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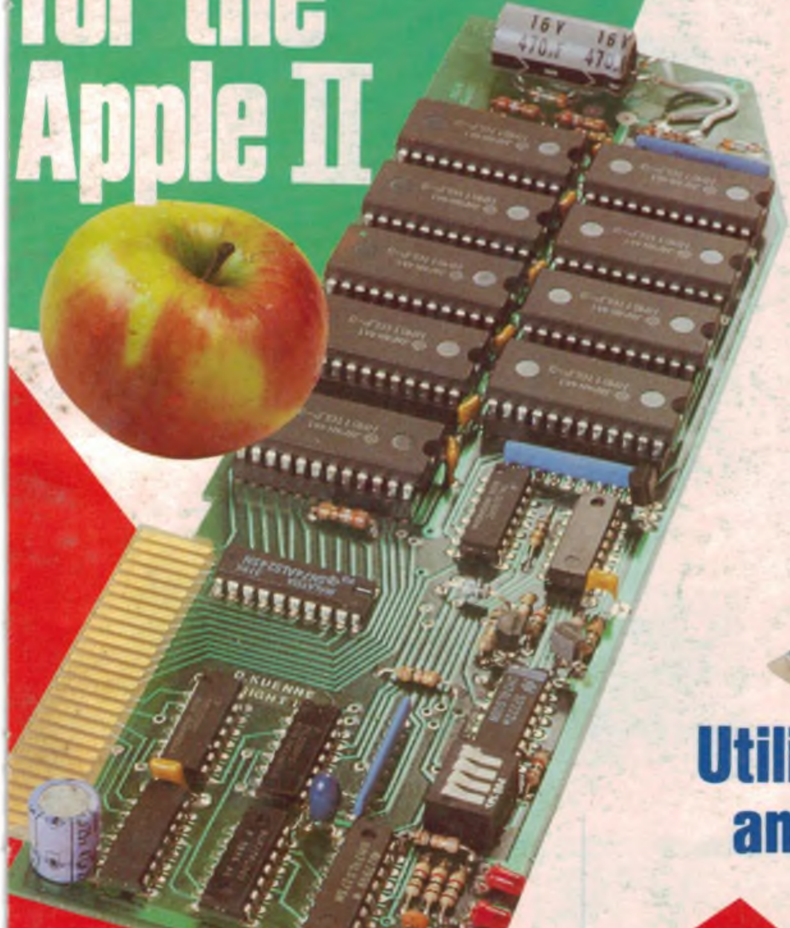
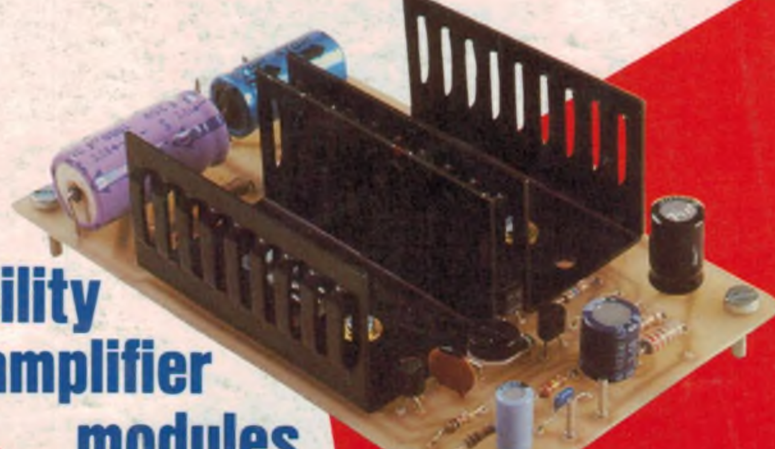
Electronics Australia

Bonus catalog from Radio Despatch Service

16K RAM card for the Apple II



BUILD THIS BRAKE LAMP FLASHER



Utility amplifier modules

Versatile electronic crossover

Diesel sound for model trains

Pioneer tape & reverberation amplifiers

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Cat K-6315

A 823 M

Electronics Australia

Volume 48, No. 11,
November 1984

On the cover

Three of our projects star on this month's front cover: a 16K RAM card for the Apple II, a brake lamp flasher circuit for cars, and a 20W utility amplifier module.

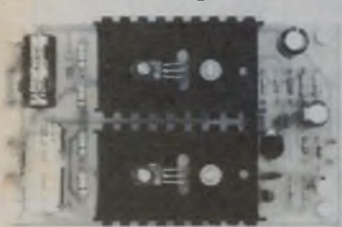
Automatic brake lamp flasher

Add this safety feature to your car. The circuit flashes a set of accessory stop lamps three times when the brakes are applied and holds them on after that while ever the brake pedal remains depressed. Construction begins on page 20.

What's coming?

Next month, we intend to describe a deluxe metal locator, an EPROM copier and a new speed control for universal motors (see also page 125).

Two low-cost utility amplifiers



Looking for a low-cost audio amplifier? This month we describe two general-purpose modules, one rated at 1W and the other capable of delivering up to 20W. Both circuits use discrete transistors and are easy to build and get going (see page 98).

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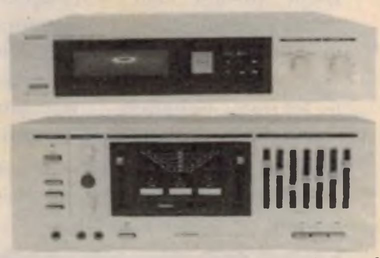
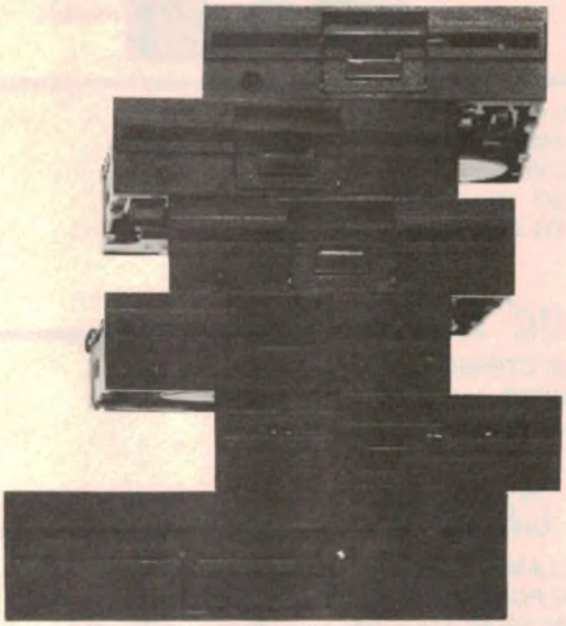
Pioneer reverb & tape amplifiers



Pioneer has released a number of products for the keen home recordist, including the SR-60 Reverberation Amplifier and the CA-100 Tape Creating Amplifier. The SR-60 features reverb, echo and duet effects while the CA-100 accepts inputs from various sources (microphones, tape decks, etc) and provides equalisation, fade and echo facilities (see page 32).

D is for Disk Drives

MITSUBISHI ELECTRIC



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Unformatted		
Disk (kilobytes)	500	1,000
Surface (kilobytes)	500	500
Track (kilobytes)	6.25	6.25
Formatted (256 bytes/track)		
Disk (kilobytes)	328	655
Surface (kilobytes)	328	328
Track (kilobytes)	4.1	4.1
Transfer rate (kilobits per second)	250	250
Mean latency time (milliseconds)	100	100
Access time (milliseconds)		
Track to track	3	3
Average	94	94
Setting time	15	15

8" (Half Height) Flexible Disk Drives

Performance Specifications		M2896-63
Memory capacity (kilobytes)		
Unformatted	Per Disk	1600
	Per Surface	800
	Per Track	10.4
Formatted	(256 bytes/track)	
	Per Disk	985
	Per Surface	492
	Per Track	6.66
Transfer rate (kilobits/sec)		500
Mean Latency Time (milliseconds)		83
Access Time (milliseconds)		
Track to track		3
Average		91
Setting time		15

5¼" (Half Height) Flexible Disk Drives

Performance Specifications	M4851	M4853	M4854	M4855
Memory capacity	500	1,000	1,600	2,000
Unformatted				
Disk (kilobytes)				
Surface (kilobytes)	250	500	800	1,000
Track (kilobytes)	6.25	6.25	10.4	12.5
Formatted (256 bytes/track)				
Disk (kilobytes)	328	655	985	1,310
Surface (kilobytes)	164	328	492	655
Track (kilobytes)	4.1	4.1	6.67	8.19
Transfer rate (kilobits per second)	250	250	500	500
Mean latency time (milliseconds)	100	100	83	100
Access time (milliseconds)				
Track to track	6	3	3	3
Average	94	94	91	94
Setting time	15	15	15	15

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

*Recommended and maximum price only.

Printed by Magazine Printers Pty Ltd, Regent Street, Chippendale and Masterprint Pty Ltd, Dubbo, NSW for Magazine Promotions, Regent St, Chippendale.

Distribution: Distributed in NSW by Magazine Promotions, 57 Regent St, Chippendale; in Victoria by Magazine Promotions, 392 Little Collins Street, Melbourne; in South Australia by Magazine Promotions, 101-105 Waymouth St, Adelaide; in Western Australia by Magazine Promotions, 454 Murray Street, Perth; in Queensland by Gordon and Gotch (A'asia) Ltd; in Tasmania by Ingle Distributors, 93 Macquarie St, Hobart; in New Zealand by Gordon and Gotch (NZ) Ltd, Adelaide Rd, Wellington.

Editorial Viewpoint

ABC radio gives great service

One cannot help feeling sympathy for the beleaguered Australian Broadcasting Corporation. They have certainly had their share of problems in the recent past and the next few years promise more rough-sailing with new management at the helm.

Not the least of the ABC's problems is the media's obsession with ratings performance, for television and radio. On the basis of the poor figures there are some people who argue that the ABC cannot justify its generous allocation in the frequency spectrum, particularly for radio broadcasts.

Judged on the basis of ratings alone, the ABC does not appear to be winning the hearts and minds of the people and this certainly appears to apply more to radio than to television. But it is well to remember that the ABC's task is not simply to gather the largest audience. It has to serve those in the minorities who are not catered for by commercial stations.

From this viewpoint, ABC radio does its job very well. It has a large array of well-produced special interest programs that are informative and entertaining.

In fact, the ABC has so many special interest programs that it is impossible for the dedicated radio listener to catch them all. Of particular note must be programs such as Monitor, the Law Report, Technology Report, the Science Show, Radio Helicon, First Edition, Letter from America with Alastair Cook and, until recently, the Body Program with Earle Hackett.

Note that most of those listed above are documentaries but there is a whole range of other special interest programs catering for a wide range of tastes. The idea that the ABC must no longer continue catering for these tastes and go for the lowest common denominator instead is repugnant indeed. We hope that the new ABC management maintains the present policy and keeps up the good work.

"Towards 2000" should be revived

We are less than happy about the ABC's decision to discontinue the program "Towards 2000". This magazine has certainly been critical of the production and presentation of this series in the past but at no time would we have wished for its cessation; quite the contrary.

We have no argument with the concept of "Towards 2000". Any program which seeks to inform the general public about new technology must be regarded as useful. It was the execution of the program that drew our criticism. There was a tendency to trivialise the program content which probably resulted from the use of presenters who had little understanding of the subject.

We have contrasted this situation with "Countrywide". This program has presenters who are very familiar with their subject material and so make few mistakes in presentation.

In fact, one of the classic gaffes of the last series of "Towards 2000" was the assertion during one program that "signals travel more rapidly in optical fibres than copper cables". We sometimes wondered whether anybody with a technical background was ever asked to check the script.

Our hope is that the ABC will produce a refined and upgraded series along the lines of "Towards 2000" which will be more informative while still being entertaining.

Leo Simpson

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Quick! Grab some of these amazing specials while stocks last. NOTE! NOTE!! NOTE!!! Not all items available in all stores. If you can't get what you want at your local store, another might have some left. But once these bargains are gone, that's it! Original prices shown are advertised or ticket prices on normal sale. Intermediate prices may have varied.

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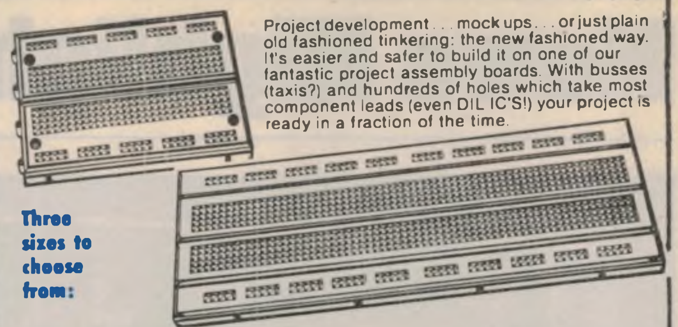

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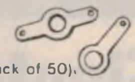

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Pack 10 male
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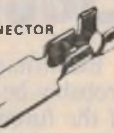
MALE CONNECTOR for P-5012



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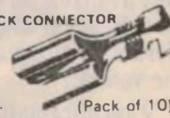
Pack 10 female
Cat P-5012

QUICK CONNECTOR



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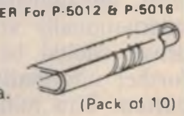
COVER For P-5012 & P-5016

Pack 10 covers
Cat P-5022



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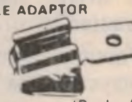

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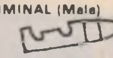

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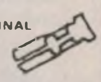

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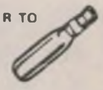
PLASTIC COVER TO SUIT ABOVE

Pack 10 covers
Cat P-5009



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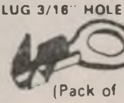

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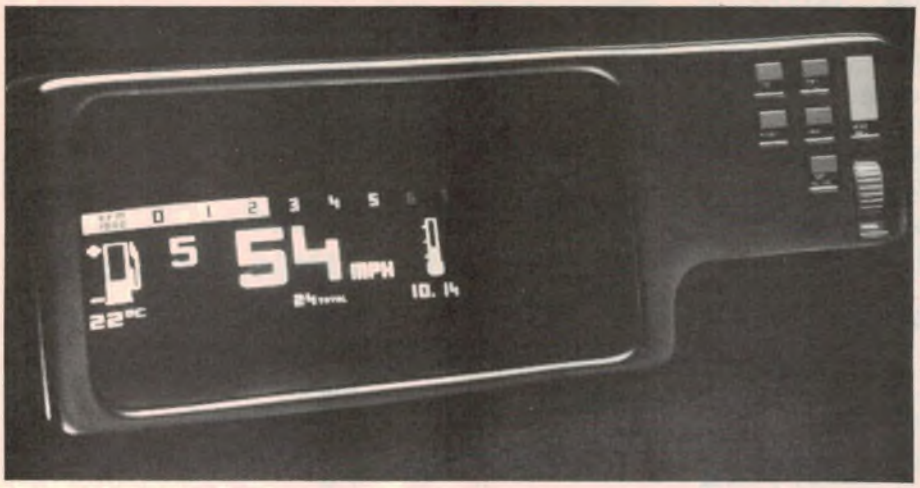
News Highlights



Electronic dash for cars

Electronic dashboard displays will probably be standard equipment in cars of the future. For the present, they are only available on some "top of the range" models. Such displays are a key selling feature, creating a "high-tech" image for the vehicle.

Vital information can be displayed in a clear, non-ambiguous format using many internationally approved symbols. The driver should be able to obtain any further information at the touch of a button. This minimises the chances of the driver becoming confused or distracted by unnecessary information.

Vacuum florescent and liquid crystal displays are the favoured devices for the present generation of electronic dashboards. Neither of these types reresents a truly flexible display — one which permits an instant change in format. BL Technology Ltd, of Warwick, England, are presently experimenting with a cathode ray tube display. Company engineers feel that this is the only way to provide a large display with the required flexibility at a reasonable cost.

The CRT display being developed by BL Technology employs a 240 x 240 pixel system with each rectangular pixel touching its four neighbours. This provides a continuous image. For maximum flexibility of the display pattern, the format is entirely controlled by software, rather than using a printed mask.

During normal driving, the display shown in the photograph will be obtained. This means that all systems are functioning correctly. The space above the main display is used for "tell-tale" symbols — indicating the operation of the demister, parking brake and other systems.

The two top corners of the display are reserved for malfunction warnings. In fact, each of these display areas can be used for more than one warning. In the unlikely event of multiple failures occuring at the same time, the warning symbols will be shown alternately.

The BL Technology prototype display also incorporated a special feature — a "More Info" button. Should the driver fail to recognize a warning or tell-tale symbol being displayed, written explanations will appear in place of the normal tachometer display.

BL Technology anticipate using a frame frequency of 100Hz in order to completely eliminate any visible flicker. At 50Hz some flicker is apparent, although it was found that most drivers did not notice it; it could be avoided at this frequency by the use of a long persistence CRT phosphor.

Alterations to the display format can readily be obtained by changing the memory contents without any change in the display hardware. The colour display is produced by a monochrome CRT using filters bonded to the face. — Brian Dance.

WE'RE MOVING!

By the time you read this, Electronics Australia should have moved to its new editorial and advertising offices in Waterloo. From November 1st, our new address will be at 140 Joynton Avenue, NSW 2017, and our new mailing address will be Box 227, Waterloo 2017.

Our new telephone number will be (02) 663 9999, and our new telex number is AA74488. We will also have access to a Group 3 fax machine, whose number is (02) 633 5144.

It's all part of a change in our ownership — EA was recently acquired by Federal Publishing Company Pty Ltd, which has big plans for helping us grow bigger and better in the future. So stay with us!

New ABC tower

Planning has begun for the construction of a new transmitting tower at the ABC's Gore Hill site. The project, estimated to cost $6.7M, is scheduled for completion in 1987-88.

The new tower will be built at the rear of the ABC's television complex at Gore Hill. It will be approximately 100 metres higher than the present tower and capable of accommodating up to 19 transmission facilities, as well as ABC outside broadcast antennas and a limited number of Government radio communications systems.

The original tower was built in 1962 to accommodate just one television service (ABN 2) and an experimental FM service. So many new television and radio services have since been added that the tower has no further potential for development.

Originally it was planned that the seven major FM services (ABC-FM, 2JJJ-FM, 2DAY-FM, 2MMM-FM, 2SER-FM, 2MBS-FM and 2CBA-FM) would be located at Northpoint in North Sydney, but the new Gore Hill tower will enable the stations to achieve a far higher quality service in the coverage area.

New RAN ship has advanced computers

The computer industry limelight has been devoted to "personal computers" in revent years. This has overshadowed advances made in other areas of the industry, such as military computers.

Some of the latest examples of such hardware can be found in HMAS Adelaide, one of the Royal Australian Navy's new guided-missile frigates.

The reason for employing this new technology on the Adelaide is to cut costs. The $250 million paid for the ship might sound a lot, but over the term of its commission it will enable big savings on manpower costs.

The ship is crewed by 152 people. According to Captain Carwardine, 10 years ago a ship this size would have had to have a crew of twice that.

Modern warfare, especially on the sea, relies on both being able to find and track the enemy and then being able to accurately "neutralise" that threat. The use of advanced computer, telecommunications and radar technology and "smart" weapons greatly increases the chances of success.

The ship's computer system is specifically designed to be able to counter simultaneous threats from submarines, aircraft, surface ships and missiles.

Her armaments include the standard surface-to-air guided missiles, the sea-skimming surface-to-surface Harpoon missile, a 76mm rapid-fire gun and a selection of torpedoes.

There are seven terminals, part of the command and control system, which receive information from the ship's sensors. These sensors include the radar, sonar, the electronic warfare system (an emission receiver) and the IFF (interrogator friend or foe) system.

When a decision has been taken to fire, the programs used to run the weapons control system automatically select the correct type of missile to be launched at the target. The choice will depend on distance from the ship and the type of target.

Radio hearing aid for classroom use

People with impaired hearing strike trouble when they have to select a specific sound in a noisy environment.

Imagine such a person standing on a street corner trying to hold a conversation with a friend; if a conventional hearing aid is used not only is the friend's voice amplified, but all the unwanted noise as well. Few of the friend's words get through.

A new radio type hearing aid devised by Mr Vic Burgess of the CSIRO Division of Applied Physics solves this problem. This device is now being developed, miniaturised and manufactured by Plessey Australia Pty Ltd for the National Acoustic Laboratories (NAL) of the Australian Department of Health.

The receiver comes in two types — a single-channel unit for a hearing-impaired child attending a local school and a 4-channel unit for youngsters at special schools for deaf children, because in these situations it is undesirable to use the same frequency in adjacent classrooms.

The transmitter is held by the person talking, or simply hangs around his neck or attaches to his belt, while the deaf person carries a small receiver connected to a behind-the-ear hearing aid.

The transmitter's microphone is mounted on a flexible "boom" so that the transmitter can be used as a hand-held wireless microphone. Alternatively, when the boom is swung back on its hinge, the transmitter may be worn upside down around the neck with the boom maintaining the microphone near the mouth.

Because any radio device needs a frequency, Mr Burgess initiated a move some years ago for the allocation of a frequency channel for international use by wireless hearing aids. Subsequently, the Australian proposal to the 1979 World Administrative Radio Conference was accepted and 3175 kHz was reserved as a worldwide frequency for their use.

Specifications were drawn up by NAL to meet the special problems encountered by children with impaired hearing. Total cost of the project will exceed $2 m. NAL is distributing the new hearing aid.

The initial order on Plessey was for 500 units but this will be extended to 1500 in the first 12 months of a 3-year program geared to produce 6000 units.

The plan is that all deaf children in Australia who would benefit from the device will be given one free.

News Highlights

Satellite communication

The Department of Aviation recently let a $12.7m contract for the construction of satellite earth stations throughout Australia. The stations, 100 in all, are to be located throughout the mainland including outback areas, with four in Tasmania and one each on Lord Howe Island and King Island.

The earth stations are part of a $31m plan to provide an Australia wide high quality aviation communication system in conjunction with the AUSSAT satellite. The first two satellites are due to be launched in July and October 1985.

The role of the earth stations depends on their location. Fifty-two remote stations will relay the VHF voice communications to and from aircraft via the satellite to the Department of Aviation's regional air traffic service centres. The other 48 stations will be for point to point communication between centres, and to the 52 remote stations.

The Department of Aviation will be the second largest single user of AUSSAT, after the ABC.

"One of the major attractions for the satellite system is that it will provide better quality communications links for essential aviation safety messages," the minister for aviation, Mr Kim Beazley said recently.

"Another major benefit for the aviation industry will be increased reliability and expanded coverage of existing VHF radio communications for aircraft."

Korean threat to Japan

The Japanese electronics industry, after more than two decades of dominance of electronics manufacturing, is finding itself under pressure from a near neighbour, South Korea.

Japan's electronics manufacturers are experiencing the same pinch as their US and European counterparts in the 1960s, with competition from a country which can boast increasing parity in technology combined with the edge provided by lower labour costs.

It is as yet early days for the Japanese manufacturers in dealing with Korean competition, but they are acutely aware of the threat which their near neighbours pose and they are planning for the future accordingly.

Essentially this means keeping a step ahead of the Koreans technologically while, at the same time, producing electronics products which offered consumers more sophistication and more features at a competitive price.

All this sounds remarkably similar to the words spoken by US and European manufacturers in the 1960s and 1970s as they struggled to withstand the manufacturing onslaught of a low labour-cost Japan but there are some distinct differences on this occasion.

Unlike their US and European counterparts of two decades ago, Japan's electronics manufacturers are, for the most part, blessed with modern manufacturing facilities which, through the use of robotics, are capable of minimising unit production costs.

It can for instance be said, as it was about the Japanese products of the 1950s and 1960s, that the Korean products, while they are cheaper, lack the quality of those produced in Japan.

However, as was the case with Japanese products 20 years ago, every year they get a little better and a little more competitive.

These Japanese concerns have been magnified in the past few days with news that IBM is considering jointly producing one of its computer models with a South Korean company.

Given the size of Japanese companies it can be expected they will withstand the threat of the Koreans, but in doing so they will have to adjust many of the philosophies which have made up their domination of the electronics market for so long.

Business briefs

Jaycar Electronics has moved its head office (from 380 Sussex St, Sydney) and its warehouse/mail order department (from 117 Parramatta Rd, Concord) to new premises at 7 Rawson St, Auburn 2144. The new mail order address is PO Box 480, Auburn 2144 and the phone number is (02) 643 2000.

According to Jaycar General Manager, Garry Johnston, The move will enable the company to retail a wider range of goods than was previously possible. The company currently has four stores and plans further expansion in the near future.

Amalgamated Wireless Australasia (AWA) has announced the appointment of Mr Greg Hughes to the position of general manager of the company's Ashfield Division.

In this role Mr Hughes assumes responsibility for the division's successful trading and manufacturing operations. These include major projects for Telecom, components for lighting products, car entertainment accessories, major two-way radio appliances, and public address and audio equipment.

Standard Components Pty Ltd has announced that their name will change to Standard Communications Pty Ltd as of October 1984. This is in line with the company's decision to discontinue its supply of television parts. In future, the company will concentrate on three major product groups: Electrophone two way transceivers, covering the 27MHz and 477MHz bands, as well as VHF and UHF commercial equipment; Hitachi oscilloscopes, including hobby and professional models; and Kingray television boosters, distribution amplifiers, converters and filters.

Standard Communications have over 800 dealers and product wholesaler outlets throughout Australia.

Hazards of micro control

In designing more efficient machinery, microprocessor control is often chosen by engineers. Increasingly, cars, aircraft and industrial equipment are relying on the fast and accurate response of the microprocessor.

For all of these machines, serious problems can arise in the vicinity of RF transmitters. To ensure a reasonable level of immunity, military equipment is usually subjected to rigorous testing in powerful RF fields. This is particularly important in the case of fly-by-wire aircraft where the pilot has no direct mechanical control of the aircraft.

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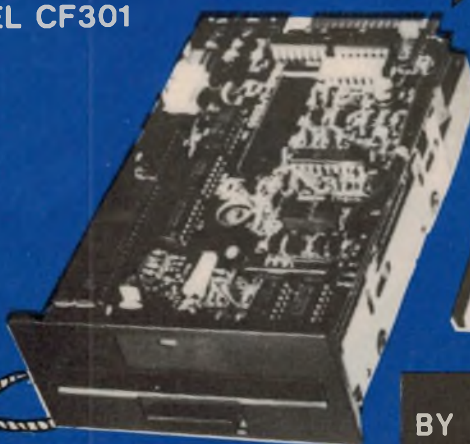

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Dear Customer, At Altronics we are continually trying out methods of improving our range of quality products and the high standard of service we offer our Shop, Mail and Phone order customers. I believe our future prosperity will be a direct reflection of the standards of service we have adopted. So for November and December 84 we pledge that if you find our products and/or service is not as we claim you may return your purchase to us for a **full refund plus $5.00** for your inconvenience (mail/phone order customers please allow transportation costs)

Regards

Jack O'Donnell

THE DAZZLING MUSICOLOR IV PROJECT

Combination Colour Organ and Light Chaser. Four channel colour organ. Internal micro-phone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.

K5800 .... **$89.50**

MICROWAVE OVEN LEAK DETECTOR

ETI PROJECT

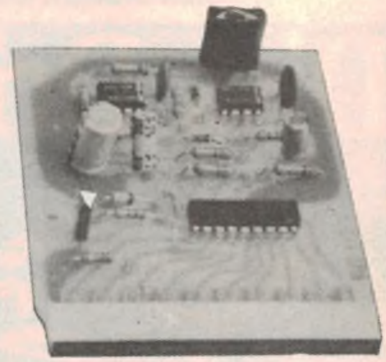
Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter.

Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter.

Genuine Hewlett Packard Hot Carrier Diode supplied.

K1724.......... (still only) **$14.50**

LED BARGRAPH PEAK DISPLAY



This easy to build level meter uses our exclusively imported LED bargraph module which gives it a very professional finish indeed. Indicates from —21dB to + 6dB using a logarithmic scale. **Great Value!**

K 5412 .... **$16.50**

★ KIT SUPPORT FOR THE MICROBEE ★

MICROBEE IS A REGISTERED TRADEMARK OF APPLIED TECHNOLOGY PTY LTD

MULTIPROM INTERFACE

44K OF PROGRAM STORAGE

A sensational new kit for the MICROBEE requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

THE MICROBEE' KIT OF 1984

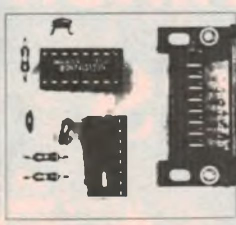
K9673.......................... **$99.50**

PARALLEL INTERFACE

BUILD YOUR OWN INTERFACE AND SAVE $$$

A simple kit to build — takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer.

K9671.......... **$29.95**



INCLUDES CENTRONICS PLUG AND CABLE

PROPORTIONAL JOYSTICK

SELF CENTERING

K9674

$32.50

(ETI DEC 83)

FOR THE BEE!

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.

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

NEW! MICROBEE LIGHT PEN

(ETI AUGUST 83)

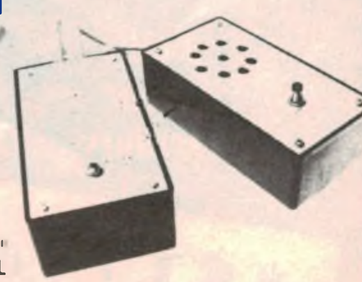
PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

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)



K 9763 .... **$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

● FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 89 ●

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UNBELIEVABLE 0.005% ACCURACY

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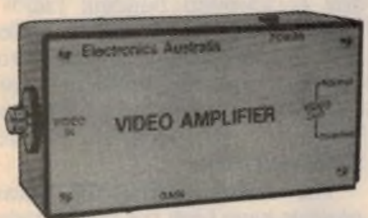
K2500.................... **$119.50**

PRESCALER
K2501.................... **$26.00**

DECIMAL POINT
K2502.................... **$7.50**



VIDEO AMPLIFIER

Brilliant new kit from EA. **Super cheap** and **Super Effective.** Whilst our K5830 is suitable primarily for VCR use this video amplifier is best suited to use with computers. The EA documentation supplied is extremely well written and provides details for installation into television sets.

NO MORE SMEARY COLOURS, SIGNAL BEATS OR RF INTERFERENCE

K5850.................... **$14.95**

VIDEO ENHANCER

Here's a **simple** but **effective** Video Enhancer that is super **easy to build** at a fraction of the cost of commercial models.
Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal.

AT LAST A VIDEO ENHANCER KIT

K5825.................... **$35.00**

VIDEO RF MODULATOR

(SEE ETI OCT 1981)

If you cannot afford a Video Monitor for your computer this is the kit for you. Super stable oscillator design and very low modulation distortion ★ Works with both B & W and Colour TV sets ★ Suitable for computers, TV games, TV pattern generators or what have you. Deluxe kit featuring heavy duty diecast box for RF shielding ★ Input and output sockets

K9760 **$17.50**

FUNCTION GENERATOR

The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

☆ 4 digit frequency readout (eliminates tiresome dial calibration) — typical accuracy ± 2% ☆ 3 overlapping ranges x1, x10, x100 ☆ 600 OHM Nominal Output — continuously variable 3MV — 2.5V P-P ☆ Distortion — sinewave : less than 0.7% @ 1KHz ☆ Linearity — triangle wave: better than 1% @ 1KHz ☆ Squarewave rise time — 6V/uz maximum output ☆ Amplitude stability — better than 0.1dB on all ranges.

K2505....................

DIGITAL CAPACITANCE METER

NEW DELUXE FINISH

We are pleased to announce the release of the Digital Capacitance Kit housed in our Deluxe H0480 ABS Instrument Case.
This superb Test Instrument Kit now compliments our top selling Digital Frequency Counter and Function Generator Project Kit. Electronics Australia Project. Measures capacitance of both polarized and non-polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges.
Check values of unmarked capacitors, especially those little trimmers that are never coded.
Select precise values for filters and timing networks within ease.

☆ **EXCLUSIVE TO ALTRONICS** ☆

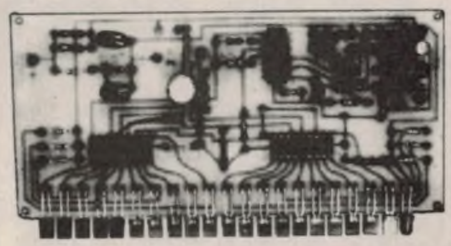
Each kit includes precision measured capacitors for accurate calibration of each range.

K2521....................

MONITOR AND IMPROVE VEHICLE PERFORMANCE

TWIN RANGE LED TACHO

(SEE ETI AUGUST 1980)



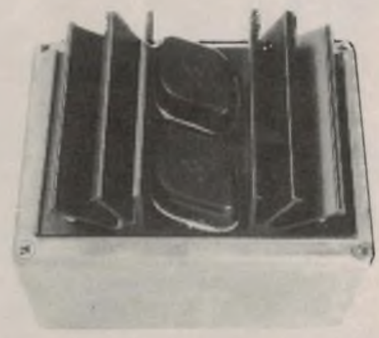
Unit suitable for 1, 2, 3, 4, 6 and 8 cylinder vehicles, 2 stroke or 4 stroke ★ fully compatible with conventional, CDI and transistorized ignition systems ★ includes protection circuitry to prevent noise and high voltage spikes from the points and coil circuit damaging the electronics. ★

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

Check The Performance of Your Vehicle At A Glance!

K4324.................... **$24.50**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



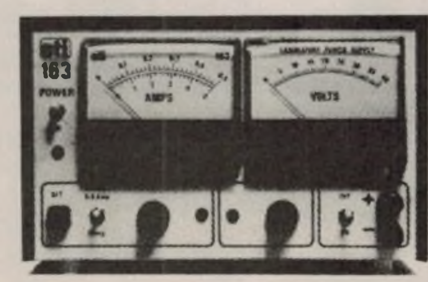
The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.

Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K4010.................... **$35.00**

0-40 VOLT/5 AMP LAB SUPPLY

(SEE ETI MAY & JUNE 1983)



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A Laboratory Supply requires specifications second to none. **This Supply has them!**

Output voltage	0-40 V variable
Output current	0-0.5 A variable limiting
	0-5 A variable limiting
Output regulation	<50 mV at up to 2.5 A
	<100 mV up to 5 A
Maximum output power	200 watts
Metering Voltage	0-40 V in 1 V divisions
Current	0-0.5 A in 20 mA divisions
	0-5 A in 200 mA divisions

Series regulator design enables design and development of sensitive high gain audio and RF circuitry free from hum and noise sometimes associated with other techniques.

K3325.................... **$175.00**

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Letters to the editor

Comment on August editorial

I thought that the days of academic bashing by people who should know the difference between a professional engineering course and a hobbyist's approach to electronics were buried in the past. Not so, judging by your editorial of August.

Academic courses are designed to give a sound theoretical basis for a profession, and whilst it is acknowledged that periodic re-training in current developments is needed from time to time, these are still based upon a thorough understanding of principles rather than practice. Design work is only one facet of engineering, and my experience (of two decades) is that the lack of sufficient engineers in industry with sound theoretical and mathematical skills is partially responsible for the short-sighted and blinkered approach to many problems. Universities and Institutes make no claim to teaching hands-on and trouble-shooting type of work, and experimental work of necessity, is carried out with prefabricated assemblies to save time.

The intense nature of academic training means that the implication of course material may not be grasped at the time. Thus, I missed the significance of differential amplifiers first time round, and only after a postgraduate course did I discover that digital transformations had been covered at undergraduate level 13 years earlier.

In fact, only a hobbyist in the true sense of the word can relate much of his/her undergraduate course material to practical electronics. If you therefore want the best of both worlds, as I have done in selecting applicants for design work, pick the person who has been attracted to professional electronic engineering from a hobbyist background. Others will find their niche, although it is my contention that the best designers (mechanical, electronic or whatever) have always revealed themselves as tinkerers from an early age.

Your own selection process surprises me. Do you find many young people of any background building radios these days? The questions hardly reflect the shift towards digital and microprocessor interests and the availability of such components and designs; these being the incentive for people to develop associated skills.

The recent UHF/VHF transceiver projects have been the first in radio for a while, and I cannot recall a TV project since the 60s. And do you really find that people who simply read your (or any other) magazine as distinct from the doers can provide adequate answers? Perhaps it is an indictment of the proliferation of magazines that take on people who have a superficial knowledge of the dazzling gear in the shops but have not handled a soldering iron or wire-wrap tool, and even you omitted entirely any mention of construction and fault finding amongst your ideal prerequisites.

As you stated, the relationship between professional engineers and the outside world has not changed significantly in recent decades; hobbyists and people who can handle grass-roots requirements are made in their teens, not their 20s. If you want the real culprits, I suggest that you question the teachers and parents who don't encourage youngsters to have a go at doing things for themselves and by themselves with the development of intrinsic concentration and pride in self sufficiency, instead of learning to relate to the community through groupy activities and a plethora of arty crafts, and even these on far too superficial a basis.

G. Payne, BE (Hons),
Essendon, Vic.

● *In writing the August editorial, it was not our intent to indulge in "academic bashing". We have a high regard for Australian academic institutions and believe that, in the main, they do an excellent job.*

RFI & cordless telephones

A recent experience with a cordless telephone may help to warn readers about the ever increasing danger of RFI.

With the introduction of cordless telephones, there have been numerous warnings issued about the dangers but as I live in an isolated area I am free from the major risk of someone else being able to use my base to make telephone calls. Nor am I troubled by excessive man-made noises or snooping. So I bought one, confident that I would have no trouble.

Not wishing to take any chances, tests were carried out to check the telephone security. I was finally satisfied that while jamming could disrupt conversations, it seemed very difficult to make a connection, much less dial any numbers.

There has also been plenty of discussion about computers causing RFI and this has resulted in some airlines banning in-flight number-crunching. My MicroBee has caused some interference to my communications receiver when they are sitting side by side but there was never any real cause for concern — until now. Half-way through loading a program from tape, the phone rang. When I answered, I was greeted by the sound of my cordless phone on the other extension merrily dialling a collection of random numbers. There was also a rather annoyed person on the line asking what the . . . I wanted.

As the computer was at least five metres away from the phone base, I class the RFI as severe. Further tests indicated that the problem occurs when my computer is running at 2MHz, but not at 4MHz. As I only use 2MHz when saving or loading, I am lucky that the fault appeared when it did and not in the wee hours of the morning!

My new metal case for the MicroBee might not look very pretty but at least it keeps its opinions to itself. If I want an autodialling modem, I can always lift the lid.

To add my bit to a continuing saga:

The serviceman will be interested to know that the wrongly coded 22kΩ (or 2.2kΩ) resistors (May and September 1984) also appeared in a Large Screen Storage CRO kit which was purchased from a Melbourne retailer. One offending resistor is in the video output section controlling the graticule brightness and total loss of sync existed until a correct value resistor was installed. A second culprit was found in the input stage, drastically reducing gain before it too was replaced.

How many more useless resistors are there, waiting to appear again to antagonise unsuspecting constructors?

J. Hiley,
Tarraleah, Tas.

A harsh & unfair judgement

I am a regular reader of your magazine and I would like to express my opinion about the contents of your August editorial. While I can say that I enjoy reading your magazine articles and generally applaud the standard of your projects, I strongly disagree with the views presented in your recent Editorial.

My only hope is that you would be courageous enough to publish this one note of dissent!

I believe that you have made a very harsh and unfair judgement towards today's engineers. It is one thing to test someone's suitability to do practical projects, or indeed to test their awareness of current technology, but it is a completely different thing to assume that they must know all aspects and facets of electronics. The field of electrical engineering (or electronics for that matter) is such a vast one, and is expanding at such a fast pace, that it is impossible to know and understand everything.

The University has the responsibility to teach the fundamentals, within the time allocated for an undergraduate education. Here we seem to agree on one thing, the teaching of "fundamentals" — only I do not consider everything in your list to be fundamentals, but merely applications of those fundamental principles underlying the specific areas you mentioned.

For example, while I was at the University during 1973-77, the subject of Communication Electronics was an elective and hence I would have missed out on the rudimentary principles of AM and FM transmissions had I chosen to elect an alternative subject. An engineer who is keen on audio and hifi would pick-up the principles of PCM recording and emphasis/de-emphasis networks for example, but they are not necessarily taught and understood by all graduate engineers.

To do this would render it impossible for the Universities to give their students a thorough background in the mathematics necessary to understand microwave transmissions, optical fibres, semiconductor physics, those areas which have given electrical engineering such a significant advance lately (eg, VLSI in electronics).

Do we want the engineers to concentrate on today's technology, and not future technologies as well?

On looking at another side of the matter being discussed, would it be reasonable and fair to assume that your keen readers would know and understand the following things: how personal computers work: the Von Neumann architecture of computers; Reduced Instruction Set computers; error correction codes as used in digital audio; spread spectrum communications; ultrasonic imaging, etc.

Note that the above are all current technology, so by your definition all engineers (or your engineer readership) should understand and be aware of these subjects.

I could go on with this letter, but I would hope that I have made my point clear to you.

A. Hadiwijaya,
Ashfield, NSW.

EA has right to comment

In Letters to the Editor (September), P. A. Ward takes you to task for expressing an opinion about the ABC program, Nationwide.

I gather from his letter that he objects on two grounds: firstly that such criticism is outside the scope of EA and secondly that your magazine should be perfect before you open your editorial mouth in critical comment.

From time to time readers have raised the first point and I think that you have made clear your editorial policy, namely that you believe far-ranging comment around the central subject of your magazine, ie electronics, is quite valid and interesting, and that your editorial staff is equipped to make such comments responsibly.

My view is that a broad subject range within such limits makes for an interesting magazine and suits the requirements of many readers.

Ward's second point, "let him who is without sin", etc, seems to me to be way out of context. How could you run a magazine on that basis? No more record reviews, no more appraisals of equipment and no more Forum. Each of these sections has, at times, been critical of something and must continue to be.

I also believe that Nationwide would feel perfectly capable of commenting on Australian electronic magazines if the producers so wanted.

So far as editorial content at EA having "reached desperate times", I would think that one of your problems would be allocating priorities to the many subjects you want to cover.

D. F. Richards,
Ebenezer, NSW.

Diversity-tuned FM stereo

by NEVILLE WILLIAMS

Reduces in-car noise and distortion

FM-stereo radio in your car is fine, except for one thing: it is subject to rapid fluctuations in signal strength — and sound quality — as the vehicle moves along the road. But take heart! Space Diversity reception, a novel system being pioneered by Sony, will hopefully do much to alleviate this longstanding problem.

Sony's new XR-100 auto stereo cassette/radio tuner, featuring Space Diversity FM reception, has recently been released in the USA and will appear on the Australian market in due course. It will involve the fitting of twin antennas to the vehicle, plus a separate stereo power amplifier, but many will consider this an acceptable price to pay for much improved FM-stereo reception.

Who knows? Twin antennas may well become one of next year's on-road status symbols!

Meanwhile, it may be helpful to explain what the new system is all about.

On their way from transmitter to reciever, all radio waves are, to some extent, ducted, impeded, absorbed and reflected by the atmosphere, by the intervening topography and by man-made structures. As a result, the strength of the incoming signal may vary widely from point to point in the area serviced by any given transmitter.

With AM broadcast stations, which operate at medium frequencies (550-1600kHz) and medium wavelengths (545-187m), the pattern of signal strength variation is spread over relatively large areas. Whole districts may have good signals or poor signals, by reason of distance or topography, but it would be most unusual for the signal strength from an AM station to vary abruptly every few metres along a highway.

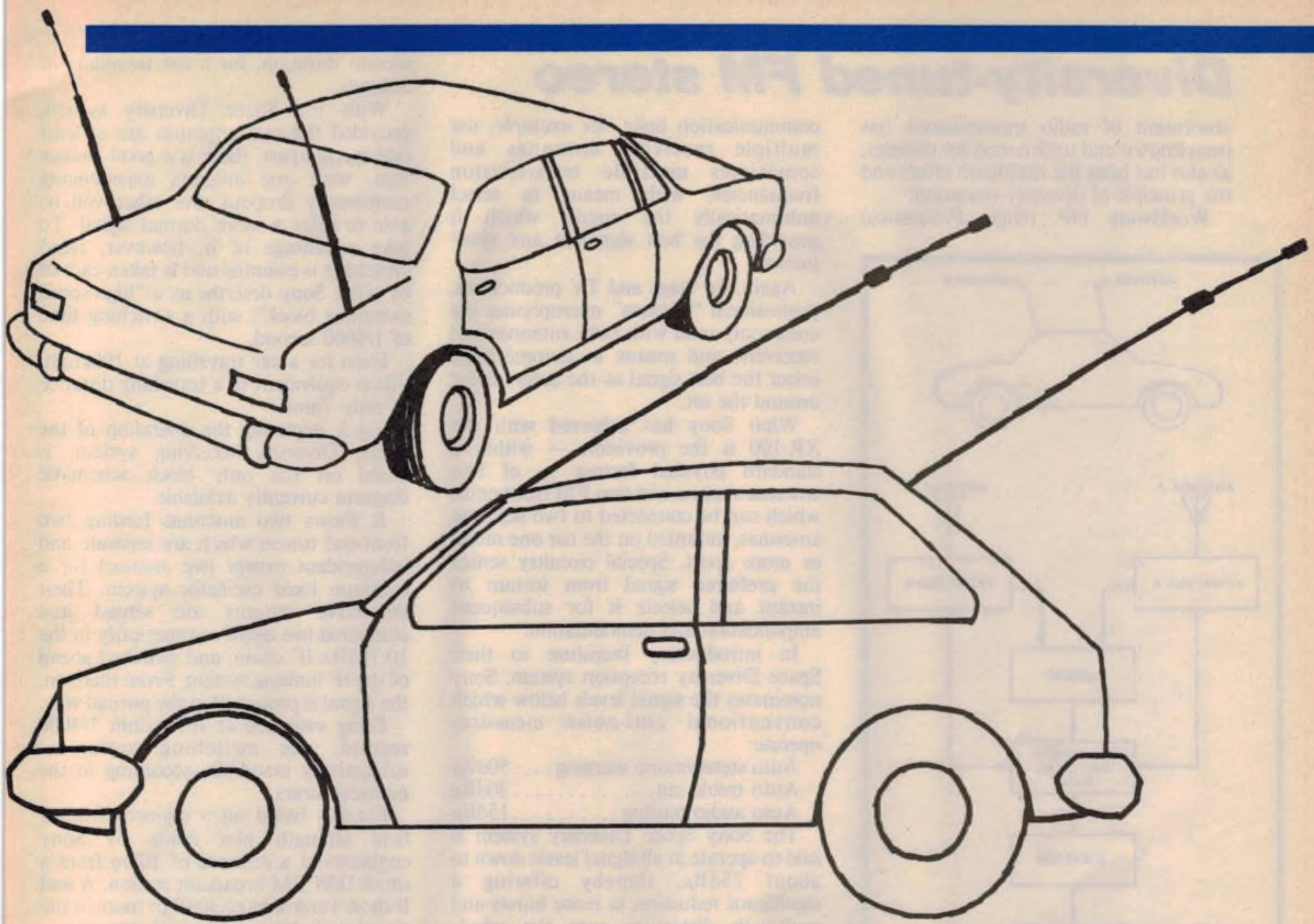
As received in a moving car, an AM signal therefore tends to be fairly consistent "up hill and down dale", for the most part becoming progressively weaker and more subject to noise as the distance from the station increases.

FM broadcast stations, on the other hand, operate in the VHF (Very High Frequency) band, 88-108MHz, and consequently at very short wavelengths: 3.4-2.8m. As such, they are much more subject to shadowing, deflection and reflection by topographical features, by large buildings and even by roadside metal poles and overhead wiring.

Particularly in hilly and built-up areas, these effects can produce a close-spaced pattern of variations in the strength of the received FM signal — from relatively strong to near "drop-out" within the space of a few metres.

As well, reflection effects can be responsible for so-called "multipath" reception whereby a car antenna may intercept multiple signals in its progress along the highway: usually the main signal arriving direct from the transmitter, plus one or more secondary signals being bounced off adjacent buildings or cliffs.

Because they have travelled a longer path, reflected signals arrive later in time than the direct signal, often with a disastrous effect on program quality. Instead of having to decode a single multiplex stereo carrier — a demanding job anyway — the receiver is faced with additional and spurious signal information which tends randomly to



add to or cancel the wanted signal, resulting in so-called multipath distortion.

While, at best, in-car FM-stereo can be fine, with clean, spaced-out hifi sound, signal dropouts and distortion can be sufficiently prevalent in some areas to be positively annoying. At worst, their incidence can build up to what has become known as "picket fence" reception. But, by that time, the average driver has usually given up and either switched back to AM or else plugged in the standby cassette!

Car radio manufacturers have sought to combat these problems, to date, by progressively refining the performance of the FM section. Up front, they have striven for the greatest possible sensitivity and the lowest possible internal noise, to cope with weak signals while, at the same time, making sure that the circuits would not overload when close to powerful transmitters. They have paid close attention to selectivity and capture ratio, to minimise potential interference, and taken special measures to ensure that receivers lock only to exact carrier frequencies.

In the audio system, car FM receivers no longer simply switch automatically from stereo to mono, when the signal level drops into the noise region. Modern practice is to use progressive stereo/mono "blending", beginning with the high frequencies, to make the transition subjectively less apparent. National go one step further by deliberately muting the audio system when the signal drops to near zero — as in a traffic underpass — to further minimise the noise impact on the occupants of the vehicle.

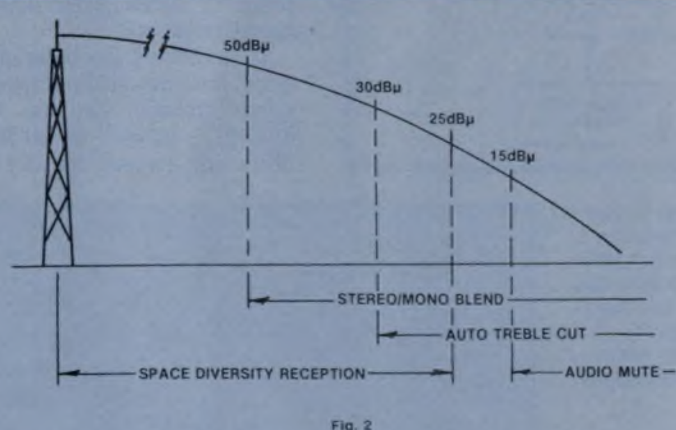


Fig. 2: Blend, treble cut and muting circuits combat noise problems at very low signal levels. The space diversity system combats multipath effects at all levels.

While all these measures are commendable, they do not directly attack the vexed problem of "picket fence" multipath noise and distortion. Sony's FM Space Diversity system does, which is why it is unique at this point in time — at least in the context of FM car radio.

Overall, the ducting, reflection and

Diversity-tuned FM stereo

absorption of radio transmissions has been known and understood for decades, as also has been the multipath effect and the principle of diversity reception.

Worldwide HF (High Frequency) communication links, for example, use multiple receiving antennas and sometimes multiple transmission frequencies, with means to select automatically the circuit which is providing the best signal at any given instant.

Again, for stage and TV productions, professional "wireless" microphones are commonly used with twin antennas and receivers, and means to automatically select the best signal as the actors move around the set.

What Sony has achieved with the XR-100 is the provision — within a standard physical format — of two antenna sockets and two FM front-ends, which can be connected to two separate antennas, mounted on the car one metre or more apart. Special circuitry senses the preferred signal from instant to instant and selects it for subsequent amplification and demodulation.

In introductory literature to their Space Diversity reception system, Sony nominates the signal levels below which conventional anti-noise measures operate:

Auto stereo/mono merging. . . . 50dBμ
Auto treble cut. 30dBμ
Auto audio muting. 15dBμ

The Sony Space Diversity system is said to operate at all signal levels down to about 25dBμ, thereby offering a significant reduction in noise bursts and multipath distortion over the whole range of signal levels down almost to signal "wipe-out".

In discussing the basic problem, Sony point out that abrupt "troughs" in FM signal strength can be very narrow indeed — as little as 20-30cm wide — producing a signal dropout of 1/4 to 1/3 second duration, for a car travelling at 30km/h.

With the Space Diversity system, provided the two antennas are at least one metre apart, there is a good chance that, with one antenna experiencing momentary dropout, the other will be able to offer a more normal signal. To take advantage of it, however, rapid switching is essential and is taken care of by what Sony describe as a "high-speed switching block", with a switching time of 1/4000 second.

Even for a car travelling at 100km/h, this is equivalent to a travelling distance of only 7mm.

Fig.3, depicting the operation of the Space Diversity receiving system, is based on the only block schematic diagram currently available.

It shows two antennas feeding two front-end tuners which are separate and independent except (we assume) for a common local oscillator system. Their respective outputs are sensed and compared (we again assume) early in the 10.7MHz IF chain, and switched ahead of the IF limiting system. From there on, the signal is processed in the normal way.

Being switched at IF, within 1/4000 second, the switching action is subjectively inaudible, according to the manufacturers.

Fig.4 is based on a segment from a field strength plot made by Sony engineers at a distance of 10km from a small 1kW FM broadcast station. A and B show variations of 30dB or more in the signal available to individual antennas — variations which could pose a problem for a conventional FM tuner. At the output of the diversity switched tuner (c), a typical signal from the same area is much more consistent with variations limited to less than 20dB overall.

Although the XR-100 would logically be used, as intended, with twin antennas, it can also operate in non-diversity mode, with a single antenna and with an order of performance in line with other up-market AM/FM stereo players.

The FM section has impressive specifications, quite apart from the Space Diversity feature although, as usual, the AM section is routine. Specifications for the cassette player are also outstanding, with both Dolby-B and Dolby-C noise reduction provided.

Early consumer reports from overseas appear to support Sony's claims for the XR-100. While its actual sensitivity is not markedly different from other top-line FM tuners, it does reportedly provide far more listenable reception in trouble-prone areas, with only two constantly flickering lights to confirm that the diversity system is really doing its job.

It would certainly seem that Sony has come up with a winner!

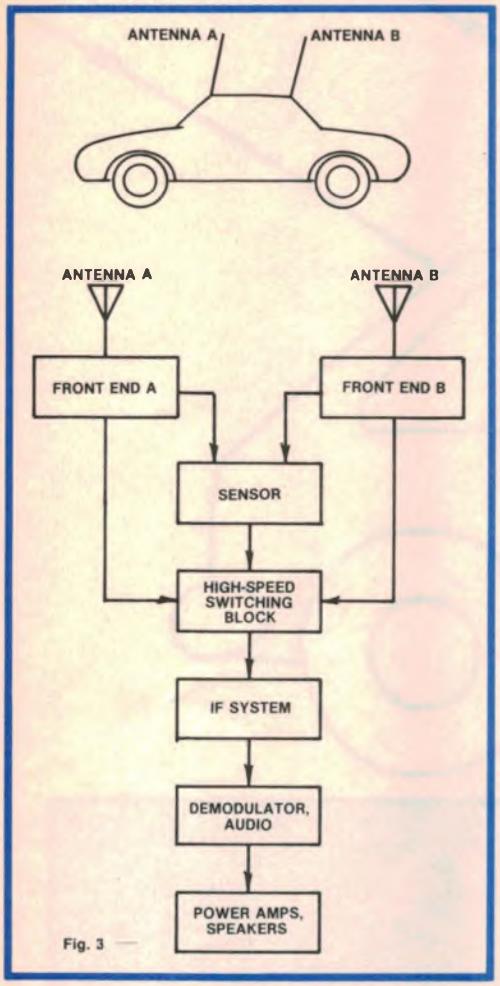


Fig. 3: Sony's space diversity reception system involves the use of twin antennas, twin front-end tuners and high-speed switching to select the preferred signal.

