Australia's Top Selling Electronics Magazine

Electronics Australia

JANUARY 1985
AUST $2.30
NZ $3.30

Registered by Australia Post — publication No. NBP 0240

30V/1A power supply

Multi-sector home burglar alarm

Win a PCB kit!

High-performance stereo amplifier

Add-ons for the VIC-20

Solar cells: pollution-free power

Review: National's hifi VCR

32 PAGE BONUS: HOLIDAY PROJECT BOOK

PRICE BREAKTHROUGH!

Beeple: the $99 pocket pager

At last there's a pocket radio pager that YOU can afford.

The Beeple. A small, lightweight and reliable unit that costs a tiny fraction of previous models. It's a price breakthrough!

What's a Beeple?

It's an instantly accessible automatic radio paging system activated by a simple telephone call. Just dial up the special number and a 'beep' sounds on the Beeple.

Inside the Beeple is an incredibly sensitive radio receiver capable of picking up signals in really bad locations, plus the decoding & logic circuitry necessary to analyse which signal is being received.

All Beeples share a common radio frequency, which helps keep the cost way, way down. It's up to the Beeple to decide whether the signal is for it: if so, it sounds the beep.

Clever, isn't it!

Because each Beeple can have up to four different access numbers (and four different beeps) you can have a system where you **know** by the sound of the beep who wants you. It's so simple.

Even more, it has a memory facility – in case you're in the middle of an important meeting and don't want to be disturbed. Not even to tell you you've won the lottery and you don't even need to be at work any more!

Where can you use your Beeple?

Virtually anywhere in the Sydney or Melbourne metropolitan areas – and up to about 100km outside.

That means your Beeple should work from about Newcastle to Wollongong and out to the Mountains from Sydney. Or down to Geelong, out on the bay, down the Peninsular and up as far as Ballarat from Melbourne. (Obviously range is limited at the extremes by topography and conditions).

Later on, it is expected that Beeple will be available in all capital cities and possibly some larger country centres too.

But that's in the future. Right now, it's Sydney and Melbourne.

Who needs a Beeple?

You do!

Businesses have recognised their value for years. Key personnel have been accessible at any time. Even staff 'on the road' have been contactable.

So why should John (or Jill) Citizen own a beeper?

Think of the times you've been away from home and needed to be contacted.

Sometimes trivial, sometimes important – but always impossible to do anything about.

Until now . . . with the Beeple:

Let's imagine Dad's at the station and wants a lift home: and you've gone next door or down to the shops. With the Beeple, you could go anywhere.

Or you go out to a show and spend the whole time wondering if the babysitter has everything under control. Take the Beeple along and you know you can be contacted if something really is wrong!

Or the kids arrive home from school and you're still out. They don't know what's happened to you. With the Beeple they can find out where you are.

Or an elderly relative or neighbour is ill: and you can't go out just in case they need help. With the Beeple, you're no more than a phone call away.

Or little Johnny goes out to visit his mates a few streets away. You start to worry when he hasn't come home and ring everyone you can think of. If he had a Beeple in his pocket one call would tell him to come home!

And there are thousands of other uses!

As you can see, it's not just Dad who needs one. Mums and Housewives find them indispensable. The kids can use the Beeple.

Everyone can use the Beeple. That's why it's called the Beeple: The Beeper for People!

Where does it come from?

Beeple is manufactured by the world-famous electronics giant STC, and is serviced by Voicecall, the largest private radio common carrier in Australia.

Because of Dick Smith Electronics wide distribution network, Voicecall suggested that we should include the Beeple in our product range. And seeing the incredible potential of this product breakthrough, we readily agreed!

How much does a Beeple cost?

Unlike most previous models of pocket radio pager, you buy the Beeple outright for the amazingly low price of just $99

Compare this with many of the 'leased' systems still around now which cost $40, $50 and more **per month!** The Beeple is incredibly inexpensive!

Charges for the Beeple service vary depending on the number of telephone numbers or "tones" you want. The more you get the cheaper each line becomes! Yearly charges are: 1 line $84, 2 lines $104, 3 lines $124 and 4 lines are only $144.

This includes the telephone line rental charge from Telecom, the use of the network of Voicecall radio transmitters to get your paging message out and a service and maintenance agreement which will look after your Beeple for you!

Even in the first year of operation when you have to take into account the yearly charge PLUS the purchase price, you will still be so far ahead of leased pager rates you'll be laughing.

The following year the savings are even greater!

And remember, if you use the Beeple in any type of business, the charge and the purchase price should be tax deductible!

How do you get a Beeple?

Simple! You go in to your nearest Dick Smith Electronics store in Sydney or Melbourne.

They'll be able to demonstrate the Beeple, show you how to operate it and, best of all, sell you one. Or more!

And they'll also be able (on behalf of Voicecall) to activate your Beeple **on the spot:** you'll walk out of the store with it completely operational! No messy forms to send away and wait weeks for authorisation. It's working from day one!

ONLY $99

DICK SMITH ELECTRONICS PTY LTD

Available in our Sydney and Melbourne area stores only (inc. Newcastle, Gosford, Wollongong and Geelong).

Electronics Australia

Volume 47, No. 1
January 1985

On the cover

Our new house burglar alarm features eight separate inputs, individual sector control, battery back up and a self-test facility. Build it and protect your home. Details page 36.

High-power Stereo Amplifier

Here is a stereo amplifier that will equal or better just about any integrated commercial amplifier, regardless of price. It is a no-compromise design capable of delivering 100W per channel at very low distortion. See page 24.

What's coming

Next month, we intend to publish a feature article on the new Philips stereo TV sets (see also page 111).

Benchtop power supply to build

This 30V/1A power supply features variable output voltage from 3 to 30V, variable current limiting over two ranges, overload protection and voltage/current metering. Construction begins on page 60.

Features

Hifi, Video and Reviews

Projects and Circuits

Personal Computers

Columns

Departments

BONUS!
Holiday Project Book

- STEREO SIMULATOR FOR VCRs *Uses three low-cost ICs*
- SIMPLE TRANSISTOR TESTER *Checks both bipolars & FETs*
- LEDs & LADDERS GAME *Tests your patience & timing*
- WIEN BRIDGE OSCILLATOR *Delivers sine and square waves*
- SIMPLE LED METER *Add it to your amplifier*
- IGNITION KILLER FOR CARS *Simple anti-theft device*

Free in this issue!

Electronics Australia

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*Recommended and maximum price only.

Editorial Viewpoint

The Australian hifi industry awards

Australia is to have its own hifi industry awards. Tentatively called the Grand Prix awards, they will be inaugurated in early 1985. They have been instituted mainly in the hope of promoting sales which have been in the doldrums for many years.

Many countries have their own hifi awards but Australia has been slow to move in this direction. One reason for this may be that there are very few Australian companies involved in this lucrative but very competitive market.

The idea of a hifi award brings to mind the *Car of the Year* award given by *Wheels* magazine but in this case the Hifi Industry Association, a group of Australian hifi importers and distributors, has been the prime mover. No single magazine or publishing company will have monopoly over the awards.

Several journalists who consistently write on the subject of audio will comprise the judging committee and no person involved in any aspect of marketing or selling hifi will be involved.

Eight categories have been defined for the proposed awards, although these may be modified or added to in future years. The categories are for best amplifier, receiver, tuner, cassette deck, compact disc player, loudspeaker system and a miscellaneous category called "Technological development". The judging committee will make their choice from equipment submitted by any company, whether a member of the Hifi Industry Association or not. The inaugural awards will be published in March 1985.

While the idea of hifi awards is a good one and will probably go a long way towards promoting product excellence, some aspects sound a little dubious. For a start, the idea of having the eight fixed categories is too rigid. We can easily envisage the situation where no award might be justified in one or more of those categories. What are the judges supposed to do then? Ideally, they would take the attitude that no award was deserved and act accordingly.

Another point involves the Hifi Industry Association itself. There should be no suggestion that the judges were subject to any influence from any member of the industry.

After all, if Australia is to have hifi awards, they will need to develop a reputation for excellence. We don't want the situation which obtains in some countries where the awards seem to be quite meaningless.

The delights of personal portables

Every time I see someone using a personal portable radio or cassette player, I have reason to bless the Sony Corporation for developing the Walkman in radio and cassette form. This very successful product has been imitated a hundred times over.

The result has been that Sony have performed a useful service for society at large. Sanity has returned to the streets. No longer do we have to endure the strangled sounds of improperly tuned "trannies". Instead, people are able to enjoy the music or program of their choice while not disturbing the people around them. They are a great idea. May they become mandatory for listening to music at beaches and in public places.

On that note, the staff of *Electronics Australia* wish all our readers a happy and prosperous year for 1985.

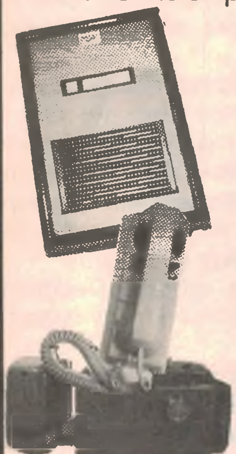
Leo Simpson

- JANUARY '85 SPECIALS

ELECTRONIC PROTECTION

At last a commercial quality single station door lock interphone system at a bargain price.

The kit of parts includes:



- ★ **Outside weather proof intercom with call button and hands free operation.**
- ★ **An inside wall mount telephone handset with door release push button.**
- ★ **A heavy duty electric door lock suitable for external entry door or outside gates.**
- ★ **A power supply - interconnecting cable and instructions.**

The electric door lock can be remotely operated from the telephone handset or by the keys supplied.

If purchased individually the component parts would cost well over **$200.**

Now you can buy the whole kit with a 7 day money back satisfaction guarantee for only **$99.00.**

This kit previously sold for **$179.00.** Zap Electronics have made a huge scoop purchase of these quality units and are pleased to pass on the savings.

$99

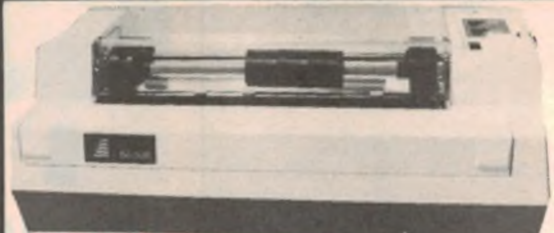
F-9700

BUY NOW AND SAVE $80

Heavy duty flexible 6 conductor telephone cable suitable for many uses. **Telephones, intercoms, security, control etc.** Extra thick and durable outer insulation.
W6010
WAS $80/100 metres
NOW ½ PRICE $40/m
But only while stocks last
Also available from stores per metre cut lengths.

TELEPHONF PLUG with grommet
T5006 **$3.95** ea
10 up $2.95 ea

TELEPHONE SOCKET
$4.95 ea
10 up $3.95 ea
T5008



GP80 PRINTER with Centronics Parallel Data Interface.
Tractor feed dot-matrix printer uses fan fold 204mm paper.

These printers are top quality, new and 100% guaranteed. C9080
AMAZING BARGAIN
SAVE $ HEAPS $$$$$$
$199

Centronics Parallel Printer Interface with graphics for the VIC-20 and Commodore 64 computers (GP80 printer compatible). C1708
$144

3-WAY HEADPHONES

Surround your head in music with these lightweight **stereo 3 way headphones** - 7 day money back satisfaction guarantee.
B0650
WAS $39.95 SAVE $10
JANUARY SPECIAL
$29.95

HAITAI SEMI-AUTO BELT DRIVE STEREO TURNTABLE
Features auto return and shut-off, top quality cartridge, static balanced tone arm, 280mm die cast aluminium platter and tinted perspex cover.
A2850
WAS $97.50 SAVE $10

JANUARY SPECIAL
$87.50

HOME ALARM ELECTRONIC KIT
All parts supplied in this kit including micro electronics black box, key code entry/exit pad, electronic siren module and four electro magnetic switches.
S1200
SAVE $20 - WAS $85
NOW $65.00
External weather proof siren
S1206 **SAVE 40% $29.50**

ZAP ELECTRONIC STORES

"TECHNOLOGICAL BREAKTHROUGH"

Zap Electronics is pleased to offer the amazing **"AD-ZAPPER"** to all VCR owners.
The Ad Zapper is a device that connects to your VCR and automatically edits the advertisements from your recorded TV programmes (when copyright permits).

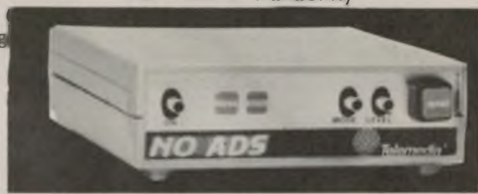
Yes, it's a technological breakthrough. The Ad Zapper detects the black space between programme and advertisement, places your VCR into pause and releases the pause on return to normal programme.

Tired of fast forwarding through those ad's in TV programmes? Now the Ad Zapper has the answer. The Ad Zapper automatically edits advertisements.

The Ad Zapper is supplied with a power supply - video cable (connect to video out) control cable with multiple plug (connect to pause or camera remote). Instructions and a video tape to explain the operation of your Ad Zapper.

An optional infra-red switch is also available for VCR's with an infra-red remote control device.

Check Stock Availability

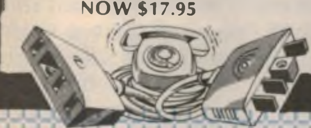


PRICES SLASHED ON TELEPHONE PRODUCTS SAVE $2 ON WHOLESALE

TELEPHONE EXTENSION LEADS
Quality 6 conductor suitable for PABX Commander and Domestic phones.
T5010 **5 metres WAS $14.95 NOW $12.95**
T5015 **10 metres WAS $17.50 NOW $15.50**
T5020 **15 metres WAS $19.95 NOW $17.95**

TELEPHONE DOUBLE ADAPTORS
Connect two phones in parallel or a telephone answering machine permanently.
T5050 **WAS $12.50 NOW $10.50 SAVE $2.00**

TELEPHONE EXTENSION REEL
20 metre, two conductor, telephone extension lead in a handy wind-up reel.
T5025 **WAS $24.95 NOW $15.95 SAVE $9.00!!**



SPECIAL INTRODUCTORY PRICE $129

(Specify Beta or VHS instruction tape)

"Infra-Red" remote control unit $29.00 for VCR's with infra-red remote control.

AD ZAPPER - the unit is manufactured in Australia by Pacifica Automation in co-operation with the Australian Government and is unconditionally guaranteed for 90 days from date of purchase.

ZAP - NO FUSS - SECURE - MAIL ORDER SERVICE

Take advantage of ZAP's wholesale mail order service for reliability, security and guaranteed protection. When you use ZAP's mail order service you are protected three ways:- Your order is despatched within one working day. At any time you can ring our service number and check stock, prices or the progress of your order. Any product purchased can be returned within 14 days of purchase date if not absolutely satisfied, and all products sold by ZAP are fully guaranteed and covered by parts and labour warranty.

NO FUSS - SECURE - MAIL ORDER SERVICE - 3 WAYS.

"Zap's policy is to offer useful and interesting electronic products as soon as they become available at Direct Import Prices"
Pat Daly,
Manager of Zap Electronics

ZAP ELECTRONICS 5 SYDNEY STORES

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HORNSBY Shop M1 Northgate Shopping Centre Ph: 476 6122
LIVERPOOL 270 George Street Ph: 602 0777
BURWOOD 51 Burwood Road Ph: 745 3188
PARRAMATTA 60 George Street Ph: 635 5877

WHOLESALE SHOWROOM AND STORE

EASTWOOD 10A First Avenue Ph: 858 2288

For tax exempt, school, government, wholesale and dealer enquires
CONTACT MARK JORGENSON - 858 2288

MAIL ORDERS TO: ZAP ELECTRONICS

10A First Avenue, EASTWOOD 2122 - Freight cost per order $5
Send cheque,or Bankcard, Mastercard, American Express details or money order. - **Phone orders (02) 858 2288**
Enquires contact Julie Macdonald

YOUR ELECTRONICS STORE

ZAP

• CHATSWOOD • PARRAMATTA • HORNSBY • BURWOOD • LIVERPOOL • EASTWOOD

News Highlights

ECHO 2000—telephone conversations for deaf

Deaf persons soon will be able to use a telephone anywhere they go — thanks to a new portable electronic device being manufactured and marketed by a South Carolina firm.

The battery-powered device, known as the Echo 2000, is easily attached to a handicapped person's telephone. Equipped with a liquid-crystal screen, it displays written messages tapped out by callers on the keys of their pushbutton phones.

At the deaf person's end of the line, the varying tones generated by the caller's pushbuttons are translated by special decoder circuits into letters that flow across the device's display window in ticker-tape fashion.

To "talk" to a deaf or hearing-impaired person, the caller must depress two telephone buttons for each letter — the first being the key on which the letter is located, the second being the number key (either 1, 2, or 3) to indicate the position of the letter on the key initially depressed. For example, to transmit the letter A, the user taps the middle key in the top row (which contains the letters A, B, and C), followed by the "1" key to indicate it's the first letter in the series. To transmit the letter B, the user would first hit the same middle key and then the "2" key, and so on.

To transmit a number, a caller simply strikes the desired number key and then the pound (#) key. In addition, there are abbreviated, two-button, codes for some of the most frequently used words. For example, "00" denotes "hello" and "*0" indicates "goodbye."

Top priority topics for CSIRO

The CSIRO has recently formed a list of eight research topics related to manufacturing which will be given the highest priority.

Included on the list are: application of computer technology and micro-electronics to industrial processes, advanced technologies for process and quality control, development of new materials and instruments for environmental monitoring and exloration. Communications devices — particularly those related to satellite communications — and various agricultural chemicals and pharmaceutical products are also included in the list.

Computer sales up but profits down

Sales of personal computers will grow more than 50% this year in the US, but the big US retailers who sell them are having a hard time making a profit. Price cutting and a near glut of personal computer products have battered stores' profitability.

These developments are already forcing a shakeout among the small retailers, particularly those that don't carry the International Business Machines Corp or Apple Computer Inc lines. But even the big chains that carry those brands are losing money or turning only small profits. Stung by an especially slow summer, these retailers are hoping for huge Christmas sales to bring profits back in line.

For many big retailers, the problems began last spring when IBM was able to ship all of the computers the retailers wanted. But sales began to slow at the same time the inventories began to bulge. Then, in June, IBM cut prices by as much as 23% and several retailers said IBM offered to reimburse them for price differences for only the previous 45 days instead of the customary 60.

As a result, many chains were stuck with loads of expensive equipment that could be sold only at discount prices. IBM declined to comment, saying its transactions with its retailers were confidential.

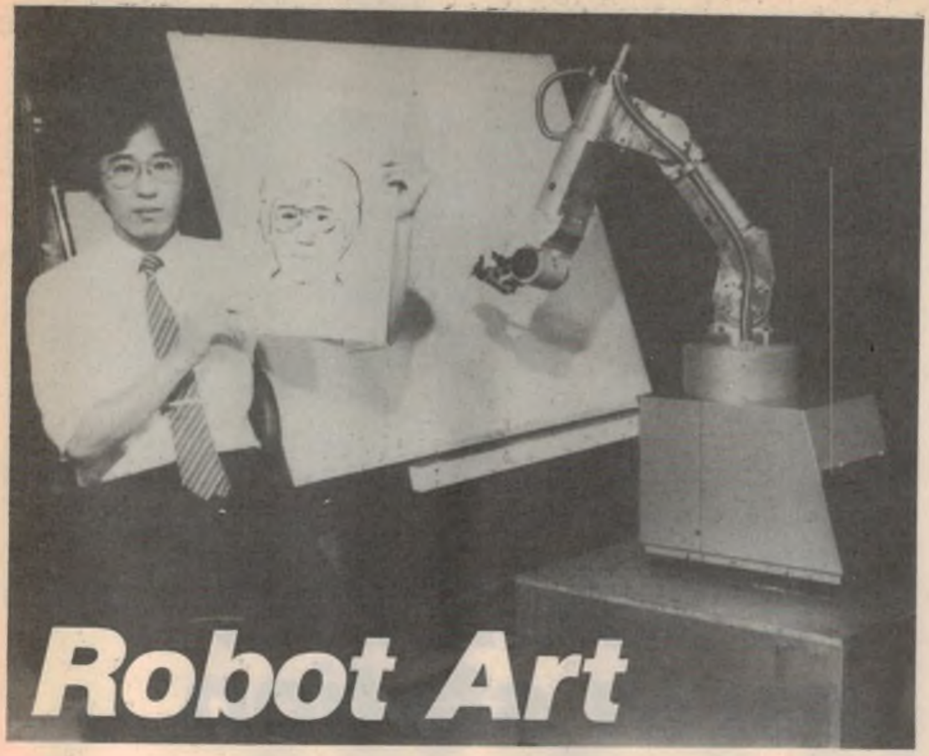
Apple dealers have had other difficulties. Apple was slow to produce software and peripherals for the MacIntosh and Apple IIc computers, initially making the computers tough to sell.

Even after accessories were available, some retailers succumbed to price cutting that drove the MacIntosh price down to $US1,995 from $US2,495 over the summer.

Even the giant Tandy Corp hasn't been immune from price cutting although, unlike the retail-only chains, it makes its own products.

Tandy, which sells its products through its Radio Shack stores, was forced to cut the price on its best-selling PC, the TRS-8 model 4, to $US1,295 from $US1,995.

The company plans to remain competitive by introducing new products at low prices.



Robot Art

Portraits painted by robots? By combining image processing and industrial robot technologies, Matsushita (National's parent company in Japan) makes it possible. Their robot system can draw a picture of a model's face with a brush in less than three minutes.

Three separate units combine to make the system work: an image processor, which uses a video camera to obtain an image of the model's face and then processes it into line image information; a robot that holds a brush and draws an image of the model on canvas according to the line image information; and a control unit that controls the entire system.

An image of the model's face is obtained by means of video camera, and then converted into a still picture.

The image processing unit converts this picture into line drawing information (drawing data) to control the movements of the robot. However, the time that the robot would require to complete a fully detailed drawing is beyond reasonable limits. Therefore, the large amount of information contained in the original image must be greatly simplified.

The image processing unit reads the degrees of variation between highlighted and shaded parts of the original picture, forming contours which are connected to form the line drawing. Only those lines representing distinct features are used as basic line drawing information. Important parts such as eyes and brows are specially processed and retained as drawing data. This complicated information is processed by a high-speed arithmetic circuit in less than 10 seconds (regardless of the model's appearance!).

Guided by the drawing data, a vertical, 6-axis, articulated robot arm produces an A3 portrait, using a brush. Actual drawing time is less than 2 minutes.

These new developments are not merely art for art's sake! The high-speed image processing technology developed for this system will make it possible to advance a robot eye function that can recognise an object's shape, position and direction for use in assembly and inspection operations.

$32M telescope for Australia

A $32M radio telescope project which will eventually link major telescopes across Australia was recently inaugurated by the Minister for Science and Technology, Mr Barry Jones.

The telescope, to be known as the Australia Telescope, will be built at Culgoora in northern NSW. It will comprise a 6km array of six fully steerable and movable 22m antennae at Culgoora, a new fixed antenna at Siding Spring (also in northern NSW) and will incorporate the already established 64m radiotelescope at Parkes, central NSW.

By linking these antennae electronically, they can be operated as one to simulate a giant telescope 300km in diameter.

Researchers from the Division of Radiophysics at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) are also looking at the possibility of linking the Australia Telescope with other radio telescopes across Australia, making it one giant radio telescope 3500km in diameter. Such an array would be able to resolve detail down to one-thousandth of a second of arc. This is equivalent to a person in Sydney being able to see a 10-cent coin (about 24mm in diameter) in Melbourne, 720km distant.

The Australia Telescope, mooted in 1975, will give Australia the most versatile telescope in the world, with a capability of making major discoveries in the field of quasars, black holes and interstellar chemistry well into the 21st century.

To observe astronomical phenomena, the antennae are designed to operate over a wide range of frequencies — from 327MHz to an upper frequency of about 115GHz. As it is not possible to design a single feed horn to operate over such a wide frequency range, a number of horns of different sizes are necessary.

The project is due for completion for the celebration of Australia's Bicentenary in 1988.

News Highlights

X-ray testing for military aircraft

A major problem involving aircraft safety, and particularly high performance military aircraft, is the down time required for regular inspections for airframe corrosion, fatigue, and other defects. The process involves removal of major aircraft sections, such as wings, tail assemblies, etc, for inspection, after which they have to be reassembled. Apart from the down time, the cost in man hours is extremely high.

As a counter to this problem the US Air Force is planning to install a giant x-ray and neutron radiography non-destructive inspection system which they hope will reduce both time and cost significantly.

The system will operate from a gantry via a remotely controlled arm, which will carry the x-ray and neutron generators and detectors, and which can be positioned to within 6mm. The neutron source is the isotope Californium-252.

Both systems will operate in conjunction with closed circuit TV systems to allow the operators to view the images. While the x-ray system will produce an instant picture, the neutron system requires time to build up an image. A feature of the neutron system is that it will detect hydrogen, resulting from corrosion, which the x-rays will not. The x-rays will detect cracks or mechanical damage.

TESS-Mobile earth station

With the commissioning of Aussat later in 1985, Australian radio and television networks will have the ability to provide live broadcasts to homes everywhere.

Soon, using a "transportable earth satellite station" (TESS), it will also be possible to bring news, as it happens, from the remotest areas.

Sam Technology, a Sydney firm which specialises in handling hi-tech systems, has gained the agreement of American Uplinks Inc, USA, to design and construct their transportable earth satellite stations in Australia to suit Australian conditions.

The TESS is self contained within a single non-articulated truck chassis — it is as transportable as the truck.

Transmission quality is said to be undetectable from local broadcasts. An on-board uninterruptible power supply accompanying TESS virtually eliminates breaks in transmission.

Each TESS will carry all its own electronic quality control monitoring systems and test gear, plus repair, replacement and backup equipment. Its five metre antenna dish will disassemble for transport.

Telecom: new zonal charges

Telecom is closely studying recommendations made by the Parliamentary Committee on Telecom's zonal charging policies.

The Committee in its report made a series of recommendations designed to improve Telecom's responsiveness to the Australian community in the 1980s. These include:

- Telecom should extend capital city local call zones to take account of rapid population growth in outer metropolitian areas;
- Reduced rates should be granted to subscribers adjacent to local call zones:
- Charges should be reduced for calls up to 50km;
- Time of day rates should be adjusted to take into account congestion in the network at particular hours and days of the week;
- Telephone directories should be simplified and amalgamated to better reflect communities of interest;
- Charging policies for provincial cities should be reviewed. Local call zones should be extended for provincial cities with high population growth, eg Gosford/Wyong, Sunshine Coast, Gold Coast. Reduced rates should apply for provincial cities linked with adjacent capital cities, eg for calls between Wollongong and Sydney and Geelong and Melbourne.
- The committee does not favour the introduction of timed local calls;
- All costs associated with extending local call zones should be financed from Telecom's internal sources;
- STD charge steps should be reduced to reflect the declining importance of distance in telecommunications.

