baud CCITT answer or originate
☐ Power 12V AC plug pack supplied
☐ Includes telephone with last number re-dial.

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But before I had much time to dwell on this problem, my attention was drawn, for the first time, to the claim that the saloon set was still quite bad. (Both sets were the same, incidently; Rank Arena 34cm models about three years old.) One glance was enough — there was no red in the picture. I pulled it out and took it back to the shop.

The RGB output transistors in this set are fed from an LSI chip, and this was my first suspect. Since I had one on hand, and they are plugged into a socket, it took only a few moments to check this. This made no difference and I eventually traced the trouble to a shorted diode in the red drive line from the chip to the output transistor. Replacing that restored the red.

WASTED EFFORT

At this stage I discovered a docket tucked away in the cabinet, put there by the servicman in South Australia. It indicated that he had also replaced the chip but, according to the skipper, the set was no different when it was returned. So much for that effort.

So I put the set back in the saloon, checked it out, and was still none too happy about it, or the skipper's. By now most of the overhaul had been completed and the ship was due to be taken out for a few days of local fishing and a shakedown cruise. So I suggested to the skipper that he try it out at sea and let me know how it performed.

A few days later the ship was back in port and I went down to see the skipper. In answer to my question he summed it all up with one brief comment, "It aint much good". Well, I couldn't argue with that. Then he went on to say that the set in the saloon was still not as good as his.

I went back to the system and took another long critical look at the pictures. I had to agree that the saloon picture was inferior to the cabin picture, though I wasn't sure why. More importantly, with the ship now moored a little distance away from its previous location, there was no doubt that the whole performance was very poor indeed. Apparently it was just getting by in the previous location.

So, what about the masthead amplifier? My first intention was to check the power pack feeding the masthead amplifier, just to confirm that it was applying the usual 22 odd volts to the coax and then to the amplifier at the top of the mast. But as I took a closer look at the power pack, and before I had made any measurements, I noticed a piece of black insulation tape wrapped around the coax where it was terminated at the power pack.

Closer inspection showed that the coax braid was terminated under a saddle clamp which completed the circuit to the earthy side of the power pack, but that someone had added the insulation tape in such a way that this connection was now open. Why, I had no idea, but the obvious thing to do was to restore the circuit and see what happened.

The result was quite dramatic — no picture at all! Well, at least that explained why someone had added the tape, but posed as many new questions as it answered. A meter across the power pack terminals, with the coax still connected, showed virtually no voltage but when I disconnected the coax I had about 25V.

Measuring across the open coax showed a dead short. I went over the coax and established that, at least from deck level, there were no joins. So it was up the mast again, with the meter and other gear tucked inside the shirt. Having confirmed that there were no joins in this part of the cable either, I concluded that there must be a short in the amplifier itself.

SOMETHING'S FISHY

I had left the coax connected to the power pack so I expected to find the full voltage across the coax as soon as I pulled it off the amplifier. But no, there wasn't even a suggestion of voltage at this end of the coax. Muttering the appropriate words, I climbed back down the mast again and disconnected the coax from the power pack. A check with the ohmmeter revealed the fault — a dead short in the coax!

But where? And why? At this point the skipper volunteered another piece of information. The coax was relatively new, having been replaced in another port only about 12 months previously. Just why the previous coax had failed, or whether it really had failed, will probably remain a mystery.

More importantly, why had this coax developed a short. It took some time to find but I did find it eventually. The coax was run along a stanchion to where it joined the mast and shared this support with several other cables. The whole lot was held in place with cable ties and someone had reefed one of these ties so tight that it had crushed the cable. I imagine the heat of the sun had done the rest by allowing the plastic to flow and create the short.

NEW COAX

The answer was obvious, if somewhat expensive; a new run of coax from top to bottom. But the result was worth it. We now had a beautiful picture in the skipper's cabin. Everything was working as it should. Not so in the saloon though. There was still something wrong with this picture, though I couldn't work out what it was for a few moments.

Then it struck me. I turned the colour control down and there it was; gross impurity. I fetched the degauss coil from the waggon and set to work. But not on the set itself, which turned out to have very little purity error. The real culprit was the steel framework surrounding the set which, for obvious reasons, was securely bolted to it.

I degaussed the framework for a metre or so around the set and this virtually cured the trouble, although I gave the set itself a once over to make sure. And that was the final operation to put the system back the way it was originally. But what a chapter of accidents and general incompetence.

So the skipper finally gave his approval, though he did have one qualification. He reckons the set in the saloon is now giving a better picture than the one in his cabin. So you can't win. But I think I detected a twinkle in his eye when he said it.

Li'l Pokey

An electronic poker machine

Here's a great little project from Dick Smith's latest publication "Funway Into Electronics, Volume 3". It's a one-pushbutton bandit that definitely won't break the bank.

by GREG SWAIN

Unlike its big brothers, Li'l Pokey is an all electronic poker machine. It has a pushbutton switch instead of a handle, 7-segment LED readouts, optional sound effects, and four LEDs to indicate the various winning combinations. The user simply presses the pushbutton switch and watches as the displays "click" over before slowing down to stop on a number between 00 and 99.

Best of all, you don't need any money to play Li'l Pokey and you can play in the comfort of your own home. On the other hand, Li'l Pokey is a real miser if you happen to pull a winning combination. It pays exactly nothing.

Never mind – you can always make up your own house rules.

There are several different winning combinations as indicated by the accompanying table. The machine "pays" two if both digits are even; five if the digits are equal; and 10 if the digits are even and equal. The jackpot number is 88. It pays 50 and the 7-segment displays flash on and off to emphasise the win.

How it works

Li'l Pokey is essentially a 00-99 random number generator with decoding and display circuitry added to register the win states. The basic circuit operation is quite straightforward. IC4 is a voltage controlled oscillator and clocks two 4518 decade counters (IC3) whenever switch SW1 is pressed. The outputs of the decade counters then drive two BCD to 7-segment decoders (IC1 and IC2) which, in turn, drive two LT313 7-segment LED displays.

The way in which the voltage controlled oscillator works is interesting. It is based on a 555 timer IC (IC4) configured in what is basically an astable mode but for one variation. In a conventional astable circuit, resistor R15 would be connected directly between pin 7 and the positive supply rail. In this circuit, however, it is connected to one side of pushbutton switch SW1.

When SW1 is pressed, C2 charges to the full supply voltage and the circuit behaves as a conventional astable oscillator. When SW1 is subsequently released, C2 begins to discharge through R15 into the discharge, threshold and trigger inputs (pins 7, 6 and 2 respectively) of the 555. As the voltage across C2 decreases, the charging current through R15 into timing capacitor C3 also decreases and so the charging period increases.

Thus, as C2 discharges, the clock frequency gradually slows until a point is reached where the 555 timer stops. This happens when the voltage on the threshold sensing input, pin 6, can no longer reach two thirds of the supply voltage. The output of the 555 appears at pin 3 and is directly coupled to the clock input (pin 9) of the "units" counter (IC3).

The output of the 555 is also used to drive an optional piezo transducer to simulate (very roughly) the rolling noise of the machine cylinders.

Win decoding

IC5, IC6 and IC7 decode the outputs of the 4518 counters and drive LED indicators to register the various win states. Quad exclusive-OR gate IC5 and OR gates IC7a, b and c decode an equal state when the contents of the counters are the same, the output of IC7c going low. This state is buffered by inverter IC8a and registered by the green LED, LD1.

Thus, when both digits are equal, LD1 lights to indicate a payout of "5".

Gate IC6a of a quad 2-input 4001 NOR package decodes the least significant bit of each counter's BCD output to register an even number. It works like this. When both numbers are even the least significant bit of each counter will be 0 and the output of IC6a will go high. This state is then inverted by IC8c to drive LD3 to indicate a payout of "2".

Li'l Pokey – in full regalia!

Similarly, OR gate IC7d uses the decoded equal signal at IC7c together with the even signal, via inverter IC6b, to register an equal and even state (payout "10") at red LED LD2.

The jackpot number, 88, is decoded in a roundabout way by monitoring the most significant bit of the "tens" counter BCD output code and the even and equal states. If the most significant bit is a "1" (ie, pin 6 of IC3 is high), then the decimal number for the "tens" decade must be either 8 or 9. If, at the same time, the decoder determines that the even and equal condition is true, then the "tens" digit must be 8 and the number must be 88.

Thus, by monitoring pin 6 of IC3 and pin 4 of IC7d, and decoding these outputs with IC6c and IC6d, we can determine when the jackpot number is displayed. The output of IC6d drives inverter IC8d and LED LD4 to indicate the jackpot payout (50).

A simple circuit consisting of inverters IC8e and IC8f is used to emphasise the jackpot win (well, it would be rather boring if only the LED lit up). Essentially, IC8e and IC8f form a low-frequency astable oscillator which is enabled/disabled by control signals applied via diode D1. Normally, the output of IC6d is low, D1 is forward

Fun Way Into Electronics, Volume 3

"Fun Way Into Electronics, Volume 3" is the latest in Dick Smith's successful Fun Way series. It details 10 easy-to-build electronic projects, all based on integrated circuits and all battery powered. Included are a mini sound synthesiser, a mini colour organ, a combination time lock switch, a night cricket, a two up game and a stereo amplifier.

The Li'l Pokey project described here is typical, although readers should note that we've rewritten the text to suit the "Electronics Australia" style. The style of the book is somewhat different, with constructional information set out in step-by-step fashion. Front panel artworks for seven of the 10 projects are printed separately at the back of the book.

In addition to the 10 constructional projects, the book contains quite a lot of useful information on project building. There are chapters on soldering, using a multimeter, component identification and marking codes, reading circuit diagrams, and useful assembly hints and tips. The book could thus serve as an ideal introduction to electronics for the beginner.

"Funway Into Electronics, Volume 3" is available for $6.95 from your nearest Dick Smith store where, incidentally, you can also buy kits for the projects it describes.

biased, and the oscillator is disabled.

When a decoded "88" appears, the output of IC6d goes high and reverse biases D1. This enables the oscillator since pin 7 of IC8f is no longer tied low. So the oscillator formed by IC8e and IC8f only runs when a jackpot is pulled.

As can be seen, the output of the oscillator is connected to the 4511 display driver blanking inputs. This causes the 7-segment displays to flash on and off at the oscillator frequency to emphasise the exciting fact that you've got a jackpot. Cunning, eh?

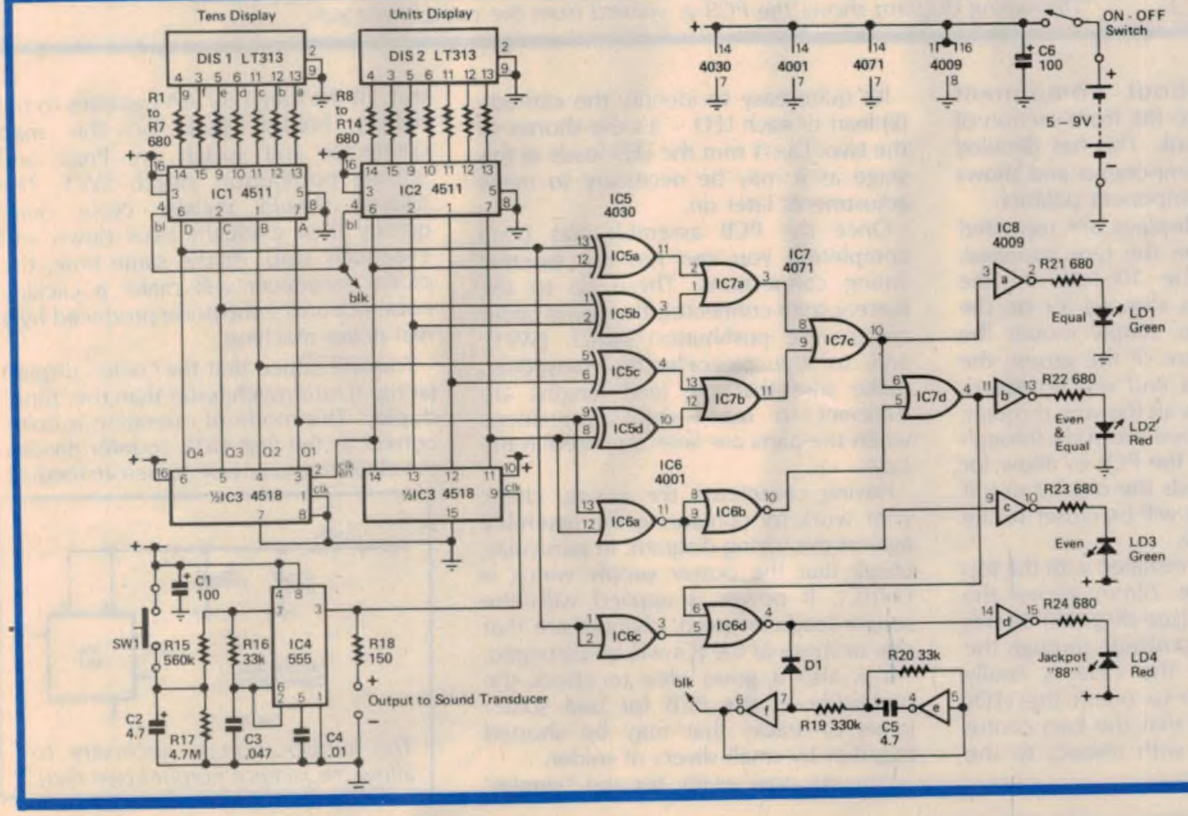
Power for the circuit is derived from four 1.5V AA cells, giving a supply rail of 6V. A 100μF electrolytic capacitor is used to decouple the supply rail.

Construction

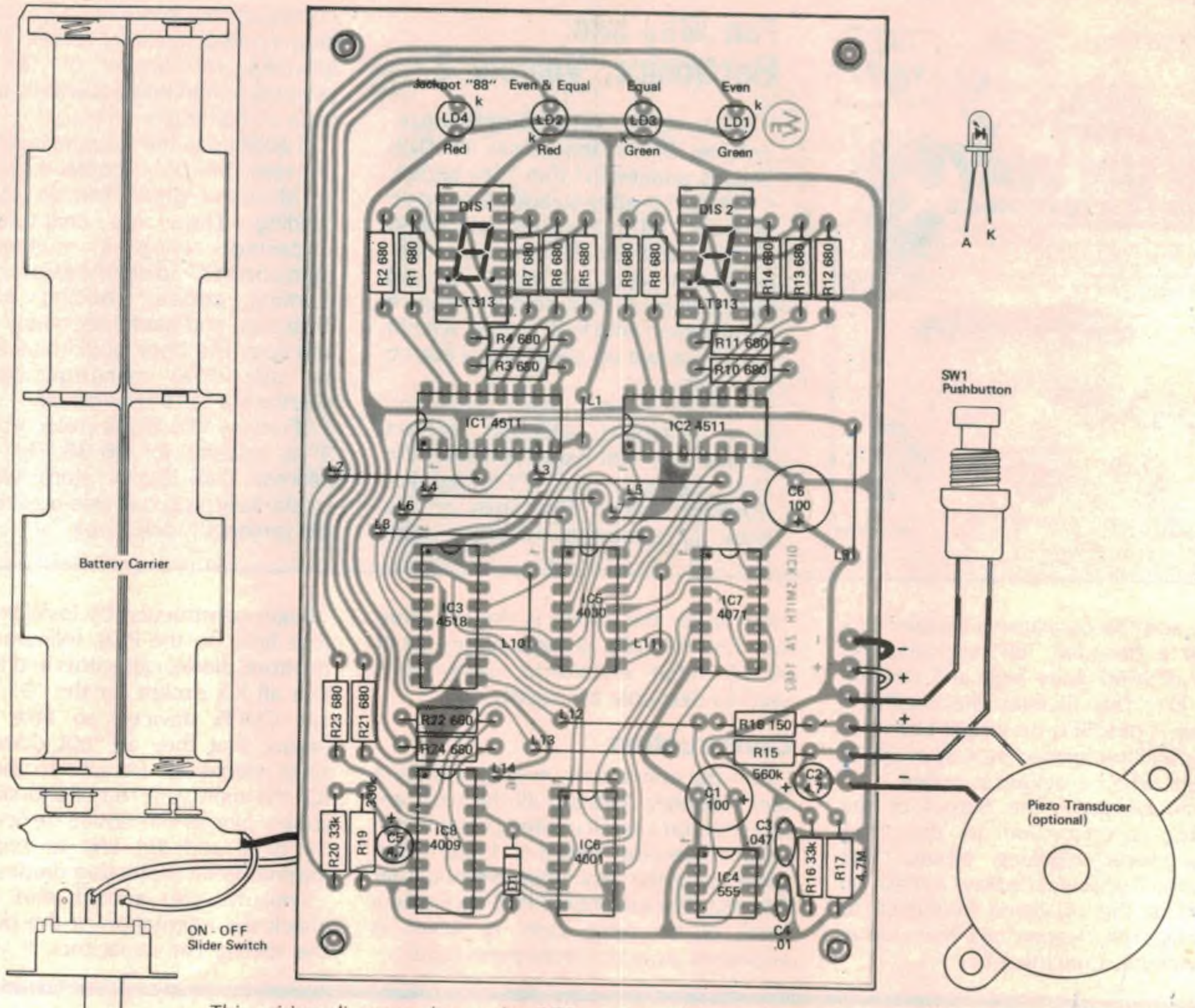
Construction is easy, even if you are a rank beginner. Virtually all the parts are mounted on a small printed circuit board (PCB) measuring 78mm x 132mm and coded with the Dick Smith type number ZA1462. The assembled PCB fits inside a small plastic zippy case, to which is added an attractive front-panel label.

Begin construction by installing the 14 wire links on the PCB, followed by the resistors, diode, capacitors and ICs. Note that all ICs except for the 555 timer IC are CMOS devices, so take care to ensure that they are not damaged by static electricity. Be sure to mount the ICs the right way round and solder the supply pins of the CMOS devices (7 and 14 or 8 and 16) first to enable the internal static protection diodes.

Similarly, you should also carefully check the orientation of the diode and the electrolytic capacitors. If you have



Circuit diagram for Li'l Pokey. IC1-IC4 form a 00-99 random number generator, while IC5, 6 and 7 decode the win states.



This wiring diagram shows the PCB as viewed from the component side.

any doubts about component orientation, refer to the front section of the "Fun Way" book. This has detailed drawings of the components and shows how to identify component polarity.

The 7-segment displays are mounted next. Depending on the type supplied, there may only be 10 legs on the package, not 14 as allowed for on the board. In this case, simply mount the display in the centre of the group; the two holes at each end are not used. Don't push the pins all the way through; only about 1mm need protrude through the copper side of the PCB to allow for soldering. This stands the display up off the board so that it will be closer to the front panel window.

The four LEDs are installed with the top of each LED some 22mm above the surface of the PCB (see diagram). In this way, the LEDs will protrude through the front panel when the case is finally assembled. Be sure to orient the LEDs correctly and note that the two centre LEDs are reversed with respect to the outer two.

It's quite easy to identify the cathode (k) lead of each LED – it's the shorter of the two. Don't trim the LED leads at this stage as it may be necessary to make adjustments later on.

Once the PCB assembly has been completed, you can run the external wiring connections. These go to the battery snap connector, the on/off slider switch, the pushbutton switch (SW1), and to the piezoelectric transducer. Make sure that the lead lengths are sufficient to reach their destinations when the parts are later mounted in the case.

Having completed the wiring, check your work by comparing the assembly against the wiring diagram. In particular, check that the power supply wiring is correct. If power is applied with the supply leads reversed, chances are that one or more of the ICs will be damaged.

It is also a good idea to check the underside of the PCB for bad solder joints or tracks that may be shorted together by small slivers of solder.

You are now ready for the "smoke" test. Fit the four 1.5V AA batteries to the battery holder, push on the snap connector and switch on. Press and release pushbutton switch SW1. The display should initially cycle quite quickly then gradually slow down and eventually stop. At the same time, the piezo transducer will make a clicking noise not unlike the noise produced by a real poker machine.

You will notice that the "units" display (at right) runs much faster than the "tens" display. This mode of operation is quite correct as the first 4518 counter divides the clock frequency by 10 before feeding

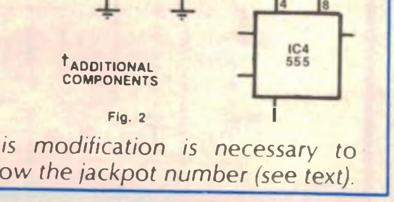
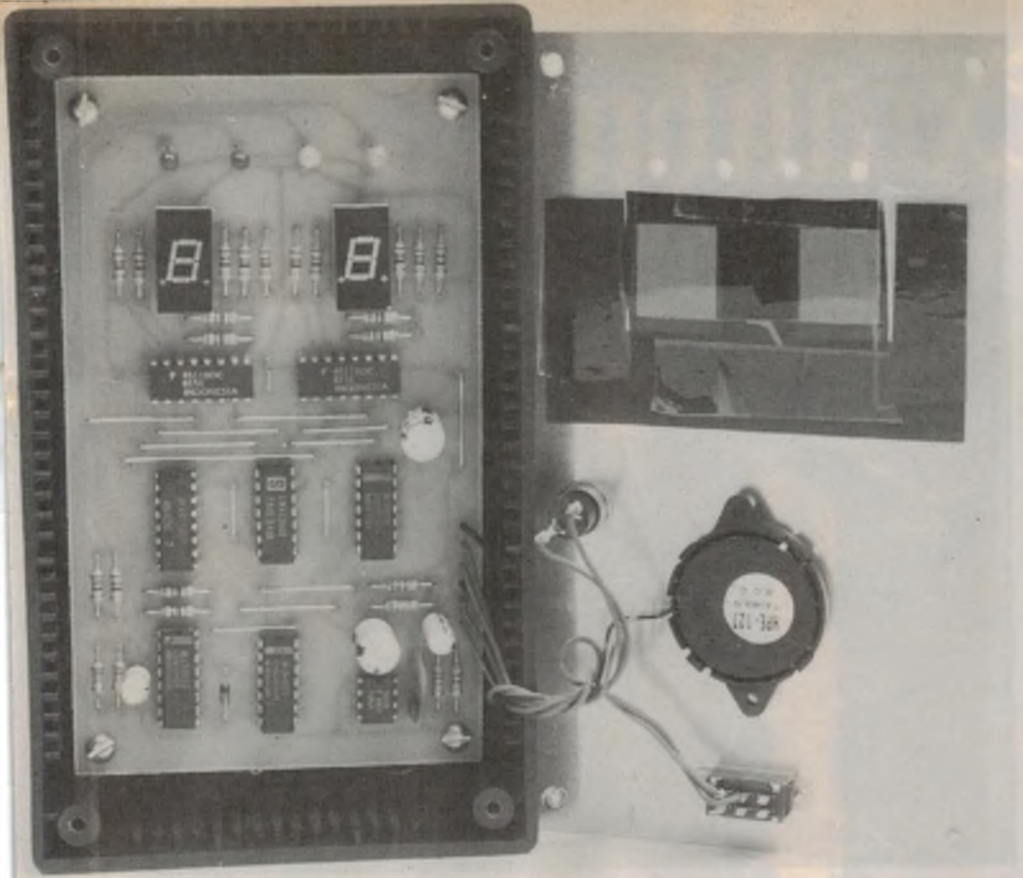


Fig. 2

This modification is necessary to allow the jackpot number (see text).



View inside the prototype. Note filter material over display cutouts.

PARTS LIST

1 PCB, code ZA-1462
1 4 x AA battery carrier
1 battery snap connector
1 momentary contact pushbutton switch
1 miniature DPDT slide switch

SEMICONDUCTORS
1 4001 quad NOR gate
1 4009 hex inverter
1 4030 quad XOR gate
1 4071 quad OR gate
2 4511 BCD to 7-segment decoder/drivers
1 4518 BCD up counter
1 555 timer IC
2 LT303/LT313 7-segment LED displays
2 3mm green LEDs
2 3mm red LEDs
1 1N4148 silicon diode

CAPACITORS
2 100μF/16VW PC electrolytics
2 4.7μF/16VW PC electrolytics
1 .047μF ceramic
1 .01μF ceramic

RESISTORS (¼W, 5%)
1 x 4.7MΩ, 1 x 560kΩ, 1 x 330kΩ, 2 x 33kΩ, 18 x 680Ω, 1 x 150Ω

OPTIONAL COMPONENTS
1 plastic zippy case, 50mm x 90mm x 150mm (UB1)
1 piezoelectric transducer
4 25mm hex threaded spacers
8 4BA x 12mm screws
4 4BA hex nuts
1 piece of foam packing
1 piece of red filter material, 55mm x 25mm
4 rubber feet

Win States	**Score Indicators**				**Score**
Both even digits	0	0	0	✱	2
Equal digits	0	0	✱	0	5
Even & equal digits	0	✱	✱	✱	10
Jackpot 88	✱	✱	✱	✱	50

it on to the second counter. Press the button several times to see if the win indicator LEDs operate whenever a winning number occurs. Obviously the "evens" will come up on a fairly regular basis whereas the jackpot may take all night (actually, it could take forever unless you add the simple modification described later).

Final assembly

Construction can now be completed by installing the assembly in the plastic case. First, cut out the front panel label from the rear of the "Fun Way" book and carefully affix it to the lid of the case using a rubber-based contact adhesive. The label can then be used as a template to drill the holes and make the front panel cutouts.

Holes for the LEDs and the piezo transducer should be drilled to 3mm, while the pushbutton switch and slider switch holes should be drilled to 7mm

continued on page 138

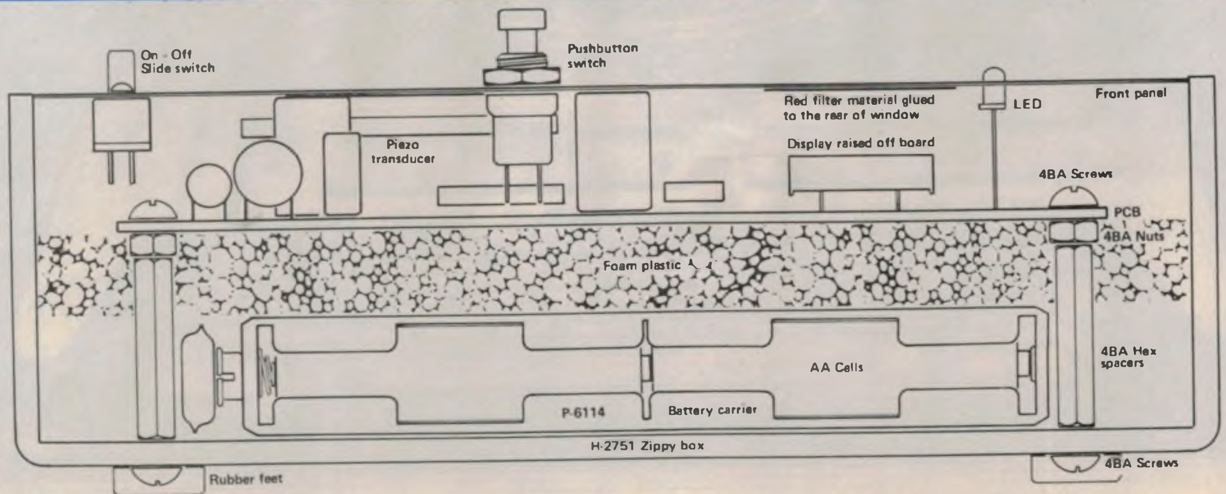


Fig. 1: how the PCB and the batteries are assembled in the case. Note the foam plastic.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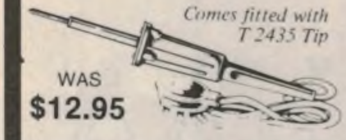

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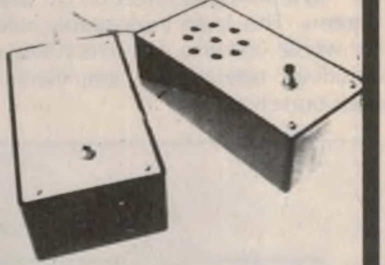

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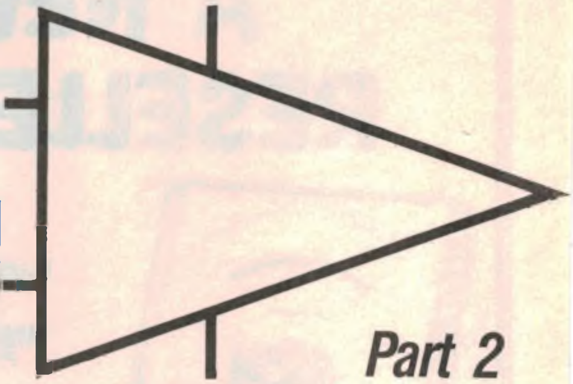
by BRYAN MAHER

OP AMPS Explained



Part 2

Our circuits can become unstable unless we observe certain precautions. This month we take a look at time constants, frequency response, and the criteria necessary to ensure circuit stability.

Every circuit, system, machine, person or thing takes time to change its state, that is, its energy. This time is a characteristic called the *time constant* and has a profound effect on circuits and systems. This is an inescapable rule for the whole universe and everything in it, including operational amplifiers and even ourselves.

A change in voltage output of an operational amplifier implies a change in energy level which *must* take time to accomplish. The circuit is quite incapable of changing its energy level instantaneously, just as we are incapable of accelerating instantaneously from standstill to running at 15km per hour (ask any slip fieldsman!).

To fully describe our circuits we must talk in terms of variable quantities such as voltage, current, frequency, power and energy; and also constant quantities which are resistance, capacitance and inductance. It is quite possible for us to invent more variable quantities, for example "period", and we could give a name to "the rate of change of voltage". But it is a fact not always recognised that in electrical circuits there can exist only three constants, the ones quoted above. There are no more!

You may immediately explode into objections and want to beat the author into the ground because he did not

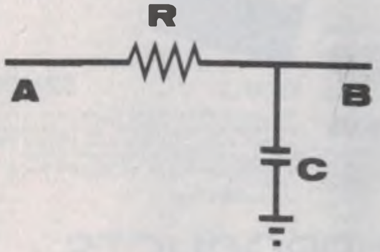


Fig. 1: A time constant.

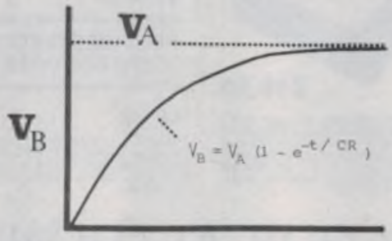


Fig. 2: The rise of voltage at B for a voltage step at A.

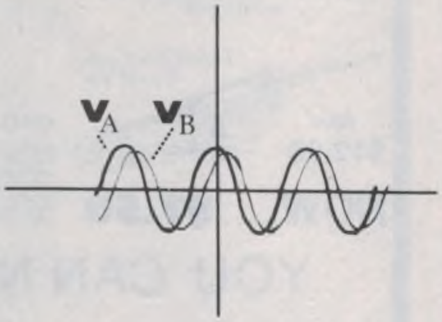


Fig. 3: The oscilloscope traces of voltages at A and B.

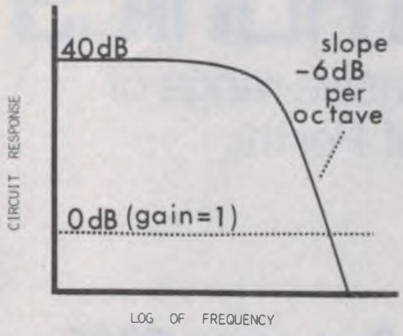


Fig. 5: Bode amplitude response for one time constant.

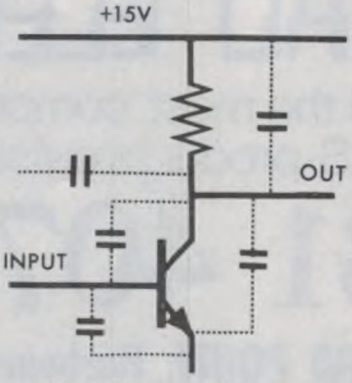


Fig. 6: Stray capacitances.

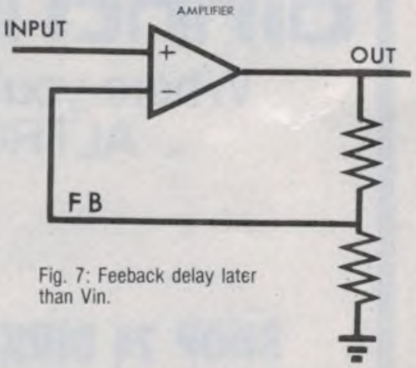


Fig. 7: Feeback delay later than Vin.

mention "conductance" and there are those other names too like "impedance" and even "admittance"! The answer to your resistance (pardon the pun) to your author's statement becomes clear when we look into the meanings of those constants. In electrical systems we can only do two things using our constant quantities: we can either *lose* the electrical form of some of our energy or we can *store* it. The loss of the electrical form of some energy is associated with resistance, and it is the idea of "loss" that is important.

It is not important whether we call it "resistance in ohms" or the inverse term "conductance in Siemens". Also it does not matter if this "loss element" is a physical resistor bought over the counter or the radiation resistance of a transmitting antenna (a non-visible quantity) or the output resistance Ro of a feedback amplifier (a defined relation: change in voltage/change in current). Whenever we lose the electrical form of energy we have the one basic constant and please yourself what you call it. The energy lost is of course i^2R (or V^2/R or VicosΘ where Θ is the phase angle between the voltage and current waveforms).

The other two constant quantities, capacitance and inductance, are quite incapable of energy loss and form two

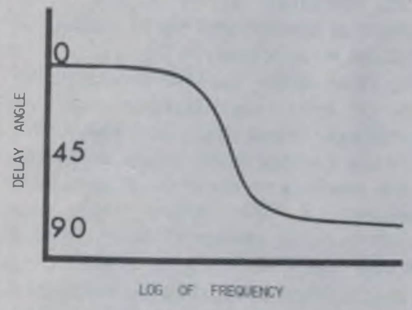


Fig. 4: Bode phase diagram for one time constant.

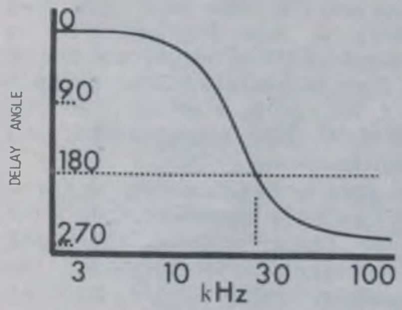


Fig. 8a: Bode phase diagram for three time constants.

Fig. 8b, c, d: How complex numbers are plotted

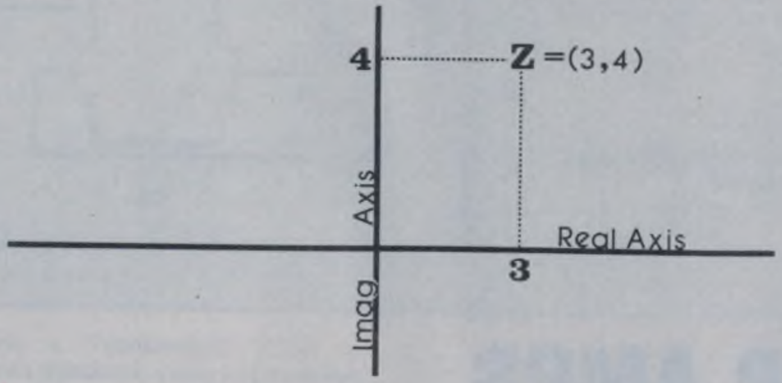


Fig. 8b: A single complex number Z = (3, 4) represented on a two axis co-ordinate system.

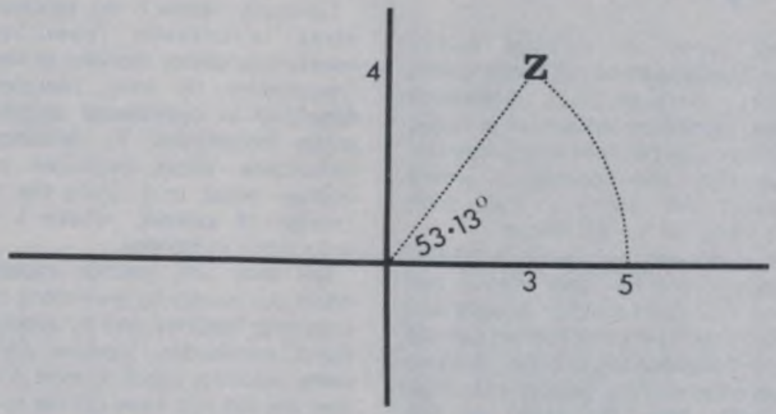


Fig. 8c: The complex number Z = (3, 4) is just the real number 5 rotated anticlockwise 53.13 degrees because the 3 and 4 and the origin form a right angle triangle. The 5 comes from Pythagoras and $5^2 = 3^2 + 4^2$. The angle comes from 4/3 = Tan (53.13°).