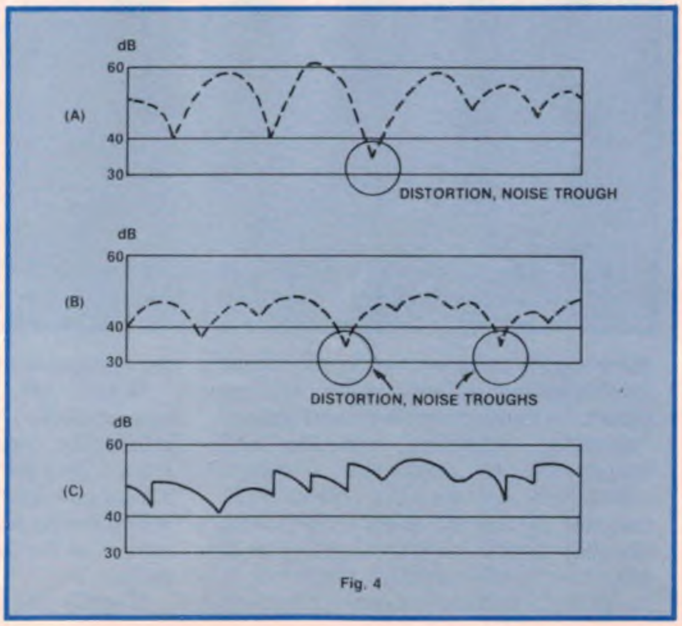


Fig. 4: Wide variations in signal level are typically evident in the output from individual antennas (A) and (B). From the diversity switch (C) the available signal is typically much more consistent.

Rod Irving TOP 20 Kits

PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

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 Mar. '83).

ETI-335 **$28.50**

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. (EA April '82)

82AO3A/B **$79.50**

ELECTRIC FENCE

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

82EF9 **$19.50**

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. '84).

84TP2 **$24.00**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. '83)

ET733 **$20.00**

SLIDE CROSS-FADER

Want to put on a really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. '81).

81SS11 **$85.00**

MOTORCYCLE INTERCOM

OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build! (EA Feb. '84).

84CM5 **$36.50**

DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. (EA March '82)

82PS2 **$87.50**

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec. '83).

ETI-162 **$49.50**

TV PATTERN GENERATOR

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, checker-board, grey scale and white raster. (EA June '80)

80PG6 **$67.50**

12-230V DC-AC INVERTER

INCLUDING TRANSFORMER 300 WATTS

This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '82)

Nominal Supply Voltage	12V DC
Output Voltage	see table
Frequency	50Hz± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

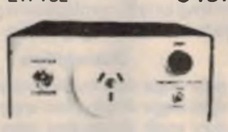
P & P $10.00. Anywhere in Australia.

82IV6 **$195.00**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time and no more glow plug burnouts on your model engines. (ETI June '83)

ETI-1516 **$41.50**



INVERTER

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

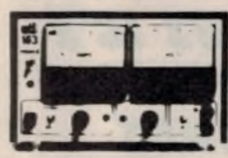
82IV5 **$49.50**

TRANSISTOR TESTER

1000's SOLD

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

83TT8 **$15.00**



LAB SUPPLY

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

ETI-163 **$175.00**

TEMP PROBE

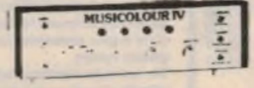
Can measure temperature from −50° to +150°C. It simply plugs into your multimeter — great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C. (ETI June '83).

ETI-153 **$22.50**

PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds of 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 Nov. '83)

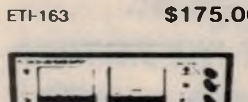
83MA11 **$15.00**



MUSICOLOR IV

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

81MC8 **$84.00**



50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design. (EA May, June '83)

83PS5 **$140.00**

ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes. (ETI May '83).

ETI-164 **$9.50**

Errors and Ommissions Excepted

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Rod Irving Electronics

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$200-$499	$7.50
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Certified Post for orders over $100 included "free"! Registered Post for orders over $200 included "free"! Account orders from schools Govt. Depts., Public Cos., gratefully accepted. Min. order of $20. (or a min. $5 accounting fee will apply.) Comet Road Freight, Airmail etc. are extra.

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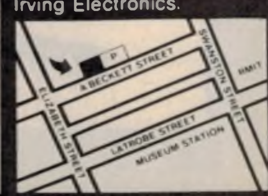
HAVE YOU BEEN INTO OUR CITY STORE???

Conveniently located on the edge of the city where parking is easy! Over 4,000sq. ft. of an extensive range of products and great "in store" bargains . . for those interested in computers we have a wide range on display upstairs. For good advice and a good price, see Rod Irving Electronics.



MOVING WAREHOUSE SALE

NEW KIT
ELECTRONIC CROSSOVER

REF: EA NOVEMBER 1984

This much sought after kit is now finally available. The unit is for stereo with 2 crossover points for each channel for 3 way speakers.
Commercial units are almost double the price.
Kit comes complete with silk screened, punched rack front panel and quality English made Lorlin switches.

$199.50

DIESEL SOUND SIMULATOR WITH LIGHTING CIRCUIT FOR RAILMASTER

REF: EA NOVEMBER 1984

You will be amazed how authentic this kit sounds. Kit includes PCB and all parts for sound effects as well as all the components for the lighting circuit.
Cat. KA-1561

$19.95

RAILMASTER KIT

REF: EA SEPTEMBER 1984

This is the most up to date train controller kit we've seen in a long time. It offers all those wanted features including inertia, full overload protection and walk around throttle. Kit includes front panel, correct console box and all parts.

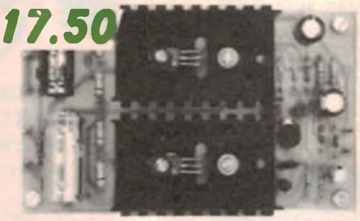
$79.95

20 WATT LOW COST AMPLIFIER

Ref: EA NOVEMBER 1984

This amplifier module uses only a handful of parts and is simple to build. Kit includes pre-drilled heatsinks which mount on the board.
Cat. KA-1567

$17.50



BRAKE LAMP FLASHER

This little device will flash accessory brake lights three times when the brake pedal is depressed. If you've had a rear end collision you will know how handy this device is.
PCB and components only. REF: EA NOVEMBER 1984
Cat. KA-1564

$16.50

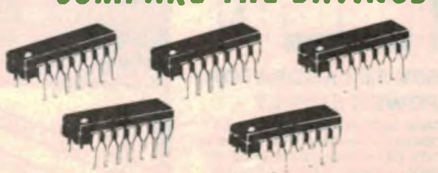
Jaycar ELECTRONICS

MANUFACTURERS SURPLUS IC'S UNBELIEVABLE SAVINGS

These would normally be up to double these prices.

ZK-8842	MM 5395 Tone dialler	$9.50
ZL-3567	LM 567 Tone decoder	$1.50
ZZ-8195	81LS95 Octal buffer	$2.20
ZV-1540	78L06 +6V 100mA Voltage Regulator	80¢
ZZ-8208	9368	$1.75
ZC-4916	74C32 Quad gate	50¢
ZC-4917	74C74 Dual flip flop	$1.50
ZC-4918	74C90 4 bit decade counter	$1.20
ZC-4919	74C107 Dual JK flip flop	80¢
ZC-4920	74C192 Decade up/down counter	$1.40
ZC-4921	74C914 Hex Schmidt trigger	$3.00
ZC-4980	74S287 1K bit PROM 256 x 4	$3.00
ZL-3348	LM 348 Quad 741	$1.50

COMPARE THE SAVINGS



NEW H.T. (SPARK PLUG) LEADS Especially for electronic ignitions!! - By popular demand. . .

Jaycar is proud to announce that we have sourced a range of spark plug leads that are without doubt, the best commercial quality in the world! Why are they so good? Well, see technical review (in box). We stock a range of **15** different lengths with combinations of right angle and straight distributor cap entry. The other end all have identical spark plug covers. (Except for coil/dist leads).

Cat. No.	Description	Price
WA-5404	30cm cable, right angle distribution entry	$3.95
WA-5408	40cm cable, right angle distribution entry	$3.95
WA-5412	50cm cable, right angle distribution entry	$3.95
WA-5416	60cm cable, right angle distribution entry	$4.95
WA-5420	70cm cable, right angle distribution entry	$4.95
WA-5434	30cm cable, straight distribution entry	$3.95
WA-5438	40cm cable, straight distribution entry	$3.95
WA-5442	50cm cable, straight distribution entry	$3.95
WA-5448	60cm cable, straight distribution entry	$4.95
WA-5452	70cm cable, straight distribution entry	$4.95
WA-5456	80cm cable, straight distribution entry	$4.95
WA-5460	90cm cable, straight distribution entry	$4.95
WA-5474	30cm cable, coil-to-distributor straight	$3.95
WA-5478	40cm cable, coil-to-distributor straight	$3.95
WA-5482	60cm cable, coil-to-distributor straight	$4.95

TECHNICAL REVIEW - Most H.T. leads supplied originally with a vehicle consist of a rubberised sheath enclosing a central conductor of carbon or carbon-reinforced material. The carbon acts as a "distributed resistor" which helps to suppress ignition interference. Unfortunately, carbon is a very brittle substance. After a fairly short time the continued shock and vibration of the engine enviroment can cause the carbon conductor to break - often in many places. This becomes the weak link in the ignition system.

The new Jaycar ignition leads are ESPECIALLY MADE for electronic ignitions. Instead of a carbon filament, a flat ribbon wire is helically wound around many strands of fibreglass "former". The wire is resistive and a RF choke is formed by coiling the wire around the fibreglass strands. The inductance value of the choke is not sufficiently high to significantly impede the rise-time of the spark pulse, but it does help reduce RFI. The important thing to note, however, is the METAL to METAL contact between the resistor and your spark plug.*

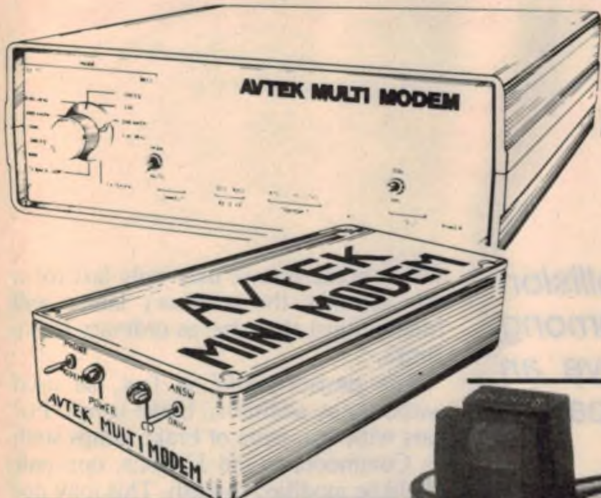
If you own a Transistor Assisted or Capacitor Discharge ignition and still have the original leads, you could just be kidding yourself. Why invest a fortune in an electronic ignition system and still leave a very weak link still there?

The leads are made in France and factory terminated. (The factory will not sell us the material in bulk because they feel that we would not be able to terminate it correctly). Sparkrite of the UK chose them because, in their opinion they are the best in the world. Each lead is fitted with a spark plug cover and rubber boot on the other end. (see list).

*Finally the Jaycar/Sparkrite plug leads are DOUBLE SHEATHED in a very high quality silicone rubber dielectric. The inner (white) insulator is super-flexible and the outer (red) sheath is designed to withstand abrasion. It, too is very flexible. Far more so than the plastic-type lead.

Fast talkers with all the right answers

MultiModem and MiniModem use the latest VLSI technology. Digital signal processing achieves functions normally requiring analogue filters. The result? Reliable data transfer on lines where most modems just won't go!



Cat. XC-4820

MultiModem only $349 inc. phone

Down the street or across the world, MultiModem speaks the language.

- ★ 300 baud full duplex, 1200 baud half duplex or 600 baud half duplex, answer or originate
- ★ CCITT and Bell standards
- ★ Auto answer and connect ability
- ★ Plugs straight in (hardwire phone)
- ★ Superior VLSI chip performance: works reliably with −43dBM signal with S/N ratio of 6dB. Error rate on this level is
- ★ Telecom approval C84/37/1135

MiniModem only $199 inc. phone

DUE FOR RELEASE IN NOVEMBER

Cat. XC-4825

- ★ 300 baud full duplex
- ★ Answer/originate
- ★ Plugs straight in (hardwired phone)
- ★ Superior VLSI chip performance (identical to MultiModem)
- ★ Telecom approval C84/37/1173

NEW - Ref: EA September 1984

HALL EFFECT SWITCH VANE INTERRUPTED

If you have a car that won't take the Jaycar KJ-6655 Hall Effect Kit (i.e. an Australian six or V8) this could be for you! It is the SIEMENS (German) made Hall Switch. It will operate from −30 to +130°C. A simple soft iron vane cut with appropriate slots will commutate the unit.

Cat HK-2101

$19.95

PCB to suit
84T19 $3.45

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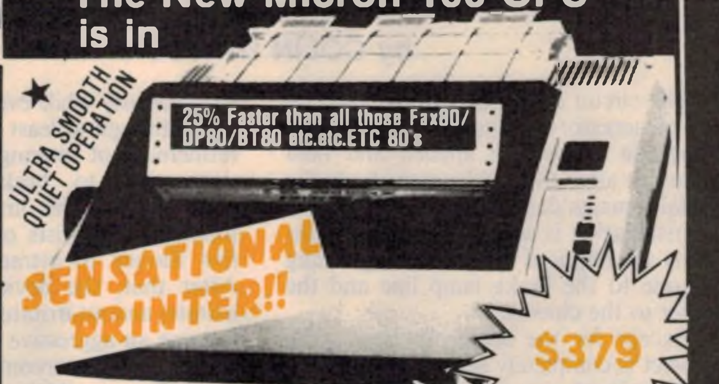

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Automatic brake lamp flasher

What's the best way to avoid a rear-end collision while braking? According to recent tests among Sydney taxi-drivers, the best way is to have an additional flashing stop-lamp installed on the parcel shelf. This project fulfils that requirement.

by COLIN DAWSON

The circuit described here will flash a set of accessory lamps three times each time the brakes are applied and hold them on after that while ever the brake pedal remains depressed.

Installation is easy. Only two connections are required to the existing wiring — one to the brake lamp line and the other to the chassis.

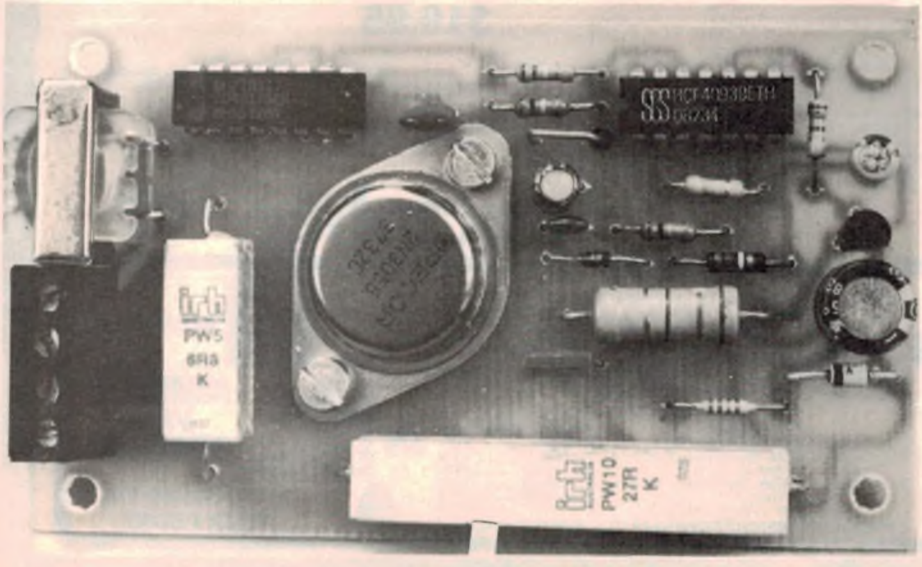
Except for the accessory lamps, the project is completely self contained on a small printed circuit board. This could easily be mounted under the rear parcel shelf of a sedan — even most hatchback cars would have some suitable "nook".

We are, of course, aware of various other schemes for flashing accessory brake lamps. Most simply flash the lamps continuously while ever the brakes are in use, although at least one has the added refinement of altering the flash rate in proportion to braking effort. The problem with this arrangement is that following motorists only need the first few flashes to attract their attention. After that, the device only serves to irritate, and an irritated driver can easily become an aggressive one.

Our circuit overcomes this problem by including a "delay" feature. This effectively causes the circuit to wait five seconds after the brakes have been released before it is re-armed. Any brake application during this period will cause the accessory lamps to operate without flashing. For bumper-to-bumper driving where brake release may only last for a few seconds, the accessory lamps will function just the same as ordinary brake lamps.

The project could, in fact, be used without any additional brake lamps. For cars with two pairs of brake lamps such as Commodores and Falcons, one pair could be modified to flash. This may not be as effective as fitting eye level lamps, but it would be cheaper.

Below is a larger-than-life size of the assembled PCB.



The circuit

The main components in the circuit are a 4093 quad NAND gate with Schmitt trigger inputs, a 4017 decade counter and three transistors. These components may be considered as three main functional elements: a clock, a counter (incorporating the delay) and the lamp driver section.

The circuit basically works as follows. When the brake pedal is pressed, the circuit is energised. This starts the clock which drives the transistor lamp driver section, flashing the accessory lamps on and off. This continues until the counter section counts up to four, after which the accessory lamps are turned on continuously, as long as the brake pedal is depressed.

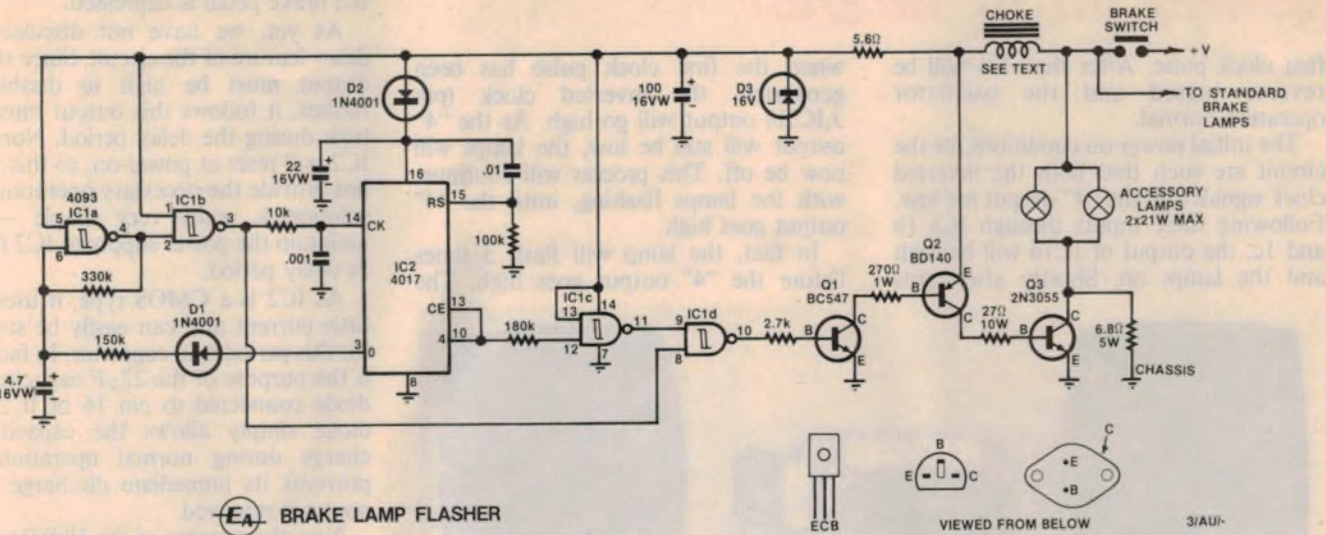
To gain a better understanding of the circuit, let's look more closely at what the 4017 does.

A 4017 decade counter is a device with ten outputs, numbered 0 to 9. Normally, each output goes high, in sequence, for one complete clock cycle. This mode of operation can be overridden by either Clock Enable (CE, pin 13) or Reset (RS, pin 15). CE

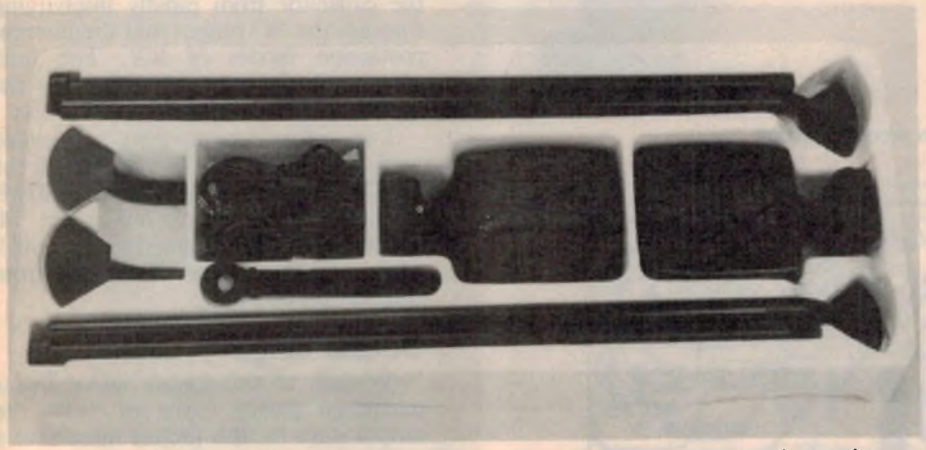
We estimate the current cost of parts for this project to be approximately

$16-20

This includes sales tax, but not the cost of accessory brake lamps.



BRAKE LAMP FLASHER



This accessory brake lamp kit comes with all the necesssary hardware for installation on the rear parcel shelf. It cost us less than $20 (from BBC Hardware).

prevents further counting when it is taken to logic high and RS sets the counter outputs to zero when it is taken high.

Notice that the Reset pin has a 100kΩ resistor and a .01μF capacitor connected to it. These two components form a power-on reset circuit. Whenever power is applied to the IC, it automatically resets to the zero count. Notice also that the "4" output (pin 10) is connected to the Clock Enable input (pin 13). This means counting ceases once the "4" output goes high.

The "4" output of IC2 is also connected to pin 12 of IC1c by means of a 180kΩ resistor. For the moment, ignore the resistor and assume that the connection is direct. IC1c simply functions as an inverter so that its output (pin 11) is low only after the "4" count has been reached.

Pin 11 of IC1c is connected to pin 9. one of the inputs of IC1d. Pin 9 acts as a control for this gate — whenever it is low, the output (pin 10) will be high. While ever this condition prevails, the lamps will be permanently on.

Until the "4" output (and hence pin 9 of IC1d) goes high, the output of IC1d will be determined by the logic state of it's other input, pin 8. As pin 8 of IC1d is connected back to the inverted clock output (pin 3, IC1b), it now becomes necessary to examine the operation of the clock in detail.

The frequency of the oscillator based on IC1a is set by the 4.7μF capacitor and 330kΩ resistor at about 1.5Hz. During normal operation, the charge on the 4.7μF capacitor will swing over a range equal to the hysteresis voltage. This might typically be between + 6V and +8.5V for a 4093 made by National Semiconductor.

Unfortunately, when the circuit is first powered up, the 4.7μF capacitor must charge from 0V to the normal operating range. This, of course, would mean that the first clock cycle takes much longer than normal.

As we want the accessory lamps to begin flashing as soon as the brakes are used, an extended first clock cycle is undesirable. As a means of preventing it, the capacitor is "fast charged" by an auxiliary circuit. This consists of D1 and the 150kΩ resistor connected to the "0" output of IC2.

When power is first applied the "0" output is high and D1 permits current to flow into the capacitor. Remember, the "0" output will only be high until the

PARTS LIST

1 PCB, code 84au9, 101 × 60mm
1 4-way PCB-mounting terminal block
1 Automotive noise suppression choke (DSE Cat. L-1900)
2 21W automotive stop lamps (see text)

Semiconductors
1 4017 decade counter IC
1 4093 quad Schmitt NAND IC
1 BC547 NPN transistor
1 BD140 PNP transistor
1 2N3055 NPN transistor
2 1N4001 diodes
1 16V/1W zener diode

Capacitors
1 100μF/16V electrolytic
1 22μF/16V electrolytic
1 4.7μF/16V electrolytic
1 .01μF metallized polyester (greencap)
1 .001μF greencap

Resistors (5%, ¼W unless noted)
1 × 330kΩ, 1 × 180kΩ, 1 × 150kΩ, 1 × 100kΩ, 1 × 10kΩ, 1 × 2.7kΩ, 1 × 270Ω/1W, 1 × 27Ω/10W, 1 × 6.8Ω/5W, 1 × 5.6Ω

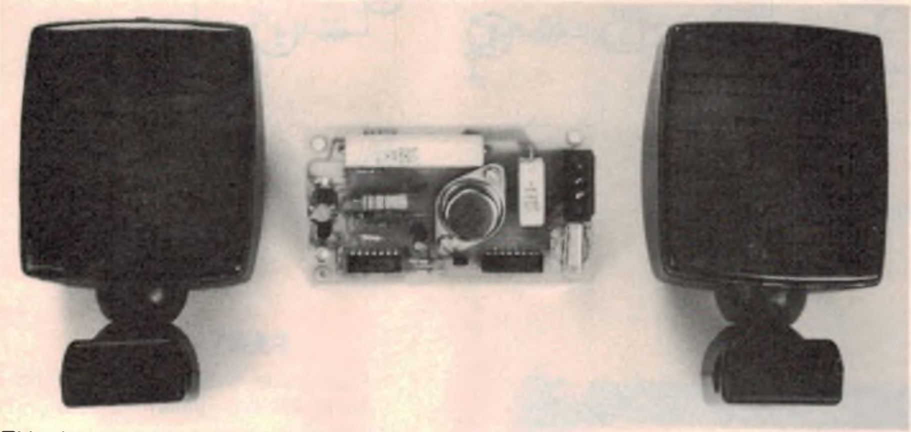
Miscellaneous
Machine screws and nuts, automotive hookup wire, solder etc.

Brake lamp flasher

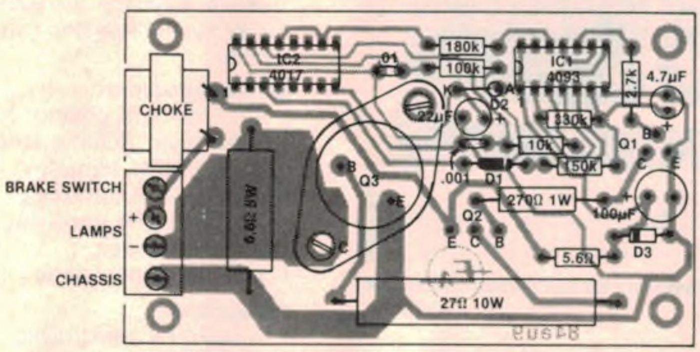
first clock pulse. After that, D1 will be reverse biased and the oscillator operation normal.

The initial power-on conditions for the circuit are such that both the inverted clock signals and the "4" output are low. Following these inputs through ICs 1b and 1c, the output of IC1d will be high and the lamps on. Shortly afterwards when the first clock pulse has been generated, the inverted clock (pin 3,IC1b) output will go high. As the "4" output will still be low, the lamps will now be off. This process will continue, with the lamps flashing, until the "4" output goes high.

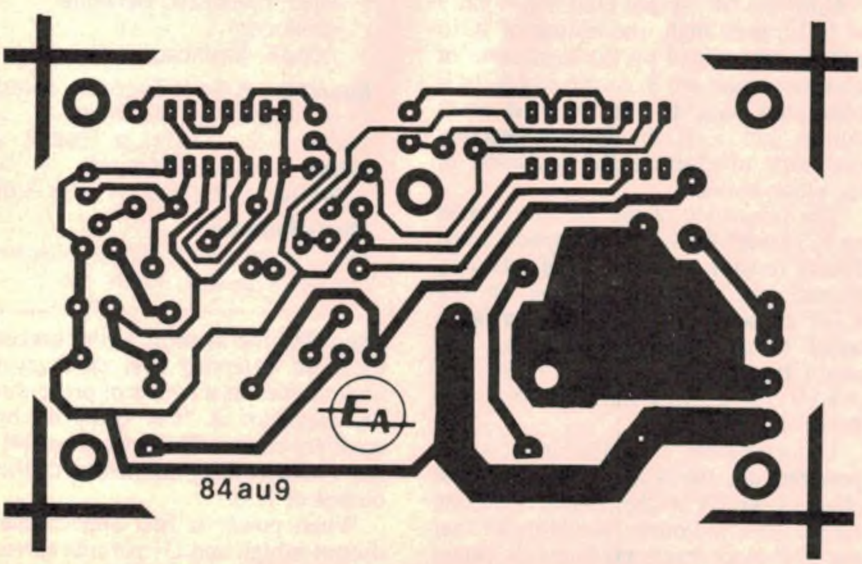
In fact, the lamp will flash 3 times before the "4" output goes high. The fourth "flash" will continue as long as the brake pedal is depressed.



This view shows the PCB together with the two accessory lamps.



Follow this parts placement diagram when wiring up the Brake Lamp Flasher. The suppression choke should be secured to the PCB using epoxy adhesive.



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

As yet, we have not discussed the delay feature of the circuit. Since the "4" output must be high to disable the flasher, it follows this output must stay high during the delay period. Normally, IC2 will reset at power-on, so this would not provide the necessary operation. The solution is really very simple — just maintain the power supply to IC2 for the 5s delay period.

As IC2 is a CMOS type, it uses very little current and can easily be supplied for this period by a capacitor. In fact, this is the purpose of the 22µF capacitor and diode connected to pin 16 of IC2. The diode simply allows the capacitor to charge during normal operation and prevents its immediate discharge when power is removed.

Now the purpose of the 180kΩ resistor connecting the "4" ouput of IC2 to pin 12 of IC1c becomes apparent. It prevents the capacitor from rapidly discharging through the "4" output and the internal protection diodes of IC1. The time constant is virtually determined by the 22µF capacitor and the 180kΩ resistor.

Two other components associated with IC2 should also be mentioned: the 10kΩ resistor and shunt .001µF capacitor at the clock input, pin 14. These are filter components which prevent hash on the clock line from causing mis-counting.

Output stage

As each of the flasher lamps has a maximum power rating of 21W, the output stage for this project must have a nominal current rating of nearly four amps. To achieve this level of drive from the CMOS output, three stages of current gain are needed. The first consists of an NPN BC547 transistor (Q1). This drives a PNP BD140 (Q2) which drives the final stage, an NPN 2N3055.

Current through the 270Ω base resistor of Q2 is about 45mA, which means that this resistor must have a power rating of 1W. Similarly, the 450mA base current of Q3 dictates that its base resistor must have a 10W rating. For periods of extended brake usage, this resistor will become quite hot.

There is another power resistor in the circuit — a 6.8Ω/5W resistor connected across Q3. This is simply a "heater" for the lamps. It maintains a filament current of about 750mA per lamp in the period between flashes. Whenever the lamps are fully on, most of the current flows through Q3 and the 6.8Ω resistor has very little effect.

To prevent ignition and alternator noise from upsetting the logic, we found it necessary to include a noise suppression choke. This is included in the brake switch line to the circuit.

In the event that this choke should fail to suppress some high voltage spikes sufficiently, a 16V zener diode in conjunction with a 5.6Ω resistor will protect the circuit from the damage.

Construction

In contrast to most automotive projects, this one is quite simple to construct and install. We have not mounted the project in a box, so construction simply amounts to soldering the printed circuit board components in place. The PCB measures 101 × 60mm and is coded 84au9.

Location of the board will depend on the type of car, although it should be somewhere towards the rear of the vehicle. This will be close to both existing brake light wiring and the new lights.

Begin soldering with the smaller components, then move on to the larger devices. The suppression choke should be held in place with some epoxy adhesive once its leads have been soldered.

Note that the accessory brake lamps must connect back through the appropriate terminal on the PCB — they cannot simply be connected to the vehicle chassis.

On Commodores and Falcons, where one pair of standard brake lamps can be used as "flashers", a small amount of modification to the vehicle wiring will be necessary. Usually, one pair of lamps will be dual filament — one filament for the tail light and one for the brake light. The other bulb(s) will usually only be single filament types. These are the ones to use with the flasher.

The chassis connection to the single filament bulbs must be broken. A Commodore which we inspected had the single filament brake lamps mounted on a plastic "card" with pressed wiring. This card was shared with the reversing lamp. To use the brake lamp as a flasher, the pressed wiring track will have to be cut. Make sure that the chassis return to the reversing lamp is not broken — you may have to make a new connection after cutting the track.

Once the chassis connection to the single filament bulb has been broken, make a new connection from the bulb to the flasher "Bulb -ve" output on the PCB. The "Bulb +ve" output of the flasher PCB need not be used as +V will be supplied to the bulb by the brake lamp switch in the normal manner.

Testing this project is simply a matter of operating it normally. Due to components tolerances, the flash rate might not be ideal. This can easily be altered by changing the value of the 330kΩ resistor associated with IC1a. Should the initial flash be of incorrect duration, alter the value of the 150kΩ resistor connected to D1.

SWR

—What it means in practice

When amateurs get together, and the talk turns to antennas, it is not long before the magic phrase, "SWR", is heard. But just what is SWR and how important is it in practice? This article looks at the subject in practical terms, at a level which everybody should understand.

by PHILIP WATSON VK2ZPW

It is an unfortunate fact that SWR, along with antenna and transmission line theory in general, is one of the most misunderstood subjects in the whole of amateur radio. It boasts as many myths and old wives tales as does pregnancy and childbirth, some of them perpetuated by supposedly reputable text books.

In trying to get a mental picture of what is, admittedly, an extremely complex subject it is often a help to start with a theoretically perfect situation, against which we can compare the usually imperfect practical situation.

The antenna

Let's start with the antenna. In any transmitter installation, this has to satisfy two basic requirements. One is to radiate the RF energy fed to it by the transmitter in the most efficient manner possible. The other is to present the transmitter with the correct load in order that the transmitter may deliver the level of RF power which the designer intended.

While both are important, the second requirement is, in many ways, the more important one. Suppose we have a typical commercial transmitter designed to deliver 10W into a 50Ω load. If we connect a pure (ie, non-reactive) 50Ω resistor directly across the antenna terminals or socket at the set, and energise the transmitter, it will deliver 10W to the resistor, which will appear as heat.

If we were to substitute some other value of resistor a number of things could happen. The most likely one is that the transmitter would no longer deliver its 10W. By how much it would fall short would depend on the error in the load value and the design and tolerance of the particular transmitter output stage.

Another possibility, again depending on the output stage design, is that it would try to deliver more than its rated power, but run into overload in the process, and destroy itself and other sections as a result. Fortunately, most commercially designed transmitters are well protected in this regard, but there is no point in taking unnecessary risks.

But, this risk aside, we should make every endeavour to present the correct load to the transmitter simply to ensure that it delivers the maximum power for which it was designed. On the other hand, there is little to be gained by simply feeding this energy into a resistor; it will radiate very little of the RF energy and waste virtually all of it as heat.

So we replace the resistor with an antenna and, fairly obviously, this antenna should look (to the transmitter) like a 50Ω resistor if it is to deliver maximum power. Assuming the antenna is resonant at the transmitter frequency, and fed at the right point, it will look like a resistor. If it is not resonant it will exhibit either a capacitive or inductive component, according to which way it is off resonance.

Assuming that it is resonant, the next question concerns the value of resistance it presents to the transmitter. And this is where the going gets tough because, in other than a very few clearly defined cases, this is very largely an unknown or, at best, "guesstimated" value.

We can, for example, nominate the resistance at the centre of a half wave dipole as being in the region of 72Ω, while a folded version of the half-wave dipole will have four times this impedance, or 288Ω (often mentally rounded off to 300Ω). A number of factors can cause minor variations to these values, such as the diameter of the elements, relative to their length, space between folded dipole elements, etc.

A more controversial value is that for the popular quarter-wave ground plane. For years it has been stated, in many popular amateur textbooks, that this is approximately half the value of the simple dipole, or 36Ω (in fact, various values have been quoted between 30 and 36Ω). This figure appears to have been based on a theoretically calculated value for a quarter-wave radiator working against an infinitely large, perfectly conducting ground plane.

Some of these text books even went so far as to describe matching devices ("Q" sections, etc) which would match this value to the popular 50Ω coax cable and transmitter load requirements. As anyone who has tried to make one of these matching systems work, or who has attempted to confirm this figure with an impedance bridge will testify, the real-life ground plane, using four quarter-wave radials, is a vastly different device.

Strangely enough, the true situation has been known for many years. At least as early as 1962, and possibly earlier, the R.S.G.B. Handbook (page 365) stated: "The radiation resistance of a ground quarter wave aerial is 35Ω, but that of a ground-plane is less than 20Ω." More recently other authorities have been emphasising this same point but, unfortunately, old ideas die hard, and the point needs to be emphasised a good deal more strongly if the error is to be corrected.

One of the most recent articles on the subject, and one of the most detailed, is that by Guy Fletcher, VK2BBF, which appeared in the August 1984 issue of "Amateur Radio", the official journal of the Wireless Institute of Australia. This, and two articles which follow in subsequent issues, are recommended to anyone wishing to get a more detailed picture of the antenna scene generally.

But this is a separate argument. The point we set out to make is that, apart from these few simple designs, it is exceedingly difficult to nominate the feed point impedance of an antenna. We do know the general effect of many design factors; that, for example, the addition of director or reflector elements to a dipole will lower the impedance. But by how much is another matter.

So we are faced with the situation that the impedance of all but the simplest antenna systems is largely an unknown quantity. With experience we can make a rough estimation that it will be between this and that figure, or below some other figure, but beyond that we must resort to some form of measurement or "suck-it-and-see" approach.

SWR meters

One such approach involves the use of a standing wave ratio meter, or SWR meter. But it would be premature to go into details at this stage. We need to talk about SWR in some detail first.

So far we have considered only those situations where a resistor or an antenna — which looked like the same resistor — was connected directly across the transmitter output terminals. Apart from a few special cases, feeding an antenna in this manner is not very practical. We need to locate the antenna as high as possible and clear of objects which might shield it, while we need to put the transmitter in a convenient indoor working location, some distance away.

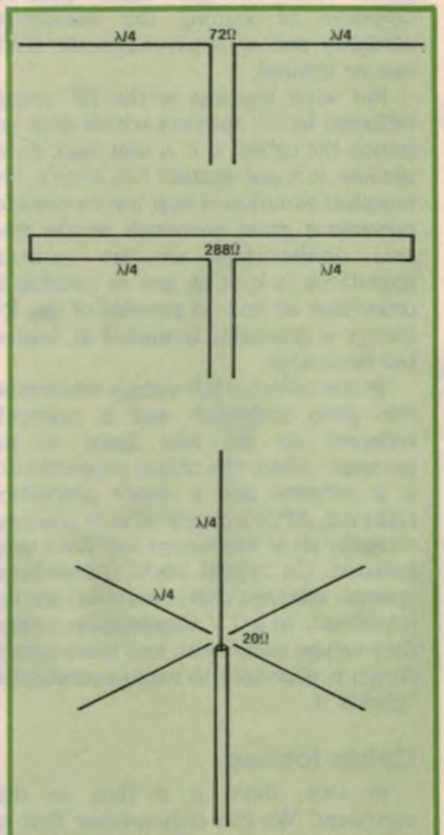
And, to couple the two together, we need a special kind of cable; one that will convey the transmitter output to the antenna with minimum loss and which, in itself, will not radiate any significant amount of this energy into a shielded environment, where much of it would be wasted.

There are two types of cable commonly used by amateurs, the open wire line and the coaxial cable. The open wire line can be homemade, has very low losses, and can be made to have any impedance characteristic over a wide range. On the other hand it can be awkward to install and is much less popular than it once was.

Coaxial cable is a commercial product, with somewhat higher losses, and is commonly available in two popular impedance values: 50 and 72Ω. It is reasonably flexible and relatively easy to install. For most of our discussion we will assume the use of coaxial cable, although most of the points would be just as valid for open wire lines.

Characteristic impedance

Undoubtedly the most important single characteristic of a coaxial cable, for the beginner to understand, is its characteristic impedance, typically 50 or 72Ω, as already mentioned. This is not an easy concept to grasp and the beginner may have to content himself with accepting some basic statements at their face value, at least initially.



Three basic antennas for which the feedpoint impedance is known with reasonable accuracy.

Coaxial cable consists of two conductors, one within the other, and insulated from each other. A common form uses solid or stranded wire as the central conductor, copper braid as the outer conductor, and a polythene insulating material between them.

The characteristic impedance is a factor of the inductance of the two conductors, relative to the capacitance between them, per unit length. These factors, in turn, are determined by the physical characteristics of the components; the inductance by the cross sectional area of the conductors, and the capacitance by their area relative to each other, the distance between them, and the dielectric constant of the insulating material. The length of the line is not a factor.

The effect of this inductance/capacitance relationship is to establish an equally firm relationship between the voltage and current of RF energy travelling up the line. This relationship is exactly the same as would have occurred across and through a pure resistor having the same value (say 50Ω) as the characteristic impedance of the cable.

It may help to grasp this concept if one is to visualise a very short burst of RF energy transmitted up the line; so short that its trailing edge has left the transmitter long before its leading edge has reached the load at the far end. Thus, something in the manner of a fired projectile, or even a thrown tennis ball, it is in a kind of limbo; while influenced initially by the manner of its launch its subsequent movement is largely a factor of its environment. And it knows nothing about what lies in store for it at the end of its journey.

We can carry the analogy a little further. If the tennis ball ultimately hits a brick wall it will bounce off (or be reflected) simply because the brick wall represents a gross mismatch to the manner in which energy is stored in the moving ball. A softer object, such as a bale of hay, may well have absorbed all the energy with no bounce (or reflection).

The same applies to our burst of RF energy. When it reaches the end of the cable it will need to meet exactly the right load if all its energy is to be dissipated in that load. And it doesn't take much imagination to conclude that the load should look like (in this case) a 50Ω resistor.

If it encounters any other value then only part of the energy will be absorbed

SWR — What it means in practice

by the load, and the remainder will be reflected down the line in the direction of the transmitter. And this is what creates what are called "standing waves" on the transmission line.

Standing waves

In greater detail, the standing waves are actually peaks of voltage between the conductors, or peaks of current through the conductors, which occur at regular intervals along the line. They occur at those points where (say) the voltage of the outgoing energy encounters voltage of reflected energy which is exactly in phase with it. Similarly for the current peaks.

The position of each peak is fixed and will always be one half wavelength away from its neighbour. Exactly between each peak, ie, one quarter wavelength away, will be a dip or voltage minimum, and it is the ratio between these two voltages which constitutes our "standing wave ratio" or SWR. (Note: wavelengths in coaxial cable will be physically shorter than in free space, according to the characteristics of the insulating material. A factor of 0.66 is typical, commonly referred to as the "velocity factor".)

In the theoretically perfect situation, where the cable is correctly terminated, all the energy is absorbed by the load, there will be no reflected wave, and the voltage and current values will remain essentially constant along the length of the line. Such a situation is said to constitute a "flat" line.

By now the reason for our interest in the SWR should be apparent. Because it occurs only if there is a mismatch, and its value is directly related to the degree of mismatch, its measurement provides a very useful "suck-it-and-see" approach to ensuring that the transmitter is presented with its correct load.

In greater detail, an SWR of (say) 2 to 1 will mean that the load is in error, relative to the cable impedance, by this ratio. But it cannot indicate in which direction the error lies. Assuming a 50Ω cable the 2 to 1 error could mean that the load is half (25Ω) or twice (100Ω) the correct value. Note, however, that this relationship is true only when the load is purely resistive.

Considering all the foregoing, and with the benefit of hindsight, one wonders whether the term "SWR", to some extent, might be misleading; and that some other term, like "mismatch ratio", might not have been a better choice.

But it is essential to keep one very important point in mind at this stage of the discussion. The existence of standing waves, in itself, is only a secondary problem. It is a useful measurement only because it tells us whether the transmitter is being correctly loaded or not and that our efforts should be directed to correcting this aspect of the problem. Whether we correct the SWR in the process may not even matter. Let us consider a practical example.

Suppose an SWR reading indicates quite clearly that there is a serious mismatch between antenna and cable. We have two options: either fit some kind of matching device between the antenna and the cable so that the antenna now looks like the correct value, or fit a matching device between the transmitter and the cable so that the transmitter sees a correct load.

In theory the first option is the preferred one, since we not only present the transmitter with its optimum load, but we eliminate the standing waves at the same time. In practice, however, the second option may well be very much more practical and convenient. It will have achieved the same primary objective of loading the transmitter correctly and in many cases the SWR can be ignored.

But what happens to the RF energy reflected by an antenna which does not match the cable? If it is sent back down the line, is it not wasted? No, it isn't. The practical situation is that the transmitter presents a gross mismatch to the line, and deliberately so. Its (source) impedance is kept as low as possible in order that as little as possible of the RF energy it generates is wasted as heat in the final stage.

So the reflected RF energy encounters this gross mismatch and is promptly reflected up the line again to the antenna, where the major proportion of it is radiated and a minor proportion reflected. After a couple of such journeys virtually all of the energy will have been radiated. (In typical audio transmission systems the time delays involved are not important. In a TV transmission system they can be significant, and more careful design is necessary to avoid transmitting "ghosts".)

Cable losses

In fact, there is a flaw in that argument. We can only assume that no energy is wasted if we ignore the inherent losses in the cable. All cables have some losses, and these increase with frequency. For example, a popular foam filled coax, RG8U, has a loss of 0.9dB/30m at 30MHz which rises to 3.5dB/30m at 400MHz. The presence of such losses means that any signal which has to traverse the line more than once will suffer additional losses on each excursion.

So we have to concede that, in practice, standing waves do create some loss. But how much, and how important is it? If we assume a 3dB loss in a cable system which is correctly terminated, ie, no standing waves, then an SWR of 3 to 1 will add a further 1dB loss. The accompanying graph indicates the additional loss for a wide range of basic cable losses and SWR values.

At 450MHz, using RG8U cable, with a run approaching 30m, a loss of 3dB could be expected and, if it had to be tolerated, then anything which would minimise further losses would be worth considering. This is a case where, all else being equal, correction at the antenna might be preferable to that at the transmitter.

At lower frequencies losses become less important. At 150MHz, RG8U wastes only 2dB/30m (an additional 0.8dB for a 3:1 SWR), and at 30MHz 0.9dB (plus 0.48dB for 3:1 SWR).

So, hopefully, that should put the SWR problem into some kind of perspective. But there are other misconceptions which we might perhaps comment upon. One is that the reflected energy finds its way back into the final stage and overheats it. Wrong!

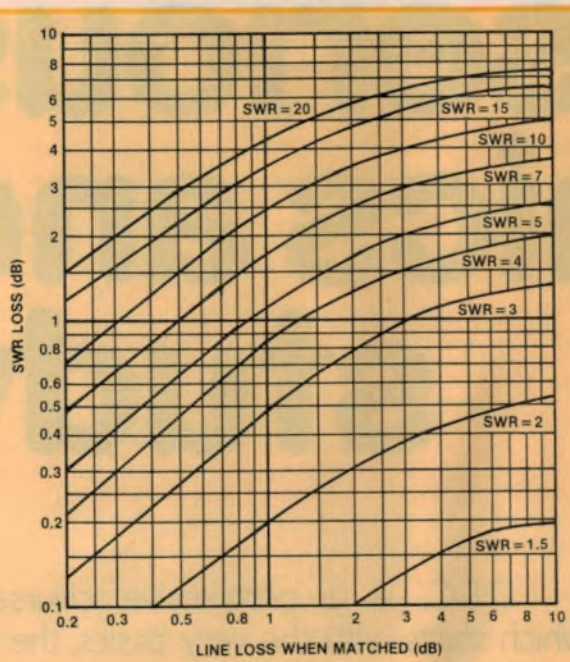
It is true that a transmitter working into a transmission line with a high SWR may show signs of distress. But the distress is not due to the SWR; rather it is due to the incorrect load at the antenna into which the transmitter is trying to work.

Cable length?

Another popular furphy claims that the length of the cable is critical; that it must be an exact multiple of a half wavelength long if the transmitter is to be properly loaded — and the standing waves eliminated — even when the antenna is presenting a proper load.

The truth is that, if the load is correct, then this value will be "seen" at the other end of the cable regardless of its length. If the load is incorrect, then this value will be seen at half wavelength intervals along the cable. But since it is wrong anyway there seems little point in trying to reproduce it.

In fact, in such circumstances, the length of the line can be critical for a



This graph clearly indicates the amount of additional loss, due to SWR, which occurs for various values of pure cable loss ie, loss when correctly terminated.

quite different reason. Between the half wavelength points the cable will exhibit a range of impedances, one of which may match the transmitter. So, by adjusting its length the cable may be made to act as a matching transformer, and load the transmitter correctly.

But don't try to do it using the SWR meter because altering the line length will have no effect on the SWR. If this trick is to be employed other measurements must be used, such as that from a field strength meter at a fixed distance from the antenna.

So, after all that, what is the role of the SWR meter? Well, it obviously isn't the universal answer to all antenna/transmission line problems. On the other hand, if it is the only instrument available it can be quite useful. An important point to realise is that, while it can indicate that there is something wrong with a particular set-up, it cannot indicate what is wrong.

Thus an antenna may present the wrong load for a number of reasons. It may not be resonant, the design may be wrong or may have been misinterpreted by the constructor, or the matching device, if one is used, may be incorrect. Alternatively, the cable impedance may be other than that claimed. (There is the story, well authenticated, about the Sydney disposals dealer who could supply either 50Ω or 75Ω cable at a very attractive price, both off the same reel!)

In other words, when the SWR meter indicates that there is something wrong, the important thing is to make a systematic approach to finding out what it is. For example, terminating the cable in a good dummy load having the same resistance will quickly indicate whether or not the cable is at fault. If it is not, the antenna is the next obvious suspect.

Exactly what needs to be done, or can be done, to change the antenna's impedance will, of course, depend on the particular type of antenna and what is physically convenient or practical. But, whatever the approach, the SWR meter can be used to monitor the effect of the changes or adjustments.

Finally, one more controversial point. Just where should the SWR meter be connected in the line: at the transmitter end or the antenna end? Some authorities are adamant that it should be at the antenna end, while others are equally emphatic that this precaution isn't necessary.

While, in theory, it can be shown that the antenna is the right place to make this measurement, the practical situation is that this is seldom a very convenient, or even feasible, arrangement. So, in practice, most people tend to make it at the transmitter end. (Where an antenna tuning unit, or other matching device is used at the transmitter, fitting the meter between the two is a perfectly legitimate way of determining when the tuning unit is presenting the correct load to the transmitter.)

The main objection to measurements made at the transmitter end is that the cable losses will mask the true ratio, the forward signal having been attenuated before it was reflected, and the reflected signal attenuated again on the way back. Depending on the severity of the losses, the user may obtain a reading below what he has set as an acceptable maximum when, in fact, the true value is appreciably higher.

Unfortunately, cable losses become worse as the frequency increases and, in the 420-450MHz (70cm) band this problem could be very real. So, be prepared to work at the antenna unless the coax line can be kept short. In cases like this it is sometimes better to move the transmitter close to the antenna, and use a much shorter line.

And so to sum up: The most important characteristic of an antenna system is to present the transmitter with its optimum load. An SWR measurement can indicate whether this is happening and, if not, the degree of error. It is valuable primarily for this reason, the standing waves in themselves being relatively unimportant.

So let's keep things in perspective.

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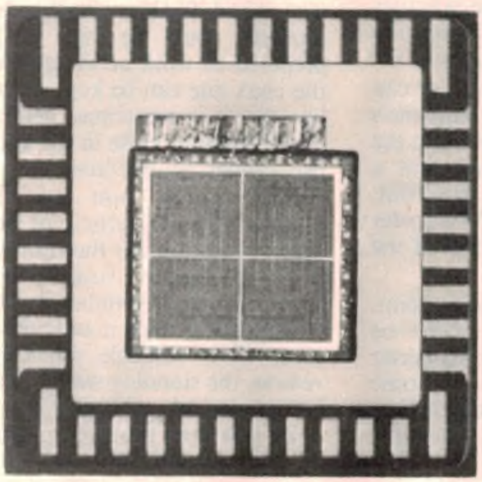

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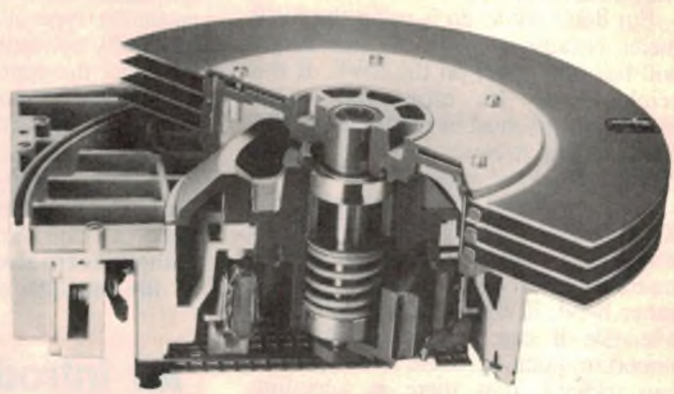

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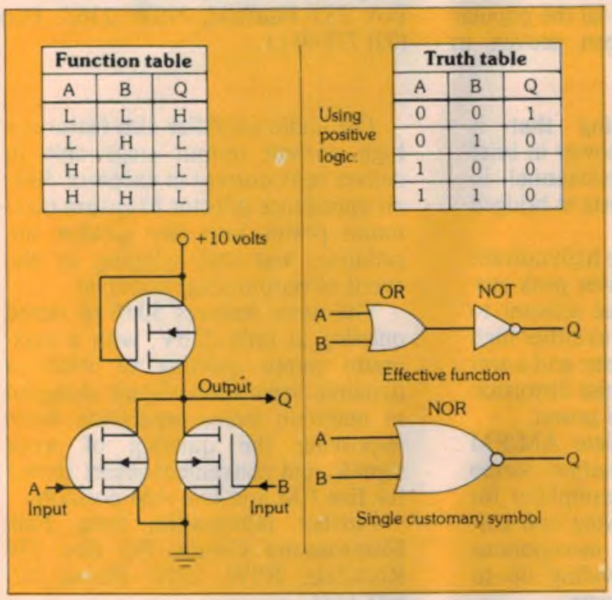

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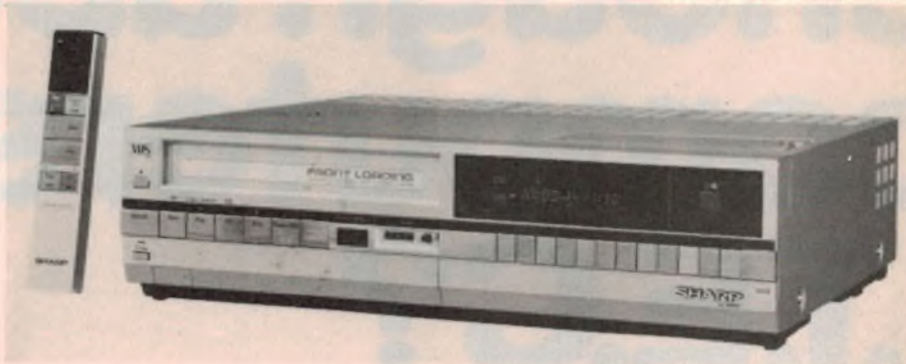
Sharp VCR features infrared control



Sharp Corporation has announced the release of a new Sharp video cassette recorder, the VC-8482X, aimed at the low cost market but featuring infrared remote control and many other features normally found on more expensive machines.