VHS editing facilities for ABC

The ABC expects to reduce costs and speed production of videotapes following the acquisition of half inch tape editing facilities.

One inch master tape will now be copied onto VHS, along with time and frame coding information. Editing will then be performed on the smaller tape format until a satisfactory article has been produced.

After preparation of the VHS tape the one inch version can quickly be edited by duplicating the VHS frame numbers. This will significantly reduce the amount of time spent on the larger editing machines.

KITS specially picked for the school holidays, from Rod Irving Electronics — the kit specialists!

★★ RECENT RELEASES ★★

ELECTRONIC MOUSETRAP
This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again! (ETI Aug '84).

Cat. ETI 1524 **$29.95**

SOUND SIMULATOR FOR MODEL TRAINS
Fancy a diesel sound simulator for your model train layout? This circuit mounts inside the train for added realism and even varies its 'speed' according to the throttle setting (EA Nov. '84). **$18.00**

1W AUDIO AMPLIFIER
A low-cost, general-purpose, 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. '84) **$9.95**

RAILMASTER PULSE POWER TRAIN CONTROLLER
Here's an up-to-the-minute train controller offering all the most desirable features including inertia, full overload protection, walk-around throttle and excellent low-speed running characteristics. Probably the best controller available, regardless of the cost! (EA Sept. '84 84tc9)

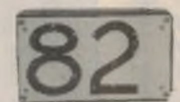
Cat. K84091 **$79.50**

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've all been asking for — a full transmit-receive system for a computer-driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are available on inter-facing the unit to other computers. (ETI Nov '84, ETI-755)

Cat. K47550 **$119.00**

DRUM SYNTH. MODULE
A simple, low-cost Module that will generate a wide variety of drum-like sounds from a pulse input provided from a sound pick up or electronically (ETI Oct. '84).

ETI-610 **$24.95**



SOLAR POWERED HOUSE NUMBER
Searching for a house at night in an unfamiliar street can be a frustrating business. This illuminated house-number switches itself on at dusk and switches off six hours later. (EA Sept. '84, 84M8B)

Cat. K84092

EA AM STEREO DECODER
AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorla C-QUAM system. (EA Oct. '84, 84MS10)

Cat. K84101 **$24.95**

READY-SET-GO LIGHTS
A simple project for starting slot car races, etc. It provides the traditional Red/Amber/Green lights with a random delay between the amber and green. (ETI Oct. '84).

ETI-277 **$24.95**

150 W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive 'commercial' ones. It delivers 150 watts into 4 ohms, has a t-band graphic, limiter, line out and bi-amp facilities (ETI Aug '84, ETI-1410)

Cat. K54100 **$299.00**

DIRECTIONAL DOOR MINDER
Most electronic door minders function by having a beam of light shining across a doorway interrupted, but are incapable of detecting whether the light beam is broken by a person entering or leaving the room. This project overcomes that problem with the aid of digital logic (ETI Nov. '84, ETI 278)

Cat. K42780 **$29.95**

EFFECTS UNIT
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects (EA June '83)

83GA6 **$65.00**

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 tup up the battery when the power is on.

(EA May '82) **$49.50**

CUDLIPP CRICKET
A fascinating Electronic Cricket with just two ICs. The Cudlipp can be used to bug your home, office etc! Great fun! (EA Feb '82)

Cat. 82EG2 **$12.00**

ELECTRONIC WATT METER
This unit will measure the power consumption of any mains appliance with a rating up to 3 kilowatts. It makes use of a special op amp called an "output transconductance amplifier" or OTA for short. (EA Sept. '83)

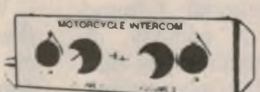
Cat. 83WM8 **$79.50**

PH METER KIT
Build this pH meter for the swimming pool season is here again!
From swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3½ digit liquid crystal display and resolution to 01pH units, making it suitable for use in the laboratory as well. (EA Dec. '82).

Cat. 82PH12 **$139.00**

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**



MOTORCYCLE INTERCOM
OVER 500 SOLD!

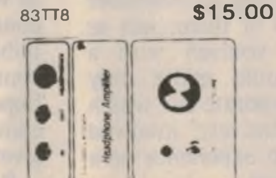
Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build! (EA Feb '84)

84CM5 **$45.00**

TRANSISTOR TESTER
1000's SOLD

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

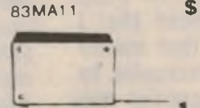
83TT8 **$15.00**



HEADPHONE AMPLIFIER
PRACTISE WITHOUT ANNOYING THE FAMILY!

If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practise for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb '84).

83MA11 **$28.00**



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**

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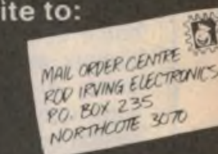

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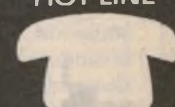

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"We wish you a Merry Christmas and a Happy New Year!" from all at Rod Irving Electronics.

Letters to the editor

"So, you think you're a journalist, mate?"

Having graduated recently with a degree in communications engineering, it was with great interest that I read your August editorial. I found this to be such a comedy of assumptions and generalisations that I feel justified in asking "so you think you're a journalist, mate?"

In the first instance you claim to be interested in engineers with a "good grounding in the fundamentals" however your "simple knowledge test" bears no relevance to fundamental principles. Had you quizzed your candidates about tuned circuit resonance or emitter-follower configurations, you may have obtained a clearer indication of their knowledge. To test for a "good all-round engineer", questions about circuit layout practices or cost efficient design would be more useful.

Contrary to your elementary understanding of the profession, Mr Simpson, an engineer is not someone who knows how everything works, but who can analyse and understand circuits, and use them in a design to satisfy a given set of specifications with due regard to cost, environmental and human factors.

A student engineer studies hundreds of circuits while at college, and cannot be expected to remember the workings of all of them; just as someone such as yourself with a business degree could quote only those sections of corporate law which he has been extensively involved with, either through experience or a special student project.

You state in your editorial that your candidates were "considerably less informed than the typical hobbyist . . . who reads *EA* . . . avidly every month"; and later on "anyone who has been a regular reader of *Electronics Australia* over the last few years would have had little difficulty handling the questions listed above". I have been buying *EA* for 10 years now, but this does not mean that I read every article, or for that matter articles in every field of electronics. In fact, I would struggle to answer two of your questions "competently". In any case, many of your articles are written in such a confusing manner that they fail to convey a proper picture of the circuit operation.

When your candidates complained that you were placing heavy emphasis on audio, you replied that "if you don't understand analog circuitry then ultimately, you don't understand digital circuitry either." Do you really consider that a lack of knowledge of specific audio circuits implies a total ignorance of analog circuitry? I think that what your candidates were getting at was that you advertised for an electronics engineer, and then asked questions more relevant to communications engineering. In any case, your particular questions do not test an understanding of analog circuits.

Despite your concluding remarks (a blunt effort to boost circulation of your magazine), I am sure that even you would concede that the institute journals and trade magazines provide the greatest source of up to date technical information.

In closing I would like to add that over the years I have enjoyed reading your magazine, and have gleaned much valuable information from it. I am however disappointed by the declining journalistic standard of late, as well as the quality of the technical content. I therefore challenge you to publish this letter to encourage comment from other readers, and hope that you endeavour to lift the editorial standard of *EA* back to the level set by your predecessor.

Richard Lawrence B.E. (Comms),
Blackburn, Vic.

• *Of course our knowledge test had relevance to fundamental principles. That was the problem for the applicants; they didn't know the principles.*

We do consider that a lack of knowledge of the complementary symmetry amplifier implies a serious ignorance of analog circuitry. We quizzed applicants closely on thermal stability of the output stages, Vbe multipliers, bootstrapping and so on. Many had no familiarity with the circuitry and, more seriously, had no ability to analyse them. *(Ed.)*

Reply to "KL"

Although I did not read the editorial which stimulated the engineers versus technicians debate, I would like to offer a comment about persons such as "KL".

The rights and wrongs of the article and the replies are not the point in dispute. Opinions are not necessarily worth the paper they are written on — a personal opinion is of no consequence.

What does matter is attitude. The fact that KL is never again to buy EA is, from any point of view, a threat. Perhaps only a little, insignificant threat, yet a threat none the less.

KL is not debating, he is opinionating and egotripping. His type of attitude causes stifling of free speech and often leads to violent conflict. In Australia, KL withholds

Editorial backlash

Regarding the Editorial Viewpoint "So you think you're an engineer, mate", you demonstrate a naivety and arrogance of such an order that it makes amusing reading.

You clearly have no idea of what is expected of a professional engineer. An electrical engineer takes an intensive four year (full time) course in mathematics, science and engineering theory. The engineer's career then spans a period of approximately 40 years during which time his/her grounding in fundamental theory should allow him/her to keep abreast of technological change at a quantitative level. The engineer (generally) is required to be a team leader and a technologist, manager and business person. The engineer's practical training effectively commences after graduation and continues for the rest of his/her career.

I agree that you could be unwise in employing a recent graduate with limited benchtop skills. However, you are totally out of order to claim that recent graduates who could not satisfactorily answer the quiz questions are not competent for a career in engineering. At worst, these young engineers are silly to apply for a job with your magazine.

I put it to you that you have had little, if any, experience in a professional engineering environment and do not have the competence to criticize formal engineering education. The reader who takes your comments on face value must be left wondering who in fact advances the state of the art in engineering (including electronics) — perhaps EA?

M.J. Flaherty,
Norman Park, Qld.

his $2.30. If this were a banana republic, he would probably be assassinating Leo Simpson for his opinion.

It is not my intention to criticise EA or its staff. At times, I too have wondered whether a particular article might be erring towards profit motive rather than information. But that is only my opinion.

However, it was EA who threw the debate open for comment. Such courage must be admired and replied to in like spirit. Issuing threats — no matter how small — completely changes the issue.

Tolerance and humour are a man's greatest assets and may well be the only virtues safeguarding us from extinction.

M. de Botella, Derby, WA.

Tripler replacement method not safe

In "The Serviceman", an article appeared regarding the replacement of triplers in early Rank Arena CTV receivers. This described the use of a Philips/Varo type tripler as a replacement type in conjunction with several resistors as a focus supply source. I produced such a note at RMIT, around 1979, for student use.

Unfortunately, on further investigation, this method is not a reliable or safe substitution. Without the large VDR resistor in circuit, the EHT voltage rises from the original 26kV to around 35kV at low brightness levels.

A substitute tripler is available from Skandia Electronics (Victoria) which incorporates the original VDR, thus maintaining EHT regulation. Alternatively, if the original Rank neoprene EHT ultor cap is used, 2 EHT cables can be inserted (with Silastic added), one from the tripler and one from the VDR resistor.

The fault occurring with the original tripler is usually EHT punch-through at the casing. Sometimes this is repairable with Silastic (clear, non-acetic), but the punch-through frequently occurs again on either the front or back of the tripler, or where the EHT cables exit. The arc-over usually destroys the vertical output and drive stages as well, so with the cost of the tripler and replacement transistors the owner will be up for repair costs of around $200.

R. Humphris, RMIT, Carlton South.

Car batteries and resistor colour codes

Over recent months you have highlighted problems in the areas of motor car battery life and colour markings on resistors. I would like to comment on these topics.

Having purchased a brand new Ford Falcon station waggon just over two years ago I was very disappointed when the battery "packed it in" after just 15 months service. I took the car back to the Ford dealer from whom the car was purchased (and who had carried out all service since purchase) believing I would have some guarantee cover on the battery for such a short service life. I was informed that there was no guarantee or warranty on batteries in new cars produced by Ford! The same applied to tyres and other items not made by Ford.

I had to accept this situation and asked the dealer to fit a new battery. When I collected the car that evening and inspected the new battery I was astonished to see that it was the same brand name as the battery that had packed it in after 15 months. I was on the point of refusing to accept this new battery when the service representative hastened to say that new car equipment batteries were of cheap manufacture, whereas the new battery, even though it was the same brand name was a top quality battery and equal to the best on the market.

Therein lie several matters of concern: batteries which last only 15 months and not three to four years as we are lead to believe; the claim that, in this instance at least, original new car equipment includes "cheap batteries"; and the absence of guarantee on items such as batteries (and tyres, etc) sold as an essential working part of a new car.

My next experience relates to incorrect resistor colour codes. Sometimes I purchase resistors in lots of 10 or more to take advantage of the lower cost. On this occasion I purchased 15 resistors of 1kΩ value and promptly put them in my 1kΩ drawer.

Some time later my son, who checks resistors before using them in a project, found that one of these resistors measured 10kΩ. We both looked at the colour bands and, sure enough, they were brown, black, and red — 1kΩ. I checked the other 14 resistors and they all measured 10kΩ and so were incorrectly marked during manufacture.

I wonder how many other people bought alleged 1kΩ resistors from this batch and have run into problems.

I hope these remarks may be of use to you.

B. Hunt, Heathmont, Vic.

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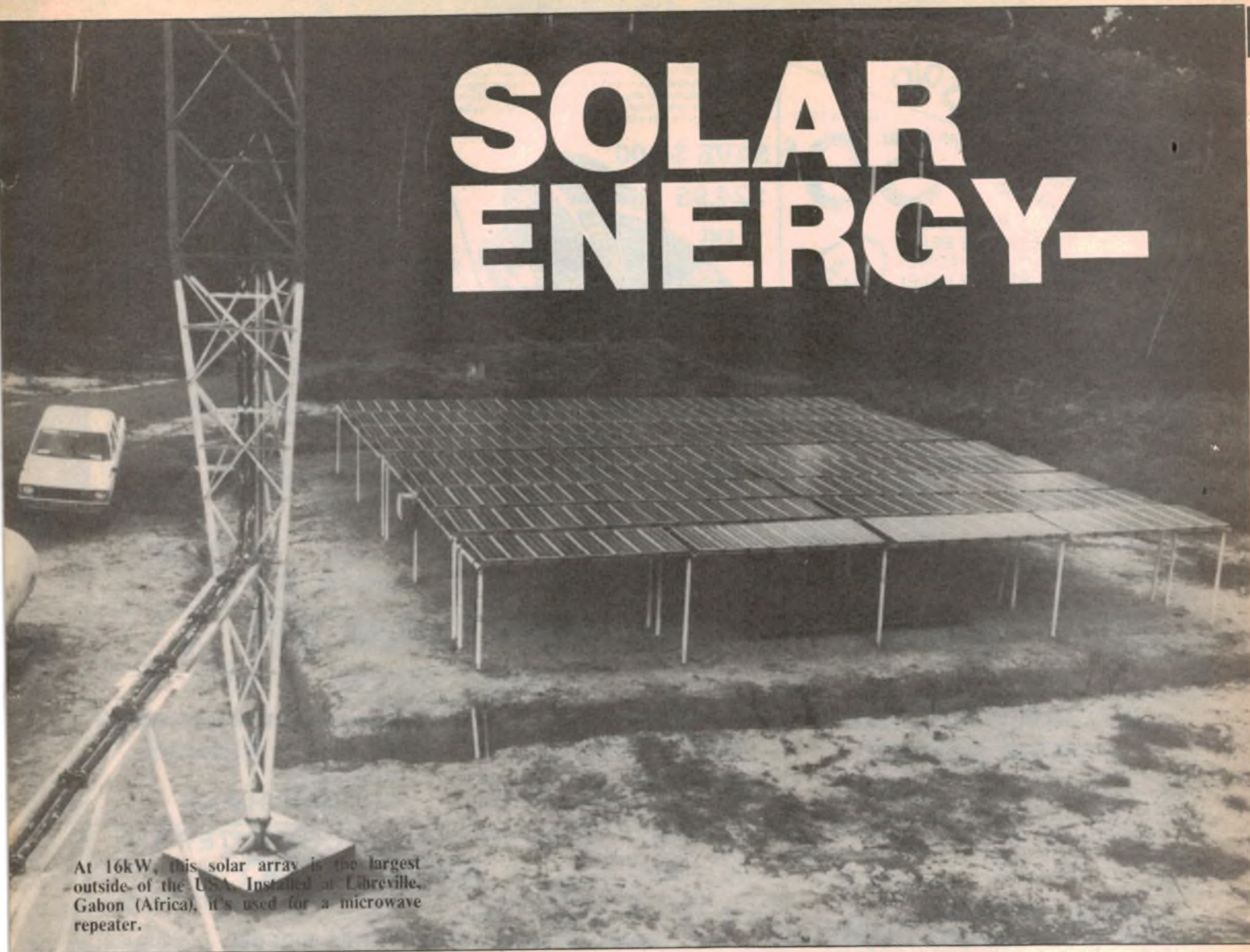


At 16kW, this solar array is the largest outside of the USA. Installed at Libreville, Gabon (Africa), it's used for a microwave repeater.

Pollution-free Power

Finding a viable substitute for fossil fuels has expended a great deal of research and development effort during the last decade. The new photovoltaic cells could be the bright light on the horizon.

Solar cell efficiencies have improved to the point where, for many applications, photovoltaic panels are now a competitive energy source for consumers in areas remote from an electricity grid. Some optimistic researchers now predict that, by the turn of the century, photovoltaics will be a cheaper energy source than oil.

The last three years have seen American manufacturers making serious commitments to photovoltaic cell production. Annual commercial production of photovoltaic cells in the USA increased 500% over the last three years. Today, most alternative energy technologies throughout the world would falter if government support of research and development were dropped. But, even without the support of research and development, the photovoltaic industry would hardly collapse, according to leading industrialists.

Members of the Solar Energy Research Institute (SERI), the US Department of Energy, and many other leading researchers and industrial developers, all agreed at SERI's last annual meeting that photovoltaic technology is ready for commercialisation. Since the first cells were made for the US space program in 1958, they have been credited as being silent, inexhaustible, and a pollution-free source of electricity — but expensive.

Now that is all changing. Solar cells have progressively become a keen competitive energy source where commercial power supplies are not available, especially in remote locations and in underdeveloped countries. Due to raw materials such as silicon and others being manufactured at a lower price with a higher purity rate, the efficiency of the units has risen considerably.

"Some oil companies have even made a commitment" says Roger Taylor, manager of photovoltaic research at the Electric Power Research Institute in the USA, "because they have vision and can see a viable and growing market. Other alternative energy technologies, such as wind turbines just don't have this backing."

Working solar-cell systems

From irrigation pumps to village power systems, solar cell installations are now economically producing electricity. One of the largest solar cell installations in the world is a 100kW unit at the National Bridges National Monument in Utah. Since June 1980, it has supplied energy for all the park's electrical needs.

These include water pumping, maintenance shops, a visitor's centre, motorists' trailers and service mains to several park-ranger's homes. Lead acid batteries, having 600kW.h storage capacity, are provided as back-up. So far the batteries have not discharged below 40% of their capacity.

The park's 1712 square metre solar cell layout contains 250,000 silicon cells in 4762 modules. The units provide 210 amperes at peak output.

The system also has diesel generators for back up but they are rarely needed to compensate for lack of sunlight. Instead, they are mainly used to equalize the charge between banks of batteries.

A self-sufficient billion-dollar-a-year industry is forecast for America by 1986. The timetable of user acceptance in the USA is predicted to follow this sequence: remote communities and houses, sunbelt residences already connected to the mains, remote water pumps for irrigation, houses in less sunny areas, etc.

A 3.5kW photocell system at the Papago Indian Reservation Village in Arizona is the first stand-alone unit designed specifically to supply power to a small village. Since 1978 it has delivered water for the village. The unit can send over 4000 litres an hour to the 41,600 litre storage tank. The system also provides lights for fifteen houses and keeps domestic appliances going.

The system is a success story but the Indians have developed an appetite for electricity and the system may have to be upgraded. One of the major drawbacks with a system like this is the need for "load-management". Available power must be used effectively and this requires careful load management.

Battery storage is invariably necessary and the size must be limited to minimise the capital costs. The solar cell system therefore has controlled independent circuits and a central control unit that uses power according to specific priorities and conditions.

In most systems of this kind, functions such as water pumping and crop-grinding are permitted only during periods of high solar gain. Also, battery back-up for these functions may not be available. With the Arizona installation, the available pumping time varies from three hours per day in winter to over five hours in summer. To protect the batteries from damage and to extend their lifetime, circuits to washing and sewing machines are disconnected at 50% depth of discharge, lights at 60%, the water pump motor at 70% and refrigerators at 80%.

Types of cells

Photovoltaic cells can be fabricated from materials in a variety of ways. Generally, the materials are grouped into four categories: single-crystal silicon, polycrystalline compounds, semiconductors such as gallium arsenide, and amorphous silicon.

Single-crystal cells are approximately 19% efficient. The best commercial module efficiencies are between 11 and 12%. Most of these cells are sawn from round silicon ingots grown by the Czochralski process, then polished. This material was originally developed to form materials for semiconductors.

Polycrystalline cells are made of compound semiconductors with small crystal-grain sizes. The highest cell efficiency to date is 11%. The cells are easily and reliably produced using thin-film techniques. Their greatest attribute is that they can be mass-produced economically.

Gallium arsenide cells: the undisputed champions, where efficiency is concerned, are laboratory cells made of gallium arsenide (GaAs). Cells measuring one square centimetre have reached an efficiency of 20.34%.

No one as yet has made GaAs cells on a production line basis. However, a Californian company is developing a mass-production process and will be making them for space applications. Much of the interest in GaAs is attributed to the potential for its use in tandem cells. These are cells made from a GaAs layer deposited on top of a silicon layer. Such tandem cells potentially may reach 30% efficiency.

Amorphous silicon cells: These are the latest of the commercial cells, the first version being fabricated in 1974. By 1982, RCA had developed a one square centimetre cell with an efficiency of 10%. Because amorphous silicon aborbs light energy more readily than single-crystal silicon, thick wafers are not needed. Of all photovoltaic cells produced in 1983, 25% were amorphous silicon cells.

Increasing cell efficiency

Until 1970, the top efficiency of any of the cells was about 14%. Today, efficiencies of up to 22% are being achieved, while tandem photovoltaic systems — groups of cells selected to utilise the wavelengths in sunlight more effectively — have produced efficiencies of over 28%. Researchers are optimistic and say that by increasing the cells in tandem, which effectively increases the light concentration, they should be able to boost efficiencies to 60%.

The goal of the US Department of Energy is to reduce photocell costs to 70 cents per watt by 1986.

Storing energy

So that electic power can be available at night and on cloudy days a storage medium is necessary with a photocell installation. Storage batteries can be too

This 300 watt array at Bronco Butte, Arizona, is operated by the Department of Public Safety. It powers three transmitters.

Solar Energy

expensive for larger solar installations, therefore alternative technologies have been proposed for energy storage and are receiving R&D treatment.

These technologies will also benefit conventional plants as well as solar plants because they will permit "load levelling" and improve the load factor of the system. They will allow energy to be stored during off-peak periods and therefore reduce the need for new generating capacity to meet increased peak demand.

Proposals include: rotating masses that store power as kinetic energy; hydrogen-based systems where water is electrolysed by the solar-plant output and the hydrogen product is consumed, as needed, in fuel cells; and hydropumping, where water is elevated by solar-powered pumps and then converted into electricity by hydroelectric turbines. Regardless of solar cell advances, large scale solar power will not be really practical until an economical energy storage system is developed.

Economics

Today, solar cell power is too expensive to compete with fossil-fuel and nuclear power. If solar cell power could be reduced to around 70 cents per peak watt then it would be a viable alternative to conventional electric power generators. Impossible? Not really. The price of cells today is approximately $10 per peak watt whereas, 10 years ago, it was $500 per peak watt.

Sunlight varies in intensity throughout the day. Therefore, 100 10MW stations scattered throughout a region will yield more average power than a single 1000MW station. Also, this scattered arrangement would eliminate some transmission costs.

Whereas the site area, per unit power output, decreases with increasing capacity for conventional plants, the site area increases linearly with output for solar plants. A 100MW solar plant would cover approximately 2.5 square kilometres of land with solar cells. A 1000MW solar plant will need 25 square kilometres.

The economics of solar plants is strongly influenced by the cost of auxiliary equipment. The cost of mirrors or lenses in concentrating systems must be taken into account, as must the cost of a tracking system to point the concentrator towards the sun as it moves from east to west.

Some experts say that if solar ceils were priced in the $1 to $2 range per peak watt, solar power would have an economic advantage over the diesel powered pumps presently used in irrigation schemes.

It is also likely that large-scale solar power will be exploited in the developing countries first, the main reason being the lack of grid and network distribution systems. With localised units, not involved with transmission costs, the higher cost of the solar cells will appear more acceptable. For example, for a village that is 100 kilometres from a power station or grid system, a cost of $2 per peak watt would make the installation of a local solar power station less expensive than extending the grid.

The experts concede that no one is thinking of a total commitment to photovoltaic power at the present time. They envisage a gradual increase in the use of solar power, mainly to relieve the load on diminishing fossil-fuels and on nuclear plants.

The future

In February 1983, a 1MW solar system using single-crystal silicon panels — the largest photovoltaic central power station in the world — was commissioned in California, USA. The plant, which cost approximately $US11 million, covers over eight hectares.

About 36MW of single-crystal-silicon modules had been installed worldwide by the end of 1983. The average selling price at the time was $7 per peak watt. At this price, an American manufacturer says, there is a $US100 million a year international market for panels. If costs could be brought down to $US3 per peak watt say analysts, then the solar market could explode overnight to $US1 billion annually. At $US1 per peak watt, an estimated $US10 billion solar energy market would await manufacturers.

There may not be much gold left in them thar hills — or much black gold left in some of those valleys, seas, or deserts — but the sun shines for us all: it's just a matter of catching it at the right price.