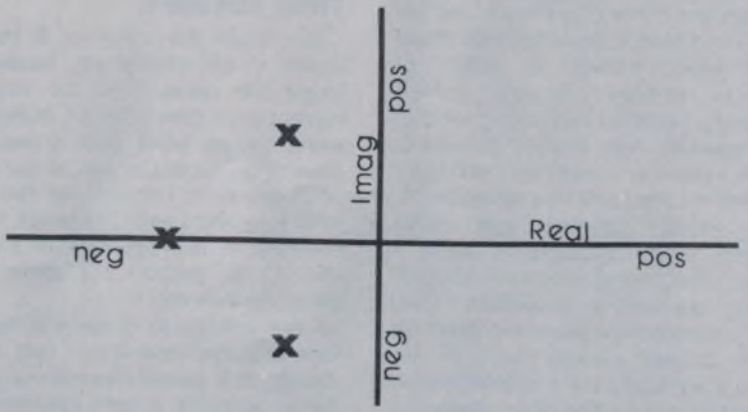


Fig. 8d: A possible set of poles for a three pole system as shown in Fig. 8a. In this case, all poles have negative real parts and the system is stable. The standard mark for a pole is X, as shown here.

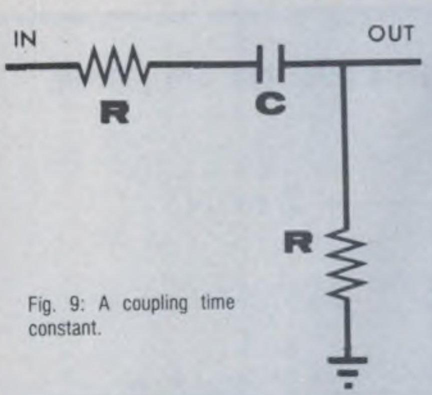


Fig. 9: A coupling time constant.

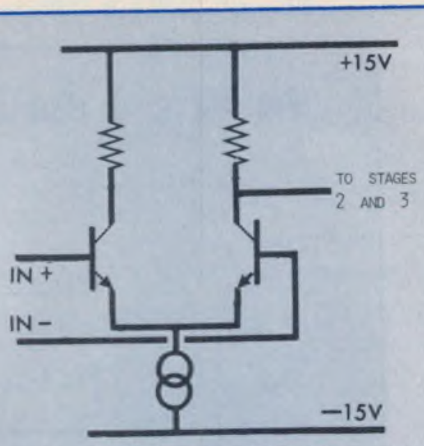


Fig. 10: A long tail pair first stage

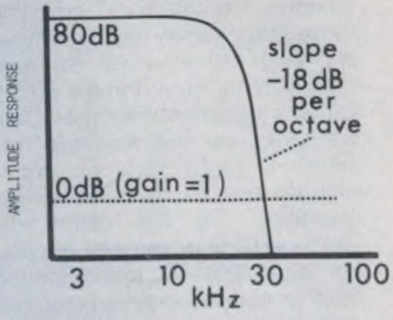


Fig. 11: Bode amplifier response for three time constants.

OP AMPS Explained

different types of electrical energy storage. We hesitate to call these "circuit elements" because that expression conjures immediate visions of a circuit component you can "put your finger on" or buy over the counter, a wrong impression! We prefer to call them "circuit ideas" or "circuit effects".

If we build into our circuit a 1000μF capacitor it will be large, heavy and obvious. A 2.2pF capacitor bought and soldered in will be small but we can still "put our collective finger on it". But two hookup wires running parallel in a circuit may easily have the effect of 5pF capacitance between them, even if we did not wish for that effect. Yes, you say, we can point to those two hookup wires, but we cannot "put our thumb on" that 5pF stray capacitive effect that we wish was not there. We try closing our eyes a few times but it won't go away: we are finally forced to acknowledge that those parallel wires posses an effect of electrical energy storage called capacitance, whether we want it or not! Semiconductors too at their junctions, exhibit similar energy storage mechanisms called junction capacitance.

These stray, junction and other unwanted small capacitances have a profound effect on all electronic circuits, including operational amplifiers. They dictate in no small measure the practical use we can and cannot make of our designs. If we really want a definition of this capacitance, it is the effect wherein a current flowing is proportional to a constant C times the rate of change of voltage. The constant C is the capacitance in Farads. The energy stored at any time is simply ½CV².

The second energy storage mechanism is called "inductance", a property possessed by every conductor carrying a current. Although straight wires have the property only in a small way, wires wound into coils have a much greater inductance, the more so if wound on cores or iron, cobalt, nickel or ferrite.

Generally, there is no problem with stray inductance from straight conductors unless working at very high frequencies. It may therefore be forgotten in operational amplifiers at audio frequencies. By definition, the inductance effect produces a back voltage equal to L times the rate of change of current, where L is the inductance in Henries.

The stray and junction capacitances affect our circuits by preventing changes occurring instantly and by reducing AC signal amplitudes. Suppose there was some electrical signal at point A in Fig. 1 and we did not have access to A, but could only look at the voltage at point B. If the voltage at A began to rise current would flow from A through R to charge the capacitor C and the voltage on C would be proportional to such charge.

Time constant

The larger the value of R the more slowly C will charge up. Similarly, the larger the value of C the longer the current must flow before C is charged to some voltage level. Both R and C slow down this process so we call the product "RC" the time constant of this circuit. With R in ohms and C in farads, the time constant RC is in seconds; or R in ohms and C in microfarads gives RC in microseconds etc.

If the voltage at A were to be in the form of a step from 0 to 1 volt, then the voltage at B would rise somewhat more slowly as in Fig. 2. Let's assume that we apply a step voltage V_A at point A in Fig. 1. The voltage at B, V_B, is given by the equation:

$$V_B = V_A(1 - e^{-t/RC})$$

where t is the time in seconds after the voltage at A took that step. After a time equal to RC seconds, V_B will be about two thirds of V_A, the exact value being $(1 - 1/e)V_A$ or $0.632V_A$, where $e = 2.718$.

Delays

One consequence of the time constant is clear – the system is slow to react. Let us look a little deeper into the circuit's workings. Say a changing input, a sine wave voltage at frequency f, is applied to A. After a time there will also be a sine wave voltage at B, but it will always be a little behind the sine wave at A. That is, A's sine wave will pass through its peak and a while later the sine wave at B will peak. As well, capacitor C provides some path to ground for this signal due to its reactance $X_C = 1/2\pi fC$. This means that there is less signal voltage at B than at A, as shown in Fig. 3.

The time delay can be measured in units of time, say microseconds, or alternatively, for a sine wave signal, the delay can be expressed as some fraction of the waveform cycle at a particular frequency f. We know that one complete cycle represents 360°. Thus, if the sine wave at B is one eighth of a cycle later than at A, at some frequency f, we can just as easily say that it is 45° late. This is called the phase or angle delay.

In most circuits, this phase delay varies with the frequency of the signal. Fig. 4 shows how the phase delay varies from nothing at low frequencies to a maximum of 90° at high frequencies for the single time constant circuit shown in Fig. 1. We call Fig. 4 a Bode phase plot after H. W. Bode, a famous electronics researcher of the 1940s.

To allow us to plot a wide frequency range we use a logarithmic scale. If the circuit contains more than one independent time constant, the maximum delay angle at high frequencies increases in multiples of 90°. For example, a circuit with three independent time constants can have a maximum delay angle of 270° (3 × 90).

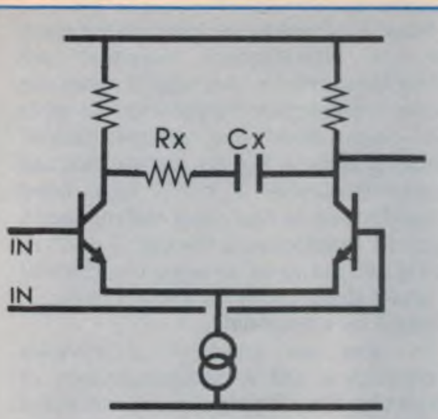


Fig. 12: The addition of Cx and Rx.

Not only does the phase angle vary with frequency but so also does the amount of signal flowing to ground via capacitor C. This is because Xc = 1/(2π fc) becomes smaller at higher frequencies. Thus R and Xc form a frequency dependent voltage divider which results in less signal at B as the frequency f rises. We see this in the Bode amplitude response curve of Fig. 5. Logarithmic scales are used not only to allow a wide frequency range but also to give the curve its classic shape.

With a circuit containing more time constants, the frequency roll off occurs at a lower frequency and the curve races off downwards at a steeper slope. A single time constant produces a −6dB per octave slope (−20dB per decade), two equal independent time constants give −12dB per octave (−40dB per decade), and so on. In practice, the frequency rolloff is determined not only by the capacitors we deliberately add to a circuit but by stray capacitance as well.

The villain

The effect of stray capacitance has the nasty habit of turning up everywhere. For example, in Fig. 6 we get stray capacitance from the collector of the transistor to earth, to the +15V rail, to the base via internal collector-base capacitance and to any earlier stages. Each capacitive path contributes to the total stray capacitance but that from the collector to base is the real villain of the story. It appears as C(cb).

Consider what happens when an input signal V is applied to C(cb). Because this signal is applied to the base of the transistor, it appears at the collector, amplified by the stage gain A, as −AV. So the current through C(cb) is a result of the difference in signal potential beteen V and −AV. Thus the current in this stray capacitance is equivalent to (Ic + AIc).

The stray capacitive current flowing to the base is much larger than expected, as if the real collector-base capacitance C(cb) had in parallel with it a fictitious capacitance A.C(cb), making the total collector-base capacitance C(cb) + A.C(cb), or if you like (1+A)C(cb). Because this effect was first explained in 1919 by J. M. Miller, we call this fictitious capacitance A.C(cb) the Miller capacitance or Miller effect. It is fictitious in that you cannot put your finger on it, but its effect is very real.

In high gain amplifier stages, this Miller capacitance is by far the biggest stray capacitance found in any circuit's backyard and is a real villain. It causes an unwanted increase in the phase angle (or time constant) and a corresponding decrease in frequency bandwidth.

Stability

All the above effects – stray and Miller capacitance, frequency response and phase angle delay – have, of course, always been present in all circuits, including our operational amplifiers. Now let's see what we are forced to consider because of them.

Fig. 7 represents our fundamental feedback circuit but now we recognise an effect that has been going on all along; because of unavoidable capacitances in our amplifier block, the output and hence the feedback FB is always later than the input. The phase delay angle of the amplifier is an important consideration when designing feedback circuits.

Take the case of three amplifier stages, each with stray and Miller capacitances. Fig. 8 is the Bode Phase Plot for such a circuit and shows the phase angle delay between the input signal and the feedback signal at various frequencies f. Now, just a cotton-picking-minute!!

At a frequency of about 28kHz we see that the amplifier has delayed its output so much that the feedback signal has rotated a whole 180°! And we remember learning somewhere that a phase rotation of 180° means the same thing as phase reversal – a change of sign. And that means the supposedly negative feedback has reversed in sign (when the frequency is 28kHz) to become *positive* feedback, which will add to the input signal not subtract from it.

This larger signal will then go into the amplifier whereupon it will be amplified again and fed back to add to the input signal and so on ad infinitum. That is obviously a runaway condition!

If we are discussing an audio amplifier the worst we can have is a unit which generates whistles, screeches and howls all on its own initiative. It oscillates its head off!

But worse could be in store in the case of an operational amplifier controlling some large electro-mechanical milling machine. The result could be physically and financially disastrous! Clearly we must take steps to prevent such uncontrolled behaviour – such oscillations. We cannot simply say "don't use 28kHz signals". That will not stop the trouble, because when power is first applied to the system, an abrupt step signal, almost a square wave, is fed to the circuit.

Since a square wave is a signal containing all frequencies (the famous Fourier analysis), all frequencies, including 28kHz, would be applied at switch-on and oscillations would start. Even without switch-on surges, the first sharp interference pulse received by extraneous pick-up would initiate oscillations for the same reasons.

What to do

What causes those oscillations and what should be done to inhibit the conditions allowing them? Thinking back, two factors were involved. Firstly the phase angle delay could exceed 180° at some frequency; secondly the gain around the loop *was greater than one at the frequency which produced 180° angle delay*. Preventing either condition will prohibit oscillations. If a circuit contains enough stray capacitances to make up three or more time constants we cannot prevent the first. So we must prevent the second.

In the Bode amplitude response curve (Fig. 5), the gain around the loop falls with increasing frequency. We must therefore ensure that the gain falls to less than one before the frequency which causes the 180° phase angle delay. That will be sufficient to ensure stability in any feedback circuit, including our operational amplifiers.

Poles and zeros

Recall from the first article published last month that we used G for the open loop gain of our high gain integrated amplifier, T for the closed loop gain, and H for the feedback factor. The closed loop gain with feedback was given by:

$$T = \frac{G}{1 + GH}$$

Really, the term G should make clear its dependence on frequency; that is, its relation to all its time constants. The time constant has the effect of reducing the gain at higher frequencies, but has no effect at DC.

To accurately calculate G and T at any frequency would submerge us deeper in mathematics than we wish. We would just like to paddle a little. It can be shown that the denominator in the above equation for T decides system stability; so much so that the special equation derived from it:

$(1 + GH) = 0$

is called the *characteristic equation* for the system.

OP AMPS Explained

As we have already seen, three time constants are unavoidable in a 3-stage amplifier system since each stage has Miller capacitance. At some frequency, the phase of the output, and hence the feedback, will be rotated 180°, resulting in instability if the loop gain at that frequency is greater than one. In fact, there are *three* frequencies at which this might happen for a three-stage system. We give these special frequencies a name. We call them *poles*.

Thus the poles of any system are those frequencies at which the system is unstable. You could say that, at pole frequencies, the gain of the closed loop system is infinite, which is really an imaginative description of a system way out of control. In general, a system has as many poles as it has independent low-pass time constants. The poles are related to the reciprocals of these time constants.

Unattainable poles

You are bursting into objection again! If all such systems have poles (which are the frequencies of instability), how come we ever have any stable systems at all? In a four time-constant system, for example, there exist four pole frequencies, any one of which will (theoretically) make the system unstable. The answer is that some or all of those pole frequencies may be unattainable in a practical system.

But hang on! Didn't we just agree that Fourier's theorem tells us that all frequencies appear in sudden step voltages (such as switch-on surges)? The answer to this dilemma lies in the fact that Fourier's theorem refers to *positive* frequencies only.

Imagine the following scenario: suppose we have a four pole system; ie there are four time constants. Yes it has four frequencies of instability. By a mathematical procedure we can find out what those frequencies are. They are, in fact, the four roots of the aforementioned system characteristic equation.

A glimmer of hope appears! Yes of course! Some equations have both positive and negative roots. Now what would "negative" mean in frequency? It would mean a frequency that was not physically realisable! So that's it – if all poles turned out from the mathematics to be negative frequencies, they would not be physically realisable. Thus, the instability condition could not be attained, which is just a fancy way of saying that the system is *stable*.

Complex is simple

Now let's think a bit more about the roots of equations in general. We recall that such roots might be positive or might be negative or might be something else. Yes, there are plenty of equations whose roots are not found amongst the positive or negative real numbers. Because of this, Karl Friedrich Gauss invented another type of number in 1797 – the *complex number*.

These are not really all that mysterious. A complex number can be simply represented as a pair of ordinary real numbers. For example, Z=(3,4) is a complex number. The 3 and the 4 are just ordinary real numbers. We have always been able to draw real numbers along a line (zero in the middle, positive to the right, negative to the left). How shall we draw these complex numbers? Easy – in a plane instead of a line. The single complex number Z=(3,4) is simply marked as a single point 3 units along and 4 units up, as in Fig. 8b. We call the horizontal axis the *real axis*, and here the 3 is called the *real part* of the complex number. The 4 in (3,4) is called the *imaginary part* and is drawn along the vertical or *imaginary axis*.

Now if it should turn out that the roots of our characteristic equation are complex numbers, that would mean the poles are complex frequencies. So what on earth does that mean? Simple! Looking again at Fig. 8b, we see that our complex number Z could have been regarded just as easily as a real number 5 rotated anticlockwise through 53.13° as in Fig. 8c. But to us an angle could mean a phase delay angle, as we saw in Fig. 3, caused by a time delay.

So now we know – a complex frequency is just a picturesque way of depicting the frequency of some signal delayed through some phase delay angle.

Complex numbers are neither positive or negative, but those terms still apply to their real parts. In Figs. 8b and 8c, the real part of Z is 3 which is positive. The criterion for stability is simply stated as:

If the real part of each pole frequency is negative, instability is not physically realisable and the system is stable. If the real part of any pole is positive, the system is unstable; ie, it will oscillate.

In Fig. 8d we see one possible set of poles for the three pole system depicted in Fig. 8a, in this case showing a stable system as all poles have negative real parts. Note that one of the poles only has a real component. However, we can regard ordinary real numbers as simply complex numbers whose imaginary parts happen to be zero. In this sense we can regard all numbers as complex.

Zeros

There is also another type of time constant, illustrated in Fig. 9, called a *coupling time constant*. This will not pass DC; ie, it has zero response at zero frequency. If included in a system, it produces some extra terms on the top line of the expression for the closed loop gain T.

Now for another definition: by a "zero" of a feedback system we mean any particular value of frequency which makes the top line equal to zero in the

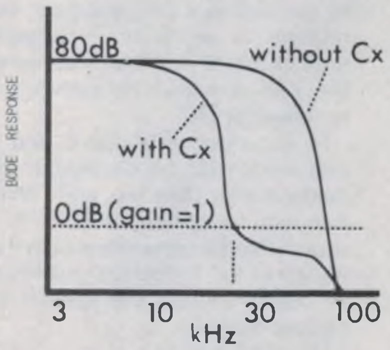


Fig. 13: The effect of Rx and Cx on the Bode response curve.

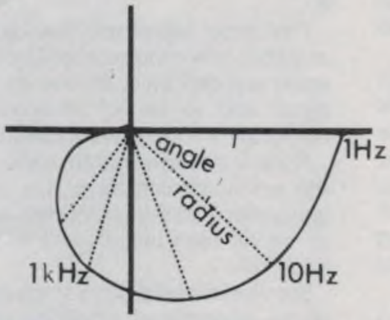


Fig. 14: Construction of Nyquist contour from radius and angle for two time constants.

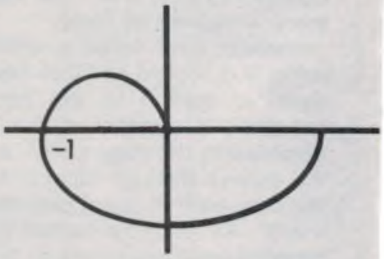


Fig. 15a: Nyquist contour for three pole unstable system.

expression for T. A "zero" is also a complex frequency. Naturally if the top line is zero, the value of closed loop gain T is zero at that frequency. Zeros have a way of cancelling poles of the same frequency.

Compensation circuit

We can now put all our new-found knowledge together. The first stage of an operational amplifier will usually consist of that beautiful differential circuit – the long tail pair as in Fig. 10. Commonly a second and third stage makes up the complete integrated circuit. Unfortunately, each stage will have Miller and other stray capacitance and we are forced to accept at least three time constants, giving Bode phase and gain plots like Figs. 8 and 11.

Because Fig. 11 shows gain still above unity (0dB) when the phase rotation is 180°, it denotes an unstable system. If a long tail pair has an impedance (any combination of resistance, capacitance and inductance) connected between the collectors it acts to reduce the stage gain – the lower the impedance the lower the gain.

Let us connect a resistance Rx and a capacitance Cx in series between the collectors as in Fig. 12. At DC and low frequencies the capacitor acts as an open circuit and both Xc and the gain are high. At medium frequencies, the gain is reduced as Xc becomes lower. This medium frequency gain is maintained all the way up to high frequencies because the impedance of this RC combination cannot fall any lower than Rx.

The Bode response curve of the modified circuit, Fig. 13, shows that the gain is safely down to less than unity (0dB) before the frequency is high enough to cause 180 degrees phase delay. Although the feedback does become positive, it is only when the gain is less than one, so oscillations cannot occur. Our system is stable.

If you feel clumsy looking at two graphs – Bode gain and Bode phase angle – to decide the stability question, we can make life easier by condensing both graphs into one. Beginning with a set of right-angle co-ordinates, we draw a radius line from the central origin with length equal to the Bode gain and angle equal to the Bode phase angle for a particular frequency, as shown in Fig. 14. By repeating this procedure for several different frequencies, we can draw a smooth continuous curve to join the tips of all those radius lines.

This curve is called the Nyquist Contour after H. Nyquist who established stability criteria for amplifier circuits during the 1930s.

Making it easier

Looking at this more closely, we observe that a loop gain of one and a bode angle of 180° results in a radius line one unit long to the left of origin. This tip of this radius line is labelled −1 on all Nyquist diagrams (since it is to the left of the vertical axis). If our Nyquist Contour cuts the negative axis outside that −1 point, it means that the gain is greater than one at a frequency causing a delay angle of 180° – ie, the circuit is unstable. Conversely, if the contour cuts the negative axis inside the −1 point, the gain is less than one and the system is stable.

The beauty of the Nyquist Contour is that if we draw the curve and mark the −1 point, we know whether or not that system is stable – just at a glance, as in Figs. 15a and 15b. All Nyquist contours enclosing the −1 point indicate unstable systems, while those not enclosing it belong to stable systems.

Some examples

The 301A integrated amplifier is a popular example of the many manufactured for operational amplifier use. You, the user, are meant to add the compensation capacitor Cx yourself. The circuit is such that if you want to make the closed loop gain = 1, you should use 33pF for Cx and connect it between pins 1 and 8. Of course, you must also install the correct values for Ri and Rf as discussed last month.

Let's assume, however, that you want to make the closed loop gain = 10. As well as choosing the appropriate values for Ri and Rf, you must now use a 3.3pF capacitor for Cx as in Fig. 16. Actually, it's quite easy to calculate the value of the compensation capacitor for the LM301AH (and the LM308AH). All you have to do is apply the formula:

Cx ≥ 30pFl (closed loop gain).

Naturally, we call this use of a single capacitor "single pole compensation". We could, if we chose, improve on the system using two capacitors and one resistor in a "two-pole compensation" scheme. The relevant data sheet should be consulted for this circuit, the improvement being noticed only when a response faster than about 20μs is desired (see Fig. 17).

For very high closed loop gains, 300 or higher, the value calculated for Cx is 0.10pF or less. This tiny capacitance approximates the stray capacitance between the legs of the integrated circuit, so no further capacitance need be added. But at lower gains we must insert capacitor Cx as calculated for these integrated circuits. Too small a Cx risks oscillation; too large a value slows down the response. The correct value gives the best bandwidth possible for a particular closed loop again.

In some op amps, the compensation capacitor Cx is built into the integrated circuit and we need not add it. Examples are the 741, 747, 740A, LH0022CH, AD545 and AD544. These integrated circuits, and many more, will give stable operation over a frequency bandwidth from DC to 10kHz or 100kHz. Others on the market extend the bandwidth to higher values. For example, the AD50XJ and LH0032 operate from DC to over 50MHz.

Next month we will consider noise and distortion in operational amplifiers and what to do about it.

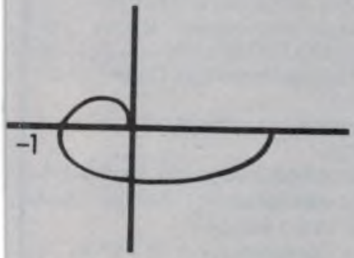


Fig. 15b: The Nyquist contour for a three pole stable system.

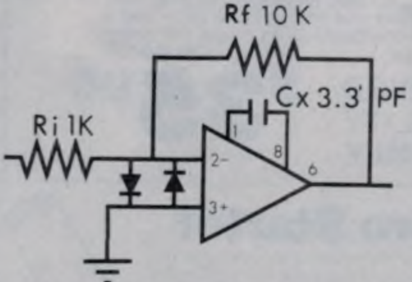


Fig. 16: The use of the LM308AH as a compensated operational amplifier, Gain = 10.

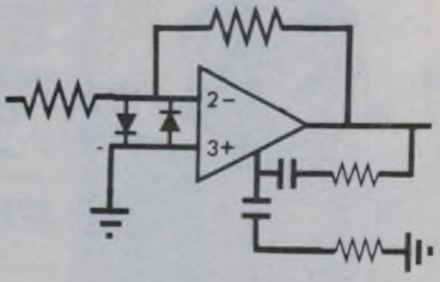


Fig. 17: Use of the LM725AH in a two pole compensation scheme, Gain = 10.

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So you choose the power supply you want to build. With electronic fuse (short circuit or over-current protection) housed in heavy gauge aluminium case. Cat K-3448

ONLY **$99**

Transformers to suit:

14A Transformer	Cat M-2010	**$49.95**
6A Transformer	Cat M-2000	**$24.95**

NEW! LET CALLER

ANYONE FOR TENNIS?

When you play McEnroe, he won't be able to dispute any calls! Portable, battery operated – use on any Court with wire rope for net. Cat K-3098

SMASHING VALUE **$19.95**

Video Enhancer

VCR's are all the rage. But the quality can be pretty crook. A video enhancer can help considerably. Build this one and find out – and it won't break the bank! Don't forget the patch over your eye . . . Cat K-3463

IMPROVED QUALITY FOR ONLY **$35.95**

See EA OCTOBER 1983

Fluoro Starter

This substitute electronic starter solves the problem of lights going blink, blink, blinkety blink and gives you a smooth rapid start EVERY time you switch on. And all the parts are housed in a standard starter case! Outlasts conventional starters by far! Cat K-3082

ONLY $4.50

See EA OCTOBER 1982

Function Generator

An essential piece of test and design gear for all hobbyists, amateurs, service technicians, engineers, etc. Produce sine, triangle and square waves from below 20Hz to 170kHz with a very wide range of output levels too. Case shown is included.

- **Negligible overshoot, droop or ringing.**
- **Readout accuracy 2% one digit.**
- **Amplitude stability better than 0.1dB in all ranges.**
- **Power consumption of 7W at 240V AC.**

AMAZING VALUE! **$89**

Cat K-3520

NEW

TV SERVICEMEN
BUILD-IT-YOURSELF BARGAIN!

TV Pattern Generator

A bargain for the serviceman, technician, hobbyist, etc. We had one of these 5 years ago and sold thousands! Now here's a brand new kit giving crosshatch, dot and raster for fast and simple convergence, etc.

SEE EA NOV. 1983 **Cat K-3472**

EXCLUSIVE VIDEO MODULATOR INC. IN THIS KIT

ONLY **$29.95**

YOUR OWN CASINO!
The Dick Smith

Electronic Roulette Wheel

PLAYING MAT EXCLUSIVE TO DICK SMITH

Wow! All the fun and excitment of Las Vegas . . . Wrest Point . . even Forbes Street. Now you can have a completely random roulette wheel – without the bias of some commercial units. **Cat K-3389** SEE EA MAY 1983

AMAZING VALUE AT **$29.50**

A GAME OF SKILL!

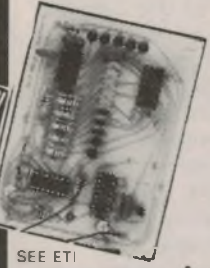
Leds & Ladders

A game of skill which is not only a lot of fun to play, but which also gives you a chance to improve your reflexes. Can you climb out of the well without being dumped back in? Easy to construct, the kit comes with all parts required and full instructions. Also included is a specially printed foil label for the box. **Cat K-3390**

VALUE AT ONLY **$16.50**

SEE EA AUG. 1980

Alien Invaders



Wow! You could save the earth from those pesky aliens...... and on a kit you built yourself! Multi-level LED display, easy to build and battery operated. Fantastic for Christmas gifts for technically inclined kids. Cat K-3393

SEE ETI AUG. 1983

ONLY **$15.95**

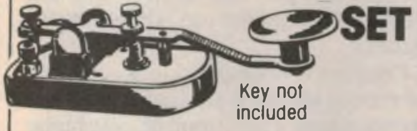
The not so random Breath Tester

Beware boys in blue and booze buses bailing belligerent Brabhams blowing bad breath into bags before banning. Check out our breath tester kit – it could be the answer to your broblems!
Cat K-3391

See EA May 1983

ONLY **$24.95**

MORSE PRACTICE SET



Key not included

Thinking of becoming an amateur radio operator? If you are, you'll need to be able to send and receive perfect Morse at a speed of 5 words per minute (or 10 words for a 'full' licence) before you can pass the amateur operator's licence examination. This Morse Practice Set will help you learn the code, and achieve the speeds necessary.
Cat K-2623

PREPARE FOR AOCP EXAMS . . .

ONLY **$4.50**

SEE FUNWAY 2 BOOK

Electronic Door Chime

An exclusive design, this unit plays a different tune every time you press the front door button. Perhaps you like one tune in particular, this is also possible. Everything you need is supplied in this great kit.
Cat K-3502

IT WILL AMAZE YOUR FRIENDS!

ONLY **$34.95**

SEE EA SEPT. 1979

IT'S AMAZING

Stereo Simulator

Wish those old video movies had modern stereo sound? This low-cost gadget turns almost any mono signal into amazingly good synthetic stereo!
Easy to build, too!
Cat K-3421
See EA April 1983

$19.95

SOUNDBENDER

With this great little kit you can sound like a Dalek, a Darth Vader, a Cylon, or any one of a dozen robotic spin offs! Cat K-3509

ONLY **$24.50**

ETI FEB '82 WAS **$29.50**

BUILD YOUR OWN

Phoney Patch

SEE ETI MAY 1983

Phone patching is legal from November 1st. Build your own phone patch and save a fortune . . . very simple kit, suits most transceivers. Compare our price with built-up units.
Cat K-3054

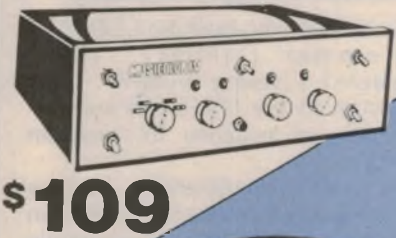
$59.50

Not Telecom Permitted

THE AMAZING

Musicolour Mk IV

The latest model Musicolour combines all the features of Musicolour III and Light Chaser, plus much more. Chaser plus 4 chase patterns, plus automatic and reverse modes for startling effects.
Cat K-3143 SEE EA AUG. 1981

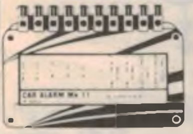


$109

FOR YOUR CAR!

IMPROVED!

Car Alarm Mk 2



See ETI JULY 1981

The Car Alarm Mk 2 uses a different triggering technique – one that makes it less prone to false triggering! It will detect a current flow ANYWHERE in the vehicle's electrical system.
Cat K-3253

$22.50

WAS **$28.50**

Transistor Assisted Ignition

Ideal for use in all conventional ignition systems, this revised unit adds to stability and gives higher energy. Housed in a die-cast box with deluxe radial fin heatsink for best possible performance. **Cat K-3301**

SEE EA FEB. 1983

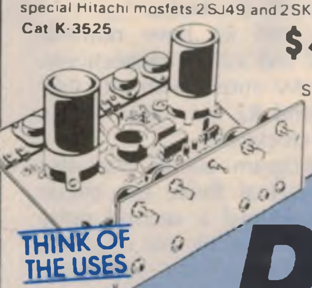
$34

150W Mosfet PA/ Guitar Amplifier

Guitar and public address amplifier utilising ETI's 499 Mosfet 150 watt power amplifier module as published in ETI March, 1982. Comes complete with pre-amp PCB and special Hitachi mosfets 2SJ49 and 2SK134
Cat K-3525

$119

SEE ETI MARCH/ JUNE 1982



THINK OF THE USES

DICK SMITH Electronics

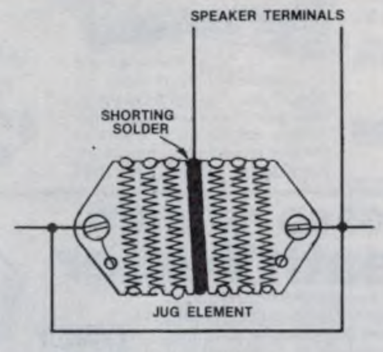
See Page 98 for full address details

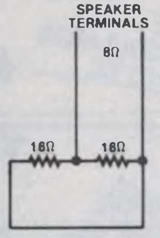
A678 M/CT

Circuit & Design Ideas

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

High-power dummy loads





EQUIVALENT CIRCUIT

When testing audio power amplifiers, it is often necessary to have non-inductive, high power 4 or 8Ω dummy loads into which the amplifier can be operated. Unfortunately, commercial resistors which meet this criteria are quite expensive. A low-cost solution is to build a 1000W dummy load using 240VAC electric jug elements.

The recommended jug elements are 1650W units distributed by Chelsea Products (Box 502 GPO, Sydney). These are specified since, unlike many other units, they are wound with resistance wire which can be soldered.

The resistance of the jug element is around 35Ω and this is reduced to 32Ω by soldering together some of the turns of wire in the centre of the element. The solder should be positioned so that the resistance between the soldered section and each end of the jug element is exactly 16Ω. A small piece of wire is then soldered between each end of the jug element, shorting the ends together and placing the two 16Ω sections in parallel to give an 8Ω load (see diagram). To produce a 4Ω load, simply parallel two of the above 8Ω loads.

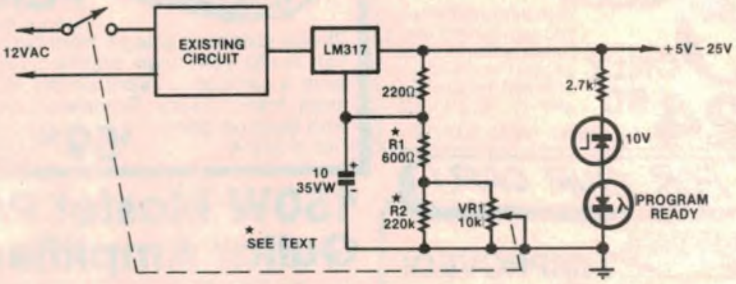
The lead running to the amplifier "+" terminal is connected to the shorting solder in the centre of the jug element while the lead running to the amplifier "–" terminal is connected to one of the shorted ends of the jug element.

During use, the dummy loads (jug elements) should be immersed in water to help remove the heat generated. For small amplifiers a jar of water will suffice but for larger amplifiers anything up to a bucket of water may be required (a 16-litre bucket of water was used to test the Perreaux amplifier in the January issue).

Resistance changes due to heating of the jug element are fairly small, the temperature coefficient of resistance being around .00017 per degree Celsius. Using this figure gives a resistance change of under 1.5% from 20°C to 100°C.

J. Skeen,
Electronics Australia.

Modifying the EA EPROM Programmer



Some readers who built the EA EPROM Programmer (January, 1982) encountered a vexing problem – the unit destroyed the EPROM as soon as switch S3 was switched to "program ready".

After some experimenting, it was discovered that a voltage transient on the OE pin of the 2716 was responsible for the destruction. This voltage transient occurred whenever the Vpp pin was switched from +5V to +25V by S3a, as the tracks feeding the OE and Vpp pins run parallel for a considerable distance.

This circuit overcomes the problem by allowing the voltage on the Vpp pin to be increased slowly from +5V to +25V. Essentially, it consists of a modification to the LM317 regulator circuit.

As long as the unit is switched on and off with switchpot VR1 rather than at the power point, Vpp will always initially be at +5V. Changing Vpp to +25V is then achieved simply by rotating the potentiometer fully clockwise.

Resistors R1 and R2 have nominal values of 600Ω and 220kΩ respectively. Adjust R1 for +5V output with VR1 fully anticlockwise and R2 for +25V output with VR1 fully clockwise.

The 50ms program circuit was also modified. In original form, the circuit occasionally produced a second pulse when the program switch was released, thereby programming two successive memory locations with the same data on "auto increment" or double programming on "step" amd "auto read". This problem can be overcome by increasing the 1kΩ resistor between the switch and +5V to 1MΩ, thereby providing more effective switch debouncing.