The remote control provides nine functions, including 10 times forward and reverse video search and noiseless still frame. Another feature is blank section scan. If a blank section of tape is encountered the recorder quickly searches for the next recorded section automatically.

Further convenience is provided by an automatic playback function whereby a pre-recorded tape (with tab removed) will commence playing automatically immediately it is inserted.

The VC-8482X retains all the popular features which have been proven in previous models, such as automatic front loading and a seven day timer.

Further information from Sharp Corporation of Australia Pty Ltd, PO Box 233 Fairfield, NSW 2165. Phone (02) 728 9111.

NAD amplifier and AM/FM receiver

The Falk Electrosound Group announce the availability of a new NAD power amplifier, model 2155, and the model 7140 AM/FM stereo receiver.

According to NAD, the 2155 power amplifier delivers substantially more than its conservatively rated 55 watts/channel into the complex and varying impedances of real loudspeakers. In the bridged monophonic mode this amplifier is rated conservatively at 150 watts continuous output. And it features 3dB of IHF dynamic headroom (2.5dB in bridged mode), meaning that it delivers twice its rated power in brief bursts: over 110 watts/channel in stereo and about 250 watts in bridged configuration.

Other features include high current output stage able to deliver peak currents up 40A, impedance selector to optimise power delivery to either high or low speaker impedances; and a soft clipping circuit to minimise distortion at levels above the rated power.

The 7140 is a complete AM/FM receiver with a 40W/channel stereo amplifier and phono preamplifier for both magnetic and moving coil cartridges. The amplifier incorporates 3dB of headroom, providing up to 80W/channel in brief bursts.

The audio amplifier also features a high current output stage able to deliver peak current in excess of 30A, an impedance selector to ensure maximum power into any speaker impedance, and soft clipping in the event of output stage overload.

The tuner features 50dB of stereo quieting at only 22uV, with a maximum stereo quieting of 80dB, a dynamic separation circuit designed to maintain stereo separation while improving the quieting of weak signals, and convenient preset tuning for five FM and five AM positions.

Further information from Falk Electrosound Group, PO Box 234 Rockdale, NSW, 2216. Phone (02) 597 1111.

Mitsubishi have developed a video printer for use with colour TV sets which produces a monochrome print from any TV frame. When commanded, the printer stores the TV frame, then feeds it to a thermal printer which, in 15 seconds, produces an 84 × 100mm print. Any number of duplicates can be produced, with the image transposed left to right, top to bottom, or in negative tone.

Further details from AWA-Thorn Consumer Products Pty Ltd, 348 Victoria Rd, Rydalmere, NSW, 2116. Phone (02) 638 9022.

Five head stereo video recorder

A new hifi stereo video recorder with a special rotary audio head system and audio performance similar to compact laser disc players has just been released in Australia. One of the first hifi stereo units available, the new National NV850A has a five-head system which offers true high fidelity stereo recording and playback.

The National 850A has a dynamic range of 80dB or more, comparable with the sound quality offered by digital compact disc stereo players. In addition it offers extremely low wow and flutter — less than 0.005% (WRMS) and greatly extended frequency response of 20Hz to 20kHz (DIN).

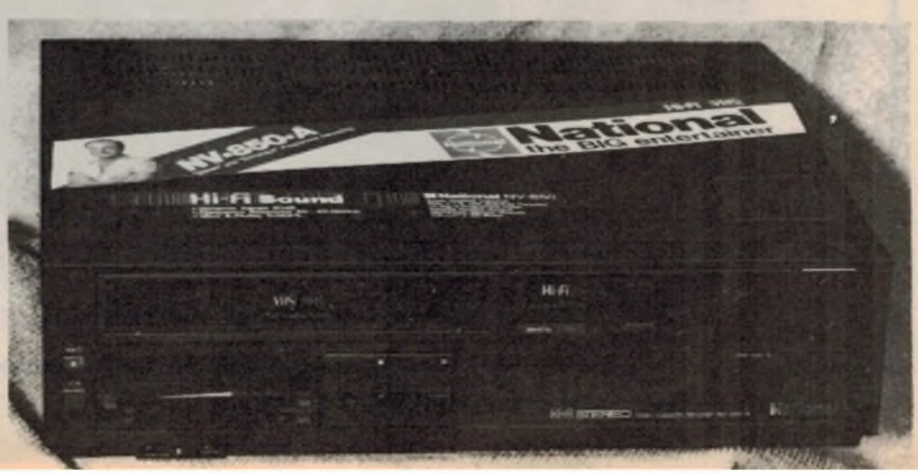
The performance advantages stem from a new five-head record/playback system. One of these is a conventional linear audio head to enable non hifi tapes to be played. Two others provide video record/playback in the normal way, and two further audio heads are mounted on the same rotary drive as the video heads.

The spinning heads trace out a pattern of diagonally striped tracks across the video tape, instead of the narrow track provided by a stationary audio head.

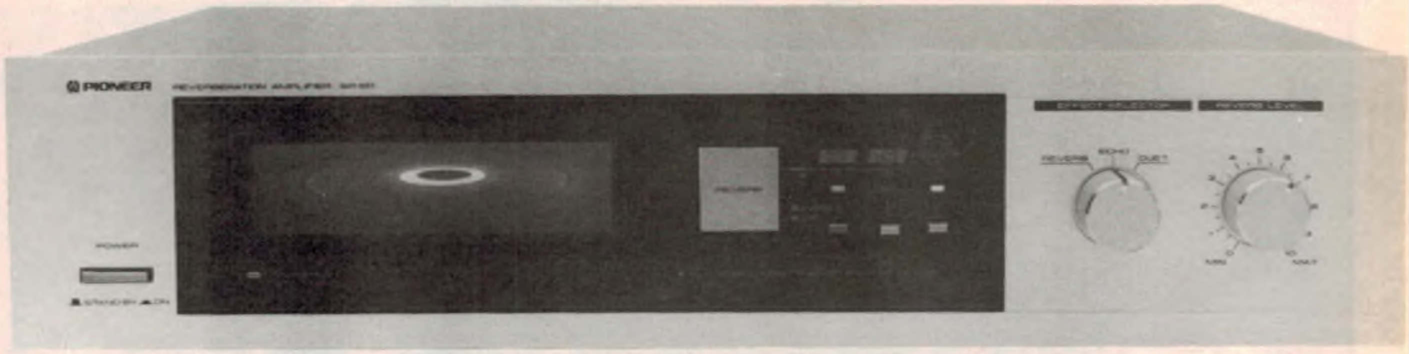
These hifi stereo audio signals penetrate the tape coating deeply, below the video signal laid down by the video head. The video and audio signals can be read with virtually no interference.

For the audiophile the NV850A can be used as a conventional two reel audio recorder with a performance surpassing the best audio recording system currently available. Used in the audio mode it gives four hours of continuous recording — more than is offered by a compact disc.

Further information from GEC Australia Video Systems Division, PO Box 563, Crows Nest, NSW 2065.



The SR-60 can be used with both hifi and video equipment and features reverb, echo and duet effects.



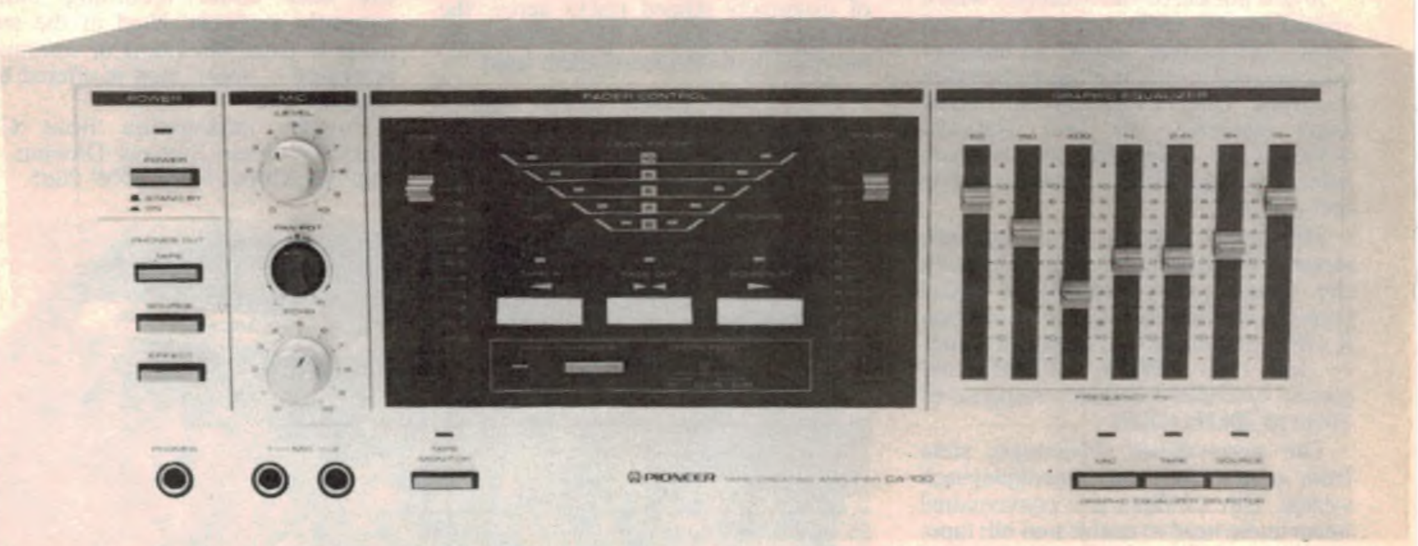
Pioneer reverb & tape amplifiers

Pioneer has released a number of products for the keen home recordist. They include the SR-60 Reverberation Amplifier and CA-100 Tape Creating Amplifier, both of which are reviewed here.

The SR-60 is intended for use in conjunction with hifi and video equipment. It provides special reverberation effects for your recordings on both video and audio tapes. Three separate effects are available: Reverb, Echo and Duet. A Reverb level control adjusts the amount of effect and this level is displayed in the Reverberation Effect Indicator.

Each of the three effects operate on the principle of delaying the signal, attenuating it and adding this to the original signal. The Reverb and echo comprise delays that extend to seconds while the number of repeated delays determine the difference between echo and reverb. Reverb has few delayed signals while Echo has many to give a chorus atmosphere. Duet has only two signals: the original and a second delayed

The CA-100 Tape Creating Amplifier. The controls may appear daunting but are really quite easy to use.



by only 100ms which gives an effect of two voices.

A graphical indication of each effect is displayed on the Reverberation Effect Indicator. This is a three dimensional display somewhat reminiscent of the "Time Tunnel" from the TV series.

The Reverberation Effect Indicator display adds life to the otherwise fairly plain front panel of the SR-60. At the far right of the brushed aluminium panel are the reverb level and effect selector knobs. Four pushbutton switches are also located within the large rectangular area of the display panel.

Overall dimensions of the unit are 420 × 340 × 99mm (W × D × H). Its mass is 4.6kg.

The four pushbuttons comprise Reverb, RECord OUT, LINE OUT and the Tape/Video Sound Monitor. The large "reverb" pushbutton enables or disables any reverb effects. When switched out, the settings of the Effect selector and Reverb level are ignored and the signal passes through the SR-60 without change. The two remaining pushbuttons are for input signal and monitoring selection.

The REC OUT and LINE OUT switches determine whether reverberation affects either the record output from the tape player or the line signal before entering the tape player. The Tape/Video sound monitor switch selects line or tape monitoring. In other words it takes the place of the tape monitor switch on a normal stereo amplifier.

Connecting the SR-60 to a stereo amplifier is accomplished by using two stereo RCA leads (supplied) and wiring into the tape monitor loop of the amplifier. The SR-60 duplicates the tape monitor record output and play input connections which are located on the rear panel. The reverberation input and output terminals are also mounted on the rear panel.

A signal attenuator switch is accessible at the rear panel of the unit and when switched in gives an attenuation of 6dB or 50%. This is provided to prevent distortion occuring due to overload when using a wide dynamic range signal source.

Internally, the SR-60 is well contructed. One large printed circuit board contains all the circuitry except for the mains wiring and transformer. All controls and rear panel terminals are directly mounted on the PCB. Circuitry includes five operational amplifiers, a CMOS inverter package and a bucket brigade device to perform the delay functions.

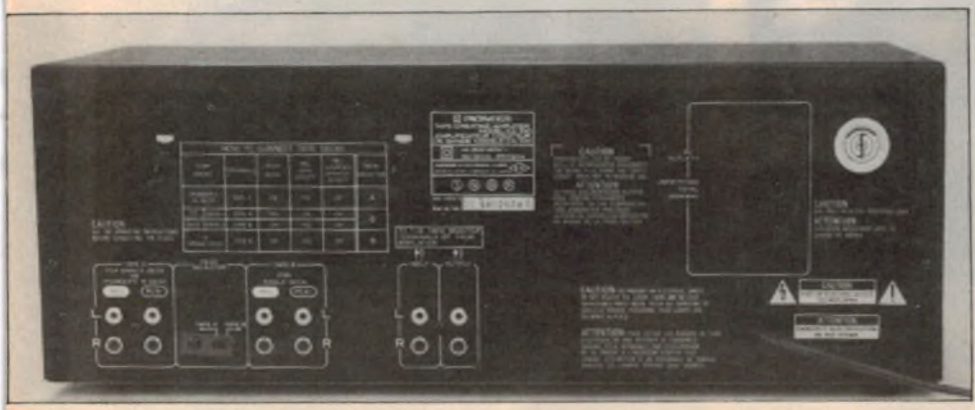
The power switch does not switch mains power. There is always DC power for the circuit as long as the mains cord is plugged into a powered socket. With the power switch on, the display and the switch indicator LEDs illuminate and the reverb effects portion of the circuitry is enabled. This is done so that the SR-60 will pass signals without reverb effects, even with the power off.

Performance

We were able to substantially duplicate the claimed performance specifications of the SR-60. Without reverberation, the distortion, noise and frequency response performance is very good and the unit can be left in the audio circuit without degrading sound quality.

Frequency response of the unit was 0.5dB down at 20Hz and 20kHz and extended way above the audio spectrum to 70kHz where the signal was down by 2.5dB. Signal-to-noise ratio with respect to 1V was 90dB with the reverb switch off and 82dB with the reverb switch on and the level set to minimum. Distortion at 1V and at 1kHz was .008% rising to .015% at 20kHz. Note that these figures do not include reverberation effects which will increase the noise and distortion components.

The reverb level control can adjust



The Tape Creating Amplifier accepts inputs from two microphones, two tape decks and the tape monitor output from a stereo amplifier.

Pioneer reverb & tape amplifiers

both the Reverb and Echo effects to give delays from zero to three seconds. The Duet setting gives a 100ms delay and adjusting the reverb control will only alter the relative signal level.

Input sensitivity is specified as 150mV into 50kΩ and the maximum output level is 6.5V.

In operation we found the unit gave very realistic echo and reverb effects. At maximum settings on echo, the sound appeared as though it were coming from a live grandstand. The Duet effect was far more subtle but it certainly made voice appear more "live".

The reverberation effect indicator gave some idea of the quantity of reverberation effect. However, the only sure method to setting the controls is to listen to the effect.

In summary, the SR-60 performed well and should prove valuable to recordists looking to add reverberation effects to their recordings.

CA-100 tape creating amplifier

At first impression, the vast array of controls on the CA-100 Tape Creating Amplifier may appear daunting. However, once you are familiar with their functions it is easy to become skilled in their operation. All the controls are located on the rather large front panel measuring 420mm wide by 158mm high. The case is 226mm deep and the unit weighs in at 4.2kg.

The CA-100 accepts inputs from two microphones, two tape decks and the tape monitor output from a stereo amplifier. This last signal input is called the Source input.

Both microphone inputs are equally mixed within the CA-100 while the overall level can be adjusted with the "microphone level" control. A "pan pot" knob adjusts the percentage of microphone signal in the left and right channels. It is adjustable from a 100% right channel signal to a 100% left channel signal.

The microphone input is mixed with either the source or tape input and the degree of mixing is set by the microphone level control.

At the rear of the unit are terminals for tape A, tape B and the source inputs and outputs. A switch at the rear selects between tape A and Tape B. Note that tape A inputs are specifically designed to mate with the Pioneer dual W deck. A single deck can be connected to these terminals for copying from tape B to tape A.

Echo effect is available on the microphone inputs only. It is adjustable up to about two seconds echo duration by using the "echo" control. This effect gives the impression that the sound is coming from a much larger space such as an auditorium or hall. It can be useful when singing to add presence to your voice.

The fader controls are centrally located on the front panel within the large rectangular grey perspex panel. They consist of the fader and cross point switches as well as tape and source level slider controls. Also included are two separate level meters, one for the tape and the other for the source inputs.

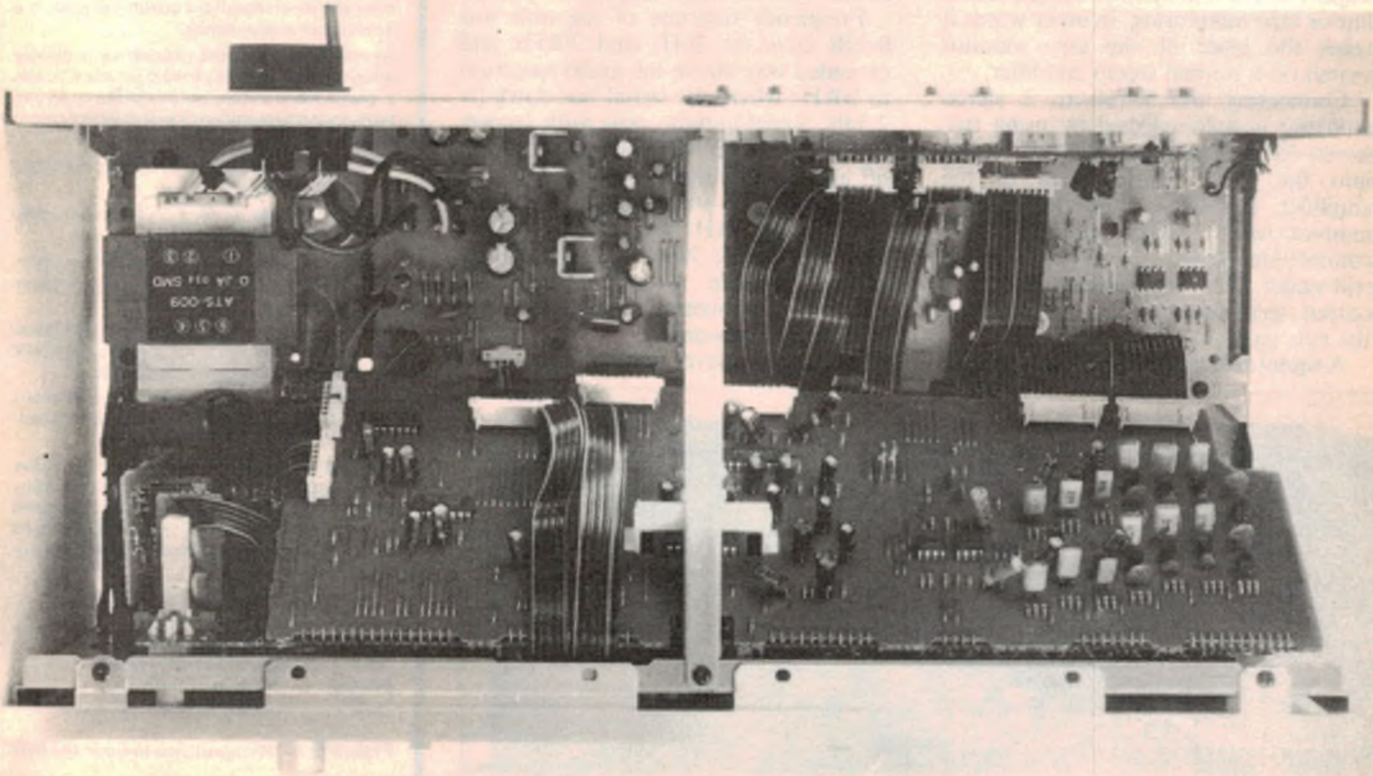
The level meters display the relative tape and source levels with a five-step LED display in 2dB increments from 2 to 10dB.

Fade in/fade out

Control of fading is accomplished with the fader on/off switch, fader initiation switches and the cross point selector.

When fading, the signal level of one source gradually decreases while the level of the other source gradually increases. This results in a smooth transition from one signal to the other. Fading is initiated by pressing the "tape in" or "source in" switches. The "tape in" switch fades out the source sound while

Continued on page 123



View inside the Tape Creating Amplifier. The angled PC boards make connections to the front panel controls.

Phone for telecommunications component innovations

Telecommunication equipment manufacturers face constant pressure for more and more user features. These pressures are accompanied by complex technical problems imposed by the highly sophisticated integration of business communications and information systems.

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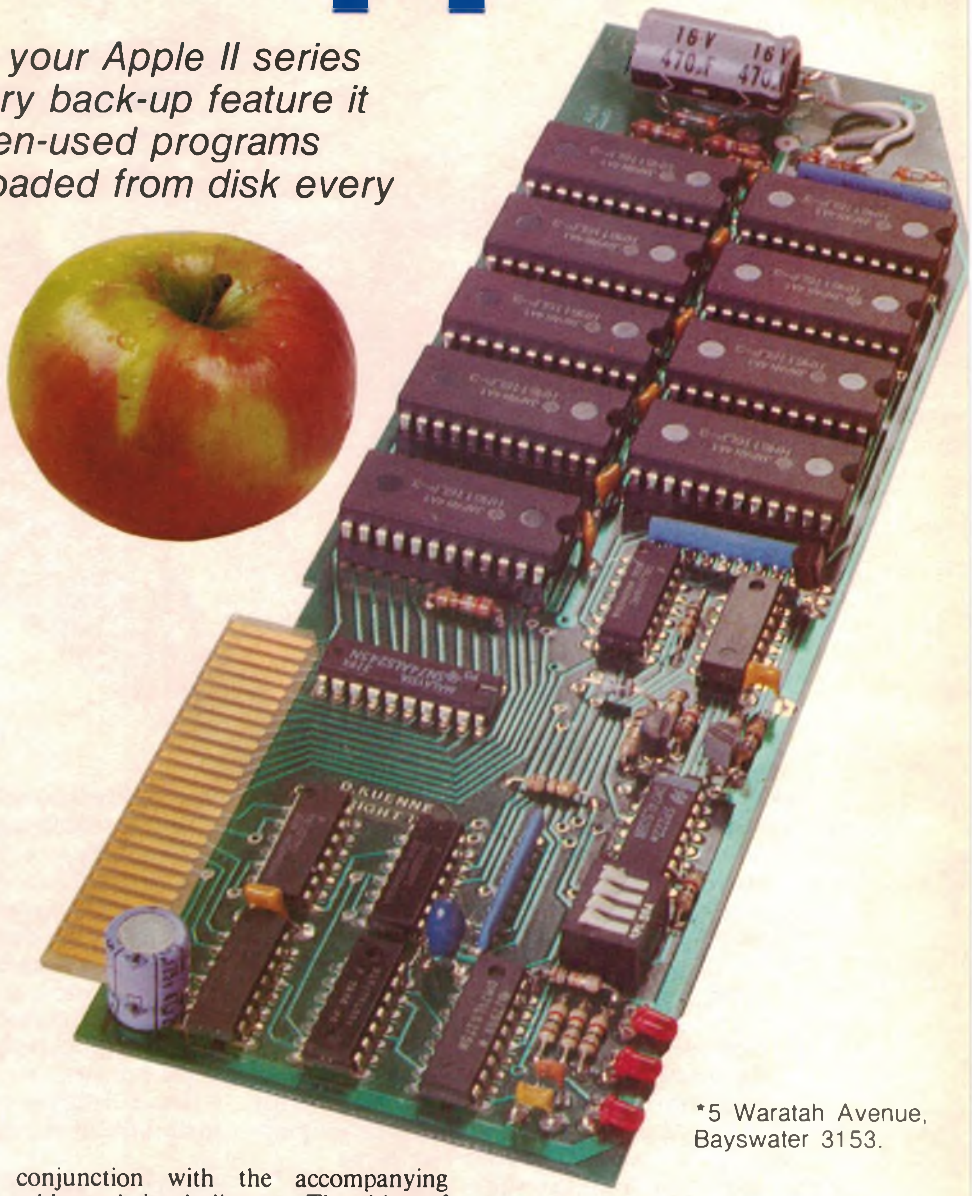
16K RAM card for the Apple II

Add a 16K RAM card to your Apple II series computer. With the battery back-up feature it can be used to store often-used programs which don't have to be loaded from disk every time you use them.

by DIETER KUENNE*



This static RAM card superimposes RAM over already existing ROM, namely Applesoft, integer Basic and the monitor. It may also be superimposed over a language card already in slot 0 (built into an Apple IIe). In the latter case a "supervisory program" or "memory management program" is required to control the cards. These are commercially available at low cost.

The card is designed to be compatible with Apple's Language card in the running of Pascal, CPM, DOS 3.3 and the current version of PRO-DOS when plugged into slot 0 of an Apple II/II+. Placed into any other slot (seven only on certain revisions of Apple's), it has available a 256-byte page of RAM to be used as a "peripheral driver" and thus can be used as a "DOS-less" bootstrap at start-up. It may also be used in conjunction with any of the available operating systems such as Pascal, DOS or CPM as a peripheral such as a pseudo-disk.

The optional battery back-up facility is very handy if you wish to operate without a disk in say, a control application. In this case, a program could be loaded via the cassette port or serially via a modem to start and then kept in RAM permanently. The boot page is used here as a "pretend disk".

Readers may at first think that 16K is not very much but if you had to load it every time from cassette (or very unrealistically, key it in) then it is quite a lot. Any one with a *Microbee* will tell you how pleasant it is to have battery backed up RAM. Once you have it, you won't want to be without it. Now let's have a look at the design and operation.

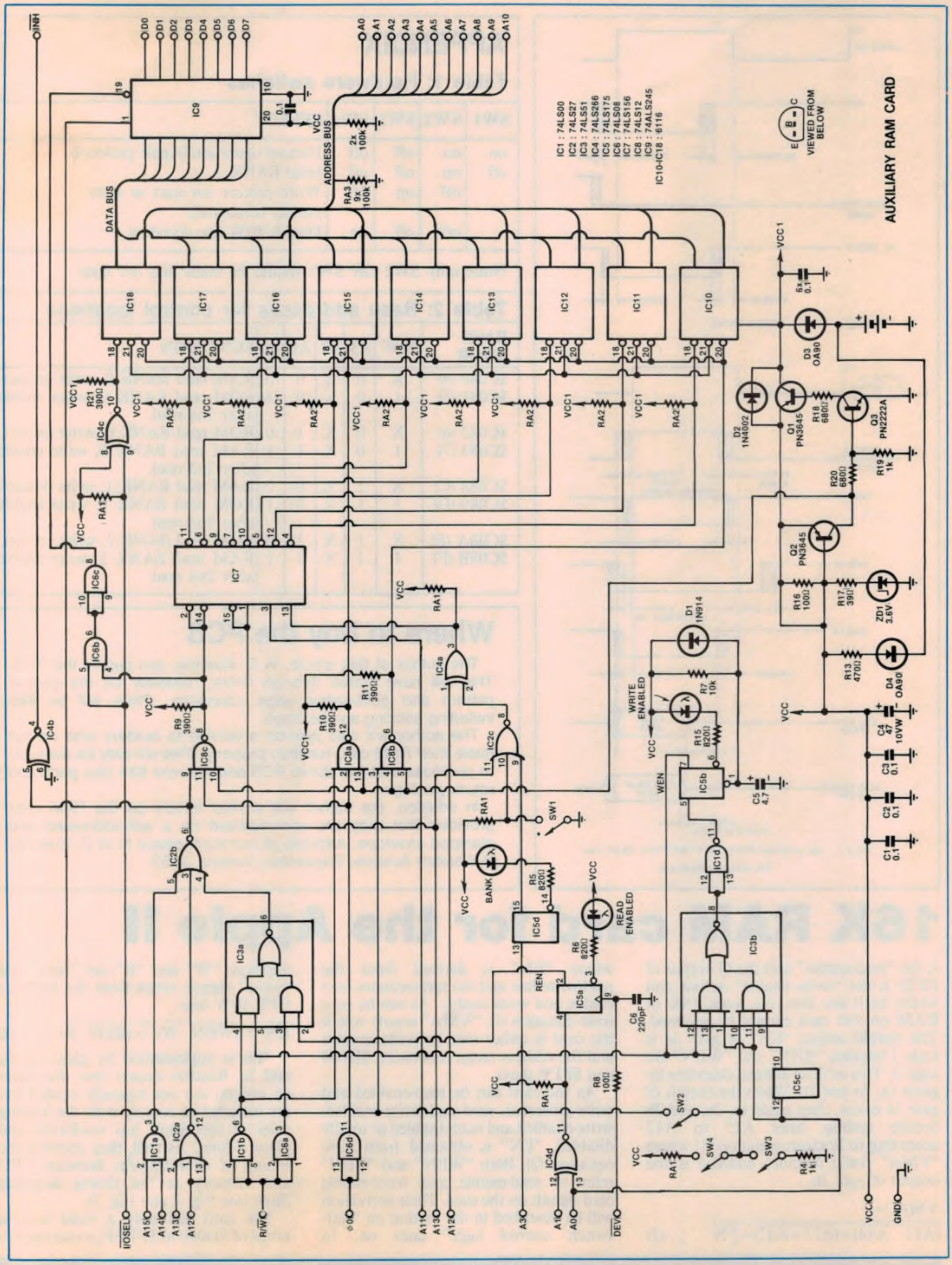
Design and operation

This section should be read in conjunction with the accompanying tables and circuit diagram. The object of this card is to be able to hold its data when the Apple is turned off and be able to look like ROM. Further it should be compatible with the Apple language card to satisfy PRO-DOS and all the current operating systems available for the Apple II series of computers when plugged into slot 0. In the back-up mode, the data would be retained by a battery or large value capacitor for a period of time between uses.

*5 Waratah Avenue, Bayswater 3153.

Decode logic

Let us assume that we are using an Apple II+ or II, that the card is plugged into slot 0 and we have just turned on. At this point, all D flipflops of IC5 are reset because the reset line (pin 1 of IC5) is held low by C5 until after full voltage is achieved by the 5V supply. This time-constant is set by R7 and C5. D1 serves only to discharge C5 more quickly when power is removed. The Q output of FF5a


AUXILIARY RAM CARD
IC1 : 74LS00
IC2 : 74LS27
IC3 : 74LS51
IC4 : 74LS266
IC5 : 74LS175
IC6 : 74LS08
IC7 : 74LS156
IC8 : 74LS12
IC9 : 74ALS245
IC10-IC18 : 6116
VIEWED FROM BELOW
DATA BUS
ADDRESS BUS
WRITE ENABLED
READ ENABLED
BANK

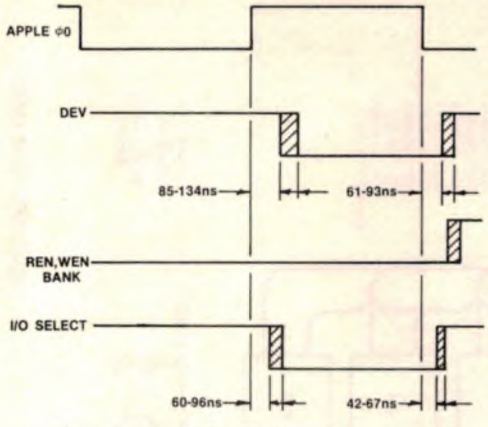


Fig. 1 ENABLE TIMING

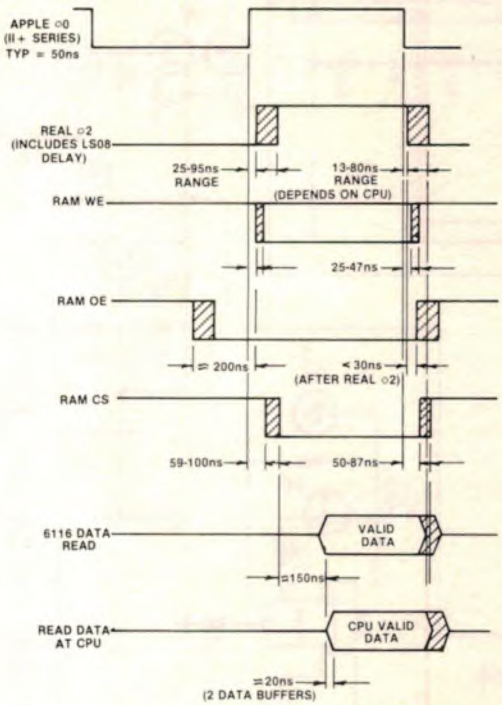


Fig. 2 NB: A TYPICAL BUFFER HOLD TIME IS 10ns, DELAY 10ns

CPU READ REQUIREMENTS

APPENDIX

Table 1: Hardware switches

SW1	SW2	SW3	SW4	EFFECT
on	on	off	off	Normal operation (Apple protocol).
off	on	off	off	Hold BANK 1.
	off	on	off	Write protect (on start or after protect command).
	off	off	on	Disable R/W line decoding.

Note: only SW2 *OR* SW3 should be made and *not* both.

Table 2: Base addresses for control locations

BASE ADDR	R/W	A3	A2	A1	A0	FUNCTION
$C080 (4)	X	0	X	0	0	RAM read BANK 0, write protect.
$C081 (5)	1	0	X	0	1	ROM read BANK 0, write enable after 2nd read.
$C082 (6)	X	0	X	1	0	ROM read BANK 0, write protect.
$C083 (7)	1	0	X	1	1	RAM read BANK 0, write enable after 2nd read.
$C088 (C)	X	1	X	0	0	RAM read BANK 1, write protect.
$C089 (D)	1	1	X	0	1	ROM read BANK 1, write enable after 2nd read.
$C08A (E)	X	1	X	1	0	ROM read BANK 1, write protect.
$C08B (F)	1	1	X	1	1	RAM read BANK 1, write enable after 2nd read.

Where to buy the PCB

The author of this article, W.D. Kuenne, can supply the PCB. This will have plated through holes, rollsolder on the copper pattern and gold-plated edge connector. Price will be **$65** including packing and postage.

The author will also provide a service to readers who cannot make their RAM card function properly. This will only be available to purchasers of the above PCB and will cost **$25** plus parts and return postage.

In addition, the author will answer letters on the RAM card provided that they are accompanied by a self-addressed and stamped envelope. Address all correspondence to W.D. Kuenne, 5 Waratah Avenue, Bayswater, Victoria 3153.

16K RAM card for the Apple II

is the "read enable" and the Q output of FF5b is the "write enable" output and whilst both are low, the main 16K of RAM on this card cannot be accessed. The enable output "EN" of gate 3a is logic 1 because "REN" and "WEN" are logic 0. This inhibits address decoding by gates 1a, 2a and 2b. When the output of gate 3a is low, then gates 1a, 2a, and 2b decode address lines A15 to A12 according to Boolean equation (1) where "VMA" (valid memory address) is the output of gate 2b.

$$VMA = \overline{(A15 \cdot A14)+(A13+A12)+EN} \ldots\ldots (1)$$

where "EN" is derived from the read/write line and the soft-switches read enable and write enable. As can be seen from equation (1), "VMA" is only true if the card is either read or write-enabled and the address range is between $D000 and $FFF (hex).

As the card can be read-enabled and write-protected, read and write-enabled, write-enabled and read disabled or totally disabled, "EN" is obtained from logic equation (2). Both "WEN" and "REN" refer to read-enable and write-enable card signals on the card. Their derivation will be described in the section on "soft-switch control logic" later on. In addition, "W" and "R" are "read" and "write" signals taken from the buffered CPU R/W line.

$$\overline{EN} = \overline{(WEN \cdot W) + (REN \cdot R)} \ldots\ldots (2)$$

This is implemented by gates 1a, 6a and 3a. Readers should note that gates 6a and 6d are not logically needed but are included to comply with the loading rules of the Apple bus read/write and phase 0 lines. As well, they improve the timing of data transfer between CPU and memory as the timing diagrams show (see Fig. 1 and Fig. 2).

The card has only a valid address range of $D000 to $FFFF, so we need to

Table 3: Address decoding table

ADDRESS	A15	A14	A13	A12	A11	MOTHER BOARD	METHOD 1 (LINEAR) BANK = 1	METHOD 1 (LINEAR) BANK = 0	METHOD 2 (AS USED) BANK = 1	METHOD 2 (AS USED) BANK = 0
$F800	1	1	1	1	1	ROM	R0	R0	R2	R2
$F000	1	1	1	1	0	ROM	R1	R1	R3	R3
$E800	1	1	1	0	1	ROM	R2	R2	R0	R0
$E000	1	1	1	0	0	ROM	R3	R3	R1	R1
$D800	1	1	0	1	1	ROM	R4	R6	R6	R4
$D000	1	1	0	1	0	ROM	R5	R7	R7	R5
$C800	1	1	0	0	1	Slot ROM	(R6)		(R4)	
$C000	1	1	0	0	0	I/O	(R7)		(R5)	

NOTE: R0 to R7 are the RAM device number for linear decode. (R6) and (R7) are the would be locations without BANK SWITCHING.
Method 1 is using AND and OR gates to BANK select.
Method 2 is using XNOR and NOR gates to BANK select.

Table 4: Read enable truth table

T(n+1) ... T(n)

R(n+1)	A0	A1	A2	A3	R/W
1	0	0	X	X	X
0	1	0	X	X	X
0	0	1	X	X	X
1	1	1	X	X	X

R (tn+1) = (A0 + A1) (tn)

Table 5: BANK select truth table

T(n + 1) ... T(n)

B (tn+1)	A0	A1	A2	A3
0	X	X	X	0
1	X	X	X	1

B (tn+1) = A3 (tn)

bank-switch another 4K over the lower range, namely $D000 to $DFFF. This is achieved by the soft-switch "Bank" (FF5d) and gates 2c and 4a. These gates form a "funny" address line given by equation (3).

$A'12 = \overline{\overline{(A13 + BANK)} + A12}$ ....(3)

For now, assume that the card is enabled for reading and writing. When the CPU reads or writes from a range of memory at $D000 and above, "VMA" will then be a logic 1. At this time the motherboard ROMs are disabled by the inversion of VMA from gate 2b by gate 4b (open-collector) pulling the INH line of the Apple bus low during CPU phase 1 and staying low for all of phase 2. The Apple IIe requires this line to be pulled low during phase 1.

Address line A13 selects one half of the dual demultiplexer IC7 (a 74LS156). Which half is determined by whether the address is above or below $E000. During phase 0, the output of gate 8c falls to actually enable one of the demultiplexers. Address lines A11 and funny address line A'12 then determine which one of the four outputs of the selected demultiplexer goes low to select a RAM chip.

Each chip-select line has a 2K range of address. Now depending on whether it was a read or write, either gate 8a or gate 8b, being the write or read control of the RAM devices, becomes active low. The read or write control lines fall at, or before, the chip-select lines so that in the event of a write, the RAM's output buffers are Tri-state, ready for data to be written to it when the bus-transceiver is enabled. Further, if it was a read, gate 8b is low as soon as the VMA line is high and stays low until well into phase 1 again, so that DATA hold time after CPU phase 2 is achieved.

The bus-transceiver type 74ALS245 is enabled two gate delays after the 74LS156 is selected and is released the same time after the 74LS156 is deselected. These gate delays are required because of a hold-time requirement of the 6502. This is 10ns after the end of the real phase 2 for reading from RAM or peripheral and the advanced phase 0 from the Apple bus. This is achieved by holding "RE" low independently by CPU address and R/W line decoding.

Writing to RAM is not as critical as the data is valid from the 6502 at least 200ns before the end of phase 2. The RAM write cycle ends before the end of the real phase 2.

One further RAM device is provided and this resides in the slot ROM page. The I/O select signal goes low during phase 0 time when the CPU is addressing $CNXX space, where N is the slot of the card. On slot 0 this is not provided, and resistor R14 pulls this line high to disable the RAM chip via gate 4c (an open-collector device). R21 pulls the CS line high during power-down time so that it also is saved along with the rest of the 16K on the card. No further decoding is provided as each slot selects a different page of RAM. This allows us to write slot-independent software.

The $C800 to $CFFF space was thought of but due to the number of additional chips required to support it, it was decided against using it as well.

Soft-switch control logic

For slot 0 there are 16 addresses between $C080 to $C08F allocated. All the soft-switches are toggled by these addresses.

In the address range $C080 to $C08F (or + $s0 for other slots where s = slot) the following results occur:
(1) If A0 is logic 0 then BANK = 0.
(2) If A0 is logic 1 then BANK = 1.
(3) If exclusive-NOR of A0 and A1 is logic 1 then the card becomes read-enabled.
(4) If the card is accessed twice with A0 at logic 1 then the card becomes write-enabled (reads).

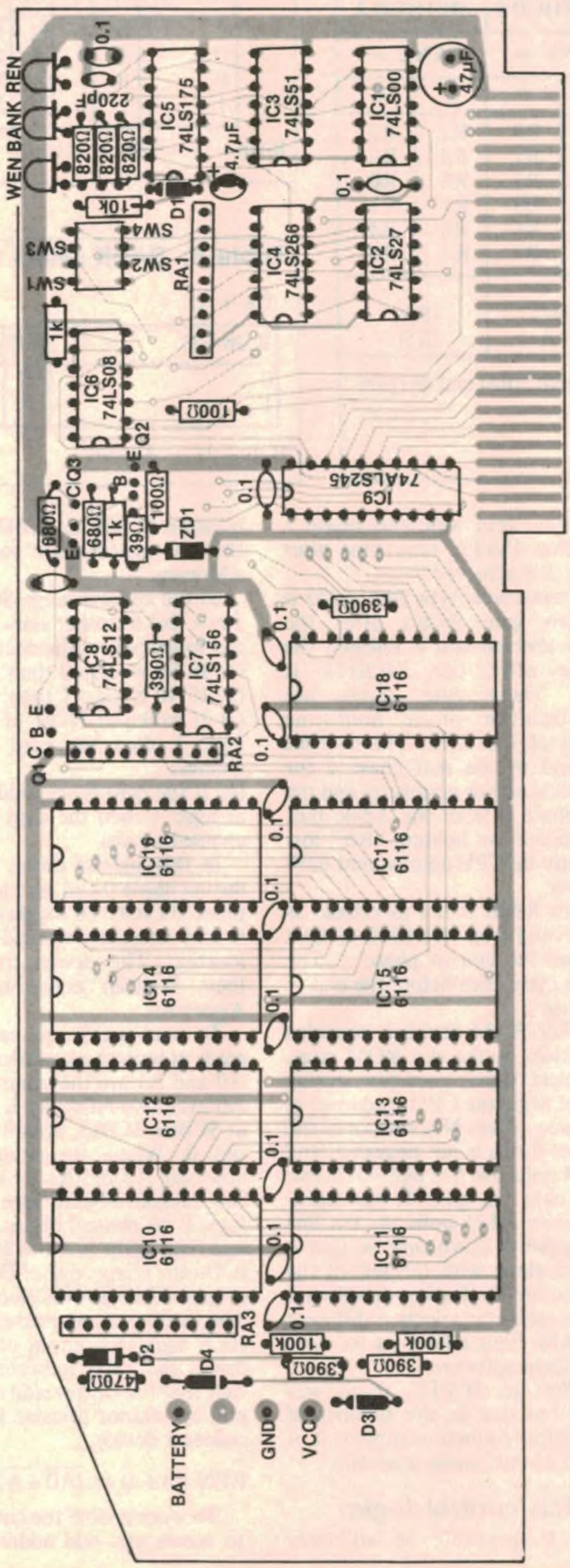
In this address range, $\overline{DEV}$ goes low during phase 0 and rises at the end of the phase 0 cycle. To toggle a soft-switch, it is only necessary to read from a control location. The design truth tables and their Boolean equations are in the Appendix.

To read-enable the card, one simply reads or writes to a control address where A0 and A1 are the same level, or where A0 exclusive-NOR A1 is true. These are at $C080, $C083, $C088 and $C08B for slot 0. When, for example, $C080 is accessed, A0 and A1 are both logic 0 and the exclusive-NOR gate 4d outputs a logic 1. As phase 0 begins, $\overline{DEV}$ goes low and rises again to a 1 at the end of phase 0. On the rising edge of $\overline{DEV}$, the output of gate 4d (logic 1) is clocked into FF5a. The card is now read-enabled via the REN signal (Q output of FF5a). The Q drives the LED indicator to show the user that the card is read-enabled. R2 is a pull up resistor because IC4 is an open-collector device.

$REN\ (tn+1) = \overline{(A0+A1)}\ (tn)$ ......(4)

To write-enable the card, it is required to access any odd address in the range

16K RAM card for the Apple II



$C080 to $C08F, the second of which must be read. On the first access with A0, logic 1 sets FF5c on the rising edge of DEV. FF5b stays at logic 0 because both WEN and Q of FF5c (pin 10) are logic 0 before the rising edge of $\overline{\text{DEV}}$.

PARTS LIST

1 double-sided PC board (see text)
1 4-way DIP switch

Semiconductors

9 HM6116LP-3 or HM6116P-3 16-bit RAM (Hitachi). (Do not use SRM2116200)
1 74LS00 quad 2-input NAND gate IC
1 74LS27 triple 3-input NOR gate IC
1 74LS51 dual AND-OR-INVERT gate IC
1 74LS266 quad exclusive-OR gate IC
1 74LS175 quad D-type flipflop IC
1 74LS08 quad 2-input AND gate IC
1 74LS156 dual demultiplexer IC
1 74LS12 triple 3-input NAND gate IC
1 74ALS245 or 74LS245 octal Tri-state buffer IC
2 2N3645 PNP transistors (plastic type preferred)
1 PN2222A NPN transistor (plastic type preferred)
1 1N914, 1N4148 small signal silicon diode
1 OA90, 91 germanium diode
1 1N4001 silicon rectifier diode
1 1N4729A 3.6V zener diode
3 red LEDs

Capacitors

1 470μF/16VW electrolytic (see text)
1 47μF/10VW PC electrolytic
1 4.7μF/35VW tantalum electrolytic
12 0.1μF/50VW monolithic
1 220pF/50VW ceramic

Resistor arrays

1 Resnet inline resistor array, 9 × 100kΩ (9 × 104M)
1 Resnet inline resistor array, 8 × 1kΩ (8 × 102M)
1 Resnet inline resistor array, 8 × 470Ω (1N × 471K)

Resistors (¼W, 5%)

2 × 100kΩ, 2 × 1kΩ, 3 × 820Ω, 2 × 680Ω 1 × 470Ω, 4 × 390Ω, 3 × 100Ω, 1 × 39Ω.

Note: Unless specified do not substitute ALS types for the above ICs.

Table 6: Write enable truth table

T (n+1) T(n)

W (tn+1)	F (tn+1)	F (tn)	A0	A1	A2	A3	R/W	W (tn)
0	0	0	X	X	X	X	X	X
0	1	0	1	X	X	X	X	0 (note 2)
1	1	1	1	X	X	X	1	0
1	1	1	1	X	X	X	X	1
0	0	1	0	X	X	X	X	1

F (tn+1) = (tn)

W (tn+1) = [F (tn) . R/W (tn) . AO (tn)] + [AO (tn). W (tn)]

where F is the first access latch and W is the write enable control signal.

Note: this is different from standard card but is transparent to all operating systems to date

This is given by equations 5 and 6 below.

D5b = (R . A0 . Q5c) + (WEN . A0) (5)

Q5b (tn+1) = D5b (tn)............(6)

On the second access with a read, the output of gate 1d becomes logic 1 in accordance with equation (5) above so that the WEN signal is logic 1 after the rising edge of DEV. Should the last access be a write (absolute), then the D-input of FF5b would be logic 0 and the card would still not be write-enabled. Or if A0 was a logic 0 then both FF5c and b would be reset and the card would be write-protected and thus two more reads are required to write-enable the card. SW2 to SW4 are used to defeat the normal control over the write-enable soft-switch.

It is done as follows. With SW2 open, and SW3 made, the D-input of FF5b will always be a logical 0 and hence with any access to a control location, the card cannot be write-enabled after it was protected. This protect condition exists on power-up. With SW2 open and SW4 made, the read write line decoding is defeated and so an instruction such as STA $C081,Y will write-enable the card because of the double access by the 6502 during an absolute-indexed write (actually a false read before write). Note also that only SW3 or SW4 should be made, not both.

To change the BANK, it is a simple matter to access a controlling location with A3 the value of the BANK to select. A3 is clocked into FF5d on the rising edge of DEV as before. Equation 7 describes the action.

BANK (tn+1) = A3 (tn)..........(7)

Resistor R8 and capacitor C6 are used to filter the DEV line and thus prevent false triggering of the flipflops in IC5.

Now that we have seen how the card is controlled, it is a matter of choosing the correct address for the desired action as listed in table 2.

Battery backup facility

This is accomplished by means of Q1, Q2, Q3, R13, R16 to R20, ZD1 and D2 to D4. It functions as follows.

When the Apple is turned on, D2 begins to conduct at about 0.7 volts on a totally flat battery and so tends to bring the RAM supply to within about 0.65 volts of the Apple's 5 volt supply. However as the voltage rises above 3.8 volts, as set by the zener diode ZD1 and the divider R16 and R17, Q2 begins to conduct.

As the voltage across R19 and R20 rises, Q3 also begins to conduct and is saturated before the voltage at PU (collector of Q2) is 2.4 volts (TTL level 1). This drives Q1 into saturation so that the RAM now has a 4.8 volt supply which is within its operating range. Without this transistor, the supply to the RAM would be below the 4.5 volt minimum recommended for operation of the devices. As the voltage passes the 4.5 volt level, PU reaches TTL level 1 and so turns on the gates of IC8. This then enables us to read and write to the RAM assuming of course we enable it first by accessing the control locations mentioned earlier.

On power-down, the sequence is reversed such that the logic level 1 to the gates of IC8 is removed when Vcc goes below 4.5 volts so that we can't access it any more. This holds true for all locations of RAM on this card. In the back up state, supply is via diode D3 and only low current is required to keep the data in the RAMs. In this mode, Q1, D4 and D2 are all reverse-biased and prevent power from the battery going back to the Apple circuitry.

Note that there is no resistor between base and emitter of Q1. This is to avoid the possibility of discharging the battery via the collector-base junction and the base-emitter resistor.

During normal operation, the battery is charged via R13 and D4. The diodes for battery charging and supply during backup are selected for low forward voltage at low current drain (type OA90 etc). Also all the CS lines to the RAM are from open-collector gates so that their voltage rises to within at least 0.2 volt of their supply. This together with tying the address lines to ground via 100kΩ resistors, minimises the total drain on the backup supply.

The backup supply would normally take the form of three or four nickel-cadmium cells connected in series and mounted on either side of the Apple main board and positioned so that any leakage will not cause damage.

As an alternative, a one Farad supercap, made by NEC and distributed by Soanar Electronics Pty Ltd (30 Lexton Road, Box Hill 3128) may be considered for the backup supply.

The prototype card is shown assembled with a 470uF capacitor as a backup supply. This gave a backup time of about four minutes. On this basis, a 1F (yes, one Farad) supercap would give a backup time of five to six days.

Construction

Before construction begins, it is advisable to read through this whole

Continued on page 125

Boolean algebra

a . a. = 0.......................(1)

a + a = 1.......................(2)

(a . b) + (a . b) = a + b............(3)

a + b = a . b....................(4)

a . b = a + b....................(5)

Bibliography

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6 Motorola Shottky TTL Data Book.

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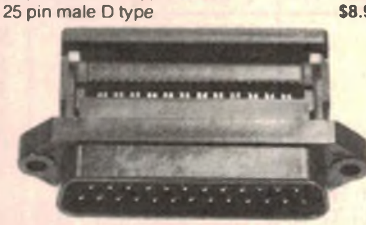

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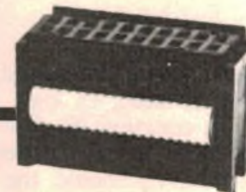

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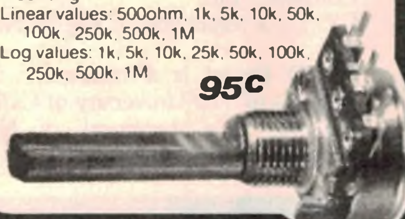

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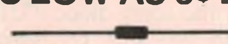

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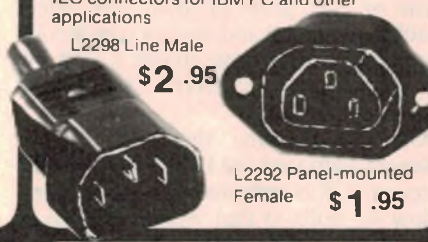

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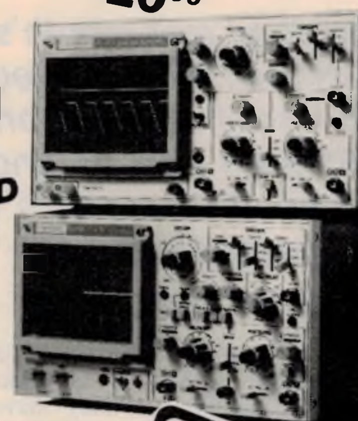

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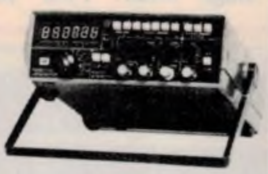

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Introduction to

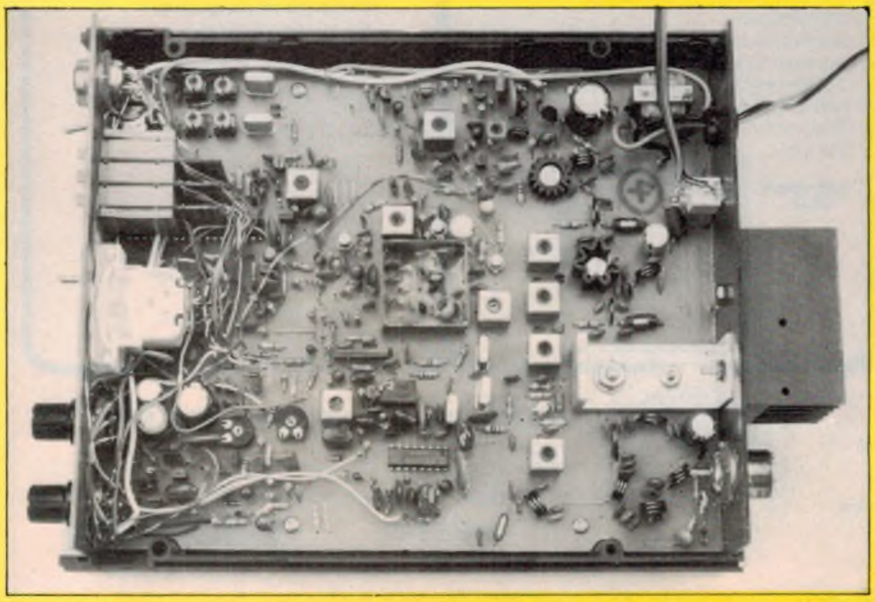
If you read last month's article on amateur radio you should have gained at least a broad idea of what it is all about. Perhaps you felt the urge to know more about it and to become actively involved. This month's article should help answer your questions.

by PHILIP WATSON VK2ZPW

Last month's article was necessarily a very condensed account of amateur radio but, hopefully, it may have whetted your appetite to the point where you are asking, "How do I become an amateur?" Well, there are several ways of going about it, and there is a good deal of help available from a number of sources. In short, you do not need to "go it alone", nor is this recommended.