NEWS RELEASE 240V AC POWER SYSTEM FROM PHOTONICS

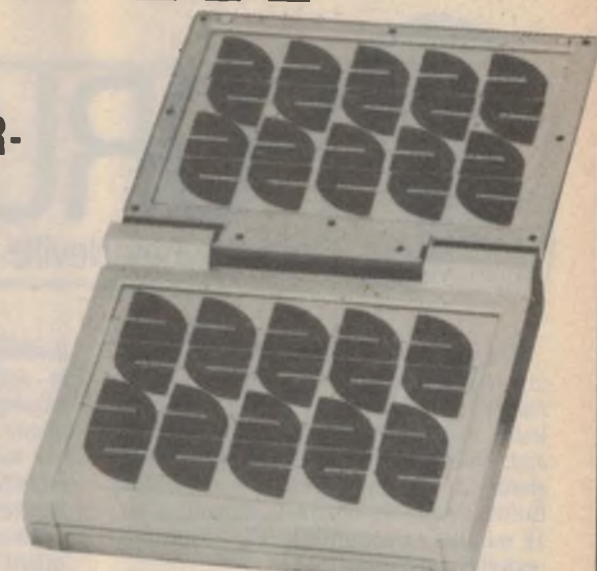
Amtex Electronics have released three photovoltaic systems designed for domestic 240VAC use. Each system consists of solar modules, support structures, deep cycle batteries, electronic control equipment, a solid state inverter and cable assembly. Although they are designed for installation by an average handyman, professional installation can be arranged. The smallest system delivers an average of 1kWh per day in the southern parts of Australia while the largest delivers 4kWh per day. Illustrated is the Amtex small AC system consisting of 8 solar modules of 40W each, aluminium support structure, 6 deep cycle batteries, electronic control equipment and 1500 inverter.

AMTEX ELECTRONICS

PORTABLE SOLAR GENERATOR

MODEL NV.500M

NOW, FROM SOLAR-TECH COMES THE WORLD'S FIRST SOLAR POWER GENERATOR THAT RECHARGES VTR BATTERY PACKS



The new NV-500M has added features making it a more versatile portable solar generator with built-in multi-volt power outlet which can deliver power to operate your appliances in 3, 6, 9 and 12 volts.

SPECIFICATIONS	Product Name	Solar-Generated NiCd Battery Charger
	Model	NV-500M
	Solar Cell-Module	P/N Single Crystal Silicon Cell Module 0 5V/0 5A Cell × 40 pcs., Isc 0.5A Voc 20V Condition: Sunlight 100mW/cm² (Facing direct to the sunlight on a clear day)
	Applicable NiCd Battery	Portable VTR Battery with capacities of 12V. 0.5Ah to 2.0Ah.
	Charging Hours	H ≒ Capacity of NiCd battery × 3.3 (from the complete discharged level)
	Charging Method	Constant current charging with over-charging protector and circuit breaker
	Operating Temperature Range	−10° ~ 80°C
	Dimensions	330mm W × 350mm H × 65mm D
	Weight	2.6kg
	Accessories	Polarities Adapter and Connector Plug

Besides recharging various VTR battery packs with this NV 500M, you can also draw power direct through the External Outlet with the battery left inside the unit. This way you can use power longer while the solar panels keep generating power simultaneously. Through direct power supply, you can operate many other appliances such as radio cassettes, AM/FM radios, public address systems, portable fluorescent light that operate on power under 0.45A (about 5W).

FEATURES

- **PORTABILITY** — A mini-powerhouse, the size of an attache case, the NV-500M can generate enough power to recharge your VTR battery packs (12V 0.5Ah ~ 2.0Ah) anywhere whenever the sun shines.
- **VERSATILITY** — The NV 500M can house, and recharge VTR battery backs of many makers regardless of difference in size. Also NV-500M can be a handy DC power source for a variety of other appliances.
- **LIGHTWEIGHT** — The moulded cabinet is sturdy and lightweight.
- **EASY CHARGING** — The custom-designed IC assures a constant current charging either from the solar cell module under the sunlight or from AC power source. (An adapter is needed).

FREE

ORDERS RECEIVED BEFORE JANUARY 31, 1985 WILL RECEIVE AT NO EXTRA CHARGE:

NI-CAD BATTERY PACK 12V 1.2AHr

NORMALLY $59

PRICE $225 EA CERTIFIED POST AND PACKING $10

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Fairfield, NSW 2165

Please send me NV500M @ $225 = $
Certified Post & Packing @ $10 = $
Total = $

Enclosed is a cheque/money order
Please charge my Bankcard.
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Leg pulling? MW radio

FORUM

Conducted by Neville Williams

Unless I am much mistaken, a number of people are hobbling around with one limb considerably longer than the other, thanks to a certain leg-pulling gentleman from New York. Either that, or the said gentleman has contrived a broadcast receiving antenna from "directional" audio cable and aimed it with unerring accuracy at Sydney, Australia!

The particular matter was brought to my notice a couple of years ago by a reader from Winmalee, NSW. I read his letter, decided it was a gag of some kind and, having more urgent things to write about at the time, filed it for possible future attention. There it remained for 18 months or so, until it fell victim to a periodic clean-out.

But that was not to be its fate, because I've just received another letter from the same correspondent on the same subject. I quote:

Dear Sir,

A couple of years ago, I brought to your attention a brief item which appeared in the Sydney "Sun" newspaper, in which it was claimed that radio 2CH in Sydney had been received loud and clear on mainland USA.

It went on to explain that an American gentleman visiting Sydney had become a devoted listener to 2CH and, prior to his departure, had rung the station and expressed his sentiments to the afternoon announcer, stating that a very sensitive receiver was on hand and that, following considerable dial twiddling, the station could be heard quite clearly.

To prove his claim, the phone was placed close to the loudspeaker, allowing the announcer to hear the music that he knew was going to air at that very moment. End of story!

In my earlier letter I posed two questions:

(1) What are the chances of a Sydney medium-wave broadcast station being received in the USA — particularly at mid-afternoon, Sydney time? In my experience it would require a near miracle to be heard in New Zealand, let alone America!

(2) "Super sensitive" receiver notwithstanding, why is 2CH not being swamped by other transmitters, many of which must surely be on or near the same frequency?

I suggested in my letter that the announcer had been the victim of a practical joke. That the American listener had phoned a willing participant in Sydney and arranged for a radio playing 2CH to be placed close to the phone. Then our prankster had phoned the announcer, spun him the amazing reception story and simply held the two phones together, by way of proof.

Even though the matter was never raised in EA, I believed that someone, somewhere would have a quiet word in the ear of the announcer and/or the appropriate staff member of the Sydney "Sun".

But no. Two years later, an item on page 4 of "The Sun" for October 5, '84 endorses the original claim. It reads:

BARRY WINS ONE LONG RANGE FAN

Barry Spicer, 2CH arvo rating's winner, has made one fan who won't give up — even 20,000 km away, at home in New York City.

Craig Thompson, a businessman, became a Spicer convert two years ago during a visit to Sydney.

Back home, he fiddled and fine-tuned his ham radio until Barry came through loud and clear and, for the past year, he has been calling Spicer about once a month for a yarn.

Next month, Craig Thompson will be back in Sydney for a spot of business — and lunch with his Aussie hero.

Seriously, Mr Williams. Having been a regular reader of EA for over 20 years, I respect your comments. In the light of recent articles touching on the ignorance of those about to enter the electronics industry, people who may have read this "amazing reception" yarn deserve the benefit of your reaction — just to get the record straight.

Derek Hobbis (Winmalee, NSW)

Long time — but not very technical — readers of the magazine may well wonder what all the fuss is all about, remembering that, once upon a time, they used regularly to log overseas broadcast stations on their Sooper Dooper Blooperdyne receivers. They might recall that American magazines, back in 1925, regularly used to advertise radio sets capable of picking up Europe. Yet none of those ancient models would have been a patch on receivers available today.

True, but there are half a dozen reasons (four, anyway) why international medium-wave reception is much more difficult now than it was then.

(1) There are far more stations on air, nowadays, with many of them, nationwide and worldwide, sharing each frequency channel in the broadcast band.

(2) A great many stations now operate 24 hours per day, so that DX (long distance) enthusiasts can no longer listen around the band after local stations have closed down.

(3) Most MW stations, these days, by choice or by law, use an antenna system which concentrates their signal in a designated service area. High angle transmission, which could reach further afield (and interfere with other stations) is deliberately minimised.

(4) Man-made electrical interference has increased enormously since the early days, blotting out signals which once might have been audible.

For all of these reasons, the chances of anyone in New York City — of all places — listening regularly (if at all) to 2CH in Sydney would seem to be nil. Especially to 2CH!

You see, 2CH is on 1170kHz, one of the few frequencies in the medium-wave band which are divisible by both 9 and 10. Therefore that exact frequency is going to be occupied by radio stations in countries using 9kHz separation (notably Europe and Australasia) and 10kHz (notably USA, Canada and Mexico).

Seemingly, Mr Thompson would have made things easier for himself by having an affair with any station in Sydney other than 2CH! At least he would not have had to face quite so much direct competition from within his own continent.

Unfortunately, Mr Thompson's credibility is not helped by the choice of

and super hifi copper!

words in "The Sun" news item, as quoted: "He fiddled and fine tuned his ham radio until Barry came through loud and clear". It has all the marks of a non-technical copywriter using words which he/she has picked up from somewhere and which sound appropriate.

Yes, a ham (amateur) receiver can receive signals, loud and clear, across the Pacific in either direction — but only only at certain times and in certain frequency bands. The medium-wave broadcast band is not one of them!

But even if Mr Thompson was using a modern communications type receiver covering the amateur AND broadcast bands (I have one myself, as would thousands of other readers) you don't have to "fiddle and fine tune" such a set; that sort of thing went out with blue serge suits; or rather with receivers that had unstable local oscillators and indifferently calibrated dials.

These days, if you want 1170kHz, you dial up that frequency and that's what you have; instantly, spot-on and no fiddling!

Whether what you hear is 2CH or babble from a dozen other stations on that frequency would be quite another matter.

But could that reference to a "ham" receiver be a Freudian slip? Derek Hobbis has suggested that Craig Thompson and a fellow practical joker could be using a double trans-Pacific phone link to prove their prank. Maybe so, but it would be Telecom that was enjoying the last laugh!

How much cheaper and more practical it would be for a local amateur, on cue, to squirt 15 seconds of 2CH's program to someone on the other side of the Pacific? Illegal, of course, but I would judge that stranger things have happened, at times, on the amateur bands.

Again, might it not even be possible to simulate an international call from right here in Sydney, without letting on that you were really in the Hilton up the street?

So there you are Derek. We've dealt with your query after a mere two-year delay; we've supported accepted theory about the coverage of MW broadcast stations; we've recounted a joke, if it is a joke; and we've provided some publicity for Barry Spicer, which I'm sure he won't mind in the least!

A warning word

Incidentally, while searching for Derek Hobbis' original letter, I came across another one from the same period, 'which had been held over, mainly because we do, at times, have to terminate discussion on particular subjects. But the matter raised in the letter is as relevant now as it was then. It is reproduced in the accompanying panel.

As you will note, the writer is concerned with the tendency for overseas tourists to snap up electrical or electronic "bargains", without even considering something as basic as the mains voltage on which they will have to operate.

At worst, they can end up with a 110V unit but, even if they buy something with a 220V rating, they still might not be out of the woods, for reasons which form the subject of the letter. I suggest you read it.

But now for a complete change of topic:

Hifi copper wire

An unnamed reader has sent me a photostat copy of an item in "New Scientist" for October 11, '84 entitled: "Hifi benefits from crystal-clear sound".

I quote:

"A development from Hitachi in Japan could make all existing quality sound recording and reproduction systems obsolete. The company is selling copper wire made up of long crystals which are free from oxygen."

It goes on to say that, without being able to offer reasons why, hifi

Asking for trouble: 220V equipment on 240V mains.

Without seeking to get involved in the question of the fire hazard supposedly presented by electronic equipment, I would like to draw attention to the fact that a lot of such equipment, purchased by tourists looking for duty-free bargains overseas, is unwittingly brought back into the country, without being checked to see whether it is compatible with Australian conditions.

My experience with appliances and electronic equipment brought to me, "blown up", for subsequent repair, indicates that manufacturers in Taiwan and Hong Kong, and to a lesser extent Japan, often use components which are "dead on" for the working voltage for which the particular equipment has been designed to operate.

This allows so little room for error, that the use of equipment designated as 220V AC on 240/250V AC mains is asking for trouble, especially in the case of cheap, sparingly designed appartus.

I have measured secondary voltages from small transformers ranging between 13.7 and 16V AC instead of the required 12V RMS. My normal procedure is to replace such transformers with compatible 240/250V primary types, as well as replacing the capacitors, resistors, etc, that may have blown up.

Some mains switches are rated at 110V AC. No wonder the insulation breaks down, necessitating replacement with a more substantial type.

Capacitors seem to be the main loser in the ratings battle, having inadequate over-voltage tolerance. Diodes and bridge rectifiers also fall frequent victim to the higher peak voltages, when plugged into 240/250V mains. Strange to say, ICs seem to have some inherent protection of their own; rarely does a chip need to be replaced.

Hair dryers rated at 220V AC are prone to the loss of the rectifier diode (rated at 240V instead of 360V) which I replace with two 1000V diodes in series, partly to alleviate the motor voltage.

I have lost count of the number of appliances, portable TV power leads, VCRs, cassette and record players, etc, which have heen brought to me to have the moulded American style plugs and leads changed to the Australian equivalent. Just as well, because about a quarter of them turn out to be designed for 110/115V mains only. In such cases, the so-called savings on the duty-free articles are absorbed in the cost of the replacement transformer, lead and labour.

Presumably, a similar proportion of purchases "blow up" when non-technical buyers simply twist the American style flat pins and push them into an Australian 240V socket. EA readers would know better but non-technical friends should be warned to have their overseas "bargains" checked by a licensed electrician.

K.B. Miranda, NSW.
(40 years a "sparks")

enthusiasts have claimed for years that audio cabling can "colour" sound and that special cables can offer subtle improvements.

That cables introduce some electrical resistance is known and understood. It has been suggested, however, that if copper contains oxygen, oxide barriers may be present between adjacent crystals, causing partial rectification effects and modifying audio signals as a result. Cables made from oxygen-free copper would avoid this effect.

Reportedly, Hitachi has discovered that, by heating oxygen-free ingots of copper slowly, crystals are formed which are 10 times the size of those in normal copper. When drawn through a die to make cable, the crystals stretch rather than break, producing a possible 1000:1 reduction in the number of inter-crystal barriers. The item concludes:

"When this cable is wired into an audio system it is, as one audio critic put it, like lifting a veil from the sound."

At first reading, the news item might suggest that, prompted by the observations of audio zealots, Hitachi scientists have been researching the properties of copper and are now able to offer cable which actually exceeds purist expectations: not only free of oxygen but with a 1000:1 reduction in the number of inter-crystal barriers along its length.

Does this mean that the zealots have been right all along and that I, with many others, have egg on our faces? Well, not yet, anyway!

While I have frequently questioned statements and attitudes of the "golden ear" brigade, I have always left the way open for them to come up with objective support for their views. I said as much in the May '83 issue, repeated in September, p.115:

"The purveyors of deluxe and directional cable would have it made if they could only find someone from that area (communication and cables) able to produce a rigorous engineering paper validating their claims. It would be a sensation!"

An invitation along these lines was repeated at the recent AES Melbourne Convention — without result.

But, if Hitachi has indeed succeeded in producing the "ideal" copper wire for audio cables, they should also be in an excellent position to provide the aforesaid "rigorous engineering paper", to validate any claims in respect to its performance. It would be a treatise that not even the most stubborn traditionalist could ignore.

But then I read the item again and realised that Hitachi may not have made any such claims or even had audio applications in mind. Quite possibly, their metallurgical research would have had to do with power generation and reticulation, in which the Company has a much bigger stake than in consumer audio.

Could it be that the reportedly new oxygen-free, long-crystal cable, developed for other reasons altogether, has been interpreted by an independent writer as a potential breakthrough in audio technology? From the way the original text reads, it would certainly seem to be a possibility.

Curiously, zealots have been claiming for some time that cables made from oxygen-free copper and installed with due attention to signal direction, open up a whole new world of sound; lifting a veil, as it were.

I can't help but wonder when the purists are going to run out of veils! Even Salome didn't have an unlimited supply!

In an effort to clarify the situation, I rang various outposts of the Hitachi empire in Sydney to try to track down the original news release about the long-crystal cable. No one had heard of it; no one could suggest anything other than I write a letter to Hitachi in Japan, in the hope that it would find its way to the appropriate section.

Shades of my recent observations about our technological isolation!

In the meantime, rather than rely completely on my own intuition, I rang a friend, a university professor, who is well informed about such things. He had seen the item in "New Scientist" and did not taken it seriously — an opinion that he expressed in quite colourful terms!

Oxygen-free copper, he said, was important for its mechanical rather than its electrical properties. Oxygen atoms may combine with with hydrogen to produce water molecules, which can have a disruptive effect on the crystalline structure under certain physical conditions, producing a tendency to brittleness.

At the university, he said, they had the means to impose a signal with virtually zero distortion across a conductor and to measure extremely low levels of distortion in the resulting current. Distortion was plainly evident in a carbon resistor but they had never been able to observe it in a copper wire, despite all the talk about inter-crystalline junction effects. As far as they were concerned, in the context of audio, ordinary copper does not present a problem that requires a solution.

More than that I am not able to say, at this moment, although some other reader may possibly be able to shed light on the announcement which prompted the news item in "New Scientist".

If Hitachi have indeed come up with a new cable with objectively demonstrable advantages in audio equipment, it is important that we should know about it.

But, if its properties relate to some other application, we may have to brace ourselves for a new round of "veil lifting", no matter how irrelevant the fancy properties may be to audio.

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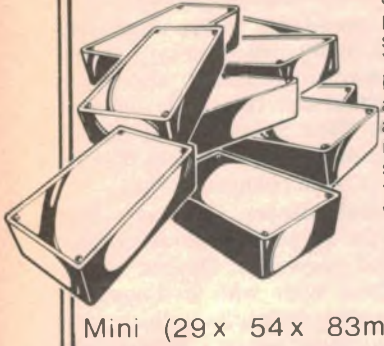

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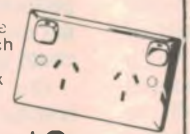

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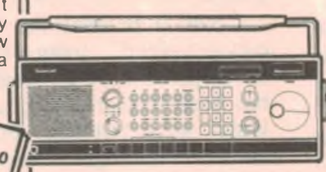

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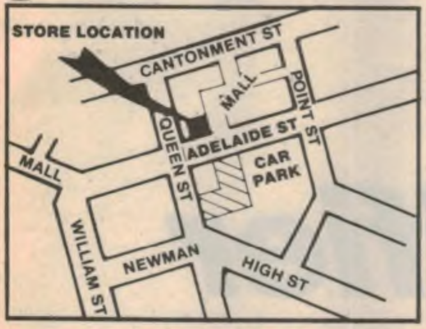

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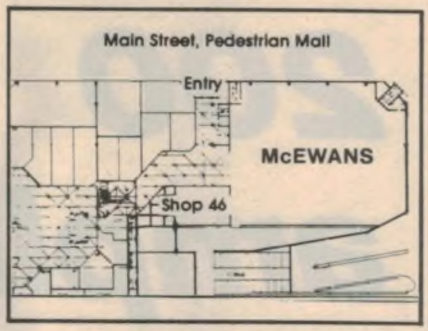

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Introducing our new high power design

Playmaster Series 200 stereo amplifier

by LEO SIMPSON

Here is a stereo amplifier that will equal or better just about any integrated commercial amplifier, regardless of price. It is a no-compromise design capable of delivering 100 watts per channel at very low distortion.

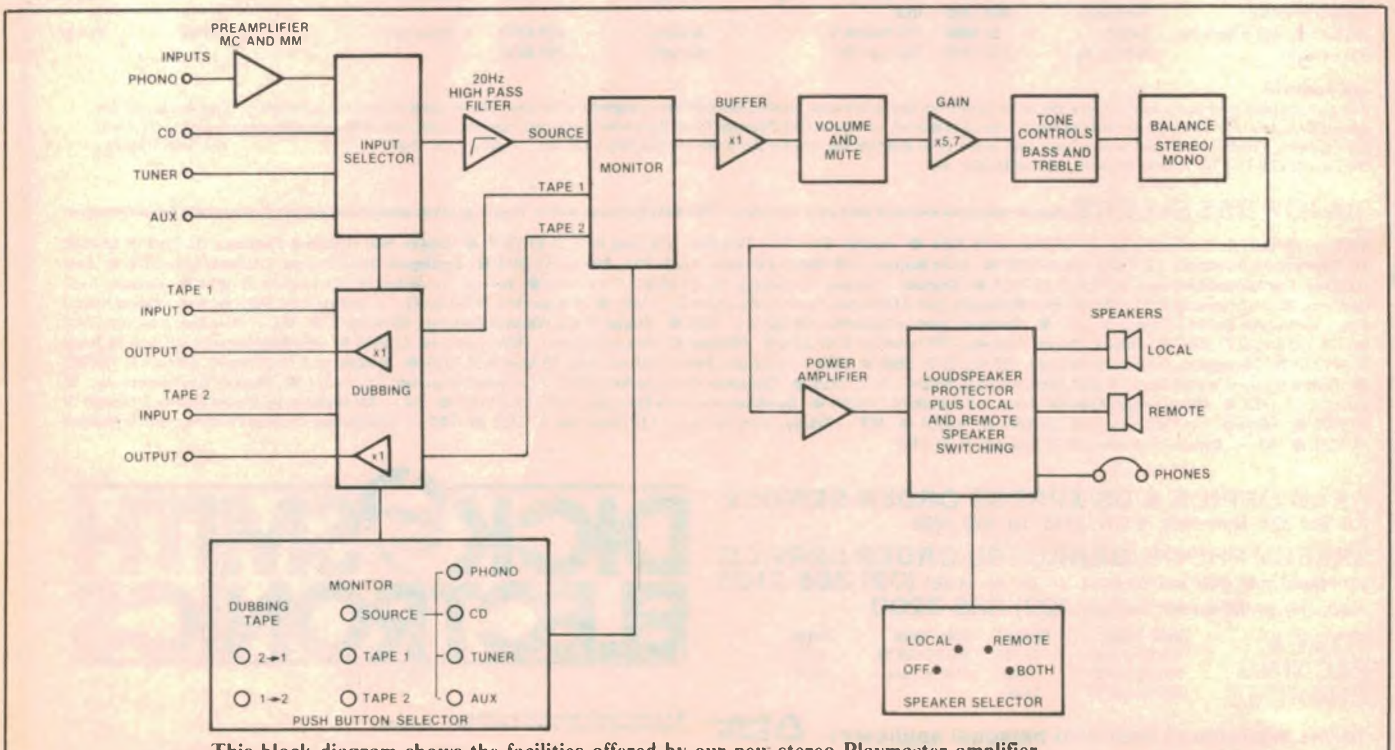
It is with a great deal of satisfaction and some degree of relief that we at *Electronics Australia* can finally present this series of articles on our new integrated stereo amplifier. This project has been over a year in development although this has naturally been far more intense over the last few months.

And now that it has finally eventuated, we are very proud of our new amplifier. In quite a few respects, this new amplifier represents a major advance over previous Playmaster amplifiers which in themselves were very successful designs.

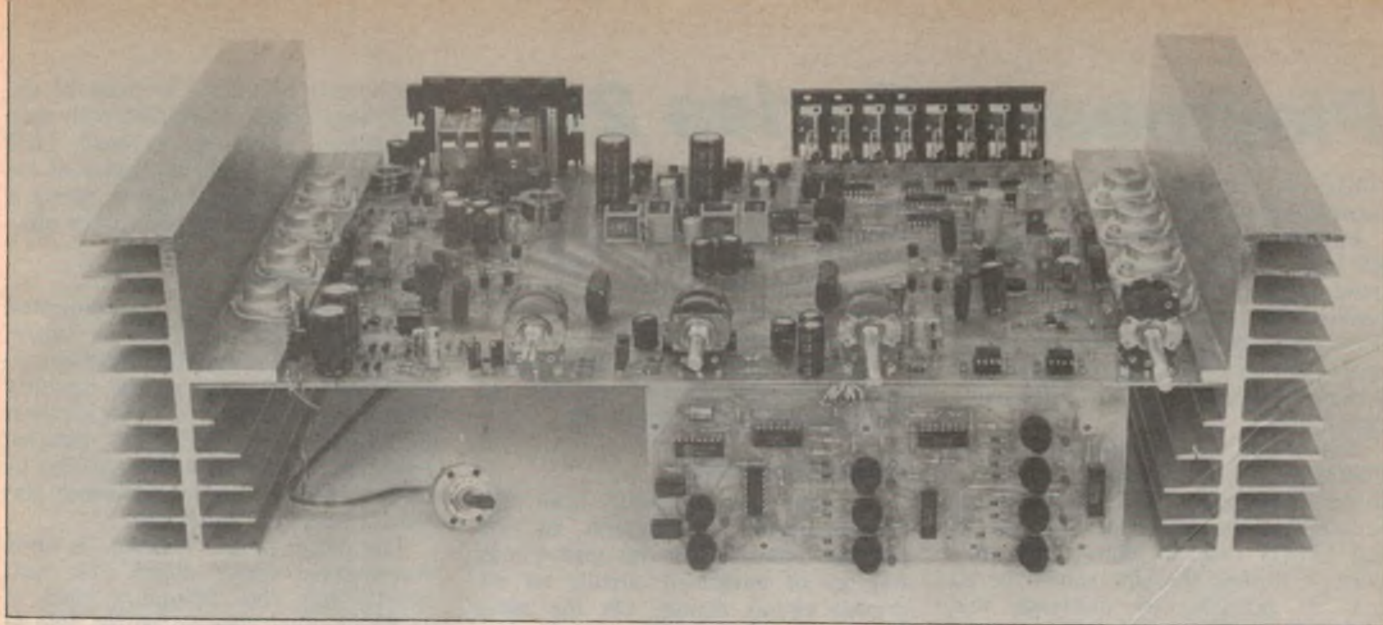
As well as providing high power and very low distortion, the new Playmaster design provides much better control facilities. It is also considerably easier to build but perhaps you, the reader, will be the best judge of this last aspect.

Let us briefly consider some of the features of the new amplifier. Perhaps this should be done while looking at the accompanying block diagram which shows all the control features of the design.

As with most amplifiers these days, there are four basic stereo inputs. Both moving magnet and moving coil cartridges are catered for, by virtue of a rotary switch of the back on the amplifier which changes the gain and input impedance of the phono input.



This block diagram shows the facilities offered by our new stereo Playmaster amplifier.



This is what the amplifier will look like before the chassis is assembled. Note the heavy duty heatsinks.