Finally, notes and errata for March 1982 neglected to add that pin 14 of IC13 should go to pin 19 of the EPROM, not to pin 15 of IC3. The circuit board is correct.

H. Franchimon,
Macquarie University, NSW.

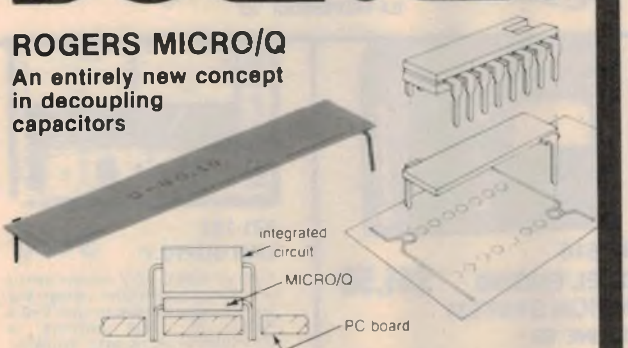
$15

Editor's note: readers are also referred to an alternative solution published on page 150 of the December 1983 issue.

NEW FROM SOANAR

ROGERS MICRO/Q

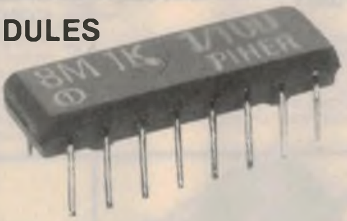
An entirely new concept in decoupling capacitors



ROGERS MICRO/Q™ is a high performance decoupling capacitor designed to reduce transient noise up to ten times better than conventional decoupling methods. It requires absolutely no redesign nor does it take up any board space due to its unique construction. Just slip **Micro/Q** under a DIP, then forget it, and your noise problems.

Micro/Q is available for all standard IC packages from 14 pin DIPs to 40 pin DIPs in capacitances from .03µF to .1µF. 50V DCW.

RESISTOR MODULES



DRM8
PIHER

The Piher Resistor Module is a transfer-moulded dual-in-line package (DIP) containing eight individual metal-film resistors or 'zero-ohm' links (Rmax. 0.5E) of the same value.

Piher Modules are designed for either manual or automatic insertion in printed circuits with standard drillings of 7.62 mm.

STOCK RANGE

Values in OHMS						
470Ω	1K	1.5K	2.2K	4.7K	10K	zero

These modules contain eight identical resistors each being the same as the face value of the module.

TECHNICAL INFORMATION AVAILABLE ON REQUEST.

SOANAR

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AR-2001 ONLY $599 INCL TAX

FEATURES:

- 25-550 MHz continuous
- NBFM — for communication
- WBFM — for BC & TV monitoring
- AM — for Air band monitoring
- 20 CH memory
- Priority Channel
- Clock

SPECIFICATIONS:

Frequency Range:	25MHz 550MHz Continuous			
Search Frequency Increments:	5KHz. 12.5KHz. 25KHz			
Mode:	Narrow band FM Wide Band AM			
Number of Memory	20 including			
Sensitivity	Narrow FM	0.3uV	12DB SINAD	
	Wide FM	1.0uV	12DB SINAD	
	AM	0.5uV	10DB S N	
Selectivity:	NFM	7.5KHz @6DB	20KHz @70DB	
	WFM	50.0KHz @6DB	250KHz @60DB	
	AM	5.0KHz @6DB	10KHz @70DB	
Spurious and Image rejection	50DB			
Modulation Acceptance:	NFM	7.5KHz		
	WFM	50KHz	AM	100%
IF Frequencies:	1st IF 750MHz	SAW Filter	3rd IF 455KHz	Ceramic Filter
	2nd IF 45.0275MHZ	Crystal Filter	(WFM) 5.5 MHz	Ceramic Filter
Reference Oscillator	(Synthesiser) Crystal Controlled			
Scanning Rate	Approx 5 Channels per Second			
Search Scanning Rate	Approx 6 Seconds per mega Hertz			
Scan Delay:	Normal.	Approx. 1 second		
	With Delay Option	Approx. 2.5 seconds		
Search Delay:	Approx. 2.5 seconds			
Priority Sampling Rate	Approx. 2 seconds			
Audio Output:	1W @10% or less Distortion			
Speaker (Internal):	8 Ohms			
Power Requirements	12V-14V DC			
Frequency and Message Readout	LCD Type			
Size:	138mm Wide × 80mm High × 200mm Deep			
Weight:	1.1 kgs			

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EMONA electronics

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PARABOLIC MICROPHONE $15

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of components for this project is around $15 including sales tax, but not the cost of batteries or headphones.

EA NOVEMBER '83

TV PATTERN GENERATOR $25

Make sure your TV is up to the mark with this low cost Pattern Generator which uses just seven ICs and gives three patterns: Dot, crosshatch and blank raster. The current cost of parts for this project is approximately $25 which includes sales tax but not the cost of a modulator or 9V mains plugpack.

EA NOVEMBER '83

ETI-268 NICAD FLOAT CHARGER

$9.00 ETI MARCH '83

Keep your NiCad batteries in tip-top condition with this cheap, simple charger.

ETI-1512 ELECTRIC FENCE TESTER

$24.50

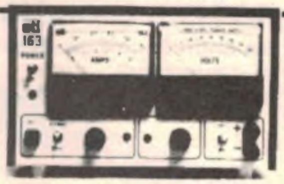
ETI FEB '83

No more checking the 'feel' of a fence with a blade of grass (and maybe ending on your . . .). This project tells you how much your fence energiser delivers and can be used for fault-finding on a fence.

ETI-1516 MODEL ENGINE IGNITION SYSTEM $41.50

ETI JUNE '83

Get sure starts every time and no more glow plug burnouts on your model engines.



ETI MAY '83

ETI-163 LAB SUPPLY $175

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

ETI-668 MICROBEE EPROM PROGRAMMER $47.50

ETI FEB '83

Simple, low cost programmer for the MicroBee can program 2716s, 2732s and 2764s.

ETI-153 TEMP PROBE

$19.95

ETI JUNE '83

Can measure temperature from -50°C to +150°C. It simply plugs into your multimeter—great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C.

ETI MAY '83

ETI-323 HEADLIGHT DELAY UNIT $17.50

Park your car and turn off the lights. Can't see where you're going? Press the button and the headlights come on to light your way, switching off automatically after 50 seconds. This is a simple, easy to build, low cost project.

ETI APRIL '83

ETI-1515 DRILL/BLENDER SPEED CONTROLLER $27.50

This project provides a full range of speed control for appliances having 'universal' ac motors. Once the speed is set, the motor will maintain that speed from no-load to heavy-load. Great for drills, blenders, grinders, etc.

ETI-162 30 V/1 A FULLY PROTECTED POWER SUPPLY

ETI DEC '83 $47.50

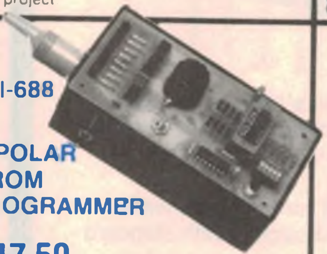
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0 V to 30 V and selectable current limit. Both voltage and current metering is provided.

ETI-654 APPLE II ANALOGUE/DIGITAL INTERFACE

$159.00 ETI MARCH '83

This project will give your Apple a set of 8-bit digital inputs and outputs plus one analogue input and one analogue output. Applications include: driving a robot, recording science experiment results, etc. (digital only shown).

ETI-688 BIPOLAR PROM PROGRAMMER



$47.50 ETI JUNE '83

Every digital workshop should have one! Can be used to program the popular fusible-link PROMs like the 74S188/288, 82S23 and 82S123 etc.

ETI-461 GENERAL PURPOSE BALANCED INPUT PREAMP $20.00

ETI DEC '83

This project can be used as a balanced mic amp with low impedance input, a low or high impedance input differential amplifier or a balanced input instrumentation amplifier.

ETI-164 ZENER TESTER

$9.50 ETI MAY '83

A simple, low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.

ETI-334 AUTO TESTER

$17.00 ETI JAN '83

Just the thing to keep in the glovebox or toolkit to find those nasty electrical bugaboos that occur at awkward times. Simple to build, simple to use.

ETI-335 PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

$28.50 ETI MARCH '83

No more fiddling with knobs and not getting the delay between wipes that you want—this windscreen wiper controller is simply programmed with two pushbuttons to provide the wiping delay you need.

ETI APRIL '83

ETI-733 RADIOTELETYPE CONVERTER FOR THE MICROBEE $20.00

Have your computer print the latest news from the internation shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee's parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too.

48-50 A'BECKETT ST, MELBOURNE 3000 VIC PHONE (03) 347 9251

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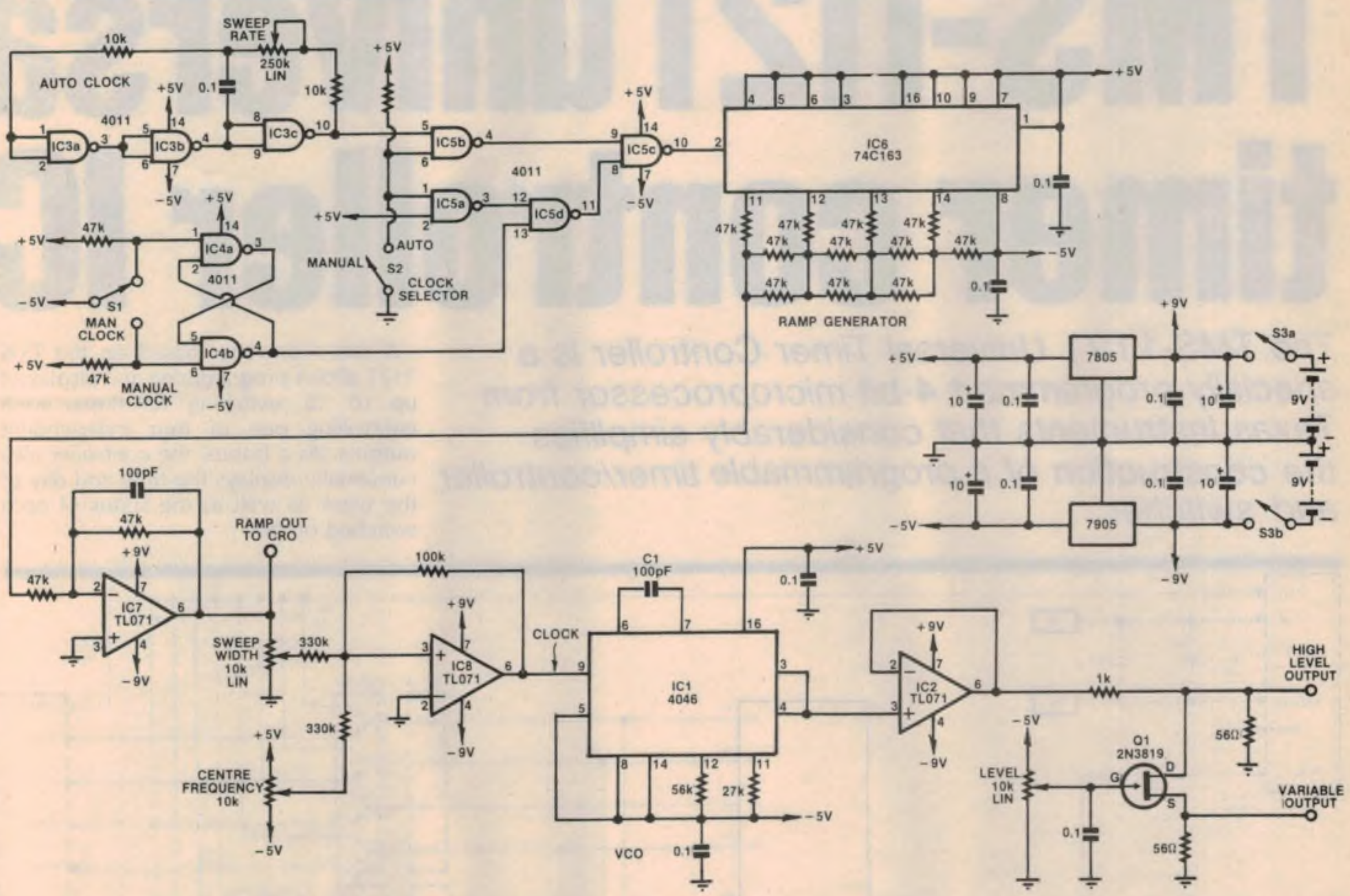
Circuit & Design Ideas



Digital sweep/marker generator

Alignment of IF stages on shortwave receivers and amateur equipment often requires the use of a sweep generator. This design is tuneable from about 400kHz to 565kHz and is self-marking by virtue of the digital circuitry employed.

Actually, the unit is not a true sweep generator in the conventional sense. Instead, it steps equally through 16 spot frequencies with the sweep width adjustable by means of a potentiometer. Stability is excellent and is generally within 10Hz for several minutes, while linearity is extremely good at around 1%.

Basically, the unit consists of a linear VCO (IC1) controlled by a stepped sawtooth waveform which also doubles as the timebase for the CRO. This sawtooth waveform can be either automatically clocked or manually stepped. IC2 buffers the output from the VCO. A high level output, intended for connection to a DFM, is derived from its pin 6 output while a variable level signal is derived via FET Q1.

The auto clock consists of a CMOS square wave generator (IC3), variable in frequency from 32Hz to about 400Hz. The output passes to the auto/manual select switch. When in the auto position, the switch passes this clock train on to a 4-bit binary up counter (IC6) which counts up from zero to 16, resets, and starts again. IC6 and its associated ladder resistor network forms a digital to analog converter (DAC). Output from the DAC is a 16-step ramp voltage, with each setp representing one clock pulse. Note that since the circut uses ±5V supplies, the ramp extends from −5V to +5V.

The output from the DAC is fed to inverting amplifier IC7, the output of which is fed to the X amplifier of the CRO and to summing amplifier IC8 via a 10kΩ sweep width pot. A 10kΩ centre frequency shift pot sets the bias on pin 3 of IC8 and thus sets the centre frequency shift voltage around which the ramp swings. This voltage is buffered by IC8, which has a gain of 1/3, and is used to control the VCO.

IC4 provides the manual clocking facility. When S2 is in the manual position, clock pulses from IC4 are stepped manually by spring-loaded toggle switch S1. Thus, the ramp can be stepped to any point on the sweep and the frequency measured.

R. Green, VK6KRG,
Donnybrook, WA.

$20

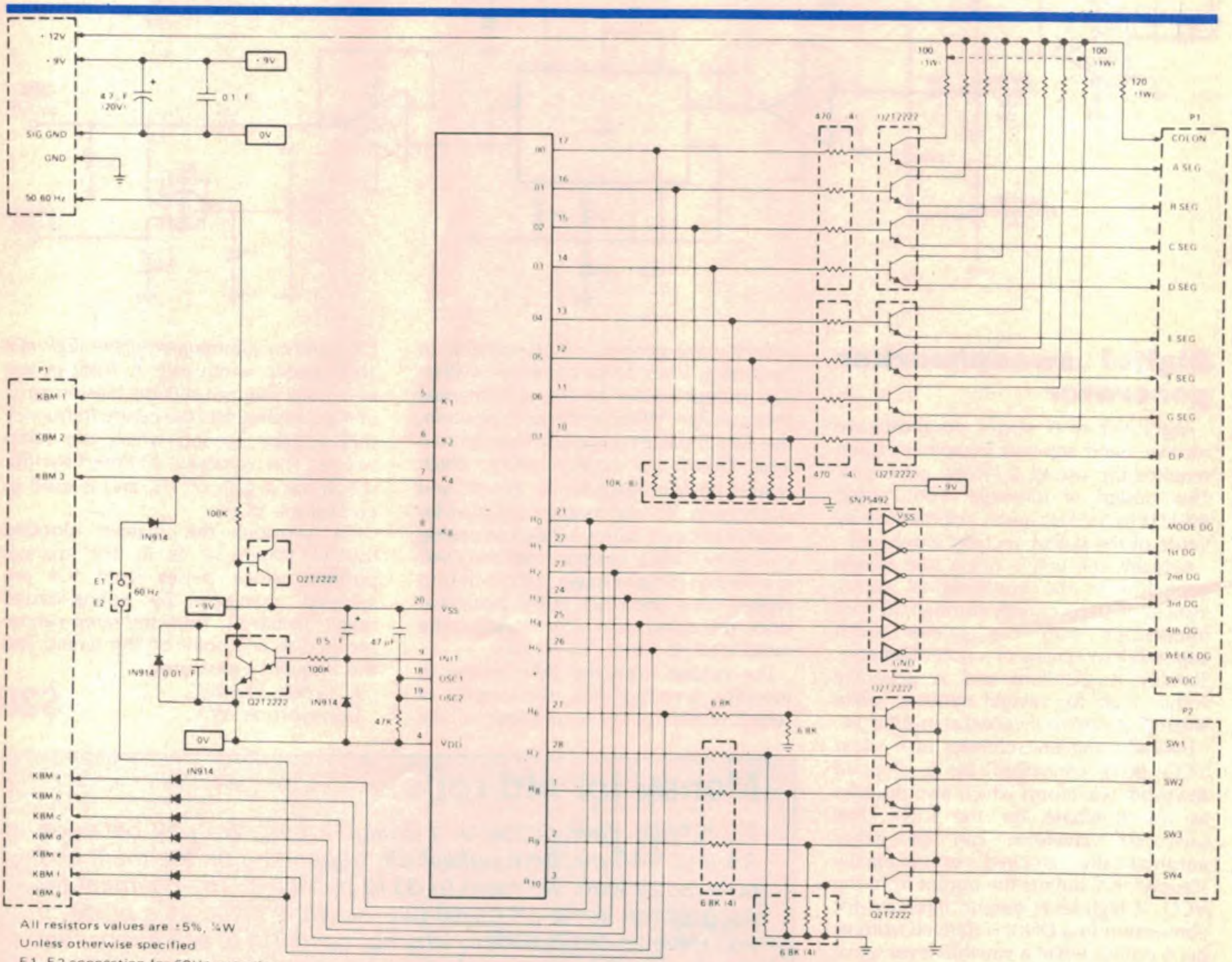
Money for old rope

WANTED: *Your circuit and design ideas. We pay between $5 and $40 per item published, depending on the merit and how much work we have to do to publish it. The payment for each of the items on these two pages is given as a guide. If you have an original idea, why not send it in to us? Every item received will be acknowledged by mail.*

TMS-1121 universal timer controller IC

The TMS-1121 Universal Timer Controller is a specially programmed 4-bit microprocessor from Texas Instruments that considerably simplifies the construction of a programmable timer/controller and switcher.

A timer/controller based on the TMS 1121 allows programming and display of up to 18 switching functions, each controlling one of four independent outputs. As a bonus, the controller also continually displays the time and day of the week as well as the status of each switched output.



NOTE: All resistors values are ±5%, ¼W
Unless otherwise specified
E1, E2 connection for 60Hz operation

Fig. 1: basic circuit for a timer based on the TMS-1121 (courtesy of Texas Instruments Inc).

Relays connected to the switched outputs can be used to control mains appliances, switching them on and off at specified times throughout the week. Typical applications include controlling heating and air conditioning, expanding the timer functions of low-cost VCRs or controlling lighting while on holidays to give a "lived in" look to an empty house.

Using the TMS 1121 requires the addition of a power supply, keypad or switch matrix, a 4-digit seven segment LED display and some discrete LED indicators as well as transistor drivers for the display and relays. Battery back-up of memory functions is optional.

Programs for the timer/controller are fed in via a 20-key keypad and the time read out on the 4-digit display. Separate LEDs are required to indicate AM and PM, the day of the week and the status of each controlled output.

As can be seen from the circuit diagram of Fig. 1, very few additional components are required.

The TMS 1121 itself operates from a 9V power supply (±1V) connected to pin 20, with ground on pin 4. This supply is most conveniently provided by an LM317 adjustable three terminal regulator fed from a 12V DC source. Since the supply to the relays and LED displays need not be regulated, 12V can also be used here, so the actual current through the regulator is just the 5mA or so required by the UTC chip.

The internal timer of the UTC is synchronised by a 50Hz input derived from the secondary of the mains transformer and squared-up by a transistor buffer. The need for this 50Hz reference signal means that the circuit cannot be battery-powered, unless a crystal-controlled timebase IC such as the MM5369 is used.

The TMS 1121 uses an RC circuit to set its internal clock frequency. To enable the internal oscillator pins 18 and 19 (OSC 1 and OSC 2) are connected together, with a 47pF capacitor from pin 18 to the 9V supply rail and a 47kΩ resistor from pin 19 to ground providing an internal clock frequency of around 300kHz. The actual processor clock frequency is not critical because the real-time clock is synchronised to the 50Hz mains frequency.

The most economical way of providing keypad inputs is to use 20 pushbuttons arranged in a 3 x 7 matrix with one location left empty. Pins 21 to 27 of the TMS 1121 scan the columns of the matrix via blocking diodes while pins 5, 6 and 7 are connected to the three rows and produce an input to the chip when a key is pressed.

The keyboard scanning outputs also serve to multiplex the seven segment displays and discrete LED indicators, so pins 21 to 27 are connected via transistor inverters to the displays. Drive to the segments of the displays and the LEDs is provided from pins 10 to 17 of the TMS 1121 via transistor buffers.

The four switched outputs are from pins 1 to 3 and pin 28. Transistor buffers connected to these pins are used to control relays which in turn control external devices. Diodes should be connected across each relay coil to protect the transistors from back EMF-

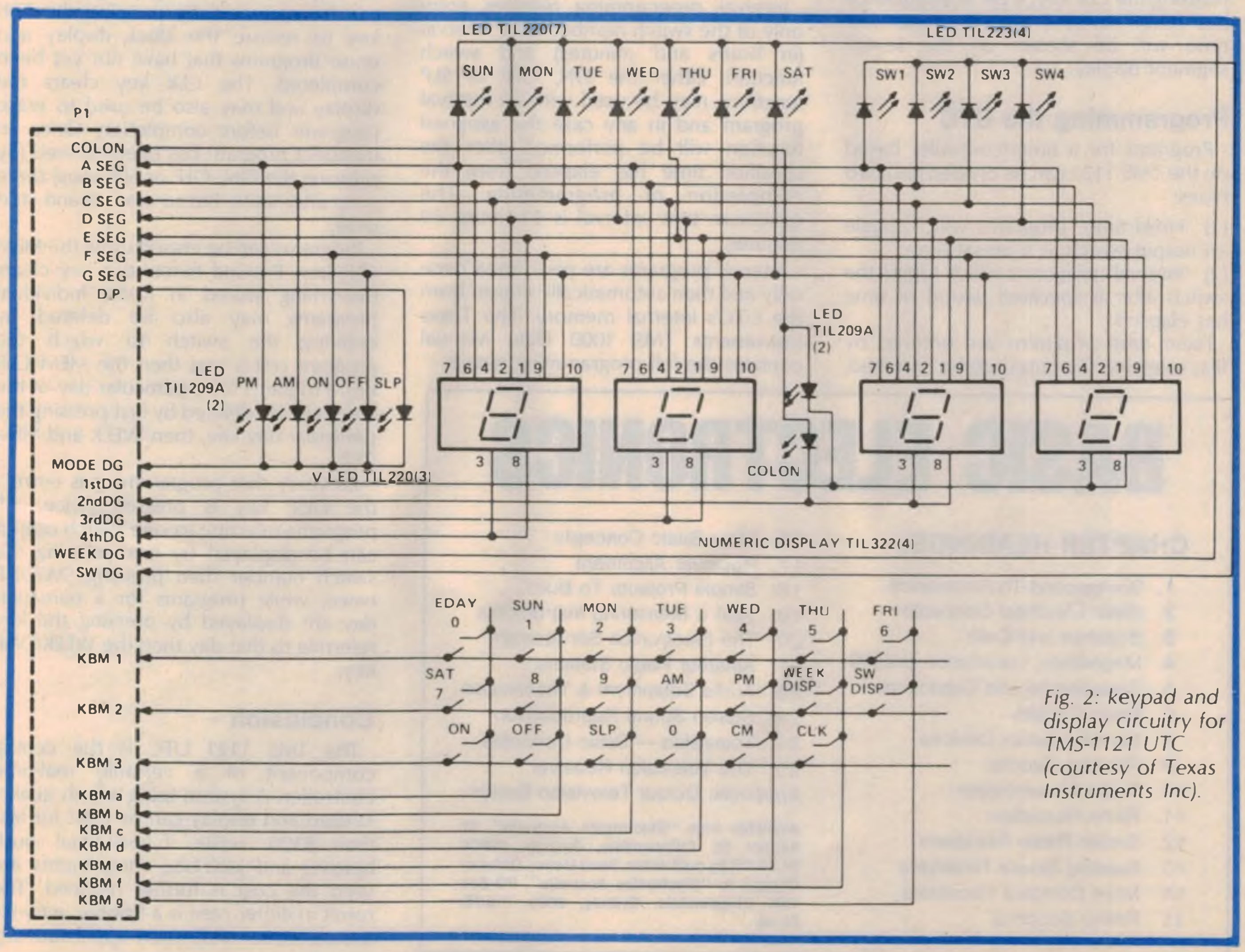


Fig. 2: keypad and display circuitry for TMS-1121 UTC (courtesy of Texas Instruments Inc).

TMS-1121 universal timer controller IC

induced by the relay coils.

A power-on initialisation circuit is required on pin 9 to reset the timer controller. A resistor/capacitor combination is arranged in such a way that pin 9 is taken high on switch-on and goes low as the capacitor charges. The pulse resets the clock to 12.00pm Sunday and erases all programs from memory. After switching on it is necessary to press the CLK button key to display the clock setting and ready the UTC for programming.

The first requirement in using the timer is of course to set the clock. Using the key labels shown in Fig. 2 the initial step is to key in the day of the week by pressing one of the labelled "day" buttons and then the "Week" button to register the input. Either the AM or PM key is pressed next and then the current time entered using the numeric keys. The specified time is then entered by pressing the CLK key. If the key sequence has been correctly followed the new time will be shown on the seven-segment display.

Programming the UTC

Programs for a timer/controller based on the TMS 1121 can be divided into two types:

(1) "Fixed time" programs which toggle an output switch at a preset time.

(2) "Interval" programs which toggle the switch after a specified period of time has elapsed.

Fixed time programs are entered by first selecting the output to be switched, using one of the numeric keys 1, 2, 3 or 4. Pressing the key marked "Switch" (SW) then assigns the selected output to the program being entered. Next the day and time of activation are entered, in the same order as the clock setting sequence described above. The final step is to specify which function will be produced – either ON, OFF or SLP. The "Sleep" function (SLP) causes the assigned output to be switched on when the specified time is reached and turned off one hour later.

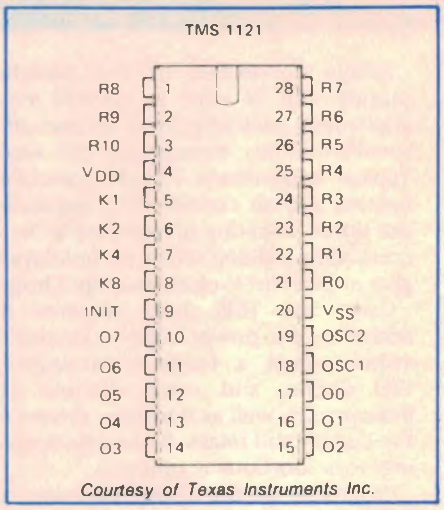
As the key sequence is entered the digital readout and LED indicators display the program settings. The clock information can be re-displayed after programming by pressing the CLK key.

The "EDAY" (everyday) key may be used in fixed time programs in place of the day a day of the week key. Using this key causes a function to be repeated at the programmed time on every day of the week.

All fixed time programs are stored by the UTC and will be performed repeatedly at the specified day and time until over-ridden by another program or deleted from memory.

Interval programming requires entry only of the switch number, time interval (in hours and minutes) and switch function. Either the ON, OFF or SLP functions may be used with an interval program and in any case the assigned function will be performed after the specified time has elapsed from the completion of programming. The maximum time interval is 11 hours, 59 minutes.

Interval programs are performed once only and then automatically erased from the UTC's internal memory. The Texas Instruments TMS 1000 Data Manual contains the full programming details.



Courtesy of Texas Instruments Inc.

Switches may also be operated directly from the keyboard simply by entering the switch number, pressing SW and then the function required. With no time entry the specified function will be performed immediately and is not stored in memory.

Errors in setting the clock or entering a program are indicated by a clock display of 99:99. Errors during program input can be corrected by pressing the CLK key to restore the clock display and erase programs that have not yet been completed. The CLR key clears the display and may also be used to erase programs before completion. Once an incorrect program has been entered (by pressing the ON, OFF or SLP keys) there is no alternative but to erase it and start over.

Programs can be erased using the MEM CLR key. Pressed twice, this key clears everything stored in RAM. Individual programs may also be deleted by entering the switch to which the program refers and then the MEM CLR key. Programs for a particular day of the week can be deleted by first pressing the particular day key, then WEEK and MEM CLR.

To verify that programming is correct the DISP key is pressed twice. All programs referring to one switch output can be displayed by first entering the switch number then pressing SW/DISP twice, while programs for a particular day are displayed by pressing the key referring to that day then the WEEK/DISP key.

Conclusion

The TMS 1121 UTC is the central component of a versatile real-time controller. A system using a high quality keypad and display can be built for less than $100, while if individual push buttons and junk-box components are used the cost is further reduced. The result in either case is a flexible, easy-to-use controller with many applications.

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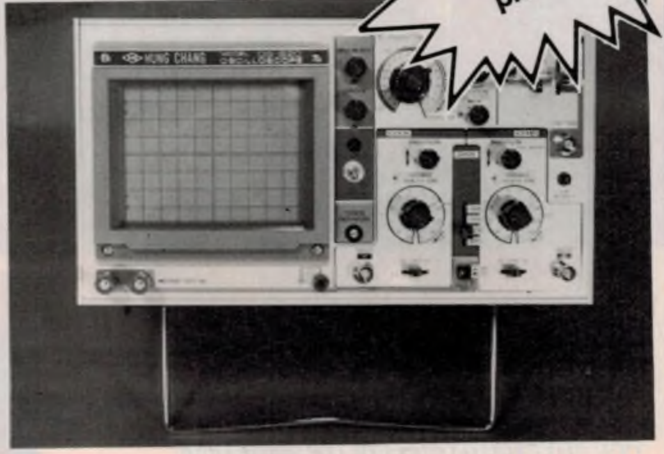

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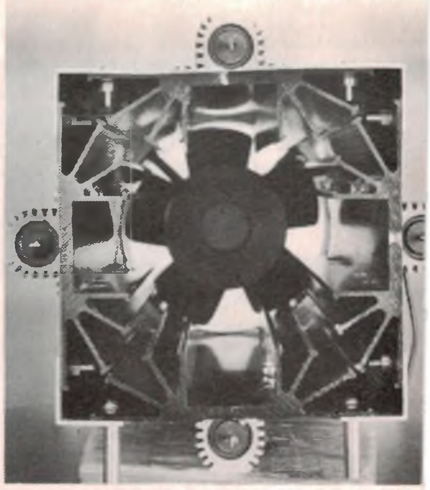
Are you good

High power dummy load

by LEO SIMPSON & BOB FLYNN

One of the most important pieces of test equipment for assessing amplifier performance is a dummy load. In its simplest form it is just a single resistor but practice demands a good deal more than that.



Looking down the heatsink tunnel of our new 200W/ch load box.

At first thought the idea of a load box for audio amplifiers is simple enough. Just obtain a few resistors of adequate power rating, a selector switch or two and a suitable box to put it all in. Nothing complicated. Well it sounds easy when stated like that but when the subject is examined more closely the design of a load box is not all that straightforward.

This project arose when we decided to replace the dummy load box used in the EA lab for quite a few years. We made quite a few enquiries in looking for a commercial unit which would satisfy our needs but there appears to be little in the way of dummy loads made for audio amplifier testing. This is surprising since a number of companies make very fine distortion measuring equipment. What about a load box?

One of the reasons why we had to replace the existing load box was that it just did not have sufficient capacity to test the power amplifiers of today. The final straw came when we tested the Perreaux 5150B amplifier featured in the January 1984 issue. This monster had a power output in excess of one kilowatt with one channel driven! With both channels driven the total power was around 1.8 kilowatts.

Our poor old load box just wasn't in the race with this monster so we had to make other arrangements. We actually used modified jug elements immersed in a bucket of water (see "Circuit & Design Ideas" in this month's issue).

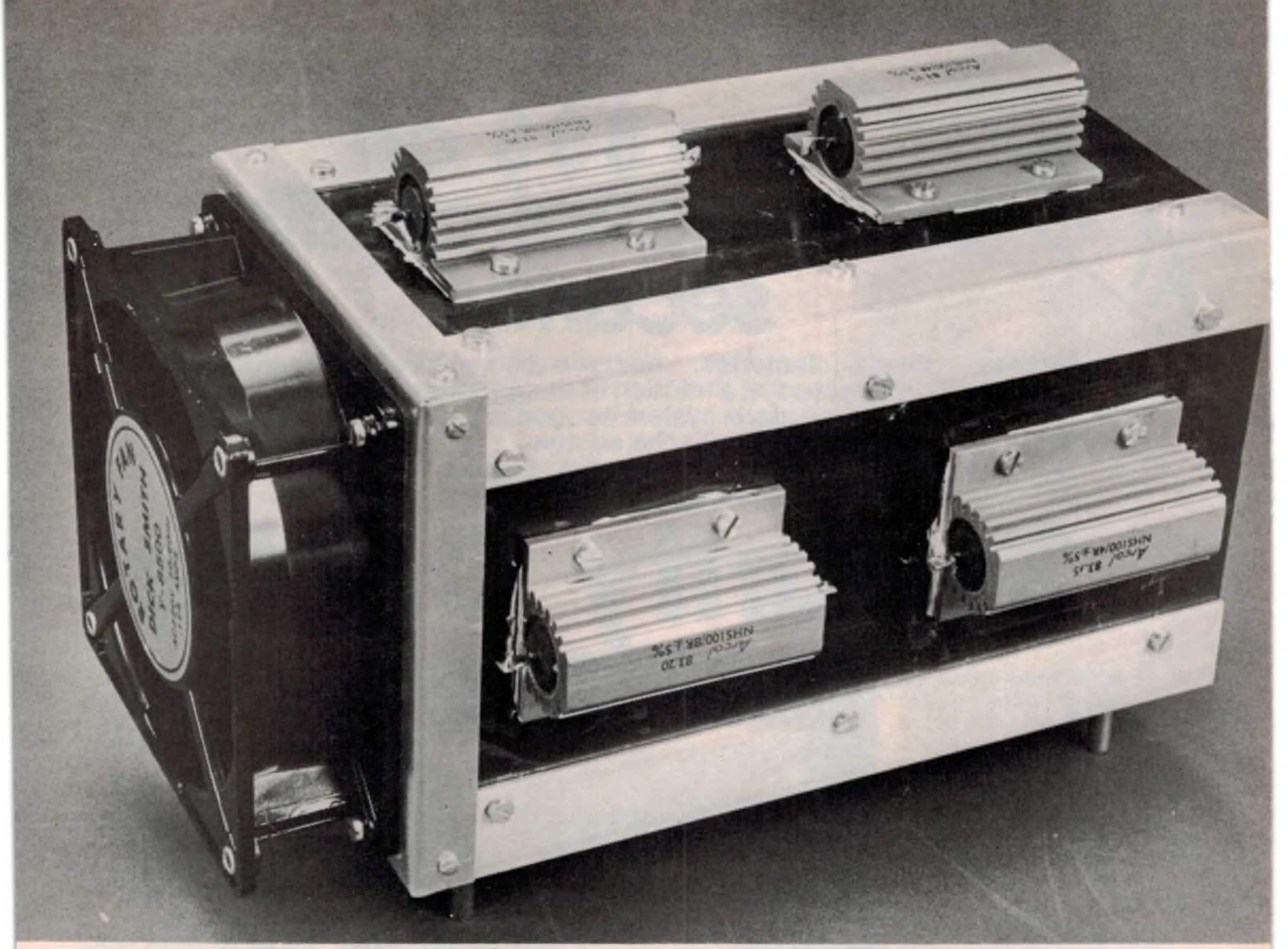
Power rating is one problem; the load value is another. Our previous load box had the ability to provide loads of 2, 4, 8 and 16 ohms and this had served us well over the years. The provision of 2Ω and 16Ω load values may seem unnecessary these days but there is good reason to have them.