Obtaining a licence is really a two stage affair. First you sit for the appropriate examination and, if you pass, you will be issued with a certificate to that effect. Then you make formal application for a licence, the certificate indicating that you are qualified to hold such a licence.

Above: Complete two-metre transceiver built from a kit and (below) an interior view of the same set (EA June/July 84). Building a set like this not only saves money, but provides the builder with invaluable experience.



There are three grades of certificate, corresponding to the three grades of licence. They are the "Amateur Operator's Certificate of Proficiency" (AOCP), the "Amateur Operator's Limited Certificate of Proficiency" (AOLCP), and the "Novice Amateur Operator's Certificate of Proficiency" (NAOCP).

By far the best approach, if feasible, is to join a local club. Most clubs conduct courses leading up to the exam, with trial examinations to test your progress, and lots of help and advice from those who have already been there.

In any case, the first thing to do is to write to the Department of Communications in your capital city and ask for a syllabus and sample examination papers for the appropriate grade certificate. These are available free.

Also available from the Department is "The Amateur Operator's Handbook" which contains the regulations under which an amateur station must operate, and on which you will be examined. Previous copies cost $3.60 posted, but a new edition is being prepared and you will need to refer to the Department for details of availability and price. If a copy is not immediately available, a club or individual amateur may be able to help out on a temporary basis.

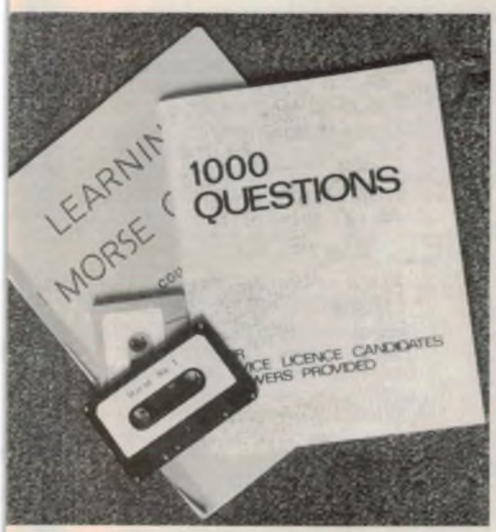
This material should provide a good indication of the standard required and what line of study to follow. All amateur exams are now of the "multiple choice" type, rather than the essay type of a few years ago. Most people find these easier to handle than the essay type, even when they know the subject thoroughly.

But don't be complacent. These exams can contain, if not trick questions, at least tricky ones. Make sure you read the questions carefully and really understand what is being asked.

Having determined what is required it is then a matter of methodical study. Two main reference books are normally recommended: the "Radio Amateur's Handbook", by the American Radio Relay League (ARRL); and the "Radio

amateur radio PART 2

The Wireless Institute Civil Emergency Network (WICEN) is a group of amateurs trained to provide emergency communications in times of disaster. Shown above is an emergency control station set up during an exercise.



Some of the novice course study material available from the Wireless Institute, and discussed in the text.

Communication Handbook" by the Radio Society of Great Britain (RSGB). Clubs which provide courses may have these available on loan. Another useful book is "A Guide to Amateur Radio", written by Pat Hawker and published by the RSGB. (This was reviewed in the May 1983 issue of EA.)

For those who, because of isolation or other reasons, cannot enlist the aid of a club, a correspondence course and study material is available from the Wireless Institute of Australia. The correspondence course is designed to cover the AOCP and AOLCP, while the study material is designed for the NOACP (novice) candidate.

Since the theory and regulations exams are the same for the AOCP and AOLCP, the same course is used for both. The course is divided into three sections and a candidate may purchase the whole course at once, or take the three sections successively, as is convenient. The current format of the course is A4 size pages held in a comb binding for easy handling.

Stage (1) consists of approximately 148 pages; stage (2) 210 pages; and stage (3) 190 pages. These stages are further broken up into a total of 46 lessons. They cover a full range of examination subjects, starting with basic electrical theory and progressing to the theory of radio receivers and transmitters, propogation and antenna systems, VHF techniques, and basic test equipment.

All lessons include a list of essay type questions to assist the student in assessing how well he has understood the lesson. In addition, there is a series of multiple choice questions, similar to those used in the DOC examinations which, again, are designed to help the student pinpoint his weak spots, as well as making him familiar with the examination standard.

The answers to these questions are returned to the Course Supervisor who assesses them and returns them to the student with whatever comments are appropriate, particularly where the student may appear to be on the wrong track. Additional advice is also available to a student who admits to some kind of "block" in grasping a particular principle.

There is no time limit on the course,

Instruction by TV

Another, rather novel, source of instruction is available to favourably located Sydney TV viewers. The Kenwood Radio Club and the Gladesville Radio Club jointly operate an amateur TV transmitter in the UHF band on 579.25MHz (vision), close to channel 34 on a UHF tuning dial. It should be receivable on any UHF TV receiver, within range of the transmitter.

The availability of amateur signals on commercial TV sets is possible because the commercial UHF band is split into two sections, band IV from 526 to 582MHz and band V from 614 to 814MHz. The 576 to 585MHz amateur band is sandwiched in between these two and actually overlaps band IV slightly. Since almost all UHF tuners can tune right across these bands, amateur stations can also be received.

The transmitter is only a modest power unit and its current location at Lane Cove restricts its useful area somewhat. However plans are under way to shift it to a much higher location in the North Sydney area, not far from the commercial TV sites, and fit it with a higher gain antenna. This should increase its range considerably.

Instructional programs are transmitted each Wednesday night, commencing at 7.30 (test pattern at 7.00), and run until about 10.00. Other amateur TV transmitters are operating on this channel in Adelaide, Melbourne, and Wagga.

Tandy ELECTRONICS

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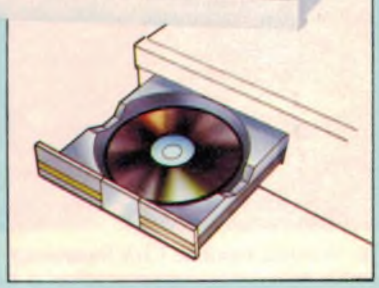
- Tri-Spot Pickup Servo System for Absolute Tracking Accuracy

It's the state-of-the-art in stereo technology, yet so incredibly easy to use! Place a disc in the drawer and push a button for automatic play.



Realistic CD-1000. Let Tandy introduce you to a remarkable new type of disc player with sound so astoundingly pure that you must hear it to believe it. Compact digital audio discs, also called CDs, play without "pops" or surface noise. There is no audible distortion. No rumble. No acoustic feedback. Dynamic range is nearly as wide as that of a live performance. And wow and flutter are virtually non-existent! The Realistic CD player reads the digital information on the discs with a beam of laser light and a sophisticated electronic eye. Because there's no stylus, there's no wear, so the life of a compact disc is practically forever. But that's only the beginning. The player's built-in computer gives you rapid access to any point on the disc and many easy-to-use programming options. Just place a CD in the drawer and press the open/close button for totally automatic play. Or use the soft-touch buttons to program up to 15 selections you want to hear, in any sequence you desire. Auto-search feature takes you to the beginning of the next selection or restarts the selection that's playing. A fluorescent display shows you exactly where the laser beam is by indicating track number, index number, minutes and seconds left to play, and mode. Pushbuttons for fast-forward and fast-reverse, stop/clear and pause. Works with any stereo system that has aux or tape-in jacks. Come in and discover the ultimate in stereo! **42-5000** **599.95**

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Frequency Response: 5 to 20,000 Hz ± 0.5 dB. **Signal-to-Noise Ratio:** 92 dB **Dynamic Range:** 92 dB. **Channel Separation:** 90 dB. **Harmonic Distortion:** 0.004%. **Wow and Flutter:** Unmesurable (quartz crystal locked). **Size:** 8.3 x 32 x 30cm.

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A. Pure Classics. The brilliance and power of the world's greatest masterpieces. Works by Ravel, Beethoven, Korsakoff, De Falla and Khatchaturian are fully revealed by the miracle of true digital recording. It will leave you breathless. **51-5001** **19.95**

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C. Big-Screen Sound. A soundtrack spectacular in your living room! Music from The Empire Strikes Back, Robin Hood, Brainstorm. North by Northwest, Star Wars, King's Row, Return of the Jedi and more. **51-5003** **19.95**

Introduction to amateur radio

enabling the individual student to progress at whatever rate is convenient in relation to his domestic commitments, employment, school work, etc. Enrolments are accepted at any time. And, while study time may vary, it is suggested that the beginner will need around 12 months solid application.

As the course is designed to meet the amateur examinations standards it does not involve advanced theory or mathematics. On the other hand it is regarded as more than adequate to meet DOC requirements.

Morse code training is by means of tapes which may be hired, as required, from the same source. They are available in a variety of word speeds. The WIA also provides a Morse session in the 3.5MHz amateur band (3.550MHz) at 7.30pm EAST each evening, generated at volunteer stations throughout NSW and should be audible on shortwave receivers in most parts of the state. It is sometimes followed by a session from South Australia.

Also available, mainly for limited licensees, is a continuous Morse service, at varying speeds, provided by the Hornsby Radio Club, in Sydney's northern suburbs, on 147.4MHz. There is a proposal to put this on 3.5MHz if a clear channel can be agreed upon.

Details may be obtained by writing to: The Course Supervisor, Wireless Institute of Australia, NSW Division, PO Box 1066, Paramatta, NSW, 2150.

For the Novice student the approach is slightly different. The WIA (NSW Division) Education Service has available a Novice Course Kit designed to provide a basis for self-study. There is no backup service, as with the correspondence course just described, but the books are designed to assist the reader in assessing his own progress and grasp of the subject, mainly by the provision of revision questions at the end of chapters.

The Novice Course Kit consists of two Morse code tapes and several books. These include "The Amateur Operator's Handbook", "Into Electronics", "Novice Electronics", "1000 Questions", "Learning Morse Code", and a handbook explaining how to use the kit.

"Into Electronics" is best described as being aimed at the completely raw beginner, starting with basic electrical DC circuits and progressing through basic principles to transistors, test instruments, and radio receivers. The style is light but informative.

"Novice Electronics" is a larger book

Below are a few sample questions from the Department of Communications syllabus for the AOCP and AOLCP theory exam, and the regulations for all three exams. There are many more questions in the actual syllabus.

AOCP & AOLCP Theory

When two resistors are connected in series:
(a) they must both have the same resistance value
(b) the voltages across each resistor must be the same
(c) they must have different resistance values
(d) the current through both resistors is the same

The time constant of a 500 microhenry inductor and a resistor of 20 ohms is:
(a) 0.01 microsecond
(b) 0.25 microsecond
(c) 1 microsecond
(d) 25 microseconds

Which of the following is not *able to be determined by using a* dip oscillator?
(a) resonance
(b) inductance
(c) capacitance
(d) resistance

A capacitance of .025 microfarad is the same as:
(a) 25 picofareds
(b) 250 picofarads
(c) 2500 picofarads
(d) 25,000 picofards

A laminated iron core reduces eddy-current losses because:
(a) the laminations are stacked vertically
(b) the laminations are insulated from each other
(c) the magnetic flux is concentrated in the air gap of the core
(d) more wire can be used with less DC resistance in the coil

With 200 volts applied across five 50 ohm resistors in parallel, the current in each resistor will be:
(a) 0.8 ampere
(b) 4 amperes
(c) 8 amperes
(d) 14 amperes

Which of the following would most likely be used in a remotely tuned, solid-state "VFO"?
(a) hot-carrier diode
(b) varactor diode
(c) pentode
(d) thyristor

These questions were taken from a sample paper of 50 questions of a similar standard. Time allowed 1½ hours.

Regulations

The distress call sent by radiotelegraphy comprises:
(a) SOS SOS SOS de VK3AA VK3AA VK3AA
(b) CQ CQ CQ SOS de VK3AA VK3AA VK3AA
(c) SOS de VK3AA
(d) SOS SOS SOS CQ CQ CQ de VK3AA VK3AA VK3AA

Wide-band television transmission or reception of images may be undertaken only in amateur bands above:
(a) 52-54MHz
(b) 420-450MHz
(c) 144-148MHz
(d) 28-29.7MHz

On which frequency is the distress call, for telegraphy, normally heard?
(a) 145.60MHz
(b) 14.20MHz
(c) 27.15MHz
(d) 500kHz

What is the "Q" code abbreviation for — "send each word or group twice"?
(a) QSB
(b) QRW
(c) QRZ
(d) QSZ

These questions were taken from a sample paper of 30 questions of a similar standard. Time allowed 30 minutes.

Introduction to amateur radio

which more or less takes over from "Into Electronics", recapping some of the material, sometimes in greater depth, but primarily orientated towards the amateur scene and the examination requirements.

"1000 Questions" is, as its name implies, just that; a set of 1000 questions of the type encountered in a DOC examination. They are grouped under 16 subject headings — "Electrical Laws and Circuits", "Semiconductor Devices", "HF Transmitters", etc — with the answers at the end of the book. Any student who understands all these questions — or even most of them — should have little difficulty in coping with a DOC exam.

Further details from the WIA Education Service, NSW Division, PO

Below are a few sample questions from the Department of Communications syllabus for the NOACP theory exam. There are many more questions in the actual syllabus.

Novice theory

An SWR meter measures the standing wave ratio on a transmission line by comparing:
(a) the voltage at the ends of the antenna to the voltage at the feed point
(b) the ratio of the maximum voltage to the maximum current in the antenna
(c) the power fed to an antenna to the power reflected back from the antenna
(d) the ratio of the maximum voltage to the maximum current in the transmission line

The resonant frequency of an inductor and a capacitor connected in parallel may be determined by using a:
(a) signal generator
(b) frequency meter
(c) grid dip oscillator
(d) cathode-ray oscilloscope

Three resistors, each of value 24 ohms are connected in series. What is the total resistance value of this combination?
(a) 24 ohms
(b) 72 ohms
(c) 8 ohms
(d) 48 ohms

When tuning the output circuit of a vacuum-tube radio frequency power amplifier stage, resonance will be indicated by a meter in the anode circuit when the meter reads:
(a) the maximum current
(b) the minimum current
(c) zero current
(d) full scale deflection

A permanent-magnet moving-coil meter may be used to measure the direct current (DC) drawn by a radio receiver, provided that the meter is:
(a) in series with a multiplier resistance
(b) shunted by a resistor
(c) connected in series with a capacitor
(d) connected in series with a silicon diode

The function of a doubler stage in a transmitter is to:
(a) double the frequency of the previous stage
(b) allow push-pull transistors to be used to increase efficiency
(c) enable two final stages to be fed by the one oscillator
(d) act as an impedance doubling device

These questions were taken from a sample paper of 50 questions of a similar standard. Time allowed 1 hour.

A855/JL

Introduction to amateur radio

Box 1066, Paramatta, NSW, 2150.

Another useful book for the novice student is "The Novice Operators' Theory Handbook", written by Graham Scott (VK3ZR) and Sandy Brucesmith (VK2AD), and published by Locum Advertising, North Sydney, NSW. (This book was also reviewed in the May 1983 issue of EA.)

All this adds up to a very substantial amount of literature; more than enough for the job if the student is prepared to do his part. The most important thing to appreciate when undertaking a course of study like this, in preparation for an exam, is the need to understand the subject. There is no future in simply attempting to memorise the text, or to memorise questions from the sample given. Examiners are too smart to be fooled like that.

If a basic principle — like Ohm's law, impedance, resonance, or something similar — cannot be grasped, don't skip it; stick with it until you are sure you understand it. A good guide is to try explaining it to someone else, even if only in your imagination. If you can do that you should be able to satisfy the examiner. And if the going really gets tough, don't be too proud to ask for help.

And, finally, when you pass the exam and obtain a licence, comes the job of getting on the air. As already mentioned, commercial equipment is almost universal these days, the main problem being to make a selection from the vast array of units available. This is where the club atmosphere, and the chance to talk to other amateurs, will prove most valuable.

Don't rush in. Pay attention to what others have to say. Most commercial equipment is of high quality and will work to specifications. The main decision to be made concerns the performance and facilities you require — and can afford.

Don't imagine that you have to spend a fortune in order to get started, or that spending twice as much will give you twice the performance. Ask yourself whether you really need umpteen memories, elaborate scanning systems, and the like. Experience suggests that many such fancy facilities are seldom used after the novelty has worn off.

Clubs frequently hold auction or similar sales and these can often provide a source of equipment and accessories at very reasonable prices. Owners often sell their equipment for no other reason than that it is no longer adequate for their needs — it is too small, or lacks certain facilities, modes etc. Yet it is still perfectly suitable to get a beginner on the air.

One approach, which has much to recommend it both technically and economically, is to assemble your equipment from a kit. Such kits are usually better value than the ready-made equivalent, and at least approach the "home brew" concept with its bonus of experience.

Two kits have been described in this magazine in recent months, both from Dick Smith Electronics. One was a UHF Transceiver (September, October, November, 1983), and the other a VHF Transceiver (June, July, 1984). An HF transceiver kit is also available in the Heathkit range, handled by Warburton Franki.

Another alternative, suitable for either of the Morse licences, is to build a Morse (CW) only transmitter. Whereas phone transmitters, particularly in the SSB mode, are complicated to build, and expensive to buy, a simple CW transmitter can be built from a handful of components, many of which could be salvaged from an old valve type TV set.

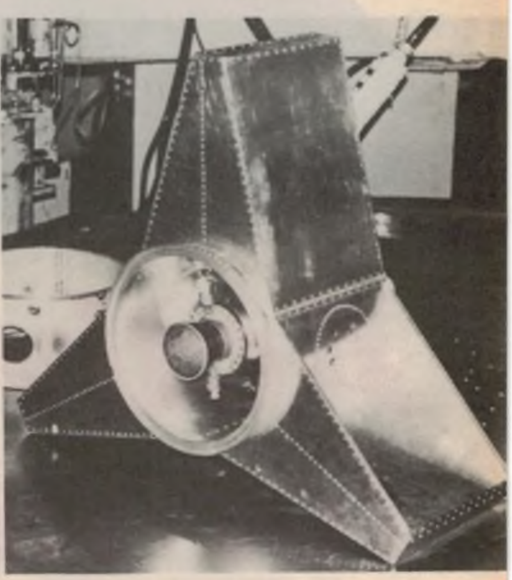
Such a transmitter need not be elaborate or powerful and, in fact, the novice licensee could probably approach his full legal power with such a set. But, in any case, international contacts can be made with such simple equipment and can provide a lot of satisfaction and valuable experience.

Let the buyer beware

When buying a piece of amateur equipment, such as a transceiver, make sure you deal with a well established and reputable firm. Among other things make sure that the firm can provide service back-up and spare parts should they be required. And make sure that this is genuine, not just lip service to the concept.

A reputable firm will also ensure that any items they sell are suitable for the Australian market; that they cover the Australian amateur bands, rather than those of another country; that, if mains operated, the cables, plugs, transformers, etc conform to Australian safety standard; and that the instruction manual is written in English.

Be wary of any organisation which advertises a cut price, carries very little stock, and is invariably "out" of the item you nominate, but can get it "in a couple of weeks". The item could well suffer any or all of the above problems, or even more.



An amateur satellite, OSCAR 6. Launched in 1972, it carried a two-metre to 10 metre repeater and two beacons. It operated satisfactorily for several years and provided invaluable experience.

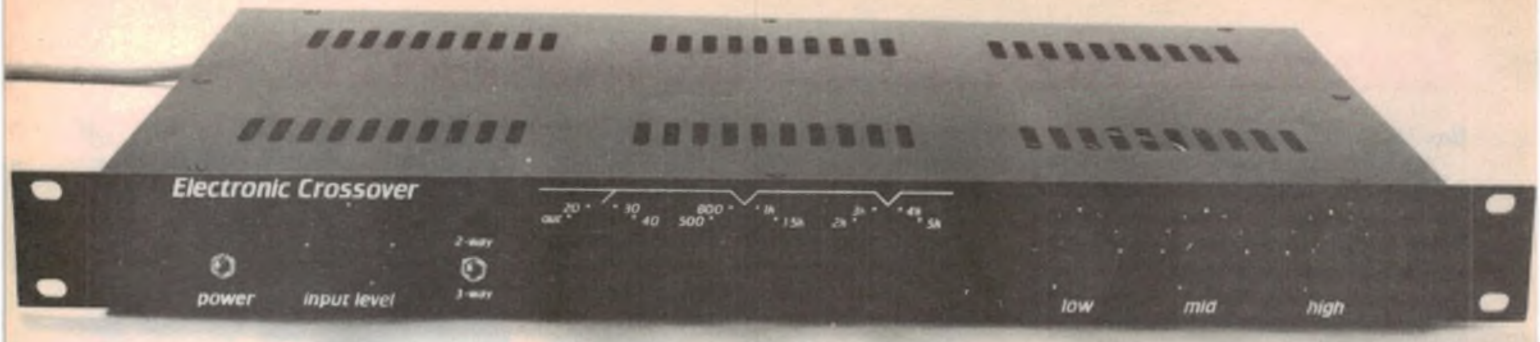
Naturally, there is rather more to getting on the air than simply acquiring a piece of equipment. There will be an antenna to build or buy, and erect. There may be a power supply or battery needed to power the transceiver if it does not have its own, and so on, according to the equipment, grade of licence, and bands involved.

There are also on-air considerations. Correct operating procedure, courtesies, conventions, etc, to be observed. Any student who has had the advantage of a club or group atmosphere will probably have acquired most of this knowledge. In any case, it is a good idea to listen for a while, before taking the final plunge.

And that more or less sums up the amateur scene from the student's point of view. The grade of licence you elect to study for, and the way you go about it will depend on your personal inclinations, the facilities available in your area, and the time you can reasonably devote to your studies.

No two people are likely to tackle it in the same way but, hopefully, all will achieve the same end result; one of the three certificates and licences which will open up a whole new world of communications, practical technology, and friendships with people of like interests. It is a very worthwhile ambition and, in years to come, you will look back and realise the vast amount of technical knowledge you have acquired, relatively painlessly, which you would be unlikely to have accumulated in any other way.

Good luck with your efforts.



Active crossover for hifi systems

Build this electronic crossover for home hifi and sound reinforcement use. It features low noise and distortion, and provides plenty of flexibility in the selection of crossover frequencies.

by ANDREW LEVIDO design by JEFF SKEEN

Today's trend in professional sound reinforcement is toward high quality reproduction. Because of the superior sound and flexibility it affords, bi- and tri-amplification has all but completely replaced conventional speaker-amplifier systems using passive crossover networks.

In a bi-amplified system, the signal from the pre-amp or mixer is split into two frequency bands by an active crossover network. Each band is then amplified separately and fed to its particular loudspeaker. A tri-amped system is similar, except the incoming signal is split into three bands rather than two. The electronic crossover described here is designed to perform this frequency dividing function.

Because they use a separate power amplifier for each individual frequency range, bi- and tri-amplified systems make it possible to get much higher power output than is possible with conventional passive crossover networks. This is partly because a passive crossover network dissipates a considerable amount of the amplifier's power and also because the lower frequencies tend to "use up" most of the available amplifier power, leaving little for the higher frequencies.

The electronic crossover allows you to use separate amplifiers for each frequency band, so you can optimise the power supplied to each speaker. In addition, each band has an output level control, so the crossover is able to perform a primary equalisation function.

In the home situation, where high power levels are not of primary importance, other advantages of the bi- or tri-amplified system come to the fore. In particular, because there is no complex passive network between the amplifier output and the loudspeaker, the amplifier sees a less complex load impedance. This leads to improved damping, especially at low frequencies.

Another advantage of this type of system over the conventional set-up is the ability to match different loudspeakers. This is normally done using L-pad type attenuators which are very inefficient and can only be used at moderate power levels. The electronic crossover is able to perform this matching function before the power amplifiers, a much more satisfactory arrangement.

The crossover described here is ideally suited for both in-home and professional use. The signal to noise ratio of the prototype was better than 90dB referred to 1 volt, with all level controls set to maximum. Distortion was measured at below 0.003% on all settings. See the accompanying specification panel for further information on the performance of the prototype.

The EA Electronic Crossover is a stereo unit, with the front panel controls affecting both channels equally. It is assembled in an attractive black rack-mounting case measuring 430 x 254 x 44mm (W x D x H). The front panel of our prototype was screen printed, giving a professional-looking finish that would not look out of place in the home, or in an amplifier or effects rack.

The EA crossover provides for either two or three-band operation, with each of the crossover points being adjustable. Each output band is provided with a level control, and an input level control is provided. A mains power switch and an indicator LED are also included on the front panel. The rear panel accommodates the RCA type input and output connectors.

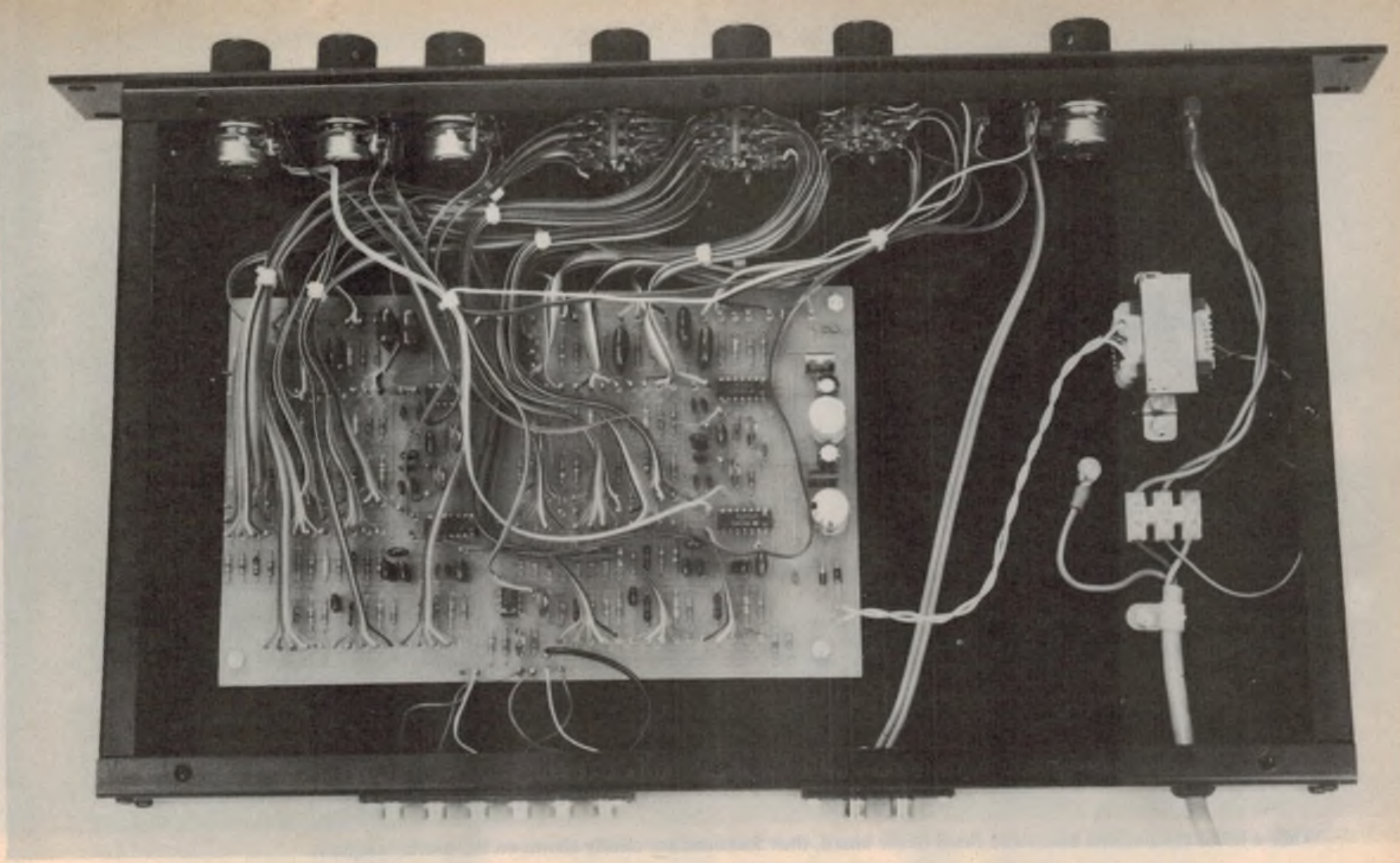
The left hand switch sets the lower cut-off frequency of the low frequency band. This cut-off can be set to either 40, 30 or 20Hz or switched out altogether, allowing flat response down to DC. The centre switch sets the crossover frequency between the low and the mid bands. The frequencies available are 500Hz, 800Hz, 1kHz and 1.5kHz.

The righthand switch sets the crossover points between the mid and the high bands. The crossover frequencies available are 2kHz, 3kHz, 4kHz and 5kHz. If the electronic crossover is being used in the "2 way" mode this crossover point is bypassed, and the mid band extends beyond

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

$200-$220

This includes sales tax.



Interior of the finished unit. Wiring data for the pots are given in the accompanying drawings.

20kHz. Thus, for two way operation, the two channels used are the mid and the low bands.

How it works

The basis of this design is an arrangement of high and low pass filters. Butterworth filters have been chosen for this application because of their flat amplitude characteristic in the passband. Third order filters have been used to provide an 18dB per octave rolloff. Using filters of this order is convenient since they can be implemented using only one op amp.

In our design the filter cut-off frequencies are made adjustable by switch selection of the resistors.

Now let's have a look at the complete circuit diagram. Only one channel is depicted although the equivalent ICs in the other channel are shown in brackets, within the op amp symbols. For example, the input buffers in each channel are IC1a and IC4a.

Low noise FET-input op amps are used throughout. The IC line-up consists of four quad op amps (LF347 or TL074) and one dual op amp (LF353 or TL072).

The input signal is buffered by IC1a and fed to each of the three filter channels. The low frequency channel consists of a high pass filter (IC1b) controlled by S3. This switch also has a bypass position which allows a response down to DC. This is followed by a low pass (IC1c) filter which defines the upper corner frequency of the low (bass) channel. The corner frequency IC1c is controlled by S4e, c and a.

The high pass filter (IC2c) which defines the lower corner of the mid band is also controlled by S4 and, because these filters are designed to have the same corner frequencies, changing the switch position is complementary and has the effect of moving the crossover frequency. IC2c is followed by a low-pass filter (IC2d) controlled by S5 (j, h and e). S2, the two/three-way switch, is connected so that when it is in the two-way position low-pass filter IC2d is bypassed.

The high frequency channel consists only of a high pass filter, IC2a, which is ganged with the low-pass filter in the mid band to provide the adjustment of the crossover point between these two bands.

Potentiometers VR2, VR4 and VR6 are each followed by an output buffer consisting of an op amp connected as a non inverting amplifier. Each of these output buffers has a trimpot to allow the gain to be adjusted. This adjustment is provided to compensate for any small differences in passband gain between the filters.

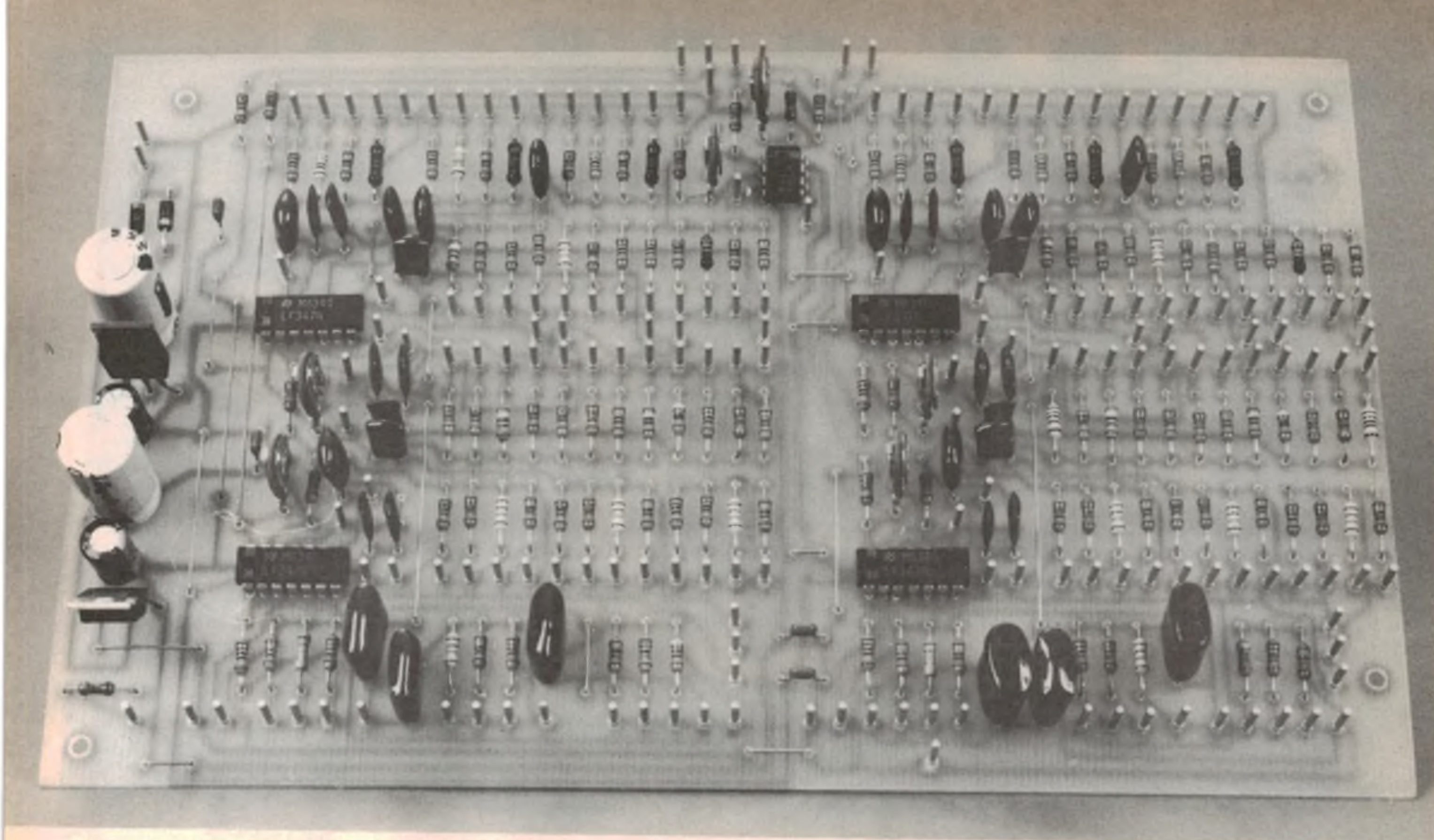
The power supply is a fairly conventional design using two half-wave rectifiers to derive a positive and a negative supply rail from a single secondary winding. These rails are filtered, and regulated by 7812 and 7912 3-terminal regulators. The power indicator LED is run from the negative supply via a 1.2kΩ resistor. The supply rails are decoupled by 0.1μF capacitors at a number of places throughout the circuit.

Specifications

Signal to noise ratio (at 1V)	
High (10kHz)	93dB
Mid (1kHz)	93dB
Low (800Hz)	93dB
Distortion (at 1V)	
High (10kHz)	<.003%
Mid (1kHz)	<.003%
Low (100Hz)	<.003%
Crosstalk (referred to 1V)	
High (10kHz)	−56dB
Mid (1kHz)	−65dB
Low (100Hz)	−91dB

Construction

Although this project is not complicated in terms of the electronics, the construction involves a large amount of wiring and is very time-consuming. The first step in construction is to drill the holes in the metalwork if this is not already done. The front panel artwork gives the location of the holes for the pots and switches, and the blank circuit board can be used as a template for



While a lot of components have to be fitted to the board, their locations are clearly shown on the overlay diagram.

Active crossover for hifi systems

marking out its own mounting holes. The locations of the other holes are not critical, and can be determined from the photographs.

PARTS LIST

- 1 PCB, code 84ac11, 141 x 231mm
- 1 rack mounting case 430 x 254 x 44mm (W x D x H)
- 1 mains transformer, 12V at 150mA, 2851 or equivalent
- 1 SPDT miniature toggle switch
- 1 DPDT miniature toggle switch
- 3 Lorlin RA series rotory switch bodies
- 8 Lorlin RA series 4 pole 4 position switch wafers
- 7 knobs
- 1 mains cord and plug
- 1 cable clamp
- 1 grommet
- 1 3-way barrier strip
- 180 PC stakes
- 3 metres 10-way rainbow cable
- 1 6-way RCA socket panel
- 1 2-way RCA socket panel

Semiconductors

- 4 LF347, TL074 quad op amp
- 1 LF353, TL072 dual op amp
- 1 7812 positive 3-terminal regulator
- 1 7912 negative 3-terminal regulator
- 1 3mm red LED

Capacitors

- 2 1000μF 25VW PC electrolytic
- 2 100μF 16VW PC electrolytic
- 6 0.22μF polyester
- 4 0.1μF monolithic
- 4 .056μF polyester
- 10 .022μF polyester
- 6 .01μF polyester
- 4 .002μF polyester
- 4 .001μF polyester

Resistors (¼W, 1% tolerance)

2 x 180kΩ, 2 x 120kΩ, 2 x 91kΩ, 2 x 75kΩ, 2 x 43kΩ, 2 x 39kΩ, 2 x 36kΩ, 4 x 27kΩ, 2 x 24kΩ, 8 x 20kΩ, 2 x 18kΩ, 2 x 16kΩ, 2 x 13kΩ, 6 x 12kΩ, 10 x 10kΩ, 8 x 6.8kΩ, 2 x 6.2kΩ, 2 x 5.6kΩ, 10 x 5.1kΩ, 4 x 3.9kΩ, 2 x 3.6kΩ, 6 x 3.3kΩ, 2 x 3kΩ, 2 x 2.7kΩ, 8 x 2.4kΩ, 4 x 2.2kΩ, 8 x 2kΩ, 2 x 1.5kΩ, 2 x 1.3kΩ, 2 x 1.1kΩ, 2 x 910Ω

Resistors (¼W, 5%)

6 x 5.6kΩ, 6 x 1.2kΩ, 6 x 100Ω

Potentiometers

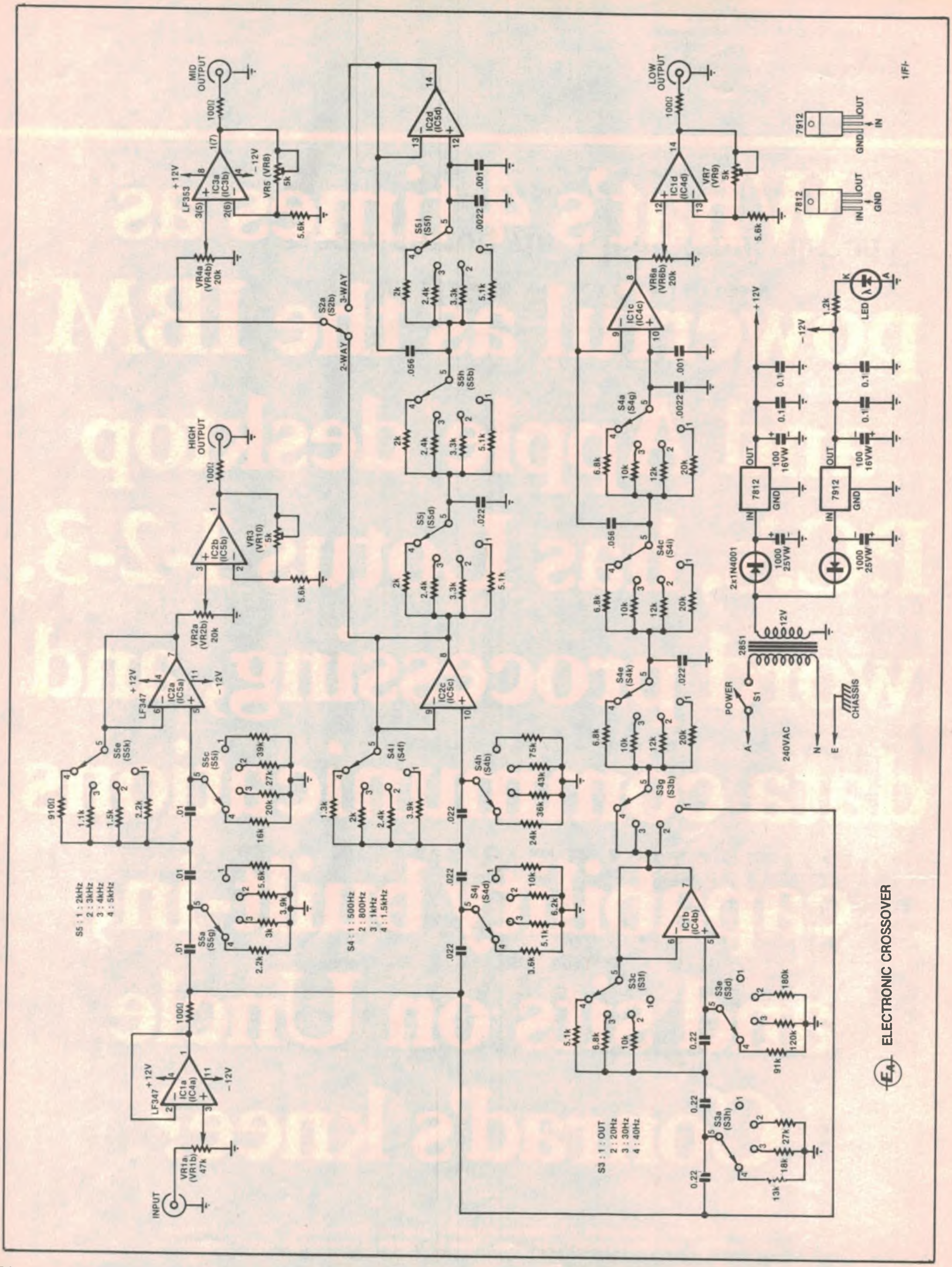
- 6 x 5kΩ miniature vertical trimpots
- 3 x 20kΩ log dual ganged pots
- 1 x 47kΩ log dual ganged pot

It is necessary to cut slots in the rear of the case for the RCA connector panels. These are best made by drilling a series of holes and filing out the unwanted metal. When all this has been done the RCA panels can be mounted, as can the power transformer, mains switch and terminal block. Wire the mains cable and switch according to the wiring diagram. Do not install the pots or switches at this stage.

The next task is the assembly of the printed circuit board. PC stakes are a necessity in this project, and they should be mounted first. After this is done assemble the board in the normal way. Be careful reading the colour codes on the 1% resistors; it is easy to make mistakes. When the board is assembled and checked it can be mounted in the case. We mounted the prototype PCB using 6mm spacers.

The multipole switches have to be assembled before they can be wired. Switch three has eight poles (two wafers) and switches four and five have 12 poles (three wafers). The wafers are stacked up on one another and the whole lot are secured to the switch body with the threaded rods and nuts provided with the switches.

Begin the switch wiring with switch five. Split the ribbon cable down the centre, and cut each strip into six equal lengths. Connect one end of each length



ELECTRONIC CROSSOVER

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to one of the poles of the switch. You should end up with 12 pieces of five-way ribbon cable connected to the switch. Mount this switch in the front panel, and begin to connect the wires to the appropriate PC stakes, according to the wiring diagram. You will need to cut the pieces of ribbon cable to a sensible length as you go.

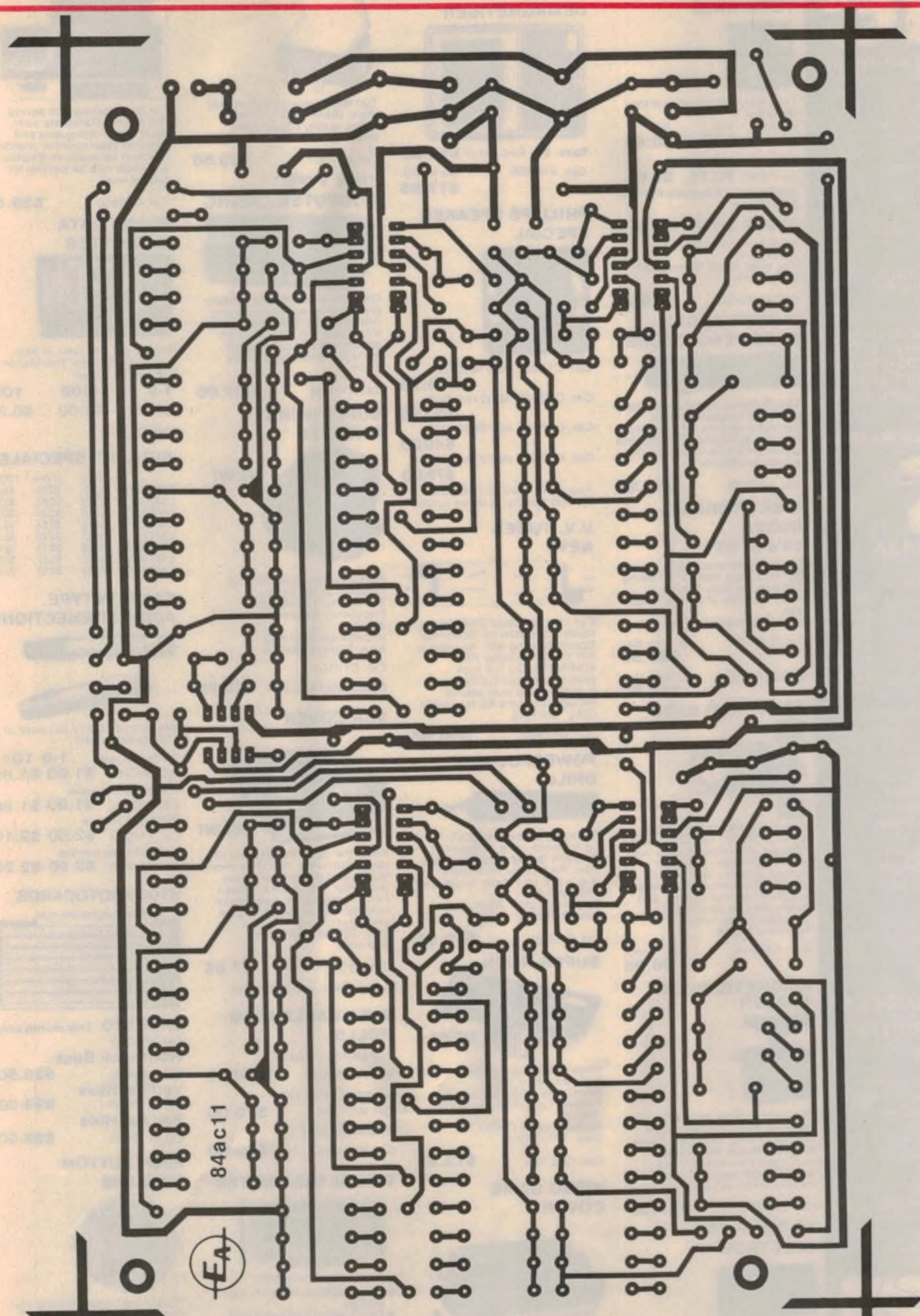
Once this is completed, move on to wire up switch four in exactly the same manner. Switch three is connected differently to the other two in that not all of its pins are used. There are also some wire links soldered between some of the switch lugs. Use lengths of four- and three-way ribbon cable to make these connections. This switch can then be mounted in the case and the connections made to the circuit board in the same way as the other two.

The pots and the two-way/three-way switch can now be mounted and wired as shown in the diagram. Lastly, wire the output sockets, the input sockets and the transformer secondary. Don't forget to install the front panel LED. When all the wiring has been completed it should be neatly tied up using a few cable ties. This completes construction of the crossover, and all that is left to do is to test it and set up the trimpots on the board.

To test and set up the crossover you will need to use a signal generator and an oscilloscope. Feed a signal into one input of the crossover and check each output in turn with the oscilloscope. Check each crossover point by using an appropriate input frequency range to confirm that the output tapers as it should. Make sure that a response is obtained which is similar to that shown in the accompanying graph. If you find any major differences between the performance of your unit and the expected results, recheck the construction, particularly the switch wiring. Repeat for the other channel.

Set up the output level by feeding in a signal in the centre of each band, and adjusting each output level trimpot for the same output signal amplitude. Make sure that for this test the front panel pots are all set to maximum. Suggested frequencies are: low band, 100Hz; mid band, 2kHz; high band, 10kHz. Note that the crossover frequency switches should be set so that the band being measured is as wide as possible.

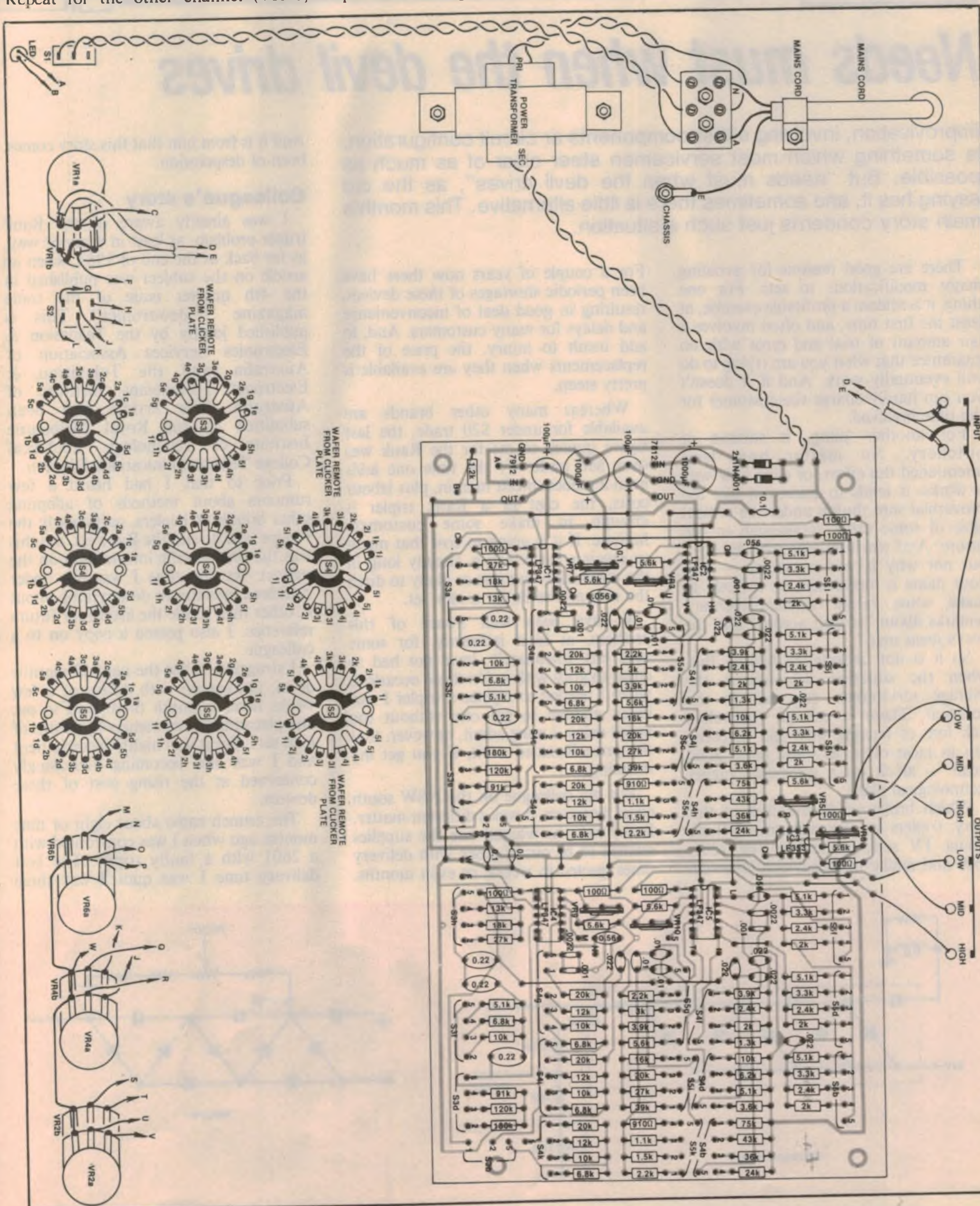
Start with the high frequency band. Feed in a signal of the appropriate frequency and note the output level with VR3 in the mid position. Next, feed in a signal of the same amplitude as before, but of the mid band frequency. Adjust VR5 for the same output level as before. Similarly, adjust VR7 for the same out-



The printed board, shown actual size.

Active crossover for hifi systems

put level with the high frequency signal. Repeat for the other channel (VR10, VR11, VR12 respectively). This completes the setting up procedure, so the lid can now be screwed down, and the crossover is ready to use.



The Serviceman

Needs must when the devil drives

Improvisation, involving either components or circuit configuration, is something which most servicemen steer clear of as much as possible. But "needs must when the devil drives", as the old saying has it, and sometimes there is little alternative. This month's main story concerns just such a situation.

There are good reasons for avoiding major modifications to sets. For one thing, it is seldom a profitable exercise, at least the first time, and often involves a fair amount of trial and error with no guarantee that what you are trying to do will eventually work. And if it doesn't you can hardly charge the customer for the time involved.

For another thing, it smacks of butchery. No matter how well intentioned the effort, or even how well it works, it tends to stand out like the proverbial sore thumb under the critical gaze of some other serviceman in the future. And when he asks who did it — but not why it was necessary — and your name is mentioned, he is likely to make some rather uncomplimentary remarks about "striped aprons" and the "cat's meat man".