Three high level stereo inputs are provided, for compact disc (CD) player, AM/FM tuner and an auxiliary input which could be from a stereo TV tuner or hifi VCR. All three high level inputs have a degree of performance which ensures negligible degradation of the signal quality available from a compact disc player or other digital source such as laser disc player or PCM adaptor.

Input facilities are also provided for two stereo cassette decks and full monitoring facilities are available for either deck plus dubbing from deck 1 to deck 2 or from deck 2 to deck 1.

Two pairs of loudspeakers are provided for and these may be used both together or separately, or both may be switched off. Nor is there any of the funny business resorted to in some amplifier designs whereby the two pairs of speakers are connected in series or via a low value resistor. Either measure degrades the damping provided by the amplifier and is highly undesirable.

The terminals provided for the loudspeaker connections are the same as found on many commercial stereo amplifiers these days. They are a twist-type binding post which takes bared wire connections, giving a secure, low resistance connection. A particular virtue of these loudspeaker terminals is that the connections are completely shrouded by the terminal so that there is no chance of accidental shorts or shocks to the user. They look good too.

Naturally there is a 6.5mm jack socket on the front panel for connection of the pair of stereo headphones. Either high or low impedance headphones may be used.

Physically, the amplifier is quite large. Its overall dimensions are 483mm wide, 150mm high and about 290mm deep, including knobs and rear projections such as the loudspeaker terminals.

The main reason why the new amplifier is so bulky is the size of the large heatsink on each side. These specially tooled aluminium extrusions are necessary to cope with the large amount of heat produced when the amplifier is running under "worst case dissipation" conditions. Normally of course, the heatsinks merely become warm to the touch.

While the large heatsink extrusions determine the height and depth of the new amplifier, the width was determined by the requirement that the new unit match the width of rack-mounting equipment, ie, 483mm. A look at the prototype unit will also reveal that the width was necessary to accommodate all the circuitry on the single large printed circuit board.

Design philosophy

One of the major difficulties in the presentation of a new amplifier is that it must be seen to be appreciably better than its predecessor. In a sense, this is no different from any other consumer durable product; the new model must be different and therefore better than the old.

So our problem was this: how do we produce a new amplifier which is substantially better than the previous two successful units, viz, the Playmaster Forty/Forty described in December 1976 and January 1977 and the Playmaster Mosfet stereo amplifier described in December 1980 and following months.

We decided that the Playmaster Mosfet model must represent the end of the line of development in its basic design philosophy, range of operating facilities and method of construction.

We had to come up with something considerably better. And that is easier said than done.

Logically, the best way to improve upon an existing design is to ask what is wrong with it and then see if it can be improved. Both the previous two designs had a single large printed circuit board which accommodated all the electronic components. This was good but it still left a lot of wiring to be performed by the constructor. All the input wiring required shielded cable which is very tedious to cut, strip, solder and strap neatly into place. So that was one of our major requirements: eliminate as much wiring as possible.

When taken in conjunction with the general and very desirable requirement that the overall performance standard must be improved, a complete rethink of the design approach was needed.

Starting right at the input sockets, we decided that we had to use a moulded RCA input socket assembly which soldered directly to the printed circuit board. This eliminates the need for shielded cable but then raises the next problem: how to select the inputs and provide the fancy switching for mode selection, tape monitoring and dubbing from deck to deck.

The refined Japanese stereo amplifiers solve these problems elegantly by the use of multiple position slide switches soldered directly to the printed circuit board and operated by flat Bowden cables from the front panel controls. Plainly, we could not take that approach.

CMOS switching appeared to be the way out. CMOS analog switch ICs are cheap, readily available and can be arranged in several different configurations to suit the required facilities. Two problems presented themselves. First, CMOS switches can be a source of distortion and second, some sort of memory system was required so that switch selections would be remembered when the amplifier was turned off. The fancy way to do this would be to have a semiconductor memory or perhaps even a microprocessor to control it all. Once again, we were not going to take that route although some Japanese manufacturers have done so.

Instead, we elected to use a number of RS and D-type flipflops which are powered by a couple of nickel cadmium penlite cells when the amplifier is off. This is neat and does not involve a great deal of circuitry. The dual cell holder can be seen roughly in the centre of the main circuit board.

The problem of non-linearity in the CMOS gates (read: switches) is overcome in the following way. Since the distortion is caused by the non-linear resistance of the CMOS gate it follows that the current through the gate should be as low as possible, to minimise the distortion signals generated.

This is achieved by buffering the output of each CMOS gate with a unity gain amplifier which has a high input impedance. Thus very little signal current flows and the resultant distortion due to the CMOS gates is negligible. It does mean that we have had to use a lot of op amps to do all this buffering but multiple op amp IC packages are cheap. They can also be configured in very low-noise, low distortion stages. So that was the ideal way to go for our design.

Loudspeaker switching

Having solved the problem of input wiring and switching, we then had to come up with a solution for the loudspeaker switching. Again, we did not want to have heavy loudspeaker wiring running to and from the front panel selector switch to the output terminals. We also had to face the question of current rating for the loudspeaker selector switch. When the amplifier is running at full power, the output currents are of the order of 10 amps peak (for a 4-ohm load). Rugged switches capable of reliably switching these orders of current are very expensive and not readily available.

Our solution was to use relays, one for each pair of loudspeakers. The two relays are controlled by the circuitry which provides initial muting and protection in the event of an internal DC fault. At the same time, the actual loudspeaker pair selection (via the relays) is made via a conventional rotary switch on the front panel. This switch carries only the DC energising current for the relay coils.

The headphone socket is permanently connected, regardless of whether the loudspeakers are selected or not.

Circuit features

As may be apparent from the accompanying photograph of the amplifier chassis, there are quite a large number of integrated circuits on the printed circuit boards. On the main board, most of these ICs are low noise, operational amplifiers which, depending on the circuit application, are either FET-input types such as the TL071, or the bipolar type Signetics 5534.

We have not used discrete transistors for any of of the low level input circuitry, apart from those used in conjuction with op amps in the phono preamplifiers.

A particular feature of the phono pre-amplifiers which should be mentioned is that they use high tolerance components in the negative feedback loop to ensure very accurate RIAA equalisation.

We will talk in more detail about the low level circuitry next month.

All the control potentiometers have a nice feature: detents. The bass, treble and balance controls have a centre detent which is desirable when you wish to centre the balance control or set the tone controls to the flat settings.

Better still, the volume control has multiple detents which make it very easy to repeat any desired volume control setting.

Another desirable feature of these pots is that they are all printed circuit mounting types which eliminates control wiring.

A similar comment can be made about the pushbutton controls. These are all momentary contact switches which are soldered directly to the vertical board, which mounts under the front of the main large board. Associated with each pushbutton switch is a small LED indicator which shows the status of the switch (this is a fancy way of saying it shows whether the switch is on or off).

Power supply

The power supply is mounted underneath the main circuit board. Having the power supply components in such close proximity to the circuitry meant that we had to have a power transformer with a very low external hum field. This condition is satisfied by using a toroidal transformer which also has the benefit of small size.

The power supply circuitry is fairly conventional (more about that next month) but does feature a total of 16,000μF filter capacitance for both of the main balanced supply rails.

The power amplifiers.

Included with this article is the circuit used for the power amplifiers. Readers with long memories may conclude that it is very similar to that used in the previous Playmaster Mosfet stereo amplifier and also in the 100W sub-woofer amplifier described in the July 1982 issue of *Electronics Australia.*

That impression is correct but while the circuit is very similar, the performance is not. The harmonic distortion is much improved, particularly compared with the Playmaster Mosfet design. Measured THD of the prototype design power amplifiers was less than .01%.

Our decision to use this design, which is based on Hitachi application notes, did not come easily. Indeed most of the development of this amplifier revolved around the power amplifiers.

We tried many different circuits and configurations. Some were completely symmetrical designs with double-differential input stages and so on. Cascode driver stages were tried as was source degeneration in the Mosfet output stages. Also researched was the effect of varying the driver stage currents to obtain the best overall distortion and slew rate.

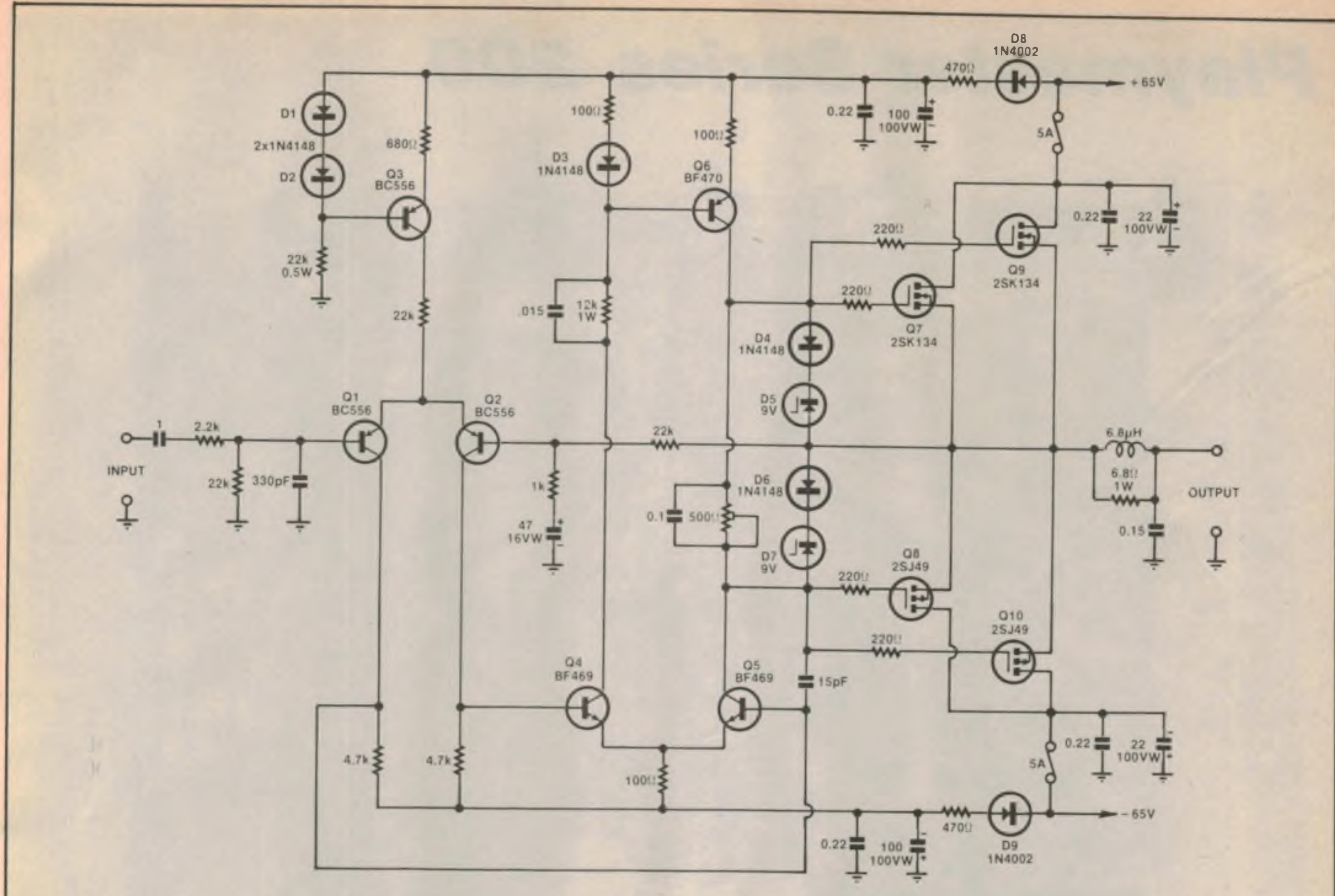
After all this, we still concluded that the Hitachi design was the best overall for simplicity and performance. But one point became outstandingly clear: the performance was very dependent on the layout of the printed circuit board.

Even quite subtle changes in layout made quite dramatic reductions in the distortion performance. And as luck would have it, these changes were almost always for the worst. In other words, the design is very cranky as far as the layout is concerned.

Now let us run through the

MAIN FEATURES OF THE NEW PLAYMASTER

- Switchable phono inputs for MM and MC cartridges
- Electronic signal switching
- Full facilities for dubbing between two cassette decks
- Monitor loop for either of two cassete decks or a signal processor
- Click action pushbutton switches for selection of input sources, dubbing and tape monitor with LED status indicators
- Centre detents on bass, treble and balance controls; multiple detents on volume control
- Heavy duty heatsinks
- Toroidal power transformer for low hum and noise.
- Easy to build construction — all parts except power supply mount directly on the two printed circuit boards; wiring has been kept to an absolute minimum
- 100 watts RMS per channel into 8 ohm loads
- Less than .01% total harmonic distortion.



This is the circuit of the power amplifiers used in our new Playmaster design.

description of the power amplifier circuit.

The input signal to the amplifier ranges up to about 1.5 volts RMS for full power and is coupled via a 1μF metallised polyester capacitor and a 2.2kΩ resistor which, in conjunction with the 330pF shunt capacitor, acts as a low-pass filter, to remove high frequency signals in the RF region. The 2.2kΩ resistor also tends to act as a "stopper", reducing the possibility of the amplifier to oscillate supersonically.

Q1 and Q2 form a differential pair with Q3 acting as a constant-current "tail". By virtue of the diodes, D1 and D2, the base bias applied to Q3 is about 1.3 volts. This sets the current through Q3 at around one milliamp and this is shared equally through Q1 and Q2.

There is one major reason for the inclusion of Q3 as a constant current source. It improves the power supply rejection of the amplifier. In op amp specifications this is referred to as PSRR (power supply rejection ratio). The better the PSRR, the less likely is the amplifier to respond to variations in the power supply rails which may include large ripple signals (hum) or harmonics of the input signal (which could lead to higher harmonic distortion).

The balanced output signals from the collector load resistors (4.7kΩ) of Q1 and Q2 are coupled to a second differential amplifier consisting of Q4 and Q5. These have an unconventional dynamic load in the form of a "current mirror" which is often used in integrated circuit op amps.

The current mirror (Q6) can be regarded as performing much the same function as a constant-current load for Q5 would do. That is, consider Q6 as a constant current source, with D3 applying its base bias. The mechanism is actually a little more complicated than that since there is a 100Ω resistor in series with D3. This means that signal variations at the collector of Q4 are reflected as small changes in bias at the base of Q6.

The net effect of the current mirror scheme is to give higher gain from the stage and better overall linearity over the full voltage swing. It also gives a greater voltage swing than could be obtained with a simple class-A driver stage with a boot-strapped collector load.

Q4, Q5 and Q6 have a collector voltage rating of 250V and are intended specifically for class-B video driver stages in television receivers. As such, they are ideally suited for use in low distortion driver stages as they have an excellent gain-bandwidth product of 100MHz and good beta linearity over a wide range of operating currents.

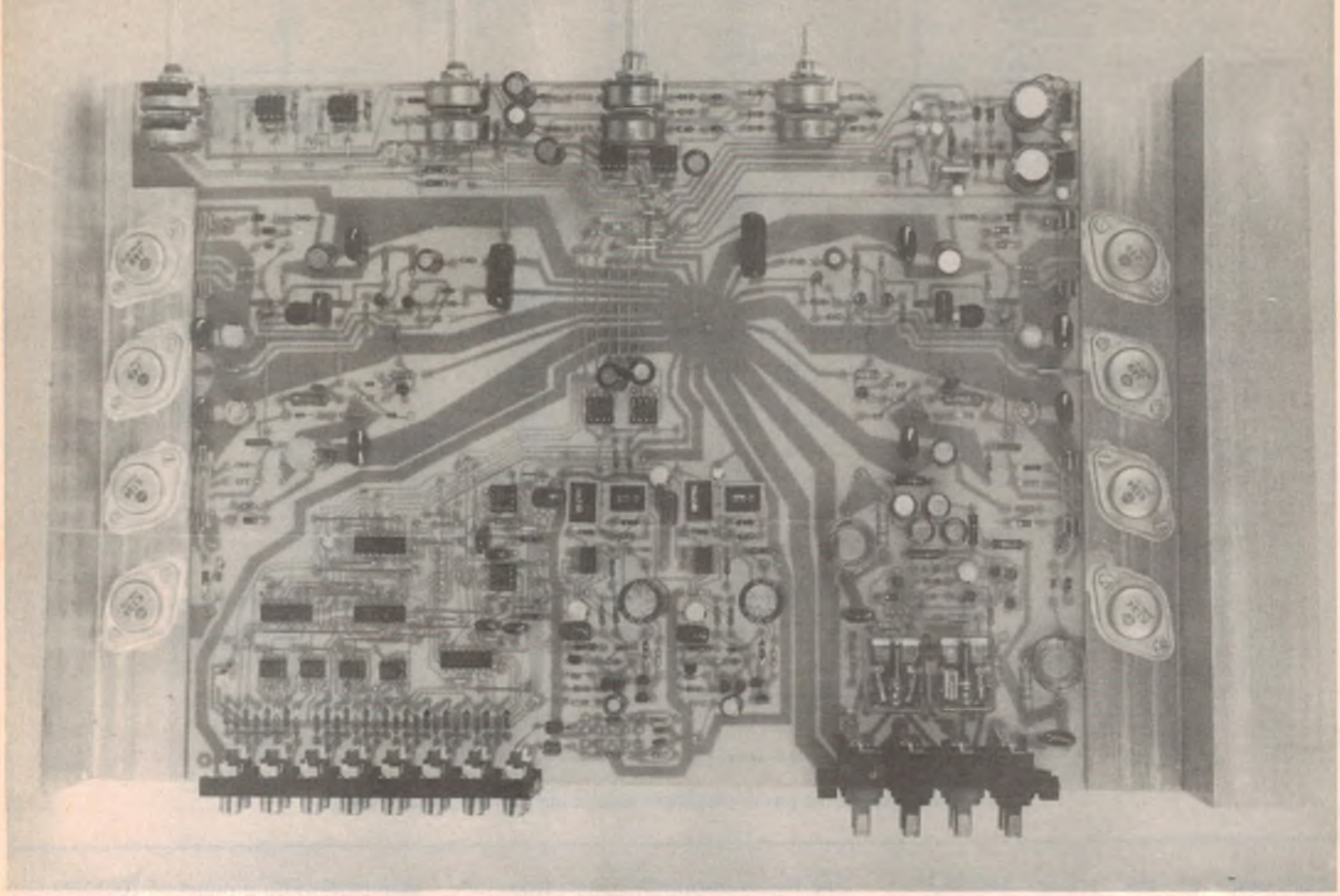
The two differential stages provide all the voltage gain of the power amplifier with the Mosfet output stage operated in source-follower mode (which gives slightly less than unity voltage gain, similar to emitter followers).

No source degeneration resistors are used in the Mosfet output circuits. We found that we were able to dispense with these and thus gain better distortion figures. This is in line with the circuit practice adopted in the very good amplifiers produced by Perreaux of New Zealand.

Nor does there appear to be any need to take measures to ensure current sharing between the parallel-connected Mosfets (by using small source resistors). In practice, if one Mosfet becomes hotter than its partner its transconductance is reduced accordingly and thus it is throttled back automatically.

The 500Ω trimpot connected between the collectors of Q5 and Q6 sets the quiescent bias applied to the Mosfet gates. The bias sets the quiescent current. The current chosen is a compromise between minimum distortion and the amount of power

Playmaster Series 200



This bird's eye view shows how the printed circuit has been laid out to avoid earth loops and common impedance paths.

dissipation produced by the output stage. Since the power amplifier employs supply rails of ±65VDC, even a relatively small current results in relatively high power dissipation.

Zener diodes D5 and D7, in series with D4 and D6, set the maximum signal level which can be delivered to the Mosfet gates. Any signal in excess of ±10V will be clipped. Thus the diodes form an effective overdrive circuit and prevent excessive power dissipation in the event of a short circuit.

220Ω resistors are connected in series with the gate of each Mosfet to function as "stoppers" and prevent oscillation at radio frequencies.

Apart from the over-drive protection already mentioned, there is no active protection circuitry in the output stage. Fuses are included in the supply lines to protect against catastrophic device failure.

The supply fuses also provide a convenient current monitoring facility (when replaced by resistors) for trouble-shooting or setting the quiescent current.

Single-pole lag frequency compensation is applied from the base to the collector of Q5 via a 15pF capacitor. This renders the amplifier stable with the overall negative feedback applied.

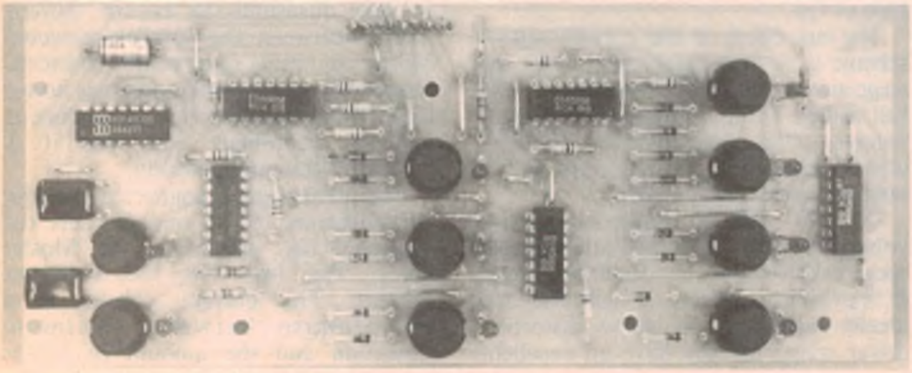
Voltage gain of the power amplifier is determined by the ratio of the 22kΩ and 1kΩ resistors at the base of Q2. The lower cutoff frequency of the circuit is set by the 47μF capacitor in series with the 2.2kΩ resistor.

A final refinement involves the RLC network in the output circuit. This has been a feature of Playmaster designs since 1976 and is based on a paper by A.N. Thiele in the September 1975 issue of Proceedings of the IREE. The network is incorporated to render the amplifier unconditionally stable.

The particular refinement we have made to the RLC network is to use an air-cored inductor instead of one wound on a ferrite rod. We have found that the ferrite core is a source of distortion, particularly during high power operation.

In the next article we will continue with the description of the rest of the amplifier circuit and give the full specifications.

The control pushbuttons are all soldered directly to the vertical board.



National NV-850A hifi stereo VCR

A new era in video sound has arrived. The latest hifi video cassette recorders deliver hifi stereo sound with performance approaching that of compact discs. The NV-850-A VHS hifi VCR from National is representative of this new technology.

The biggest disadvantage of VCRs in the past has been their poor sound quality. This situation has now changed following the introduction of stereo hifi VCRs by both the VHS and Beta camps. Now, for the first time, video recorders are able to record and play in hifi stereo sound.

As an audio recorder, a hifi VCR offers much better sound quality than a conventional cassette deck. Hifi VCRs have a wider dynamic range, lower noise and distortion, improved bandwidth characteristics, and much less wow and flutter. By investing in a hifi VCR, you get a superb audio recorder and a video recorder all in one package.

Of course, to derive the benefits that a hifi VCR has to offer, a stereo amplifier and good quality speakers must be used. For the enthusiast, the new technology opens the way to a new range of pre-recorded movies with hifi sound quality.

Considerable ingenuity has gone into the development of the hifi VCRs. They need to preserve compatibility with existing tapes and yet clearly the conventional linear track at the edge of the tape, reserved for audio, is inadequate for hifi. The combination of narrow track width and slow tape speed produce high noise, distortion and a narrow frequency response.

To obtain hifi sound, the track width needs to be wider and the relative speed of the head across the tape increased. The solution utilises the same helical scanning system used to record the video information. This allows a faster head speed by tracking transversly across the tape width.

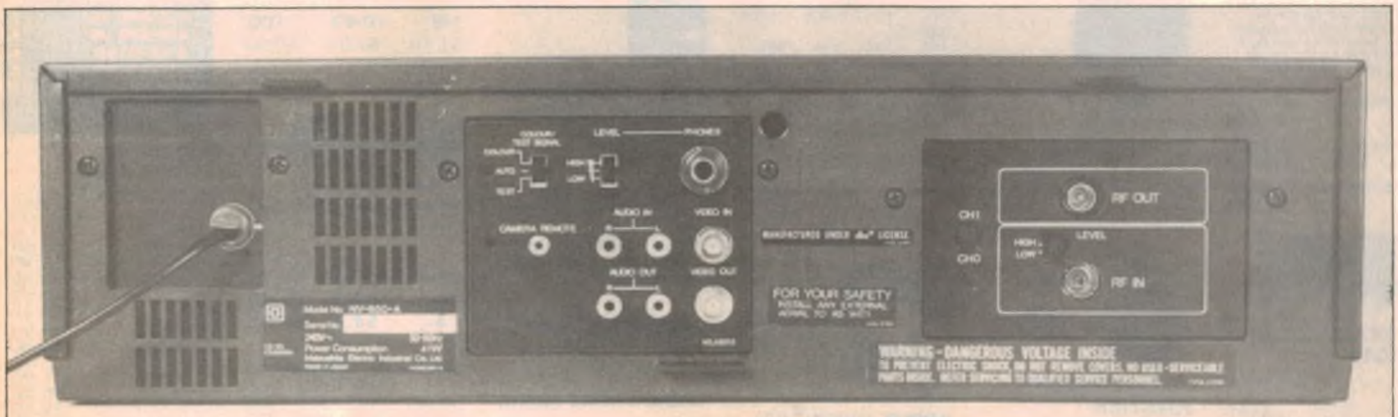
Both audio and video information are recorded onto the same track area. To minimise crosstalk between the video and audio signals, three safeguards have been designed into the system.