This load box provides four load resistance values. The shunt terminals enable connection of a capacitance substitution box for stability testing of amplifiers.

It may be thought that a 2Ω load is too severe for most amplifiers but it could easily occur if two 4Ω loudspeaker systems are placed in parallel. In fact, most manufacturers do not rate their amplifiers for this load value and will sometimes arrange the speaker switching so that when two pairs of speakers are in use they are connected in series. We think that is cheating of course.

We always test EA amplifier designs into a 2Ω load impedance. It is a good test of the ruggedness of the output stage and while the amplifier in question may not be able to wishstand full power into this load for more than a few seconds it should be able to survive without any damage. The worst that should happen is that the fuses blow.

The 16Ω load is less useful but it can be used as a good pointer to the headroom of an amplifier when driving 8Ω loads. In this case, we test for maximum power,



Fan cooling was the only way to ensure that resistor temperatures remained within limits.

into 16Ω loads and double the figure to gain an idea of the headroom or margin over steady-state full power then driven into 8Ω loads.

As it turned out, with the resistor values we used it is easy to provide the 16Ω load condition anyhow.

The range of load values and the final power rating have to be considered together since there must ultimately be a compromise between the total cost of the load box and its power rating. As may be seen from a glance at the accompanying circuit diagram, the new EA load box uses 4Ω and 8Ω resistors switched in series and in parallel to obtain the various load values.

This approach is economical because it means that we can standardise on just two values of resistor and the power dissipated will always be shared equally between two resistors (for one channel). This means that the power which can be dissipated is twice the rating of the individual resistors.

Non-inductive resistors

We also wanted the load box to be non-inductive. Ordinary wirewound resistors have only a relatively small value of inductance but that is sufficient to significantly alter the performance of most amplifiers. The residual inductance will usually exacerbate any crossover distortion and will also mean that the load is no longer the designated value at high frequencies.

Non-inductive resistors are obtainable but as might be expected they are more expensive than the equivalent inductive sort.

With the above considerations in mind, we finally opted for a nominal load box capacity of 200W for each channel. This would allow us to test the vast majority of amplifiers presently made. The unusual cases like the Perreaux model mentioned above could be handled in other ways.

The resistors we used are made by the Ashburton Resistance Company Ltd, of Cornwall, England. Branded Arcol, they are distributed in Australia by Mayer Krieg & Co, 49/51 Brodie St, Rydalmere NSW 2116.

These Arcol resistors are wirewound using a copper-nickel alloy or nickel chrome alloy, depending on resistance value. They are housed in a finned aluminium extrusion which aids heat dissipation. The type we used is non-inductively wound and is rated at 100 watts. Arcol resistors are available in ratings up to 300 watts in air-cooled types while there is a water-cooled type capable of dissipating up to 900 watts.

Load switching

It is desirable to be able to switch the load value while the amplifier is delivering full power. This means that the switch must be rated to break and make the full load current which could be 10 amps or more.

We wanted to be able to switch the load in both channels of a stereo amplifier simultaneously which meant a fairly hefty switch, particularly as we intended to use the load box to switch three pairs of loudspeaker systems as well.

The switch we used is an NKK type HS-16-4 which has a contact rating of 12 amps at 125 volts AC. It is nominally a 4-pole 11-position switch but has an adjustable stop to restrict the rotation to any desired number of positions.

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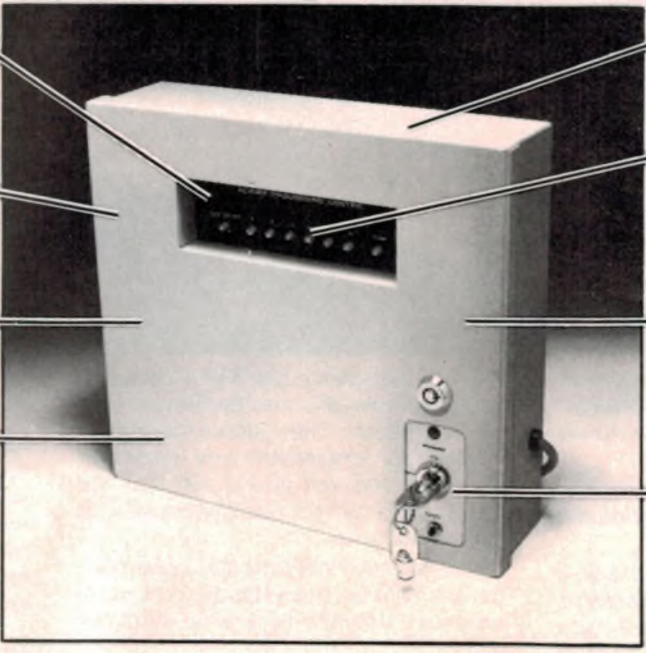

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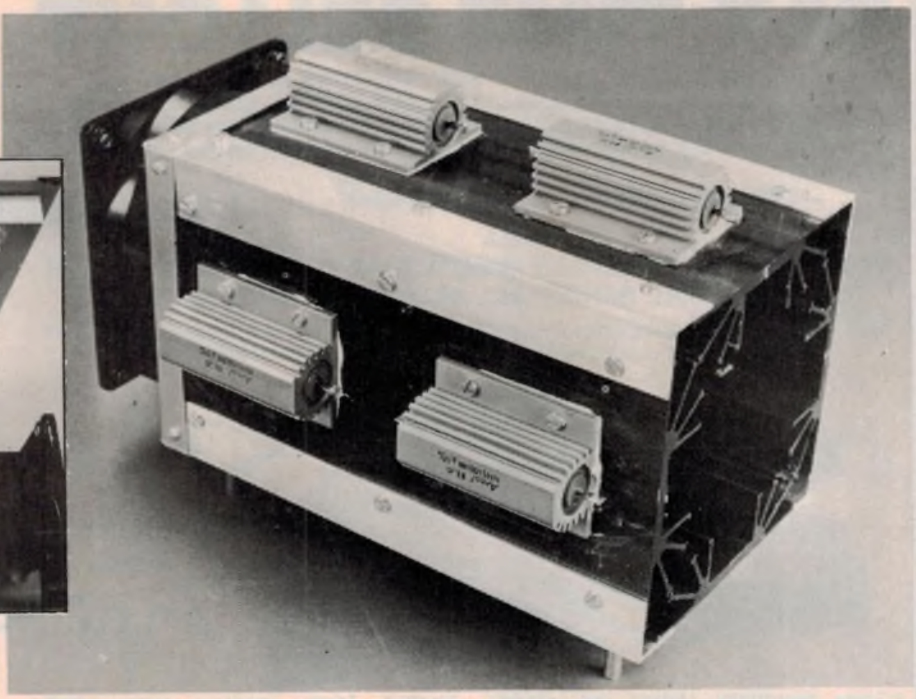
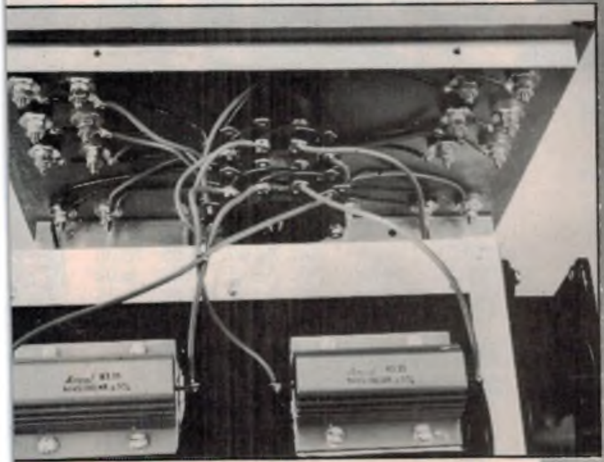
At right is another view of the heatsink assembly before mounting in the box.



Pictured below is the heavy duty 4-pole switch rated at 12 amps.



High power dummy load

Our sample switch was kindly supplied by STC-Cannon Components Pty Ltd, 605 Gardeners Road, Mascot NSW 2020.

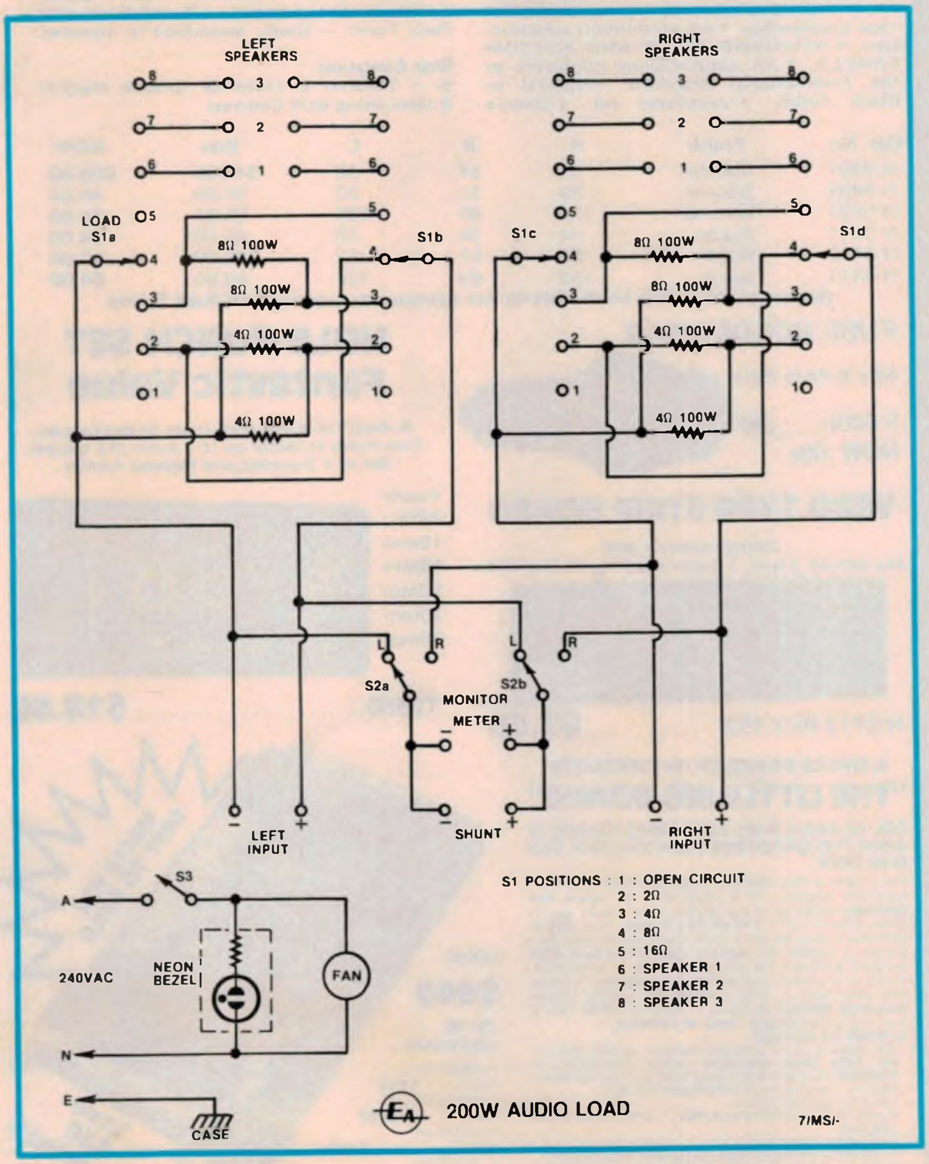
Cooling

We realised that cooling a dummy load box of this capacity would be a problem. After all, 400 watts is almost half the rating of a small domestic one-bar radiator and they get red-hot! Accordingly, we decided to use a forced-air cooling system using a standard computer ventilation fan.

We made up a heatsink tunnel using four single-sided heatsinks (DSE Cat. No H-3426 or equivalent) 225mm long. These were bolted together with the aid of aluminium angle extrusion. As can be seen from the photographs, the eight resistors were bolted in position, two to each heatsink. The fan, also from Dick Smith Electronics (Cat. No Y-3500), was then bolted onto one end of the assembly.

Photos tell the rest of the assembly story. In use we have found that the fan cooling works very well and limits the surface temperature of the resistors to about 90° Celsius when running at 200 watts per channel.

This suggests that we should be able to use the load box for even higher powers. The NHS100 resistors are rated at 100 watts for a maximum surface temperature of 200°C. With fan cooling we should be able to use the load at powers of up to 300 watts per channel while still keeping the resistors comfortably within their temperature ratings.



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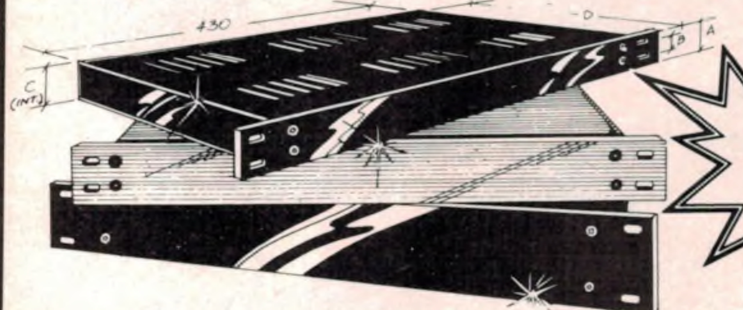

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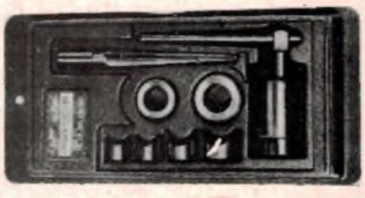

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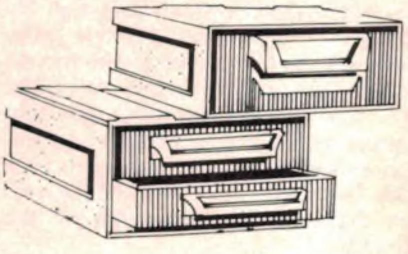

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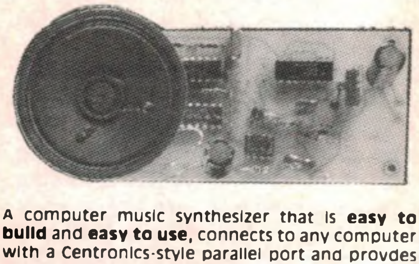

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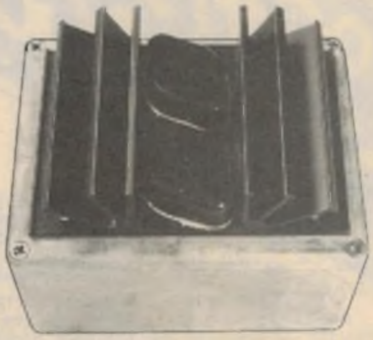

The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

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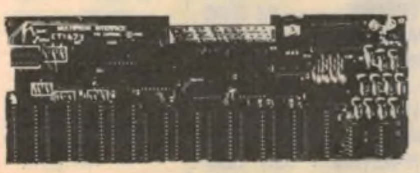

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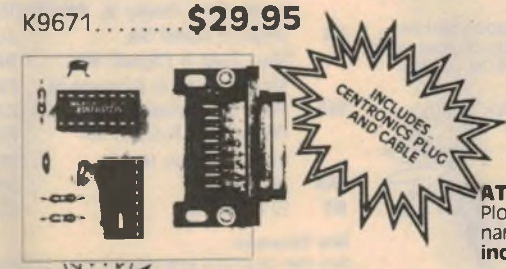
K9671........ **$29.95**

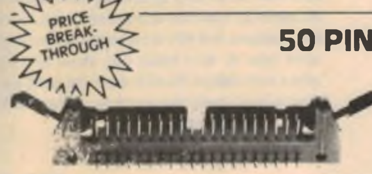


PROPORTIONAL JOYSTICK

K9674
$32.50
(ETI DEC '83)

AT LAST AN ANALOGUE JOYSTICK
Plot X-Y co-ordinates on the screen, sign your name. A great graphics aid. Complete kit **including case,** software example.

50 PIN EXPANSION SOCKETS



Right angle type to suit Microbee, floppy disk controllers etc
Mounts on PCB and mates with IDC sockets.

P 0932... **$6.50**ea 10 up ... **$6.00**

EPROM PROGRAMMER

(ETI JAN '83)

K9668 .... **$55.00**

Versatile, low cost and easy to build. Plugs straight into the microbee I/O port. Suitable for 2716, 2732, 2532, 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time.
KIT FEATURES Sockets for all other IC's 1 x 2716 supplied — get started straight away Front Panel and Mains (SEC approved) transformer 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included) DB 15 Plug Complete to last nut and bolt

(See Review ETI AUGUST 1983)

RADIOTELETYPE DECODER

(ETI APRIL '83)

K9733 .... **$19.50**

Display RTTY encoded messages on your Video Monitor. Receive up to date weather information, International News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques Single PCB Construction Kit includes DB15 Plug and backshell for connection to microbee Shielded pretinned PCB

MICROBEE LIGHT PEN

(ETI AUGUST '83)

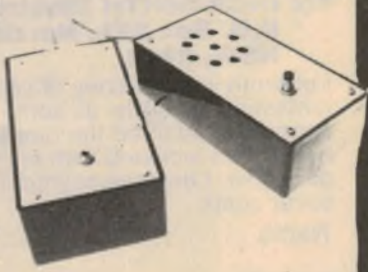
PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

K9649 .... **$19.95**

AT LAST — a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the I O port • Complete kit including DB15 2m CORD • Fully documented with software example

FAX-DECODER

(ETI SEPT '83)



K9733 .... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc and then reproduce them on your dot matrix printer.
- Complete kit of parts includes DB15, Ribbon Cable
- SOFTWARE LISTING

BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008-999-007 FOR NEXT DAY JETSERVICE DELIVERY

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008-999-007

OUT NOW! 1984/5 CATALOGUE

Inside this issue you should, by now, have discovered every hobbyist's dream: the all-new, updated, latest, bright, shiny, up-to-the-minute Dick Smith **Supercatalogue.**

You'll have already discovered the fantastic new products for '84. You might even have seen the 32 pages of hobbyist data. And you would have found a large number of our low, low prices are actually lower, lower than 1983!

What's that? You haven't discovered any of these things yet?

Your copy is MISSING?

Shock, shock. Horror, horror. Panic, panic.

How can you possibly last the rest of 1984 without your new Dick Smith Catalogue? It's like lasting the rest of the year without eating?

Stob sobbing this minute! Fill out the coupon below. Enclose a dollar and we'll send you a copy of your very own! And we'll even include a coupon inside so you can get your dollar back!

(Your coupon can also be used at any Dick Smith Electronics store.)

To: DICK SMITH Electronics
P.O. Box 321, North Ryde,
NSW, 2113.

I urgently need a copy of your incredibly fantastic catalogue, as some light-fingered nurd lifted the one that should have been included with my magazine purchase. I enclose payment of $1 to cover costs.

Name ....

Address ....

....

.... P/code .....

STORE LOCATIONS

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	Parramatta Rd & Melton St	AUBURN	648 0558
	T55 Terrace Level	BANKSTOWN SQ	707 4888
	613 Princes Hwy	BLAKEHURST	546 7744
	Oxford & Adelaide Sts	BONDI JCT	387 1444
	531 Pittwater Rd	BROOKVALE	93 0441
	147 Hume Hwy	CHULLORA	642 8922
	162 Pacific Hwy	GORE HILL	439 5311
	315 Mann St	GOSFORD	25 0235
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	263 Keira St	WOLLONGONG	28 3800
ACT	96 Gladstone St	FYSHWICK	80 4944
VIC	Creswick Rd & Webster St	BALLARAT	31 5433
	Cnr Hawthorn Rd & Nepean Hwy	BRIGHTON (EAST)	592 2677
	260 Sydney Rd	COBURG	383 4455
	Nepean Hwy & Ross Smith Ave	FRANKSTON	783 9144
	205 Melbourne Rd	GEELONG	78 6766
	399 Lonsdale St	MELBOURNE	67 9834
	Bridge Rd & The Boulevarde	RICHMOND	428 1614
	Springvale & Dandenong Rds	SPRINGVALE	547 0522
QLD	293 Adelaide St	BRISBANE	229 9377
	166 Logan Rd	BURANDA	391 6233
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	William St & Robinson Ave	PERTH	328 6944
	Centreway Acde, Hay St	PERTH	321 4357
TAS	25 Barrack St	HOBART	31 0800
NT	17 Stuart Hwy	STUART PARK	TBA

Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days. Or unforeseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first . . . just in case!

Thanks.

Dick Smith & Staff

STORE HOURS

All Dick Smith stores are open for trading during the normal trading hours for their particular area (either 9–5.30 or 8.30–5). Many stores are also open for late night trading. Please ring the store concerned for their particular hours.

SPEEDY PHONE/ BANKCARD ORDER SERVICE

Just phone your order and Bankcard details — it's so simple!

(02) 888 2105

Orders only on this number.
Enquiries: (02) 888 3200

HEAD OFFICE & MAIL ORDER CENTER:

P.O. BOx 321, North Ryde,
NSW 2113.
Tel: (02) 888 3200

Post & Packing Charges

Order Value	Charge
$5-$9.99	$2.00
$10.00-$24.99	$3.50
$25.00-$49.99	$4.50
$50.00-$99.99	$6.00
$100 or more	$8.00

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MAJOR RESELLERS

● **Atherton Qld:** Maarten's Music Centre, 55 Main St 91 1208 ● **Ballina NSW:** A. Cummings & Co. 91-93 River St 86 2285 ● **Bowral NSW:** Barry Gash Electronics, 370 Bong Bong St 61 2577 ● **Broken Hill NSW:** Hobbies & Electronics, 37 Oxide St. 88 4098 ● **Bundaberg Qld:** P M Electronics Takalvan St 72 8272 ● **Cairns Qld:** Electronic World Shop 27 K-Mart, Westcourt Plaza, Mulgrave Rd 51 8555 ● **Campbelltown NSW:** Fishers 'Chip' Shop, Shop 3, 274-276 Queen St. 27 1475 ● **Coffs Harbour NSW:** Coffs Harbour Electronics, 3 Coffs Plaza, Park Ave 52 5684 ● **Darwin NT:** Ventronics, 24-26 Cavanagh St 81 3491 ● **Deniliquin NSW:** Deni Electronics, 220 Cressy St 81 3672 ● **East Maitland NSW:** East Maitland Electronics 99 High St 33 7327 ● **Echuca Vic:** Webster Electronics 220 Packenham St ● **Gladstone Qld:** Purely Electronics Shop 2 Cnr Herbert & Auckland Sts 72 4321 ● **Goondiwindi Qld:** Border T R C 50 Marshall St 71 2353 ● **Gosford NSW:** Tomorrows Electronics & Hi Fi 68 William St 24 7246 ● **Inverell NSW:** Lyn Willing TV 22A Evans St 22 1821 ● **Launceston Tas:** Advanced Electronics 5A The Quadrant 31 7075 ● **Lismore NSW:** Decro Electronics 3A 6-18 Carrington St 21 4137 ● **Mackay Qld:** Stevens Electronics 42 Victoria St 51 1723 ● **Maryborough Qld:** Keller Electronics 218 Adelaide St 21 4559 ● **Morwell Vic:** Morwell Electronics 95 George St 34 6133 ● **Mt Gambier SA:** Hutchesson's Comm. 5 Elizabeth St 25 6404 ● **Mildura Vic:** McWilliams Electronics 110A Langtree Ave 23 6410 ● **Port Macquarie NSW:** Horton Centre Horton St 83 7440 ● **Nelson Bay NSW:** Dales Dynamics Cinema Mall Stockton St ● **Orange NSW:** M & W Electronics 173 Summer St 62 6491 ● **Port Lincoln S.A.:** Basshams T.V. & Computerworld 22 Liverpool St ● **Rockhampton Qld:** Purely Electronics 15 East St 21 058 ● **Shepparton Vic:** G.V. Electronics Centre 189B Corio St 21 8866 ● **Townsville Qld:** Tropical TV 49 Fulham Rd Vincent Village 79 1421 ● **Wagga NSW:** Wagga Wholesale Electronics 89 Forsyth St ● **Whyalla SA:** Mellor Enterprises Shop 2 Forsythe St 45 4764

DICK SMITH Electronics

DSE A727 PA

Letters to the editor

Low-powered public broadcasting stations

Recently, I have been interested in the "public" broadcasting stations that have come on-air in the Sydney metropolitan area. Naturally I was happy to notice that a "full frequency list" was published in the February issue. However, when I turned to page 126, I was dismayed to find an incomplete list.

My six additions are only for the Sydney area. If you have overlooked a similar percentage in the other capital cities, not to mention the rest of the towns and cities around Australia, your list must be woefully incomplete. I trust that this was only a case of someone not doing their homework, and not a snub just because they are low-powered!

How about an article on this new breed of broadcasters?

1629kHz	2RPH
88.1MHz	2RDJ
88.7MHz	2BCR
88.9MHz	2RSR
89.3MHz	2GLF
89.7MHz	2RES

I have read your magazine since the days of Radio, TV and Hobbies. Normally, they have been good.

C. D. Reynolds,
Paddington, NSW.

Comment: Our list was compiled using the most up to date information we could obtain from the Department of Communications. In fact, they have a book called "Sound and Television Broadcasting Stations 1983" which makes no mention of the stations you list.

Microphone in a football?

In the article entitled "Microphone in a Cricket Stump" (Feb '84) you confidently expressed your trust in the Australian side's ability to contain their emotions in "any situation that might give rise to undesirable language". Questioning this, we took an FM radio to the 1st WSC final played at the SCG on February 8, hoping (but not expecting) to be able to receive one of the four stump microphone signals.

Reception was found to be surprisingly good, considering the low power which the stumps must broadcast at. The instantaneous sound of willow-on-leather enhanced the game greatly.

We are pleased to be able to report that not once did a player disgrace himself near the stump operating at around 88MHz. All players maintained their composure even through the most trying moments of the game. We wonder what the Rugby League grand final would sound like if someone could get a microphone into the football?

S. Keller and C. Tinney,
Peakhurst, NSW.

Murphy's Law and its variants

For those interested in Murphy's Law, and many others, I wish to refer them to a little paperback by Arthur Bloch entitled: "Murphy's Law and Other Reasons Why Things Go Wrong", published by Price, Stern & Sloan, Los Angeles.

I don't know if it is available in Australia (I bought my copy in Denver, Colorado), but it assigns the origin of the law to one Captain Ed Murphy who was working on Colonel J. P. Stapp's experimental crash research testing.

Frustrated with a strap transducer which was malfunctioning due to a wiring error, Ed Murphy remarked: "If there is any way to do it wrong, he will" — referring to the technician who had wired the unit. George E. Nichols of the Jet Propulsion Laboratory assigned the title "Murphy's Law" to the statement and the associated variations.

Arthur Bloch's book contains 96 pages of variations on the law and corollaries which can be drawn from them: Finagle's Law, Sod's Law, the Laws of Gardening, Parkinson's Laws and many others. It is indeed a treasurehouse of laws covering many aspects of life.

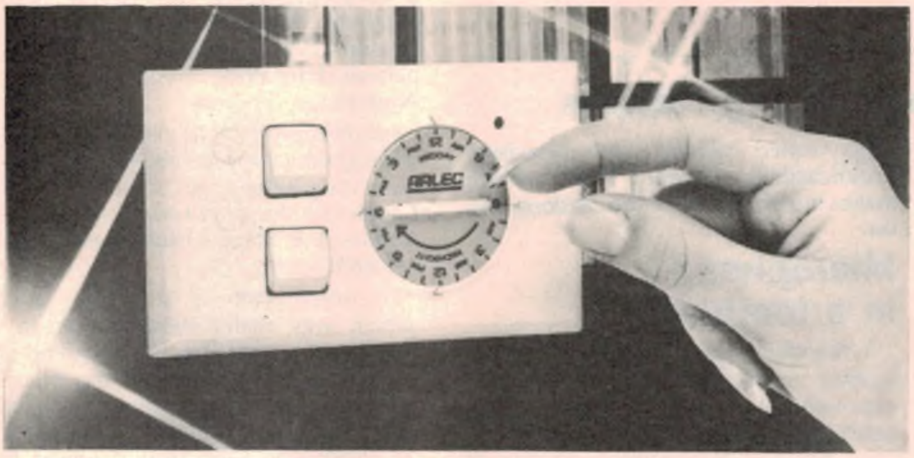
However, Bloch's book does not support reader D. Call's letter on the origin of Murphy's Law and most authorities I know agree with Bloch in attributing the law to Captain Murphy.

Although there are many variants of Murphy's Law, some of them exceedingly funny, the brevity and simplicity of this statement cannot, in my opinion, be excelled: "if anything can go wrong, it will".

Dr W. G. Flux,
Hobart, Tasmania.

New Products...

Product reviews, releases & services



Programmable time switch for security lighting

Arlec Pty Ltd has introduced the new PC700 "Security Switch" which can be programmed to turn household lights on and off up to 48 times each day to give a natural "lived in" look to homes. The idea is that burglars will be deterred by a variable pattern of lighting as they will be convinced that the occupants are present.

Long term observation of the house in an attempt to establish a pattern of light switching will also be defeated as the switch is designed to automatically turn lights on and off at slightly different times each day. It is also possible to simulate the normal "at home" pattern of lighting by allowing the security switch to program itself, based on manual switching of the lights over a 24 hour period.

An internal memory stores the times at which the light is turned on and off and can be instructed to continuously repeat this pattern whenever the householders are away from home.

The switch is designed for wall mounting and can replace existing wall switches directly. It will control incandescent lamps to a total of 500W but is unsuitable for use with fluorescent or other types of gas discharge lamps.

In normal use the lights can be controlled manually by pressing on the time setting dial, allowing lights to be turned on and off without disturbing the preset time setting stored in the memory. A power back-up feature will retain memory contents for five minutes during power failures.

Switching times are programmed by dialling a time setting and switching the lights either on or off. The switching operation and time are then automatically stored for future use.

For further information contact Arlec Pty Ltd, PO Box 170, Box Hill, Vic 3128. Phone (03) 840 1222, or branches in NSW, Queensland, South Australia and Western Australia.

"Do it yourself" six sector alarm controller

Dick Smith Electronics has introduced a new alarm system designed for installation and operation by the user. The home security control centre provides six individually controllable sectors, each with instant/delayed entrance and exit facilities and resistive detection loops which makes it more difficult to "jumper" window tapes and switch lines.

Provision for a fire alarm is also included, with a Panic/Fire siren control.

The unit is housed in a metal box with in-built mains supply and room for a back-up battery. On/off operation is by a keyswitch.

Other features of the unit include low power consumption, a test function, indicator LEDs for each sector and adjustable entry times. Designated Cat L-5100, the security control system retails for $199 and is available from all Dick Smith Electronics stores.

Bosch releases handheld VHF transceiver range

Bosch has released a synthesised handheld transceiver for the 146-174MHz VHF band. The new HFG164 transceiver can be programmed for operation on up to 32 channels and has a transmitter output of 2.5W. A range of options including five-tone selective calling, vehicle mounting hardware and rechargeable Nicad batteries are also available.

According to Bosch the HFG164 is the first of a new range of transceivers which will shortly include synthesised UHF and VHF low band transceivers.

Further information is available from Robert Bosch (Australia) Pty Ltd, Electronic Products Division, Cnr Centre and McNaughton Rds, Clayton, Vic.

Versatile counter timer from Global Specialties

Global Specialties Corporation has introduced a new counter-timer, the Model 5001, which offers a versatile combination of time and frequency-measuring capabilities plus signal-conditioning facilities. Operating up to 10MHz as a frequency counter, the Model 5001 also provides period and multiple-period averaging, time-interval and multiple-time-interval averaging, frequency-ratio measurement, and unit or event counting.

The Model 5001 has two DC-coupled BNC inputs both of 1MΩ plus 20pF input impedance and a sensitivity of 20mV RMS. Each has a three-position attenuator (x1, x10 and x100), a positive/negative-going slope selector and a variable trigger-level control. Maximum frequency at the "A" input is specified as 10MHz and at the "B" input as 2MHz.

An 8-digit, 7-segment filtered light-emitting diode display with 11mm-high digits is used to ensure easy readability in all ambient light conditions, and for ease in noting or recording displayed readings a variable-delay control is provided to add between 75ms and 7.5s to the usual display time of one gate period (which can be 0.01, 0.1, 1 or 10s), subsequent measurements are also postponed by this variable delay, and a "hold" position is provided if it is required to maintain the displayed reading indefinitely.

As a frequency counter, the Model 5001 provides a selection of four gate times from 0.01 to 10s, giving a selectable resolution of 100Hz, 10Hz, 1Hz or 0.1Hz. In each range, the decimal point is automatically positioned for a direct readout in kilohertz.

In the period-measurement mode, the Model 501 measures the time between successive rising edges at the "A" input. This measurement is taken over a range of one, 10, 100 or 1000 cycles, and the average period-per-cycle within the sample is displayed, giving resolutions of 100ns, 10ns, 1ns or 100ps, respectively. Maximum input frequency is 5MHz. The shortest period that can be measured is 400ns, and the longest is 10s.

Time-interval measurements are taken between the rising edge of the signal at the "A" input and the next rising edge occurring at the "B" input. This reading may be displayed directly for a single cycle, or averaged over 10, 100 or 1000 cycles, and the resultant resolution is 100ns, 10ns, 1ns or 100ps, respectively. The shortest interval that can be measured is 200ns.

The frequency-radio mode measures the number of cycles appearing at the "A" input. This information is displayed as a ratio of cycles of "A" per cycle of "B", with respective resolutions of 1, 0.1, 0.01 and 0.001.

Further information can be obtained from the Australian distributors, Vicom International Pty Ltd, 57 City Road, South Melbourne, Victoria 3205. Telephone (03) 62 6931.

JAYCAR BOOKS

VIDEO BOOKS

THE CHEAP VIDEO COOKBOOK

Complete discussion of a new, low-cost way to get words, pictures, and opcode out of your computer and onto any ordinary TV set. Don Lancaster outlines an easy-to-build, seven-IC circuit which you can build for less than $20. this circuit can be software-controlled to provide any alphanumeric or graphics format including a high resolution (256 x 256) and a four-colour mode.
256 Pages. 5½ x 8½.

Cat. BS-0510 .... **$11.95**

SON OF CHEAP VIDEO

This sequel to *The Cheap Video Cookbook* provides a complete video display system which you can build for as little as $7. Likewise, transparency display can be created for under $1 by using a video circuit called "The Snuffler" which is completely described in Chapter 2. This book makes cheap video even cheaper!
224 Pages. 5½ x 8½, soft.

Cat. BS-0604 .... **$15.95**

VIDEO TAPE RECORDERS
(2nd Edition)

In this completely revised 2nd edition of *Video Tape Recorders*, the author tells in simple language how helical VTR's work and how to operate or service them. Includes numerous examples of electronic circuits and mechanical systems.
400 Pages. 5½ x 8½, soft.

Cat. BS-0610 .... **$15.95**

VIDEO/COMPUTERS

by Charles Sippl & Fred Dahl

How to make full use of your home video equipment, how to transmit data over phone lines, display edited data, and more.

Cat. BS-0640 .... **$11.95**

CABLE TELEVISION
(2nd Edition)

Designed for the engineer or technician wishing to improve his knowledge of cable television. Each component of the cable system is examined separately and in relation to the system as a whole. 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. 5½ x 8½, soft.

Cat. BS-0560 .... **$21.00**

TV ANTENNAS AND SIGNAL DISTRIBUTION SYSTEMS

An aid in selection and installation of TV antennas and signal distribution systems and how to implement these systems for high-quality TV reception. Includes valuable performance data based on actual measurements made by the author.
256 Pages. 5½ x 8½, soft.

Cat. BS-0542 .... **$13.95**

THE COMPLETE HOME VIDEO BOOK VOLUMES I and II

by Peter Utz

Starts with elementary concepts, builds to more complex video activities, and ends with semi-professional techniques, graphics, copying a video tape, editing a video tape, planning and scripting, and more.

BOOK 1 · Cat. BS-0648 .... **$22.95**
BOOK 2 · Cat. BS-0649 .... **$22.95**

SINGLE-CAMERA VIDEO PRODUCTION HANDBOOK

by Barry Fuller

How to produce quality video programs with tips on audio, lighting, shooting, editing, set design, graphics, putting slides and film on video tape, and more.

Cat. BS-0644 .... **$29.95**

VIDEO FUNDAMENTALS

by Welby Smith

A practical handbook for entry-level video users. Presents ● money-saving ideas on choosing the right video equipment ● step-by-step instructions (with detailed diagrams) for making audio dubs, duplicating tapes etc. ● planning video programs from script development to location shooting.