So it is not undertaken lightly. But, when the situation demands it the average serviceman can rise to the occasion. There is enough Australian folk lore of fencing wire and kerosene tins in most of us to stand us in good stead — albeit on a somewhat higher technological plane.

Which brings us to the crux of this story; triplers for the older model Rank Arena TV sets, particulary the 2201, 2601 and similar models which followed. For a couple of years now there have been periodic shortages of these devices, resulting in good deal of inconvenience and delays for many customers. And, to add insult to injury, the price of the replacements when they are available is pretty steep.

Whereas many other brands are available for under $20 trade, the last figure quoted to me for the Rank was over $60 trade. By the time one adds even a modest profit margin, plus labour costs, the cost of a Rank tripler is enough to make some customers hesitate. If it is going to cost that much to repair a set which is already long in the tooth, they are just as likely to ditch the idea and settle for a new set.

I have been well aware of this problem, at least indirectly, for some time but, fortunately, have not had to come to grips with it. On those occasions when I needed to replace a tripler I was lucky enough to get one without too much delay. I must admit, however, that the price Rankled a bit, if you get my meaning.

For my colleague on the NSW south coast, however, it was a different matter. Every time he wanted one the supplies seemed to be out of stock with delivery times quoted in weeks, or even months. And it is from him that this story comes, born of desperation.

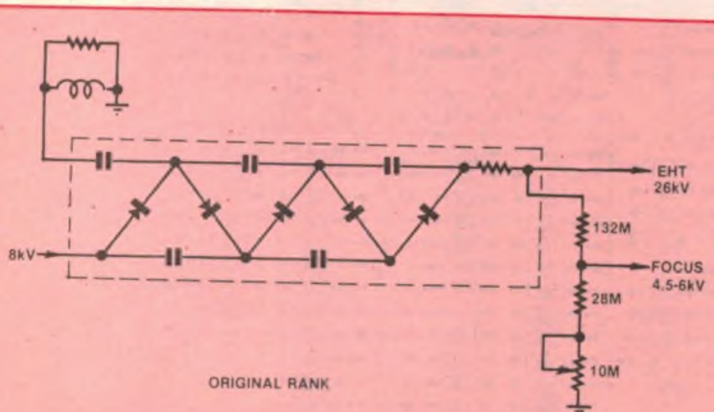
Colleague's story

I was already aware of the Rank tripler problem, at least in a minor way, as far back as the end of 1982, when an article on the subject was published in the 4th quarter issue of the trade magazine "Video-tronics". This is published jointly by the Television & Electronics Services Association of Australia, and the Television & Electronic Technicians Institute of Australia. The article had been submitted by the Royal Melbourne Institute of Technology, Technical College Telecommunications Division.

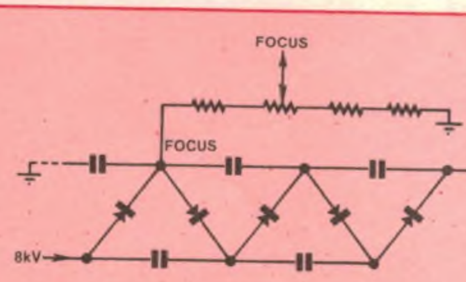
Prior to that I had heard a few rumours about methods of adopting other brands of triplers, particularly the Philips type, to suit the Rank set, but this was the first specific information on the subject. At that time I was not under sufficient pressure to do anything about it, other than to file the article for future reference. I also passed a copy on to a colleague.

I struggled on for the next 12 months or so, putting up with delays of a few weeks here, a month there, and so on, and placating my customers by means of loan sets. But it was highly inconvenient and I was also becoming increasingly concerned at the rising cost of these devices.

The crunch came about eight or nine months ago when I was confronted with a 2601 with a faulty tripler. The best delivery time I was quoted was three



ORIGINAL RANK



PHILIPS

months, and even then it was a bit tongue-in-cheek. That was a bit much to ask of any customer and I wasn't too keen on tying up a loan set for that length of time. After all, it would mean one less set that I could use to tide other customers over short term repairs.

So I fished out the "Video-tronics" article and, having read it over again, decided that this was the time to take the bull by the horns. Maybe it did smack of butchery but at least it seemed that I would be in good company.

To understand the basic problem it is necessary to look at the difference between the Rank tripler setup, and that used by Philips and several other manufacturers. Electrically, most triplers follow a standard configuration; a combination of five diodes and five capacitors in what is really an extension of the voltage doubler concept. The overwind on the line output transformer is designed to deliver a little over 8kV which, when applied to the tripler, produces between 25 and 26kV for the picture tube final anode.

The main difference as far as this problem is concerned is the manner of providing the focus electrode voltage. The Rank system might best be described as "crude but effective" (as the monkey said), though this is not meant as a criticism. It uses a voltage divider network, fed from the 26kV rail, consisting of 132MΩ and 28MΩ fixed resistors and a 10MΩ variable resistor, with the focus voltage taken from the junction of the 132 and 28MΩ resistors. This gives a range of 4.5 to 6kV.

Philips and others use a tripler fitted with a focus terminal delivering about 8kV. This, in turn, feeds a voltage divider consisting of several fixed resistors and one potentiometer, the moving arm of which supplies the focus voltage and allows it to be varied for optimum focus. Again, the voltage is around 4.5kV.

The arrangement recommended by the Melbourne Institute of Technology was to delete the Rank network from the 26kV rail — but retaining the 10MΩ pot — and to fit a voltage divider from the 8kV focus terminal consisting of two 3.3MΩ resistors, the original 10MΩ Rank pot, and two more 3.3MΩ resistors, all in series to deck. The focus voltage was taken from the moving arm of the pot.

On the face of it this seemed logical enough, and not particularly difficult to implement, so I promptly set to and wired it up as suggested, using 1W high stability, high voltage 3.3MΩ resistors. For the initial switch-on I disconnected the EHT lead from the picture tube and connected it to the voltmeter EHT probe, just to be on the safe side. In fact, the voltage came up to almost exactly 26kV and I confidently connected the lead to the tube and switched on again.

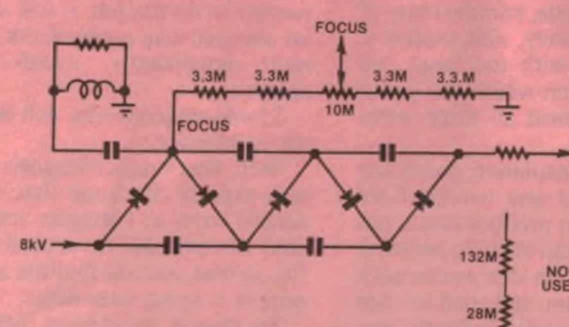
And the situation still looked promising. The tube warmed up, a picture appeared, and the only fault was lack of focus. Adjusting the focus pot improved the situation, but I couldn't get a peak. A little juggling of resistor values in the divider put this to rights and I had what appeared to be a perfect picture.

Scanning problems

Unfortunately, closer examination revealed a snag. The picture was under-scanning slightly and I was about to alter the tapping arrangement used in the Rank when, on an impulse, I varied the brightness control. To my dismay this caused the picture width to wander all over the place. As the brightness was reduced the scan increased, and vice versa. Under worst conditions the picture was under-scanning by about 35mm on each side.

This was a bitter disappointment. As a permanent solution to the tripler shortage problem it was clearly quite unsatisfactory. On the other hand, there was little else I could do at the time to get my customer back "on the air". After all, with all its limitations, the picture being produced was a lot better than no picture at all.

So I contacted the customer, explained the situation, and offered the present arrangement as a temporary solution



RMIT SUGGESTION

The Serviceman

until I could obtain a proper tripler and fit it. I set the system up for maximum width which, at normal picture brightness, was still under-scanning slightly, and duly delivered it to the customer's home.

As it turned out, the customer didn't seem to be unduly worried by the slight underscan, or tendency to wander somewhat. He had a picture that moved, the colours were right, and it looked "nice and sharp", as he put it. So, for the moment, the crisis was over.

But naturally I wasn't very happy to leave it at that. While I might eventually be able to fit the right tripler to this set, there would undoubtedly be other shortages in the future and, having come this far, I was keen to find a satisfactory solution. Fortunately, a colleague in the city had been through more or less the same exercise as I had, with the same result, and begun his own investigation.

His theory was that the original Rank divider network did more than simply provide a focus voltage; according to him it also provided a simple but effective shunt load which stabilised the EHT system, and the various voltages derived from it. Well, that seemed like as good an explanation as any and I began mulling over what might be the best solution.

Fuzzy picture

A few ideas came to mind, but there wasn't really much I could do about it until I had another Rank tripler failure. So I waited. One did turn up eventually but I wasn't very happy about it because it was the one I had already modified. The owner rang to complain that the picture had "gone fuzzy" which, in technical terms, translated to lack of focus.

The reason was obvious; the divider chain for the focus voltage had packed it in, the resistors being obviously incapable of working in this circuit, in spite of their high voltage rating. And, while I didn't know it at the time, I later learned that a colleague who had tried the same modification at about the same time had subsequently had the same problem. So it wasn't just bad luck.

So it was time to try my next approach. This was simply to revert to the original Rank configuration, but using the Philips tripler. While a simple enough concept in theory, and one which I felt reasonably confident would work, its practical application was another matter, and I could readily understand why those who had gone before had adopted what was a much simpler arrangement.

The Rank tripler is made with the 132MΩ resistor as an integral part. Two leads emerge from the tripler, side by side, one being the EHT lead and the other, about 25cm long, carrying the resistor in a moulded tubular housing. This is mounted vertically on the chassis and forms the first part of the divider chain.

What I had to do was to cut into the Philips tripler EHT lead and join the 132MΩ resistor lead to it. This sounds easy when you say it quickly, but actually requires a fair amount of care. One can't leave bare wires lying around when they are carrying 26kV.

I started by cutting off the EHT lead from the Philips tripler, about 30mm from where it emerged, and removed an appropriate length of insulation to leave a short length of bare wire. I did the same with the other part of the EHT lead, and the lead from the 132MΩ resistor. Now all I had to do was join all three together so as to make a well insulated and strong mechanical joint.

Above is the modified tripler with the 132MΩ resistor in the foreground.

After a certain amount of brain racking I suddenly had an idea. Tucked away in a box were some tapered plastic sleeves, left over from various masthead amplifier installations. As well as being tapered they are made with the small end closed off so that, depending on the diameter of the coax cable involved, the end can be clipped off so as to make a tight fit.

I placed the loose EHT lead and the resistor lead side by side, trimmed one of the sleeves appropriately, and slipped it over the two leads with the large end facing towards the joint which was yet to be made. Then I joined all three wires and soldered them.

To complete the insulation procedure I turned to my tried and trusted Roof and Gutter Sealant; a product which has been described in detail in these notes on previous occasions. The idea was to pack the sleeve with sealant and then to slide it towards the tripler until it finally met up with it, thus enclosing the joint in a generous quantity of sealant.

A minor problem is to adequately fill the sleeve with sealant, since there is a tendency to trap air bubbles inside it. I found the best arrangement was to slide the sleeve away from the joint by about 50mm, pack in as much sealant as possible, move it forward a little to draw the sealant inside, then repeat the process until it is well packed. When finally in position it was put aside for about 36 hours to ensure it was completely cured.

(If the plastic sleeves I mentioned are not readily available I suggest that a suitable substitute would be a piece of plastic tubing, about 75mm long and about 12mm OD, similarly filled with sealant and slid over the joint.)

And, I'm happy to say, the finished job worked like a charm. There were no fireworks, the EHT came up spot on 26kV, the focus control needed only a touch, and the scan was both adequate and stable. More importantly, the set has now been running for over six months with no hint of trouble and several more sets have been modified since. Three brands of tripler have been used: Philips, Varo, and a Siemens. All have been completely trouble free.

To make these later jobs a little easier I was fortunate to get hold of a discarded Rank tripler, salvage the 132MΩ resistor, and make up a spare modified tripler in anticipation of the next job. This saves a lot of time when the call comes, and the resistor from the faulty tripler becomes the basis for my next stock modification.

One point that did concern me was whether the Rank divider network might possibly present more of a load to the alternative triplers than they were designed to stand, possibly resulting in overheating and eventual damage to the tripler. Calculations seemed to indicate that this should not be so, but I kept the first couple of jobs under close scrutiny, for any sign of overheating, before they were returned to their owners. As far as I can see there is no problem of this kind.

So, after a lot of mucking about, we appear to have come pretty well full circle, retaining the original Rank configuration and simply replacing the tripler proper. And, in spite of the time needed to do the job, it still works out a lot cheaper than a new Rank tripler and, more importantly, avoids any long delays.

I hope someone else will benefit from my experience.

Well, that's my colleague's story and I also express the hope that others may benefit from it. I suggest you add some kind of reminder to your Rank service file, so that you can find the article if you need it at some later date.

To change the subject, here is a brief comment following a contributor's story in the June 1984 issue. This was from Mr K.H. of Bundaberg, Queensland, and told of a strange fault in a transistor which seemed to be due to some kind of metallic deposit between the leads.

In commenting on this I recalled a similar problem with certain 9-pin valves, and even speculated that I had run a story about it many years ago, but added that it would be too hard to find at this juncture. But, for once, I was lucky. An EA staff member, while searching back issues for a quite different reason, and having read the June notes, suddenly came across the article in question.

It was in April 1959 (25 years ago!) and, in that issue, I suggested that it was probably grease which had collected dust and other foreign matter, absorbed moisture, and produced a leakage path. By the July issue I was able to report two more cases described by contributors. And, thus prompted, I took the matter up with one of the valve manufacturers. (It was mainly the 6M5 valve, by the way, one of the few with adjacent grid and screen pins.)

The manufacturers were well aware of the problem and, in fact, had already found a cure. The pins were silver plated to provide good contact with the socket, and it was the silver which had migrated across the glass from one pin to the other. The solution was not to plate the entire pin, but to stop it short of the glass by a small amount.

As far as valves are concerned, of course, all this is of academic interest, but I wonder if the same thing is happening with transistors. Are some leads being plated with silver or some other metal which, in spite of the much lower voltages involved, is behaving in the same way?

Maybe someone out there can tell me.

Beware cheap multimeters

And, to finish off, here is a brief story of interest to those who argue about the relative merits of the old analog meters and the "new fangled" digital versions. It comes from my amateur friend who had built the "Explorer" UHF Transceiver described in the September 1983 issue of EA, and who was in the process of final adjustment and alignment.

One of these steps involves monitoring a voltage (TP2) while making an adjustment to the VCO circuit to bring the voltage to a nominated value; an adjustment which, I gather, should be done with a fair amount of precision. And, to emphasise this, the instructions suggest that a digital voltmeter be used if available.

My amateur friend doesn't have a digital voltmeter, but he went to some trouble to borrow one from the "salt mine". Then he connected it to the appropriate pin and switched on. The voltage was required to be adjusted to 2.5V and he confidently expected it to be somewhere in this vicinity, even without any adjustment.

He was rather surprised, therefore to find that the digital meter read no less that 14V, but appeared to be dropping. He let the set run for an hour or so, by which time it had dropped to around 12V, but seemed to be wandering up and down by up to 0.5V for no apparent reason.

Highly suspicious by now my friend disconnected the digital meter and substituted his old tried and true analog meter. And that told a quite different story; it read within a few tenths of a volt of the specified value, and responded immediately to the appropriate adjustment.

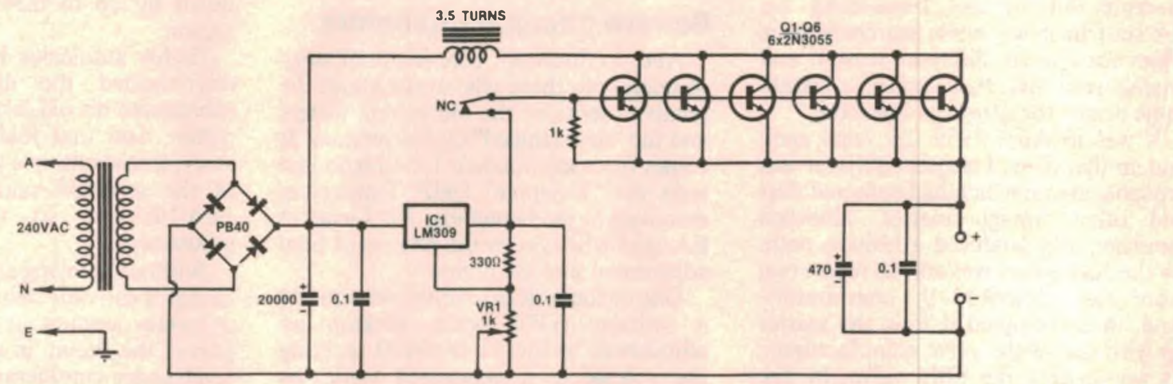
Without knowing a lot more about the circuit, I can only assume that there was a certain amount of "rubbish" in this part of the circuit, in addition to the DC level under consideration, and that this particular digital meter, at least, didn't like it. Other types, of course, may have handled the problem better.

While I have no wish to become involved in any arguments, I do think it is worth pointing out that problems like this apparently can arise. So if you're in the market for a digital meter it would be nice to be able to check this point before you make a final choice.

How? Frankly, I don't know. I'm afraid that's your problem.

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.



13.8V power supply

A modified relay is used to provide overcurrent protection in this 13.8V 20A power supply circuit. When the relay trips, it disconnects the drive to the six 2N3055 output devices (Q1-Q6).

Drive current for the output devices is supplied by an LM309 five volt regulator and is nominally 650mA. Although the LM309 incorporates overcurrent protection, this does not operate below about 1.5A. This would correspond to a grossly excessive current in the output of the supply, so some other form of protection is required.

By wiring the relay coil in series with the supply output, the relay is able to operate as a current sensing device. When the output of the supply is shorted, the relay operates and opens the circuit between the LM309 output and the bases of the series pass transistors. As soon as the transistors turn off, the relay releases and the short circuit current again flows through the load.

The relay thus operates and releases continuously until the short circuit is removed. Under these conditions, a short circuit current of about 12A is drawn from the supply.

In the original circuit, 3½ turns of wire sufficed for the relay coil. This figure will vary, depending on the relay used and the trip current. In any case, the original relay coil will have to be replaced.

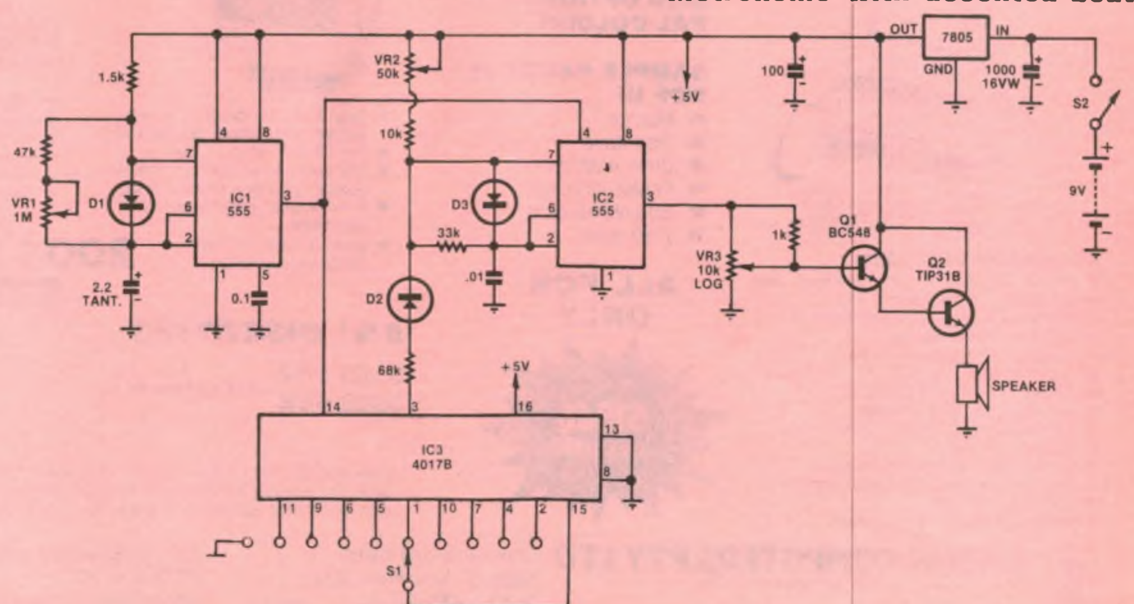
As a means of determining the ampere-turns required to operate the relay, a test winding of say 200 turns can be used. The original relay produced a figure of 70 ampere-turns. Once the figure has been deduced, it is a simple matter to substitute a coil of fewer turns, suitable for the anticipated overload current.

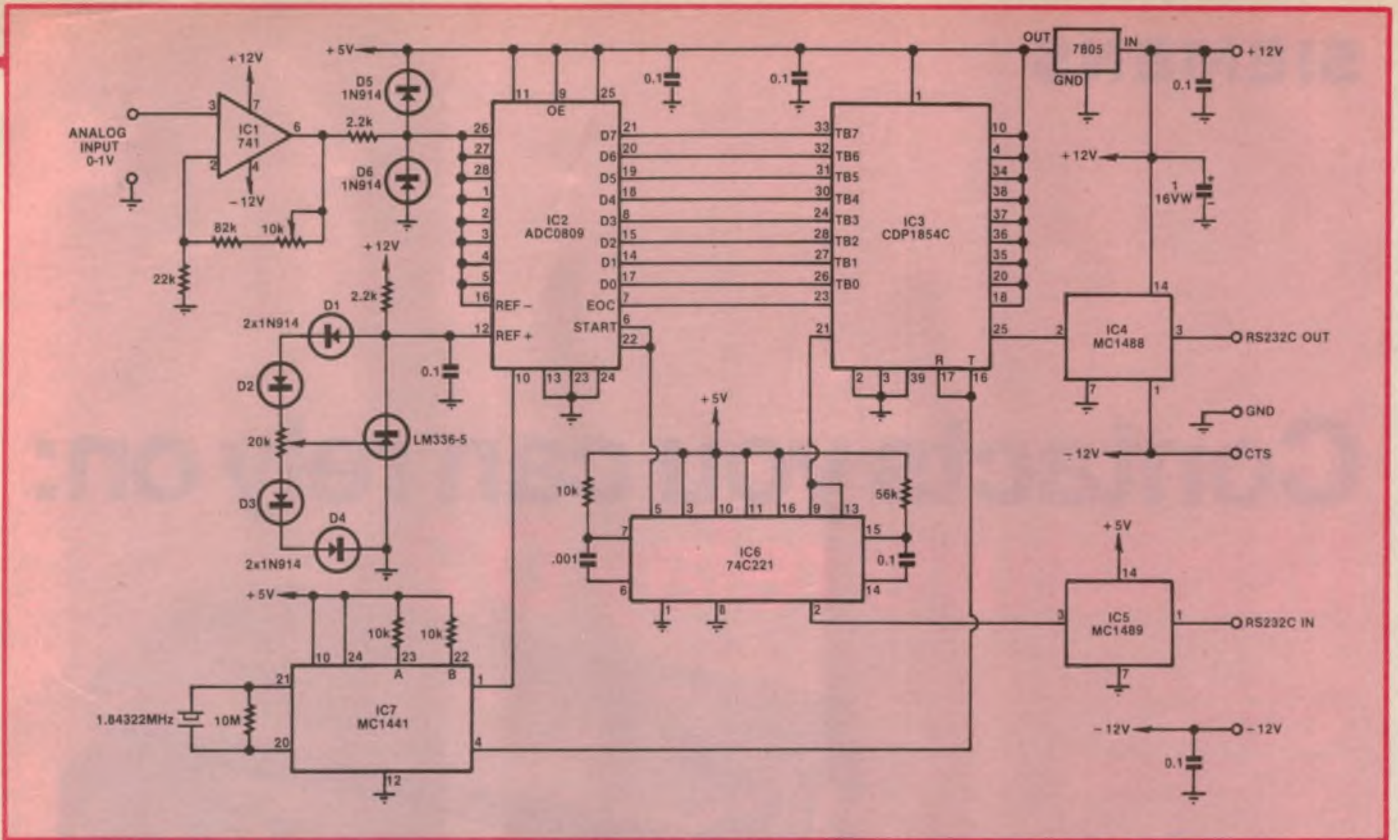
Editor's note: we suggest the inclusion of 0.1Ω/1W emitter resistors for the 2N3055s to ensure equal load sharing. Note also that the type of overcurrent protection offered by this circuit protects the supply rather than any load device.

D. Allen,
Findon, SA.

$12

Metronome with accented beat





RS232C serial A-D converter

This 8-bit A-D converter features a 120μs conversion time with a serial output at 4800 baud in RS232C form. It can be used with any computer which includes an RS232C interface.

The 741 opamp (IC1) has a gain of five so that, for a 0-1V input, it provides a 0-5V signal suitable for full conversion of the A-D converter, a National Semiconductor ADC0809 (IC2). This IC comprises an eight channel multiplexer to select one of eight analog input channels, a successive approximation register, a 256R resistor ladder D-A converter, and a comparator. The 8-bit output is a Tri-State latch.

To begin A-D conversion, IC2 requires a Start signal. When conversion is complete an End of Conversion (EOC) signal results. Note that only one channel of the eight inputs is used.

A CDP1854 UART (IC3) converts the parallel data from the A-D converter to serial data. The output is then converted to ±12V swings by IC4 (MC1488).

Looking from the other direction, RS232C signals from the computer are first converted to +5V digital pulses by IC5 (MC1489) and then applied to dual monostable IC6. IC6 stretches the start conversion and master reset pulses from the computer to 5.6ms and 10μs respectively. These trigger pulses control the sampling of the A-D converter.

Once the A-D conversion is complete, the serial signal from the UART is sent to the computer. The data comprises one start bit, the 8-bit A-D conversion signal and two stop bits.

Timing is achieved by the MC14411 bit rate generator (IC7). This generates 614kHz and 76.8kHz clock signals for the A-D converter and UART respectively.

To operate the A-D converter send either 255 or 0 via an OUT command to the serial port of the computer. Note that the value sent depends on the format of the computer.

Note also that this A-D converter is designed only for slow-changing signals. For a complete sine wave cycle to be converted with the maximum 256-bit resolution, the signal frequency must be less than 0.3Hz. Signals above this frequency will be converted with reduced resolution, but note that a sample and hold circuit should be used to prevent the input voltage changing while conversion takes place.

P. Fariman,
Brisbane, Qld.

$20

This circuit is for a wide range metronome (40-600 beats/minute) with accented beat facility. Practically any time signature can be used as any beat up to the tenth can be accented. The beat being accented has a slightly higher pitch than the other beats and so seems to be more pronounced.

IC1, a 555 timer, is used in the astable mode to provide the timing pulses for the circuit. Diode D1 ensures that the charge rate and hence the pulse width remains constant. The pulse rate is varied using the 1MΩ pot (VR1) which determines the discharge rate of the 2.2μF timing capacitor.

The output of IC1 (pin 3) gates 555 timer IC2 which results in an output consisting of very short bursts of tone (these sound more distinct than simple pulses in the loudspeaker). Diode D3 is used to control the mark/space ratio, while VR2 sets the tone frequency.

The output of IC2 appears at pin 3 and is coupled to Darlington pair Q1 and Q2 via VR3 (the volume control) and its associated 1kΩ resistor. From there, the signal passes to the loudspeaker which is in the emitter circuit of Q2.

Accent is achieved using IC3, a 4017 counter clocked by the timer pulses from IC1. This counts up to any number between one and 10 and is then reset, the number being determined by the position of rotary switch S1. After each reset, pin 3 goes high and this results in an increase in the pitch of one beat by increasing the charge rate of the .01μF timing capacitor in the gated oscillator (IC2).

Power for the circuit is derived from a 9V battery and regulated to +5V using a 7805 3-terminal regulator. Supply line decoupling is via the 1000μF and 100μF electrolytic capacitors connected to the regulator input and output respectively.

D. Tate,
Upper Sturt, SA.

$15

Circuit & Design Ideas

Multi-channel CRO Adaptor

Extend the versatility of your single-or dual-trace CRO with this analog multiplexer circuit. The circuit comprises up to eight independent preamplifier stages which are switched in sequence to a common output amplifier stage. With the output connected to a CRO input, up to eight traces can be displayed simultaneously.

The preamp circuits are identical for all channels so only one is shown in detail. To minimise circuit cost and complexity, there are no switched input attenuators. Instead, the input signal to each channel is attentuated by a fixed 10:1 ratio (with frequency compensation). Input signal levels up to about 80V p-p can be handled without overload.

An input capacitor (not shown) can be included if desired for AC coupling. The input impedance for each channel is 1MΩ shunted by approximately 10pF (plus input cable and stray capacitances). The small signal frequency response is from DC to over 1MHz for one channel, but as the number of channels is increased the high frequency response will be reduced due to the increased capacitive loading imposed by the switching circuitry.

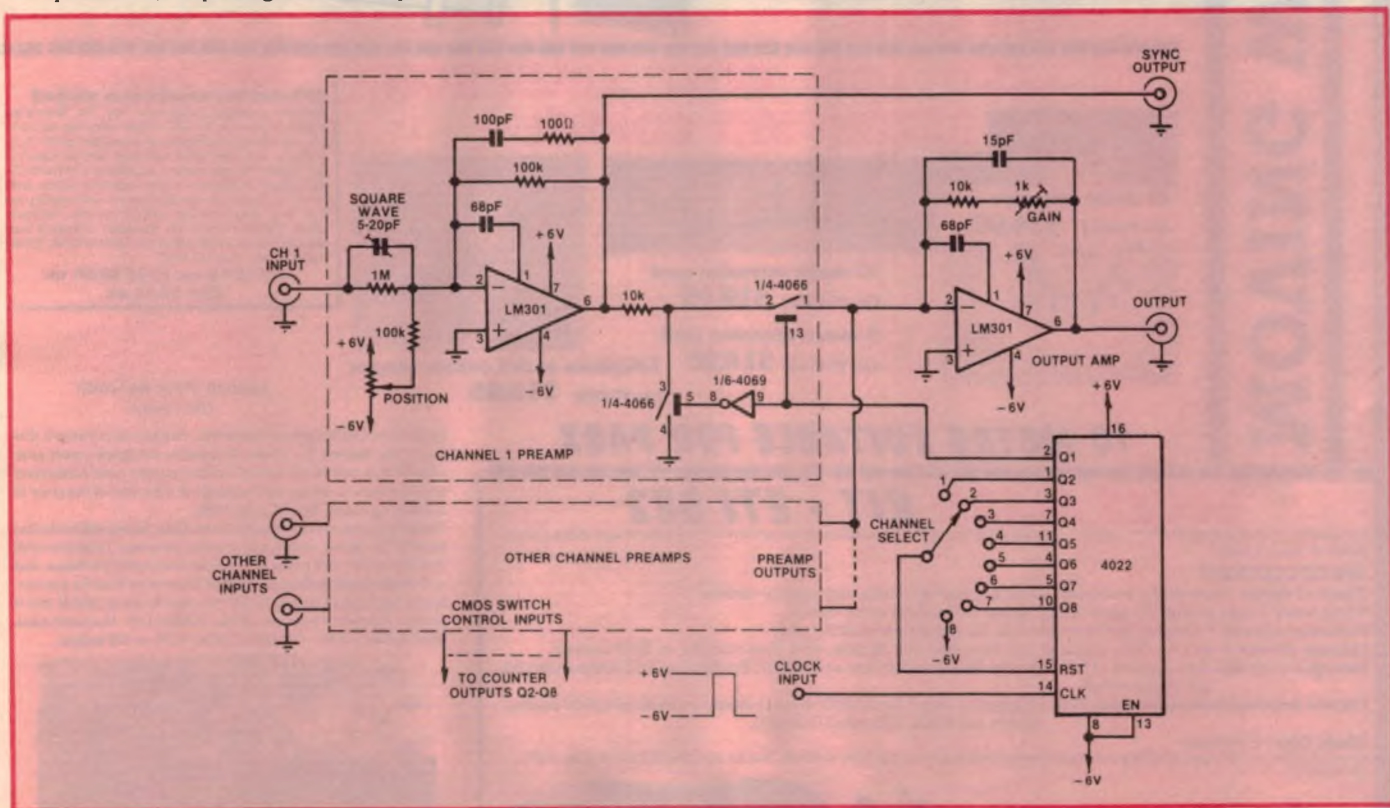
The gain of the output amplifier can be adjusted by a small amount (about 10%), if necessary, to compensate for "on" resistances of the CMOS switches employed in the switching circuitry. A low-level, buffered (and inverted) signal is taken from a low impedance point in the "channel 1" preamplifier for connection to the CRO "ext sync" input.

Channel switching is controlled by a 4022 CMOS octal counter. Each Q output controls a pair of CMOS switches associated with a corresponding channel preamplifier. An 8-position "channel select" switch selects the number of channels to be displayed.

The circuit may be operated in either a "chop", "alternate" or "manual" mode, depending on how the clock pulses to the pin 14 input of the 4022 are derived. For "chop" mode you can use the square wave output of an astable CMOS oscillator. For the "alternate" mode, the clock pulses will have to be derived from the internal sweep circuit of the CRO. The "manual" mode may be achieved by using a pushbutton switch to feed clock pulses one at a time, and is useful if you want to display one channel at a time.

H. Nacinovich,
Gulgong, NSW

$20



MOVING WAREHOUSE SALE

SCOOP PURCHASE
of 4 COLOUR PRINTER/PLOTTERS!!

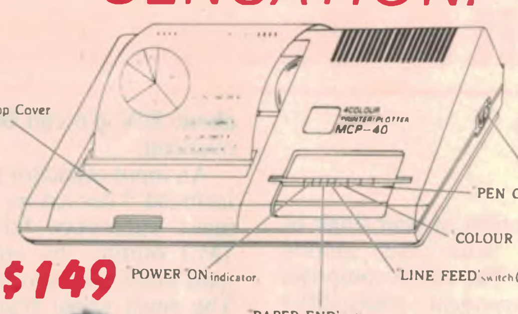
Jaycar has done it again! We have made a scoop purchase of 4 colour printer/plotters at a never-to-be repeated price!! The SAME printer has sold elsewhere for up to **$299** but currently sells for as low as $169. At $169 it is an absolute bargain! (See specs). Now Jaycar can offer you the SAME printer for $149!! How do we do it? We have bought BELOW IMPORTERS COST and have passed the SAVINGS on to you!

QUANTITIES STRICTLY LIMITED. We have less than 80 pcs in stock at the time of going to press. To avoid disappointment, we suggest that you ACT QUICKLY.

The printer/plotter is supplied with mains lead, a roll of paper 114mm x 55m long (4.5" x 180') and a set of 4 pens (black, blue, red & green). Spare rolls and pens are available from other major electronic suppliers and for a short time, us. **Cat. XP-4605**

Cat. XP-4606 Spare Paper Rolls $3.30
Cat. XP-4607 Set of 4 Pens $7.50

SENSATION!



$149

DON'T PAY
~~$299~~
~~$229~~
~~$169~~

BARGAIN OF THE CENTURY!!

How do we do it? Another BARGAIN!!

Once again, Jaycar has secured a massive below-cost scoop purchase. This time a nifty combination VHF/UHF television tuner assembly! We DARE NOT MENTION the FAMOUS JAPANESE BRAND of this quality assembly!

- ★ Brand, spanking new
- ★ Separate VHF rotary tuner
- ★ Separate UHF rotary tuner
- ★ All knobs and wiring INCLUDED!
- ★ Attractive front panel fascia included!
- ★ Circuit diagram included!

Be quick to secure one of these as we only have limited stocks
Cat. DM-9004

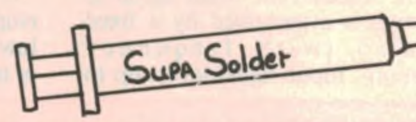
ONLY ~~$69.95~~ - HURRY!!
SAVE $10 NOVEMBER
NOW $59.95

AMAZING SUPA SOLDER

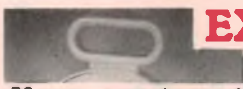
SOLDER PASTE IN A TUBE!

Extremely versatile solder compound that contains tin, silver and non-toxic chemicals. Quick low temperature soldering (222°C) with bonds 8 times stronger than lead solder. Joins ferrous and non ferrous metals with the heat from a cigarette lighter. Suitable for use on brass, bronze, nickel, stainless steel, copper base metals and steel.
Cat. NS-3000

$7.95



AT LAST! LOW COST TELEPHONE EXTENSION CORDS!



20 metre extension cord
Cat. YT-6014 **$24.95**

10 metre extension cord
Cat. YT-6012 **$19.95**

5 metre extension cord
Cat. YT-6010 **$14.95**

Telephone socket double adaptor
Cat. YT-6020 **$19.95**

10 METRE SUITABLE FOR PABX

SCOOP PURCHASE!!

600 ohm line transformers slashed!

Another amazing below-cost buy. An Australian made chassis mount 600 to 600 ohm line isolating (or matching) transformer at a bargain price! Both primary and secondary windings are an identical 600 ohms. The transformer measures 27(W)x20(D)-x21(H)mm & features a grain-oriented silicon steel for Hi Fi. There is no doubt that the unit would pass line level, even +4dBm without trouble. Probably more. We have nearly 1½ thousand of them & they are offered on a first come, first served basis. Prices include tax. Cat. MT-4725

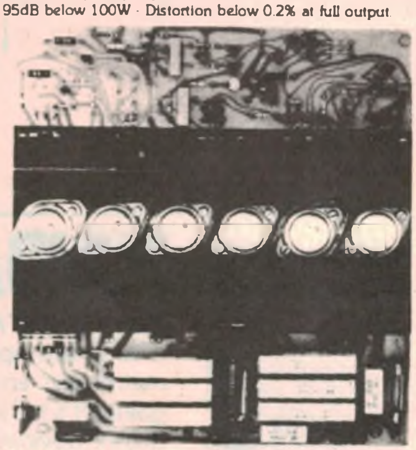
1-9 $2.95 ea: 10-24 $2.50 ea: 25+ $2.25 ea

300 WATTS OF MUSIC POWER!

Limited Stock Be Quick
(Kit Form)

For professional sound reinforcement, musician or home hi-fi, this one really delivers the power. A superbly designed power amp module that only needs a simple power supply, case, connectors and hardware to be up and running - at a fraction of the price of commercial units. See EA June 1980

This kit includes all parts to build the module. Additional kits below provide the power supply and speaker protector. Team this with one of our 19" rack cases, a Sprite fan and some hardware, and you've got a high performance 300W mono amp ideal for any use. Specs are: Output power 300W rms into 4 ohms (200W into 8 ohms) - Frequency response 20Hz - 20kHz - 1dB - Hum and noise 95dB below 100W - Distortion below 0.2% at full output.



Module Kit complete .... Cat. KA-1115 **$89.95**
Power Supply/Transformer .... Cat. KA-1116 **$69.95**
Speaker Protector .... Cat. KA-1117 **$12.95**

HOUSE ALARM KIT - ETI 582

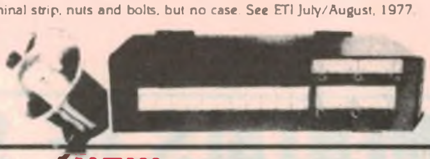
This great kit was released by ETI back in 1977. To make it easier for the constructor we have joined the two PCB's together and added a power supply on the one board.

SPECIFICATIONS

Types of inputs Silent entry, perimeter circuits, internal circuits, emergency circuits.
Silent entry Single circuit, 30 second exit delay, 30 second entry delay.
Perimeter circuits 7 circuits, N/C contacts can be expanded in units of 4.
Internal circuits 4 circuits, N/C contacts, can be expanded in units of 4. Any number of N/O circuits.
Emergency circuits Any number of N/O circuits. These circuits are active even if perimeter and internal circuits are switched off.
Current drain and battery life (type 732) Emergency only 2.5mA (4000 hours); Alarm active 9mA (2000 hours); Alarm sounding 500mA (10 hours)
Alarm time 12 minutes

All components are supplied, including mains transformer, lead, terminal strip, nuts and bolts, but no case. See ETI July/August, 1977.
Cat. KE-4032

ONLY $59.95



NEW - XR2240 IC

Programmable Timer/Counter chip as used in ETI's experimenters corner.
Cat. ZK-8832

$4.25

NEW - EZI CLIPS

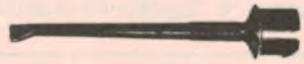
3 for the price of 2

These have a syringe action and are ideal for working with small components. These are larger than usual 90mm long. They are normally worth $1.50 each.

THIS MONTH ONLY 99¢ each

Buy one red + one black and we'll give you a black one FREE.
Cat. HM-3042 RED Cat. HM-3043 BLACK

NOVEMBER ONLY 99¢ each



8" WOOFER

This superb Pioneer woofer will handle about 20 watts rms. Frequency response is 50 - 3kHz. These are usually worth $15 each.
Cat. CW-2112

ONLY $7.50 each

SAVE $7.50 each (50%!!!)

TWEETER

Add this tweeter to the 8" woofer and you've got a great small speaker system for $21.00.

UNBELIEVABLE

Tweeter handles 20 watts in a system. Frequency response up to about 18kHz.
Cat. CT-2002

ONLY $2.95

SAVE $3.00 - 50%!!

For a crossover between the 8" woofer & tweeter use a 2.5uF Bipolar capacitor. Cat. RY-6804 55¢ each

Twetter supplied could vary from one pictured

PIONEER 10" GUITAR SPEAKER

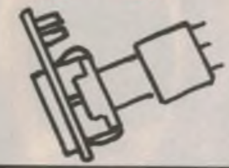
Quality Pioneer brand - check the specs! Check the price!
★ Impedance 8 ohms ★ Voice coil diameter 1½" ★ Power rating 60 watts rms ★ Resonant frequency 80Hz ★ Sensitivity 98dB(dB/W) ★ Response 80Hz - 7kHz ★ Total flux 61,100 Maxwell ★ Flux density 8,300 Gauss ★ Net weight 1.54kg.

ONLY $29.95
CATALOGUE PRICE $39.95

C&K PUSHBUTTON SWITCHES

These great pushbutton C&K quality switches have a built-in black panel which houses the actuator and a hole for a 5mm LED (not supplied). Switches are SPDT momentary changeover.
YOU WOULD NORMALLY EXPECT TO PAY BETWEEN $5 AND $6 FOR THIS TYPE OF UNIT
Cat. SP-0786 YELLOW ACTUATOR
Cat. SP-0785 RED ACTUATOR

ONLY $2.95 each



EXPERIMENTERS LED DISPLAY

7 segment display similar to those used on earli type pocket calculators, with a built-in magnifier. Where else can you get a 7 segment display for this price
Cat. ZD-1896

$2.95 each

MICROCOMPUTER POWER SUPPLY

A handy supply for those into microcomputers. Unit is built and tested and includes a gold anodised heatsink, wiring instructions and schematic diagram. Transformers are not supplied.
Cat. MP-3024
Output voltages: +5V 6A; −5V 0.5A; +12V 1.5A; −12V 0.5A.

SAVE $5.00
NOW ONLY $34.95

SENSATIONAL DEALS ON 3-WAY SPEAKER SYSTEMS!!

A massive scoop purchase of factory distress stock has enabled us to pass on unbelievable prices on quality speaker systems. The component speakers in these systems are normally incorporated into cabinets for many well known national brand Hi Fi companies. Each speaker is factory guaranteed for 90 days, however we doubt whether you will ever need to worry about it.

8" 3-WAY SYSTEM

Superb 8" woofer with foam surround suspension and heavy magnet assembly with sealed back midrange and tweeter. System impedance 8 ohms. Power handling 40 watts rms. Crossover capacitors and connecting diagram and recommended 8" cabinet detail drawing supplied.
Cat. CS-2453 (2 required for stereo)

SAVE $5.00
NOVEMBER ONLY
$24.95 set

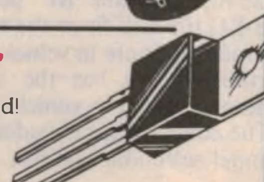
10" 3-WAY SYSTEM

Once again, a high quality 10" woofer with high power, sealed back midrange and tweeter. System impedance 8 ohms. In addition a quality Pioneer 3-way crossover is provided at no extra charge. Connection instructions are also provided as well as recommended 10" cabinet plans.
Cat. CS-2454 (2 required for stereo)
INCLUDES PIONEER 3-WAY CROSSOVER

SAVE $5.00
NOVEMBER ONLY
$34.95 set

VN88AF

We're overstocked!
$2.95 each
SAVE $2.00
Cat. ZT-2294



FULL 90 DAY WARRANTY
★ NEW IMPROVED MODEL ★
As reviewed in Electronics Australia Oct 1982 & Electronics Today International Nov 1982

Cat. XC-2010

At $199 the Voyager Car Computer represented outstanding value for money. The Voyager is the only low-cost unit that will give you full consumption (the most important feature in a car computer) in both metric litres/100km AND good old MPG! At $199 many, many hundreds have been sold. NOW you can grab one absolutely complete for only $125 - a saving of 37% or $74! The Voyager comes complete with all fitting hardware - even down to a roll of insulation tape! Installation generally takes between 4 and 6 hours depending on vehicle.
SPARE FLOW SENSORS To avoid problems when changing cars, why not buy a spare fuel flow sensor? They are about the only thing that can wear out.
Cat. XC-2036 ONLY **$29.50**

The Voyager is available from the following dealers at your convenience.
★ ALL JAYCAR STORES AND BY MAIL ORDER: JAYCAR P.O. Box 480 Auburn 2144 ★ ZAP ELECTRONICS (all stores) ★ ROD IRVING (Melbourne 347 9257 or Northcote 489 8131 ★ ALTRONICS (Perth 328 1599)

ONLY $125 COMPLETE
MASSIVE SAVING OF $74

BELOW MANUFACTURER'S COST!!

5000 POWER AMPLIFIER "BLACK MONOLITH"

REF: ETI JAN/MARCH 1981

COMPLETE "BLACK MONOLITH" KIT ONLY
Cat. KE-4200
$319.00

"BLUEPRINT"

REF: ETI JUNE/OCTOBER 1981

5000 CONTROL PREAMPLIFIER $299
FOR THE COMPLETE KIT
Cat. KE-4202

SEE OUR OTHER ADS FOR ADDRESS PANEL AND OTHER INFORMATION

UHF transceiver for 450-470MHz

Imark Pty Ltd has released the Sawtron KG105 UHF transceiver for use on the 450-470MHz commercial radio band. The KG105 is a UHF FM mobile transceiver with up to 16 frequency synthesised channels and 15-25W adjustable RF power output. The KG105 will fit in the smallest DIN size radio aperture in vehicle dashboards. Furthermore, it has the ability to be remote mounted in vehicles.

The control head includes controls for channel selection, volume, squelch, and optional Selecall tone selection (last two digits only). LEDs are included for channel display which flash if a non-programmed channel is selected. Individual LEDs are also used to indicate the last two tones and to indicate channel busy and transmit status.

A comprehensive range of accessories is available including five tone Selecall with automatic answer back, automatic identification, data transmission, single and multiple tone CTCSS squelch system, DTMF or dual tone signalling and an adjustable time out timer.

Further details from Imark Pty Ltd, 167 Roden Street, West Melbourne, Victoria, 3003. Telephone (03) 329 5433.

Radio headset for breathing apparatus

Niros Telecommunications has released a communications headset for breathing apparatus face masks. Intended as an accessory for Niros' TRX707 portable radio, the headset is designed to clip on to Draeger breathing apparatus face masks. Up to this time communications headsets for face masks have been cumbersome and messy arrangements requiring personnel to attach their headset separately, usually before fitting the face mask.

The Niros Draeger compatible head set clips onto the face mask in a matter of seconds. Voice reproduction to and from the head set is accomplished through a polymer membrane audio transducer capsule. This is fitted into a compartment which clips onto the side of the face plate.

Because of the noise associated with breathing masks, voice operated relays cannot be used. Niros provides a large nob which can be activated by the elbow or hand of the wearer.

Further information from Telmar Communications, 604 City Road, South Melbourne, or any of its distributors throughout the country.

Nickel cadmium batteries from Arlec

Arlec Pty Ltd advise that they are now marketing a range of rechargable nickel cadmium batteries under the Arlec brand.

Nickel cadmium batteries do not deteriorate when stored, nor do they leak in normal use. Their performance is excellent during high rates of discharge and they maintain stable operation over a wide range of temperature fluctuations, ensuring very reliable service. Output voltage remains very stable in use and stays close to the 1.25V rating almost to the point where the charge is exhausted.

Available in four sizes, AAA, AA, C and D, these batteries are suitable for powering toys, cassette recorders, calculators, radios, computer games, flashlights, portable TV sets, wireless telephones etc. They are extremely economical in use as they can be recharged and used literally hundreds of times.

Further information from Arlec Pty Ltd, PO Box 170, Box Hill, Victoria, 3128. Phone (03) 895 0222.

Miniature cable and interconnect system

East-West Electronic Distributors Pty Ltd announce the release of the AMP Interconnect System, AMPMODU. This miniature cabling interface system starts by providing an ultra-reliable contact in a large variety of modes. Each termination is based on dual gold plated phosphor bronze cantilevers providing a minimum of two contact points per conductor. Cantilever pressure may be ordered in one of three available values, depending on the application. Receptacle assemblies are available in dual or single row, PCB or cable mount.

Pin header assemblies are manufactured with the same attention to detail. Posts are made from gold plated phosphor bronze and mounted into a polyamide moulding for easy handling. Straight or right angled posts provide the design engineer with maximum flexibility. Shunt plugs are available to provide wiring across printed boards. The pin header assemblies can be so mounted on a PCB as to provide a matrix of connectors providing the engineer with a large variety of shunts or configuration modes.

Further information from East-West Electronic Distributors Pty Ltd, 117 Smith St, Fitzroy, Victoria, 3065. Phone (03) 419 9833.

One and two-channel time switches

Wattmaster Alco Pty Ltd has introduced a new range of budget-priced time switches onto the Australian market.

The new range comprises the single-channel Digi 49-72 for surface or flush mounting and Digi 49-45 for DIN rail, and the two-channel Digi 56-72 for surface/flush mounting and Digi 56-45 for DIN rail.

The range offers longer memory reserves, larger memory capacities, day-blocking (several days' switching instructions can be programmed without affecting memory capacity) and simpler programming with a handy daylight saving switch. Increased simplicity of operation makes them suitable for use by non-technical personnel.

Wattmaster's Digi series can be used for accurate switching control of interior lights, heating, cooling, floodlights, and controlled lighting of municipal playgrounds, sporting grounds, and industrial areas.

The single-channel units have a memory capacity for 14 programmable instructions, while the two-channel model has 56. The two-channel memory capacity means it has a total of 784 switching possibilities, which exceeds all normal requirements.

The single-channel models are plug-compatible with Wattmaster's previous range of electronic and synchronous time switches. The two-channel range, which is being introduced for the first time, will also be plug compatible with future models.

The single-channel Digis will be priced at only $86, while the two-channel Digis will cost $118.

Further information from Wattmaster Alco Pty Ltd, PO Box 75, Ermington, NSW 2115. Phone (02) 648 1332.

Etching station companion for UV exposure box

An etching station designed for one-off production is now available by mail order from Sesame Electronics (see August 1984 issue for details of UV light exposure box). It comprises an adjustable electric heater/blower mounted on a base, and which directs hot air into a plastic dish which contains the PC board and the etching solution. The heating of the fluid, and the moving currents produced by the fan, greatly speed up the action, so that the whole operation is completed, hands free, in about ten minutes.

This system permits the use of etchants which only work when warmed, such as ammonium persulphate. This etchant has certain advantages: it is clean and will not stain clothes and, being transparent, it allows the etching to be seen. It is also very rapid.

Supplied as part of the etching station are a pair of tongs, a scourer for scrubbing the PC board, a fine brush for applying the resist, and two plastic trays. One tray is used for the etching process and the other for developing. The system will handle boards up to 180 x 130mm, but larger boards can be handled by using a larger dish.

The Etching Station is $39.00, postage included.

Further information from Sesame Electronics, Box 452, Prahran, Victoria, 3181. Phone (03) 527 8807.

Alarms, security systems, and radio control

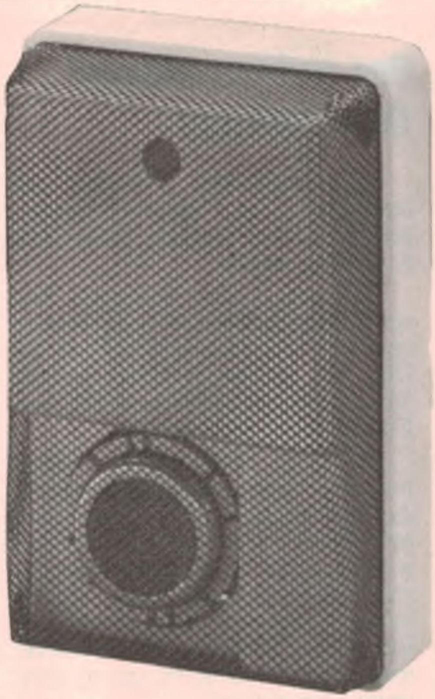
For those with a security problem, either domestic or industrial, Electron Alarms Security Engineers offer a wide range of security devices and systems.

Foremost among these at domestic level is the "Monosonic" ultrasonic detector. It is supplied with transmitter and receiver in a single compact unit. It operates in a steady state (rather than pulsed) mode for minimum component count and maximum reliability.

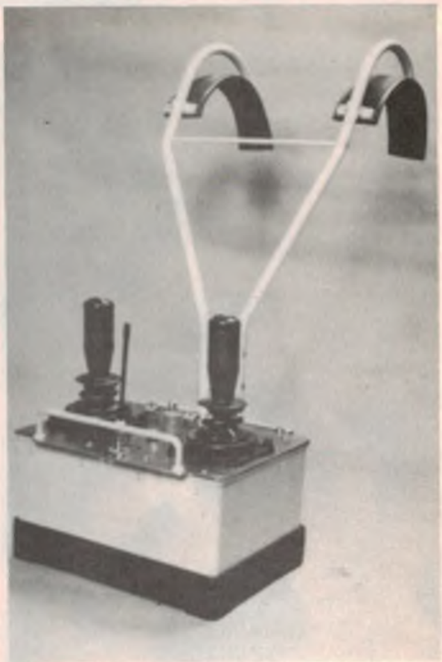
Other equipment available includes the "Piezox" piezoelectric siren. This has a high level of sound emission (116dB at 1m) yet uses only one tenth the power of conventional magnetic loudspeakers. It is fitted with an anti-tampering device and its small size and attractive design make it suitable for mounting anywhere, regardless of the decor.

Also available is the "Gulliver" radio control system suitable for security gate or garage door control and anti-theft systems. Operating in the 300MHz range, a most attractive feature is the small size of the transmitter: 35mm wide, 60mm long, and 12mm thick. It weighs 21g. Operating range is 80 to 100m.

Further details from Electron Alarms Security Engineers, 225 Ramsay Rd, Haberfield, NSW 2045. Phone (02) 799 4745.