Twin carrier FM signals

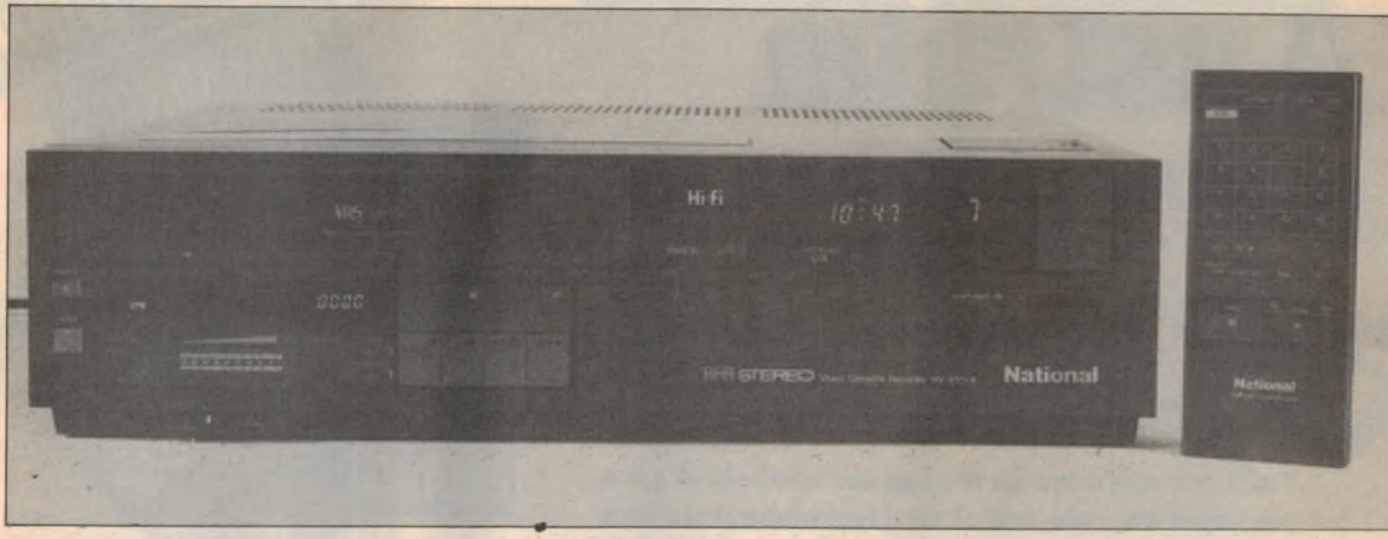
- In the case of VHS, the left and right channel signals are frequency modulated on to two carriers, centred on 1MHz and 2MHz. These carrier frequencies were deliberately chosen so that they were within the bandgap between the chrominance signal which runs up to 1MHz and the luminance signal which ranges up from 2MHz.
- Two extra heads are fitted to the video drum and impose the twin sound carriers onto the tape just ahead of the video signal. Crosstalk is minimised by aligning the audio and video heads at vastly different azimuth angles. The audio heads are aligned at ±30° while the video heads remain at ±6°.
- The audio FM signals are recorded deeply into the magnetic layer of the tape by using a high current and a wide-gap tape head. The video heads, however, use low currents and narrow gaps to produce a shallow recording. During recording, the video signal actually erases the preceeding audio but only to the shallower depth of the video signal. The audio information thus remains at the greater recorded depth.

These three factors, reduce crosstalk between the video and audio signals to a minimum and any interference between these signals is inconsequential.

The major performance specifications quoted for the twin-carrier recording system are as follows: frequency response 20Hz to 20kHz; dynamic range with noise suppression 80dB; and wow and flutter less than .005%.



The rear panel features a test switch, a stereo headphone socket and switchable channel output.



The multi-function infrared remote control duplicates most of the control features on the front panel.

National's NV-850-A

The National NV-850-A hifi VCR is a front-loading unit with overall dimensions of 430 x 370 x 115mm (W x D x H). The front panel finish is black with smoke-grey perspex used for the front cassette loading flap and as a window for the three vacuum fluorescent displays. An infrared remote control unit is supplied and duplicates most of the control features on the front panel.

Centrally located on the front panel are the controls for the tape transport mechanism: Stop, Play, Pause/Still, Still Advance, Rewind and Fast Forward. These allow the standard control features found on most VCRs, eg still frame and frame-by-frame viewing, fast frame scanning in both forward and reverse directions, and fast forward and reverse. The fast forward and reverse take five minutes to fully wind a 180 minute cassette, while the fast frame scanning increases the playback speed to five times normal.

To the left of the tape transport controls is an integrated multi-function display and audio level meter. The display indicates the status of the tape at any one time. For example, the display indicates Play, Record, Audio Dubbing and also the direction of tape travel when in Rev, Forward or Still.

A counter on the right of the display indicates tape location. The VCR can be automatically set to search for the reset (0000) tape position by using the memory search button.

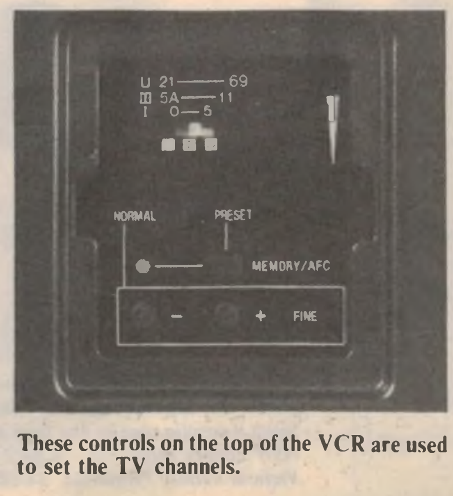
Below the multifunction display is the audio level meter. This displays the relative level of audio signal from +10dB down to a useable −60dB. A switch below this can select for "display off", for "audio level" or "hifi tracking". The hifi tracking indicator allows correct setting or the head azimuth. Being able to turn the audio level meter display off is a very useful feature as it can be very distracting if it can be seen while you are watching TV.

On the far left of the control panel is an eject button and a VTR switch. These two perform the same functions as on conventional VCRs.

An attractive feature of the National NV-850-A is One Touch Timer Recording (OTR). This controls recording for a duration of either 30, 60, 90 or 120 minutes. Recording is initiated immediately after programming or, alternatively, OTR can be set to begin recording after the elapsed times indicated above (standby OTR).

This feature is extremely useful and is more likely to be used than the full timer programming features.

A flip-down cover at the lower right or the machine reveals a multitude of less used controls. These include the 14-day 8-program timer. This is a comprehensive timer and features a real time clock and every day and every week recording.



These controls on the top of the VCR are used to set the TV channels.

Other controls include the Record, Audio Dub and Audio Record Mute switches. The Audio Dub switch allows recording over the sound track of an existing video recording, while the Audio Record Mute prevents audio recording.

The NV-850-A hifi VCR can be used in any one of four recording modes:

- recording TV/FM simulcasts;
- recording TV stereo broadcasts;
- direct video plus sound recording from a camera and microphone; and
- audio recording only.

When using a TV signal as a program source, several options are available for the recording and subsequent playback of stereo and bilingual sound. When the TV signal is bilingual, you can select either channel 1, channel 2, or both channel 1 and channel 2 for recording in the hifi mode. Alternatively, channel 1 can be recorded on the normal sound track (standard mono VHS). Note that channel 2 is used for the second language in the transmission.

When the TV signal is in stereo, you can select either left, right, left and right or mono. All these selections are recorded in the hifi mode except for mono which uses the normal VHS sound track.

The above facilities are indicated by backlit lettering positioned just below the clock and timer display.

The Input Select switch selects recording of either audio source, camera, tuner (TV) or simulcast audio. Hifi sound recording is available for each of these sources. The "audio" position allows the VCR to be used as an audio

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YOU CAN BE A WINNER OF THE Electrolube CM100 Circuit Maker Kit

The CM100 Circuit Maker Kit is the latest addition to the well-known Electrolube range of chemicals and service aids for the electronics industry. It contains virtually everything you need to make high quality printed circuit boards using the photo-etch method, from either your own tape patterns or from same-size printed layouts. No darkroom or camera is necessary.

The kit contains the following:

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

All necessary chemicals:

- developers • fixer • film clearing solution
- photoresist • copper etchant • and a combined soldering flux/protective lacquer

- A complete set of photographic dishes.
- A liquid measure.
- A retouching pen.
- A liquid-crystal thermometer.
- A couple of 1.1mm PCB drills.

And all extras like:

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

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

hifi recorder while the simulcast position allows the user to record directly from a high-quality FM tuner during simulcasts. A microphone input records the sound when the camera selection is chosen.

Also located within the flip down cover area are three rotary controls for picture, tracking and audio record level. The picture control provides a soft to sharp range for adjusting the level of detail of the video. Tracking adjusts the azimuth of the heads for best playback response and is useful if the recording was made on a different VCR (the slight differences in azimuth between one machine and another can affect performance unless adjusted correctly).

The Audio Record Level sets the audio signal level during recording. It also has an automatic gain setting (AGC) which is the same as the ALC control found on many tape recorders.

The two large pushbutton controls to the right of the time display are used to increment and decrement the TV channel. The channel number is displayed to the right of the time display and up to 16 channels can be selected.

The TV channels are initially tuned by operating the controls beneath a small cover on the top of the VCR. These controls are easy to use and, once set, do not require further adjustment.

At the rear of the VCR is a Colour/Auto and Test switch. When in the test position, it allows adjustment of the VCR RF output frequency. Either channel 0 or 1 can be selected and two vertical bars displayed on the TV screen indicate when the TV set is correctly tuned to the VCR frequency.

Also located at the rear of the VCR are the various input and output sockets. The audio in and out sockets are RCA types while the video in and out sockets are BNC. The RF output plug and input socket are the standard "PAL" type, or Belling Lee as they are otherwise known.

A stereo headphone socket is also located on the rear panel and a 3-position level switch selects the volume level applied to them. The remaining socket is the camera remote socket.

Removing the top cover of the NV-850-A reveals a well-constructed interior. The main support chassis is a massive precision diecasting which ensures mechanical integrity, while the tape transport mechanism is also solidly constructed. The circuitry is all accommodated on printed circuit boards, stacked one on top of the other, and includes a large number of LSI circuits.

A new noise reduction chip provides dbx noise reduction to give the 90dB dynamic range that this recorder features.

Test results

Since the video performance of the NV-850-A is equivalent to standard VHS machines, our tests were mainly concerned with audio quality. We should emphasise, however, that the hifi audio features had no effect on picture quality.

Total harmonic distortion was measured with and without the AGC and, as expected, distortion was somewhat higher (at low frequencies) when the AGC was in operation. For 0dB level we measured 0.4% THD at 100Hz, 0.5% at 1kHz and 1.6% at 6.3kHz without AGC. With the AGC in circuit, the distortion remained unchanged for the 1kHz and 6.3kHz signals, but rose to 2% at 100Hz.

Distortion at +6dB without AGC was slightly better than at 0dB, measuring 0.25% at 100Hz, 0.4% at 1kHz and 1% at 6.3kHz.

Frequency response was measured at 0dB level and resulted in −3dB points at 20Hz and 18kHz. The response was −7dB down at 10Hz and −4dB at 20kHz.

We also ran a check on the linearity. This measurement involves recording at decreasing signal levels and noting the playback response. The NV-850-A was only 0.5dB high at the −50dB and −60dB levels and linear for signals above this level. This is an excellent result.

Signal-to-noise ratio with respect to a +6dB level was measured as 73dB unweighted, while the wow and flutter was measured at .004%. This is slightly better than the .005% claimed. However the S/N ratio does not match the claimed 80dB figure.

Crosstalk between left and right channels with respect to a +6dB level was 50dB at 100Hz, 63dB at 1kHz, and 53.5db at 10kHz.

How it sounds

Subjectively, the audio recordings made on this VCR were superb. When making A-B comparisons directly between a compact disc source and the same material recorded on the VCR, we found it extremely difficult to distinguish between the two sources. A similar comparison using a standard audio cassette player always reveals a rise in the noise level after recording.

Although the NV-850-A VCR performs very well with regard to sound recording, several features prevent it from directly competing with a standard cassette recorder. The main problem with a VCR, when using it for sound recording, is the very slow response time of the tape mechanism. It is necessary to wait for the tape to spool itself around the tape head before play or record can begin.

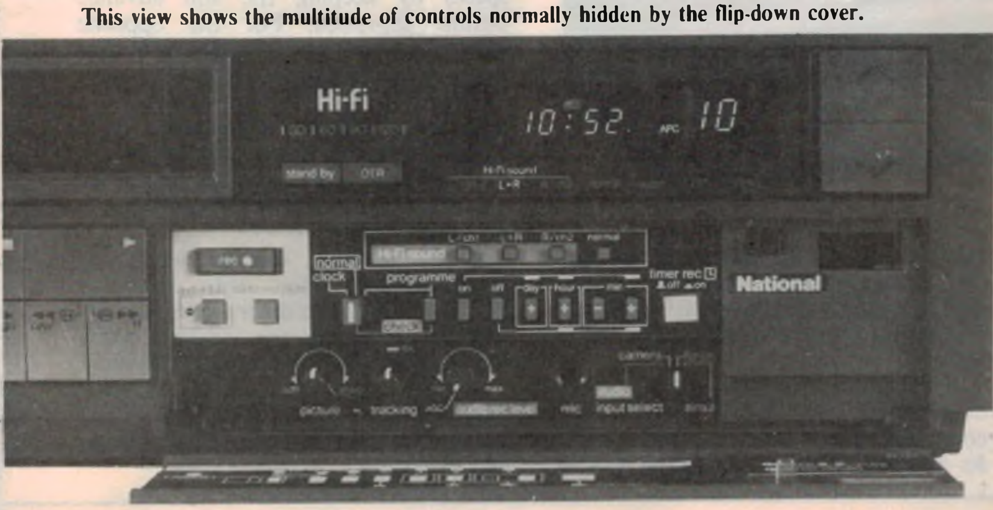
Similarly, on stop, it is necessary to wait for the tape to unspool before rewind or fast forward functions operate.

The machine does, however, have a pause feature and a memory search function which quickly accesses the reset (0000) position of the tape. These features, along with the excellent timer functions, do help negate the tape transport objections. Overall the machine makes a very good audio recorder and does not require any of the bias adjustments necessary for a standard audio cassette recorder.

In summary, the National NV-850-A hifi stereo VCR is an excellent performer. The superb sound quality, excellent video reproduction and infrared remote control facilities make this a tempting package for any prospective VCR purchaser.

Recommended retail price is $1299.

This view shows the multitude of controls normally hidden by the flip-down cover.



Pioneer car stereo systems

Pioneer has announced the release of two new 20W stereo combinations for use in cars, the KPH4000 and the KPH7000.

The KPH7000 is powerful enough to meet most people's requirements on its own. It has four separate in-built mono amplifiers which are switchable to give 20W through each of two speakers or 6.5W through four speakers. It can also be the starting point for those seeking hifi power and flexibility in a car, van or boat, through the addition of even more powerful external power boosters or amplifiers. These can be added to the system at any stage.

The KPH7000 has a built-in preamp fader control which achieves balance between front and rear speakers through the amplifier sections. It also has a loudness contour switch and separate bass and treble controls.

The auto reverse cassette deck section has lock-in fast forward and rewind, automatic tape tensioning, "Dolby B" noise reduction and full metal/chrome tape compatibility.

The KPH4000 is a lower priced companion model to the KPH7000. It offers 20W through two speakers utilising two separate amplifier sections. Its other features include separate bass and treble controls, loudness contour, an AM/FM stereo tuner, and a full auto-reverse cassette deck with automatic tape tensioning and key-off release and key-on play, safeguarding tape damage.

Further information from Pioneer Electronics Aust Pty Ltd, PO Box 295, Mordialloc, Victoria, 3195. Phone (03) 580 9911.

Pioneer's powerful new KPH700 car stereo player.

Versatile video projection system

GEC Video Systems Division has released a new, versatile colour video projection system, the National TC-10010 PSN. Designed for front or back projection, from a ceiling or bench mounting, the unit will reproduce PAL, SECAM and NTSC VTR signals onto a range of flat or curved screen sizes from 1.3m to 2.5 metres diagonal. Each projector comes complete with a full-function remote control unit.

The TC-10010 PSN has been designed to automatically detect PAL, SECAM or NTSC input signals and reproduce them in the correct mode. If automatic detection is not required, the unit can be preset for any one format.

The new National projector is claimed to provide a high quality picture with flat or curved screens from 1.3m to 2.5m diagonal. Three special high-brightness 180mm projection CRT's and f1.1 lenses give a resolution of 450 lines and luminous flux of 170 lumen. A complete built-in cross hatch generator is included so that the user can make precise convergence adjustments.

Each projector comes with a remote control unit (pre-wired to 1.5m but available with optional 15m, 30m and 50m cables) for routine alignment and on-the-spot adjustment.

Further information on the National TC-10010 PSN is available from GEC Video Systems Division, 2 Giffnock Avenue North Ryde, NSW, 2113. Phone (02) 887 6222.

Slim and streamlined ... National Panasonic's NV-450A

Slim package video recorder

National Panasonic has announced the release of a new, slimline video recorder, the NV-450A. With a height of only 9.9cm, its simple, streamlined appearance makes it a great match for audio components and other equipment. The unit features convenient front loading operation and 43cm width and fits perfectly into a standard size audio rack.

According to National, the NV-450A combines excellent operating convenience with superb picture quality. Its 3-video-head-system provides special playback functions such as super still playback without noise or jitter and still advance. A slow motion effect is obtainable also (1/6 normal playback speed) by keeping the still advance button depressed. For the opposite effect, cue and review operate at five times normal playback speed.

The NV-450A is equipped with a 27-function infrared remote control and has a large fluorescent multi-function display panel which gives instantaneous confirmation of every activated function at a quick glance.

Other features include a 14-day programmable timer with everyday function; one-touch timer recording with stand-by function for deferred OTR start; auto-rewind and memory function.

Further information from National Panasonic (Australia) Pty Ltd, 95-99 Epping Rd, North Ryde, 2113. Phone (02) 887 5333.

Pioneer Electronics has created a complete new range of home entertainment cabinets, based on extensive market research into the type of furniture Australians prefer in this role. The designs use a new Laminex finish called "Royal Walnut", exclusive to Pioneer. Twelve cabinets have been produced, designed to accommodate a wide range of Pioneer audio systems, including Avante systems and the Pioneer Sound Creator. Other designs make provision for Laserdisc, Compact Disc, and VCR systems. Matching speaker cabinets are also available. Pioneer Electronics Australia Pty Ltd, PO Box 295, Mordiallic, Victoria, 3195.

Broadcast monitoring stereo AM tuner

Audiosound Laboratories have just released a Motorola system stereo version of their AM 102 broadcast monitoring tuner. The new unit, titled the AMX 1, features an audio response to 12kHz (−3dB), carrier and modulation fail alarms, balanced line-output amplifiers with 40Ω source impedance, and a balanced low-noise antenna system (supplied). Two switchable 9kHz notch filters ensure excellent filtering with minimal audio loss.

Used in conjunction with Audiosound Laboratories' PM 1 stereo program monitoring unit, the AMX 1 forms a complete AM stereo off-air receiver with modulation monitoring.

Also due for release is the AMX 1's "little brother". This domestic version lacks the alarms and balanced output amplifiers, but retains all other technical features.

Further information from Audiosound Laboratories, 148 Pitt Rd, Nth Curl Curl NSW. Phone (02) 938 2068.

The Audiosound AMX 1 AM stereo monitoring tuner features adjustable RF gain, switchable bandwidth, and modulation and carrier fail alarms.

Portable video player from Bell & Howell

Bell & Howell has acquired the rights to manufacture an improved version of the all-in-one video presentation unit designed by Tracker Electronics. The new model, the VS-1B, is lighter and incorporates the National NV-180A, a "super lightweight" VCR recently introduced by GEC Australia Video Systems Division. The NV-180A weighs 2.3kg and measures only 215mm x 69mm x 263mm.

The compact 13kg VS-1B combines a 34cm colour monitor with the NV-180A to produce a tough, fully portable, video player suitable for sales presentations, training or educational applications.

Of particular value for use in presentation systems, the NV-180A has a double video head system for super still and super still advance playback without jitter or distortion, plus adjustable super-fine slow motion.

To produce the VS-1B, Bell & Howell strip the channel select and tuner assembly from a standard TV set and insert the NV-180A in their place. Vertically mounted, this forms one side of the modified monitor, allowing easy cassette access.

Bell & Howell estimate an annual market for the VS-1B in Australia of up to 1500 units with potential overseas sales of many thousands more. They see all kinds of applications for the unit from point-of-sale video messages to sales presentations and staff training. Several major business organisations, the police, the army, government departments and some media sales teams have already put the earlier model into use.

Further information from Bell & Howell Aust Pty Ltd, 55-59 Murray St, Pyrmont, NSW, 2009. Phone (02) 660 5366.

Keep thieves at bay—
Multi Sector Burglar Alarm

by
ANDREW LEVIDO

Protect your home from intruders with this up-to-the-minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight separate inputs, individual sector control, battery backup and a self-test facility.

For one reason or another, there has been a dramatic increase in the number of house break-ins over the last few years. No area is immune, although some have worse records than others as statistics released by various state police forces show.

The prime targets of thieves are the portable, easily saleable items with which we fill our homes. Cash, jewellery and electronic equipment such as VCRs are items which immediately come to mind.

Unfortunately, the recovery rate of stolen goods is very low. This is partly because of the sheer volume of property stolen, and partly due to difficulties associated with the identification of goods.

The financial cost of this massive increase in crime is only part of the story. Damage can be repaired and goods replaced, but the emotional effects of a robbery can often last for many years. The feelings of anger and frustration subside relatively quickly, but there is always that nagging worry that you are not safe, even in your own home.

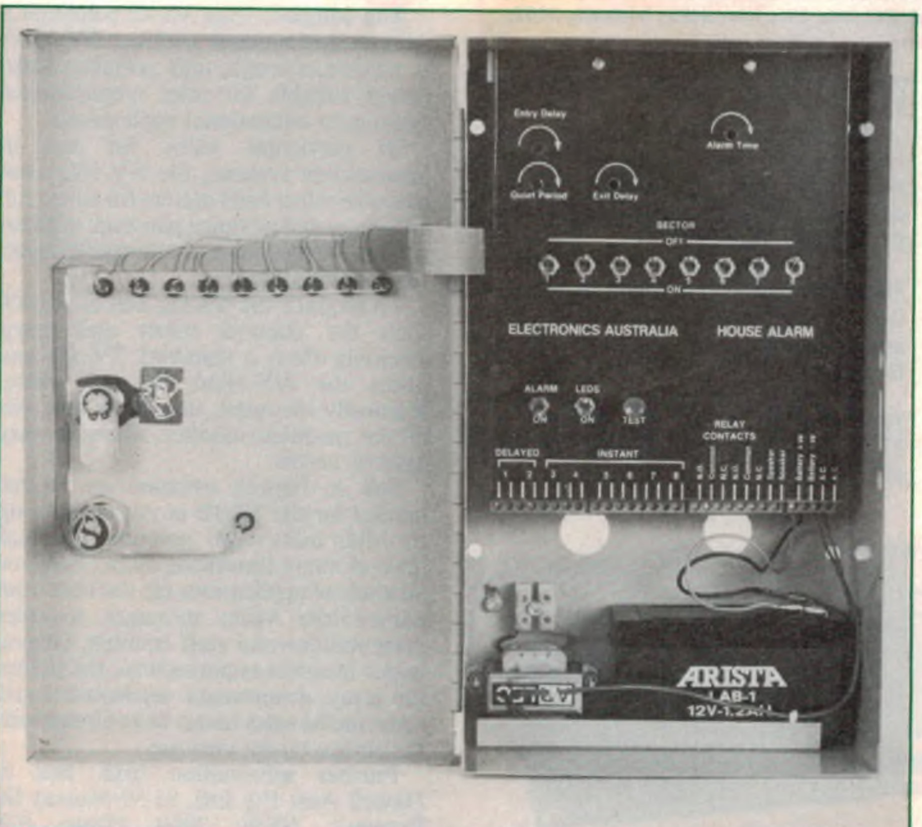
Although the statistics paint a gloomy picture, you do not have to accept a burglary as an inevitable result of city living. There are several steps that you can take to drastically reduce the odds of your home becoming a target. The obvious things are a good start: always lock the house securely when going out, and leave a light on indoors if going out at night.

While these steps may well serve to discourage an amateur thief or passing opportunist, they present merely a minor inconvenience to a professional burglar. Against these more determined intruders, positive security measures are required. An electronic alarm system is the most common form of protection used in this role.

There is a wide range of electronic alarm systems available for protecting homes and small business premises, ranging from very cheap models to multi-thousand dollar professional installations. The very cheap models do not provide some of the features which are highly desirable, such as variable entry, exit, and alarm periods; multi-sector control; and battery back-up.

The more up-market models do provide these features, as well as others, but they can be very expensive, especially if they are professionally installed. We felt that there was a definite need for a reasonably priced, yet comprehensive alarm system for the householder who is willing to do the installation himself.

The result of our endeavours is presented here — an alarm system with all the features of the better commercial models but without the price tag. It is



install this

We estimate that parts for this project will cost approximately

$130

This includes sales tax and the cost of the 12V battery, but does not include alarm sensors.

simple to build and can be used with a variety of sensors.

Main features

At this point it would probably be a good idea to examine the features built into the alarm in some detail.

The alarm has eight separate input circuits so that eight areas (or sectors) can be monitored independently. Each circuit is provided with an indicator LED and a sector on/off switch.

This multi-sector approach has a number of practical advantages. Most importantly, it means that if one sector is triggered, and the alarm cycle has run its course, the rest of the house is still protected by the remaining active sectors.

Similarly, if one sector is not secure when the alarm is set, say because a window is left open, all areas other than that which includes the open window will be protected. This situation need not arise, however, since a check on the status of each sector can easily be made. To do this, the LEDs On/Off switch is turned on, and the LEDs checked. If a LED is lit, that sector has been activated (eg, a window has been left open) and needs to be made secure before the premises are vacated.

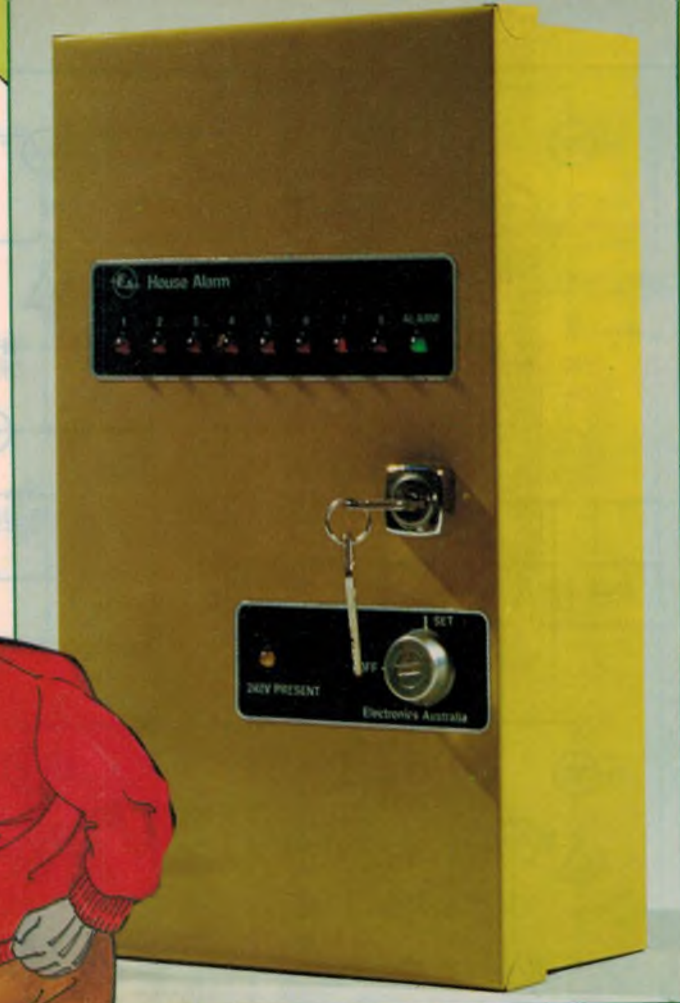
The LEDs switch should be turned off after this check to prolong battery life.