Cat. BS-0646 .... **$22.95**

TRS-80 INTERFACING BOOK 2

Provides you with a number of practical and useful ways to utilize your knowledge from Book 1. Applications include how to generate voltage and current signals used in a variety of control applications, how to measure unknown voltages how to drive high current and high voltage loads, and many more. Complete software programs are included.
256 Pages. 5½ x 8½, soft.

Cat. BS-0574 .... **$16.95**

PET INTERFACING

Demonstrates how you can build numerous interfacing devices for your PET hardware. BASIC language programs are used throughout the book, so you should be familiar with this powerful programming language. The Commodore PET microcomputer has several special purpose interface connectors that ease the job of interfacing the computer to "real-world" hardware. Also includes a discussion of the microprocessor's internal architecture and general software/hardware interfacing.
264 Pages. 5½ x 8½, soft.

Cat. BS-0576 .... **$25.95**

'I buy my books at Jaycar'

MICROBEE BOOKS

★ USERS MANUAL

Is your manual old and tattered? Or do you want a spare manual? This manual has orange coloured guide pages to find the chapter easy. Neatly bound in an attractive cover and an asset to have beside your MicroBee. Excellent value.

Cat. XB-9002 .... **$15.95**

★ AN INTRODUCTION TO MICROBEE PERSONAL COMPUTERS AND PROGRAMMING

Just started learning BASIC? Then this is the book for you. With easy to read text and excellent examples it makes an ideal book for anyone wishing to learn to program the MicroBee.

Cat. XB-9003 .... **$14.95**

★ WORDBEE USERS MANUAL

This manual explains fully all of the facilities available to you using Wordbee. It explains everything from the basic commands through to preparing large documents and lots more. Unrivalled value.

Cat. XB-9001 .... **$7.95**

★ EDITOR/ASSEMBLER MANUAL

This manual covers all topics needed for your MicroBee Editor/Assembler. This includes full descriptions of error messages and has a program which you are guided through by the manual for "hands-on" experience.

Cat. XB-3000 .... **$7.95**

★ MICROSOFT BASIC

This neatly bound book contains all commands supported by Microsoft BASIC interpreter for CP/M-80. Each command is dealt with individually and commented on such as Purpose, Syntax and examples. An excellent book.

Cat. XB-9000 .... **$29.95**

★ MICROBEE ENGINEERING NOTEBOOK

This notebook contains hardware modifications, improvements etc. Some of the modifications include printer interfaces, cassette motor control, 64K ROM pack, Joystick and lots more. Definitely value for money.

Cat. XB-9020 .... **$2.00**

★ WILDCARDS Vol. 1

A potpourri of application notes and tips for the MicroBee. This book has received rave reviews from all computer publications. A must for all MicroBee owners.

Cat. XB-9010 .... **$15.00**

★ WILDCARDS Vol. 2

A potpourri of more application notes. Vol. 2 continues from Vol. 1, and again is a must.

Cat. XB-9011 .... **$16.00**

APPLE INTERFACING

Apple interfacing helps you to understand the important task of successfully interfacing your Apple computer to a variety of electronic devices. Using this book, you will be able to perform useful experiments which will provide a much clearer understanding of the fundamentals of computer interfacing and computer electronics. You will be better able to understand interactions between computer hardware and software so that you can effectively communicate with your Apple computer.
208 Pages. 5½ x 8½, soft.

Cat. BS-0568 .... **$15.95**

MOSTLY BASIC: APPLICATIONS FOR YOUR APPLE II, Book 2

Provides you with 28 ready-to-use. BASIC language programs which have been completely tested and debugged for use on your Apple II. Includes a telephone dialler, digital stop watch, spelling test, a house buying guide, a gas mileage calculator, and many others useful to businessmen, hobbyists, scientists, and computer enthusiasts.
160 Pages. 8½ x 11½, comb.

cat. BS-0600 .... **$17.95**

APPLESOFT LANGUAGE

Sams offers you the *only* complete text on Applesoft BASIC. The book is written in a self-paced, self-teaching format, using easy-to-understand, non-technical language. Apple II owners who use Applesoft BASIC are introduced to Applesoft syntax, step by step and at an easy pace. Perfect for all Applesoft programmers, including hobbyists, businessmen, and professional users. There are a number of ready-to-use programs and a section on the use of low resolution graphics.
256 Pages. 5½ x 8½, soft.

Cat. BS-0570 .... **$14.95**

TRS-80 INTERFACING BOOK 1

Written for users who have a fairly good understanding of Level II BASIC. Author John Titus introduces you to the various I/O signals used by the TRS-80 and explains how these signals can be used in a number of interesting and practical circuits. Numerous hands-on experiments are included.
192 Pages. 5½ x 8½, soft.

cat. BS-0572 .... **$15.95**

EXPERIMENTS IN ARTIFICIAL INTELLIGENCE FOR SMALL COMPUTERS

Conducts interesting and exciting experiments in artificial intelligence with this book, a small computer with extended BASIC and some knowledge of the BASIC language. The author first introduces you to artificial intelligence - the capability of a device to perform functions normally associated with human intelligence, such as game playing, problem solving, reasoning, creativity, and verbal communications. Then game-playing programs, with a checkers-playing game as the main topic are explained.
112 Pages. 5½ x 8½, soft

Cat. BS-0512 **$12.95**

CP/M PRIMER

If you are a first-time microcomputer user wanting to increase your technical knowledge or a veteran who wants to explore switching to the CP/M operating system, this book can help you find the answers. It's the only complete one-stop source available on CP/M - the very popular operating system for 8080-8085 - and Z80 based microcomputers. Includes a complete list of CP/M compatible software, too!
96 Pages. 8½ x 11 soft.

Cat. BS-0564 **$24.95**

THE COMPUTER IN YOUR LEGAL PRACTICE

by Michael Marcus & Leroy Brown

For lawyers, a book on how to computerize their practice. Applications include ● law office management ● data bases and research ● document control ● word processing ● records management ● accounting ● electronic mail and more.

Cat. BS-0678 **$25.95**

HOW TO MICROCOMPUTERIZE YOUR SMALL BUSINESS

Compiled by the staff of a major time-sharing service bureau and computer consulting firm, this book takes the technicality out of microcomputers - enabling managers to make computer decisions rationally and wisely. Case histories and step-by-step guidelines instruct readers on: data processing capabilities, equipment selection, potential pitfalls, soliciting bids, implementation and evaluation.

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An introduction to the Microsoft Disk operating system that gives the beginner a complete explanation of DOS fundamentals including DOS for the IBM-PC (over 60 computers use MS DOS or a related version). Provides handholding examples.

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by Ken Susnjara

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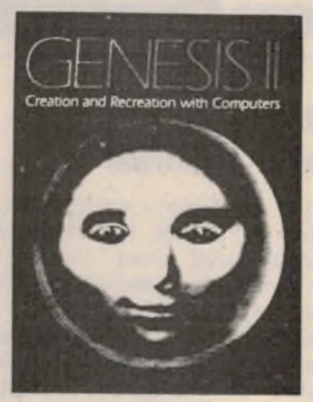

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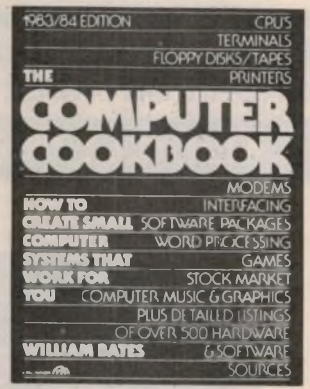
Cat. BS-0700 **$23.50**



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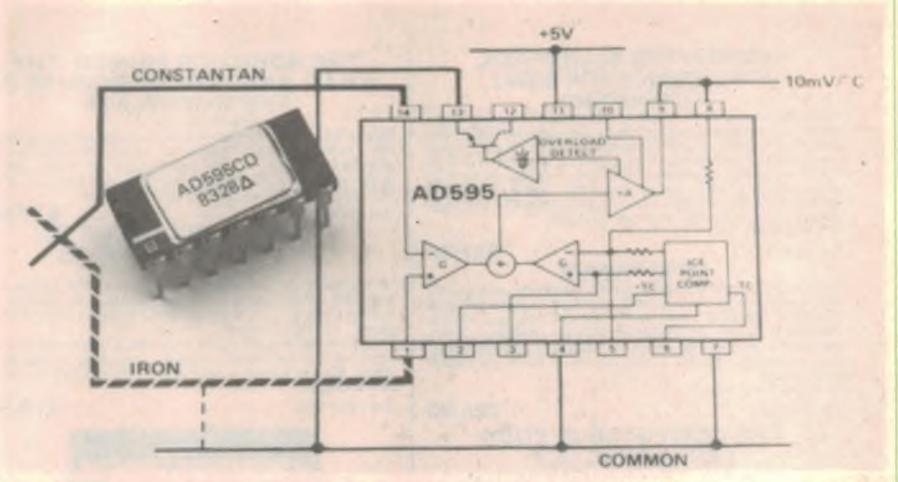
Colour chart of radio spectrum

The Department of Communications has produced a colour-coded chart showing the complete use of the radio spectrum frequency in Australia. The information on which the chart is based is set out in the Australian Table of Frequency Allocations, which in turn is based on the International Telecommunications Union (ITU) radio regulations.

The new chart provides a quick and easy-to-read guide to Australia's increasingly congested frequency spectrum. Each band is divided into sub-bands which are used by particular services such as land-mobile radio, broadcasting, aeronautical, maritime or space services. The spectrum used by different services is shown in the chart by different colours.

The chart is available from Australian Government Publishing Service outlets in all capital cities at a cost of $3.00.



Single chip amplifier for thermocouple controllers

Parameters Pty Ltd has available a new integrated circuit thermocouple amplifier, the AD595, for use in temperature measurement and control applications.

The chip provides a temperature measuring circuit, instrumentation amplifier and open thermocouple alarm circuit and allows temperature to be measured with an accuracy of ±1°C. Control pins allow the AD595 to function either as a set-point controller with a switched control output or as a temperature transducer with an output of 10mV/°C.

In the event of a broken thermocouple connection the chip will also produce an alarm signal which can be used to trigger an automatic controller interrupt or drive a LED in a manual control system.

For further information contact Parameters Pty Ltd, 41 Herbert St, Artarmon, NSW, 2064. Phone (02) 439 3288 or 53 Governor Rd, Mordialloc, Vic, 3195. Phone (03) 580 7444.

MODEL 175 AUTORANGING BENCH/PORTABLE DMM

KEITHLEY INSTRUMENTS

The new Model 175 Autoranging Bench Digital Multimeter, from Keithley Instruments, Inc., combines the measurement capabilities of much higher-priced system DMMs with several new features to extend its utility, yet retain simplicity of use. Ideal for use as a bench meter in production or lab work, this 4-½ digit autoranging DMM also has a field-installable battery option, making it fully portable. Fast autoranging (up to 200ms per range change on DCV) enables the user to concentrate on getting the reading without worrying about choosing the appropriate range.

The Model 175 features digital calibration for reduced cost of ownership, as many users can now calibrate the meter in-house. With the Model 1753 IEEE-488 (GPIB) option, the 175 is the lowest-priced IEEE-interfaceable DMM available.
Model 175's 100-point data logger monitors drifts, determines rates of change, and collects response curve data without a printer, output cables, or complicated hook-ups. The data logger has six different store rates from one reading/400ms to one reading/hour, and data recall is "push-button" easy.

Other features of the Model 175 include:
- 4-½ digit LCD display with annunciators for function, range, and feature indication
- 10µV/10mΩ/10nA sensitivity
- 0.03% basic DCV accuracy
- True RMS AC
- 10A capability
- 100kHz bandwidth in AC
- dBm/relative function
- Relative reference
- Max/Min reading hold
- Safety input jacks
- Front panel accessible amps fuse

For more information on the Model 175 Autoranging DMM, or on a variety of other industrial electronic testing and measurement equipment, contact:

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New chip for April

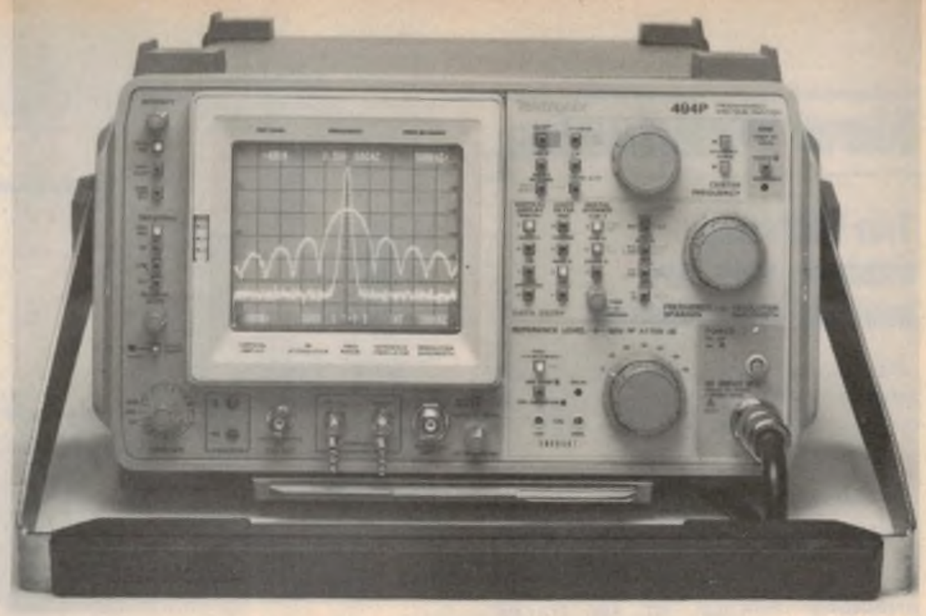
Scientists at FTL Corporation announced on April 1 that they had perfected a new logic process called FTL (Faster Than Light). The process allows the production of standard logic devices which have a negative propagation delay.

FTL said that the new production process would allow the construction of more user-friendly computers. A word processor, for instance, built with the new chips would actually anticipate what the user was about to type and display it on the screen before it was written, eliminating tedious keyboarding.

Other applications are seen in transient detection and fault monitoring. The FTL chip can sense that a power line transient is about to occur and shut the system down before any damage is done.

"We are also working on a share market analysis program and a Lotto selector using FTL logic. Our new computer system has predicted big sales for the devices," a spokesperson said.

Free samples of the new devices are available to customers who apply on April 1.



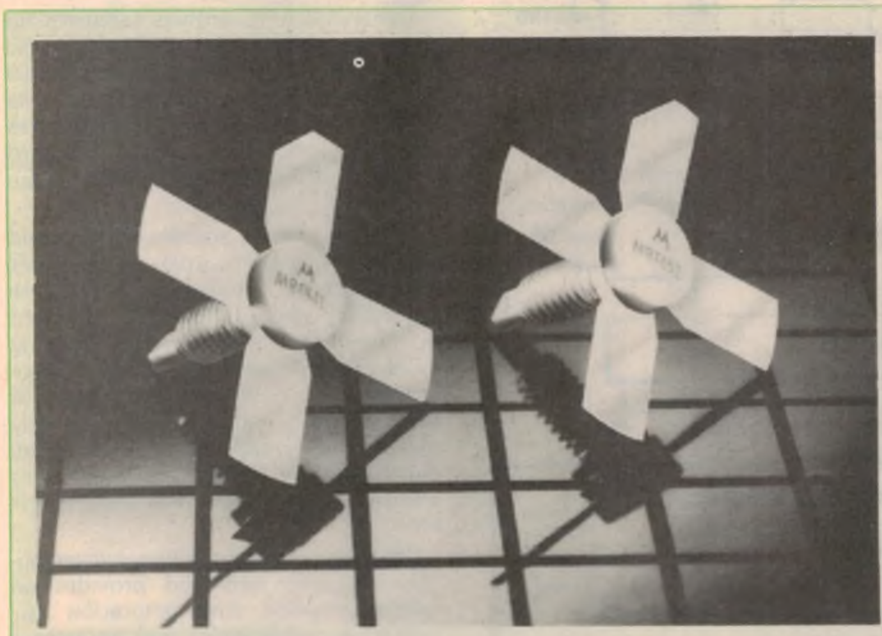
Tektronix launches new spectrum analysers

Tektronix has introduced two new spectrum analysers, the Model 494 and a programmable version, the 494P. The new analysers cover a frequency range of 10kHz to 325GHz and offer a "help" mode which provides explanations of controls and functions on the unit's CRT screen.

The portable spectrum analysers also offer accuracy of ±13Hz at 7.1GHz and ±27Hz at 21GHz, 30Hz resolution and direct entry of frequency, span/division, reference levels and vertical scale factors through a numeric keypad. Ten on-board registers are available for storage of control settings.

Additional 50-75GHz, 75-110GHz and 110-170GHz coverage is also included, with waveguide mixers for these frequencies to enable amplitude and frequency specified waveguide mixers covering from 18GHz to 325GHz.

Further details are available from Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW, 2113. Phone (02) 888 7066.

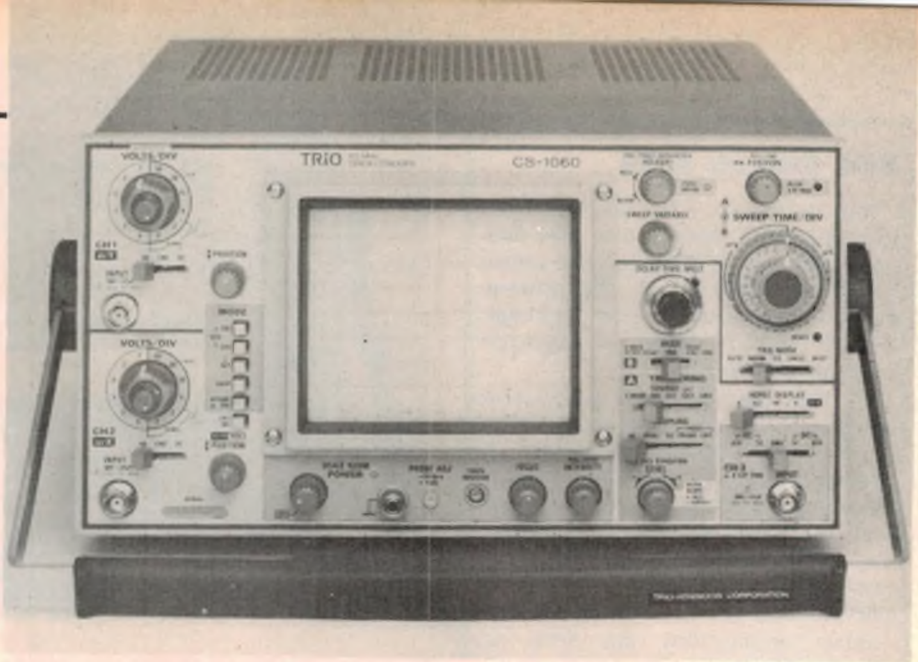


High gain RF transistors from Motorla

Motorola has introduced two new high gain UHF and 800MHz RF power transistors, the MRF652 and MRF841, providing a minimum gain of 8.5 to 10dB and a typical efficiency of 65% at an output power of 5W. Both new devices are designed primarily for driver and output stages in mobile and handheld equipment. Higher gain and improved power dissipation are the chief advantages claimed for the products.

New Products...

Trio CRO range expands with two new six trace models



Parameters has announced new additions to the Trio range of oscilloscopes, the CS-1060 and the CS-1040.

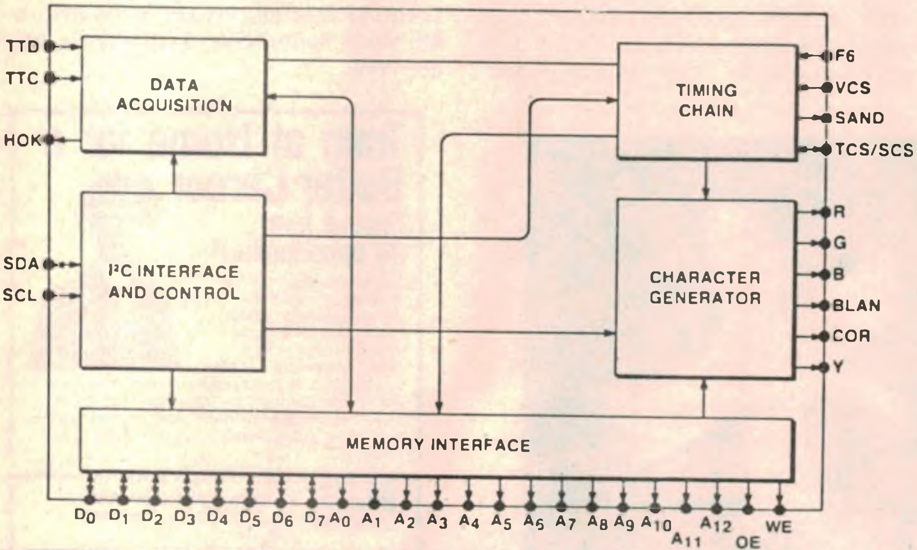
The two new models feature three channels each of which can be displayed simultaneously using the main sweep while individual delayed waveforms of these channels can also be displayed providing a total of six traces. Bandwidths are 60MHz (CS-1060) and 40MHz (CS-1040).

Along with the wide bandwidth and six trace capability goes a range of other capabilities such as sensitivity down to 1mV/div, a 150mm rectangular, high resolution 16kV CRT with an illuminated inner-face graticule and eight full divisions of usable dynamic range for accurate, undistorted waveform display. In addition they feature vertical-axis signal output (for a frequency counter etc), and automatic synching of video signals.

Indicative of the new styling adopted by the 100MHz models, the CS1040/60 come in a lightweight (11kg) package measuring 304mm x 160mm x 401mm. The carrying handle doubles as a tilt stand for user convenience and controls are grouped by function and colour coded.

For further information contact Parameters Pty Ltd, PO Box 573, Artarmon, 2064. Phone (02) 439 3288.

Second generation Teletext chip set



Philips Electronic Components and materials has introduced two new integrated circuits which together provide all the functions necessary for a Teletext decoder.

The SAA5230 IC extracts Teletext data from the video signal, regenerates the Teletext clock and synchronises the text display to the television sync signals. Its companion, the SAA5240 incorporates all the logic functions of a UK standard Teletext decoder as well as a Viewdata (Prestel) display generator.

The SAA5240 is actually a dedicated microcomputer and gives set manufacturers a selection of software controlled features which are not economically feasible with existing Teletext chip sets. Up to four page requests can be processed simultaneously and initiated directly using a direct multi-page memory drive, eliminating the need for TTL interfaces and significantly improving page access time.

The IC also switches between three on-chip character sets and provides an internal cursor for generation for interactive applications and an output for a hard copy printer. Facilities have also been included for advanced features such as full channel Teletext reception and an 8-bit data receiver to allow computer software to be delivered in place of the Teletext signal.

For further information contact Philips Electronic Components and Materials, 67 Mars Rd, Lane Cove, NSW, 2066. Phone (02) 427 0888.

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The supplier Boo-Boo'ed and we got them! Will take ¼" shaft and has retaining grubscrew.
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Fantastic. PCB terminals, panel mount.
FEATURES: ★ Right and left input jacks are different colours to assist identification ★ Earth binding post included ★ 2 rows of eight. Can be snapped apart (vertically) for smaller configuration.
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NEW MICROBEE SOFTWARE BEE BUG

A very well written utility program. It locates, disassembles single steps with break point, watch point and displays the registers. It's a definite must for M/C language programmers.
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BRILLIANT NEW COMPONENT

AS USED IN THE LATEST PERREAUX & YAMAHA AMPS

Modern high-power amps produce voltages at the speaker terminals which can give a nasty shock. The new PT-3010 efficiently connects and insulates the exposed speaker wire. The bare wire is simply inserted and the plastic shroud twisted.

The connector is capable of panel mounting and is ideal for PCB termination with panel fixing. The PT-3010 is supplied as two rows of alternate black and red twist terminals.
Cat. PT-3010

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MINI BREADBOARD

Just the right thing for many small projects. This board has the same features as our larger breadboards but measures a compact 80 x 60mm. It has 420 holes. Perfect for the occasional project.
Cat. PB-8808

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BARGAIN 4700 CAN CAPS

4700uF/40V quality Philips upright chassis mount caps. Screw terminals.
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ONLY $2.95 each

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EXCLUSIVE TO JAYCAR

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SIMPLE TO USE You only have to connect power and a TV signal and you're away. (Instructions supplied)

DON'T PAY HUNDREDS OF DOLLARS TO UPGRADE YOUR PERFECTLY GOOD VHF TV TO AN EXPENSIVE UHF SET!

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UHF Tuner Module $34.50

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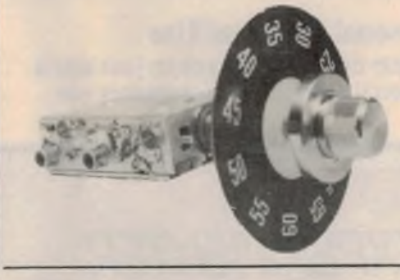

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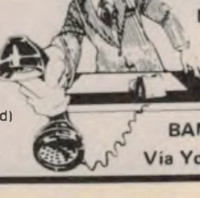

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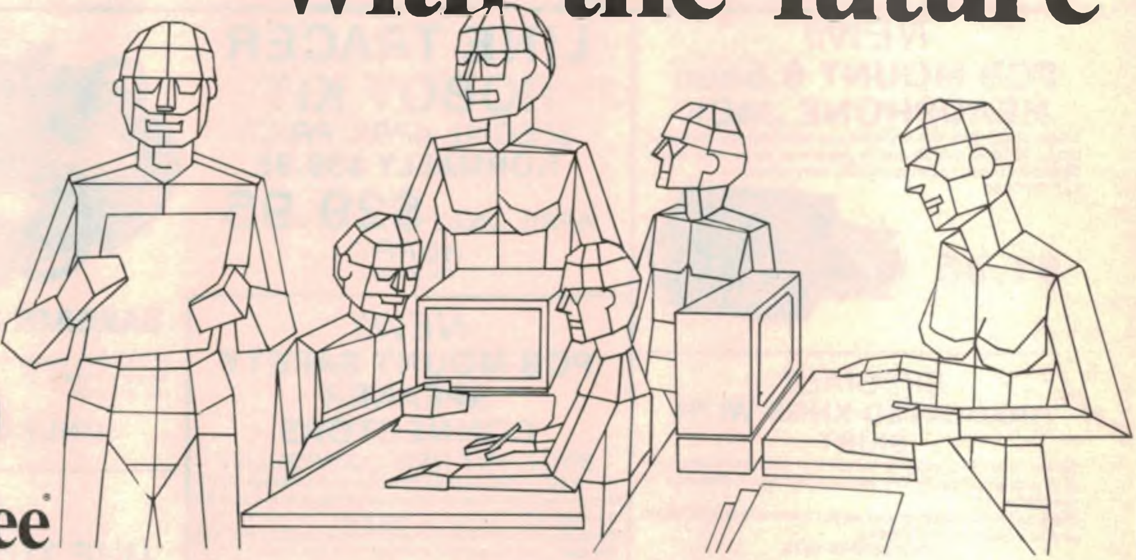

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microbee is now officially recognized as Australia's Educational Home Computer. With the release of BEENET 2 it is now possible to NETWORK 16 or more **microbees** in a classroom with each student station linked to the teacher's file server to produce the ideal classroom system sharing printers, disk drives and rapidly transferring information as required.

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Not all applications need to be so serious. **microbee** is ideal as a basis for exciting and stimulating games for all the family. Fast moving graphics, sound effects and over 200 top quality popular games mean your **microbee** is ideal for family fun as well.

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Microworld BASIC has long been a powerful feature of the **microbee**. A vast library of educational, entertainment and utility software is now widely available on the market. Microworld BASIC supports full high resolution graphics, colour if required, music, I/O data can be directed at will and, best of all, MW BASIC is a breeze to learn to program yourself.

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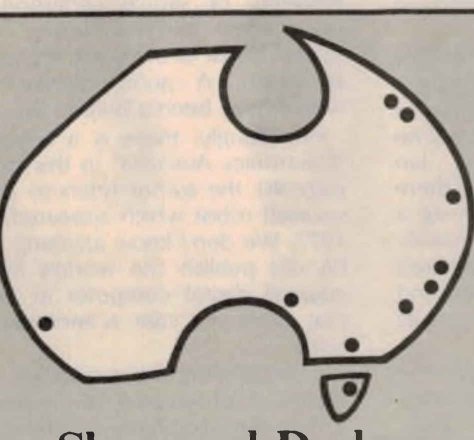

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Books & Literature

The truth about home computers

MICROCOMPUTERS by Ian Reinecke. Published 1983 by Penguin Books Australia Ltd, Victoria. Soft covers, 114 x 181mm, 205 pages. ISBN 0 14 00 7170 9. Recommended retail price $6.95.

At last, someone has got around to putting out a no-nonsense book which seeks to counter all the hyperbole about personal computers. Ian Reinecke's book is not for the person who has decided what personal computer to buy or the person who wants a detailed comparison of the major computers on the market.

Instead, the book is written solely for the completely non-technical parent who feels that he should buy his son or daughter a computer so that they will be well-prepared for the future. Ian Reinecke makes it quite clear that there is a vast difference between buying a low-cost machine which is mainly intended for playing games compared with a machine costing several thousand dollars which is needed if any real use its to be obtained.

Educational software is put right into perspective with the author indicating that the whole subject is really a joke. Parents wanting to do the right thing by heir children would be better off nsidering the purchase of a set of yclopaedias.

The book is completely non-technical in approach. In fact, the author seems to have gone out of his way to avoid being technical. He has probably carried this to extremes when he persists in referring to video monitors or terminals as "screens".

On the other hand, on the occasions when he does become slightly technical, he makes a mess of it. For example, on page 56 he mentions that the "green of the characters produced on most video monitors is produced by phosphorescence, the same quality which makes clock faces glow in the dark". We wonder how all other cathode ray tube devices work!

Similarly, the author should be advised that "more expensive" computers do not necessarily transmit data over the telephone lines at a higher data rate than cheaper models. The limiting factor is the data handling capacity of the telephone lines, not the computer. Someone should also explain to him the difference between compilers and interpreters, and that most microcomputers *do not* use compilers.

To say that a light pen, for instance, transmits light, rather then being a passive light sensor, is an excusable technical error. To say that the Osborne Executive computer is compatible with the IBM PC is more serious, but possibly understandable in that the Osborne can read IBM data disks, but not run the programs. However to say that the Microsoft company is the author of "WordStar" indicates a failure of research, or simple confusion. While these errors do not detract from the overall thrust of the book they do cause confusion. A good technical editor would have been a help in this respect.

Interestingly, there is a reference to "Electronics Australia" in this book. On page 40, the author refers to a build-it-yourself robot which appeared in EA in 1977. We don't know anything about it. EA did publish the world's first do-it-yourself digital computer in 1974 but that does not rate a mention in this book.

Even so, while these quibbles indicate some lack of research on the part of the author, the overall theme of the book is good and will serve as a useful balanced overview of the computer market for those who have no knowledge of computers at all. (L.D.S.)

Motorola data books

MOTOROLA SMALL SIGNAL TRANSISTOR DATA. 1st edition published 1983 by Motorola Inc. Soft covers, 175 x 231mm, 1200 pages approx. $18.95.

MOTOROLA RF DATA MANUAL. Second edition published by Motorola Inc, 1981. Soft covers, 175 x 231mm, 1160 pages approx. $16.95.

The above two data books are now available from all Dick Smith Electronics stores at the indicated prices. They will both be very useful to the hobbyist and engineer alike as hitherto data for discrete devices has been relatively hard to come by.

Both data manuals are very comprehensive and present complete data for all the relevant Jedec devices as well as the host of devices sourced only from Motorola.

To a small extent the Small-Signal Data manual overlaps the RF Data Manual in that it covers RF transistors and Field-effect devices. However, while the former book is confined almost entirely to device data, the RF book has a great deal of design information which is essential to anyone delving into RF.

Both books can be recommended to anyone wanting data on discrete devices. Have a look at them at your DSE store. (L.D.S.)

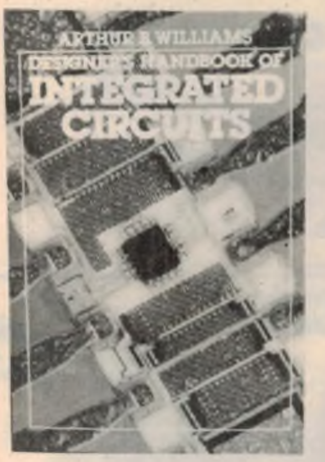
Designer's handbook

DESIGNER'S HANDBOOK OF INTEGRATED CIRCUITS by Arthur B. Williams. Published 1983 by McGraw-Hill Australia. Hard covers, 160 x 235mm, 806 pages. Illustrated with many diagrams and tables. ISBN 0 07 070435 X. $126.50.

The aim of this book is to assist the engineer or technician in the selection of ICs for a given application and in the choice of the particular circuit configuration. It assumes that the reader has a good engineering background; it is not a book for the hobbyist or student.

There are 14 chapters in all, outlined as follows. Chapter one covers the review of op amp theory. Chapter two is titled "Function Circuits" and is devoted to four quadrant multipliers, waveform generators (such as the XR2206), voltage-to-frequency converters (and vice versa) and so on. Chapter three covers active filters using op amps and is probably of the most practical use to many designers. Chapter four covers the whole gamut of telecommunications circuits, from pulse diallers and DTMF (dual tone multifrequency) encoders to Codecs and PCM line filters. Chapter five covers phase-locked loops while chapter six is devoted to timer ICs.

Chapter seven is titled "IC Power Management Circuits" and covers linear and switch-mode regulators. Chapter eight covers A/D and D/A conversions. Chapters nine and 10 cover SSI and MSI logical circuits respectively and chapter 11 is devoted to microprocessors. The final three chapters are devoted to optoelectronics, LSI peripheral devices and interface circuits.



On the face of it, the book appears to cover just about every IC application there is but the question is whether it is of much use to a practical designer who already has a good background knowledge. For example, the chapter on timer circuits deals at some length with devices such as the 555 but the information provided is no more comprehensive than that provided by the IC manufacturers. In fact, when it comes to unusual applications it is a good deal less useful.

Similarly, the chapter on active filters effectively covers most filter configurations but none of the information is really specific enough to help with a practical design.

continued on page 138

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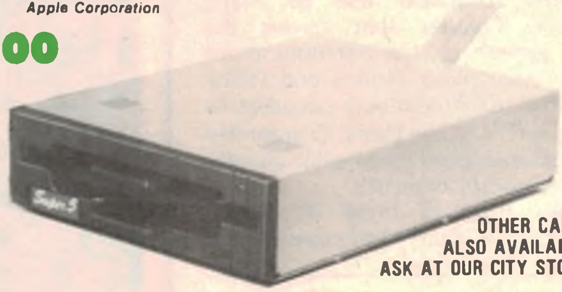

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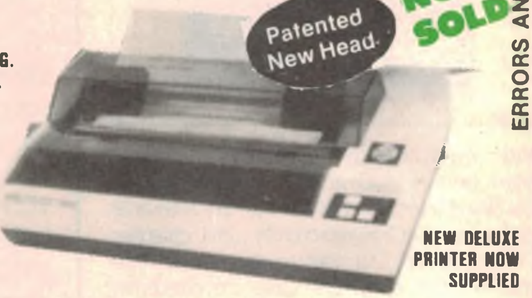

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ELGAR SERENADE

English pieces for Small Orchestra. Elgar, Vaughan Williams, Warlock, Butterworth and Delius. The Academy of St Martin-in-the-Fields conducted by Neville Marriner. Argo Analog Disc ZRG 945.

Here is a collection of sophisticated lollipops, to use a favourite term of the late Sir Thomas Beecham. They are well contrasted and all are easy to listen to, even by a tyro.

Elgar's serenade though an early work, was set down with great assurance. Its atmosphere is post-Victorian bourgeois comfort. Elgar was schooled thoroughly on the late 19th century romantics though even his earliest works show a mind of his own and a style which always dwells lovingly on the interval of the rising sixth. This Argo analog has a fine bloom and impeccable clarity.

Elgar was no hacking-jacketed squire. It was perfectly natural for him to drop into the local pub to place a bet with the SP bookmaker. He came of modest origins and wrote like an aristocrat.