The Monosonic alarm is designed to blend in with household decor.



Remote control from Moog

The Moog NDL radio system for underground hardrock mining front-end-scoops has evolved from over 14 years of development with a wide range of mining environments. Although basically developed for mining applications this radio control system has been readily adapted for cranes, fire fighting equipment, utility service vehicles, grain trippers, winches, hoists and for any equipment operating in a hazardous environment.

The radio link contains a digital address code for protection against outside interference such that more than one machine can safely operate in the same area. No adjustments are required in the field.

For details contact Moog Australia, 53 Glenvale Crescent, Mulgrave, Vic 3170.

New agency for Promark

Promark Electronics have recently been appointed Australian agents for Angstrohm Precision Inc, who manufacture a broad range of resistive products.

Angstrohm has wire wound power rheostats from 12.5 to 300W, precision fixed resistors with temperature co-efficients to 5ppm and a range of precision metal film resistors for military applications.

A wide variety of wirewound fixed resistors are also offered from miniature PCB types to large shunts for current measurements.

Product details are available from Promark Electronics, PO Box 381, Crows Nest, NSW 2065. Phone (02) 439 6477.

New IC for cordless telephones

A low voltage, low power, narrow band FM demodulation system, the LM3361A, has been introduced by National Semiconductor. The main application is in the cordless telephone market. The LM3361A functions include an oscillator, mixer, FM IF limiting amplifier, FM demodulator, op amp, scan control, and mute switch.

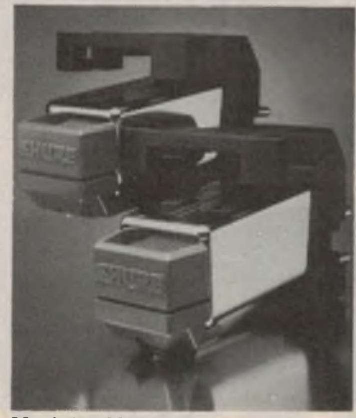
The LM3361A is fully operational on a supply of under 2V, so that only two cells are required in the handset. Current is 2.8mA typical (at VS = 3.6V) during normal receive mode and is only 0.6mA typical when the system is on standby.

The mixer is double balanced to reduce spurious response and combines with the crystal oscillator to convert the input frequency from 10.7MHz to 455kHz. The IF gain block is a six-stage cascaded limiting amplifier where most of the filtering and amplification is performed. A conventional quadrature detector is used to demodulate the FM signal. An on-chip squelch circuit is also included.

Additional applications for the LM3361A include cellular radio subscriber units, message pagers, scanners, marine receivers, and amateur radio FM transceivers.

Further information from National Semiconductor (Aust) Pty Ltd, 23 Cleg St, Artarmon, NSW 2064. Phone (02) 439 6455.

Make your music happen with Shure's new line of stereo cartridges



Models M99E and M92E. Excellent sound on a tight budget. Eliptical stylus, alloy shank. Suits both ½" and P-mount tone arms.

Models M105E and M104E. Outstanding performance on a limited budget. Suits both ½" and P-mount tone arms.

Model 111E and ML110HE. Unique stylus shank and hyperelliptical diamond tip. For both ½" and P-mount tone arms.

Model ML140HE. Hyperelliptical tip and Beryllium Microwall/Be™ Stylus Shank for ruler flat response and superlative tracking.

Model ML120HE. Hyperelliptical tip, Dynamic stabilizer and Stylus Guard Protector. Response is ruler flat 20-20,000Hz.

Your cartridge is the most critical device in your sound system. No other manufacturer in the world knows more about phono cartridge design than Shure. Whether your turntable has a tonearm with a standard ½" headshell or the new P-mount plug in connector, Shure's line of cartridges is especially designed to help you get the maximum enjoyment from your system.

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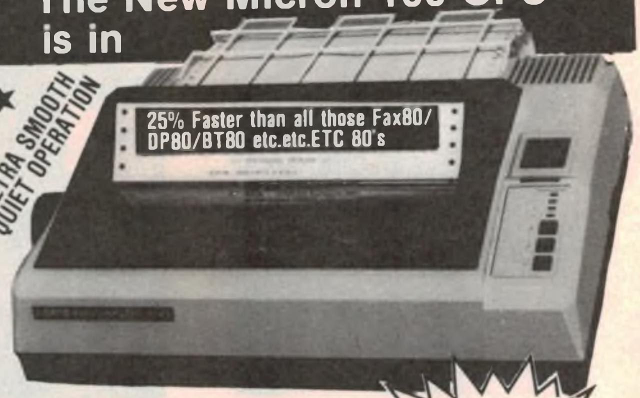

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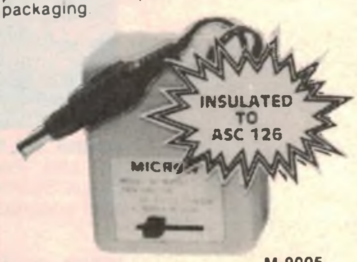

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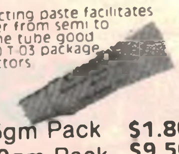

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EA OCT '82 P26-28
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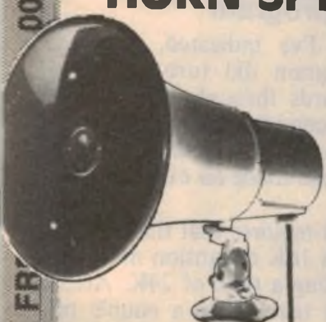

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Fully weatherproof. New unique voice coil construction ensures high dependability on full drive.
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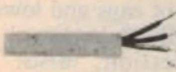

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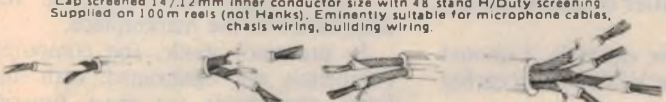

W 0211	W 0214	W 0216	W 0219
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Freight Packing - due to the bulk and weight of this unit - freight is $5.00 per unit.

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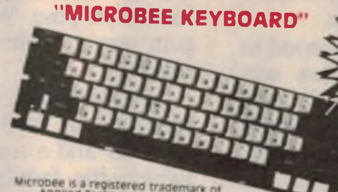

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SPECIFICATIONS:
Screen — Green phosphor. **Front Controls** — Power on/off, character brightness/intensity, display centering. **Rear Controls** — Background intensity, vertical and horizontal adjustment etc. **Input Impedance** — Switch 75/10K O. **DC Socket** — 12V DC output at 1.1 amp — power your micro direct from the monitor. **Bandwidth** — 10Hz-22MHz. **Resolution** — 1050 lines minimum at centre screen.

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This was written on a

If you're wondering about the above somewhat satirical heading, it's intended to mirror the one used for "Forum" in the August issue, namely: "An important role for 'useless' small computers". How more effectively could I emphasise the validity of that article than by now using just such a computer as a word processor, to write this latest instalment?

FORUM

Conducted by Neville Williams

As you might recall, the basic theme in the August "Forum" was that small computers had come down so far in price that they could now be considered by many families as an affordable, even expendable, learning tool for the '80s.

At $99, for example, the Video Technology VZ200 (from Dick Smith Electronics) offered so much computing potential for such a modest outlay that it presented a golden opportunity for adults and children alike to gain hands-on keyboard experience — at home, in spare time, as an interesting diversion.

That the same notion had occurred to other writers and commentators was evident from the fact that it was mentioned on two or three occasions while our own article was in limbo, somewhere between the typewriter and the printing press. It has certainly been talked about since then.

As noted in the August issue, my observations were inspired, in part, by a couple of typical young families that I knew socially, in which there was evident pressure to buy a home computer of one kind or another. It is interesting to record what has happened in those homes during the intervening weeks.

Case histories

Initially, both families invested in a VZ200 basic computer, which they simply coupled to the family TV set, and both experienced a communal fascination and involvement with the games, the programs and the graphics that they were able to set up on the screen.

Objective number one — "Keyboard Konfidence" — soon became evident, with the kids variously fiddling with simple programs, practising poems on screen (even in raw BASIC), setting up "Flashwords", etc — each according to his/her age and interest.

It was about this time that father number one managed successfully to couple a portable tape recorder to his computer. Thus encouraged, he invested in a 16K memory module and, as well, obtained or contrived an elementary word processing program. From somewhere else came a printer of sorts; he was really having fun — and putting the system to tentative use as Honorary Secretary of a youth group.

Father number two was an interested observer but, over and above immediate family involvement, he had another objective in view: the ultimate purchase of a larger system for a business venture. Sooner or later, he would have to decide which to buy of those being offered to him as "absolutely and uniquely ideal" for his purpose. What he was hoping to gain was a better feeling for the whole subject.

So he bought a memory expansion module, a $40 Datasette cassette recorder and a small colour TV receiver (which the family needed, anyway) to serve as an interim monitor. He was lucky enough, also, to be able to borrow a simple printer and interface for a few weeks.

It was at that psychological moment that Dick Smith Electronics came up with a word processor program for the VZ200, on cassette for around $30. Father number two bought one immediately and set about using it for composing reports, planning documents and so on. It was consciously experimental and provisional but it allowed him to gain a much better appreciation of what he needed — and what he could afford!

As I write he has just invested in a modest but adequate business system, with a great deal more assurance than would otherwise have been possible. So, in that respect, his VZ200 has served its purpose, although I gather that he plans to leave it set up for casual use by the rest of the family.

While the foregoing might serve to validate what I was talking about in August last, the matter certainly doesn't rest there.

In that article, for example, I quoted from a review of the VZ200 in an earlier issue:

"If you want a computer to look after your share holdings, or for word processing, look elsewhere."

I didn't see fit to question that verdict because, at the time, no word processing program appeared to be available for the VZ200. There had been talk of one being written "some day" but a last-minute call to DSE brought nothing new to light.

In any case, could one take a VZ200 word processing program seriously if, as seemed likely, the text would comprise capital letters only?

Processor program

In fact, as I've indicated, a word processing program did turn up very shortly afterwards through DSE and I didn't have to spend much time with it to realise that the originators, G. Epps and M. Fackerell, had made an excellent job of it.

The program requires that the VZ200 be fitted with a 16K expansion memory module, providing a total of 24K. After loading, which takes only a couple of minutes, just over 15K of RAM is available for storing text.

Allowing an average of five characters plus one space per word, that means direct accommodation for about 2500 words of running text — sufficient for a fairly substantial essay or article, before resource to back-up cassette storage.

No less to the point, the new program enables the computer to input both upper and lower case letters to a printer so that the keyboard can be used, with Shift key, in the manner of an ordinary typewriter, The screen still displays capitals only but the text, as printed, is the normal mix of caps and lower case.

As to the VZ200 keyboard, I soon began to question, also, earlier reservations about the soft-touch "rubber" keys. In fact, they are not very different in appearance and touch from those on the Brother electronic typewriter reviewed in the August issue — and apparently enjoying ready acceptance in the marketplace.

In processor mode, the computer is completely re-programmed, with single-letter commands for most functions. Text can be typed in, then freely added to, deleted, modified, corrected, swapped around, tidied up, and so on, without any

'useless' computer!

"Ah yes . . . I remember it well!"

I received my July issue of "Electronics Australia" and was very interested in the article on the "Reinartz Two" radio receiver. It revived memories of my own early days in radio — an era when one had to improvise because of the scarcity of parts at the time.

I still have two photographs: one of myself, taken in 1925, holding a one valve receiver and a long-wave crystal set; also a photograph of the cover of the first issue of "Radio & Hobbies" in April '39. I have all the issues since then, except for those published during World War II.

The one valve radio was from the original Reinartz design, which I constructed using "honeycomb" coils, manually adjusted for best reception and regeneration. These were subsequently changed for "spider web" coils, which were adjusted in the same manner. Later on, I used a variometer (variocoupler) device, with one of its inductors providing regeneration.

Then, in 1924, the "Extraordinary One Valve" receiver circuit appeared, using a small tuning capacitor to control regeneration. As with other receivers, the inductors had to be wound patiently by hand but, with this receiver, they were wound on old valve bases and varnished cardboard tubing. By using valve sockets as plug-in sockets for the coils, changing over from long-wave to medium-wave or shortwave reception was much easier.

Using the shortwave coils in the receiver, I could, under ideal conditions, receive signals from the West Coast of the USA.

The valves used in these early designs were either Osram or De Forest types or, more commonly, RCA UV199 or UV201A. I still have some of these valves or, as we used to call them, "vacuum tubes".

The crystal radio receiver was made in 1922 and was very much an experimental model. There were no transmitters in this area in those days so an antenna was erected with twin aerial wires 80ft (24m) long and 40ft (12m) high. Under ideal atmospheric conditions, we could obtain intermittent reception from experimental long-wave transmitters — hence the large diameter coil with a large number of turns.

I still have the headphones and many of the components used for the "Extraordinary One Valve" receiver, plus a hand drill and the round nosed pliers I used in its construction. The pliers contained a forming device to put angle bends in the tinned copper square-section busbar used in wiring the old radios. Components had screwed connections and the round nosed pliers formed the loops that fitted the screws. No solder was used.

The square section busbar was available only in 18in (45cm) straight lengths. Coloured cambric spaghetti tubing was slid over it to denote the different circuits.

I also have an original 1924 issue of Henley's "Workable Radio Receivers" from which many circuit designs were taken. I subscribed to "Wireless Weekly" for many years after it was first published and often talked to the Technical Editor, Ross Hull. I wonder what he would think of present-day electronics!

In 1926-28, I was employed as a radio coil winder, assembler and bakelite front panel fabricator by George Field, Newcastle's first radio component retailer.

Most of the radio receivers manufactured at the time were of TRF neutrodyne design, and the majority of the components were imported from England and USA: BGE, Ferranti, Gilfillan, RCA, etc.

One of my treasured radios is a 1922 model Telefunken three valve model. It needs a new A415 valve and I was wondering if the HL2K valves used in your Reinartz Two would be obtainable.

So much for nostalgia and those intereresting, experimental days of radio.

Electronics has been my forte all my working days and I still maintain an active interest. I could tell many a good story of my experiences in radio-electronics, especially concerning my involvement in a wide sphere of industrial electronics, remote supervisory control and telemetry in collieries, etc.

J.W.P. (Charlestown, NSW).

inhibitions about lines and line numbers. It is a word processor in the true sense of the term.

After loading and pressing the Return key, the user is faced with a "menu" inviting him/her to specify what they want to do next:

(E)dit text
(C)lear text
(P)rint text
(L)oad file
(S)ave file
(V)erify file
(Q)uit program

Press "E" for Edit and text can be inserted, removed or modified, as required.

Press "C" for Clear text or "Q" for Quit the processor program and the user must verify the command with (Y)es before it is actually executed — a very desirable precaution.

Press "P" for Print, and the computer requests instructions in regard to the number of columns (20-99), single or double-spacing, left-hand margin, right-hand ragged or justified, page length and numbering, number of copies, etc.

Helpfully, each time the Menu is called up, it displays the number of spaces still left in the memory. The figure starts off at 15,042 and gradually diminishes as the stored text grows. As well, when text is being Saved on cassette, an on-screen display counts the number of characters as they are transferred.

Practical set-up

In my case, all these initial observations were made with the VZ200 system spread out on a workbench, along with sundry instruments and tools and with an ageing EMI TV set as the monitor. I was intrigued to know how the system would appeal in more congenial surroundings as a complete budget-priced, domestic word processor — one of the roles we had originally dismissed as not worth considering!

Thinking about a monitor, I was intrigued by the possibilities of the 30cm "Princess" B&W TV receiver, which has been available for some time through chain stores like Woolworths and K-Mart. They are a good match for the VZ200 in size, colour and style and can be bought for $90 or less — complete with a 3-year warranty!

While the VZ200 program uses colour to emphasise block markers, etc, a tri-colour screen is not necessarily the best medium on which to display text. So why not a $90 monochrome monitor on which, with this program, the text would show up in white against a dark grey background?

As it turns out, the "Princess" TV receiver has a normal 50Hz mains power supply, with the internal circuitry fully isolated from the mains. This, plus a couple of video test points suggest the possibility of ultimate adaption as a video monitor. However, it worked so well with normal RF access through TV channel 1 that I did not feel necessary to pursue the matter at that stage.

What I did do was to make up a small wooden cradle on which the receiver could rest, raising it just enough (about 45mm) to allow the Memory Module and the Printer Interface to slip in underneath it. This allowed the computer to slide back against the base of the monitor, with the keyboard directly below the screen, in the approved manner!

Set up on a small (90cm × 45cm) table, with the cassette recorder on the right and the printer on the left, the system began really to look the part.

One difficulty that did arise concerned the provision of mains power. Four outlets are required, with two having to accommodate 1A plugpacks. These are too large to fit conveniently into any commercial 4-way outlet that I could find, so I made up one of my own, which I then fitted under the table for tidiness sake.

In actual use

This done, I simply sat down and "processed" the two main articles required for this issue: "Sony's Space Diversity Reception System" and "Forum". By the time I had finished "Forum", operation of the system had become almost second nature; that's how simple it is to use for running text.

There was ample room in the memory to accommodate either one of the articles, which proved handy when I wanted to flip back and add a par or modify something that I had said.

But, every now and again, I took a couple of minutes off to dump the contents of the memory on to a cassette as a precaution against a silly error, a malfunction or a power failure. As most computer operators can testify, any one of those things can wipe out hours of work in a split second and it is reassuring to have at least most of it safely on tape (or disc) as a precaution against any such eventuality.

I did, in fact, unearth one aberration in the Epps and Fackerell program: if, by accident or oversight, three block markers are placed simultaneously on the left-hand side of the screen, the memory sheds some or all of the text as rapidly as if the "(C)lear Text . . . (Y)es" instruction had been punched in! So be warned.

But, enough said!

What the excercise has served to demonstrate is that a very useful word processor for running text can be assembled around a VZ200 system and a "Princess" TV receiver for between $550 and $580 — depending on your choice of cassette recorder. It would be well suited to producing draft copies of letters, essays, papers, articles, etc, ready for final typing.

Re-inventing the wheel

At this point, some may feel that I have devoted a whole article to re-inventing the wheel — but I don't think so. It is true that, every day, countless thousands of Australians produce letters, papers and articles on word processors but the vast majority of them would cost at least four or five times as much as the small, very useful system that I've just described.

You'd prefer to produce finished rather than draft text? And tackle more elaborate work? In the main, that would involve investing in a more elaborate printer, compatible with the VZ200 — something that father number one, mentioned earlier, is currently contemplating.

FOOTNOTE: At this point in the article, calling up the menu indicates that 2705 character spaces remain unused in the memory. Subtracting that figure from 15042 gives the length of text as 12337 characters; dividing by 6 puts the number of words at 2056 (approx) — a handy check if the requirement is to produce an article of specified length.

Now back to the '20s . . .

Reproduced herewith is a letter from J.W.P. of Charlestown (Newcastle, NSW) — one of a number to hand from long-time readers of the magazine. Some have been prompted by my own (formal) retirement and others by the description, in the magazine, of modern counterparts of old-time receivers. I have read such letters with considerable interest and have been genuinely appreciative of the many expressions of goodwill. A sincere thank-you!

In fact, J.W.P's practical experience in wireless/radio/electronics predates my own by several years, although I was close enough behind him to have been familiar with the situations, the components and the designs to which he refers. I well remember the front-panel, swivelling, plug-in, honeycomb coils of the '20s and how a whole generation of them became redundant when local broadcast stations began to use the medium-wave rather than the long-wave band.

J.W.P. also has the advantage, in that I never knew Ross Hull personally, although his reputation as a hobbyist, a radio amateur and as the Technical Editor of "Wireless Weekly" had become almost legendary. At a time when travel was much less common than it is today, he made it to the USA and to the precincts of the ARRL, only to lose his life by electrocution.

While he undoubtedly would have gazed frequently into his technological "crystal ball", I very much doubt that he or others of his day could have had the slightest inkling of the digital era in which we now find ourselves.

John Moyle, who subsequently took over the job of Technical Editor, was like Ross Hull in many ways. He and I spent countless hours discussing the past, present and future but, while that happened much more recently (pre 1960) I doubt that even John envisaged the direction that electronics would take within the next 20 years.

But of this I'm certain: men of that calibre, with their love of electronics, their insatiable curiosity about technical things . . . they would not have been content to live in the past. While fondly remembering their one-time "home brew" equipment, they would have been heard calling CQ on a solid-state Kenwood or Yaesu.

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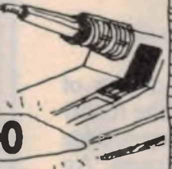

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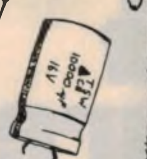

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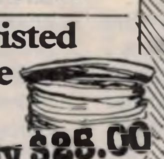

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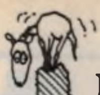

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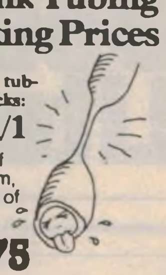

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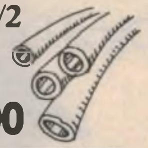

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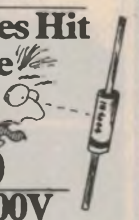

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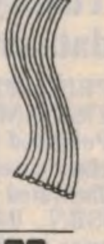

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Books & Literature

Theory of digital data transmission

PRINCIPLES OF DIGITAL DATA TRANSMISSION by A. P. Clark. Published by Pentech Press London. Hard covers, 150 × 220mm, 310 pages, illustrated with diagrams and graphs. ISBN 0-7273-1613-3. Recommended price £16.00.

This book is aimed at the student or practising engineer interested in the design and development of data transmission systems. It is concerned primarily with the basic principles and techniques, rather than with details of equipment design. The content is particularly concerned with digital data transmission using existing channels designed for voice communication, such as telephone and HF radio circuits.

The book is divided into two main sections. The first, comprising chapters 1 to 11, is largely a non-mathematical treatment of the properties of various types of voice communication channels. Different modulation techniques are discussed, and the problem of distortion and noise are considered.

Part two of the book is a theoretical comparison and analysis of the various methods of data transmission introduced earlier. Various types of detectors are discussed and compared in detail, and these are contrasted with a theoretical ideal detector. A reasonable degree of mathematics is presented, and the reader is assumed to have a working knowledge of calculus and Fourier transforms. An understanding of probability theory would also be of help in the chapters on random noise.

The book makes no attempt to be a practical handbook on digital data transmission, but rather is designed to be used in the way of a textbook. In fact the author suggests that the book could be used as the text for an undergraduate course in digital communication.

To sum up, this text provides a thorough treatment of digital data transmission from the theoretical angle. Despite the sometimes daunting mathematics it is easy to read, and the reader is introduced gently into the subject. The book could be recommended to anyone on the strength of the first part, but it is necessary to have some mathematical leaning to get the best out of the remainder of the book.

Our copy came direct from the publisher, Pentech Press, 3 Graham Lodge, Graham Road, London NW4 3DG. (A.L.)

Recording techniques and equipment

MODERN RECORDING TECHNIQUES by Robert E. Runstein. Published by Howard W. Sams & Co. Indiana USA. Soft covers, 136 × 214mm, 367 pages, illustrated with photographs and diagrams. ISBN 0-672-21 037-1. Recommended price $18.95

This book is intended to introduce the reader to equipment and techniques involved in the production of tape and disc recordings. It mostly concentrates on the studio aspects of this process but a chapter is devoted to the cutting and pressing of the records themselves. The author also makes an attempt to introduce the reader to some of the theory behind acoustics and sound recording.

The book begins with an overview of the recording chain, and moves on to discuss aspects of sound waveforms and their effects on the human ear. The coverage of studio equipment begins with the microphones, including the selection and placement of microphones for various applications. Professional tape recorders are then discussed, including a thorough coverage of the theory of recording.

Signal processing equipment is covered next, then recording consoles, noise reduction devices and studio monitors. The book goes on to describe the various operations involved in a recording session, as well as those involved in the mixdown and editing of the multitrack recording.

Individual chapters are devoted to a discussion of automated mixdown consoles, quadraphonic disc systems, and disc cutting and pressing. The appendix contains a number of articles reprinted from bulletins published by the 3M corporation. These articles cover various aspects of magnetic tape and recording in some depth, and are of a more technical nature than the rest of the book.

In our opinion this book suffers from two drawbacks, one being that it is an American publication, and so concentrates mainly on American equipment. The other is that the book was first published in 1974 and so is quite dated. No mention is made of solid-state delay lines and reverb equipment. Digital recording is mentioned in passing as a hope for the future, but is not treated in any detail.

In summary, despite its age and American slant, this book provides a thorough introduction to studio recording equipment and techniques. It provides a good starting point for those interested in looking further into areas such as acoustics or sound engineering, and it would be highly suitable for someone interested in the technical side of record production.

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OP AMPS Explained

Part 9

High voltage operational amplifiers may be built to any specification by combining ICs with transformers and transistors. Here we consider a number of practical circuits.

Most op amp applications generally familiar to us involve low-voltage signals, generally in the range 1mV to 10V. Stages which simply tailor or manipulate signals — for example volume controls, tone controls, and addition or integration sections — have the simple requirement that their output signal voltage be suitable as an input for the following stage; not too small and not too large. This requirement is generally easy to meet.

However, when we come to the final stage, which drives some external load, the situation is usually quite different. Our amplifier must provide an output signal voltage level which suits the requirements of the load — no matter what those requirements may be. So while we can choose the signal voltage level for the intermediate stages of our circuit, we do not have much say at all about the output signal voltage level.

Signal level choices

Being astute humans, we generally choose a nice easy signal level of about 1V for all intermediate stages. This allows us to simply rush to our nearest electronic supply counter and purchase economical integrated circuits, resistors and other electrotechnical paraphernalia, race home, construct something and have it working in short time. As we only want a signal level of about 1V, we can use nice low voltage power supplies, say ±9V, or ±12V, or even ±15V.

A slightly more subtle point may have escaped us: with very little effort on our part, the circuit will also probably achieve such desired properties as low noise, low drift, compact size and low cost. Before we take such widely-valued achievements for granted, let us acknowledge the fact that all these highly-prized attributes stem, in part, from the fact that the signal and power supply voltages are low.

Let's now face up to the output stage requirements. Notice we said *requirements*, not *choice*. It is the *load to be driven* (whatever that may be) that actually *demands* the voltage level here.

For example, to play records in the lounge room, a common 8Ω speaker at 1W power level must be driven by a signal level of 8V peak-to-peak. We have no choice if 1W is wanted and the speaker is 8Ω.

For 10 watts and the same speaker, 26V peak-to-peak is demanded and for 200 watts, 114V peak-to-peak. Obviously the amplifier output stage is also required to provide the appropriate current, which will be fairly high.

High voltages

We'll leave our discussion of high-current power amplifiers until the next chapter. For the time being, let's consider high voltage amplifiers for loads which, because of their high impedance, require very little current. There are more loads of this type around that may be at first thought. Domestic examples include electrostatic loudspeakers and the TV picture tube grid.

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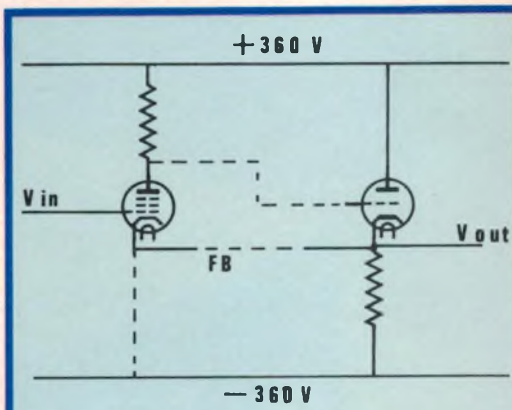


Fig 1: When grandpa used valve op amps he had no trouble producing outputs of ±100 volts or more. The dotted lines represent circuit details not shown.

Away from home we may meet such loads in radar tube applications; cathode ray oscilloscope blanking, Z modulation and deflection circuits; piezo-electric transducers; current sources; detonator firing systems; long signal cables; silicon controlled rectifier (SCR) firing circuits; electrophoresis, and more. In such sciences as neuropharmacology and biology we may meet microiontophoresis. Here the art of passing charged ions of exotic organic compounds through small-diameter, high-resistance microelectrodes demands a drive signal of a hundred or more volts.

Valves

In earlier years, when valves were used, high voltage signal requirements posed no problem. Electron tubes or valves were, by their very nature, high voltage devices. In fact, it was very difficult to manufacture a valve which was happy with low voltages. Mostly they operated from 150 to 300V supplies.

Some readers may be a little shocked at the idea that operational amplifiers could be anything else but integrated

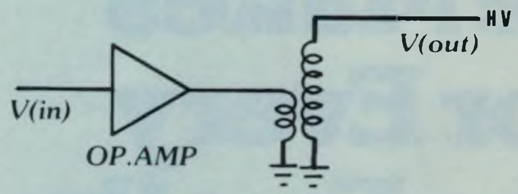


Fig 2: Using a small power op amp we can drive a transformer primary. If the secondary has a large number of turns a high output voltage will be produced. Problems will arise because the large back voltages generated by the transformer may damage the output stage of the amplifier.

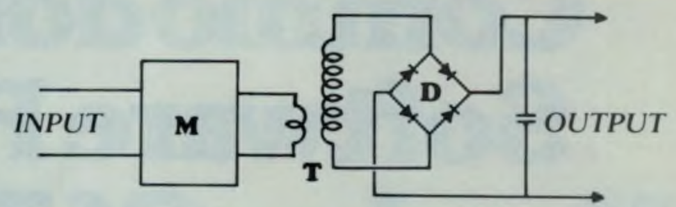


Fig 3: This is the circuit of a DC transformer. The input is either DC or long positive rectangular pulses. M is a feedback modulated RF oscillator, and T is an air cored RF transformer which produes a high voltage output. The output is rectified by the diode bridge D, which produces isolated DC or long positive pulses.

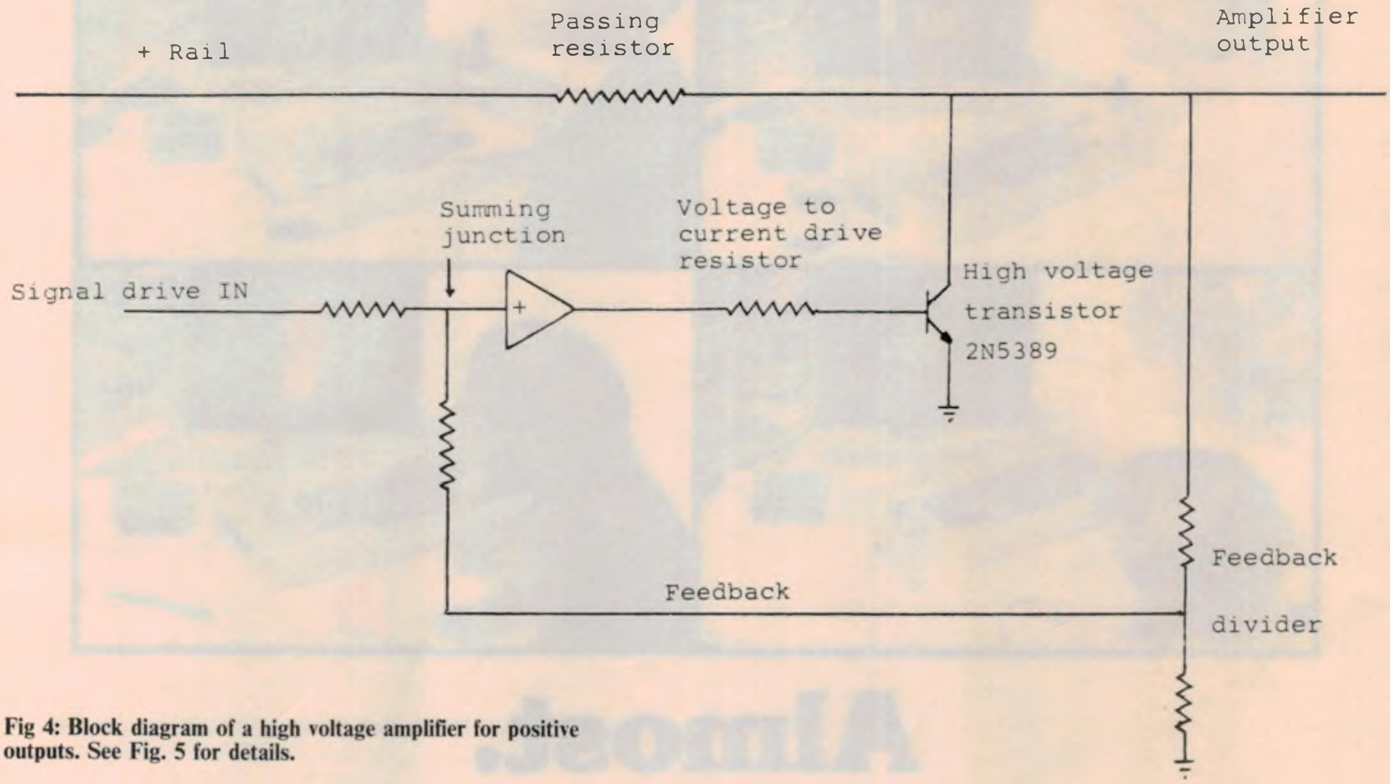


Fig 4: Block diagram of a high voltage amplifier for positive outputs. See Fig. 5 for details.

solid state circuits! Sorry to disillusion you, but operational amplifiers were first invented using valve technology (eg, the Tektronix Operational Amplifier Type O).

Consider Fig. 1. This shows a once popular valve operational amplifier circuit, wherein the provision of a 100V swing at the output was no trouble at all. Now that all valves (except large transmitting types) have been cast out in disdain, what shall we do for those occasional applications where the load demands a high-voltage, low-current drive?

FETS and transformers

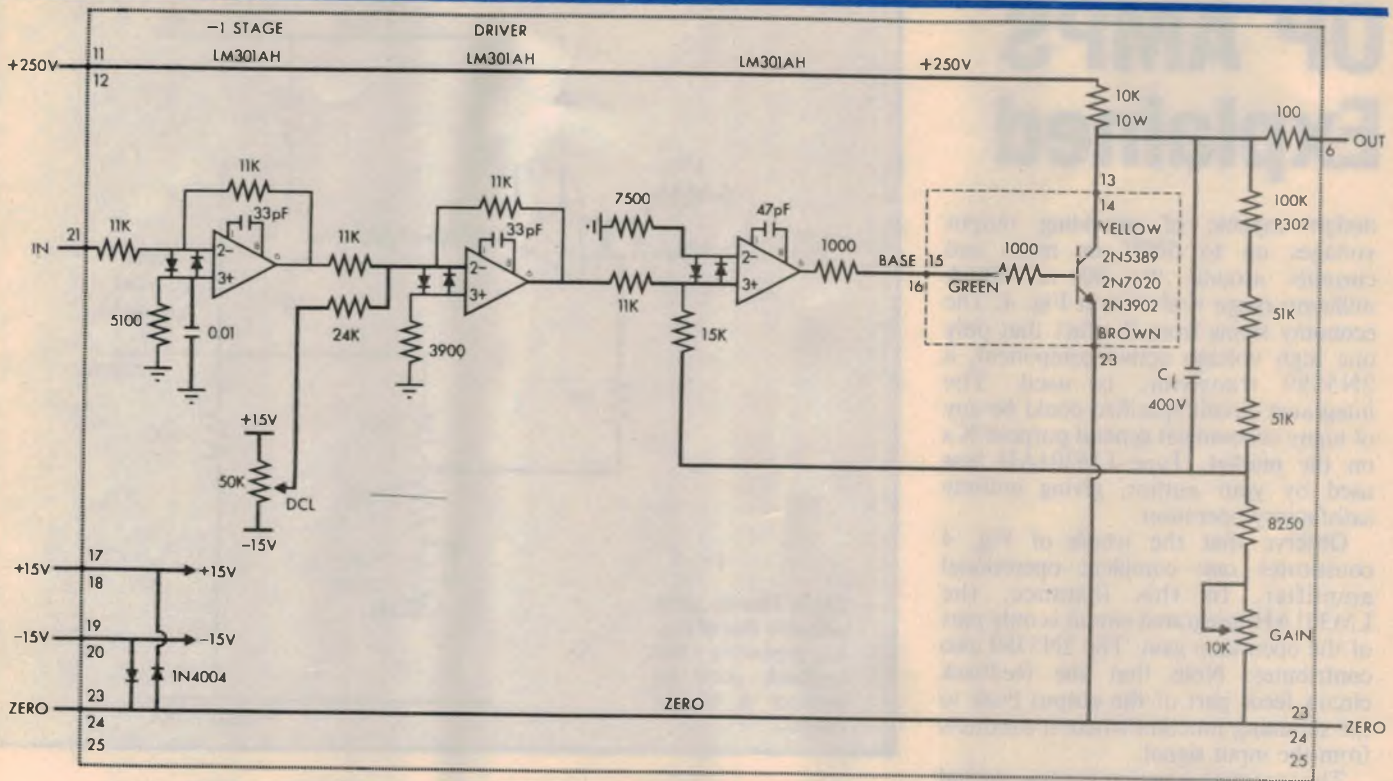
If we had field effect transistors (FETs) of sufficiently high voltage rating, we could implement Fig. 1 by directly substituting FETs for valves. If we did we would be giving credence to the saying of a wise circuit designer: "It is only circuit ideas that really matter — the technology used is a mere detail". But such FETs are rarely available, so we probably would not take that step.

Fig. 2 shows a way out if the signals are nice and "rounded", like sine waves. An ordinary step-up transformer driven by a low voltage solid state amplifier could provide high voltage output signals. Four points would need due attention if we used such a design.

(1). Even though the load is high impedance, the amplifier still needs to be a high-power type because of transformer magnetising current requirements.

(2). Strict precautions against repetitive or occasional high-voltage spikes caused by the inductive nature of the transformer are mandatory. Recall that an inductor produces a voltage that is proportional to the rate of change of current. Such spikes are notorious for their ability to damage transistors and integrated circuits. Just because you vow to always use signals with slow rise times does not preclude spikes caused by sudden changes. Remember that switching a circuit on or off can also generate voltage spikes.

(3). The foregoing and the limited frequency response of most transformers makes the reproduction of fast rise square pulses difficult.



RESISTORS IN OHMS 1% 0.1W } UNLESS SHOWN
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EXPECTED LOAD ≑ 5mA MAX LOAD = 12.6mA (15.85KΩ)	DCL RANGE 100–240V GAIN RANGE 18–28 FOR INPUT 0 – +5V	240V MAX 0V MIN	OUTPUT	
C_f = 8.2pF FOR SE7020 C_f = 18pF FOR 2N5389 2N3902	BYPASS EACH LM301AH USE 0.15µF PINS 4,7	SET 201V SET 99V	OUTPUT	LINEAR HIGH VOLTAGE AMPLIFIER
R_0 = 100Ω	BANDWIDTH 20KHz	+5V 0V	INPUT	

Fig. 5: Detailed circuit diagram of a positive, linear, high voltage amplifier. See also block diagram, Fig. 4.

OP AMPS Explained

(4). Low frequency square waves pose a different problem due to insufficient inductance in the transformer. The limiting case, DC, is of course utterly impossible. On low frequency signals, transformer coupling results in voltage depression below the baseline. This means that, as with coupling capacitors, the output is forced to assume equal positive and negative areas under the waveform (see Part 4, June 1984).

Despite its difficulties, the transformer-coupled scheme does have some uses. Two favourite applications are 600Ω audio lines, as in multiple public address loudspeaker systems, and SCR gate triggering circuits. Both instances, though very different, may need signals measured in hundreds of volts. Note one automatic (and desirable) property of transformer coupling: circuit isolation.

DC transformers

When low frequency square waves are required or where isolation is also a requirement, the scheme shown in Fig. 3 is occasionally used wherein the signal is used to modulate a high frequency carrier. The system shown here provides a simple method of coupling long, strictly positive, pulses. More complex arrangements are needed if a double-sided (bipolar) output is wanted. Fig. 3 is sometimes called an FM transformer or, alternatively, a DC transformer.

As long as circuit isolation is not a requirement, wouldn't it be nice to have a simple operational amplifier capable of directly providing the required high voltage output. Then the waveform could be any shape, slow or fast, or even DC. Of course such amplifiers would have to operate from high voltage rails.

High-voltage op amps

There are only a few high-voltage op amps on the market and, of these, only a couple are capable of working from rails of 100V or more. Because such voltages mean that a fair amount of power has to be dissipated, it is difficult to integrate the circuit onto one chip.

For this reason, some manufacturers prefer high-voltage op amp modules made up from discrete transistors. The parts are usually mounted on a small PC board and then encapsulated in an epoxy resin compound to ensure good thermal coupling. These modules are generally fairly expensive.

Other manufacturers produce integrated amplifiers with voltage ratings up to ±40V, such as the Harris type HA2640/2645 and the Motorola type MC1536. These are capable of giving up to 70V output voltage swings, meaning that the HA2640 output can swing anywhere from −35V to +35V. Load currents up to 15 milliamps and open loop gains up to 500,000 are part of their specifications.

The final approach is to build our own operational amplifier. This particularly applies if we require an output voltage swing greater than 100V.

A basic idea for a simple, low-cost

OP AMPS Explained

design capable of providing output voltages up to 500V or more and currents around the 30 or 40mA milliamp range is shown in Fig. 4. The economy stems from the fact that only one high voltage active component, a 2N5389 transistor, is used. The integrated circuit specified could be any of many economical general purpose ICs on the market. Type LM301AH was used by your author, giving entirely satisfactory operation.

Observe that the *whole* of Fig. 4 constitutes *one* complete operational amplifier. In this instance, the LM301AH integrated circuit is only part of the open loop gain. The 2N5389 also contributes. Note that the feedback circuit feeds part of the output back to the summing junction where it subtracts from the input signal.

The summing junction is a true virtual earth and the "+" mark on the integrated circuit indicates the IC's own positive input (pin 3). The vital point is that the phase change in the 2N5389 makes the overall gain (from the summing junction to the amplifier output) negative.

This is a good example of the drum your beloved author is fond of beating — that an integrated circuit of itself is not an operational amplifier!! Only a complete circuit with negative open loop gain and a closed negative feedback loop constitutes an op amp. With such high open loop gain $[A_o = (\text{gain of LM301}) \times (\text{gain of 2N5389})]$, the circuit

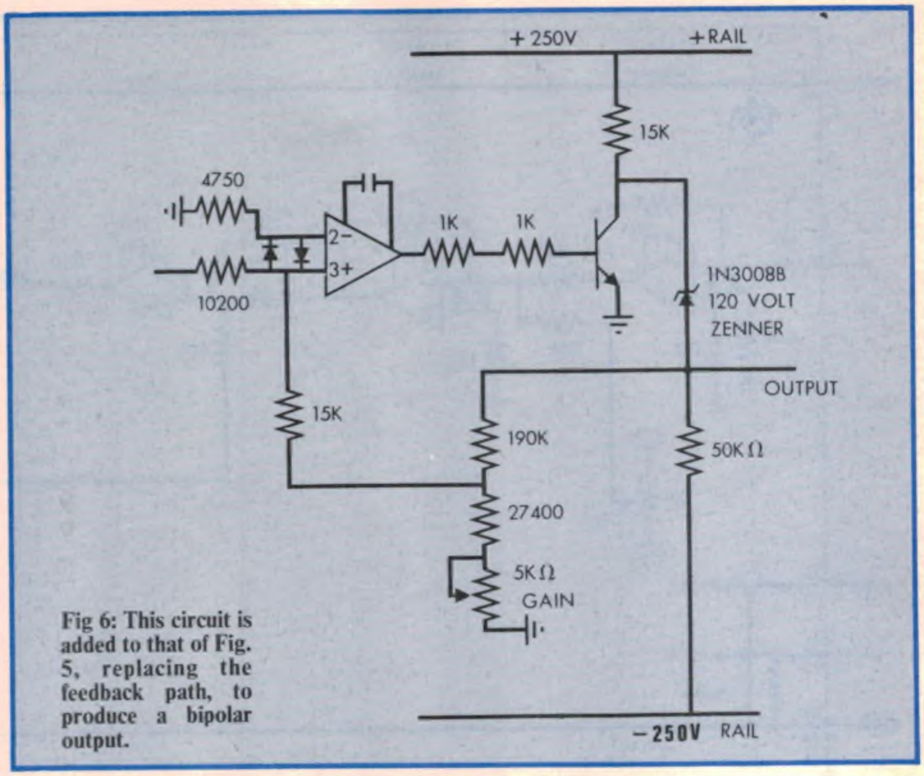

Fig 6: This circuit is added to that of Fig. 5, replacing the feedback path, to produce a bipolar output.

accuracy is impressive.

The block diagram Fig. 4 and the detail diagram Fig. 5 are for an amplifier required to furnish positive output only.

The output, as shown in Fig. 5, swings between 0V and +240V, and the maximum output current is 12.6mA. Negative feedback is provided by the four resistors and the potentiometer from the output to zero, together with the 15kΩ resistor between the virtual earth (pin 3) of the right hand LM301AH. Feedback capacitor C_f is chosen for the particular transistor type used, (any one of the 2N5389, 2N3902 or SE7020). As shown in Fig. 5, C_f is either 8.2pF or 18pF.

The circuit in the right-hand half of Fig. 5 is called a shunt controlled negative feedback system and is, in fact, one large operational amplifier. Note that the large shunt transistor, 2N5389, must be kept cool to minimise collector-base leakage, i_{CBO}, while working in linear mode on such high voltages. It should therefore be mounted on a large, finned heatsink.

The feed resistor to the transistor base consists of two 1000Ω units in series, one of which is mounted directly at the transistor base to suppress parasitic-oscillation. This resistor must not be

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OP AMPS Explained

wire-wound; ie it must not be inductive.

The preceding stages consist of two LM301AH units, each acting as independent unity gain op amps. The one marked "driver" sets the DC level of the output and, as readers will see, is actually a "level shifter" or "voltage-adder-translator stage" (big name for a small stage, eh?). The chosen DC level is set by the potentiometer marked DCL, and shifts up to 242V are possible.

The first stage, on the extreme left, simply provides phase-reversal. Note that all LM301AH integrated circuits should operate from well-regulated ± 15 volt supplies, bypassed at each IC using 0.15μF ceramic capacitors. The high voltage supply to the output transistor stage is +250V.

The overall gain is set by the 10kΩ potentiometer marked "gain" in the feedback chain, and may be set to any value in the range 18 to 28. This range could be extended by changing resistor values, but such a step would require a different C value and would modify the system bandwidth and perhaps drift rate.

The complete amplifier has a bandwidth from DC to 20kHz and rise and fall times of less than 22μs. The amplifier is linear to at least 0.1%, while the measured drift rate is less than 2mV per day (at a constant room temperature).

Spin-offs

Another amplifier was constructed whose circuit is the "mirror image" of Fig. 5; that is, a PNP power transistor was substituted in the output stage and a −250V high voltage supply was used. Changes to the DCL potentiometer circuit were only minor. The characteristics of this amplier are similar to the previous version except that the output now swings between 0V and −240V.

A third amplifier was implemented for output signals swinging both positive and negative, the high voltage supply being ±250V. This is easily achieved by the "add-on" shown in Fig. 6. The circuit has low drift and features a measured bandwidth of DC to 24kHz.

But, gentle reader, that's not the end of the possible evolution of "spin-offs" from Fig. 5. Yet another amplifier was built to supply an output signal swinging between +1V and +400V, from a high voltage supply of +430V. To achieve this, several resistor values were changed, giving gain of up to 41 and a measured bandwidth from DC to 14kHz.

Power supplies

By now, you are probably blinking your eyes and wondering just where your so-and-so author got all those high-voltage regulated power supplies. Do not fret, it is not that difficult really. Look closely again at Fig. 5. If the input is held constant, then the output will also remain constant, ie, the circuit will behave as a regulated, high-voltage DC supply. Fig. 7 shows a practical regulator circuit.

Fed from a 300V RMS winding on a mains transformer, the diode bridge rectifier provides an unregulated, filtered

Continued on page 122

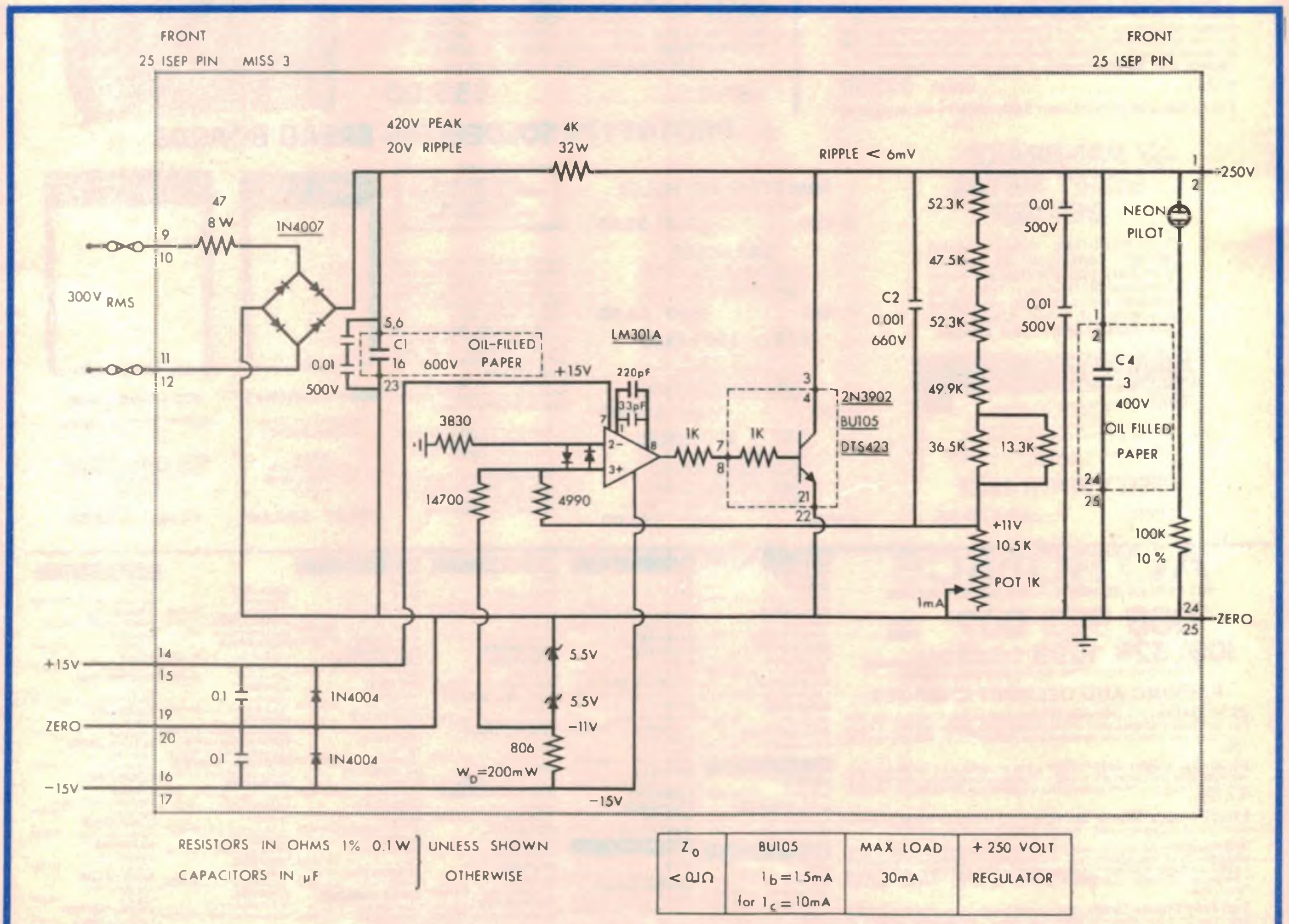

Fig 7: Here is the circuit diagram of a 250 volt, 30 miliamp, linear regulated voltage supply.

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MAHLER

Mahler: Symphony No. 4. Chicago Symphony Orchestra conducted by Sir George Solti with Kiri de Karawa in the fourth movement. Decca digital 410 088-1.

I do not like this reading of Mahler's Fourth at all. Solti overdoes the expression in this essentially simple work. It is difficult to imagine any conducter sounding more self-indulgent.

The tempos are wayward, accents are unexpectedly all over the place. And Chopinesque rubatos abound. It is all an exercise in gutsy sentimentality. Solti in turn teases it, pets it, and it's not too extravagant to say that he hugs it shapeless in a possessive love affair with the music. He should listen to the late George Szell's account of the work.

In the soprano solo in the Fourth Movement, Kiri de Kanawa is in good voice but sounds a wee bit too sophisticated, too contrived to win the childish effect the composer expected. And everywhere the sound is much too loud. Turn down your gain or face irate neighbours. (J.R.)

MOUSSORGSKY

Moussorgsky: Pictures from an Exhibition. Taneyev: Prelude and Fugue in G sharp Minor. Borodin, Scherzo, Tchaikovsky, Dumka. Vladimir Ashkenazy (pianist).

The 15 short pieces comprising Moussorgsky's Pictures from an Exhibition run for well over half an hour. As you probably know they are graphic little musical sketches of things and people in mid-19th century Russia and elsewhere.

When I think of recent great Russian pianists I automatically recall Richter and Cherkassy, plus Ashkenazy, of course. Of these Cherkassy, some couple of years ago, gave us a beautiful account of this work, restrained in the composer's most violent moments, always intensely lyrical, always precise and tonally lovely. On a 45rpm disc it took up the whole record.

This present 12-inch needs filling, hence the assortment of sometimes uneven little pieces by famous Russian composers as listed above, But first let us look at the Pictures. It is digital which gives it an edge in the heavy bass line by Bydlo. There is little to choose between the earlier recording of Limoges with its bustling market scene.

But here we have a more powerful Baba Yaga, forceful yet masterful. Gnomus attracted me by its continuing contrasts and the Great Gate of Kieff brings the performance to a brilliant end. Among the smaller pieces, the ever-popular Tchaikovsky Dunka is followed by Liadov's equally and utterly charming Musical Snuff Box. There is a bright Taneyev and delightfully melifluous Borodin Scherzo. I think Ashkenazy fans — and they number millions, to my mind deservedly — will not be disappointed. (J.R.)

DONIZETTI

Donizetti: Il Campanello Comic opera in 1 Act. Agnes Blatsa (soprano), Enzo Boro (bass), Carlo Gaifa (tenor). Biencamira Casoni (mezzo soprano). Angelo Romero (baritone), with the Vienna State Opera Chorus, Vienna Symphony Orchestra conducted by Gary Bertini. CBS Masterwork D584450. Digital.

CBS must have been eager indeed to find something out of the 18th century museum to attract the collectors of oddities when they chose Donizetti's inconsiderable work to replace the copious recordings of better known and better loved operas.

Until now I had thought this was the strictly private domain of our Joan and Richard to dig out these early 18th century museum pieces since anything with Joan Sutherland's name on it sells well. They revive these works — if revive can be used here in the more mundane sense of having restored life. Wouldn't it be better to let them rest in peace than reappear as spooks?