The sector disable switches are another convenient feature. These allow the user to isolate one or more sectors as required. In this way, some areas of the house can be used while others remain protected; eg, the internal alarm sectors can be disabled while the perimeter sectors remain active.

Each sector input stage is identical and has been designed to accept both normally open (NO) and normally closed (NC) sensors. Figs. 1-3 show how the various types of sensors should be wired. The 47kΩ resistor is necessary for correct operation of the input circuit. It should not be installed directly across the alarm terminals, but rather at some remote point in the loop. Thus if any attempt is made to cut or short circuit the wires leading to the alarm, it will be triggered.

Many different sensors are suitable for use with this alarm. The input stage will accept any device which has normally closed or normally open switch outputs. Such things include reed switches, pressure mats, window foil, pushbutton (panic) switches, light beam relays, ultrasonic movement detectors, microwave detectors — in fact anything that you can think of which has, or can be adapted to have, switch type outputs.

Two of the inputs to the alarm are provided with an entry delay. These inputs are intended to be connected to, say, the front and the back door sensors to allow you time to enter and disable the alarm before it sounds. The delay time before the alarm sounds can be set anywhere between 10 and 75 seconds.



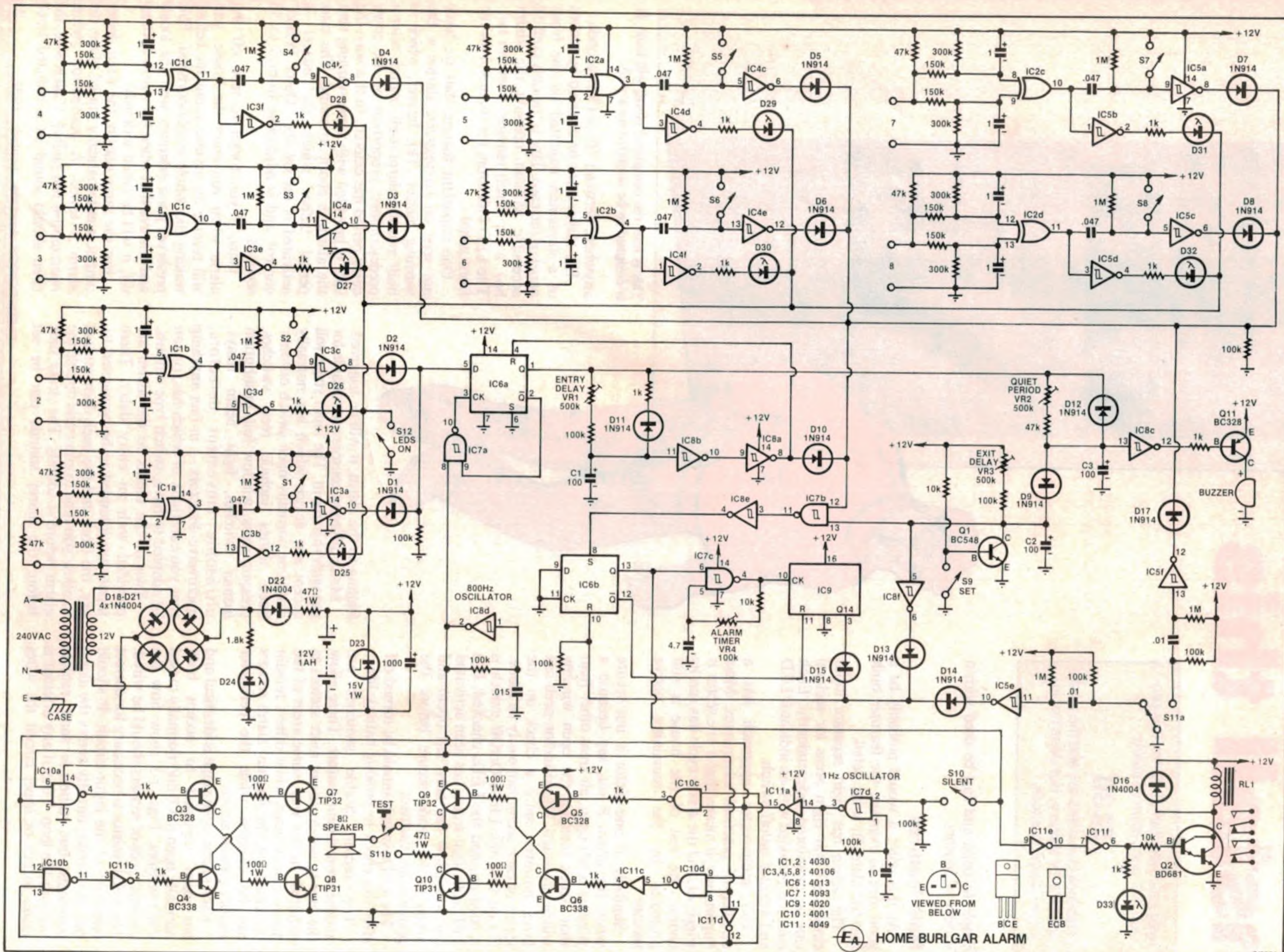
This is how the completed alarm will look. It is designed to be mounted on a wall.

The alarm is set or disabled by means of a keyswitch mounted on the front panel of the case. This is the only control accessible without opening the alarm box, a job which requires a second key. The LED indicators are mounted on the front panel.

One important feature that we have not seen on commercial alarms is the warning buzzer. This buzzer, which is built into the alarm itself, sounds after a predetermined proportion of the entry delay period has elapsed. In this way, the user is provided with some warning that the alarm is about to sound. The time period before which the buzzer is activated is set by the "Quiet Period" control, and is adjustable from 5 to 55 seconds.

Thus, if you forget to turn off the alarm when you enter the house, you will receive an audible reminder before waking the whole neighbourhood. This preserves good relations with the locals and ensures that when the alarm does go off, it will be taken seriously.

For the same reason, the siren driver output is automatically muted when the alarm is tested. A pushbutton switch operates this test facility. If all is well, the siren should sound (at a reduced level)



HOME BURLGAR ALARM

3/MSI-

Burglar Alarm

when the button is depressed, and cease when it is released. This will only occur if the alarm is set, and after the exit delay period has expired.

The exit delay is set by yet another timer circuit and is adjustable between 5 and 45 seconds. After setting the alarm, you have to be out of the house before this delay period expires.

When triggered, the alarm drives a separate horn-type loudspeaker for a period of between one and 15 minutes and trips a relay. The relay has two sets of contacts for connection to external devices. It could be used to turn on a bell or a closed circuit TV camera, for example.

Alternatively, you can have a silent alarm simply by opening the ALARM On/Off switch. In this case, the relay contacts would typically be used to activate an auto-dialler circuit.

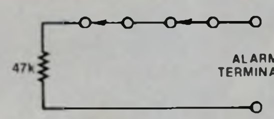
The alarm is provided with battery back-up, which means that removing the mains to the house does not render the alarm inoperative. The battery, a 12V gel type, is continually charged while ever mains power is applied to the alarm circuitry.

The battery specified is a 1.2A.h model which fits nicely into the alarm case. This battery will allow the alarm to operate for over two days if the mains is disconnected. We are aware that a 2.6A.h battery is also available (for little extra cost), and this will allow operation for over five days. The latter will not fit inside the specified case, but could be mounted externally if desired.

Quite some thought went into the selection of a suitable case to house this project. A sturdy, lockable case was required, but the purpose-built alarm boxes we investigated were far too expensive. After much head scratching, the idea of using a cheap readily available cashbox came to light.

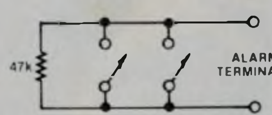
As it turned out, the case we chose was ideally suited to this application and very little mechanical work was required to produce an attractive and functional unit.

Wiring of NO & NC switches



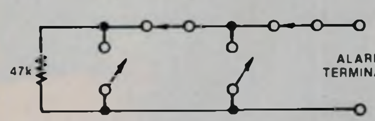
NC SWITCHES IN SERIES

Fig. 1



NO SWITCHES IN PARALLEL

Fig. 2



NO AND NC SWITCHES

Fig. 3

These three diagrams show how normally open and normally closed switches should be wired. Note that a 47kΩ resistor is required in each case.

Specifications

- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing: suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charger circuit.
- Built-in siren driver

How it works

Although the circuit of the Home Burglar Alarm is quite complex, it can easily be broken down into a number of simple sections. Each of these sections will be examined in turn and its operation explained.

The eight input stages have been designed for connection to both normally open and normally closed switches; ie, both types of switch can be connected to one input at the same time. This is made possible by having each input terminated by a resistance of 47kΩ. Normally closed switches are connected in series with this resistor while the normally open switches are connected in parallel with it (see Figs. 1-3).

Thus, when any of these switches changes state, the input will go either open or short circuit. The input stages are designed to respond to either of these conditions. As can be seen, the eight stages are identical and are built around exclusive-OR (XOR) gates IC1a-IC2d.

Let's consider input 1 which uses XOR gate IC1a, together with Schmitt trigger inverters IC3a and IC3b.

Normally, with the input terminated with a 47kΩ resistor, the junction of the two 150kΩ resistors is held at half of the supply voltage. This means that pins 1 and 2 of IC1a will be held at two thirds and one third of the supply voltage respectively. Thus, the output of the gate (pin 3) will be high.

This will hold the .047μF capacitor discharged, so that the input to the Schmitt inverter IC3a will be high. Thus, the output of IC3a will normally be low. IC3b is used to drive a LED indicator. Under normal conditions the LED will be off.

Note that the cathodes of all the LEDs in the input stages are connected together and switched via S12 to ground. This switch should normally be off, and should only be turned on long enough to determine the states of the sectors. If the switch is left on, with more than one or two sectors tripped, the current drain will be such that the battery will begin to discharge.

If the input now goes open circuit, pin 1 of IC1a will rise to almost the full supply voltage while pin 2 will rise to approximately two thirds of the supply voltage. This corresponds to a logic one on each input of the XOR gate. Under these conditions the output of the gate will go low.

If, on the other hand, the input is short circuited, pin 2 of IC1a will go to 0V while pin 1 will be pulled down to one third of the supply voltage. This corresponds to a logic 0 on both inputs of the gate, again resulting in the output of the gate swinging low.

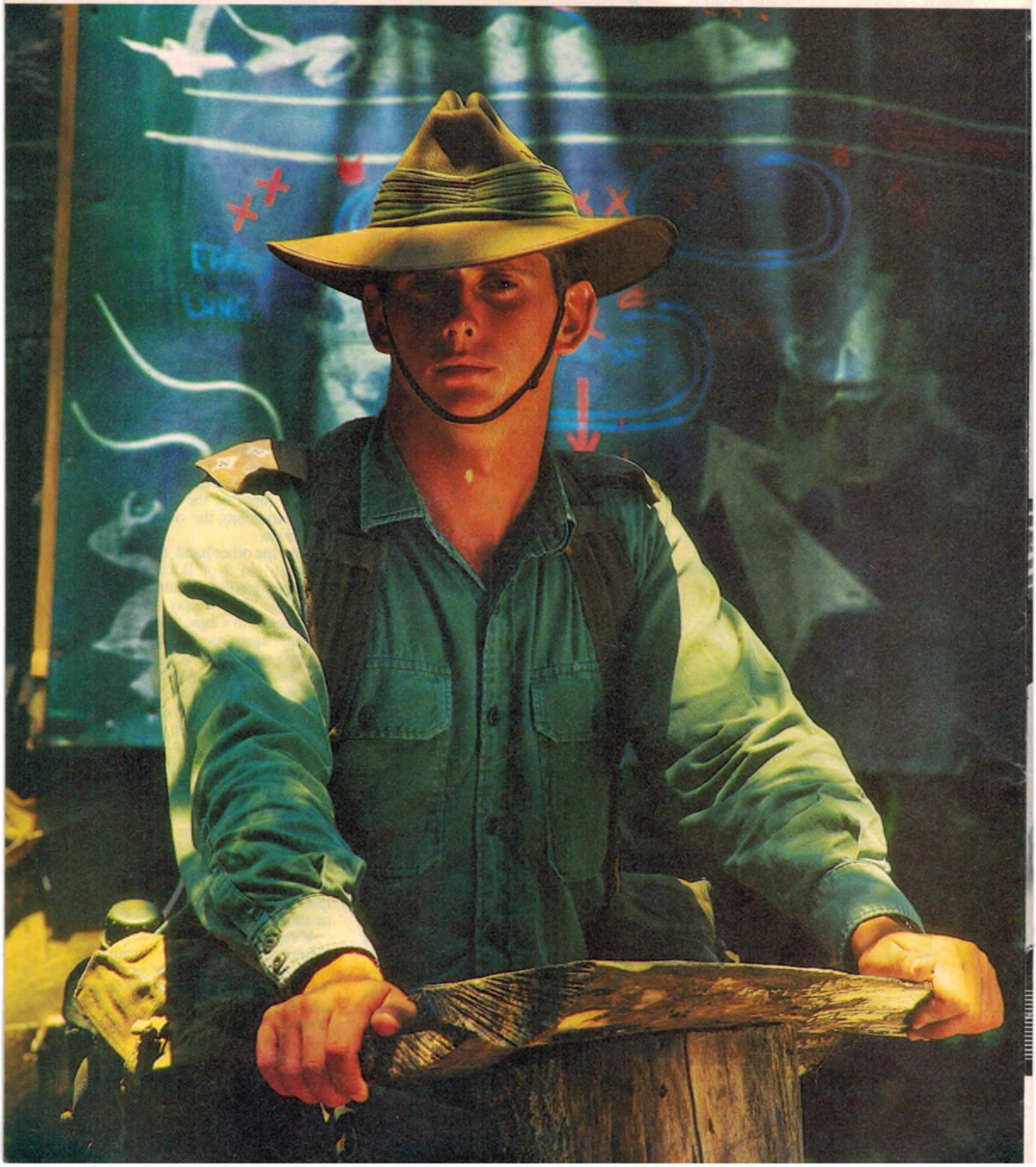
In each of the above cases the 1μF capacitors prevent false triggering of the alarm due to spurious signals which may find their way into the input circuitry.

If, due to either an open or a short circuit on the input, the output of the XOR gate swings low, the indicator LED will light (assuming S12 is closed). As well as this, the input of inverter IC3a will go low until the .047μF capacitor charges via the 1MΩ resistor. This takes about 50ms. Thus, a short positive going pulse is developed at the output of the inverter if the sector input is either open or short circuited.

If switch S1 is closed, the input to the Schmitt inverter will be held high, so there can be no change at its output. This is a useful feature if it is required to disable any particular sector for some reason.

The outputs of Sectors 1 and 2 are fed to a timer circuit to provide the entry delay feature mentioned earlier. These are the two inputs that would normally

What would you do,



Burglar Alarm

be connected to the front and back door sensors. The timer circuit consists of D-type flipflop IC6a (4013) and functions in the following manner.

Normally, the flipflop IC6a is held reset, so that the Q output is low and the $\overline{Q}$ output is high. The latter controls NAND gate IC7a. This gate is connected such that the clock signal generated by IC8d is gated through to the clock input of the flipflop.

Diodes D1, D2 and the 100kΩ resistor form an OR gate, so that if either sector 1 or sector 2 is tripped, a pulse is applied to the data input of IC6a. This pulse will be clocked through to the output on the first positive transition of the clock signal. Thus, Q will go high and $\overline{Q}$ will go low.

Because $\overline{Q}$ goes low, the clock input of the flipflop will be forced high via IC7a. Thus, the flipflop will latch up, with its Q output high.

Capacitor C1 now charges via trimpot VR1 and the 100kΩ resistor in series with it. When the voltage on the capacitor reaches about 70% of the supply voltage, the output of IC8a switches high, triggering the alarm via D10 and, at the same time, resetting IC6a.

The Q output of IC6a now switches low again and discharges the 100μF capacitor through the 1kΩ resistor and diode D11. After about 50ms, the output of IC8a switches low again, thereby ending the reset pulse and rearming IC6a.

IC8c, Q11 and associated components provide the warning buzzer feature. During the entry delay (ie, while C1 is charging), capacitor C2 charges via VR2 and, when it reaches 70% of the supply voltage, turns on Q11 via inverter IC8c. Q11 in turn drives the warning buzzer to indicate that the entry delay is about to expire.

Trimpot VR2 sets the "quiet period" before the warning buzzer sounds. The buzzer circuit is disabled either via D9 or D12. D9 pulls pin 13 of IC8c low when S9 is opened (ie, the alarm is turned off), while D12 pulls pin 13 low at the end of entry delay period.

The outputs of the other six input stages are OR-ed with the output of the entry delay circuit via diodes D3-D8 and D10. This instant trip line is gated through to the alarm timer by IC7b and IC8e, provided pin 13 of IC7b is high.

Pin 13 of IC7b is controlled by the exit delay timer. When the alarm is off (ie, keyswitch S9 open), transistor Q1 is on, pin 13 of IC7b is low, and the alarm timer is held reset via IC8f and diode D13.

When the alarm is set (S9 closed), Q1 turns off and C3 charges via VR3 and the 100kΩ resistor. When the voltage on the capacitor reaches the upper threshold voltage of IC8f it is interpreted as a logic 1 and the alarm is triggered.

IC6b, IC7c and IC9 form the alarm timer which controls the length of time that the alarm sounds. Since this has to be a very long time delay, a simple RC time constant circuit is not practical. This timer works in the following way:

When the alarm is set, IC6b is initially held reset via IC8f and D13 until the end of the exit delay. This means that Q is low and $\overline{Q}$ is high and thus IC9 is also reset. At the end of the exit delay, the output of IC8f goes low and removes the reset signal from IC6b. If the output of IC8e now goes high momentarily (ie, if the alarm is triggered), Q of IC6b will go high and enable Schmitt trigger oscillator IC7c.

Trimpot VR4 sets the oscillator frequency so that the alarm time can be adjusted (1-15 minutes).

IC7c clocks IC9, a 4020 14-stage binary ripple counter. After 8192 clock pulses, Q14 of IC9 goes high and resets IC6b via D15. This, in turn, resets IC9 and disables IC7d and the siren driver circuitry.

IC11e and IC11f form a non-inverting buffer which drives indicating LED D33 and Q2, which controls the relay. Both of these devices are on when Q of IC6b is high (ie, during the alarm period). If switch S10 is closed, the siren driver is also activated for this period.

Siren driver circuit

The siren driver circuit has two inputs: an oscillator input and a gating signal input. Schmitt trigger oscillator IC8d provides the siren tone and has a nominal frequency of 800Hz. Its output is gated by NAND gates IC10a and IC10d and, via IC11d, by IC10b and IC10c.

The gating signal is connected to the remaining inputs of IC10a, b, c and d. When this signal is low, the outputs of these gates will all be high, so transistors Q3, Q5, Q8 and Q10 will be off. IC11b and IC11c invert the outputs of IC10b

PARTS LIST

1 PCB, code 85ha1, 150 x 191mm
1 cash box (SWS 74-12), 305 x 182 x 91mm (see text)
1 12V, 1.2Ah sealed gel battery (see text)
1 12.6V, 150mA transformer (type 2851 or equivalent)
1 8Ω horn speaker
10 SPDT toggle switches
1 DPDT momentary action pushbutton switch
1 barrel-type keyswitch
1 12V DPDT relay, 5A contacts (DSE S-7130 or equivalent)
1 electronic buzzer
3 8-way PC-mounting terminal blocks
1 4-way PC-mounting terminal block
10 LED mounting bezels
3 Scotchcal panels
1 aluminium sheet, 150 x 190mm, 1.6mm thick
2 spade connectors, female
1 2-way mains terminal block
4 20mm spacers
2 25mm tapped spacers

Capacitors

1 1000μF 25VW axial electrolytic
3 100μF 16VW PC electrolytic
1 10μF 25VW PC electrolytic
1 4.7μF 25VW PC electrolytic
16 1μF 50VW PC electrolytic (RBLL type)
8 .047μF polyester (greencap)
1 .015μF polyester
2 .01μF polyester

Semiconductors

2 4030 quad exclusive-OR gates
4 40106 hex Schmitt inverting buffers
1 4013 dual D-type flipflop
1 4093 quad Schmitt NAND gate
1 4020 14-stage ripple counter
1 4011 quad NAND gate
1 4049 hex inverting buffer
2 TIP31 NPN transistors
2 TIP32 PNP transistors
2 BC338 NPN transistors
3 BC328 PNP transistors
1 BC548 NPN transistor
1 BD681 NPN Darlington transistor
1 15V, 1W zener diode
16 1N914 diodes
6 1N4004 diodes
8 5mm red LEDs
1 5mm green LED
1 5mm yellow LED

Resistors (¼W, 5% unless stated)
10 x 1MΩ, 16 x 300kΩ (1%), 16 x 150kΩ, 10 x 100kΩ, 17 x 47kΩ, 3 x 10kΩ, 1 x 1.8kΩ, 15 x 1kΩ, 4 x 100Ω (1W), 2 x 47Ω (1W), 3 x 500kΩ miniature horizontal trimpots, 1 x 100kΩ miniature horizontal trimpot.

Miscellaneous
Machine screws and nuts, 16-way ribbon cable (2 metres), solder, etc.

and IC10d, so transistors Q4, Q6, Q7 and Q9 will be also off. In this state, the circuit draws very little current.

When the gating signal is high, the 1kHz siren tone is gated through to the driver transistors by the NAND gates. The signal is inverted before being applied to IC10b and IC10c, so that the driver stage operates in the push-pull mode. This means that the signal across the speaker is about 24V peak-to-peak.

The Q output of IC6b is not used directly as the gating signal for the siren driver, since this would result in a continuous tone being emitted. Rather, the Q output is used to enable a low frequency oscillator formed by IC7d. This oscillator has a nominal frequency of 1Hz. Inverter IC11a is necessary since, when the oscillator is disabled, its output is high.

The result of all this is an ear-piercing 800Hz alarm tone, modulated at 1Hz.

Muted test facility

Note that the siren driver circuit is actually capable of driving two 8Ω horns connected in parallel. This may be useful if you own a very large house. If you do elect to use two horns, then the large 2.6Ah battery should be employed to cope with the increased current drain.

Up to this point, the 47Ω resistor and switch S11b have been ignored. These components form part of the test facility which has been incorporated into the alarm. For normal operation, the switch is normally in the position shown, so the resistor is not in circuit. When the alarm is tested, this resistor is connected in series with the horn speaker, thereby reducing its output considerably.

The other pole of this test switch (S11a) is used to provide trigger and reset pulses for the test function. The switch normally rests in the position shown and, when pressed, pulls the input of IC5f low until the .01μF capacitor charges up via the 1MΩ resistor. Thus a short (10ms) positive pulse is delivered to the instant trip line. Provided the exit delay has expired, the alarm will then sound.

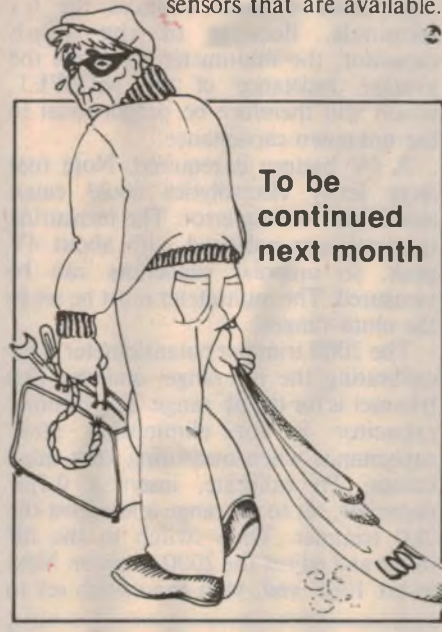
When the test button is released, a reset pulse is delivered to IC6b via IC5e in exactly the same way. This pulse resets the alarm timer and so stops the siren.

The last section of this circuit worthy of comment is the power supply section. This is built around a 12V, 1.2 amp-hour, sealed gel battery. This battery provides power for the circuit at all times, and is kept recharged by the mains supply.

A standard bridge rectifier circuit is employed for the power supply and charges the 12V battery via D22 and a 47Ω 1W resistor. LED D24 and its associated 1.8kΩ current limiting resistor provides power on/off indication for the mains.

Finally, zener diode D23 prevents damage to the circuit if the battery is removed while the mains is present. If the battery is removed, then D23 clamps the supply rail to 15V, which is within the ratings of the CMOS ICs.

Next month, we will continue with the construction details and take a look at the different types of alarm sensors that are available.



To be continued next month

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.

Simple pulse generator

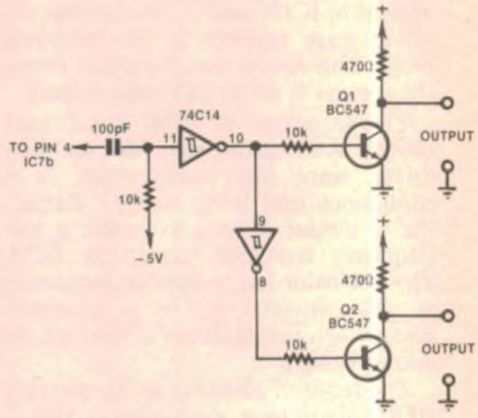
This simple circuit is designed for use with EA's Function Generator (April '82) and delivers complementary 1μs digital pulse trains.

The input square wave signal is derived from pin 4 of IC7b and applied to an RC network (100pF and 10kΩ) which determines the pulse width. The signal is then buffered using the two spare inverters in the 74C14 to provide the complementary outputs.

Because the 74C14 uses +5V and −5V supplies, each inverter output drives a single transistor stage to provide a TTL-compatible 5V output. The pulse train frequency is determined by the setting of the front panel controls as before.