Delius flourished during the peak of the folk song period as was the case all over Europe. The Cuckoo is of Norwegian origin though it was our Percy Grainger who gave him the lovely melody he found in Lincolnshire for use in Delius' Brigg Fair. In the Cuckoo we have Delius in a mood of placid joy, his theme richly harmonised, indeed there is a surprise in nearly every bar. There is no bustling gaiety. Just plain delicious peace.

Butterworth, represented here by his Banks of Green Willow is perhaps not heard at his most attractive though this simple work displays the promise that was so meanly interrupted by his death fighting in World War I. He too was one of the folk song enthusiasts.

It will be noted that all the composers are British and the recital closes with the great Tallis Fantasia of Vaughan Williams and an exhuberant set of early French Dances by the ebullient Peter Warlock. The whole disc is beautifully played and recorded and I can recommend it without hesitation. (J.R.)

TCHAIKOVSKY

Piano Concerto No. 1 in B Flat Major. Claudio Arrau (piano) and the Boston Symphony Orchestra conducted by Sir Colin Davis. Philips (Arrau Edition) analog disc 6851 516.

I share my admiration of Michelangeli with Claudio Arrau though they are a good generation apart and Arrau has reached the stage where one says: "Isn't it wonderful that he plays at all." And I also share my disappointment with Arrau's Tchaikovsky as I did Michelangeli's Emperor. But for different reasons. (See opposite page).

I have never heard either artist before in the works but my dislike is for different reasons. I felt that the Italian wasn't keen on the inflated concerto but Arrau was altogether too gentlemanly to cope with the Russian's pyrotechnics.

Philips have done Arrau proud in their presentation of his recording. A double disc with the two inside covers filled with pictures of Arrau as he was at various ages. And what a handsome chap he appears as a young man. The technical contents are not up to the same standard.

There is a fair bit of reverberation, the piano tone is slightly honky-tonky and the piano was recorded a bit too forward to balance well with the orchestra. And the conductor's name contains a slight puzzle. It reads "Conductor conducted by Director Sir Colin Davis", whatever that may mean.

Arrau's reading is, not surprisingly, a refined one. There is no vulgar bashing or flashy fireworks. It is a very gentlemanly reading though it is never sissy. The sound is not very attractive — an unusual state of affairs with Philips especially as this is one of a so-called Arrau series. Some unusual notes are emphasised in the cadenza. To sum up, much as I admire Arrau this is not a disc I would recommend.

The second movement starts eccentrically slowly but picks up later and by the time players reach the little nursery tune everything is delightful. The scherzando bit is a delight and more like the real Arrau and the finale is up to tempo, but the balance is a little odd here and there, I repeat, not for me. (J.R.)

DUKAS

L'Apprenti Sorcier, La Peri, Overture to Polyeucte. Rotterdam Philharmonic Orchestra conducted by David Zinman. Philips Analog Disc 9500 533.

An unusual event — an indifferent technical recording from Philips. La Peri has so wide an analog dynamic range that the opening bars are literally inaudible when the gain is fixed to make the fortissimos bearable. Also in the loud tuttis the eloquent Dukas scoring is lost in the bedlam.

The balance is variable. The shimmering figurative background quite overwhelms the melody here and there. Altogether very disappointing, especially from Philips.

The Apprentice is better though far from first class Philips. This is very well played and reasonably recorded. The usual abridged score is used. I suspect further abridged although I couldn't check this repetitive piece without a score.

Zinman loses no time jumping into the

tempo nor does he linger long on pauses. But on the whole everything is far superior than in the Peri. The Polyeuchte overture is a very early work and not characteristic Dukas. Here the young composer is struggling hard with the spirit of Wagner which pulls him first one way and then the other. The result – honours even.

This is the best recording of the three and its background atmosphere is truly tragic in the Corneille tradition. Here is a classic example of a promising young composer struggling to throw off the shackles of a great predecessor. (J.R.)

BEETHOVEN

Piano Concerto No. 5 (Emperor) Michelangeli and the Vienna Philharmonic Orchestra conducted by Carlo Maria Giulini. DGG Analog Disc 2531 385.

While I yield to no one in my admiration for Michelangeli's playing – if he's not the best in the world today who is better? – I must confess disappointment with this Emperor of his. To me it sounds as if he doesn't like it much. Thumped accents and strange divergences from the score markings disfigure the work to my mind.

The whole work is full of idiosyncracies sometimes amounting to eccentricities and sometimes downright perversities. His attitude to the work made me think he treated it superciliously.

It would be impossible in a review this length to describe every fault – and I am using not too strong a word. In addition to the misplaced accents there is a bad balance between the piano and orchestra, the piano being placed so forward that important orchestral passages are lost. This however might be blamed on the live recording with its tags of first and last applause.

Michelangeli starts imperiously then becomes pugnacious. In this he is obviously encouraged by Giulini and the orchestra, perhaps under strong persuasion from the conductor. Giulini as a rule does not underplay his accompaniments. Technically the performance is irreproachable, indeed there are moments when it could be described as descending to mere virtuosity.

Some of it is unbearably strident. Here and there you find something interesting in the way of rhythmic treatment. One factor much in its favour – though it is a live recording the audience is impeccably behaved. No coughs or feet shuffling distract the attention. I nearly wrote "more's the pity." (J.R.)

DEVOTIONAL

Instruments of Praise, featuring the Tom Keene Orchestra. Stereo LP, Light LS-5823. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135).

To go by the title of this album, one would rather expect it to be a forthright orchestral presentation of the great praise hymns of the Christian church. In fact, it is something quite different, as noted on the reverse side of the jacket:

"Whispering strings and woodwinds sing the melodies of these classic hymn favourites. Let them lead you into those quiet moments of praise, prayer or just peaceful repose."

Tom Keene uses his orchestral voices collectively and individually by way of variety, but he maintains an overall even volume and even tempo to sustain the relaxed, restful mood.

There are four five-minute brackets on each side as follows: (1) Songs of our Heavenly Father, of our Saviour, of God's Nearness, of God's Dearness. (2) Songs of dedication, of God's indwelling Spirit, of God's love and grace, of Jesus' love for us. The 26 hymn tunes making up these brackets are all well known, and few churchgoers will need to be reminded of the words.

Recorded in the Paramount Recording Studio in Hollywood, the quality is well up to standard but whether you enjoy the contents will depend on you and your lifestyle: whether you take time off occasionally to relax and meditate in the way that Tom Keene has in mind. (W.N.W.)

VOICE OF IRELAND

Clannad: "Magical Ring". RCA stereo LP PL-70003; re-branded RCALP-6072.

In the absence of any jacket notes or supportive literature, I know very little about the background to this particular album.

It was manufactured in Germany for international release through RCA but was recorded and mixed in London, apart from one track which originated in Dublin. It has received some airplay in Australia.

If names mean anything, the five young vocalists pictured on the cover are as Irish as Dublin itself but the acknowledgements, which include Yorkshire TV, would suggest that they are based mainly in England.

Backed by four guest musicians (drums, percussion, accordian and electric guitar) they present their own gentle, folk-like arrangements of songs, some traditional, some composed by members of the group. The titles: Theme from Harry's Game – Tower Hill – Seachran Charm tSiail – Passing Time – Coinleach Glas an Fhomhair – I See Red – Ta Me Mo Shui – Newgrange – The Fairy Queen – Thios Fa'n Chosta.

It is a pleasant, gentle sound and the quality is excellent.(W.N.W.)

FOLK-ETHNIC-ROCK

Sirocco: "Earth Dance". Stereo LP, Arika AR006. (From Arika Records, P.O. Box 2, Pymble, NSW 2073.

If you haven't caught up with them as yet, Sirocco is a Sydney-based group who are pursuing a common interest in folk-based music – not necessarily with the objective of re-creating the original

Records & Tapes

Sirocco: From left, Bill O'Toole, Andrew De Teliga, Guy Madigan, Michael Atherton.

form but of using it as an inspiration for experiment and development in a present-day context. To that extent it might be described as musical exploration but I suspect that some of it at least, is produced for the fun of it!

The group comprises Bill O'Toole, the founder, instrument craftsman and bagpipe player, who also happens to play a string of other instruments, some of them his own creation. Then there is Andrew de Teliga, an ex rock-and-roll guitarist, who is most at home with strings, but can turn his talents as necessary to vocals and drums. Guy Madigan is the Group specialist on drums and percussion, while Michael Atherton can take a turn at a whole array of string and wind instruments, plus vocals.

The 13 tracks on this album add up to a comprehensive program and to a sampler of the Group's interest in folk-based music from around the world. "Shetland Dances" (the home of the folk-dance fiddlers); "Askeval" (Scotland and the Vikings); "Tarantella" (Latin America); "Vangelio-Garifalia" (Greece); "Gathering" (ancient instruments); "Devil Train" (a Sydney send-up); "Turn the Tide" (modern protest); "Wet The Whistle" (Irish style fragment); "Tourdion – Isabeau s'y Promene" (a couplet of traditional items); "Didgeridoo-Tom-Tom" and "Janindji Jalpadu" (Aboriginal context); "Hungarian Rant" (wild Hungarian village music).

That adds up to quite some variety but while you may smile at the humour and foot-tap to the rhythm, Sirocco would obviously prefer you to get rather more involved in the music than that. It certainly has the potential to interest as well as to entertain.

Recorded in Honeyfarm Studios in Sydney, the sound quality is excellent and you need have no worries on that score. (W.N.W.)

DEBUSSY

Nocturnes: Nuages; Fetes; Sirenes. Jeux: Poeme danse. Played by the Concertgebouw Orchestra, Amsterdam; with the Collegium Musicum Amstelodamense. Conducted by Bernard Haitink. Philips compact disc 400 023-2.

A noticeable omission from the title display for this new compact disc is the word "Digital", suggesting that its original source was probably an analog master. Such is indeed the case but it turns out to be an example of good, rather than questionable practice.

As one hifi writer has pointed out, there is a wealth of fine analog recordings in the vaults of companies like Decca, EMI and Philips and many of them are prime candidates for transfer to compact disc – providing processing begins again with the original masters. With the benefit of Dolby-A noise reduction, giving an S/N ratio of better than 70dB, a very clean signal is commonly available for subsequent digital reprocessing.

While I am not sure of the technical history of this particular Philips recording, I do know that it won an award from "Gramophone" magazine, some time ago, for best engineering. And I do know that, as a compact disc recording, it is outstandingly successful. What noise there is is a vague ambient from the recording venue itself, while the dynamic range is as much as one can possibly cope with in a domestic situation.

This is all first-rate but it was the seldom-played "Jeux" that really caught my ear, both musically and technically. Written in 1912, to be presented by the Ballet Russes as a sequel to Debussy's "Prelude a l'apres-midi d'un faune", the music and the choreography was a bit much for the audience of the day, although it has since come to be more highly regarded.

My tip is that most will react warmly both to the music and to the performance. No less to the point, you will be impressed by how good an original analog recording can sound, when translated into the home by digital means. (W.N.W.)

HAYSI FANTAYZEE – Sister Friction (Remix) (Side A), Here Comes The Beast (Side B). Regard Records 104173. Festival Release.

This single has been released by Haysi Fantayzee as a follow-up to their highly successful song, "Shiny Shiny". Unfortunately, neither song on the single comes anywhere near to the standard set by "Shiny Shiny". Haysi Fantayzee will have to do much better than this if they are not to be written off as "one hit wonders". (J.S.)

CROCODILE TEARS – Listen To You (Side A), World Away (Side B). Powderworks POW 0135. RCA Release.

Both songs on this single are catchy tunes aimed fairly and squarely at the pop market. "Listen to You " is by far the better of the two songs and defintely worth a listen if you come across the single at your local record bar. Crocodile Tears are a group I have not heard of before, however if this single is typical of their work we can expect to hear more of them in future. (J.S.)


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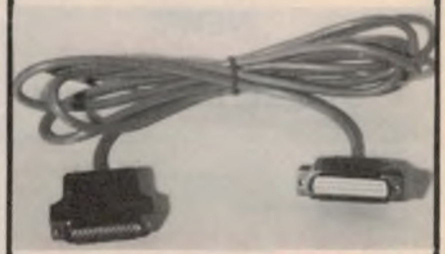

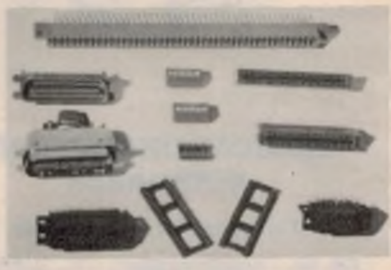


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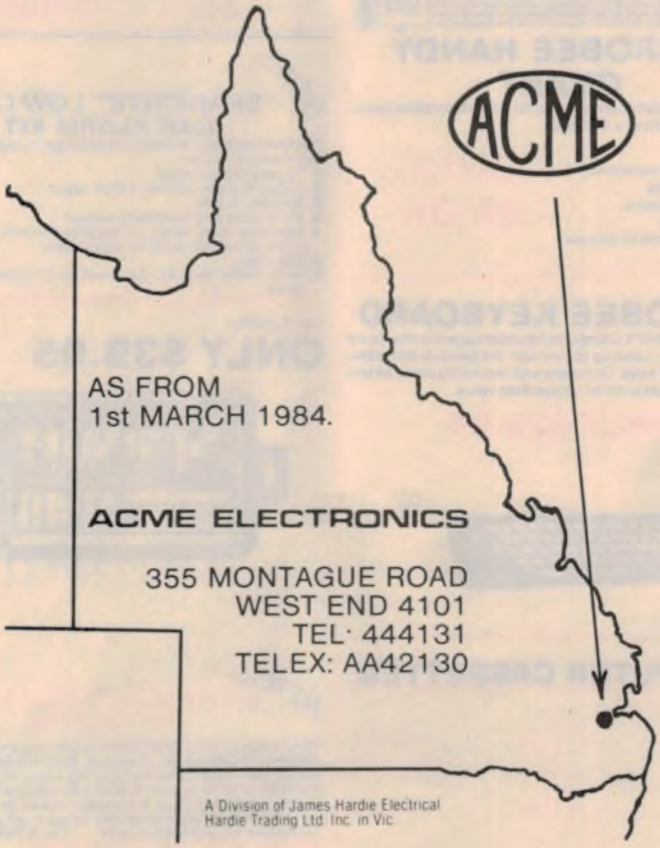

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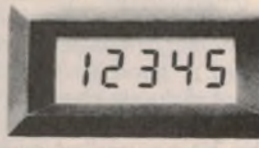

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CP/M and its competitors

8-bit operating systems: which is best?

by DAVID SHEARER

Which 8-bit microprocessor is the best? And which operating system is the most efficient? Computer people often bandy these topics about but as this article shows, there is no definite answer.

Let's set into perspective some of the facts, myths and innuendo that surround the on-going comparison between the 6809 software world and the CP/M software environments. Discussions of the relative merits of operating systems and programming languages at times degenerate into a "good guys versus bad guys" type of dialogue characterised by rather emotional "taking of sides".

I will also be accused of pushing an opinion, but perhaps with a slight difference; I have implemented from the ground up both a FLEX based 6809 system and a CP/M based Z80 system of comparable configuration, cost and capability. In the process of using both systems I have accumulated literally hundreds of hours of exposure to the internals of each operating system.

The following comparisons look at several different aspects; the actual processing elements, 6809 vs 8080/8085/Z80, the respective bus architecture S-50 or S100, the operating systems FLEX and OS9 as opposed to CP/M, and the applications, languages and utilities that are available for each.

Comparing the microprocessors

Let's start with the chips, but with one proviso – this is not going to be a hardware-oriented discussion, as I will defer to others much more qualified than I in that regard. In my opinion, from a register architecture and instruction set point of view the 6809 is the most "elegant" processor in the 8-bit world.

Although the 8080 and particularly the Z80 at first glance offer a wide range of registers, the 6809 compensates with the regularity of its instruction set and the extensive array of addressing modes. It is true that the Z80 offers a superset of the functions of the 8080 and 8085 but an often overlooked fact must be remembered – seldom is this extra power used by people who write CP/M software.

Software authors target their products at the largest possible audience and under CP/M tend to limit their instruction usage to 8080 instructions only. Using Z80-specific functions would preclude use of the software by CP/M users with 8080 or 8085 processors. The result is that the Z80's true potential is seldom exploited in a CP/M environment.

CP/M is officially shipped by its author (Digital Research) for use in 8080 systems. Cromemco's CDOS is one of the few CP/M "work-alikes" that makes use of the full Z80 instruction set, and CDOS programs will not necessarily run on other CP/M systems.

One other advantage of the 6809 should be noted in passing, and that is its ability to address memory beyond the 64K limit of other 8-bit processors. The "Dynamic Address Translation" circuitry which is standard in S-50 bus systems using the 6809 provides direct addressing of memory in a one megabyte address space. Z80 systems which offer 128K to 256K of memory use some form of bank switching, complicating the task of the programmer.

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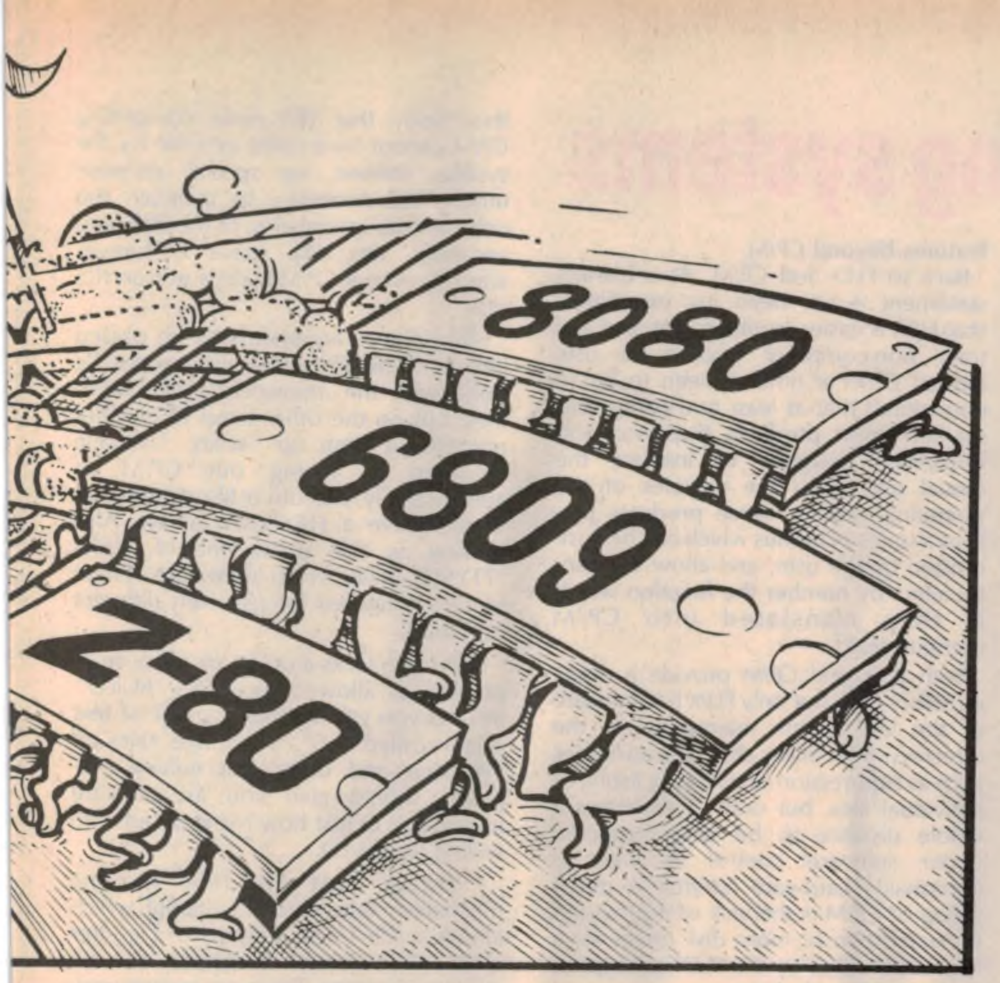
Neither the 6809 or the Z80 is by definition tied to a specific physical bus configuration, but in each case a de facto bus organisation has emerged. Note that not all 6809 computers use the S-50 bus nor do all 8080/Z80 computers use the S100 bus. Many major manufacturers have elected not to incorporate a bus design into their computer. Neither Tandy nor the Xerox computers are bus-oriented, for example.

Such machines almost invariably suffer from a lack of flexibility and expandability as a result of the lack of a bus. I will not discuss the merits of the S-50 bus versus the S100 bus from an architectural point of view, but it must be noted that the S100 bus has been adopted by the IEEE as an industry standard. It must also be said that there is no reason why a 68XX chip cannot be placed on the S100 bus, although putting a Z80 on the S-50 would be more difficult.

If you are anticipating doing much assembly code work, I assure you that the



6809 world is preferable from a development point of view. The problem with the 8080/Z80 assemblers goes something like this:

Originally Intel, the manufacturer of the 8080 and 8085 processors, defined the mnemonics and assembler syntax for the 8080. Zilog (who manufacture the Z80) introduced their enhanced instruction set, but were unable to use the copyright Intel mnemonics and in any case found them to be less than ideal. They therefore came out with a new list of mnemonics which are totally incompatible with the original Intel set.

Software houses as well as both Intel and Zilog wrote assemblers to support the various mnemonics, and at least one such software house made further changes and introduced more confusion. Gary Kildall, president of Digital Research and an ex-Intel man, doggedly stuck with the Intel mnemonics and indeed all the assemblers from Digital Research steadfastly refuse to assemble the Zilog mnemonics unless you define them in a macro-instruction library and later expand them into appropriate Z80 instructions.

Of course you need a macro-assembler to do this, and of course the assembler provided when you buy CP/M is not a macro-assembler and on and on it goes. I have four or five assemblers that I use when working with CP/M. Some support Intel, some Zilog mnemonics, one supports both, some support macros, and two produce relocatable, linkable code. Believe me there are days when I long for the straightforward TSC (Technical System Consultants) assemblers for the 6800 and 6809.

How fast will it go?

After digesting my comments on the power and elegance of the 6809 architecture and instruction set, you might assume that it outperforms the Z80 in processor speed benchmarks. Well . . . not always. For purposes of comparison I will refer to the informal benchmark tests conducted over a period of two years by Jim and Garry Gilbreath, the results of which were published in the September 1981 issue of "Byte" magazine and updated in the January 1983 issue. Where possible I have personally confirmed the results.

Gilbreath's benchmark uses a variation of the classic "Sieve of Eratosthenes" algorithm for computing all the prime numbers between 3 and 16,381. Other than the fact that the algorithm was chosen to avoid division, it itself is arbitrary as this was not a contest to determine the quickest way to compute prime numbers. The algorithm was coded as consistently as possible in each of several different languages and compiled and/or interpreted as necessary on many different processors and computer systems.

In order to set a more meaningful result the program was run 10 times, except for extremely slow machines or languages. On these occasions the algorithm was run only once and the resulting times multiplied by 10 to allow proper comparisons. I will constrain myself to summarising the 6809 and Z80 results although everything from Apples to the Cray-1 supercomputer were exercised with the original tests. Note that other than assembly language, the results shown in Table 1 are a reflection on the relative efficiency of the compiler or interpreter as well as the microprocessors.

Table 1 lists popular 6809 and Z80 language systems with their respective results. I suggest that no one take the results too seriously as there is a certain element of "apples and oranges" comparison, and of course, one small algorithm hardly comprises a thorough evaluation. However some interesting observations can be made – the first being the Cobol does not belong on 8-bit computers unless you have a lot of time on your hands.

At the assembly level the 6809 is very competitive with the 4MHz Z80, and is in fact substantially faster on a percentage basis. But when you compare the compilers and interpreters it becomes apparent that Z80 users are most often enjoying a huge speed advantage. Nearly all of the well known and widely used Z80 compilers produced results in the 14 to 20 second range when run on a 4MHz Z80. On the 6809 only the Introl C compiler and the IMS Pascal compiler were in this league.

The TSC Pascal compiler, while not comparable to the Pascal MT compiler was at least reasonable. The real price/performance winner in the Pascal world is the JRT p-code implementation which comes as a complete (non-standard) package for a fraction of the price of its competitors. In defence of Lucidata, I believe that the run was made on a 1MHz 6809 as this was not made clear in the original articles.

What conclusions can be drawn? It appears that the 6809 is quicker than the 4MHz Z80, but not quite as fast as the 6MHz version. How about at 4MHz 6809, Mr Motorola? It also appears that the Z80 CP/M user has a broader range of very well constructed language systems from which to choose.

The 6809 user has most of the popular languages available, but amongst these there are fewer really good implementations. The implementation of a compiler is very important – just compare the IMS p-code Pascal results with other p-code implementations on the same processor. Lest the compiler writers declare war on me, I should also say at this stage

8-bit operating systems

that the speed of the resulting object code is only one measure of the quality of a compiler. Speed of compilation, size of resulting executable code etc are other important considerations when comparing compilers.

The operating systems

Most of my comments must be directed towards FLEX on the 68xx side and CP/M 2.2 on the Z80 side as my experience is limited to these two. First, however, a few words about the other most used operating systems on these machines.

While I have not used either OS9 or Uniflex, my understanding from discussing them with those who have indicates that they are way beyond either CP/M of FLEX in many areas largely as a result of successfully implementing much of the Unix environment. Also in the "way beyond" category is an 8080/Z80 operating system known as OASIS.

All of these more advanced operating systems allow multiple users and multiple tasks and also implement a more sophisticated file system. CP/M itself actually has a multi-user big brother known as MP/M. It is not nearly as widely used as CP/M and requires multiple banks of memory to accommodate the multiple users. MP/M offers little in the way of features beyond CP/M.

Back to FLEX and CP/M. As a blanket statement it has been my experience that FLEX is easier to implement, use and train non-computer people to use. Indeed CP/M at times is seen to be so convoluted that at least two companies market major products (Supervyz and Organiser) designed to insulate the casual user from the vagaries of the operating system. These products present a series of menus which can be customised by the user, and allow the user to select by number the function which is then translated into CP/M computerese.

Both FLEX and CP/M provide a single directory disk, but only FLEX has the date of the last update maintained in the directory. Both allow attaching attributes such as suppression of directory listing of individual files, but only CP/M allows a whole diskette to be write-protected under software control as well as (optionally) hardware control. A major failing of CP/M is the lack of a provision to search two or more disk drives for a file, as provided by the FLEX concept of system and work drives.

FLEX itself is maintained as a file which is read in at boot time, whereas CP/M is stored physically on the first two tracks of the disk. There are two problems with this; firstly that the code comprising CP/M cannot be treated as a file by the system utilities, so special purpose utilities are necessary to maintain the code and its special area of the disk, and secondly, this disk space is forever wasted, even if CP/M itself is not on the disk.

8-bit processor benchmark results

All times in seconds

	2MHz 6809	4MHz Z80	6MHz Z80
Assembler	5.10	6.80	4.50
IMS Pascal compiler	8.78	—	—
Introl C compiler	11.00	—	—
TSC Pascal (Uniflex compiler)	34.00	—	—
TSC Pascal (Flex compiler)	54.00	—	—
IMS Pascal (p-code)	105.00	—	—
BASIC09 (OS9 interpreter)	238.00	—	—
Dynasoft Pascal (p-code)	309.00	—	—
Lucidata Pascal (p-code)	735.00	—	—
TSC XBASIC (Flex interpreter)	840.00	—	—
FORTRAN (Microsoft compiler)	—	13.90	9.20
PL/1 (Digital Research compiler)	—	14.00	9.33
CB80 (Digital Research Basic compiler)	—	15.70	10.46
Pascal MT+ (Digital Research compiler)	—	19.00	12.66
UCSD Pascal (p-code)	—	239.00	159.33
JRT Pascal (p-code)	—	383.00	255.33
CBASIC (Digital Research interpreter)	—	484.00	322.66
CBASIC (as above but all real numbers)	—	1430.00	953.32
COBOL (Microsoft)	—	5115.00	3410.00

CP/M allows arguments to be passed into its "SUBMIT" files which cannot be done with the equivalent FLEX "EXEC" files, but on the other hand CP/M does not offer a "start up" facility. The pain involved in faking out CP/M to automatically execute a file on start up would leave a FLEX user aghast. Also missing is the equivalent of FLEX's "TTYSET" utility which allows the system to be configured for use with different terminals.

CP/M also lacks a utility for quick entry of text, as allowed by FLEX's "BUILD". Instead you get the infamous CP/M text editor called "ED". The huge sales of Wordstar and other text editing programs should give you an accurate impression of just how many people are willing to use ED.

I always liked the FLEX spooling mechanism (after I got it working), which allows a file to be output to a printer while the system continues to run another program. There are several versions for CP/M but only at extra cost. Having once seen a CP/M spooler implemented I've never bothered buying one as it is complicated and inferior to the FLEX spooler.

On the subject of I/O, FLEX allows complete re-direction of input and output using the "O" and "P" commands. Programs can take input interchangeably from the keyboard, a disk file or a communications port, and send output to a terminal, printer, disk file or output port. CP/M allows output to a video terminal to be copied to a printer only, but also includes "PIP", the "Peripheral Interchange Program" which provides a host of useful facilities.

CP/M's famous PIP utility replaces the FLEX list, copy and append commands and still has features to burn. Briefly it copies (append is treated as a special case of copy) data from any source to any destination. The source and destination may be any physical character-oriented peripheral or a disk file. PIP allows you to (for example) type from the console keyboard to a printer, a modem or to another disk file etc. PIP and several other utilities allow specification of incomplete file names for the purpose of name matching.

Perhaps the greatest feature of PIP is the "filters" it can use on the data during data transfers. Formfeeds or the parity bit in ASCII data can be removed, characters can be translated to all upper-

Operating systems

An operating system is the interface between the user and the hardware of a particular computer system. The DOS manages communications with video terminals, printers and of course disk drives, and usually consists of a small machine-dependent section of code accompanied by a standard command interpreter. Transferring the operating system to a new type of machine then only requires re-writing the machine dependent portion (the BIOS of CP/M for example) not the entire operating system.

Most operating systems have no processing power of their own (there is no provision for performing arithmetic, for example, in the CP/M operating system). "Utility programs" must be added in order for the system to do useful work, and one measure of the versatility of an operating system is the number of utility programs available for it.

Programming languages such as Basic and Pascal interact with the computer hardware through the operating system. If, for example, a machine runs the FLEX operating system it can run any language or other program which is available for FLEX, while a CP/M system can run any software designated as designed for CP/M, subject to the problem of differing disk formats.

While comparisons between operating systems may seem to be highly theoretical, in fact the versatility and ease of use of any computer system is ultimately dependent on the power and details of its DOS (Disk Operating System). To clarify some of the issues here's a brief run-down on the operating systems considered in the article.

CP/M, distributed by Digital Research, is probably the most widely used microcomputer operating system. Originally written for the Intel 8080 microprocessor, it also runs on systems uding the 8085 and the Zilog Z80 microprocessor, although as the author of this article points out CP/M on a Z80 does not fully utilise the power of the processor. Be this as it may the wide variety of programs available under CP/M has ensured that the system has wide and continuing support.

FLEX, from Technical Systems Consultants (TSC) is the de facto standard operating system for the Motorola 6800 and 6809 microprocessors. Originally written for the 6800, it was re-written to take advantage of the greater power of the 6809 (FLEX 09) and is perhaps the most prevalent operating system for these microprocessors.

Unlike CP/M however, FLEX has a number of competitors, chiefly OS9 and Uniflex. Both of these systems are loosely based on Bell Laboratories Unix operating system and share the same hierarchical disk directory structure. Under this scheme a device or disk file is referenced through a "path name", a list of files and sub-directories which can be linked to any degree of complexity.

In contrast to CP/M, OS9 and Uniflex can be run on multi-user computer systems and it is here that the more sophisticated file structure proves an advantage. Individual users can have their own files which are in themselves directories or lists of a set of files. Each file can be associated with various protected status flags, ensuring that data cannot be over-written by other users of the same computer system.

Unix was a major influence on the development of Uniflex, an operating system which combines the features of both Flex and Unix. The major internal feature of Unix, "pipelines" which serve as user-specified communication channels between programs, is preserved. A great deal of flexibility is provided by this approach as it allows standard utilities to be combined in a variety of ways to perform useful functions directly from the operating system "shell" or command processor.

case, TABs expanded, page numbers added and more. FLEX has nothing that comes even close to the versatility of PIP.

CP/M also supplies a utility called "DDT", or "Designer's Debugging Tool". This is somewhat similar to the machine language monitors contained in EPROM in most FLEX systems, but works directly with the file system as opposed to the usual sector level operation of monitors. DDT also provides features in a single operation which can only be duplicated by combining several monitor facilities.

Memory management

Due to the way in which the CP/M memory map is arranged CP/M must be at the top (high addresses) of configured real memory, with the lowest 256 bytes left free. Unfortunately it cannot relocate itself at boot time and thereby adjust to a system with less memory. Thus, several utilities are provided to move CP/M around in memory, but these are not for the beginner.

Having built a memory image of your re-located CP/M with one utility, another utility program must be used to write it out onto those two disk tacks mentioned earlier.

Concerning memory maps, I must say that I prefer the Motorola style of memory-mapped I/O (with I/O ports appearing as memory locations) from a programming point of view. However the Intel method of providing a separate I/O space doesn't cause the memory map to be hacked up simply to allow for the presence of input or output devices and may be preferable from a hardware point of vi perspective.

With the Intel approach we get a continuous 64K of memory which CP/M is quite happy to use. Most CP/M systems also use a "ghostable" EPROM which turns itself off after loading in CP/M and allows the full 64K space to be used for programmable memory, although there is no reason why this could not be done on S-50 systems as well.

File management is very similar from a user's point of view on both systems. Both provide sequential and random access methods, but there are major differences in the way they implement the file system. FLEX defines a file as a linked list of sectors, while CP/M allocates space with a bit map technique. Which is better? I would say that I think FLEX reads and perhaps sequential files faster, but CP/M may have the edge with random access. In any case the speed differential was not that great, based on subjective observations, not measurement. However one thing I can say is that FLEX disks are much more susceptible to corruption due to broken chains in the sector linkage. I have never had a CP/M disk damaged. Both of my systems use the same type of disk drives, but admittedly the controllers are different.

I wonder how many people have used TSC's general purpose version of FLEX to implement their own FLEX system from scratch? I have and it was both fun and quite easy. Nothing fancy about TSC's documentation but it sure gets the job done. FLEX's interfaces to the outside world are contained in two modules, the console I/O driver and the disk driver package (which the user must supply if installing their own version of FLEX). The interface is the picture of simplicity and very well defined.

If you have set up FLEX in this way and are looking for a new challenge, may I recommend doing the same thing with CP/M? This is a job for those with stout hearts and a penchant for

8-bit operating systems

documentation apparently written in Swahili or whatever. (For those of you with Swahili as your native tongue, I apologise for comparing it with Digital Research's documentation.) Fundamentally, you need to do all the same things, test your code, integrate it, write a loader, cross your fingers and if all went well . . . It seemed harder with CP/M.

Both FLEX and CP/M have several other utilities and languages available. TSC at a reasonable cost makes available a large set of programmers' utilities and diagnostic programs. On the CP/M side, because of its far greater usage it seems that everybody and his brother has another language, editor, modem/-communications package, sort/merge package etc for sale. However one of the greatest sources of fine software is the CP/M Users Group. To date I believe they have distributed around 80-90 disks of software for CP/M.

As you may imagine, 75% of this is of less than commercial quality and often poorly documented etc, but the occasional gem is wonderful. For example there are 13 or so languages, numerous directory display programs, a complete spelling checker, dozens of games, business programs etc. Being able to access this wealth of goodies is quite important to me.

As indicated in the discussion on the speed benchmark results, I believe that the CP/M user has a much wider selection of quality software from which to choose, allowing you to select the features you want at a price you can afford. I've often thought that the only reason I endure CP/M at all is to gain access to all the superb CP/M software.

I love the languages I can buy for CP/M. If you like Basic and are not embarrassed to use it after all the hate articles it has inspired over the last two years, CBasic and its big brother compiled version CB80 is the greatest thing since sliced bread. Microsoft, famous for implementing Basic, cannot touch this stuff, and sorry to say, neither can TSC's XBasic. At the other end of the spectrum are a couple of extemely good Pascal compilers, and even more good p-code versions. For those of other inclinations there are dozens of versions of Forth, a few subsets of ADA, COBOL, Fortran, Lisp and close to a dozen C compilers.

It seems that between FLEX, Uniflex and OS9 the 6809 user has access to most of the popular software items of the day; screen editors, spelling checkers, languages, spread sheet calculators and so on, but at the risk of being repetitive I must admit that CP/M users have a far greater choice and perhaps better implementations.