Moreover it seems a trifle extravagant to pack only one disc in a box but I suppose the accompanying libretto was the reason, especially when non-Italian speaking listeners do not know the work.

In any case it is very well recorded with an atmosphere I can only call vivacious. The story is a well used bridal night Italian comedy and the music below Donizetti's best standard. But the singing is generally very good and the Vienna Symphony responds with a splendidly adjusted early 18th century idiom. (J.R.)

FALLA

Falla: Nights in the gardens of Spain. Albeniz: Arranged Halffter. Rapsodia Espanola. Turina: Rapsodia Simfonica. London Philharmonic with Aligia de Larrocha; Decca Digital 410289.

It is so long since I heard this work I had forgotten how attractive it is. Only rarely played nowadays its conductor is seldom heard from. Yet here both shine luminously. There is a perfect balance between piano and orchestra, though the piece is not a piano concerto. It is just another orchestral instrument in the brilliant scoring.

Its true atmosphere is established at once with faithful piano tone and sumptuous orchestra. Falla, a contemporary of Les Six in Paris, was not linked to any of them though his music always showed elegant originality. And here might be as good a place as any to clear up the pronunciation of the composer's name.

He is usually called Fieya or de Fieya. Neither is correct. Spaniards never use the "de"; when using only the surname. The correct pronunciation is Fallya or Manual de Fallya. I got this not long ago from the Australian Ambassodor to Spain who lived in a street of that name and the taxi driver in Madrid who took us there confirmed it.

Are the rubatos self-indulgent? Perhaps, So what? They belong to the musical text.

Also on the disc is Albeniz' Rapsodie Espagnola, lightly scored for orchestra so that the original solo piano text can be played unaltered. It is a pleasant enough work though not in the same class as the Falla.

TAPES INTEREST

A third piece is not quite so well recorded — Turina' Rapsodica Sifonica, another piece that I haven't heard for 59-odd years. It delighted me, as did the whole disc. (J.R.)

STRAUSS

Richard Strauss: Burlesque for Piano and orchestra. Rudolf Serkin (piano) with the Philadelphia Orchestra conducted by Eugene Ormandy. Horn Concerto No. 1; Myron Bloom (horn) with Cleveland Orchestra under George Szell. Oboe concerto; Neil Blace (oboe) with English Chamber Orchestra under Daniel Barenboim. CBS Masterwork Analog CB211.

More music for piano and orchestra. The disc (analog) has a very hard tone and is recorded much too loudly. Reduce your gain well below its usual level. The playing is very exact and completely humourless — wooden, in fact. Even the Mendelssohnian bit in the middle is precise but much too stern. After all the composer named it Burlesque. It's all very brisk but that's all I can say about it.

This piece is also accompanied by a shrill orchestra — all but the horn tone. An early work it sounds very trite nowadays with its square-cut diatonic tunes and student-like harmony. The horn solo is stylishly played — if you like the fat German horn tone. Orchestrally one need only say it's Szell and the Cleveland to hint at the perfect precision.

In contrast, the Oboe concerto was written towards the end of the composer's life and here we have the pen of a master. The recording is again coarse. And the well-played oboe, if you use your usual gain-setting, becomes as loud as a muted trumpet. On the whole not recommended. (J.R.)

BEETHOVEN

Beethoven: Sonata No. 3 for Cello and Piano in A major Op 69. Sonata No. 5 for Cello and Piano in D major, Op 102. Yo-Yo May (cello) and Emanuelax (piano).

The year or so ago recording of the first two of the Cello Sonatas amazed me by the sheer churtzpah of its effortless virtuosity. On hearing it many must have wondered just how the more

serious Third and Fourth would go. About 18 years separated the composition of the two brackets. They need not have worried.

To support this statement, play the Adagio of the D major and hear its lyrical eloquence. The introspective first movement, inturned and outgoing, is splendidly realised by both performers. So too is the fugato Finale, digitally clear and hard-minded. Opus 69, perhaps the most deservedly popular of all five cello sonatas, is always dramatically treated and magically clean in the first movement.

Equally dramatic, though in unexpected places is the following Scherzo. For the Adagio refer to the Adagio noticed above. This serves you as an introduction to the romping Finale presented with such ease that the players could be chuckling at the time, as the picture on the record sleeve might suggest. Exhilarating works peerlessly played. (J.R.)

CHRISTMAS ALBUM

Amy Grant: A Christmas Album. Stereo LP, Myrrh 6768. From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.

Recorded in the latter part of last year, this album reached me just too late for inclusion in the December '83 issue, so I held it over for the current Christmas season.

Looking at the credits on an inner sheet, it is apparent that quite a story could be written on how the album was recorded. The basic tracks were laid down in Nederland, CO, while the strings and woodwinds were recorded at separate locations in London and

Canada (presumably Ontario). The horns were recorded at Nashville, the Choir at Hollywood, with additional overdubs coming from three other studios. All this was assembled by a group of panel engineers and finally committed to disc by none other than Doug Sax.

So, if you get to read the credits and to hear the extensive backing support that Amy Grant has, remember that the only time they all got together was in the final mix-down!

Fortunately, none of this venue-hopping is evident in the sound as heard. It is clean, well balanced and well arranged, lending generous support to the soloist, without ever dominating her voice.

Not surprisingly, Amy Grant's is a distinctly American Christmas, with snow, sleigh bells and chestnuts, and little in the way of simple, traditional carols. For the most part, the arrangements are modern, up-tempo but certainly not way-out.

The titles, with lyrics supplied, are: Tennesse Christmas — Hark! The Herald Angels Sing — Praise The King — Emmanuel — Little Town — Christmas Hymn — Love Has Come — Sleigh Ride — The Christmas Song — Heirlooms — A Mighty Fortress/Angels on High.

Assuming that you already have your share of traditional carols, the chances are that you'll quite enjoy Amy Grant's Christmas by way of a change. Well worth a hearing. (W.N.W.)

A SUPERB LP

Debussy: La Mer. Three Nocturnes. Andre Previn conducting the London Symphony Orchestra, with the Ambrosian Singers. EMI digital/DMM stereo LP, ASD 1436321.

Julian Russell warmly commended this same coupling on a Philips LP, in November last year, played by Colin Davis and the Boston Symphony Orchestra. I did not hear that recording personally but Michael Oliver in "Gramophone" selected it as the one with which to compare this new performance by Previn and the LSO. His verdict: Previn is a little warmer, a little more emotional, but both are "performances I could gladly live with".

I, personally, could live very easily with this new EMI release. Its dynamics run from the merest murmur of sound to a fortissimo that even Telarc would be proud of. The surface is dead quiet, the sound stage magnificently defined and the sound itself immaculate.

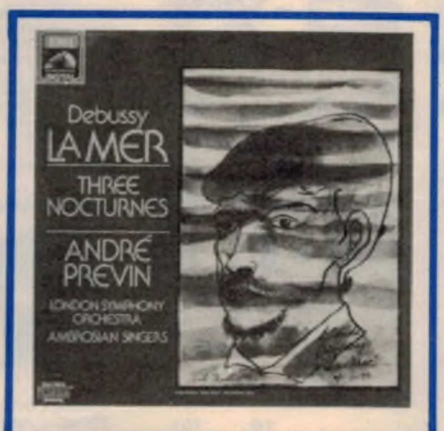
As I listened to this latest example of "black" disc technology — digital recording and direct metal mastered — I had to marvel yet again at the resilience of the stylus-in-groove system. Having held its own against a massive challenge from tape, here it was producing sound that, subjectively, was little different from that from compact disc.

The music itself is highly descriptive and easy to assimilate.

"La Mer" (The Sea) was completed during a holiday at the Eastbourne Hotel (UK) in July, 1905 and performed for the first time in Paris in October of that same year. It has three movements which, in abbreviated English describe: "Morning on the Sea", "Joy of the Waves", and "Dialogue: The Wind and the Sea". As James Harding points out in his jacket notes, Debussy's "La Mer" is descriptive but not superficially so. Rather is it "a masterpiece of musical impressionism . . . with each detail of the intricate mosaic . . . placed in its context with the utmost precision".

The Three Nocturnes predated La Mer, having been first conceived by Debussy around 1890, revised in 1894 and again in 1899. "Nuages" (Clouds) is restrained and gentle, befitting the unhurried procession of clouds to the distant horizon. "Fetes" was said by Debussy to refer to specks of dust dancing in the sunshine; he likened them to "Festivities" and that's how they sound. "Sirenes" has to do with those fictional maidens who, with their songs, sought to lure sailors, to their death. Listen to the Ambrosian Chorus in this role and I suggest that they will at least help to lure you to the cash register!

In short, this is a disc that belongs in your collection. (W.N.W.)



TWO SYMPHONIES

Mozart: Symphonies 40, K550; 41, K551 "Jupiter". The Los Angeles Chamber Orchestra conducted by Gerard Schwarz. Delos compact disc D/CD 3012. From P. C. Stereo Pty Ltd, PO Box 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612.

In his booklet notes, David Wright suggests that these two symphonies are unusual in that, unlike the majority of Mozart's other works, they do not appear to have been composed with any particular occasion or concert tour in view. Nor is there any record of a performance, actual or anticipated, until years after the composer's death.

No less curious is the fact that his last and greatest symphonies, Nos. 39, 40 and 41, were composed in a brief two-month period in the summer of 1788, when desperate financial problems and the death of his infant daughter had pushed him to the brink of despair. Yet, in those two months, he completed the "joyous and graceful" symphony No. 39, the "dark and brooding" No. 40, and No. 41, of such "Olympian splendour" that it later earned the title: "Jupiter".

Did those contrasting compositions reflect Mozart's rapidly changing emotions or do they signify an ability to

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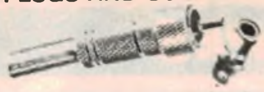

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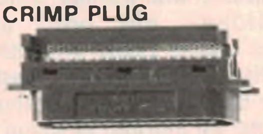

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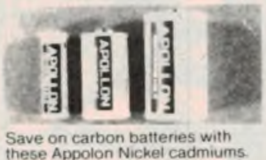

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distance his art from the mood of the moment?

Whatever the answer to that question, says David Wright, "these are the works, if any are, that ushered in the 'symphony' as we now know it". He then goes on in his notes to detail the structure of symphonies 40 and 41, to assist those to whom they may be unfamiliar.

Both are presented on this disc by Gerard Schwarz conducting the Los Angeles Chamber Orchestra, regarded by many in the USA as the finest ensemble of its kind in the country. While of modest proportions by symphonic standards, it is appropriate to Mozart's original scoring, and is not lacking in weight, when called upon.

You may be interested in this recording as a student or simply fancy it for your collection but, either way, I don't think you'll be disappointed. There's certainly nothing to complain about in the technical quality, which we commended last year in the digital-LP version. (W.N.W.)

BEETHOVEN

SYMPHONY No. 5 in C Minor, Op. 67. Egmont Overture, Op. 84. Boston Symphony Orchestra conducted by Seiji Ozawa. Telarc compact disc CD-80060. [From P. C. Stereo Pty Ltd, PO Box 272. Mt Gravatt, Qld 4122. Phone (07) 343 1612]

For a work that was to become possibly the most frequently played of all major orchestral compositions, Beethoven's Fifth Symphony had a most unfortunate premiere in Vienna during the December of 1808:

Seiji Ozawa and Boston Symphony Orchestra.

It was performed under the wrong title (described as the 6th), and included in a program of all new music (Beethoven premieres), that was too long anyway (four hours or more). The theatre was bitterly cold, the orchestra was under-rehearsed and compensated by playing too loudly, and a soprano soloist for one of the works suffered a chronic case of stage fright!

It took 18 months and a rave review of another performance, by writer/composer E.T.A Hoffman, to cancel the memory of that disastrous evening.

The composition acquired yet another name during World War II, that of "Victory Symphony", when it was noted that its opening phrase of three staccato chords and one long one formed the Morse Code sound for Churchill's famous V-for-Victory slogan.

However, in his lengthy booklet notes, Stephen Ledbetter points out that the actual term is much older than that, having been coined by Goethe to describe Beethoven's incidental music for his historial play "Egmont". As the curtain falls and Egmont is taken away to a hero's death, the music swells, according to Goethe, into a "victory symphony". (The Egmont overture is the second item on this disc).

I note that, in the April '83 issue, Julian Russell referred to a "much acclaimed" recent issue of the Beethoven 5th by Kleber, and to a then-new "attractive" and "picturesque" version on Decca by Ashkenazy and the Philadelphia Orchestra. In fact, this Ozawa/Boston SO performance has been around since 1981, but it has won acceptance and stood the test of time as a digitally-sourced LP.

It is a vigorous and polished performance, with a sound that is best described as full and cohesive. The recording is characterised by excellent dynamic range, occurring naturally, without any attempt at ostentation for its own sake. Even more important, it is very clean and virtually free from the "papery" edge that is sometimes evident in complex orchestral sounds.

If you have a place in your collection for another Beethoven 5th or, more likely, for one in the CD format, Telarc's CD-80060 is well worth considering. (W.N.W.)

Two low-cost utility amplifiers

Here we present two general-purpose audio amplifier modules, together with detailed explantions of how they work. One module will deliver 1 watt while the other is capable of delivering up to 20 watts.

by ANDREW LEVIDO

Low power audio amplifiers are used in a surprising variety of electronic devices. The TV set in your lounge room uses an audio amplifier, as do transistor radios, tape players, record players, electronic musical instruments, movie sound projectors, and electronic games. For this reason, a general-purpose audio amplifier is a handy device for any hobbyist to add to his workbench.

Some modern audio amplifiers use an integrated circuit module, but a surprising number are still designed around discrete transistors. There are several reasons for this. Discrete designs are usually more reliable, cheaper, and easier to service.

The two designs to be described thus use discrete transistors and are very easy to build and get going. In addition, they present an ideal opportunity for the hobbyist to gain an understanding of how an audio amplifier works. IC "black boxes" are fine, but they don't tell you anything about the circuit operation.

To this end, fairly detailed explanations of the circuit operation are given. In particular, we explain how a complementary symmetry amplifier works and discuss such things as bias stabilisation and Vbe multipliers.

The accompanying specification panels and the graphs give the technical details of the amplifiers, while the physical details can be determined from the photographs. Each amplifier is built on a printed circuit board which, in the case of the 20W version, also carries the heatsinks. They are not intended to be hifi amplifiers, although the 20W version could form the basis of a modest stereo system.

How it works

Before involving ourselves with the details, let's first review the basic theory underlying amplifiers of this general type. Fig. 1 shows a basic complementary symmetry output stage which forms the basis of both amplifiers. Note that the bias components have been omitted for clarity.

The circuit consists of two emitter followers connected together such that each amplifies half of the incoming waveform. The circuit is so biased that the bases of the two transistors, and thus their emitters, are held at half the supply voltage when no signal is present.

Imagine a sinusoidal signal applied to the bases of the two transistors. When a positive half-cycle occurs transistor Q1 is forward biased and thus operates as an emitter follower. Similarly, Q2 is forward biased during negative half-cycles of the input signal. Thus the whole input signal is amplified and applied to the load.

To use the popular jargon, Fig. 1 is known as a class-B output stage. The big advantage of this scheme is that, when no input signal is present, both transistors are off and so no current is drawn from the supply. Class-B amplifiers are thus quite efficient in terms of current consumption.

A class-A amplifier, on the other hand, is one in which the active device is turned on for the full input waveform. In other words, the transistor is biased so that it operates over both positive and negative excursions of the cycle. This type of circuit draws considerable quiescent current in the no-signal mode and is thus relatively inefficient.

There is one major problem with class B- amplifiers, however, and that is crossover distortion. This occurs because neither transistor will turn on until the base-emitter junction is forward biased by about 0.7V. Thus, there will be a period when both transistors will be off; ie while the input voltage is between +0.7V and −0.7V. This means that there will be a discontinuity in the output waveform as it passes through the mid-point.

This situation is obviously not acceptable, so some way must be found to eliminate the problem. The most

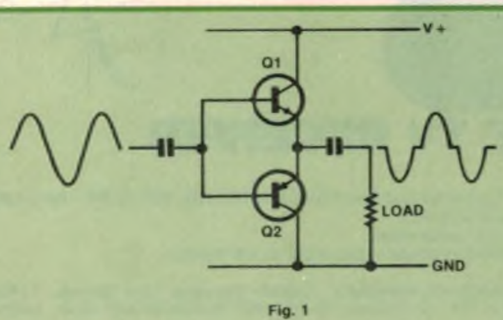


Fig. 1

Fig. 1 (left) shows the basic class B output stage, while Fig. 2 (right) shows the same stage with additional components to eliminate crossover distortion.

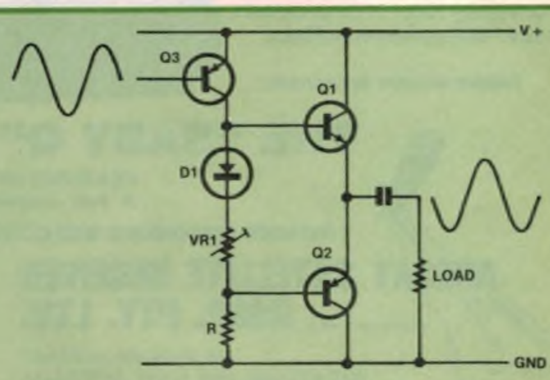
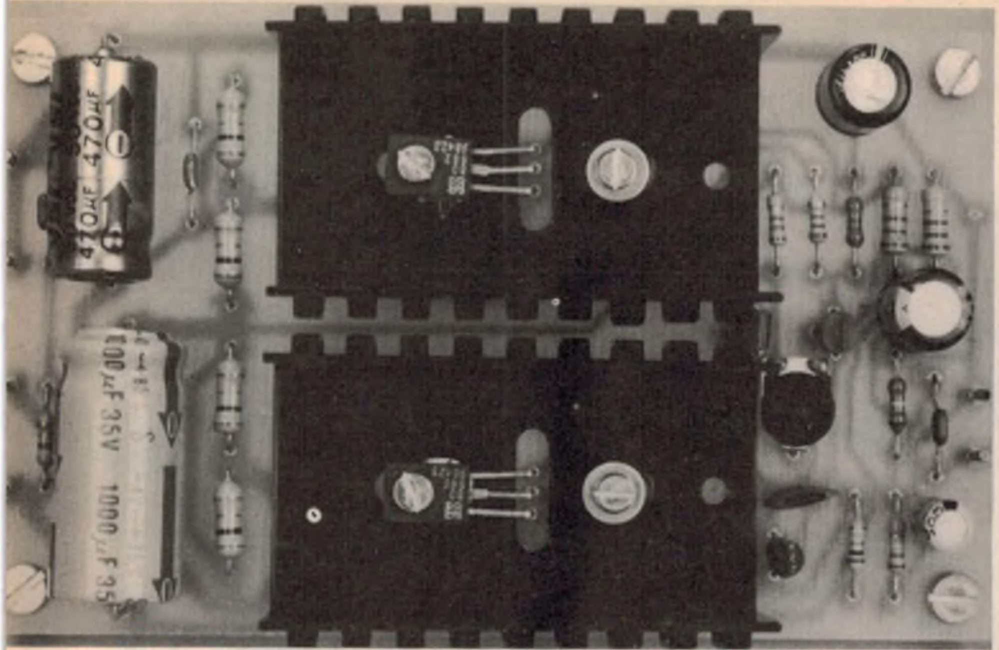


Fig. 2



This photograph shows the completed 20 watt amplifier. Note the heatsinks on the board.

We estimate that the current cost of parts is

$9-10

for the 1W Amplifier and

$17-20

for the 20W Amplifier. These prices include sales tax.

obvious solution is to bias both transistors so that they are just turned on with no signal present. If this is to be the case the bases of the output transistors cannot be connected together but, instead, must have about 1.4V between them. Fig. 2 shows one configuration which provides this condition.

Q3 is biased so that, with no signal present, a small current flows through it. This current flows through D1 and VR1 to provide the 1.4 volts difference between the bases of Q1 and Q2. A variable resistor is used in this position so that the bias current can be adjusted to the minimum value required to eliminate crossover distortion.

The diode is used to provide temperature compensation. The voltage which we are trying to match, the voltage across the base-emitter junctions of the output transistors, does not remain constant with temperature. Thus a diode, with its similar voltage-temperature coefficient, is used to compensate for the change in base-emitter voltage with temperature.

1W amplifier

Referring now to the circuit diagram of the one watt amplifier, it can be seen that the output stage of Fig. 2 is used with only one minor variation. The resistor on the base of Q2 is no longer connected to the negative rail but is instead connected to the output terminal.

The reason for connecting one side of the 1kΩ resistor to the output rather than the negative supply is to provide "bootstrapping". Because the output stage is essentially a complementary emitter-follower with almost unity gain, there is almost no difference in AC signal voltage across the 1kΩ resistor. Therefore very little signal current flows in this resistor and so there is less loading on Q3 than there otherwise would be. This translates into slightly more output signal and slightly less distortion.

The only other addition to the circuit is the stage containing Q4. This stage provides some of the voltage gain of the amplifier as well as establishing the bias conditions throughout. The +12V rail is decoupled by the 100kΩ resistor and the 22µF capacitor, and then applied to a voltage divider consisting of 1.8MΩ and 2.7MΩ resistors. This sets the voltage on the base of Q4 to just over half supply.

The emitters of the output transistors are held close to half the supply voltage by means of DC feedback provided by the 2.2kΩ resistor. In simple terms this is how it operates. If the voltage on the emitters of Q1 and Q2, and hence the voltage on the emitter of Q4, is lower than 6V, then Q4 turns on harder since it's base is held at just above 6V. This means that Q3 also turns on harder, and so the voltage at the emitters of the output transistors is forced to rise.

In the same way, if the voltage at this point rises above 6V, Q4 reduces the drive to the output stage, thereby lowering the voltage at the output.

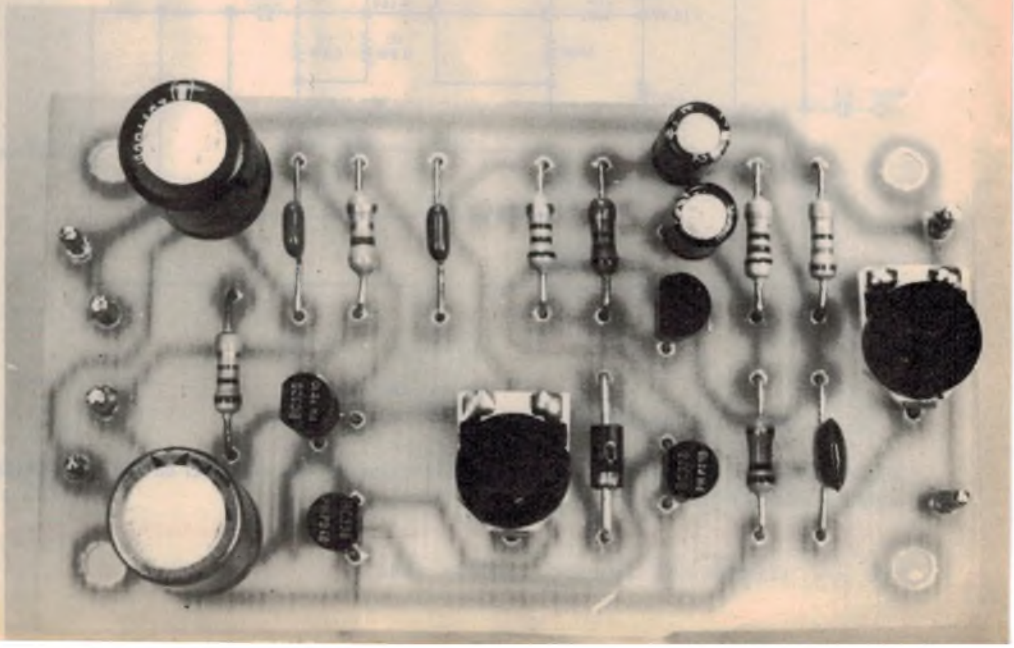
Now let's consider what happens when a signal is applied to the input. Trimpot VR1 sets the signal level into the amplifier while a .01µF capacitor provides AC-coupling to the base of Q4. Note that since the impedance at the base of Q4 is about 1MΩ, VR1 determines the overall input impedance of the amplifier (ie, the amplifier has an input impedance of 100kΩ).

Q4 is configured as a common-emitter amplifier. The 2.2kΩ resistor provides overall AC feedback around the whole amplifier, as well as the DC feedback mentioned earlier. Feedback is used in this way to increase the stability of the amplifier and to reduce dependence on the gain of individual transistors.

The load for the common emitter stage is provided by Q3, which is the driver transistor for the output stage (Q1 and Q2). The output stage provides the necessary current gain to drive low impedance loads such as loudspeakers.

A 470µF capacitor is used to block the DC component present on the output. The 4.7Ω resistor and 0.1µF capacitor

The completed 1 watt amplifier is mounted on a PC board measuring only 44 × 77mm.



Low-cost utility amplifiers

across the output form a Zobel network to ensure the amplifier remains stable into all types of loads. Filtering of the supply is provided by the 100μF and 0.1μF capacitors connected from the +12V rail to ground.

Using the components shows in Fig. 3, the voltage gain of the circuit is approximately 15.6. This can be adjusted to suit individual needs and is set by the ratio of the 2.2kΩ and 150Ω resistors. For example, reducing the 150Ω resistor to 100Ω increases the gain to 23.

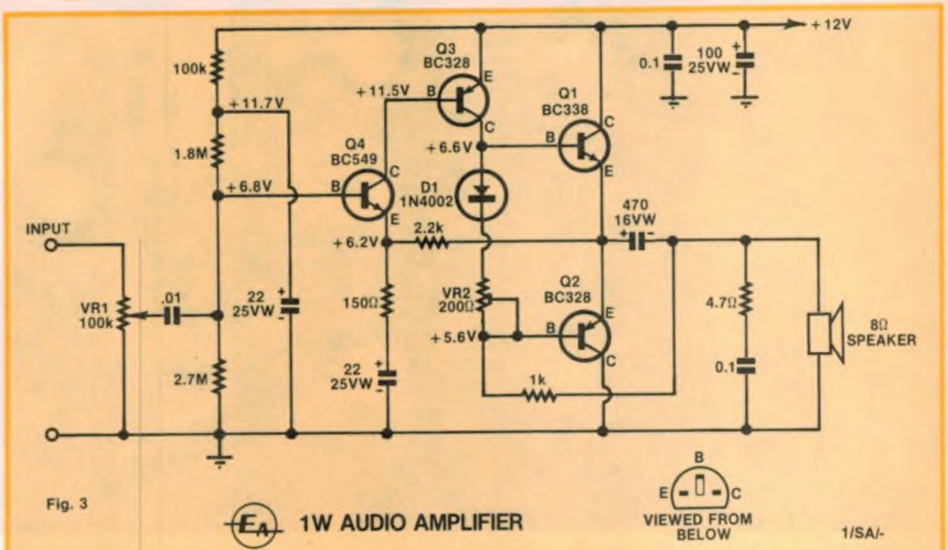


Fig. 3: The voltages shown on this circuit diagram are measured with no signal present. They clearly illustrate the DC conditions under which the amplifier operates.

20W amplifier

Now let's turn our attention to Fig. 4. Although this circuit is slightly more complex than the lower-powered version, the same general principles apply.

The input stage is virtually identical and bias is provided to the whole amplifier in the same way. The most obvious differences are around the output stage where Darlington transistors have been used. These transistors were chosen because they can supply a higher current without requiring much more drive, since they have a very high beta. They also allow greater power dissipation than the transistors used in the other version.

A different form of load bootstrapping has been used in the bigger amplifier. Instead of connecting one end of the collector load resistor for Q3 direct to the output, we have a split load, consisting of two 220Ω resistors. The junction of these two resistors is connected to the output via a 100μF/25VW capacitor.

From here on, the principle of bootstrapping the collector load of Q3 is the same as for the smaller amplifier. Because of emitter followers Q1 and Q2, there is little difference in signal voltage between the base of Q2 (and Q1) and the output. Therefore, very little signal current flows in the collector load resistors for Q3 and thus it "sees" a much higher value of load.

The advantage of using the split load for Q3 together with the 100μF capacitor is that this amplifier can operate without any load being connected. Thus it can happily drive high value loads such as high impedance headphones. By contrast, the smaller amplifier will cease to operate if the load is disconnected, because that would interrupt the DC current flow through the 1kΩ collector resistor for Q3.

Another obvious change involves the substitution of Q5 for the resistor/diode network of Fig. 3. Q5 is called a Vbe multiplier because the voltage between the collector and the emitter is equal to some multiple of the base-emitter voltage of the transistor. The multiplying factor is dependent upon VR1 and the 560Ω resistor.

This technique provides better temperature compensation than an equivalent diode/resistor network. It's also more reliable and easier to adjust.

While Q5 compensates for the variation in Vbe of Q1 and Q2 with changing temperature, further measures are required to ensure freedom from thermal runaway (ie, eventual destruction). This could arise due to an increase in beta of Q1 and Q2 as they become hot or because of a rise in collector-base leakage current of these two transistors.

To prevent thermal runaway due to these causes, Darlingtons Q1 and Q2 are connected to the output via parallel-connected 1Ω emitter resistors. Now, if the current through Q1 and Q2 tends to rise because of heating effects, the

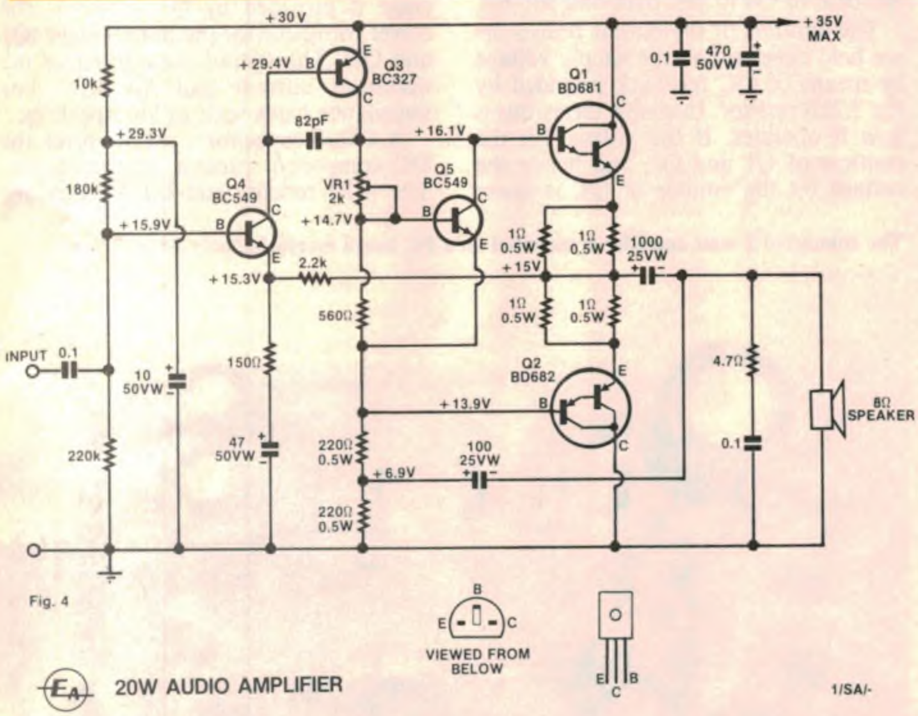
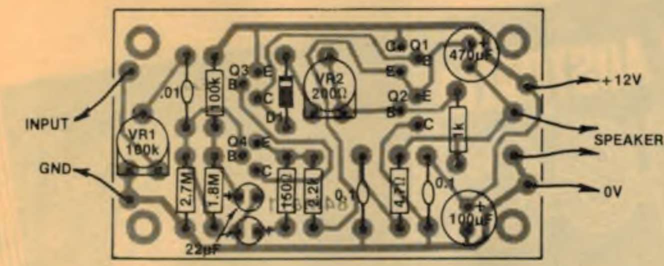


Fig. 4: The circuit diagram of the 20 watt amplifier. Note the Vbe multiplier circuit (Q5) and the output bootstrapping.



Here is the component overlay for the 1 watt amplifier. Take care with the orientation of polarised components.

Specifications: 1W Amplifier

Supply voltage	12 volts
Power output	1 watt RMS
Input impedance	100kΩ approx
Output impedance	0.7Ω approx
Signal-to-noise ratio	64dB with respect to 1 watt
Frequency response	3dB at 75Hz, −0.5dB at 100kHz
Load impedance	8Ω or greater
Quiescent current	5.6mA with 8Ω load

voltage across the emitter resistors will also tend to rise and cancel a portion of the voltage developed across Q5. Thus the output transistors will be partly shutdown and no thermal runaway will occur.

The only other component which is not used in the 1 watt amplifier is the 82pF capacitor between the base and collector of Q3. This capacitor is included to roll off the gain of the amplifier at high frequencies. This is necessary to ensure that the amplifier will remain stable under all load conditions.

Construction

The 1 watt amplifier is assembled on a small printed circuit board coded 84ma11 and measuring 44 x 77mm. All components are mounted on this board including the input level trimpot (VR1). This could be left off the board and mounted elsewhere if required. Follow the component overlay closely to ensure correct location and orientation of all components.

The high power amplifier is assembled on a larger circuit board coded 84pa11 and measuring 77 x 127mm. This should be assembled in the same manner as the other board, leaving the output transistors off for the moment. Each heatsink should be mounted on the board using a bolt through the hole not used for the transistor.

Make sure that the slot in the heatsink is directly over the transistor mounting holes, and that the heatsinks are not touching each other. The transistor leads can then be bent through 90 degrees, about 8mm from the body of the transistor. This done, smear the mating surfaces with heatsink compound, bolt the transistors to their respective heatsinks, and solder the leads.

There is no need to use mica insulating washers but note that the heatsink for the BD681 will sit at the supply voltage. This is because the metal tab of each output transistor is at collector potential.

PARTS LIST

1W Amplifier

1 PCB, code 84ma11, 44 x 77mm

Semiconductors

1 BC549 transistor
1 BC338 transistor
2 BC328 transistor
1 1N4002 diode

Capacitors

1 470µF 16VW PC electrolytic
1 100µF 25VW PC electrolytic
2 22µF 25VW PC electrolytic
2 0.1µF metallised polyester
1 .01µF metallised polyester

Resistors

1 x 2.7MΩ, 1 x 1.8MΩ, 1 x 100kΩ, 1 x 2.2kΩ, 1 x 1kΩ, 1 x 150Ω, 1 x 4.7Ω, 1 x 100kΩ miniature horizontal trimpot, 1 x 200Ω miniature horizontal trimpot.

20W Amplifier

1 PCB, code 84pa11, 77 x 127mm
2 heatsinks, DSE type H3401 or similar

Semiconductors

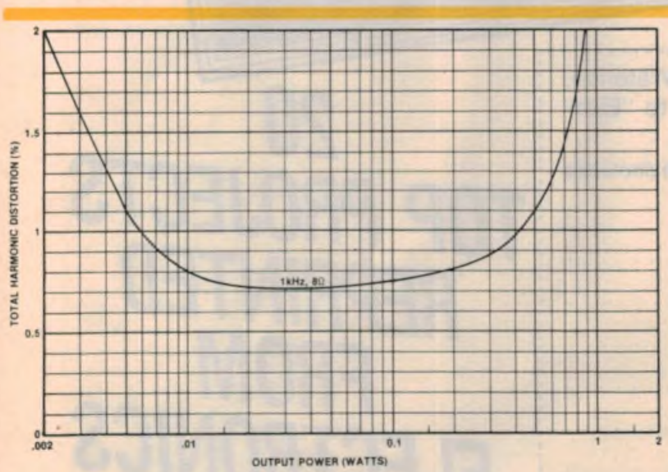
2 BC549 transistors
1 BC327 transistor
1 BD681 transistor
1 BD682 transistor

Capacitors

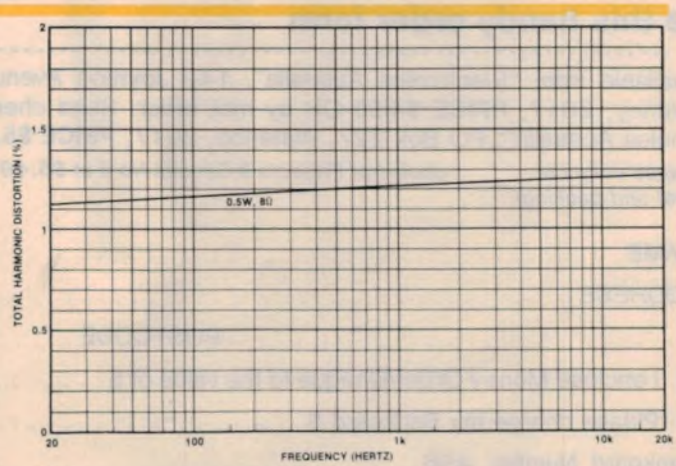
1 1000µF 25VW axial electrolytic
1 470µF 50VW axial electrolytic
1 100µF 25VW PC electrolytic
1 47µF 25VW PC electrolytic
1 10µF 50VW PC electrolytic
3 0.1µF polyester
1 82pF ceramic

Resistors

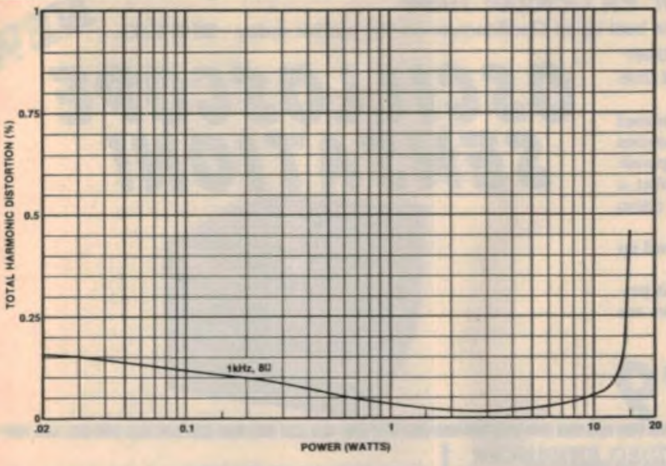
1 x 220kΩ, 1 x 180kΩ, 1 x 10kΩ, 1 x 2.2kΩ, 1 x 560Ω, 2 x 220Ω ½W, 1 x 150Ω, 1 x 4.7Ω, 4 x 1Ω ½W, 1 x 2kΩ miniature horizontal trimpot.



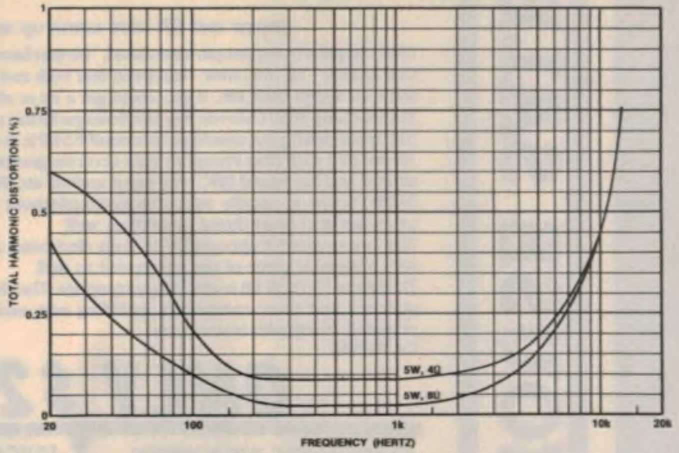
This graph shows the power versus distortion characteristic for the 1 watt amplifier. The measurements were made using a 12V supply.



Here is the distortion versus frequency characteristic for the 1 watt amplifier.



This graph shows the distortion versus power characteristic of the 20 watt amplifier. The measurements were taken with the amplifier powered from a 30V supply.



Here is the distortion versus frequency characteristic of the 20 watt amplifier. The amplifier was powered from a 30V supply and was delivering a power of 5 watts into the load.

Low-cost utility amplifiers

Whatever you do, don't let the heatsinks touch.

Setting up

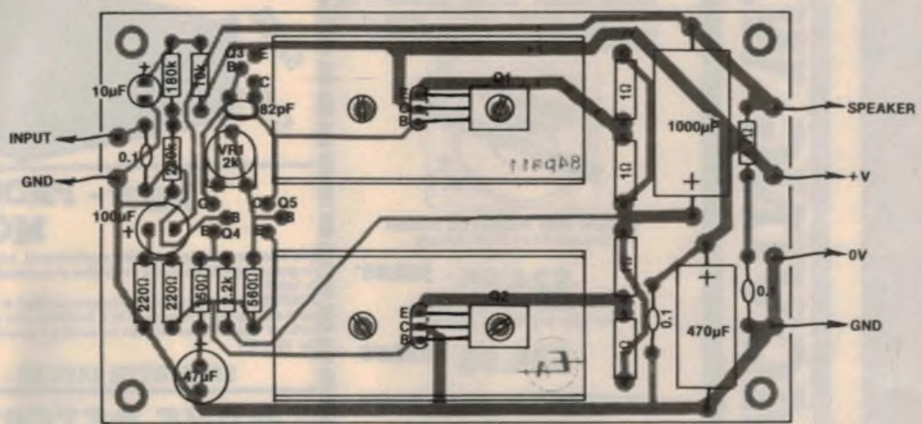
Before the amplifiers are used the bias current must be adjusted. Set the bias pot (VR1) to the minimum value (fully anticlockwise), and connect the appropriate power supply. Feed a sinusoidal signal into the input of the amplifier and, with a load connected, observe the output waveform on an oscilloscope. Some crossover distortion should be apparent. Turn the pot clockwise until the distortion just disappears.

If you do not have access to test equipment, the quiescent current may be set in the following way. First, connect a jumper lead between the bases of Q1 and Q2. With a load connected (in the case of the 1W amplifier) measure the current drain at 12V and no signal. It should be close to 6mA. Now remove the jumper lead between bases of Q1 and Q2 and adjust VR2 so that the total current increases to 10mA.

In the case of the 20W amplifier, no load needs to be connected to set the quiescent current. Again with a jumper lead between the bases of Q1 and Q2, the current with 30V supply and no signal should be close to 31mA. Now remove the jumper and adjust VR1 to give a total current of 40mA.

Finally, note that these amplifiers should be powered from well-filtered mains supplies. Do not exceed the power supply voltages shown on the circuit diagrams, or use lower than recommended load impedances, or reverse the supply connections. If these points are kept in mind, you should have no problems using these amplifiers.

Note: PC artwork for these amplifier modules is reproduced on page 125.



Here is the printed circuit board overlay for the 20 watt amplifier. Make sure that the heatstinks do not touch each other.

Specifications: 20W Amplifier

Input impedance	100kΩ approx
Output impedance	0.1Ω approx
Signal-to-noise ratio	58dB with respect to 1 watt
Frequency response	−3dB at 45Hz and 68kHz
Load impedance	4Ω or greater
Quiescent current	22mA with 8Ω load

Supply voltage	Power into 8Ω	Power into 4Ω
20V	4W	6.6W
30V	8W	12W
35V	15W	19W

Note: 35 volts is the maximum supply permitted.

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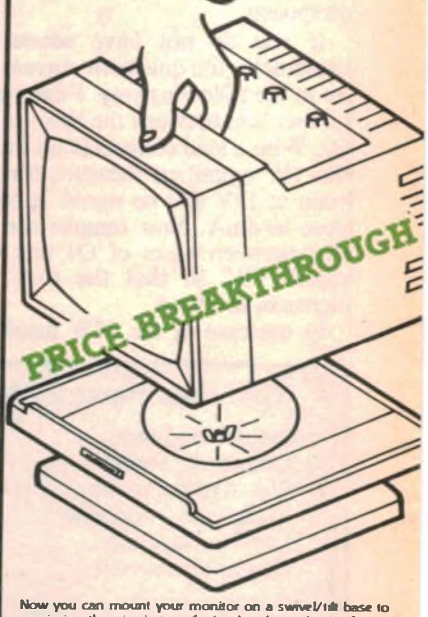

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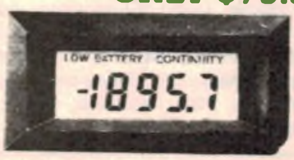


Texas Instruments portable computer

Texas Instruments Australia Ltd has announced a new portable computer that is compatible with the desktop TI Professional Computer. The new model is available with either a built-in 23cm colour or monochrome display. Both displays incorporate the same 25-line by 80 columns format and a resolution of 720 x 300 pixels.

The TI Portable Professional Computer offers the same high-resolution graphics, colour capability, memory expansion up to 768K bytes, and easy-to-use keyboard as the Texas Instruments Professional Computer. Because the new portable is totally compatible with the TI Professional Computer, an extensive software library and numerous hardware options are available.

The keyboard of the TI Portable Professional Computer attaches to the system unit, which contains the central processing unit, the video display monitor, and the diskette drive. A built-in storage compartment for cable and electric cords makes the computer easy to pack, and a built-in handle makes it easy to carry. A carrying case is also available as an optional extra.

Other features include a 16-bit 8088 central processor, a minimum of 128K bytes of random access memory (RAM) expandable to 768K bytes, five expansion slots, and an integral 5¼-inch half-high floppy diskette drive with space for an additional built-in disk drive option. Storage capacity of an individual floppy diskette is 320K bytes under MS-DOS 1.1 and 360K bytes with MS-DOS 2.1.

A 10M byte Winchester disk option is available which has been designed to meet the requirements for operating a Winchester disk in a portable environment. TI engineers have shock-mounted the drive inside the portable microcomputer and added a software controlled "landing zone".

Further information from Texas Instruments Australia Ltd, PO Box 106 North Ryde, NSW, 2113. Phone (02) 887 1122.

Latest IBM personal computer

IBM Australia Ltd has announced the availability of its latest portable personal computer. The new computer weighs approximately 13.6kg and measures 508 x 432 x 203mm. It packs into a self-contained unit with a handle for easy transportation.

Main features include 256K of random access user memory, expandable to 512K; a 360K slimline diskette drive and adaptor; five additional expansion slots in the system unit; and an optional second slimline diskette drive which can be added to the system unit, doubling diskette storage to 720K.

Other features include a built-in 229mm monitor that displays graphics and up to 25 lines with 80 characters per line; a universal power supply for use in different countries with addition of an appropriate power cord; and a carrying bag for the system.

The IBM Portable Personal Computer uses the same 16-bit 8088 microprocessor used in the IBM PC and PC XT. With IBM Disk Operating System (DOS) 2.1, the portable can use most of the software already available for IBM Personal Computers.

Further information from IBM Australia Ltd, Box 3318 GPO, Sydney, 2000. Phone (02) 234 5678.

COMPUTER PRODUCTS

Back-up power supply for computers, etc

Datasaver, from Data Cable Pty Ltd, is a new product which protects data against unexpected power failures, brownouts and transients. Compatible with most computer systems, Datasaver is a totally self contained battery powered AC backup unit.

Rated at 240V, 250W, 50Hz it can, if operating at full rated output load, supply up to 25 minutes of power, and 50 minutes if operating at half rated output power. Upon loss or interruption of input line power or an undervoltage situation, Datasaver takes over in about one hundredth of a second.

This eliminates the worry that a day's work stored in memory could be erased due to a power failure or a change in voltage. Immediately a power failure is detected, the Datasaver automatically switches to back up power, enabling important information in RAM to be dumped onto disc. The user is instantly alerted by way of a front panel indicator light and an alarm which can be situated away from the unit.

The Datasaver is able to power large capacity micro computers, remote computer terminals, programmable logic controllers, private telephone exchanges, TV translators, electronic cash registers, and electronic typewriters. It has inbuilt transient overvoltage protection comprising power line filter and surge divertors. It houses a battery, automatic battery charger, solid-state power inverter, AC line voltage monitor, and cutout switch.

Further information from Data Cable Pty Ltd, Croydon and Lincoln Rds, Croydon, Victoria, 3136;. Phone (03) 725 0933.

AWA-Thorn to launch personal computer

AWA-Thorn are ready to launch the British designed Amstrad Micro Home Computer.

A 64K RAM unit, the Model CPC464 is aimed at the home computer market. It will be available in two packages: system one, which will include a high resolution green VDU and inbuilt data recorder and which should be available for around $500; and system two, which will include a colour monitor and inbuilt data recorder for around $750.

Some important features include: 32K ROM, 80 column display, 640 x 200 graphic resolution, numeric key pad, 12 function keys, 27 available colours, stereo sound facility, copy cursor, and RGB outputs.

A range of peripherals will be available including a dot matrix printer, disc drive with CPM and Logo, joysticks and an abundance of software — 60 to 70 titles at launch.

The Amstrad CPC464 will be released in November 1984 and will be distributed throughout Australia by AWA-Thorn Consumer Products Pty Ltd.

Software for PCB Design

Libra Data Pty Ltd, computer consultants, announce the availability of a design automation package by Dasoft, for automating the PCB design process.

Dasoft's software package frees designers from the repetitive element and time-consuming design loops typically associated with CAD processors by providing:

- A full screen design editor that substantially reduces the time required for drawing, verifying and documenting schematics;
- A macro device library/editor for creating, altering, copying or deleting component information;
- Automatic generation of automated logic drawings;
- An outline editor for specifying items such as dimensions, mounting hole sizes and trace widths; and
- An "autorouter" for automatic routing of PCB interconnections and outputting of camera-ready artwork as well as schematics.

The Dasoft Design Automation Package is available for use with the Digital Rainbow, Apple, Kaypro, IBM PC and other microcomputers running CP/M 2.0.

Further information from Libra Data Pty Ltd, Suite 4, 5-7 Chandler Rd, Boronia, Victoria, 3155.

Simple circuits provide added realism

Sound & lighting for model trains

Fancy a diesel sound simulator for your model train layout? This circuit mounts inside the train for added realism and varies its "speed" according to the throttle setting. Also described is a simple lighting circuit.

by ANDREW LEVIDO

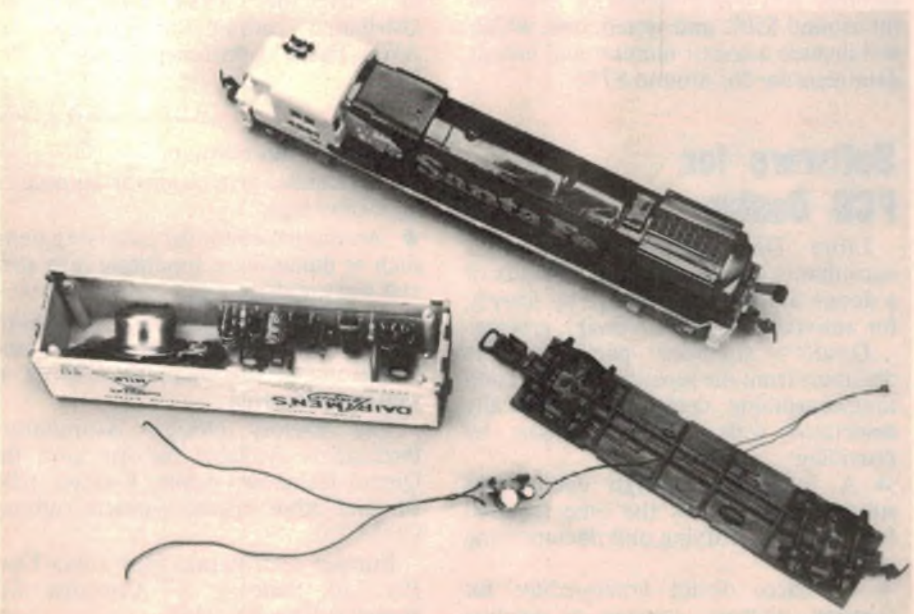
Model railway enthusiasts have been known to go extraordinary lengths to achieve realism in their layouts. They buy expensive locomotives and rolling stock, and spend many hours constructing a layout and working on the scenery. One only has to thumb through one of the model railway magazines to see the results of these labours and to appreciate the effort involved.

Unfortunately, the full impact of this work is often lost when the trains are running. Despite all the time and money spent creating the visual illusion, the train still sounds like a model. Instead of a throb of a diesel engine, only the irritating buzz of the small electric motor can be heard.

Some modellers use a sound effects generator to add to the realism, but these are usually mounted beside the track, so that the sound comes from a fixed source and not from the moving loco. This set-up is better than no sound effects at all, but it is far more realistic to have the sound effects generator mounted inside the locomotive or in one of the carriages.

That is where this new Diesel Sound Simulator circuit excels. The circuit mounts easily inside both HO and OO scale rolling stock and produces a very realistic diesel engine sound. The engine noise varies according to the throttle setting and ceases when the throttle is closed.

We mounted the Diesel Sound Simulator circuit inside an enclosed goods wagon.



Mounting the sound effects electronics inside the train poses two major problems. The first of these is the need for a constant supply voltage to the electronics despite the throttle setting. This is difficult to produce in systems which use resistive or series regulating controllers since the voltage applied across the tracks can vary from zero to the full supply voltage.

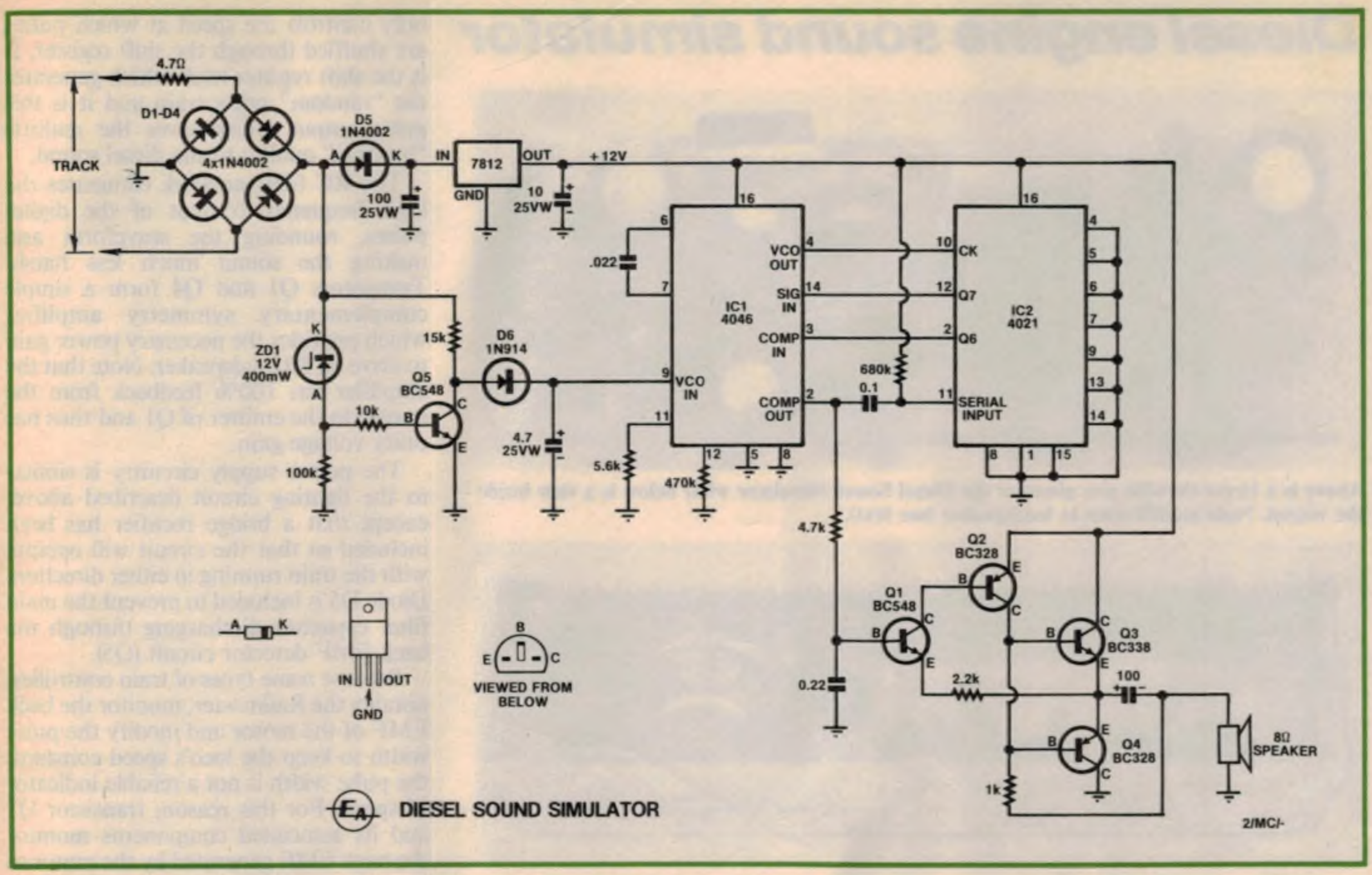
With pulse-type power supplies, however, a constant voltage can be easily derived since the peak track voltage remains constant over the entire throttle range. For this reason, the circuit described here is best suited to pulse-power train controllers such as the Railmaster described in the September issue of *Electronics Australia.*

The second problem is one of space. All the electronics plus a loudspeaker of some kind must fit inside the train. There is probably not enough room inside most locomotives for all this, so we recommend mounting everything inside an enclosed wagon. Power for the electronics can be obtained through the wheels, as for the locomotive, or from the loco itself via a pair of fine wires.