Most of the extra parts can be mounted on the back of the PC board and the output run to BNC sockets on the rear panel. Note that it is necessary to isolate pins 9 and 11 from the −5V rail before mounting the extra parts.

M. Hedley,
Chatswood, NSW. **$15**



Capacitance meter

This neat little device plugs into any digital (or analog) multimeter and reads any unknown capacitance in the range 3.3pF (0.1pF resolution) up to 2000μF (1μF resolution), including polarized capacitors such as tantalum and electrolytics. There is nothing to adjust: just plug in the unknown capacitor, switch to high-range (nF) or low-range (pF), and read the capacitance value.

The unit can be made very small and can plug directly into the meter banana sockets. There is only one control switch, a three-position DPDT centre-off type. For correct readout in nF or pF, the reading on the meter must be divided by 10. That is, observe the reading in ohms and then shift the decimal place on one position to the left: it is then in nF or pF. For example an ohms reading of 1MΩ is in fact 100,000pF or 100nF.

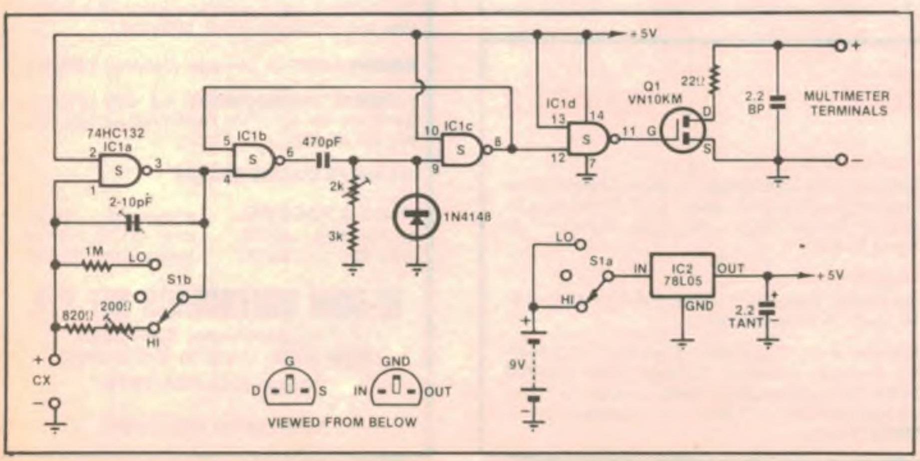
IC1a forms an oscillator, the frequency of which is dependant on the value of the unknown capacitor. The output of this oscillator is fed to a monostable formed by IC1b and IC1c. The resulting signal is then inverted and used to drive the MOSFET (Q1).

The result of all this is that the FET is driven by a signal which has a pulse width proportional to the value of the capacitance connected across the Cx terminals. Because of the 2.2μF capacitor, the multimeter measures the average resistance of the MOSFET, which will therefore be proportional to the unknown capacitance.

A 9V battery is required. Note that large leaky electrolytics could cause significant reading error. The measuring terminals are polarised with about 4V peak, so unipolar capacitors can be measured. The multimeter must be set to the ohms ranges.

The 200Ω trimmer potentiometer is for calibrating the nF range, and the 2kΩ trimmer is for the pF range. The trimmer capacitor is for eliminating stray capacitance when measuring very small values. To calibrate, insert a 0.1μF capacitor, set to pF range and adjust the 2kΩ trimmer. Then switch to the nF range and adjust the 200Ω trimmer. Next insert 10pF and, with the switch set to pF range, adjust the trimmer capacitor to give the correct reading. Should the 2kΩ pot have insufficient adjustment range, which is unlikely, reduce the 3kΩ resistor to 2kΩ.

B. Kauler,
Collie School of Mines, WA. **$20**



Checking transistors with a multimeter

Most readers will know how to use an ohmmeter to identify the base of a transistor, and to decide whether it is NPN or PNP. With the addition of a single resistor, one can use the same instrument to distinguish between the collector and emitter, and to estimate the current gain.

Suppose that you have an NPN transistor for which the base has been identified. First connect the base through a 20kΩ resistor to the positive terminal of your analog multimeter. Note that on most multimeters the black lead is the positive one. Now connect the two remaining pins to the two multimeter leads and note the resistance. Swap the two transistor leads around, leaving the base connected. The collector will be connected to the more positive lead (black) when the resistance is lowest.

The gain can be determined from the actual value of the resistance measured. If the resistance were, say, 500Ω then the current gain of the transistor would be 20,000/500 = 40.

Follow the same procedure for a PNP transistor except that the base must be connected to the more negative terminal of the multimeter.

D. R. Watson,
Corio, Vic. **$15**

Beeper for vehicle flasher

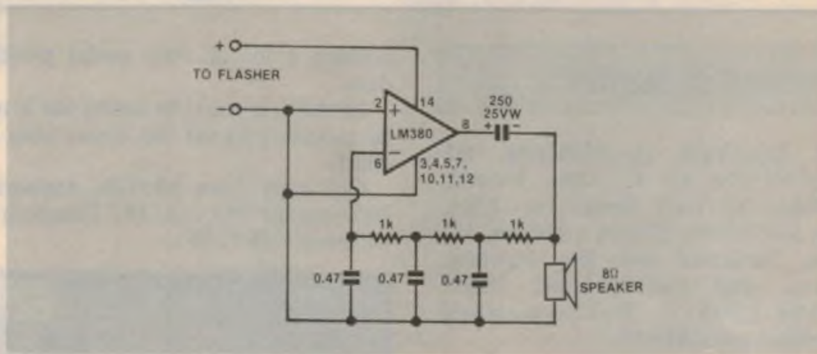
A vehicle direction indicator which fails to reset can be a real traffic hazard. This often happens after a smooth curve or when changing lanes. If the driver has a high frequency hearing loss this problem is compounded since he cannot hear the flasher relay clicking. This circuit provides a low frequency beeping sound while ever the indicators are on, thus providing a simple solution to the problem.

The LM380 is wired as a phase shift oscillator, the values of the feedback components being chosen to produce a frequency of about 800Hz. The circuit is connected across the flasher relay terminals, and hence will operate when the flasher contacts are open.

The circuit should be mounted in a small box, and installed near the flasher relay. Before connecting the leads to the relay terminals it is necessary to determine the correct polarity. This can be done with a multimeter. When operating the circuit draws about 60mA.

H. L. Harvey,
Cairns, Qld.

$20



Modification to railmaster train controller

While the Railmaster train controller featured in September EA has a lot of nice features, it does have one drawback. If the controller is switched into reverse while the train is running at speed, it will try to change the direction instantaneously. Depending on the speed of the train, this usually leads to a derailment.

This circuit solves that problem. When the reverse (or forward) position is selected, it initially slows the train according to the inertia setting. Then, when the train has halted, it automatically switches the track polarity and brings the train back up to speed in the new direction, again with full inertia.

Only three ICs and a couple of SPDT relays are required for the modification. Initially, the Q and D pins of IC4 (a 4013 flipflop) are at the same logic level, pin 3 of XOR gate IC5 is low, and Q5 and relay RLA2 are off. The controller thus functions as normal with the voltage set by the speed control pot (VR1) applied to the 47μF capacitor via VR2 and the NC contacts of RLA2.

Suppose that the train is initially travelling in the forward direction. If S3 is now switched to the reverse position, RLA3 will release and pull pin 5 of IC4 and pin 2 of IC5 low via its NC contacts. Thus, the output of IC5 goes high and transistor Q5 turns on and activates RLA2.

The 47μF capacitor on pin 10 of IC1c now discharges via the inertia pot (VR2) and the NO contacts of RLA2 into the low output of IC1a. IC3a is wired as a voltage comparator. When pin 8 of IC1c falls below IC3a's non-inverting input, pin 1 of IC3a switches high and clocks the low D input on IC4 through to the Q output.

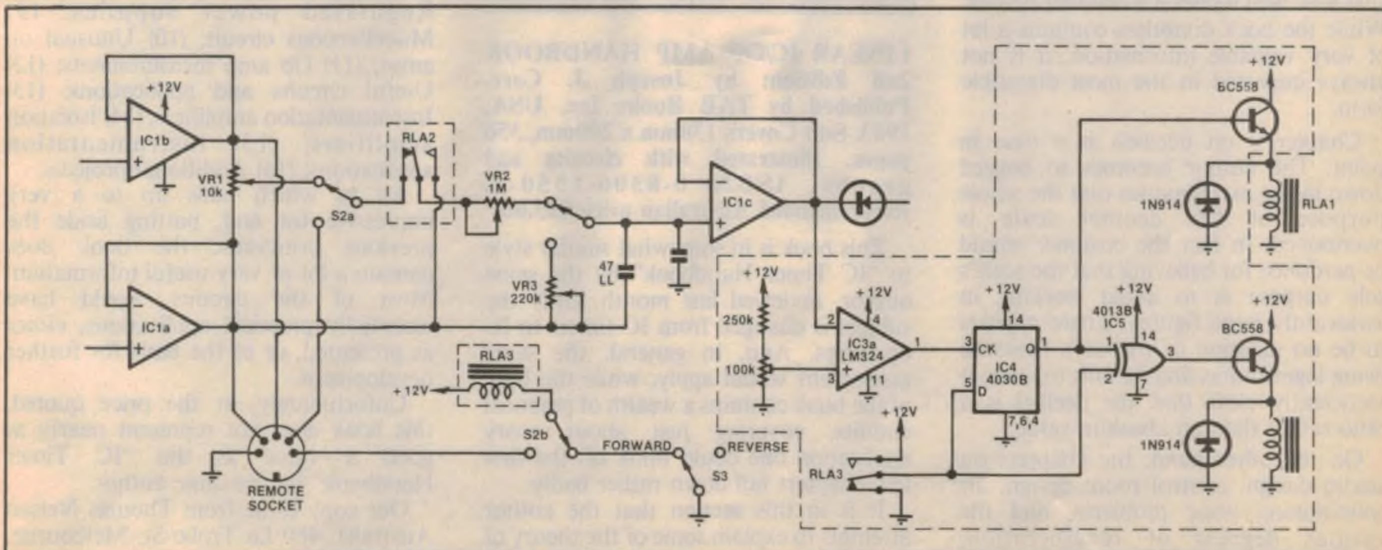
The output of IC5 now goes low and Q5 turns off. At the same time, Q6 turns off and releases RLA1 which switches the track polarity. The train is then gradually brought up to speed in the new direction as the 47μF capacitor charges via the NC contacts of RLA2 and the inertia pot (VR2).

VR4 sets the throttle voltage at which the train reverses direction. It should be set so that the train is almost brought to a halt. Do not set the voltage on pin 3 of IC3a below that on pin 3 of IC1a otherwise the train will never change direction.

Note that S2a (the local/remote) switch has been moved so that the inertia can be set by the pot on the main unit rather than having to wire a separate inertia control into the remote throttle.

B. Wu,
Lindfield, NSW.

$30



Books & Literature

Practical Acoustics

THE MASTER HANDBOOK OF ACOUSTICS: by F. Alton Everest. Published by TAB Books Inc. USA, 1981. Soft covers, 130mm x 210mm, 352 pages. Illustrated with line drawings, graphs, and photographs. ISBN 0-8306-1296-3. Recommended Australian price $19.95.

This book is intended to cover the subject of acoustics from the fundamentals of sound and hearing to the practical problems involving control of acoustic characteristics — echo, reverberation, etc — in studios, listening rooms domestic environments, and how these may be measured, evaluated, and controlled.

The book contains 17 chapters, under the following headings (abbreviated): (1) Sound fundamentals; (2) Hearing; (3) The decibel; (4) Sound outdoors; (5) Comb filter effects; (6) Sound indoors; (7) Echoes; (8) Reverberation; (9) Noise, music and speech; (10) Absorption; (11) Diffusion; (12) Quiet studio ventilation; (13) Home listening room; (14) Building a studio; (15) Multitrack recording; (16) Control room; (17) Acoustical measurements. There is also an appendix of sound absorption coefficients.

From the above it can be seen that the book endeavours to cover a very wide range of acoustic theory and practice. Just how well it does it is another matter. While the book doubtless contains a lot of very valuable information, it is not always imparted in the most digestible form.

Chapter 3 on decibels is a case in point. The author becomes so bogged down in the mathematics that the whole purpose of the decibel scale is overlooked. In fact the beginner would be pardoned for believing that the scale's sole purpose is to avoid working in awkwardly large figures. There appears to be no mention of the ear's response being logarithmic, and he fails to make it sufficiently clear that the decibel is a ratio rather than an absolute value.

On the other hand, the chapters on studio design, control room design, air conditioning noise problems, and the various degrees of reverberation, absorption etc required, would seem to contain a lot of very useful practical data.

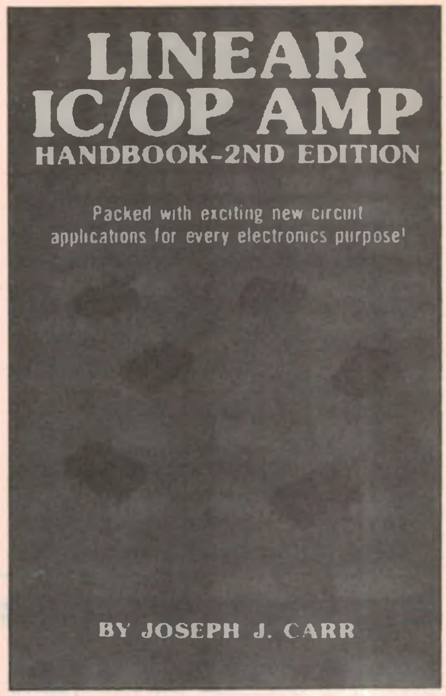
In short, it could be useful but it may be necessary to sift the wheat from the chaff.

Our copy from McGills Authorised Newsagency Pty Ltd, 187 Elizabeth St, Melbourne (P.G.W.).

Component data

LINEAR IC/OP AMP HANDBOOK 2nd Edition: by Joseph J. Carr. Published by TAB Books Inc. USA, 1983. Soft Covers 130mm x 209mm, 356 pages. Illustrated with circuits and graphs. ISBN 0-8306-1550-4. Recommended Australian price $25.00.

This book is in somewhat similar style to "IC Timer Handbook" by the same author, reviewed last month. Only the subject is changed from IC timers to IC op amps. And, in general, the same assessment would apply; while the bulk of the book contains a wealth of practical circuits, covering just about every application one could think of, the first few chapters fall down rather badly.



It is in this section that the author attempts to explain some of the theory of op amps. It is not that he is lacking in his own understanding of the subject, on the contrary he understands it too well to make a good teacher. As before, he pushes the reader in at the deep end on the assumption that he can already swim — or at least dog-paddle!

For the student who is really unfamiliar with the subject — and it is assumed that this is the type of person who would be attracted to the book — this approach is more likely to frighten him off, with the fear that he could never understand it.

The book has 16 chapters and four appendices and their headings (abbrev.) are as follows. (1) Inverting followers; (2) Non-inverting followers; (3) Differential amplifiers; (4) Op amp problems; (5) Op amps in computation; (6) Op amp instrument design. (7) Active filters; (8) Regulated power supplies: (9) Miscellaneous circuit; (10) Unusual op amps; (11) Op amp measurements; (12) Useful circuits and applications; (13) Instrumentation amplifiers; (14) Isolation amplifiers; (15) Instrumentation applications; (16) Additional projects.

All of which adds up to a very impressive list and, putting aside the previous criticisms, the book does contain a lot of very useful information. Most of the circuits would have essentially practical applications, either as presented, or as the basis for further development.

Unfortunately, at the price quoted, this book does not represent nearly as good a value as the "IC Timer Handbook" by the same author.

Our copy came from Thomas Nelson Australia, 480 La Trobe St, Melbourne, 3000 (P.G.W.)

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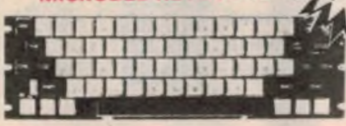

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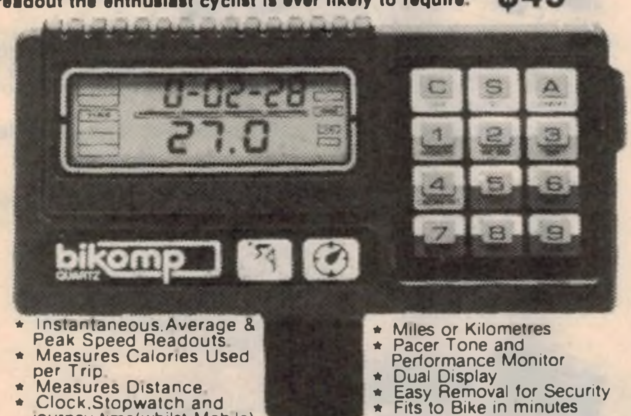

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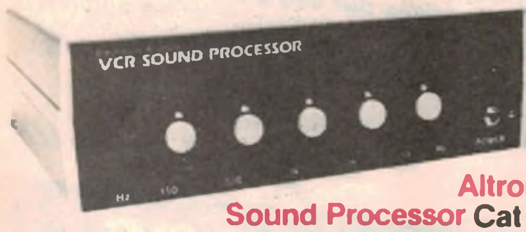

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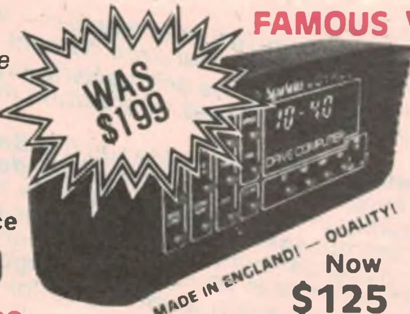

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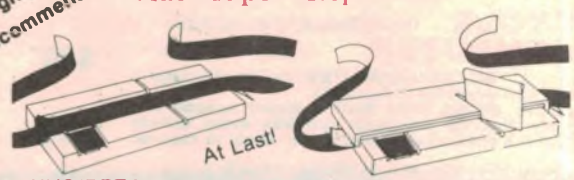
Highly Recommended

Video Tape Repair Kit



A **VHS/BETA** Video Tape Repair Kit. No need to throw out your damaged tapes—this nifty splicing kit can save you a fortune (if you've got small children this kit will save you several fortunes!!)
All accessories included for joining tape and refixing leader ends etc.

A 9315 **Fantastic Value $7.95**

At Last! Head Cleaners That Really Do A 100% Job

Our exciting range of head cleaners are the best we've seen and more importantly they are gentle on your heads.
Why risk damaging your video or audio cassette player with inferior units.

Audio Cassette
Type A 9200
Were $5.95 Now **$3.95**

Beta Video
Type A 9300
Were $17.50 Now **$9**

VHS Video
Type A 9310
Were $17.50 Now **$9**

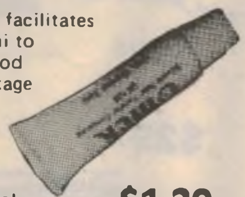
DE-SOLDER BRAID

HALF PRICE

T1230 .... **$1**

HEATSINK COMPOUND

Heat conducting paste facilitates heat transfer from semi to Heatsink. One tube good for up to 30 TO3 package semiconductors.



H 1600...7.5g Pack........ **$1.20**
New trade pack
H 1610...150g Pack........ **$7.50**
SAVE UP TO 33%

SUPER TYPE GLUE

New patented easy flow Dispenser and carry tube dispenses only when tube body is depressed-ensures no leaks. Many times the number of bonds over conventional tubes.

Sticks in seconds—1000' of uses

T 3010
~~$2.95~~
$2

PROFESSIONAL QUALITY

SOLDER SUCKERS

Not to be compared with inferior Hobby types. Saves countless hours in fault finding and repair of complex PCB's.
SINGLE HANDED OPERATION
SELF CLEANING PLUNGER
LONG LIFE TEFLON TIP
DOUBLE DIAPHRAGM,
DUAL O-RING SEAL
225mm x 20mm(d)
50mm STROKE
POWERFUL
SUCTION

T1240. . only ~~$11.95~~
T1241. Replac tip **$1.95**

Professional Nicad Rechargeable Batteries

From
$1.69

		ea	10+
S 5020	"AA" Penlight	1.95	1.69
S 5022	"C" Size 1.65 AH	4.95	3.99

VINYL BINDER

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

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

B 9999.........$5.50
THIS MONTH
$5.00
4 or more $4.50 ea.

PROFESSIONAL AUTOMATIC

WIRE STRIPPER

Automatically adjusts to insulation/wire diameter This absolutely brilliant stripper is the finest we've ever used.

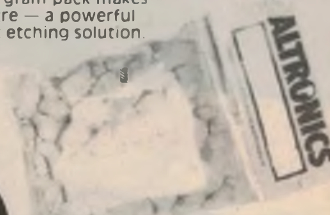
$5

T 1520
~~$9.50~~

All quality Altronics Imports — Not "Hobbyist" Seconds

FERRIC CHLORIDE BEADS 200g

200 gram pack makes 1 litre — a powerful fast etching solution.



H 0800
NOW **$1.50**

LOOK

Hardware Prices from less than 1 cent per piece

DIL SWITCHES

GOLD PLATE SELF WIPING CONTACTS

From 80¢
Near 1/2 Price

		ea.	25 Up
S 3050	4 way	90¢	80¢
S 3060	8 way	1.25	1.00
S 3065	10 way	1.50	1.35

RUBBER FEET

Packs 100

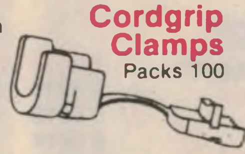
H 0913 STD 13mm **$6**
H 0942 Stickon 12mm **$8**
H 0952 Stickon 20mm **$9**

Rubber Grommets

Chassis Hole 9.5mm
Cable Size 5-7mm
H 1450.... **60¢**

Cordgrip Clamps

Packs 100



H 1476 Cables to 9mm **$9**
H 1471 Cables to 6.3mm **$8**

ULTRASONIC TRANSDUCERS

D=16mm H=12mm

Ultrasonic transmitter and receiver transducers operating at 40KHz + or - 1Khz. Perfect for security applications etc. i.e. alarm sensors, counting sensors, remote control sensors and many other uses.

Sensitivity S 5115 TX 106db S 5110 RX 65db **Disperson angle** 20 deg. **Max input voltage** 20V RMS **Impedance** S 5115 500 Ohms S 110 30K Ohm. **Operating range** up to 9M.

S 5110 Receiver **$4.95** 10 up **$4.50**
S 5115 Trans **$4.95** 10 up **$4.50**

Nylon Cable Clamps

Cat. No.	Pack	Size	Price
H 1480	6	6mm	.55
H 1481	100	6mm	5.00
H 1485	6	9mm	.60
H 1486	100	9mm	6.00

Nickel Plated Brass Spacers

Packs 100

TAPPED 4BA
H 1380 Length 9mm **$8**
H 1384 Length 12mm **$10**
H 1388 Length 25mm **$15**

UNTAPPED 4BA or 1/8" Clearance
H 1359 Length 6mm **$7**
H 1365 Length 9mm **$8**
H 1374 Length 12mm **$9**
H 1376 Length 25mm **$12**

Quality Plated Screws

at less than Wholesale Prices

Whitworth — Steel Nuts and bolts (Roundhead) Zinc Plated

	Length	Pack Qty	Price
H 1002	9mm	500	$4.50
H 1007	12mm	500	$4.50
H 1011	25mm	500	$6.00
H 1022	Hex Nut	500	$5.00
H 1032	S/Proof Washer	500	$6.00

BA Bolts Cheesehead Steel, Nuts Brass

H 1050	4BA/12mm	25	50¢
H 1060	6BA/12mm	25	50¢
H 1070	Nuts 4BA	25	90¢
H 1080	Nuts 6BA	25	90¢

BANKCARD HOLDERS—PHONE ALTRONICS TOLL FREE 008 • 999 • 007 FOR NEXT DAY JETSERVICE DELIVERY

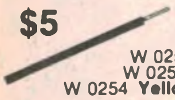
PRICE SENSATION

Wire and Cable Sellout!!!

All Supplied on Sturdy Reels—Not those tanglesome Rolls ! !

Pro Grade Hook Up Wire
All on 100M Reels

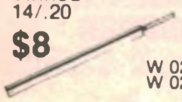
Light Duty
Tinned 13/.012
$5



Buy Eight Reels For Only $30

W 0250 **Red** W 0251 **Black** W 0252 **Brown** W 0253 **Orange** W 0254 **Yellow** W 0255 **Green** W 0256 **Blue** W 0257 **White**

Medium Duty
Tinned 14/.20
$8



Buy Four Reels For Only $28

W 0260 **Red** W 0261 **Black** W 0268 **White** W 0265 **Blue**

Heavy Duty
24/.20
$10

Buy Four Reels For Only $30

W 0270 **Red** W 0272 **Black** W 0274 **Green** W 0276 **Brown** W 0278 **Blue**

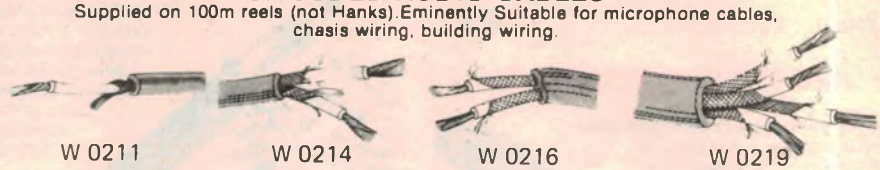
Extra H/Duty
32/.20
$15

Buy Two Reels For Only $25

W 0280 **Brown** W 0282 **Blue**

SHIELDED AUDIO CABLES

Supplied on 100m reels (not Hanks). Eminently Suitable for microphone cables, chasis wiring, building wiring.



W 0211	W 0214	W 0216	W 0219
SINGLE CORE	TWIN CORE	TWIN CORE Fig "8"	4 CORE
$18	**$29**	**$29**	**$49**

TV Feeder 300 Ohm

W 0220 Flat Ribbon **$15**

FIGURE "8" CABLE

For Speaker Wiring, Security Systems, PA Systems, Low Voltage Wiring etc. All include polarity trace.