Where are each of the two environments headed? At the moment Digital Research has released CP/M version 3.0 which by all accounts provides greatly enhanced features. Specifically most of the complaints I have registered above have been addressed. However I think it safe to say that version 3.0 may be the last release of CP/M for 8-bit machines as the 16-bit processors are attracting most of the attention of software developers, including Digital Research.

Versions of CP/M have now been implemented for the Intel 8086 and the Motorola 68000 families, but the notion that this is somehow upward compatible with 8-bit CP/M is totally false. Only the user interface and disk formats stay the same, although a program in a high level language (not assembler, of course) would be transportable at the source code level.

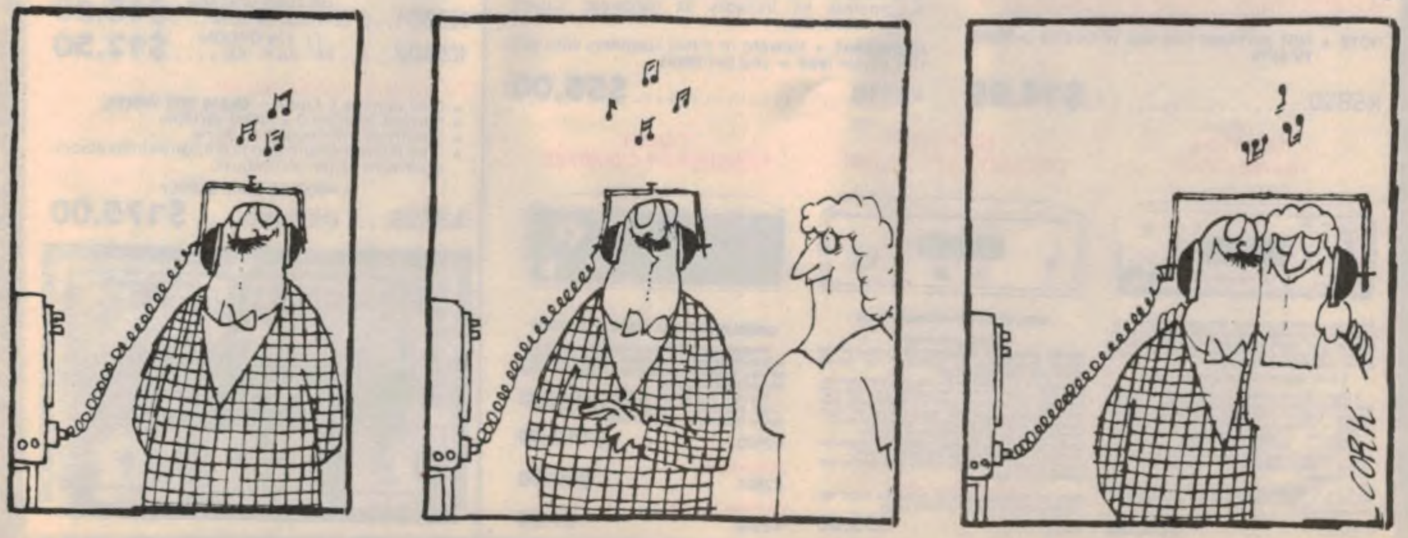
However CP/M-86 is not likely to dominate the 16-bit world in the way it has completely ruled the 8080/Z80 machines. Already Microsoft's MS-DOS (PC-DOS when used by IBM) is leading the way in this arena, and MS-DOS 2.0 adds further Unix-like enhancements. MP/M is already going by the board, and I can't see anyone wanting to run CP/M-86 on a 68000. Why bother, when far superior operating systems including full Unix are available?

In a similar vein, most would agree that FLEX as we know it has reached its full development and should not grow much farther. Instead we have as alternatives OS9 and Uniflex which are both very solid operating system environments.

It is almost always true that an end user who sees the computer only from the perspective he or she can gain from sitting at a terminal entering the day's general ledger postings cannot tell what kind of computer is running the program. The business person hardly cares whether it is a Z80 or 6809, whether or not the bus is S-50 or S100 or whether the application program is written in Pascal or C. The main question is whether the machine successfully fills the role for which it was intended.

From a hobbyist point of view I prefer the 6809 instruction set, the ease of use of FLEX, TSC's documentation and the promise that OS9 and Uniflex hold for the future. However I also like the selection of hardware I can use because I have an S100 bus computer. Memories, music boards, colour graphics boards and 16-bit processor boards are all available on the bus. I also like the incredible selection of software and the access to the CP/M Users Group that I get with CP/M. Since CP/M is so widely used, the single density format for 20cm disks has also become a de facto standard for software distribution, easing disk incompatibility problems.

But if you can't have a version of both systems, I guess you'll have to decide for yourself!



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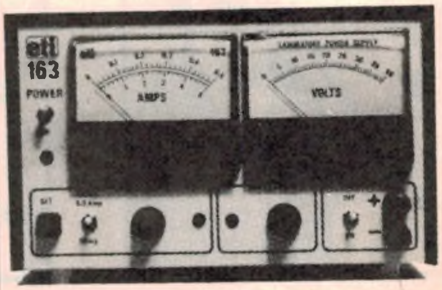

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Micronews

The ACT Apricot

—innovative and easy to use

Designed and built in the UK by Applied Computer Techniques Ltd, the Apricot personal computer was released in Australia recently by the local distributor, Barson Computers, who also distribute the popular Sirius Computer. It is intended to complement the higher priced Sirius, but is potentially a more powerful system.

For starters the Apricot uses the full 16-bit 8086 microprocessor, with an Intel 8089 controller chip handling input and output. Standard memory is 256K bytes, expandable to 896K, and two Sony "microdrives" are built in, providing disk storage of 315K each in single density, unformatted. Double density disk drive controllers expand this storage to 640K bytes per disk.

The Apricot is an attractive computer, with a low profile logic unit, a detachable, 96-key keyboard and 22.5cm (diagonal) green phosphor display screen. The keyboard and logic unit fold up into one compact case for transport.

The keyboard is particularly worthy of note. It contains its own controller and is capable of both sending and receiving information from the computer. Apart from the usual array of programmable function keys it also contains a two line by 40 character LCD "microscreen" which displays the time, day and date and can be used as a four function calculator, independently of the remainder of the system.

Six membrane keys beneath the LCD display can be labelled on the LCD screen, and information displayed on the microscreen can be sent to the main video display at the touch of a button, a convenient feature when including results of calculations into other documents. According to the manufacturers the micro LCD screen also allows the keyboard to be used alone in a semi-portable mode.

Other hardware features include a single key screen print function, built-in disk cache memory to speed disk I/O, a "smart" printer driver with its own 2K buffer memory, and full diagnostics in ROM to verify correct operation. The screen display is 25 lines of 80 characters, with a graphics resolution of 800 x 400 pixels (monochrome only).

Without software, however, the most sophisticated computer is useless, and the range and variety of software available for the Apricot is impressive. Firstly, the Apricot is 100% compatible with the ACT Sirius, which immediately provides some 400 applications programs. Special emulator software also enables the Apricot to run 95% of all IBM Personal Computer programs.

No less than six operating systems are available; MS-DOS 2.0, Concurrent CP/M-86 and CP/M-86, UCSD Pascal, Xenix and the UK BOS system. The first three operating systems are included in the price of the Apricot.

Also included in the price are a full range of utilities for each operating system, Digital Research GSX graphics extension to CP/M, communications software and a printer spooler. A "System Manager" comes between the user and the chosen operating system, enabling applications programs to be selected from an on-screen menu using a mouse pointing device.

The Supercalc spreadsheet, Microsoft Basic and Digital Research Personal Basic are also provided with the basic unit. A wide range of applications programs from US, UK and Australian companies will run on the Apricot, including WordStar, Superwriter, DBase II, Multiplan, and packages for accountants, farmers, auctioneers and others.

Including the three operating systems the recommended retail price of the dual disk Apricot is $4444 (with sales tax).

Commodore releases 700 business computer

Commodore Computer has released a new small business system, the Commodore 700, in a new "rounded" style enclosure based on the new 6509 8-bit microprocessor.

The unit is available with either 128 or 256K of programmable memory, expandable to 896K. Since the 6509 is an 8-bit processor the memory is arranged in banks of 64K which are switched in automatically as required.

An 8088 16-bit microprocessor add-

Mr John O'Brien with the NCR terminal and NEC Spinwriter printer.

Goodyear computerises retail operations

Goodyear Australia is about to become the first fully computerised auto parts company in Australia with the introduction of a retail store management system to its 116 service centres throughout Australia. The system uses terminals from NCR and NEC Spinwriter printers supplied and installed by the Datascape company.

The new system will automatically update inventory, financial records, cash control and accounting ledgers as each sales transaction is completed. Sales information from each store will be processed overnight at Goodyear's Granville head office and the results made available to all stores the following day.

Mr John O'Brien, general manager of Goodyear's retail stores, said that the system is being introduced because it is no longer economic to handle yearly sales of $100 million in the traditional way. "We had to mechanise, and now is a good time because the economy is improving, and we are hiring more staff who will be getting in on the ground floor of this new technology.

"RSMS is a tool for management, and gives us the edge over competitors. Planning and marketing will now be done more effectively because sales figures will be current and accurate. It will improve stock and credit control, purchasing and reporting, and free store managers from much of the present repetitive workload."

A major reason for the choice of the NEC Spinwriter was its front inserter attachment, which allows single cut forms, ledger cards and multi-part business forms such as invoices and purchase orders to be processed automatically. Mr O'Brien complimented Datascape on the level of support and assistance provided by the company.

Apart from NEC printers, Datascape act as Australian agents for companies including Ampex, Anadex, Daytronic and Lebow-Eaton. Further information is available from the company at 33 Grosvenor St, Neutral Bay Junction, NSW, 2089.

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on is available as an option, allowing the Commodore 700 to run operating systems such as CP/M-86 and MS-DOS.

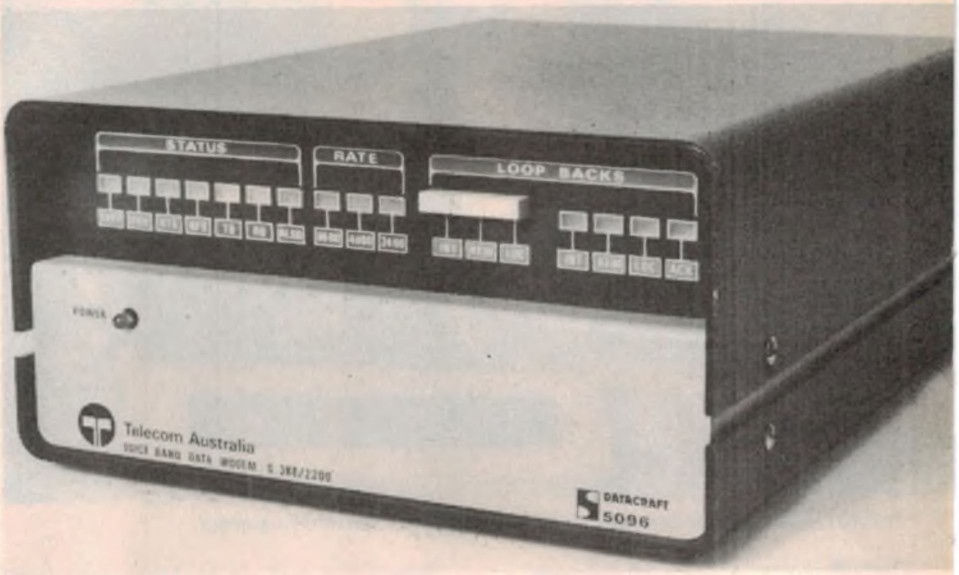
Commodore International currently faces major changes with the resignation in January of Mr Jack Tramiel, the founder and president of the 25-year-old company. Four other executives have also resigned and the company has delayed shipments of its new 264 and 364 home computers for unknown reasons.

The changes at the top leave Commodore with no clear-cut strategy in the rapidly changing microcomputer market, according to analysts. New personnel will have to take up the reins at a time when future directions are uncertain.

In the home computer business Commodore remains unchallenged however, and has probably sold more small computers (under $500 models) than any of its competitors. According to the company, more than 1.2 million Commodore 64 computers were sold in 1983, and sales in Australia are estimated at more than 5000 machines a year.

Micronews

Datacraft modems for Telecom



In another example of local high technology expertise, Datacraft (Australia) Pty Ltd has won contracts totalling $7.5 million to supply Telecom Australia with its Australian designed and manufactured high-speed data modem, the 5096. The Melbourne based company won the contract against competition from more than a dozen international competitors.

Managing director Mr George Kepper says that the success of the product has vindicated the substantial research and development effort required to bring it to the market. "Surely we are an example of a 'sunrise' industry if ever there was one," he says. "We are at the forefront of modern technology, we are employing large numbers of local people, we are putting substantial effort into R and D, we are winning important contracts, and we are helping to keep profits in Australia."

The 5096 modem is designed to be a single economical replacement for three separate data modems currently in use around the world. An important feature of the modem is its automatic equalisation to suit different conditions in telephone circuits, making it suitable for applications ranging from small in-house operations to data transfers across international circuits.

Computer-aided design software for IBM PC

Sourceware Pty Ltd has announced a new graphics software package for the IBM PC which allows architects and engineers to design and model using three dimensional projections. Called "MicroCAD", the system was developed by US company Computer Aided Design, and is expected to retail in Australia for $1100.

MicroCAD makes it possible to design complex objects in three dimensions, and is expected to find applications in architecture, engineering, interior decorating and education.

Users can build a collection of data files representing three dimensional objects and recall them for display in any combination. Images can be moved on the screen, rotated and scaled and viewed in perspective, with explanatory labels. Co-ordinates, bearings and line lengths can be edited on a monochrome monitor while the resulting constructions are viewed on a colour graphics monitor.

A light pen, digitiser tablet and a range of plotters are fully supported by MicroCAD, which can also take data from Visicalc files and display them as graphic charts.

The software is designed to run on an IBM PC or IBM XT with a minimum of 128K of memory and two disk drives. It will also work with a hard disk drive.

Further information is available from Sourceware Pty Ltd, 4/73 Albert Ave, Chatswood, NSW, 2067. Phone (02) 411 5711.

Automatic IC tester from Microtek

Microtek International has released the latest product in its MATE series of automatic test equipment. Known as the TC2000 Digital IC Function Tester the new instrument can automatically test 1600 varieties of integrated circuits, including 54/74 series TTL and high speed CMOS devices, and 1800 and 4000 series CMOS devices.

A 15 key keyboard allows particular pre-programmed test sequences to be selected, without the use of plug-in modules, test adaptors or multiple switches. Eight, 14, 16, 18 and 20-pin dual in-line packages can be tested and exercised through their complete truth tables. Output characteristics such as open collector and high impedance modes can also be distinguished.

Other features include a Loop function which allows automatic repetition of a test cycle, and an auto search mode which allows identification of unknown ICs.

Throughput of the device is limited only by the speed at which an operator can load and unload devices and results are clearly indicated as Pass, Fail or Fail Overcurrent.

For further information contact Macro Dynamics, 66 Barry St, Bayswater, Vic 3153.

Microsoft programs for Macintosh

Microsoft Corporation has announced a range of software for the new Apple Macintosh computer. Special versions of Microsoft's Multiplan, Word, Chart and File programs have been developed as the first software to be announced for the Macintosh by an independent vendor. Microsoft Basic will also be available for the system.

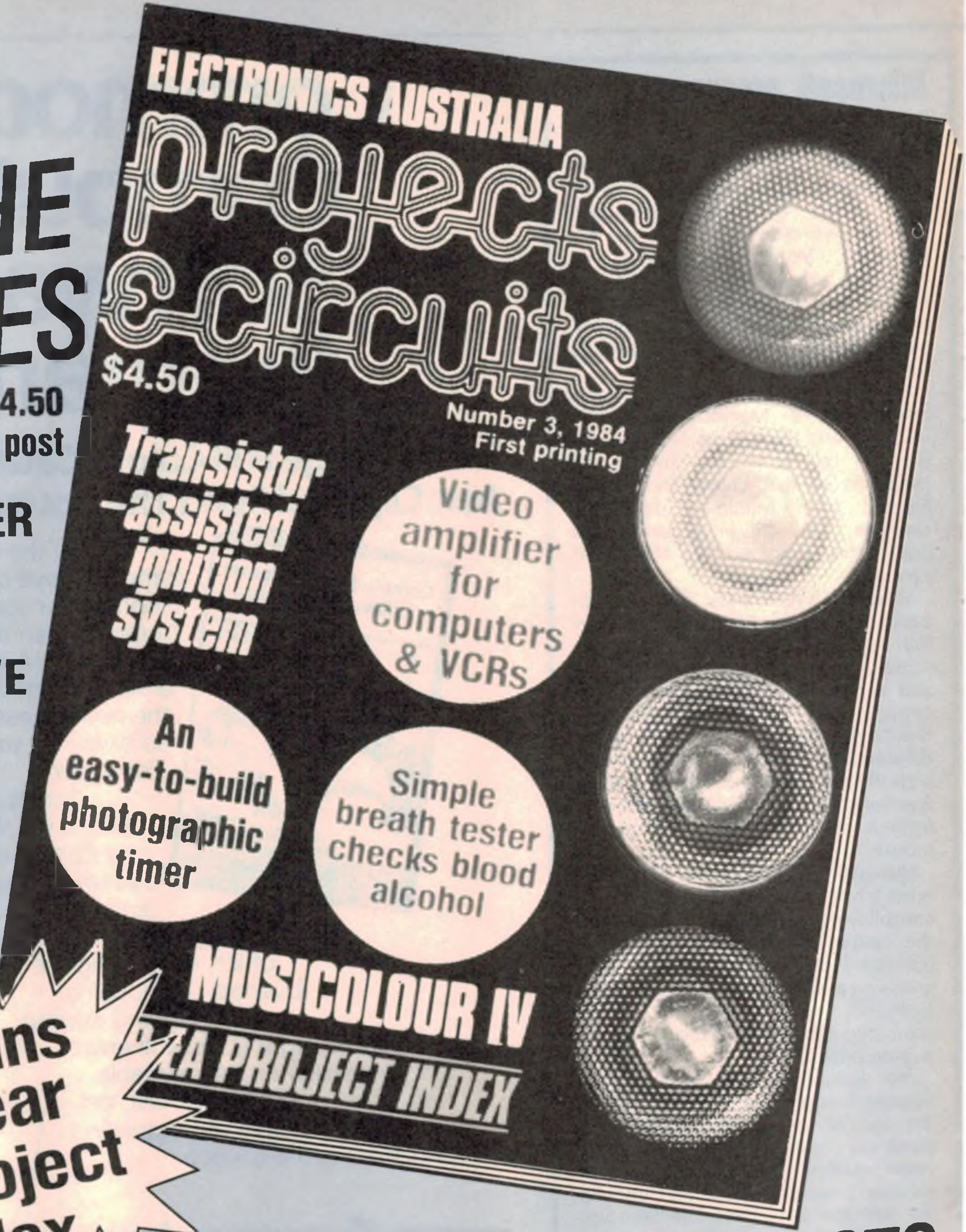
All the application programs take advantage of Macintosh's screen windows and the mouse. Graphics are used in the same way by all the programs so that charts and graphs created from Multiplan data, for example, can be incorporated in documents prepared by the word processor.

Microsoft Word uses the graphics capabilities of the Macintosh to allow full representation of text on the screen, including proportional spacing and various type styles. Moving and copying portions of the text, including the movement of text between different documents, is accomplished with the standard Macintosh editing functions, cut, copy and paste, selected from a menu by movement of the mouse.

Microsoft Basic for the Macintosh takes advantage of the large addressing capability of the MC68000 processor of the system. A decimal mathematics package allows arithmetic with 14 digit precision and string variables and string expressions can be up to 32,767 characters long. (That's about six type written pages.)

The Basic also works with the Macintosh screen interface and allows the use of three different kinds of windows; one for command entry when editing a program, one for viewing program listings and one for the output of a program. The Basic also provides many of the extended graphics capabilities of Microsoft's GW Basic (as running on the IBM PC, etc) and supports the Macintosh font manager and quick draw graphics routines.

Bill Gates, president of Microsoft, said of the new system "Microsoft expects the Macintosh to become very widely used and we are committed to being in the forefront of providing software that takes full advantage of all the features and power of the Macintosh. We believe that as much as one-half of our 1984 and 1985 application program revenues could come from sales of Microsoft's Macintosh programs."



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Number 3, 1984
First printing
Transistor -assisted ignition system
Video amplifier for computers & VCRs
An easy-to-build photographic timer
Simple breath tester checks blood alcohol
MUSICOLOUR IV
EA PROJECT INDEX

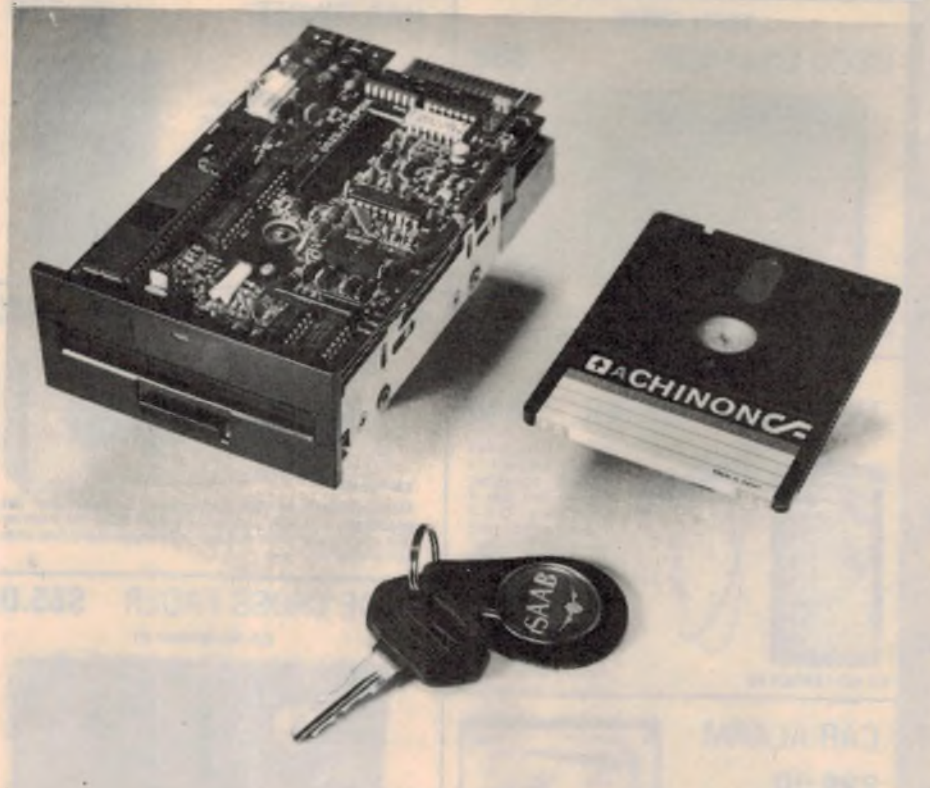
Micronews

Daneva stocks micro floppy drive

In response to the demand for more compact data storage for portable and business microcomputers, Chinon Industries Inc of Japan has developed their own version of the "microfloppy" drive, the CF-301.

Measuring just 90mm x 150mm x 40mm (W x D x H) and weighing 600g, the new drive provides 250K bytes of storage (unformatted) per side on a plastic encapsulated micro disk. Both sides of the disk can be used, doubling the storage capacity, although access to the other side requires removing and re-inserting the disk in the drive (it is not automatic, as in a standard "double-sided" disk drive).

The CF-301 is controlled by an on-board microprocessor and is plug compatible with standard 13cm minifloppy disk drives.



Although the Chinon drive is said to use standard 3 inch media, there is no indication of whose standard has been followed (there are at least three, each incompatible with the others). Three major computers recently released use Sony microdrives; the HP 150, Apple Macintosh and the ACT Apricot, and this format has become the leading contender for standardisation.

If the Chinon drive is compatible with Sony media, Daneva Australia Pty Ltd, the distributors in this country, will be well-placed. Further information is available from the company by writing to PO Box 114, Sandringham, Vic 3191.

Imagic to develop robotic software

Imagic Australasia has begun a program to develop specialised applications software for the RB5X robot, a device manufactured in the United States by RB Robot Corporation.

The RB5X series is a fully programmable robot designed for home use and experimentation. Fittings include a sonar rangefinder, bumper switches and an on-board microprocessor with 16K of memory. Optionally available are voice recognition and synthesis modules and an articulated robot arm.

The robot is programmed through a microcomputer using a purpose-designed "Robot Control Language". Coupled with the robot's own processor, this language enables the RB5X to navigate around a room and automatically recharge its battery. Pre-programmed EPROM modules are currently available to put the robot through its paces, including one which turns the RB5X into an intruder detector.

Imagic are planning to develop software which enables the robot to be used as an aid to the handicapped. With the ability to obey voice commands (detected and translated by an external Apple IIe computer) and possibly able to perform useful functions with its articulated arm, the robot may find a place as an aide for the disabled. Imagic do not say when this will be, however.

Imagic is also seeking the participation of other organisations wishing to develop robot applications of the RB5X robot. For further information contact Imagic Australasia Pty Ltd, PO Box 300, Forrestville, NSW, 2087.

The Box 8 and 16-bit development systems

Zax Corporation, represented in Australia by Z Systems Pty Ltd, has announced two new microcomputer systems, known imaginatively as "The Box".

"The Box" is available in either 8-bit or 16-bit configurations, using the Zilog Z80B or Intel's 8086 microprocessor. Features include two megabytes of mass storage on dual 20cm disks, a programmer for EPROMs and electrically erasable PROMs, four RS-232C serial ports and a Centronics printer port. Optionally available are 20 and 40MB hard disk drives and an IEEE 488 interface board.

Eight bit systems are supplied with 64K of user memory, expandable to 748K internally. The 8086 system is supplied with 512K of memory and expands to a full megabyte. Operating systems available are CP/M, CP/M-86 and MS-DOS.

The Zax computers are intended to form the basis of powerful software development systems, and are designed to work in conjunction with Z Systems' Z80B and 8086 stand alone in-circuit emulators. Software created on the host system can be down-loaded to the emulator and tester using a variety of powerful diagnostic tools.

For further information on "The Box" 8 and 16-bit development systems contact Z Systems Pty Ltd, 196B Vulture St, South Brisbane, Queensland, 4101. Telephone (07) 44 3715.

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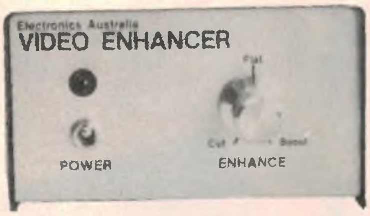
100's SOLD

VIDEO ENHANCER $35



Like tone controls in a hifi amplifier, touch up the signal with this Video Enhancer **EA OCTOBER 83**

1000's SOLD

TRANSISTOR TESTER $15

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

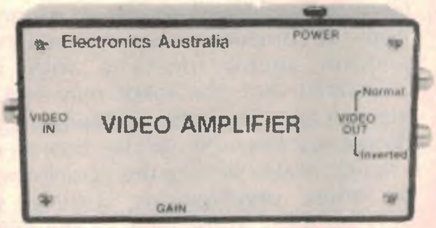
EA SEPTEMBER 83

CAR ALARM

$29.00

This Car Alarm uses the battery earth strap as a sensor to detect when a "courtesy" light or other electrical load occurs when a thief enters a vehicle. The circuitry is simple and immune from false triggering problems. **ETI July 81**

VIDEO AMPLIFIER $15



EA AUG 83

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead. It's much better. The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugpack supply. **INCLUDES JIFFY BAG**

LOW OHMS METER

$34.50

How many times have you cursed your Multimeter when you had to measure a low-value resistance. Well alas, with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms. **ETI 158 November 81**

NAIL FINDER $10

Essential for the home handyman the Nail Finder will help locate timber studs behind Gyprock or plasterboard wall surfaces as well as locating pipes and wiring buried in walls

EA OCTOBER 83

MOTORCYCLE INTERCOM $40

EA Feb 84

Motorcycling is fun but conversation between rider and passenger is usually just not possible. Build this intercom and you can converse with your passenger at any time while you are on the move.

SLIDE CROSS FADER $85.00

EA November 81

PHONE MINDER $25

EA Feb 84

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or can perform either function separately.

±12V RAILS FOR LAB POWER SUPPLY

EA July 1983

$13

An inexpensive addition to the 50V 5A Lab Power Supply which should prove its worth many times over. It provides additonal fixed ±12V outputs for lower power applications

Driveway Sentry

$32

Activated by your car's headlights, the "Driveway Sentry" will turn on a driveway or garage light so that you can make a safe exit from your car on the darkest of nights. At the end of five minutes, it will automatically turn the light off again.

SPEED SENTRY $21

EA OCTOBER 83

Paying speeding fines can be a painful business. Build this Speed Sentry and avoid further pains in the wallet

50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design

EA May, June 1983 **$140.00**

CAR IGNITION KILLER

$13

EA Feb 84

Most car burglar alarms are easily circumvented, but not our cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterrent to thieves!

Electric fence $19.50

Check our prices

SEPTEMBER EA 1982

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

EA GUITAR BOOSTER

$17.50

JUNE EA 1982

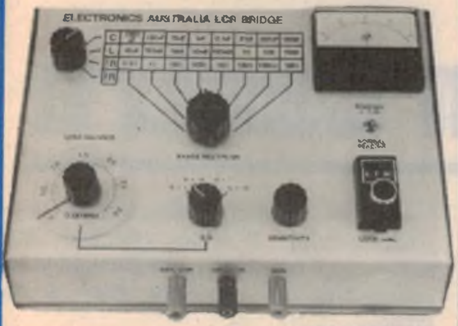
48-50 A'BECKETT ST, MELBOURNE 3000 VIC **PHONE (03) 347 9251**

Mail Order Delivery Instructions: Minimum Pack and Post $3.00 for Australia Post. Please allow extra for bigger orders and Certified, Airmail or Registered Post. Minimum order is $5.00. Please address orders to Mail Order Department, PO Box 235, NORTHCOTE, 3070, VICTORIA. PHONE (03) 481 1436.

NEW KITS FOR THIS MONTH

LCR BRIDGE

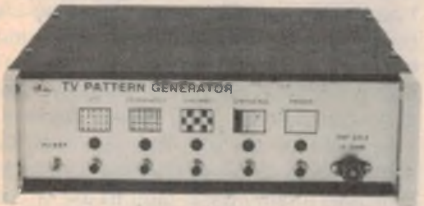
$149



EA APRIL 84

TV PATTERN GENERATOR

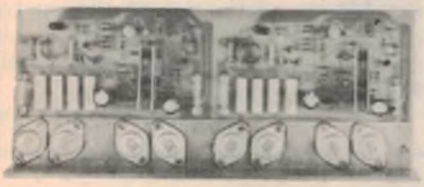
$67.50



Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns: dot, crosshatch, checkerboard, grey scale and white raster.

ETI 477 MOSFET MODULE

$63.50



Remember the great ETI 5000 power amp. With this module as the hub of the ETI 5000 and a transformer you get an amazing power output of 150W RMS.

Plus Power Supply (No Trans) **$49.00**

Plus Transformer **$39.50**

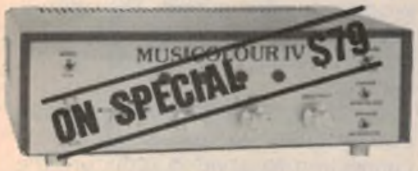
TRANSISTOR ASSISTED IGNITION

EA November 79

$34.50

MUSICOLOR IV

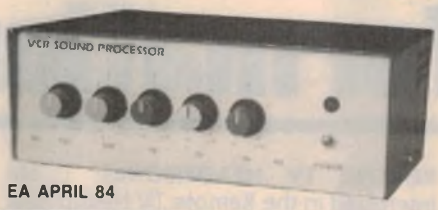
$84.00



Add excitement to parties, card nights and discos with EAs new Musicolor IV light show. This is the latest in the famous line of Musicolors and it offers features such as four channel "Color Organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety. **EA August 81**

VCR SOUND PROCESSOR

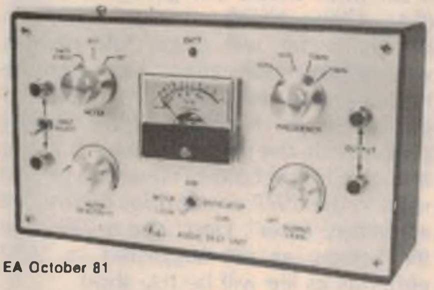
$57



EA APRIL 84

AUDIO TEST UNIT FOR CASS DECKS

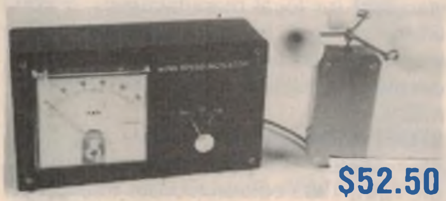
$47.50



EA October 81

WIND SPEED INDICATOR

October 81

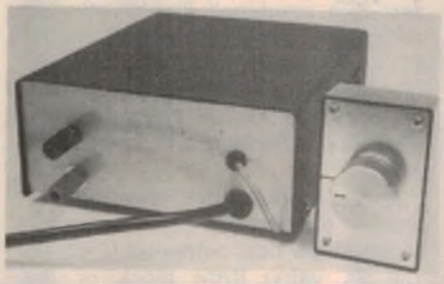


$52.50

BIPOLAR TRAIN CONTROLLER

EA December 80

$34.50



PC BIRDIES

$14.50

Granny's Birthday – PC Birdies.

Grannys got a birthday coming up and you don't know what to give her! Her cat ran away, her dog starved and the fish turned upside down. Well here's the perfect gift. A no-nonsense, no maintenance companion. The PC Birdies — She'll whistle, sing and dance for hours to this amazing electronic canary. **EA May 81**

SOUND LEVEL METER

$64

EA MARCH 84

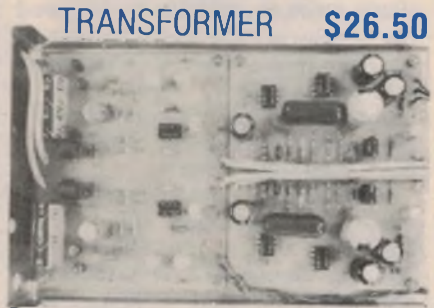
HEADPHONE AMPLIFIER

$28

EA MARCH 84

MIXER PREAMP TRANSFORMER

$26.50

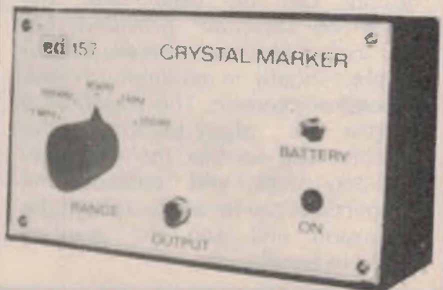


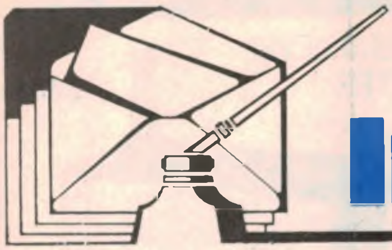
Easy construction and versatile operation, this Preamp was for coupling with the 300W "Brute" Power Amp. **ETI 467 July 80**

CRYSTAL MARKER (INC 1MHZ X)

$34.50

ETI 157 October 81





Information centre

METAL DETECTORS: I would appreciate some technical information concerning metal detectors particularly gold detectors.

Is it possible to obtain, modify or build a detector that will locate gold to a depth of one metre? If not could you please tell me why not and what are the limiting factors? (P.B., Manningham, SA).

● It is doubtful whether any metal detector could indicate gold at a depth of one metre. The trouble is that the conductivity of the ground masks the conductivity of the gold. The vast majority of nuggets found by metal detectors have been buried under just a few centimetres of earth.

Our most recent metal detector was published in November 1979. This was quite a cheap design which cost around $20. It is possible that some metal detectors which cost hundreds of dollars more are more efficient but we think you would be paying a great deal more for those extra knobs.

Photocopies of the article are available from our Information service at $3.00 which includes postage.

REMOTE TV HEADPHONES: I am interested in the Remote TV Headphone circuit described in EA, November 1977 (File No 3/MS/72). Could this circuit be used with lightweight 32Ω headphones? If so, what circuit changes are needed? (P.M., Glebe, NSW).