The loudspeaker represents the greatest hurdle. The smallest readily-available unit measures 57mm in diameter and is too big to fit inside HO or OO scale rolling stock. We tried several small transducers from headphones but none provided sufficient volume to mask the sound made by the locomotive itself.

The solution is to modify the 57mm loudspeaker by trimming two 10mm sections from the edge of the cone. This can then be mounted inside the carriage as shown in one of the photographs.

> We estimate the current cost of parts for this project to be approximately
>
> **$15–18**
>
> Parts for the lighting circuit will add an extra $2.50.



Before readers complain too loudly, we should point out that the loudspeaker still works surprisingly well.

Since a constant supply voltage is easily derived from the track voltage in pulse type control systems, we have also developed a small lighting power supply. The circuit is so simple that we have included it on one end of the sound effect board. This can be cut off and used in the loco or wherever it is required, and will power the lamp at constant brightness for all throttle settings.

Lighting circuit

We will look first at the lighting circuit since it is similar in operation to the power supply section of the sound simulator circuit. The voltage across the tracks is a rectangular wave with an amplitude of about +22V and a mark space ratio of between zero and 50%. The motor responds to the average voltage which thus varies from zero to about +12V. The lighting circuit, however, relies on the fact that as soon as the throttle is moved off the zero mark the peak voltage of +22V is available.

This voltage is used to charge a 100μF capacitor via a 4.7Ω resistor and diode D1. The resistor limits the peak current when the capacitor charges while the diode prevents the capacitor from being discharged by the motor when the voltage from the controller is zero.

The capacitor charges up to almost the full +22V. And this is regulated to +12V by the 78L12 3-terminal regulator. A 10μF capacitor on the output of the regulator ensures that the regulator remains stable. A 12V grain-of-wheat type light bulb is used as the load.

Our bulb was obtained from Hobbyco (561 George St, Sydney) and is a standard model railway item. Any bulb can be used as long as it is rated for 12V operation and draws less than 50mA.

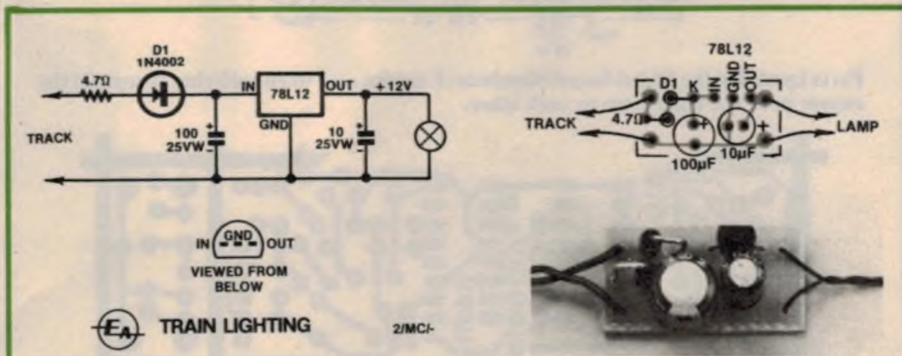
Diesel sound simulator

A typical diesel engine sound contains detonation ping, exhaust beats, supercharger whine and alternator hum. Our circuit provides a very good simulation of this sound by using a voltage controlled oscillator (VCO) and a shift register. These combine to produce a repeating sequence of "random" pulses, thus providing the characteristic throbbing sound of a diesel locomotive.

Our circuit is based on an item which appeared in the February 1984 issue of the US magazine *Model Railroader.*

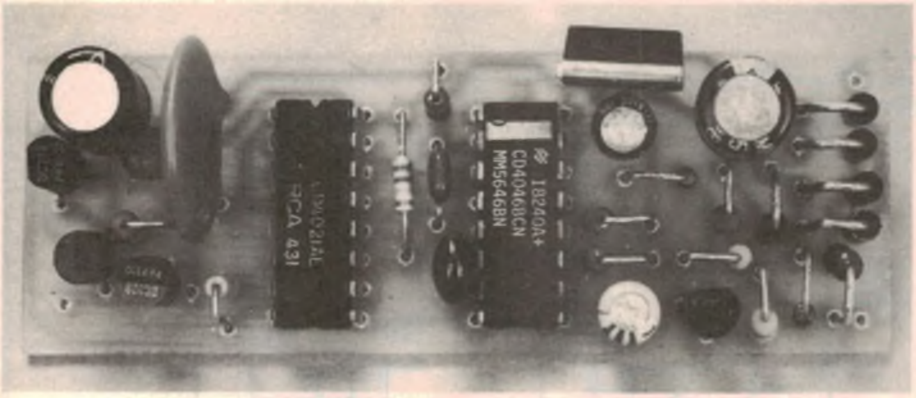
ICI is a 4046 phase locked loop and contains the voltage controlled oscillator, a source follower and two phase comparators. Only the VCO and one of the phase comparators, an exclusive-OR (XOR) gate, are used in the circuit. The frequency of the VCO can be varied over a certain range by applying a DC control voltage to the VCO input (pin 9).

The 5.6kΩ and 470kΩ resistors, together with the .022μF capacitor, set the range of the VCO from 400Hz to



The lighting circuit provides a constant +12V supply from the +22V peak track voltage. Watch the orientation of the 3-terminal regulator.

Diesel engine sound simulator



Above is a larger-than-life size photo of the Diesel Sound Simulator while below is a view inside the wagon. Note modification to loudspeaker (see text).

approximately 6kHz. When there is no control voltage on pin 9, the VCO runs at its minimum value of 400Hz, thus setting the engine idle speed.

The output of the VCO (pin 4) clocks the 4021 shift register, IC2. As a result, the pulses on IC2's pin 11 input are shifted serially through the shift register. The RC network on pin 11 (680kΩ and 0.1μF) provides an input pulse for the serial data input when power is first applied.

Pins 2 and 12 of IC2 are the Q6 and Q7 outputs of the shift register and are coupled to the inputs of the phase comparator in IC1. The phase comparator output appears at pin 2 of IC1 and consists of the desired repeating pattern of pulses. These pulses are coupled to the serial input of IC2 via the 0.1μF capacitor and are also filtered by a 4.7kΩ resistor and 0.22μF capacitor.

An important point to appreciate about the circuit is that the VCO output only controls the speed at which pulses are shuffled through the shift register. It is the shift register itself which generates the "random" pulse train and it is this pulse output which gives the realistic "hunting" quality to the diesel sound.

The RC filter network eliminates the high frequency content of the digital pulses, rounding the waveform and making the sound much less harsh. Transistors Q1 and Q4 form a simple complementary symmetry amplifier which provides the necessary power gain to drive an 8Ω loudspeaker. Note that the amplifier has 100% feedback from the output to the emitter of Q1 and thus has unity voltage gain.

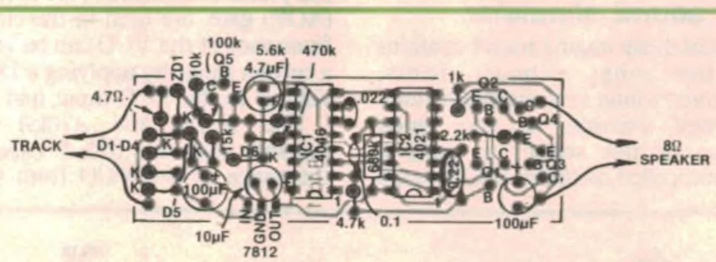
The power supply circuitry is similar to the lighting circuit described above, except that a bridge rectifier has been included so that the circuit will operate with the train running in either direction. Diode D5 is included to prevent the main filter capacitor discharging through the back EMF detector circuit (Q5).

Because some types of train controller, notably the Railmaster, monitor the back EMF of the motor and modify the pulse width to keep the loco's speed constant, the pulse width is not a reliable indicator of speed. For this reason, transistor Q5 and its associated components monitor the back EMF generated by the motor to produce the VCO control voltage.

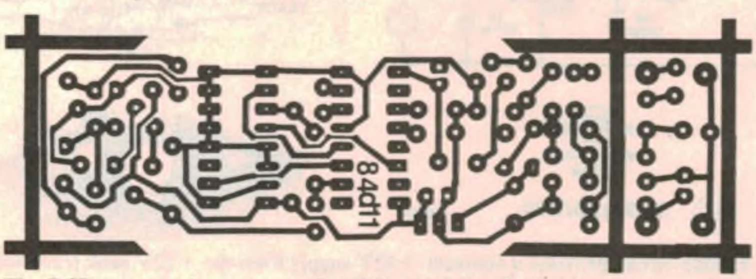
In between pulses, when only the back EMF is present, Q5 is turned off. This is because the back EMF is not large enough to cause zener diode ZD1 to conduct. During this period the 4.7μF capacitor is charged up to the back EMF voltage through diode D6.

When a pulse subsequently occurs the zener diode conducts, turning Q5 on and pulling the anode of D6 to ground. This prevents the capacitor from being charged up to the full 22V. The diode (D6) prevents the capacitor from discharging through Q5 when the latter is turned on.

Thus the 4.7μF capacitor remains charged at approximately the back EMF voltage which is directly proportional to the actual motor speed. This voltage is applied to pin 9 of the PLL IC which, as discussed earlier, is the control input of the VCO. In this way the speed of the engine sound is made proportional to the locomotive speed.



Parts layout for the Diesel Sound Simulator. Exercise care when soldering as some of the copper pads are quite close to each other.



The PCB pattern also accommodates the parts for the lighting circuit.

Construction

The Diesel Sound Simulator is built on a small PC board coded 84d11 and measuring 25 × 91mm. This board also carries the lighting circuit which should be cut off before any parts are mounted.

Mount all components on the board in accordance with the overlay, making sure that the polarised components are oriented correctly. Note that most of the resistors and diodes are mounted

PARTS LIST

Diesel Simulator
1 PCB, code 84d11, 25 x 91mm
1 57mm 8Ω loudspeaker

Semiconductors
1 4046 phase locked loop IC
1 4021 shift register IC
1 7812 3-terminal regulator
2 BC548 NPN transistors
2 BC328 PNP transistors
1 BC338 NPN transistor
1 12V 400mW zener diode
5 1N4002 diodes
1 1N914 diode

Capacitors
2 100μF 25VW PC electrolytics
1 10μF 25VW PC electrolytic
1 4.7μF 25VW PC electrolytic
1 0.22μF 25VW ceramic
1 0.1μF monolithic
1 .022μF greencap

Resistors (¼W, 5%)
1 × 680kΩ, 1 × 470kΩ, 1 × 100kΩ, 1 × 15kΩ, 1 × 10kΩ, 1 × 5.6kΩ, 1 × 4.7kΩ, 1 × 2.2kΩ, 1 × 1kΩ, 1 × 4.7Ω/½W

Lighting circuit
1 12V grain-of-wheat bulb
1 78L12 3-terminal regulator
1 1N4002 diode
1 100μF 25VW PC electrolytic capacitor
1 10μF 25VW PC electrolytic capacitor
1 4.7Ω resistor (¼W, 5%)

standing end on. This was done to conserve space.

Be very careful when soldering the components since some of the copper pads on the PC board are very close to each other.

To test the sound simulator, connect it to the track and to a suitable loudspeaker, position the locomotive, and advance the throttle. If all is well you will be greeted with realistic engine sounds. If not recheck all your work, paying particular attention to component placement and orientation.

Once the sound generator is running correctly, you may wish to adjust either the idle speed or the maximum engine speed to suit a particular locomotive. Both of these adjustments are easily made by changing resistor values. The resistor connected to pin 11 of IC1 sets the idle speed, while the resistor connected to pin 12 sets the maximum speed.

To increase the speed, decrease the appropriate resistor value, and to decrease the speed, increase it. Note that the two adjustments are somewhat interactive, and that the total speed range is limited. For this reason we recommend that only one resistor be varied at a time. For most purposes however, the values given should be suitable.

Once any necessary adjustments have been made the board can be mounted in the desired piece of rolling stock. We mounted the board using double sided adhesive tape, as shown in the accompanying photos. The loudspeaker, as mentioned above, has to be butchered before it will fit in the model. We used a pair of tinsnips to perform this surgery. The loudspeaker can then be glued inside the carriage using an epoxy adhesive.

Do not use a hacksaw or other method to cut the loudspeaker otherwise there is a risk that iron filings will be caught in the voice coil gap. If that happens the speaker will have to be discarded.

Holes will need to be drilled in the floor of the wagon to let as much sound out as possible. We drilled holes through the floor, in the vicinity of the two bogies, so that they would not be readily visible from the underside.

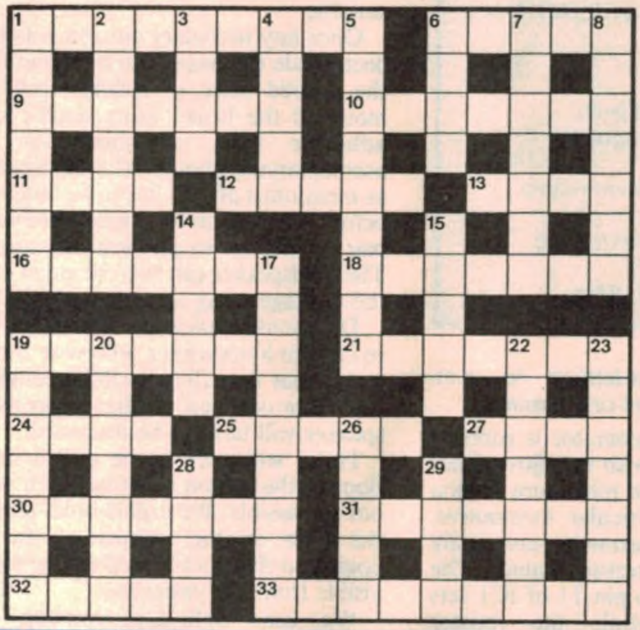
We used light-duty hookup wire to obtain power from the motor

Continued on page 123

NOVEMBER CROSSWORD

ACROSS

1. Electronic security devices with auto setting. (3,6)
6. Converter of electrical energy. (5)
9. Magazine featuring batteries, cartridges, fuses, repeaters, etc. (7)
10. Compatible systems. (7)
11. Element. (4)
12. AC event. (5)

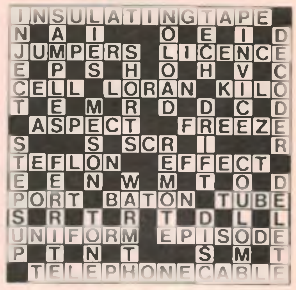


13. Possible circuit condition. (4)
16. This is often added to the board in quarters! (7)
18. Valves. (7)
19. Frame for electronic components. (7)
21. Some car antennas can do it. (7)
24. Obtain memory information. (4)
25. Communication channel. (5)
27. Issue a summons electronically. (4)
30. Derivative of George Leclanche's invention. (3,4)
31. Removed cassette. (7)
32. Electrical symbol. (5)
33. Result of spark in 9 across? (9)

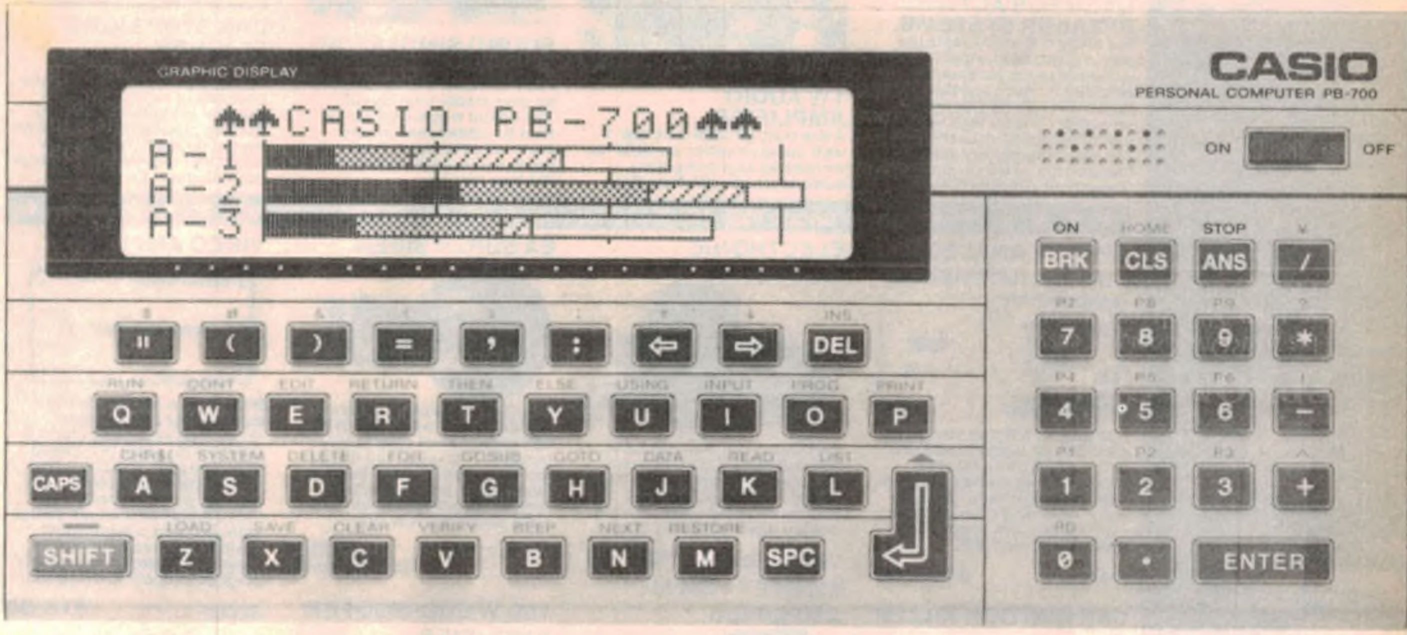
DOWN

1. Type of cable. (7)
2. Produce required data. (7)
3. Part of a communication network. (4)
4. Electric switch. (5)
5. A working model. (9)
6. Alter the volume. (4)
7. This could be the appearance of an antenna. (1-6)

SOLUTION FOR OCTOBER



8. Which wires are often positive? (3,4)
14. Which ionisation potential is the lowest? (5)
15. Characteristic of a band. (5)
17. Light globes are usually such. (3-6)
19. Communication system. (1,1,5)
20. Determine components. (7)
22. Electrical fitting. (7)
23. Forerunner of the electric motor. (7)
26. Parts of a tape recorder. (5)
28. Video system. (4)
29. Grid. (4)



Casio PB-700 hand-held computer

Personal computers seem to be developing along four separate lines: desk, portable, lap-type and hand-held. Here we review Casio's latest hand-held computer, the PB-700.

Compared with lap-type computers such as the Tandy Model 100 or Canon X-07, the Casio PB-700 is really small, at less than half the size. It measures 200 x 88 x 23mm (W x D x H) and weighs a mere 315 grams, including the batteries.

The keyboard is split into two sections with alphabetic on the left (QWERTY-style) and numeric keypad on the right. In all, there are 58 keys, most of which provide a particular control function.

Basic is used as the programming language and to make things easier, the most-used commands are entered by only two key presses.

Memory

Up to 10 programs can be stored and any program can be accessed by two key presses. Memory capacity of the PB-700 is 4K of RAM which can be extended to a maximum of 16K by the addition of three 4K RAM modules. Note that the amount available for the user is 1232 bytes less than the amount of RAM installed because the first 1232 bytes is required by the PB-700 itself.

The liquid crystal display format is four lines of 20 characters each. This is a lot less than the Tandy Model 100 for example (8 lines x 40 characters) but for a lot of applications it is quite adequate.

As with most liquid crystal displays, the viewing angle is relatively small, particularly the vertical viewing angle. This problem is overcome to an extent by the contrast control. This really should be called the "viewing angle" control since it alters the polarising voltage on the display.

However, even when viewed at the optimum angle, the contrast of the PB-700 display is not particularly good. This should not be a real drawback though, unless the unit is to be used for long periods at a time.

On the other hand, while some calculators using liquid crystal displays seem to have an overly long keyboard response time, the PB-700 is very fast. While it is not possible to touch-type on the closely spaced keys, even very fast key presses do not catch the unit out.

The character format is 8 x 5 dots and lower case characters such as y have true descenders when they are actually displayed. Normally though, all characters are displayed in upper case, even though they are held in memory in upper and lower case for subsequent printout if required.

Power supply for the PB-700 is from two battery sources. The main supply is four 1.5V penlite cells while a lithium battery powers the RAM for program retention.

Casio recommend replacement of all five batteries after two years to avoid possible damage due to leakage of battery contents. However, in normal use the main batteries may have to be replaced more often than that. Estimated life of the penlite cells with continuous use is about 100 hours. Compared with the usual battery life of the larger lap computers, this is very good.

To conserve the batteries, the PB-700 has an automatic power-down feature to switch the unit off eight minutes after the last keyboard entry, unless a program is running.

CASIO PB-700: Commands and Functions

Manual Commands
CONT, DELETE, EDIT, LIST, LLIST, LOAD, NEW, PASS, PROG, RUN, SAVE, SYSTEM, VERIFY.

Program Commands
ANGLE, BEEP, CHAIN, CLEAR, CLS, DATA, DIM, DRAW/DRAWC, END, ERASE, FOR-TO-STEP/NEXT, GET, GOSUB/RETURN, GOTO, IF-THEN-ELSE, INPUT, LET, LOCATE, PRINT/LPRINT, PUT, READ, REM, RESTORE, STOP, TRON/TROFF.

Numerical Functions
SIN, COS, TAN, ASN, ACS, ATN, EXP, SQR, LOG, LGT, ABS, INT, FRAC, SGN, ROUND, PI, RND.

Character Functions
ASC, CHR$ VAL, STR$, LEFTS$, RIGHTS$, MIDS$, LEN, INKEY$.

With the main batteries removed, the lithium battery will protect the standard 4K of RAM for 10 months; for 16K of RAM the protection period drops to 2.5 months. Again, according to the manual, the life span of the AA cell is approximately 100 hours for continuous use.

One final point worth mentioning is that when the batteries need to be changed, no loss of program will result if one supply is removed at a time. During this operation the PB-700 should be switched off.

For those fully familiar with Basic programming, the PB-700 command list booklet is all you need to start using the unit. This has 22 pages and contains lists of manual commands, program commands, numerical functions and character functions. Also included are lists of error messages and operations, a character code table and plotter commands.

Included in this article is a list of the various commands and functions which demonstrate that the PB-700 is certainly a fully-fledged computer capable of use in many applications.

For those who are programming novices, the manual accompanying the PB-700 is invaluable. While other books on Basic would be useful as background, the PB-700 manual, entitled "Easy Trip to Basic", contains all the needed information and instruction.

With 326 pages, the manual has six chapters which go into every aspect of Basic which the PB-700 encompasses. There are also quite a few sample programs which demonstrate particular Basic commands and functions.

PB-700 capabilities

As depicted in the accompanying list, the PB-700 has 38 separate commands and 29 separate functions. Most of these require little comment and are fully explored in the manual.

One of the more interesting commands is called PASS. This command prevents the accidental erasure or alteration of programs that may have taken a great deal of effort to create.

The PASS command is used quite simply by typing, for example, PASS "FRED" and then return/line back. This now protects all 10 program locations which are normally accessed by pressing "Shift" and then one of the numeric keys. This does not stop the programs from being used or examined but you can no longer alter them, write over or erase them.

If you forget the password though, you have a problem. The only way to solve the problem is by first dumping the said programs onto tape and then using the NEW ALL command or removing the batteries. Of course, if you can still remember the password, it is a simple matter to release it and gain access to the program area for alterations and erasure.

The SYSTEM command informs which program locations are already used, the number of bytes of RAM left, the type of angle measurement used, for example degrees, and the program area currently being accessed.

A random number generator is also provided on the PB-700. It takes the usual form of RND; in other words when the PB-700 executes this numerical function, numbers are randomly generated in the range 0 to 1.

So to gauge the performance, two lots of 10,000 random numbers were generated which were then averaged to give the following results: 0.5033 in the first instance and 0.5052 in the second instance.

Since a perfect score would be 0.5 exactly, the PB-700 really performs very well in this exercise.

All the usual numerical functions are also included in the PB-700, for example SIN, COS and EXP. As well there is a useful set of Character Functions, such as CHR$ and ASC.

Casio PB-700

On the calculator side of the PB-700, there is a very useful key, called ANS. On pressing this key you obtain the result or "answer" of the last calculation, whether it was from program execution or by manual means. So even if you forget to jot the last answer down it can always be retrieved until a new calculation is carried out.

An interesting application of ANS is when you want to run a long program which only returns one answer of interest. You simply run the program and leave the PB-700 indefinitely. Once 8 minutes have elapsed from the time the program finishes, the PB-700 will switch off automatically. On returning to the PB-700, you just need to press the ON button followed by the ANS button and the desired result will be displayed.

Graphics

The PB-700 has a quite extensive graphics capability. In the graphics mode, the liquid crystal display is accessed by the CPU on a dot-for-dot basis, 32 x 160 or 5120 dots in all.

Two commands are available for using individual dots in drawing curves, DRAW/DRAWC and POINT. This is opposed to positioning the cursor by the command LOCATE in order to write characters where required.

The Casio PB-700 can be used to generate graphic displays as this sine plot shows.

The DRAW command is used in the following way. DRAW (x1, y1) simply draws one dot located at x1 dots across and y1 dots down from the top left hand dot located at (0, 0). To draw a line from (x1, y1) to (x2, y2) the command DRAW (x1, y1)–(x2, y2) is used. The DRAWC command works in exactly the same way except it erases rather than draws.

The command POINT on the other hand is used to determine whether a particular point is turned on or off. This command is used in the same way as the DRAW command; POINT (x1, y1).

From the program listing for the sine wave, you can see that the DRAW function is quite simple to use. The DRAW (X, Y) statement actually does the drawing of the sine wave; DRAW (A, 2)–(A, 28) is used for the vertical axis and DRAW (A, B)–(A + 150, B) is used for the horizontal axis.

The version of Basic used by the PB-700 has the ability to trace programs. This feature is generally used for debugging. To start a program trace the command TRON is used while to end the trace sequence the command TROFF is used. Since TRON, TROFF are program commands, they can be used in programs but they are usually used by direct entry.

To obtain an appreciation of the speed of the PB-700 the following program was run.

```
10 FOR Y = 1 TO 1000
20 NEXT Y.
```

This simple program puts the unit into a loop which it repeats until Y = 1000.

Execution of this program by the PB-700 took approximately 12 seconds, or in other words each loop took 12 milliseconds to execute. The same program run on a TRS-80 was found to execute in 2.7 seconds.

So the PB-700 is not fast.

Accessories

As already mentioned, add on RAM packs are available for the PB-700. These RAM packs fit into a compartment on the back of the PB-700.

```
10 REM--- SINE---
20 CLS
30 A = 5: B = 15
40 M = 12
50 FOR I = 0 TO 580 STEP 4
60 X = A + I/4
70 Y = B-SIN(I)*M
80 DRAW (X, Y)
90 NEXT I
100 DRAW (A, 2)-(A, 28)
110 DRAW (A, B)-(A + 150, B)
115 BEEP
120 LOCATE 2, 3
130 PRINT "sine"
140 LOCATE 13, 3
150 PRINT "wave"
160 GOTO 160
```

This short listing can be used to generate the sine plot depicted above.

The most powerful accessory for the PB-700 is the combined printer plotter and microcassette interface. This clips onto the PB-700 and prints in four colours on 114mm wide paper. A separate microcassette recorder is also available and this plugs into the cassette interface port on the PB-700.

Conclusion

While the PB-700 is a useful machine, it is fairly slow. For many applications, a scientific calculator would be cheaper and much faster. However, for applications requiring long and complicated calculations the PB-700 could well come into its own for ease of data entry and retention of final results.

Prices of the PB-700 and its accessories are as follows. The PB-700 itself retails for $299. The FA-10 printer-plotter is priced at $399 while the CM-1 micro-cassette recorder is $69. The 4K RAM packs sell for $69.

The Casio PB-700 is distributed in Australia by Mobex Pty Ltd, 76 Parramatta Rd, Camperdown, NSW 2050. Phone (02) 516 4055.

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- DISPLAY: Text — 20 columns x 4 lines (80 characters). Graphics — 160 x 32 dots
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- OPTIONS:

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FA-4: Printer interface comforming to Centronics standard and cassette interface.
CM-1: Microcassette tape recorder.
OR-4: 4K byte RAM expansion pack.
BK4E: Program Library.

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OR4	$48.50	$ 58.20	~~$ 69.95~~
FA4	$ 73.40	$ 88.00	~~$ 49~~
FA10	$250	$300	~~$399~~
CM1	$ 82.20	$ 98.65	~~$129~~
BK4E	$ 22.75	—	~~$ 26.99~~

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- Ram cards have own power.
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PB410—2K RAM CARD (OPTIONAL 4K CARD)	$105	$126	$149
FX720P—2K RAM CARD (OPTIONAL 4K CARD)	$113.50	$135.90	$159

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FX802p — PB300 with 25 Scientific Funcs	$135	$162	~~$220~~
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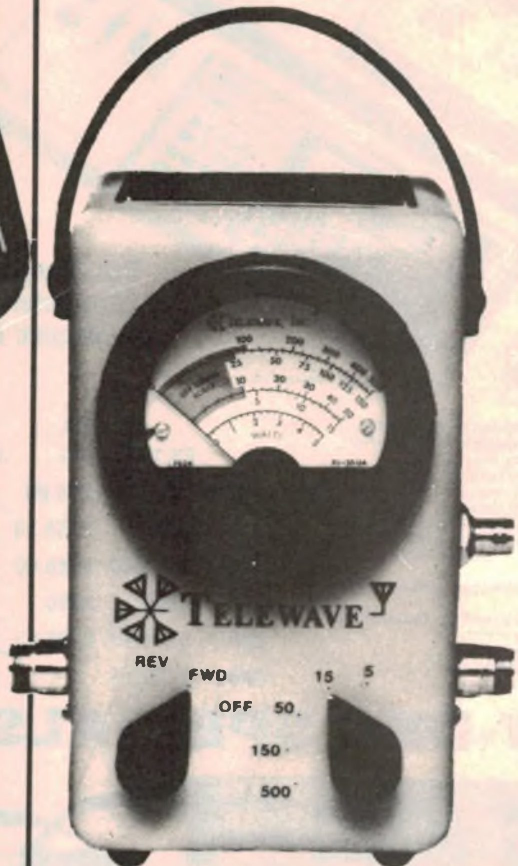
Model 44A



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50 and 25 years ago...

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

Wireless Weekly 3d

November 1959

Air race drama: one of the most thrilling features of the centenary Air Race was the fight for second place between the Dutch and American entries. The big Dutch plane became lost over the Victorian border, but with the aid of radio they were soon landed safely at Albury.

Seeing that a landing would be inevitable, the local broadcasting station, 2AY, which is situated about three miles from Albury, requested car-owners to drive their machines to the landing-grounds, so that their headlights would supply flood-lighting and help the 'plane to locate the ground.

The Albury postal officials, with rare initiative, co-operated with the lighting authorities, and, by using the main switches, blinked out the name "Albury" in Morse code.

It is reported that the Dutch airman could not understand some of the names broadcast to them during the race — names such as Tangambalanga and Cootamundra.

Perfect amplifier. The cover of this issue of "Wireless Weekly" really should have been decorated with a border of flags to celebrate the passing of a milestone in radio history. We have achieved the design and construction of an amplifier so nearly perfect that only the most sensitive of laboratory instruments can fault it.

This amplifier has several features to recommend it, apart from the fidelity. In the first place it is absolutely free from hum of any description. The gain is fairly low as amplifiers go, there are no chokes or audio transformers to pick up induced hum, and there is little need for effective filtering, because the two push-pull stages both buck out any hum.

Death ray: The newest terrible story is from a French paper which explains how very soon the military authorities of many countries would have the secret of a wireless death-ray capable of wiping out 400 aeroplanes travelling at a height of 250 miles. But it is reassuring to see how this discovery is being shared out among several countries, thus giving them all a sporting chance of killing each other off.

Peace ray?: The scientists whose misguided ingenuity makes possible the wholesale carnage of modern warfare may yet by their skill defeat their own ends. They may yet realise with despairing astonishment that they have made warfare as we know it utterly impossible.

We may yet learn to broadcast radio waves which will act upon explosives in the same way as the detonator itself — an intangible fulminate which would instantly explode any munitions of war which come in its path.

RADIO TELEVISION AND HOBBIES 2/6

November 1934

New RAAF radar: A jeep crossing the runway or a jet plane flying at 50,000 feet can readily be detected by a radar system now being installed at some RAAF bases.

First installations will be made at Pearce in Western Australia; Richmond, NSW; and Laverton, Vic.

The new system is known as "Quadradar," because of its facilities in four different uses. While the RAAF was installing Quadradar as a low-cost precision approach aid to guide aircraft, the equipment could also be used as a surveillance radar, as a height finder and as an airfield surveillance radar.

Tunnel Diode: the newest "baby" in the fast-growing family of electronic devices — the "tunnel diode" — is coming of age. The new device, little over a year old, is better understood and closer to commercial application as a result of an intensive research program, according to General Electric's director of research.

The high speeds at which electrical charges travel in the tunnel diode make it possible for the device to operate at extremely high frequencies. Oscillation frequencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future.

It is superior to vacuum tubes and transistors for applications in low-noise amplifiers and mixers for high frequencies.

Solar Power: a working model has been produced of a solar-powered thermoelectric generator for use in space vehicles.

The generator weighs 3lb, is 20in long and converts solar heat into 2.5 watts of power.

It has a reflective aluminium sheet mounted on a 20 × 50in semi-cylindrical shape to collect the sun's energy and concentrate it on the thermoelectric material.

Coloured PCB: a complete colour-coded printed circuit, developed by Motorola for a portable TV set, makes the job of tracing leads actually easier than working with handwiring.

Resembling a roadmap, the circuit board is printed in red, yellow, blue, green and black plus the natural colour of the copper leads.

The six by 14.5-inch colour-coded circuit board contains the TV schematic, on which every circuit can be traced from either side. Transfer of opposite side colour plating to observe side with black coding makes the plated circuit a single-sided board on each side.

Hydrofoil: christened "The Bat" a small snub-nosed boat has been produced by the American firm of Roberts Industries. Foils, bent from extruded aluminium, are attached to the sides of the boat. At speed, they lift the hull clear of the water. The makers claim that they give a much smoother ride and increase the speed of the craft by 100 per cent.

Information centre

Better metal locator wanted

In the Information pages of a recent edition you made a comment concerning metal locators which is not correct. I have built three of your November 1979 metal locators (not for myself) and have found that there is absolutely no comparison between this and most other detectors costing $100 more. They work a lot better.

I feel you may find a lot of hobbyists interested in a decent pulse induction or VLF design if you could produce one. Ground tuning would be a must although discrimination would not be essential.

On another subject, congratulations on the article in the April issue headed "What to do if your project won't work". This type of advice will help me and other readers considerably. (C.L., Baxter, Vic).

● *Your letter on metal locators is timely since we plan to publish a completely new design. It will be considerably more expensive than our November 1979 design but it also works a lot better. Thanks also for the favourable comment on the troubleshooting article.*

Complete list of projects wanted

Please provide me with a complete list of project series, title explanations, cost etc. Alternatively, where can one obtain compendium and price?

I also want to construct a remote visual front door alarm system with single or multiple receivers, to assist the deaf. And I need a schematic showing modification of a battery charger from 12 volt to 6 volt operation by switching when necessary. (T.M., Faulconbridge, NSW).

● *The closest we can come to meeting your request is to note that our latest "Projects & Circuits", volume 3, has a listing of projects published by "Electronics Australia" over the last 10 years. "Projects & Circuits" is available from our Information Service for $5.40 including packaging and postage.*

We have not published any sort of front door alarm but we have published several battery chargers suitable for 6V and 12V batteries. The most recent was described in February 1982. Note that it is doubtful whether you could assemble a battery charger for less than the price of a charger from a large supermarket or auto accessory store.

Solution to tacho problems

I noticed, in the Information Centre pages of the September issue of EA, that a couple of readers were having tachometer surge problems when using the EA Transistor Assisted Ignition unit.

I built this ignition unit and fitted it to my car (a Fiat 124 sport coupe) some two and a half years ago and had the same problem; ie, above about 1500rpm the tachometer needle was all over the place.

The ignition system itself was obviously OK as the motor was not missing and was, in fact, behaving better than ever. A thorough check of wiring and connections revealed nothing so, on a "try it and see" basis, I transferred the tachometer connection from the points to the TAI switched side of the ignition coil and lo a perfectly well behaved tachometer.

This must, of course, be due to the waveform presented to the tachometer (I have no idea what it's input circuit is) but, despite firm intentions, I never did get round to investigating it and by now the "it's working so leave it alone" effect has taken over completely.

However, even without knowing "why" I felt that you may like to pass this idea on for readers with similar problems to try.

As for the TAI itself I can only express total approval. It provides a quite noticeable improvement in low speed torque and smoothness together with an overall improvement in fuel economy of 4%. The unit has well and truly paid for itself. (K.T., Eastwood, NSW).

● *Thanks for raising the subject of tachometer connections again. Our article on Transistor-Assisted Ignition in the February 1983 issue of EA noted that impulse tachometers should be connected to the collector of Q4 (as you have found) but our later article in December 1983 and the answer in September 1984 neglected this point.*

Cranky Hall effect ignition systems

A few readers have experienced starting problems with the Hall effect cum Transistor-Assisted Ignition system described in our December 1983 issue. One letter in the September Information pages may have also fallen into this category.

Now a Queensland reader who had the same starting problems has phoned with a suggested solution. It involves changing the 5.6V zener diode, D3, to a 6.2 or 6.8V diode. This helpful reader, who declined to be identified, claims that this provides a complete cure to hard starting and erratic running.

Op amps explained ... ctd from p90

400V DC supply. The rest of the circuit acts as one big operational amplifier with a constant −11V input to pin 3 of the LM301A provided by two 5.5V zener diodes in series. Pin 3 is the virtual earth point and the circuit description is similar to that of Fig. 5 except that the output voltage is higher at +250V DC constant. The capacitors used are hermetically-sealed, steel can, oil-filled paper dielectrics of 600 or 400V rating. These are much more reliable than electrolytics at high voltages.

The 1kΩ gain potentiometer provides fine adjustment of the output voltage. With the values shown, adjustment between +246V and +253V DC is possible.

This +250V supply is capable of load currents up to 30mA. Its output drifts only 18mV per day at constant room temperature and load, the measured output resistance is 60mΩ, and the output ripple is 6mV. It makes a very satisfactory voltage regulator and is eminently suitable for driving our high voltage amplifiers. A mirror image version was also built to provide a −250V supply, while a third version using different component values was constructed to supply +400V DC.

That's it for now. Next month we will consider audio amplifier circuits.

We have not tried this although there is no reason why it should not work.

Needs light shed on Autodim project

I built the Autodim light dimmer described in the January 1981 issue of EA. Up to now, I have not had any success with the project, despite having consulted two qualified TV mechanics.

I installed IC 4030 incorrectly to start with and nothing at all worked with the dimmer. Both transistors, BC337 and BC549, and the 4030 IC were replaced at this stage to rectify my error. Results of these replacements were to allow my lamps to light, but no dimming effect could be gained. The TV mechanic, in order to obtain an auto dimming effect, installed a 750kΩ resistor across terminals 1 and 2 of the IC.

This in effect automatically dimmed my lights off over a 30 minute period. This is where my next problem started. My lights were dimming over a 30 minute period, but a few minutes after the lights dim out, they come back on again with a non-strobe light effect. My TV mechanic, after spending considerable time on my project, could come up with no answer to this problem, so I was forced to take it elsewhere.

The second TV mechanic looked at the diagrams on pages 3 and 4 of the project article and compared them with schematic on page 2. He decided that there was a circuit error, with both transistors being installed completely opposite to how they should be. After replacing the IC, both transistors and reversing them, I now have a dimmer that turns on and off with no dimming capabilities at all.

All I require my dimmer to do is automatically dim my lights off over a 30-minute period. I would have liked to be able to vary this dimming time as well, but I don't feel this circuit allows for this.

Could you please let me have a

Continued on page 125

Diesel Sound ... from p113

terminals of the loco (ie, from the track). These were passed through small holes drilled in the front wall of the wagon and connected to the motor via a two-pin section cut from an IC socket (see photograph). There is no need to use a plug — the tinned ends of the wire leads are simply pushed into the socket.

The big advantage of this scheme is that it makes it easy to swap locomotives or to disconnect the sound effects carriage and transfer it to other layouts.

Pioneer Tape & Reverb amplifiers ... ctd from p34

bringing in the tape. The "source in" switch conversely fades out the tape and brings in the source signal. The "fade out" switch fades out the source or tape signal without fading in the other signal.

The cross-point control sets the level at which the fade out signal equals the level of the fade in signal. At the minus infinity setting of the cross-point switch, the signal is faded completely out before the second signal begins to fade in. The other settings of the switch are −20dB and −6dB. This final setting provides a constant volume of the resultant signal while fading in and out.

Note that fading only occurs when the fader on/off switch is on. The level meters then become fade meters.

Graphic equalisation is available for all three sources. The "graphic equaliser selector" switches allow equalisation of tape, mic or source signals or any mixture of the three. When using the microphone and tape inputs for instance, both mic and tape signals can be equalised by pressing both switches.

The equaliser has seven bands centred on 60, 150, 400, 1k, 2.4k, 6k and 15kHz and up to 10dB of boost or 10dB of cut is available.

The equaliser is useful for many purposes such as "colouring" the sound of vocals or instruments, preventing feedback between microphone and speaker and reducing noise and tape hiss during recording and playback. You can also use it to improve room acoustics — brightening sound in a room which attenuates bass and treble frequencies or damping sound which is too bright due to room reflections.

The tape monitor switch is used for tape recording and in playback. In the off position, the features of the CA-100 can be used to modify the content of the sound being recorded. With the switch on, the effects of the CA-100 are disabled and the monitored sound from the tape is unaffected by the settings on the CA-100.

A headphone socket and three associated switches allow monitoring of either tape, source or the effects signal.

Performance

We were able to substantially duplicate the performance specifications of the CA-100. Distortion was measured at .01% and frequency response for the tape and source inputs was 0.5dB down at 20kHz. The microphone input was 3dB down at 150Hz and 10kHz.

Signal to noise ratio was 80dB with respect to 1V for all inputs.

Overall we found that the CA-100 performs very well. It is sure to find a keen following among tape recording enthusiasts, whether they are users of cassette decks or open reel machines.

Recommended retail prices for these Pioneer amplifiers are $309 for the SR-60 and $465 for the CA-100. Further information can be obtained from hifi dealers or Pioneer Electronics Australia Pty Ltd, 178-184 Boundary Road, Braeside, Victoria, 3195. (J.C.)

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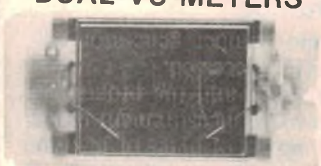

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250K dual	$1	2 meg single	50c

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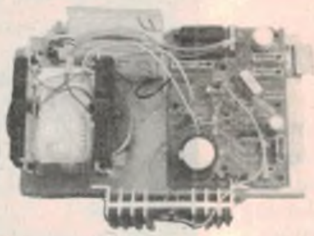

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1000 UF 63V	each $1
22 UF 160V	3 for $1
1000 UF 16V	each 50c
63 UF 25V	5 for $1
470 UF 63V	each 50c
47 UF 160V	3 for $1
470 UF 25V	4 for $1
40 UF 25V	5 for $1
470 UF 40V	3 for $1
47 UF 10V	10 for $1
100 UF 25V	5 for $1
25 UF 25V	10 for $1
470 UF 16V	5 for $1
220 UF 50V	each 50c
47 UF 200V	each 50c
1000 UF 10V	4 for $1
2.2 UF 200V	4 for $1
22 UF 16V	10 for $1
330 UF 63V	each 50c
1MFD 50V	10 for $1
33 UF 10V	10 for $1
33 UF 10V	10 for $1
1MFD 50V	10 for $1
33 UF 10V	10 for $1
0.0039 1500V	each 50c
6N8 1500V	each 50c
220 UF 35V	4 for $1
1000 UF 25V	each 50c
680 UF 50V	each 50c
22 UF	10 for $1
100 UF 6.3V	10 for $1
330 UF 25V	3 for $1
2000mfd 25V chassis mount	$1
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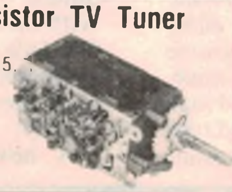

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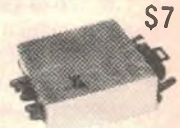

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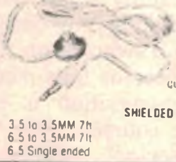

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possible answer to my problems as I have reached the stage where this dimmer must be fixed due to costs incurred? (D.C., Taree, NSW).

● *Your trouble with the Autodim sounds like a case of too many cooks spoiling the broth. The first thing to do is to get rid of that 750kΩ resistor across pins 1 and 2 of the IC.*

Next, we strongly suspect that transistor Q1 is either faulty or has been installed incorrectly. This transistor (type BC 337) should be replaced, this time making absolutely sure that you get the connections right. The wiring diagram on page 57 of the January 1981 issue clearly indicates how the transistor should be oriented.

You should also check that Q2 has been installed correctly. If not, it too should be replaced.

Finally, go over the project carefully and check that all diodes and electrolytic capacitors are correctly oriented. Correct any mistakes before switching on.

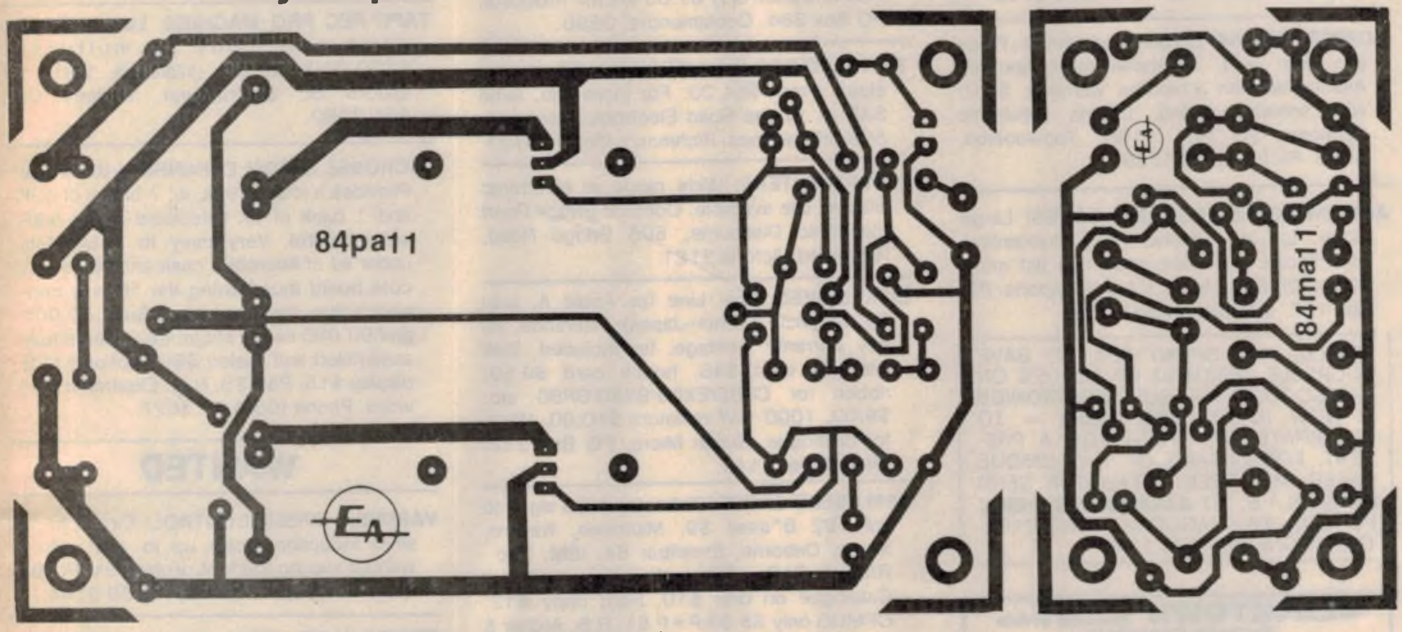
The problem of lamp flicker or strobing is covered on page 54 of the article. In your case, however, the circuit was probably upset by the inclusion of that 750kΩ resistor. If you do encounter lamp flicker, try increasing the value of the 120kΩ resistor on the emitter of Q2 to 150kΩ.

Notes and Errata

TV SOUND CONTROL (January 1983, File 6/CTV/7): the infrared transmitter may not operate at the correct frequency due to different hysteresis levels for different 4093 NAND Schmitt trigger ICs. If you are supplied with either the Philips HEF4093B, SSS SCL4093B or Motorola MC14093B device, then the following circuit changes should be made: (1) increase the 2.2kΩ resitor on pin 2 of IC1a to 6.8kΩ; (2) increase the 18kΩ resistor on pin 12 of IC1b to 47kΩ; and (3) increase the 10kΩ resistor on pin 6 of IC1d to 33kΩ.

The circuit is correct for the National CD4093BC, RCA CD4093B and SGS HCC/HCF4093B types.

Low cost utility amplifier ... from p103



Here are actual size artworks for the amplifier printed circuit boards.

Next month in Electronics Australia*

EPROM Copier

This *EPROM Copier* is easy to build and will cost you less than $90. It can program both 2716 and 2732 EPROMs and copy 2708, 2716 and 2732 devices.

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Realistic's new CD-1000 compact disc player sells for just $599.95, yet features full programming facilities. Watch for our review in December.

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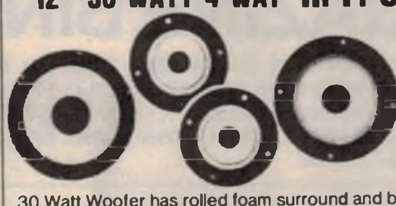

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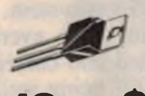

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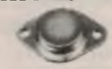

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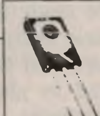

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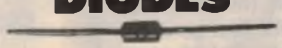

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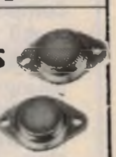

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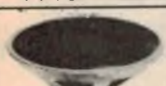

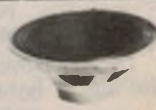

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16K RAM card from p41

section, making notes if you decide that your card should be assembled differently. The method described below is the way the original was built and it has proved to be the most reliable. It should result in a product of quality and reliability which approaches that of most reputable manufacturers.

Construction of the circuit involves the mounting of all the components onto the double-sided printed circuit board. Firstly all the sockets for the RAM chips should be soldered into place. All the remaining LS devices were directly soldered into the board as this maximises reliability. It is therefore desirable to use new ICs throughout. Next, all remaining LS devices should be tacked in place by two of their leads with solder. A final check should now be made that they are definitely in their correct place and orientated correctly. If OK, they can be fully soldered in place. The resistors and capacitors, diodes, transistors, LEDs and the dip-switch may now be soldered in place. Do not install the RAM at this stage.

Having soldered all components into place, it is a good idea to have one final check to see that all components are correctly installed.

All OK? Then the card may be checked out with the help of program listing 1. Also required is a backup copy of the DOS 3.3 master disk with the integer Basic on it and Apple Cillin II or other test program if you have one (don't worry if you don't).

The procedure is as follows:

(1) Turn the Apple off (important) and remove its lid.

(2) Take out all plug-in cards for the first switch on.

(3) Plug the partially constructed card into slot 0 (the card should not have any RAM).

(4) Connect a video monitor as usual and switch the system on and set the card switches to normal.

(5) The system should display "Apple II" and the blinking cursor as a DOS-less system. If it hangs, there is a fault and everything should be checked and corrected.

(6) All being well, key in the short machine routine of listing 1 and RUN.

(7) The keys pressed will then exercise the soft-switches and the LED indicators should show their settings.

(8) Press <ESC> to end.

(9) Turn the Apple off and remove card.

(10) If all was well then the RAM may now be installed in the sockets and the card plugged into slot 0.

(11) Install the disk controller card and boot up the system master (back up). The card should load the integer basic and when it finishes, type "INT" <CR>. You should have a ">" prompt followed by a flashing cursor to show all is well.

(12) Key in a short program as in listing 2 and let it run for a while. The program should not bomb out nor should funny characters be placed onto the screen. If this program does go strange after a while, then there is a timing fault. If it bombs first go then there is probably a faulty RAM chip or other hardware fault. The use of Apple-Cillin II (or other diagnostic program) to test your board fully is highly recommended.

Note: On boards that have problems reading RAM E8 (IC11), a supply lead pair should be connected between C4 (close to edge-connector) and the 74LS245 supply pins. This condition should not be confused with errors occurring all over the RAM range.

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- Memory repeat/play/stop
- CPS (Computomatic Program Search)
- Rec mute with auto spacer
- Standard remote control unit

Z-6000

- 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)

Z-7000

- 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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