● This circuit will drive 32Ω phones without any modifications. However, the headphone amplifier circuit we published in February 1984 would probably do the job just as well. It might also give better battery life as the LM380 used in the 1977 circuit does tend to be a "battery eater". Don't use a 216 type 9V battery as we suggested in 1977 either as its life will be too short.

One other comment is important. This circuit was designed before transformerless TV chassis became standard for local manufacturers. If you intend using a recent model set make sure that the loudspeaker (or earphone) circuitry is isolated from the 240VAC mains.

STEREO SIMULATOR: I have just built your Stereo Simulator as presented in the April 1983 edition of your magazine. I find the resultant performance very disappointing. I have checked the accuracy of my work carefully with your circuit and am confident there is no error.

When connected to the output of my amplifier the resultant sound is reduced by at least 90%. In addition a rhythmic static is produced in time with the music. I appreciate reading your magazine and have never encountered difficulties before. I would appreciate your advice if you are able to help. (K.B., Mackay, Qld).

● Unfortunately, your letter gives us very little to go on. The fact that the signal seems to be so drastically reduced indicates a fairly basic fault in the circuit. Have you made any voltage checks?

First you should verify that you have 9V on pin 7 of each of the three ICs. Similarly, you should have close to 4.5 volts at pin 6 of each IC. If the latter condition is not met, you should check the voltage across the 10μF capacitor (lefthand side of the circuit). This should be 4.5V. If not, the capacitor is probably leaky or the wrong way around.

If the DC conditions are correct, yet

Hi-Res Graphics Display for the System-80

HI-RES DISPLAY BOARD: Having read the article on the High Resolution Graphics Display for Z-80 Computers in the February 1984 issue, I wondered if this could be used with a Dick Smith System-80 computer. I have a 48K disk system.

Unfortunately, I cannot find a pin on either the expansion bus in the computer or on the 50-pin S100 interface connector in the expansion unit labelled Enable or R/W. I also require clarification of pins 10 and 12 of the 40-pin connector. Are they for the video output? (J.W., Bairnsdale, Vic).

● The high resolution graphics display can be used with the System-80 computer provided that you can make connections to the graphics board in addition to your expansion interface. This would be a matter of "piggy-backing" the graphics unit so that the necessary address, data and control line connections can be made to both the expansion unit and the graphics board in parallel.

The R/W signal referred to in the text is a combined Read/Write line which is "0" when writing to RAM and "1" when reading from RAM. The WR line on the System-80 expansion port connector is exactly equivalent (on pin 40 of the System-80 expansion port).

As the article in the February issue states, the Enable signal controls whether the host computer writes to the 8K video RAM block or the memory is read out and used for a screen display. When Enable ="1" the RAM is read by the display controller, and when Enable ="0" the RAM block is available for reading or writing by the host computer.

As you have discovered, there is no Enable signal on the System-80 expansion connector and you will need to produce your own such signal. It should go "0" when the System-80 accesses a particular 8K block of memory (the uppermost 8K, at E000-FFFF, would be most suitable). Some additional circuitry is necessary to produce this signal.

To produce this signal use a four-input NAND gate such as the 7420, and a single inverter from a 7404 package. Connect address lines A15, A14 and A13 from the System-80 to the inputs of the NAND gate, and connect the MREQ line from the System-80 to the input of the inverter. The output of the inverter is connected to the fourth input of the NAND gate.

When A15, A14 and A13 and the (inverted) MREQ signal are all "1" the System-80 will be able to access the video RAM block. All other combinations of these four lines will enable the video display board to produce a video output. This address decoding scheme places the video board memory in the upper 8K of a 64K system.

Pin 10 of the graphics board is the composite video output for connection to a video monitor. The combined horizontal and vertical sync signals on pin 12 are for other special purposes and is not required for graphics displays.

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

you still have this signal loss problem, it is possible that the feedback resistor for IC1 is the wrong value. If this is correct, look for possible open-circuits in the signal path from IC1 onwards.

Bear in mind that if the DC conditions are correct it is most unlikely that you have faulty op amps. The fault is likely to be quite simple and easy to fix. We can assure you that the circuit works very well and produces negligible noise.

TRANSISTOR ASSISTED IGNITION: In the January information pages you have a letter from a reader having problems with TAI fitted to a Jaguar. I had the same problem with my Jaguar. The Jaguar is unusual in that the tacho relies on a current feed from the points rather than a voltage feed. In fact it uses a small transformer to monitor the whole current from the points to the ignition coil. Hence, when TAI is fitted the tacho circuit is too insensitive to work properly.

I cured the problem on my car by modifying the current transformer. This has two turns on its primary. I removed one turn which effectively doubles the turns ratio. I then had to recalibrate the tacho. There is a screwdriver preset on the back of the tacho housing which lets you do this job. (W.J., Inglewood, SA).

● Thanks for the tip. Your information clears up what was a puzzling problem to us. It may also be possible to make the tacho work with TAI by using it to monitor the coil current although recalibration may also be necessary.

MOTORCYCLE INTERCOM: Lately I have had more than a passing interest in motorcycle touring and was thrilled to read that you were to publish a motorcycle intercom in the February issue. I duly read the article and now

Help wanted with Trip Meter

TRIP METER: In response to the request for a Trip Meter (Halda) in this column, page 150 Dec 1983, I have designed and built a prototype electronic Halda based on EA's Car Computer (August 1982).

The unit contains two independent 5-digit distance counters accurate to 1/100km and a 4-digit timer accurate to 1 second. Information is displayed on two 5-digit LED displays. Control is via a 10-key keyboard and a handheld unit that duplicates two of the 10 keys.

The counters and timer can count up, down, remain stationary and be reset; they can also be preset to a certain distance or time. Other features include automatic calibration. However, like all good ideas, the prototype with a test program in it does not yet work. Repeated examination with a logic probe and CRO has failed to find the cause.

I have had the circuit diagram checked out and this is not a fault and I would be happy to supply it on request. I would also be extremely grateful for some help in finding the fault. A 6800 assembler would also be useful as the final program is not completed. Can any reader help me? P. Broughton, Moore Lodge, Whitley College, 271 Royal Parade, Parkville, Vic 3052. Phone (03) 347 8114.

write in response to that article.

Your advice on how to attach the helmet components will, in some cases render the helmets non-functional, ie, dangerous. Cheaper motorcycle helmets are made of polycarbonate plastic and this material is very easily affected by hydrocarbon fumes. The use of contact cements that rely on hydrocarbon solvents will severely damage such helmets.

Your readers may also be tempted to drill holes in the shell of the helmet to attach the internal components. This can also destroy the protective properties of a helmet which relies for its strength on the integrity of the shell.

The internal parts can be effectively sewn into the lining without, as far as I can determine, causing any danger. I hope these observations are of some use. (R.S., Hurstville NSW).

- Thank you for your comments. We had thought that polycarbonate helmets were no longer being sold but the press clipping you sent to us put us straight on that score. We agree that as far as polycarbonate helmets are concerned, contact adhesives should be avoided. We also agree with your comments on drilling helmets. We had not mentioned this in the article because we had not thought anyone would be silly enough to do so but your warning is probably sound. Sewing the components to the helmet lining, as outlined in the article, is the recommended way of doing it.

PCB HOLES: Firstly let me say as an avid reader of your magazine that I find it always to be interesting and challenging. My query is this: I, and I'm sure many others, would like to know how a plated-through hole PCB is made. (A.Z., Kingscote, SA).

- The making of boards with plated through holes is quite different from that for a conventional single-sided board. The single-sided board is first coated with photo-resist, then exposed with the artwork, developed and then etched. Finally all the holes are drilled. Other steps include the addition of solder-resist to the underside and screenprinting the component overlay on top, but the basic process is as outlined.

The difference with double-sided boards having plated-through holes is that the holes are drilled first, before any other processing of the board. Then the board is dipped and plated with copper and tin which provides the connection through all the holes. After this the board is exposed with the artwork on both sides and processed as before.

MAGNETOPHON: I have recently been given a 20 year-old Telefunken Magnetophon 97 tape recorder and was hoping you could help me. Can you tell me where I would be able to get a replacement rec/play head and the following valves: ECC81, EL95, EF86, EM84? Are "solid state" replacements for valves still available and if so where? (G.J., Eastwood, NSW).

- Unfortunately we do not know where you can obtain a suitable rec/play head for your machine. It may be possible to adapt a head from one of the early National or Sony tape machines which used valves and for which parts are probably available. The valves you mention are still available from component supply houses such as Martin de Launay Pty Ltd, 287 Clarence St, Sydney. Phone (02) 267 1055.

By "solid state replacements" we assume that you mean the triode equivalents made some years ago using Fets. As we understand it, these were mainly intended for military applications and were never seriously considered for consumer use.

SPEAKER CABLES: Please advise if you can supply information on high quality speaker cables. I understand that there is at least one brand available in Melbourne, going under the name of "Monster Cable".

I understand that the cable is similar to "Litz" were – to reduce inductance. My speaker leads are long (approx 10 metres each channel) and I will install the cables if there is an improvement over electrical building cable, ie. 23/.0076" or 7/.036". (J.N., Churchill, Vic).

- We discussed this subject at some length in a column entitled "Audio Talk" in our April 1979 issue. Photostat copies are available from our Information Service at the usual charge of $3.00 including postage.

Briefly the gist of the article was this: Ideally, your loudspeaker cables should have a total resistance of not more than 0.5 ohms to give good performance. If you need thick leads it is better to use ordinary mains or automotive cable than to pay out for expensive cables such as the brand you mention.

Books . . . . . . from p111

comparison tables detailing the microprocessors made by all the world's manufacturers but again, who would have any real use for it.

It seems then that here is a book into which a great deal of effort has been placed but the end product will probably be of little use to most people. And for the cover price of $126.50 you can buy a stack of data books. (L.D.S.)

Li'l Pokey . . . from p71

and 2.5mm respectively. Two different methods can be used to produce the square cutouts – you can either use a fine-toothed coping saw, or you can drill a series of small holes around the inside perimeter of each cutout and then file to shape.

Always file inwards so as not to damage the front panel label.

The PCB is mounted centrally in the case on 28mm standoffs, while the battery carrier sits beneath the board and is wedged firmly in position by a layer of foam plastic. Fig. 1 shows the mechanical details. Note that each 28mm standoff assembly is made up by a 4BA x 25mm threaded spacer and a 4BA x 3mm hex nut and these must be fitted to the PCB before it is installed in the case.

Mount the PCB in position, then install the switches and the optional piezo transducer on the front panel. The piezo transducer is mounted over the previously drilled holes and is held in position using contact cement. We also glued a small piece of red filter material over the rear of the display cutout to improve display visibility.

Finally, the lid of the case can be screwed down and four rubber feet (optional) fitted to the bottom of the case as shown in Fig. 1. That's it – from now on, you can play the one-button bandit for free!

Footnote: It was impossible to get the jackpot number, 88, on the prototype. This fault was caused by spurious operation of the 555 timer IC due, in turn, to poor supply line regulation.

Here's how this spurious operation occurred. Each time the unit stopped with the number 88 in the counters, the win indicator LEDs and all the display segments would begin to turn on. The result was a momentary drop in the supply voltage, causing the 555 timer to immediately restart and advance the reading another two or three counts. So, as far as the player was concerned, the jackpot number was impossible!

The solution is quite simple and involves extra supply line decoupling for the 555 time IC. Fig. 2 shows the details. The extra components consist of a 100Ω resistor and a 1000μF electrolytic capacitor and these can be mounted on the underside of the PCB.

Notes & Errata:

PHONE MINDER (February 1984, File 1/1A/20): Some electrets have been found to be low in sensitivity and the circuit may only emit a single tone burst for each ring cycle of the phone. The cure is to reduce the 120kΩ input resistor (to pin 2 of IC1) to 47kΩ.

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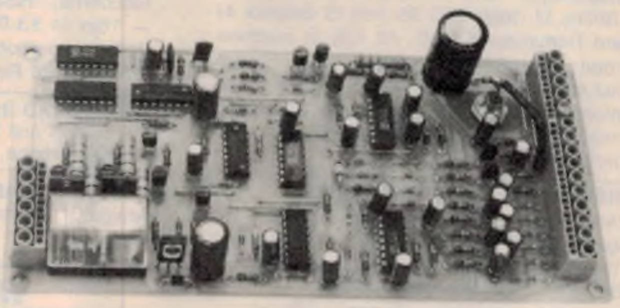

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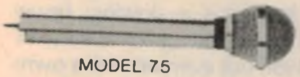

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FOR PERSONAL COMPUTERS, ETC, ETC

Input 240AC
50HZ
Size 155 x 55 x 85mm

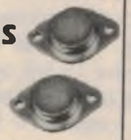
$17.95

OUTPUT 6, 7.5, 9, 12V DC 1 AMP **CONTINUOUS** CIRCUIT BREAKER PROTECTED. SEC APPROVED

P-P NSW $2.50
INTERSTATE $3.50

POWER TRANSISTORS

140V 20AMP
MJ15003 NPN
MJ15004 PNP



$7.90 PAIR P-P $1

240V 50Hz 5 AMP MAINS FILTER

Professional Quality.
Ex-computer.
Also ideal audio gear, receivers, etc.

$9.50 P-P $1.50

A1 QUALITY TRANSISTORS

2N3055

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7805 + 5V. 7905 – 5V 1A

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$3.75 P-P 75c

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Good Quality JABEL. All ¼" Shaft. 1 Pole 4 Positions. 1×11. 1×12. 2×2. 2×3. 2×4. 2×5. 2×6. 3×2. 3×3. 3×4. 4×2. 4×3.

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OR 10 MIXED
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DIODE IN 4004. 50 FOR $2.50
P-P 80c

2SD200 = BU205 TRANSISTOR

NPN VCBO 1500V ● VCEO 700V ● 2.5 AMPS

4 FOR $3.75 P-P 75c

BSR

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MANUAL OPERATION
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Very Latest Model ● Electronic Speed Change 33 45 rpm. ● Auto Shut Off ● LED Power indicator ● Straight Tone Arm ● Angled Head Shell ● Cueing Lever ● Ceramic Cartridge ● Diamond Stylus ● Plays 17, 25, 30cm Records

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Or 12V DC Model with Power Transformer, Diodes, Capacitor, Cable. Diagram and simple instructions for

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P-P NSW $3.50. Q. V. SA. T. $5.50. WA. NT. $6.50

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(LIMITED STOCK)

A.

B.

CABINET A. Brushed aluminium chassis and front panel. Black Marviplate steel lid with folded edges for extra strength. Feet included.

CABINETS B, C, D, E. Black Marviplate steel surround with folded edges and back plate. Brushed aluminium front panel.

A.	B.	C.	D.	E.
237x93x225mm	178x127x102mm	178x102x102mm	165x115x51mm	127x101x75mm
$12.50	$5.95	$5.50	$4.95	$4.00

P-P. NSW $1.50. INTERSTATE $2.50.

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TOP QUALITY — AS USED BY MANY GOVT. DEPTS.

SIZE	AH	PRICE EA	OR 4 FOR	P-P
AA.	500MA.	$2.75	$10	$2.75
Sub C.	1.2	$4.95	$18.25	"
C.	1.8	$6.50	$23.50	"
D.	4.0	$7.85	$28.00	"

CHARGE FOR 14 HRS AT — 1.2AH. 120MA — 1.8AH. 180MA — 4AH. 400MA.

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GENUINE FACTORY PRICES

Rugged top quality Aust made brand new bargains — all with factory warranty

Model	Size	Cone Type	V/Coil	Reson Hz	Freq Hz	Watts Rms	Price Ea or	2 for
4310	38cm	Straight surround	8 or 15 Ohms	45	40-6000	60	$69.00 or	$132.00
4510	38cm	Straight surround	8 or 15 Ohms	45	40-6000	100	$89.00 or	$170.00
4350	38cm	Hi-Fi	8 or 15 Ohms	30	30-4000	120	$69.00 or	$132.00

Pack — Postage add for one 25/30cm model NSW $3.50. Interstate $5. For two 25/30cm models NSW $5. Interstate $7. For one 38cm model NSW $4.00. Interstate $6.00. For two 38cm models NSW $7. Interstate $8.50.

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BD135 NPN. 45V, 1A, 8W

10 FOR $1.95 P-P $1

2N441 = ADZ11

PNP 40V 150W 15A TO-36 CASE

2 FOR $7.50 P-P 90c

50 & 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, 1934

Walkman fans beware: Mr Fode, chairman of the Wireless Trade Association in Denmark, says that crystal sets are unhealthy, because the earphones tend to slow circulation of blood round the brain; in this he is supported by a prominent doctor, but ridiculed by other doctors.

☆ ☆ ☆

And it was all done with valves: Los Angeles police have demonstrated a belt radio receiving set developed for police use by local radio amateurs. The set is built into the Sam Brown belt, with its several parts contained and concealed in small cases attached to the belt. The antenna is wound into a triangular leather back piece. If the set is adopted policemen patrolling their beats will be able to pick up the radioed alarms, and so will be able to augment the auto police who respond to calls sent out by the division station.

☆ ☆ ☆

The bite was worse than the bark: It is said that a Berlin listener wishes to sue the Berlin broadcasters because a talker brought his dog to the Berlin microphone and the dog barked, whereupon the listener's dog flew at the loudspeaker and destroyed it.

☆ ☆ ☆

The times they are a-changing: From April 22, English listeners began to grow used to hearing "19 o'clock" instead of "7 o'clock" or "7pm". This will end (although they will change their programs by degrees) the "pm" and "am" signs, and 10 past 12 (midnight) will be written "00.10" while 8.10pm will become "20.10". It is said that the BBC is instituting this change by Government order and that the idea is to "educate the public in 24 hour time".

Smile please: The western Electric Company has produced a camera which takes 2000 pictures a second, so that a shattered electric light bulb looks like slowly drifting snowflakes, and a motor manufacturer found a defect in one of his processes which endangered all the rest of the car. The time is recorded on the film simultaneously with the movement of the image. It is calculated by a precision electric clock driven by a current generator consisting of an electrically actuated tuning fork.

☆ ☆ ☆

Who paid for it? Baden-Baden, with a population of about 30,000, made a fierce anti-interference drive, and claims to have eliminated 94 per cent. of machine-static, or the noise of 1316 vacuum-cleaners, 784 sewing machines, 258 small household motors, 285 electric fans, 56 haircutting machines and dentists' drills, 18 X-ray equipments, 197 high-frequency massage plants, 20 diathermy equipments, 58 violet-ray equipments, 8 neon-tube installations, 24 electric alarms, 37 office machines, 63 lifts, 1670 workshop motors, and 27 refrigerators.

RADIO TELEVISION AND HOBBIES

April, 1959

Another transistor triumph: Recently developed components have made possible a radio thermometer to monitor the temperature at which the penguin keeps its eggs. The unit uses a transistor oscillator powered by three mercury cells. It is said to operate continuously for 150 hours. The use of a transistor was a natural. It is not only small, light and economical of power, but does not generate heat. The radio thermometer has a range of 80ft, is accurate to within 0.2°F and weighs only 80 grams.

When the valve was king: The sale of radio valves and picture tubes in the USA is certain to rise very considerably during 1958, according to report from Sylvania. The replacement radio and TV parts segment of the industry continues to expand while the sale of television sets is down for the third straight year. Consumer buying is a slowing. Fewer people will be spending for a new TV set during 1958 but everyone who owns a TV set will want to make sure it's in top working order. Several million more receiving valves will be sold during 1958 than last year, when total sales reached 185,000,000.

☆ ☆ ☆

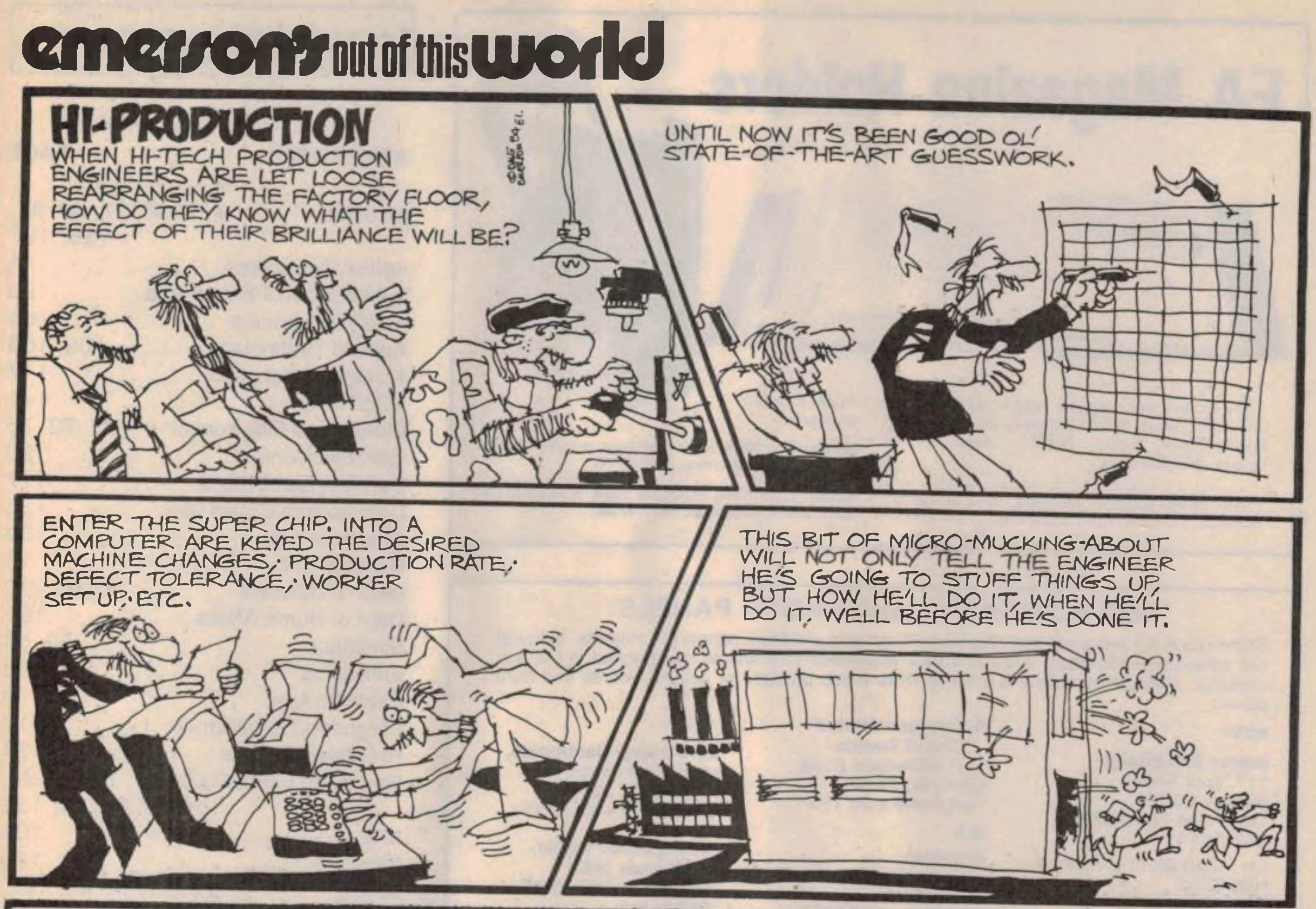
Before we had a coaxial cable: Television station ATN in Sydney performed a remarkable feat on February 25 when it televised the visit of the Queen Mother to Canberra. It covered the inspection of Duntroon Military College in the morning, and the Ball at Government House in the evening. This was done by use of a microwave TV link operating over a total distance of 170 miles. This is believed to be the longest TV link ever attempted by a station using its own facilities. ATN was able to mount two repeater points in addition to its normal OB van, and these were used for the broadcast. The first link was established on Mt Gibraltar between Moss Vale and Mittagong. The second repeater was installed on the top of a high mountain outside Canberra in such a position as to allow a clear path back to Gibraltar and down to the valley in which Canberra lies.

☆ ☆ ☆

Wheel-less cars by 1978: Detroit designer, Carl Reynolds, predicts the car of the future will have no wheels. It will be propelled by ducted fans, and travel two feet above the roadway. Small light-weight engines are required. Target date—1978.

☆ ☆ ☆

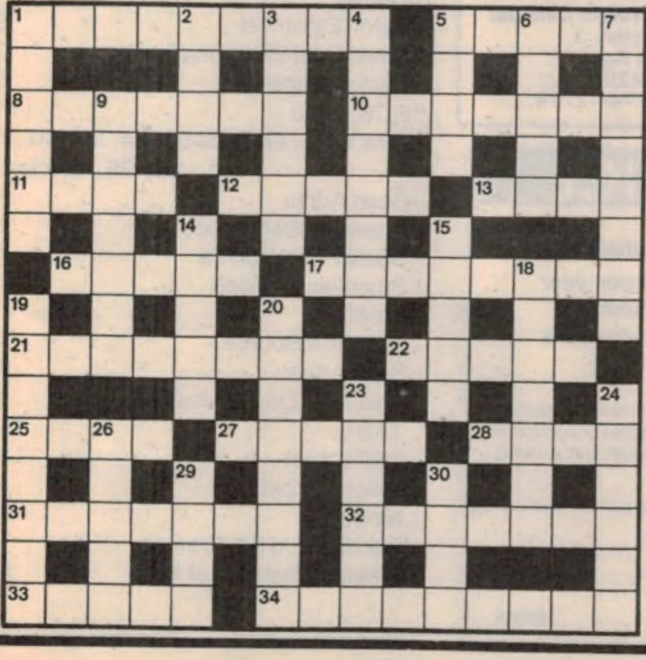
Still a long way to go: A portable 14in picture tube, cordless TV, powered by two 12 volt nickel-cadium rechargeable batteries, was recently exhibited in Chicago by Motorola, Inc. The unit has 31 transistors and consumes 10W. Battery life is six hours. A monopole 4½ft antenna is used. Motorola says "the unit is not a laboratory freak. We can start building them right away if the economics make it feasible. We want to encourage component manufacturers to get behind this." Weight with batteries is 32lbs.



APRIL CROSSWORD

ACROSS

1. Transmission band. (5-4)
5. Communication code. (5)
8. Information display. (7)
10. Agent for preparing PCs. (7)
11. Unit for rate of transmitting data. (4)
12. Electronic appliance. (1,1,3)
13. Colour in a television test pattern. (4)



16. Type of cell. (5)
17. Choke. (8)
21. Said of computer operation, etc, using current data. (4-4)
22. Produce a permanent image on a page of paper. (5)
25. Gas used in some bulbs. (4)
27. Flux used in soldering. (5)
28. Benjamin Franklin flew it. (4)
31. Another TV test pattern colour. (7)
32. Battery restorer. (7)
33. Selects desired frequency. (5)
34. Counductor which emits or collects charge. (9)

DOWN

1. Device which produces light, briefly. (6)
2. Implement. (4)
3. Said of a component, etc, which introduces gain. (6)
4. Parts of a TV anetnna. (8)
5. Natural insulating material. (4)
6. State of an appliance in the stand-by mode. (5)
7. Operating position of a car radio antenna. (8)
9. Aluminium oxide. (7)
14. Components. (5)
15. Television pioneer. (5)
18. Mechanical coupling to synchronise two or more circuits, etc. (7)
19. Send. (8)
20. Current flow. (8)
23. A Lissajous figure. (6)
24. Qualification. (6)
26. Electronic instrument. (5)
29. Half of the binary code. (4)
30. Antenna tower. (4)

SOLUTION FOR MARCH

M	O	D	U	L	E	■	K	E	Y	B	O	A	R	D
U	■	R	■	A	■	T	■	N	■	I	■	C	■	A
T	R	I	M	M	E	R	■	A	M	A	T	E	U	R
U	■	F	■	P	■	A	■	B	■	S	■	T	■	K
A	U	T	O	■	S	C	A	L	E	■	P	A	S	S
L	■	E	■	E	■	E	■	E	■	B	■	T	■	T
■	E	D	I	T	E	D	■	S	L	A	V	E	■	A
I	■	■	■	U	■	■	■	■	■	L	■	■	■	R
N	■	M	O	D	E	M	■	F	L	U	O	R	O	■
T	■	O	■	E	■	A	■	R	■	N	■	A	■	C
H	I	S	S	■	X	G	A	I	N	■	I	D	E	A
E	■	F	■	C	■	N	■	N	■	B	■	I	■	V
E	X	E	C	U	T	E	■	G	A	L	V	A	N	I
A	■	T	■	E	■	T	■	E	■	U	■	T	■	T
R	E	S	I	S	T	O	R	■	F	R	E	E	L	Y

EA Magazine Holders

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Mail orders should be sent to Electronics Australia. PO Box 163. Chippendale. NSW 2008.

Prices including postage are:

Holders: $5.50 NSW; $5.60 other states: or six for $29.00 NSW; $31.50 other states, $A33.00 NZ.

Binders: $7.00 NSW; $8.50 other states: or six for $33.00 NSW; $36.00 other states, $A37.00 NZ.

EA PC BOARDS AND FRONT PANELS

Some readers have problems obtaining PC boards and front panels for projects. Many of our advertisers sell these items and their advertisements should be checked in the first instance. Failing that, below is a list of firms which produce or sell PC boards and front panels.

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Jaycar Electronics
117 York Street,
Sydney 2000.
Telephone 264 6688,
267 1614.

Cnr. Carlingford & Pennant Hills Road,
Carlingford 2118.
Telephone 872 4444.

115-117 Parramatta Road,
Concord, 2137.
Telephone 570 7000.

121 Forest Road,
Hurstville 2220.
Telephone 570 7000.

Radio Despatch Service,
869 George Street,
Sydney 2000.
Telephone 211 0816.

RCS Radio Pty Ltd,
651 Forest Road,
Bexley, NSW 2207.
Telephone 587 3491.

Acetronics Printed Circuit Boards,
112 Robertson Road,
Bass Hill, 2197.
Telephone 645 1241.

WA

Altronics,
105 Stirling Street,
Perth 6000.
Telephone 328 1599.

Jemal Products,
5 Forge Street,
Kewdale, 6105
Telephone (09) 451 8726.

N.Z.

Marday Services,
PO Box 19 189,
Avondale, Auckland.

Mini Tech Manufacturing Co Ltd,
PO Box 9194,
Newmarket.

Printed Circuits Limited,
PO Box 4248,
Christchurch.

VIC.

Rod Irving Electronics,
425 High Street,
Northcote, 3070.
Telephone 489 8131.

48 A'Beckett Street,
Melbourne 3001.
Telephone 347 7917
347 9251.

Kalextronics,
101 Burgundy Street,
Heidelberg 3084.
Telephone 743 1011.

Shop 11,
Regional Shopping Centre,
Melton 3338.
Telephone 743 1011.

Sunbury Printed Circuits,
Lot 14, Factory 3,
MacDougal Road,
Sunbury 3429.
Telephone 744 2714.

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ADVERTISING INDEX

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A force of over 22,000 highly trained professionals operating a network of bases and facilities across the nation.

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RGI.FPC124

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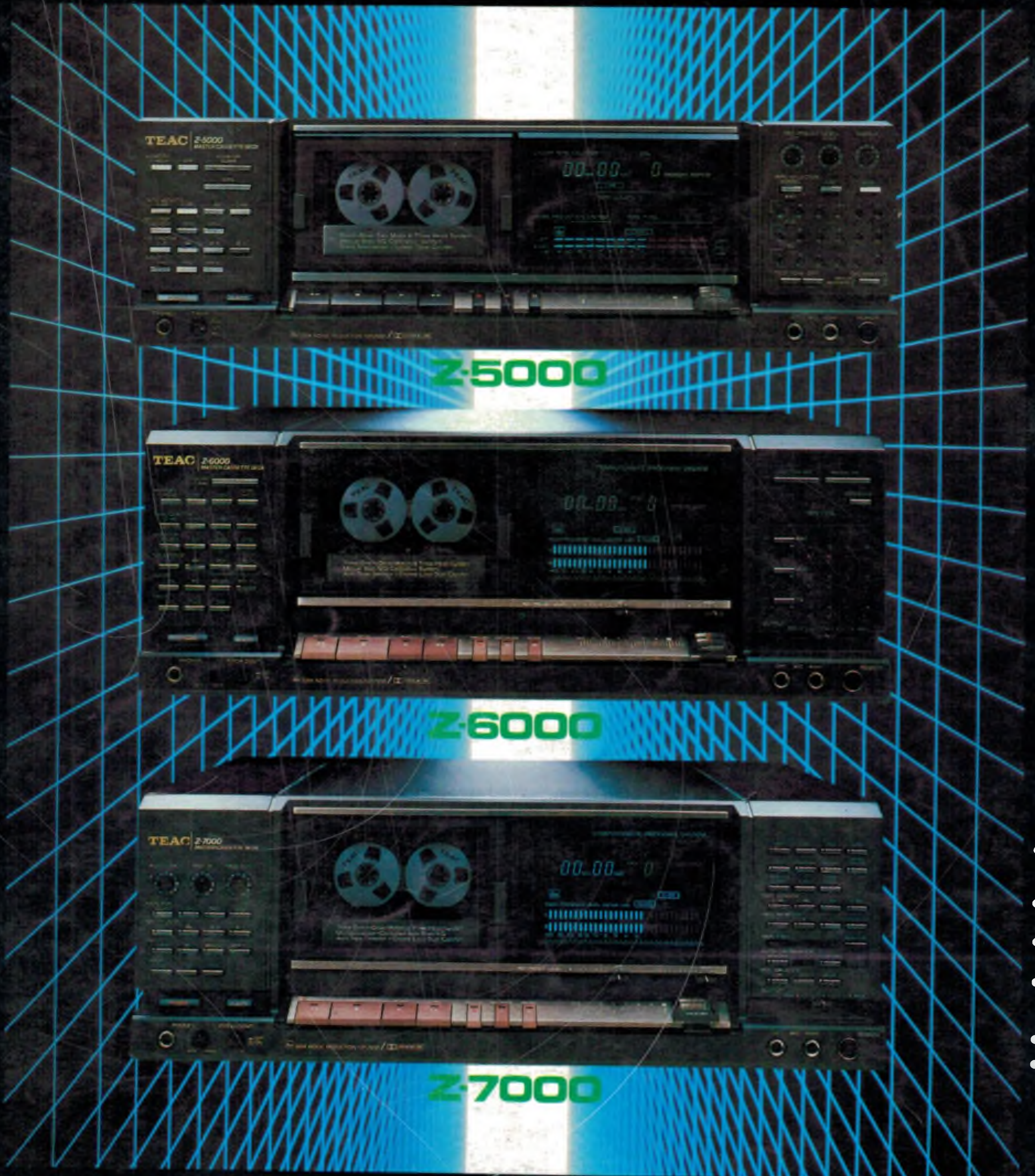
The TEAC Z Series. Three cassette decks that are all the cassette deck anyone will ever need. Designed and built to provide absolutely the finest in cassette reproduction quality. In precision of performance. And in operational versatility. The transport and electronics are the pinnacle of TEAC technology, drawing on our know-how in producing superior open reel decks and professional equipment. Operational sophistication is unmatched. Any function worth having on a cassette deck is on the Z-7000. And the Z-6000 and Z-5000 are almost as impressive. In fact, you can tell just by looking that these decks are in a class by themselves. Bigger. Heavier. Without extraneous frills. Built for solid, stable, permanent excellence. The Z Series. Cassette deck performance from A to Z.



- Direct-drive capstan motor
- 3-head system
- dbx and Dolby B–C noise reduction
- Manual recording bias, level and EQ calibration system
- Heavy duty diecast chassis
- Electroload head loading system

- Direct-coupled playback EQ amplifier
- Real-time tape counter
- Memory repeat/play/stop
- CPS (Computomatic Program Search)
- Rec mute with auto spacer
- Standard remote control unit

- 3 direct-drive DC motors
- Direct-coupled playback EQ amplifier
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Manual recording bias, level and EQ calibration system

- Dual-capstan closed-loop transport system
- Real time tape counter
- Automatic tape select
- 30-segment FL peak level meters
- Memory repeat/play/stop
- CPS (Computomatic Program Search)

- 3 direct-drive DC motors
- 3-head system
- dbx and Dolby B–C noise reduction
- dbx disc position
- Automatic recording bias, level and EQ calibration system
- Tape calibration memory
- Block Repeat

- Dual-capstan closed-loop transport system
- Real-time tape counter
- Automatic tape select
- Search To Cue, Search To Zero, Search To Record
- Spot Erase System
- CPS (Computomatic Program Search)

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