W 0200 2X 14/.14 100m **$6**
W 0201 2X 14/.19 100M **$8**
W 0204 2X 19/.193 Red Trace Band 200M **$25**
W 0205 2X 19/.193 Black Trace Band 200M **$25**
W 0208 2X 24/.20 Red/Black 200m **$30**

FROM $6

COAXIAL

W 0222	TV 75 Ohm	STD	**$25**
W 0224	TV 75 Ohm	Low Loss	**$35**
W 0226	RG 58 AU	52 Ohm	**$29**

Phone your Order Toll Free On 008 999 007

IDC COMPUTER CABLE

		Per Metre	Per M 10 Metres +
W 0610	10 wire	.99	.89
W 0616	16 wire	1.59	1.39
W 0626	26 wire	2.59	2.29
W 0634	34 wire	2.99	2.69
W 0650	50 wire	5.99	4.99

FUZES 3AG

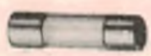
1 - 9 **.20**
10 - 99 **.15**
100 plus **.10**
Mixed 500 **.08**

S 5940	100MA	S 5950	1A	S 5960	7.5A
S 5942	150MA	S 5952	1.5A	S 5962	10A
S 5944	250MA	S 5954	2A	S 5964	15A
S 5946	500MA	S 5956	3A	S 5966	20A
S 5948	800MA	S 5958	5A	S 5968	25A
				S 5970	30A

PHOTOGRAPHIC XENON TUBE

Great For Strobe Light Projects
S 4050 ~~$2.95~~
Now $2.00

FUSES M205



20 x 5mm

S 5910	250MA
S 5912	500MA
S 5914	1A
S 5916	2A
S 5918	5A

1 - 9 **.20**
10 - 99 **.15**
100 plus **.10**
Mixed 500 **.08**

"Save up to 60% on these prices"

VELOSTAT

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

H 0500 ...... ~~$3.50~~ **$2.00**

MINI PCB RELAYS

Low Profile 14H x 20W x 12D
12V DC Bobbin
1 AMP Contact Rating

S 4060 SPDT $2.00
Now **$1.80** 10+ **$1.50**
S 4061 DPDT $2.50
Now **$2.00** 10+ **$1.70**

HEAVY DUTY RELAY

S 4074 ~~$9.95~~
NOW **$7.00**

12V coil 10 AMP DPDT contacts OEM Quality. Heavy Duty Relay. Ideal for power supply and control circuit switch. Socket allows easy chassis mounting and quick cable connection to screw terminals.

SCREW TERMINAL OCTAL SOCKET TO SUIT
S 4075 $3.95 10 up $3.50

2N3055'S SLASHED
Z1174

PRIME SPEC S.G.S.

1 - 9	10 - 24	25 - 99	100+
95¢	**90¢**	**80¢**	**70¢**

MINI PCB RELAY H/D

Low Profile 15mm (H)
12V DC Bobbin 3 AMP Contact Rating

S 4066 SPDT $2.75
10 Up $2.25

COMPONENT JOYSTICKS
Standard type (non-centering)

NOW $2.50

- Resistance 100K ohm
- Lever movement 60°
- Metallic knob
- For TV games, RC units
- Life 300,000 cycles

K 9680
~~$4.95~~

Self Centering Type

Resistance 5K ohm suit ETI project for microbee Proportional Analogue Joystick Dec 1983

K 9689 ~~$17.50~~ NOW **$7.50**

Micro Switch Bargains
250V 3A
Single Pole c/over Contacts

Push Button Type

S 3255 **$2.00**
10 Up **$1.70**

S 3250 **$1.25**
10 Up **95¢**

MINI TOGGLE SWITCHES
OEM QUALITY 250V 2 AMP RATED

6mm mounting hole
12mm x 12.7mm x 20mm (D)

SAVE 30%

	ea.	10 Up
S 1010 SPDT	$1.00	.90
S 1025 SPDT Centre off	1.10	.90
S 1020 DPDT	1.10	.99
S 1030 DPDT Centre off	1.50	1.20

STANDARD TOGGLE
Sturdy • Reliable 125V/ 3 AMP Rating

S 1040 SPST	$1.00
10 up	.90
S 1050 DPDT	1.30
10 up	1.10

HEAVY DUTY TOGGLE DPDT CENTRE OFF
125V/10A (250V AC/5A)

Ideal for car antenna switch, automotive and marine electrical use

S 1055 **$1.95**

SEALED PCB MOUNT ROTARY SWITCHES
Why Pay Over $3 ?

1 - 9	**$2.00**
10-24	**$1.80**
25-99	**$1.60**
100 +	**$1.40**

"Lorlin Style"

A real plus feature is the ability to set the number of stops to suit your own distinct requirements, e.g. A 1 pole 9 position is easily implemented using our S 3021.

S 3021 . . . . 1 Pole
Configure from 1 pole 2 position through to 1 pole 12 position

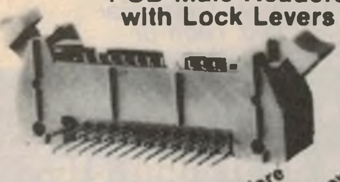
S 3022 . . . . 2 Pole
From 2 pole 2 position to 2 pole 6 position

S 3025 . . . . 3 Pole
From 3 pole 2 position to 3 pole 4 position

S 3024 . . . . 4 Pole
From 4 pole 2 position to 4 pole 3 position

Remember Altronics deliver Next Day via.Jetservice Courier to all Capital Cities and suburbs—Country Areas please allow extra 24—48 hours.

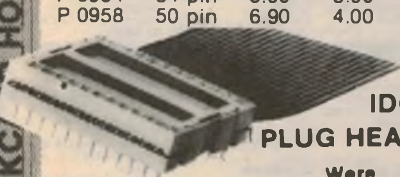
Insulation Displacement Connectors
PCB Male Headers with Lock Levers



90 Degree Type		Were	Now	10 Up
P 0926	26 pin	3.95	2.50	2.00
P 0926	34 pin	4.95	3.20	2.95
P 0932	50 pin	6.50	3.90	3.40
Straight Type				
P 0939	26 pin	3.95	2.50	2.00
P 0941	34 pin	4.95	3.20	2.95
P 0945	50 pin	6.50	3.90	3.40

Cable Mounting Socket (Female)

		WERE	NOW	10 UP
P 0952	26 pin	3.95	2.50	2.00
P 0954	34 pin	5.90	3.90	3.40
P 0958	50 pin	6.90	4.00	3.50

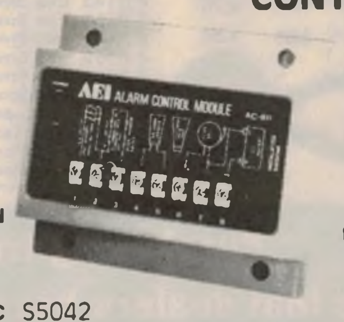


IDC DIL PLUG HEADERS

		Were	Now
P 0917	14 pin	1.50	1.10
P 0918	16 pin	1.80	1.50
P 0920	24 pin	2.50	2.10
P 0921	40 pin	3.50	2.95

Amazing Value

ALARM CONTROL MODULE



The AC-811 is a low cost professional burglary protection system which detects the presence of an intruder who breaks into your home, office or business. The system also allows connection of emergency panic buttons, wall vibration switches, smoke and heat sensors, as well as freezing or flooding detectors to form a complete protection system.

EXIT/ENTRY DELAY
BOTH N/C AND N/O CONTACTS

Ideal for homes, offices, factories, shops, caravans, any area requiring protection.

EASY TO INSTALL ★ BUILT IN SIREN DRIVER—DIRECTLY DRIVES LOW COST 8 OHM HORN SPEAKERS, SIREN HORNS AND MECHANICAL BELLS ★ LOW POWER 12V DC OPERATION.

S5042
Only ~~$39.50~~ **Now $32.50**

MINI BUZZER 1.5-5V DC
SENSATIONAL LOW PRICE

Handy little solid-state audio "Buzzer" or signalling device. Just the shot for communicator panels, or for timer alarms or in the car. Polarity conscious.

S5062 ~~$1.95~~ Now **$1**

16 WAY PARTS DRAWER SET

See through acrylic parts drawer. Slide-in ident card fronted drawers. Ident. cards supplied. VALUE PLUS!

H 0440 . . . . ~~$17.50~~.Now.**$15.00**

WEATHERPROOF SIREN HORN

12V DC operated — Deafening Siren Wail. Super handy for audio signalling, security systems etc. Current drain 500MA approx. Completely weatherproof. Attractive off-white PVC finish.

S 5058 . . ~~$19.50~~ NOW $15.00 ea. STREWTH!

PIEZO ALARMS

Similar to "Sonalert" type. Absolutely ear piercing sound. Recommended voltage 5-15V DC Ideal for almost all audio signalling applications, i.e. fire, water and gas signalling, computer alarms, etc.

S 5066 $4.95 **Now $3.50**

Dual Function Type
Pulsed or Continuous output
S 5070 $5.95 **Now $4.50**

EGAD!!

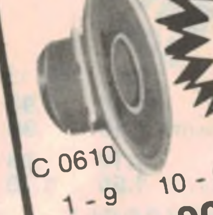
Popular D Range Computer Connectors all 1/2 Price

Be Very Quick This Month Only

	WERE	NOW
P 0880 DB 9 Male 9 Pin	2.50	1.25
P 0881 DB 9 Female 9 Pin	2.95	1.50
P 0882 DB 9 Male PCB Mnt	3.25	1.60
P 0883 DB 9 Female PCB Mount	3.95	2.00
P 0885 DB 9 Backshell Cvr	1.80	.90
P 0890 DB15 Male 15 Pin	2.95	1.50
P 0891 DB15 Female 15 Pin	3.50	1.75
P 0892 DB15 Male PCB Mnt	3.95	2.00
P 0893 DB15 Female PCB Mount	4.95	2.50
P 0895 DB15 Backshell Cvr	2.00	1.00
P 0900 DB25 Male 25 Pin	4.50	2.25
P 0901 DB25 Female 25 Pin	4.95	2.50
P 0902 DB25 Male PCB Mnt	4.50	2.25
P 0903 DB25 Female PCB Mount	5.50	2.75
P 0905 DB25 Backshell Cvr	2.00	1.00

Stock Up Now and Save a Bundle

SPEAKER 8 OHM 2 ¼ INCH



From 69¢

C 0610

1 - 9	10 - 99	100 up
$1	90¢	69¢

ECONOMY RACK CABINET

* Solid steel construction
* Black anodised front panel
* 3 unit (132mm)
* Conforms to International Standards
* Ventilated top and side panels

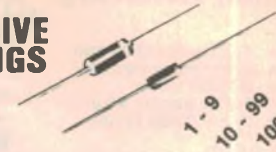
H 0400 ONLY ~~$45.00~~ **$40**

LEDS

	ea	10 Up
Z 0140 Led 3mm Red	.14	.10
Z 0141 Led 3mm Green	.20	.18
Z 0143 Led 3mm Yellow	.22	.20
Z 0150 Led 5mm Red	.14	.10
Z 0151 Led 5mm Green	.20	.18
Z 0152 Led 5mm Yellow	.22	.20
Z 0154 Led 5mm Orange	.25	.22
Z 0159 Led 5mm Flashing FRL4403	.49	.45
Z 0160 Led Rectangular Red	.22	.19
Z 0162 Led Rectangular Green	.25	.22
Z 0164 Led Rectangular Yellow	.25	.22
Z 1072 Led Infra Red CQY89A	.55	.52

DIODES SLASHED DIODES SLASHED

MASSIVE SAVINGS



	1 - 9	10 - 99	100 up
Z 0101 1N914/1N4148 Diode	.05	.04	.03
Z 0105 1N4002 100V 1 Amp	.06	.05	.04
Z 0109 1N4004 400V 1 Amp	.07	.06	.05
Z 0112 1N4007 1000 1 Amp	.08	.07	.06
Z 0115 1N5404 400V 3 Amp	.15	.12	.11
Z 0118 1N5408 1000V 3 Amp	.16	.13	.12
Z 0120 R250 A 400V 6 Amp	.60	.50	.45

Technician's Multimeters 10K Ohm/Volt

Robust Meter Movement

NOW JUST HALF PRICE

Q 1015

$9.90

Limited Stocks at This Price

DC Volts	5 ranges	.25	to	1000V
AC Volts	4 ranges	10	to	1000V
DC Current	3 ranges	100 MA		to .5A
Resistance	3 ranges	100 Ohm to 10K centre scale		

Positively Ist Class For the Field Tech or Bench Enthusiast

Purchasing from Altronics Resellers

Please note that dealers have additional costs such as freight etc. and in most cases dealer prices will be somewhat higher than offered here. Dealer prices will, however, represent a considerable saving on our competitors prices

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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

January 1935

Report from USA: Mr A. Scott, chief engineer for Stromberg-Carlson, returned from an overseas tour and reported on developments in the USA.

"Plenty of experiment is going on at present with the ultra-short waves, or wavelengths from five to seven metres.

"There are several reasons for this. One of the biggest is television, which, it is generally accepted, is likely to come on the short waves.

"Television," said Mr Scott, "is proceeding mainly along cathode-ray lines, and I saw some very good stuff being put over. It is not yet ready for release on a big scale, however, and with some engineers talking about 600 lines per inch pictures it looks as though there is a long way to go before it will be.

Automatic distress signal: The first vessel in Australia to be fitted with an automatic distress signal wireless transmitter is the steamer Birchgrove Park, a small vessel trading between Sydney and Newcastle and the South Coast of New South Wales.

Only three years have elapsed since this type of wireless equipment was invented and developed by Amalgamated Wireless for the purpose of meeting the needs of small ships.

Amalgamated Wireless had to keep in mind the developing of a wireless set that would be rugged, dependable, and efficient, but occupy very little space, and also send out a call for help without necessarily having on board anyone who knew the slightest thing about the Morse telegraph code.

Associated with a very robust spark transmitter, the automatic sending mechanism takes the shape substantially of two discs, on the peripheries of which are fixed small raised pieces of metal in the proper order of dots and dashes, so that when the disc rotates and the transmitter has the power switched on, a succession of dots and dashes are radiated as well as can be done by the most expert operator.

Don't laugh; this was serious: Surely one of the snappiest ideas ever put forth in the Sydney radio trade must be the special self-baking intermediates for the new Kriesler models, a patent for which has been secured by Mr Ray Weingott, of that firm.

Difficulty has been experienced through the effects of humidity on intermediate transformers and so in the new Kriesler intermediates there is a miniature radiator built inside the can. A nichrome winding on an asbestos former is placed in the can and is heated from a special winding on the power transformer.

Possibly in later models it will be found possible to utilise the resistance of the nichrome windings to act as bias resistors in the circuit.

RADIO TELEVISION AND HOBBIES · 2/6

January 1960

Flight recorder: A new British device called a flight and crash recorder was described by its inventor, Kenneth Dobson, in a recent BBC broadcast. During a flight the device records all important facts, such as instrument readings, engine performance and all the stresses and strains on wings and landing gear.

Should there be a crash, it will give the investigators something to work on; if the flight is perfectly normal, it will provide maintenance engineers with a record of the plane's performance that may result in not having to replace parts as often as at present.

In the event of a crash, Mr Dobson said, 99 times out of a 100 it should be possible to recover the record, which would show everything that had happened in the aircraft.

Flying TV station: A Dutch firm is preparing to transmit television programs from the air. Its transmitter will operate from a plane circling Holland and West Germany.

The transmission is expected to reach Britain, though few receivers would be able to reproduce the pictures because of the difference between British and Continental standards.

A spokesman of the firm formed to operate the service said in Amsterdam transmission probably would start early in 1960.

The plane would circle at a height of about 26,000ft, transmitting telerecorded programs.

Pushbutton telephone: Designed on the basis of many months of "human factor" study, a pushbutton type phone is said to give greater accuracy in dialling than the conventional method. This and other advances are made feasible by various electronic developments, including the transistor. Authorities say it is only a matter of time — and money — before subscribers will have available loudspeaker telephones, "television" systems, automatic transcription from teletype to words, and "personal" phones. These latter will be styled and worn like a wrist-watch and will operate into the wired system without the need for connecting leads. The pushbutton phone has been developed by Bell Laboratories.

Pedal plane: Britain is planning to build a man-powered plane. It will be powered by a propeller driven by a chain from pedals operated by the pilot. Some of Britain's leading aeronautical engineers are among a group to meet in London to raise the £10,000 needed for the project.

Most of the information needed to start work is already at hand, according to the chief engineer of British European Airways, Mr B. S. Shenstone. However, the project would not begin until the money has been found.

Britain's attempt was likely to be a fixed-wind aircraft with a propeller, which would be rotated by one or more men using bicycle pedals.

One of the main difficulties was to make the fame light enough for a man to lift. This would be overcome by using wood.

Engineers say drive would be by a flexible bicycle chain, allowing a direct drive from pedals to propeller shaft.

The Serviceman

Not so elementary, my dear Watson!

In all the best detective stories, from Sherlock Holmes to the present day, it is customary to tidy up all the loose ends with the unmasking of the villain in the last few paragraphs — the "apples bit" as one of my colleagues calls it (from "she's apples, mate"). In real life, unfortunately, not all crimes — or TV problems — can be as successfully concluded.

The story I am about to relate is a typical example. While the various technical villains were eventually unmasked and the situation brought to a technically satisfactory solution, there were a number of questions left unanswered. So don't expect too much of the "apples bit".

The set involved was a Kriesler 660/3, one of the deluxe Kriesler colour TV sets in a beautiful double ended console cabinet; a most impressive piece of furniture in its own right. In fact, this is an important aspect of the story because it was a major factor in justifying the amount of work the owner, and particularly his wife, were prepared to authorise.

At a more technical level the chassis is our old friend the 59-1; a very popular one in its day and, in spite of its age, still able to hold its own alongside most modern sets. Properly adjusted it can produce a most impressive picture. The particular set was one I had known and serviced since new, mainly for quite minor problems.

At least, that was the situation until about four years ago when the owner moved to the other side of the city, well out of my territory, and rather too far for me to travel on a routine basis. So I more or less lost touch with the family, apart from an odd report from other customers who knew them.

Then one day the owner was on the phone with a real tale of woe. The basis of his call was to enquire whether I would have a look at the set and, appreciating the distance involved, he was quite prepared to bring it to me. On that basis I readily agreed but I was naturally curious as to why he should go to all that trouble when there were almost certainly plenty of service organisations in his area just as able to help him.

It was then that the tale of woe emerged; most of it right there on the phone, and some of it later when I began asking questions. But, pieced together, it went something like this. The failure was quite sudden. The set had been performing normally when, as the owner put it, ". . . it suddenly stopped with a loud bang."

Not expecting that it would be anything more than a routine repair job he called in a local serviceman. The serviceman called at the home and spent some time working on the set, but without, apparently, making any real progress. Eventually he decided that it was a job for the workshop and took the set away.

He kept the set for about two months, then returned it with the pronouncement that it could not be repaired. He went on to explain that the line output transformer had failed, that he had bought and fitted a new one, but that "voltages were excessive" and that the set was a write-off. The "voltages were excessive" bit seemed to be a rather strange remark, even to the owner, and it meant no more to me than it did to him. (I did find out what it meant later.)

But the family's affection for the set wouldn't allow them to accept that verdict, at least without a second opinion. They valued the set highly, both as a source of entertainment and as an important part of their lounge room decor. They weren't going to give up without a fight. Which, of course, was where I came in.

Thus it was that the owner duly appeared, in a borrowed utility, with the set having been manhandled on board by himself and a neighbour. Together we manhandled it off and into the workshop. To be honest, I had some misgivings about the job. In fact, I had warned the owner that it might, in truth, be a write-off and that any undertaking to tackle the job would be subject to preliminary examination, and at his risk.

While he was still there I pulled the back off the cabinet and took a quick look. What I saw didn't reassure me. The deflection board, particularly around the line section, was a mess; whoever had been working on it would have qualified for the striped apron award of the year.

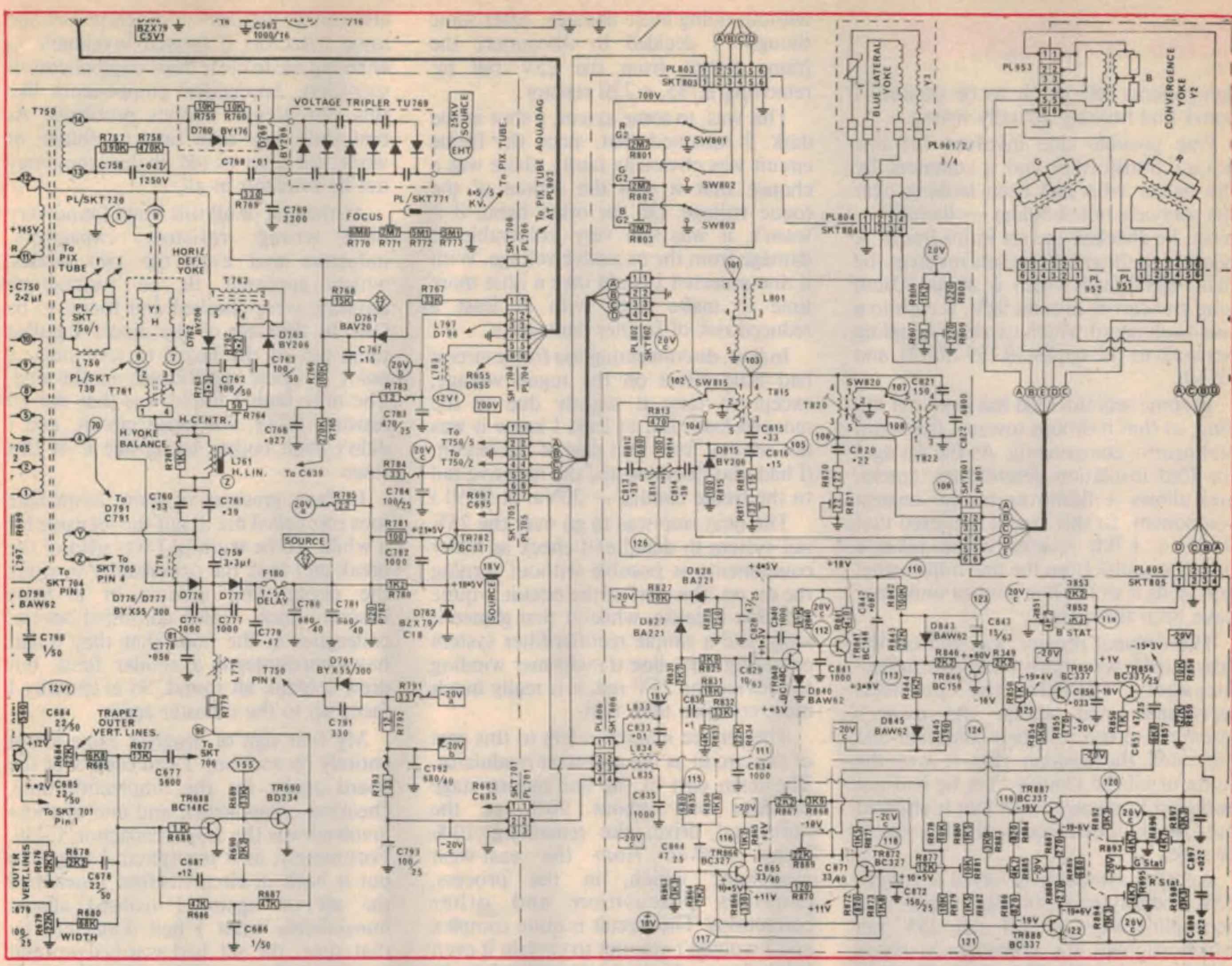
I plugged the set in and switched it on, keeping my finger on the switch. The power supply immediately hiccuped and I switched off. Next I slid the yoke back along the neck of the picture tube and examined the glass. If my predecessor had been mucking about with vital parts in the line output stage, particularly involving C747 or 746, it was quite possible that the picture tube might have been punctured by excessive EHT.

In fact I could find no such evidence, which was a relief, but this was no guarantee that the tube might not be faulty in some other way, and I pointed this out to the owner. So I thought about it for a while, and we talked it over, and I finally agreed to have a go at it — but with certain provisos.

As I put it to him, "You're obviously going to be up for quite a lot of money. You might be looking at a couple of hundred dollars. And that's assuming that the picture tube is OK. If it isn't, well, it might be hard to justify the cost."

He didn't hesitate long. "Well, my wife really wants the set fixed, its her pride and joy, and I like it too. It's gone well over all these years and if you think you can fix it within that figure, go ahead." And so it was agreed.

Technically, the first question was why was the power supply hiccuping. It could be an overload anywhere in the set, particularly on the butchered line board, or it could even be in the power



Faulty circuit section of the butchered Kriesler 660/3 colour TV set.

supply itself. The last possibility was easily checked; I had a spare power supply board on hand and it was a simple matter to substitute it.

The result was quite conclusive; the known good board hiccuped just as did the old one, which fairly definitely cleared the latter. However I did take the opportunity to check the main supply rail voltage from both boards. This is normally 155V and is most easily checked at plug and socket 703 on the deflection board. In fact it was around 90V on the original board and slightly less again on the replacement board.

I refitted the original board and began looking for the likely cause of the overload. One of the first checks was to disconnect the tripler, but this proved negative. Progressive disconnection of other sections followed and it didn't take long to track it down. It was TR746, one of a pair of BU108 transistors (BU208 on the circuit) connected in parallel as the line output stage. It was short circuit.

This cured the hiccuping and the set showed signs of life. We had sound and something on the screen, the "something" being a not too sharply focused white line, roughly in the centre of the screen, and about half the screen wide. So we had no frame deflection and only a limited line deflection. On the other hand, the tube was at least working, apparently on all three guns, even though there appeared to be a focus problem.

I checked the HT rail again and found that it was now up to about 130V, a lot better than before but still not right. I surmised that there was still an excessive load of some kind, though not severe enough to shut down the power supply. As a matter of course I tried adjusting the preset control in the power supply, R186, a 4.7kΩ pot. Although there was plenty of adjustment available, it had no effect.

But the real puzzle was still to come. The next most vital rail in the system is a 25V rail derived from a tapping on the line output transformer via a couple of diodes (D776, D777) and a filter network consisting, primarily, of two 680μF electrolytics (C780, C781). There is also a 1.5A fuse (F180) and this provides a convenient voltage check point.

I wouldn't have been surprised if this voltage had been down also, but I wasn't prepared for it to be higher; and not just a little higher, but reading close to 70V! Where it was coming from I had no idea but, more importantly, I shuddered to think what it might be doing to various components connected to it.

I switched the set off and had a long hard think about the situation. A major problem was how to keep the set running for long enough to track down the cause, without risking further damage to voltage sensitive components. And it would help if the symptoms so far could provide some clue as to the possible cause.

So what did I have? There was frame collapse, insufficient line scan, the main rail some 25 volts low, and the 25V rail about 45 volts high. I had already examined both sides of the deflection board, looking for dry joints, solder blobs or slivers, and burnt or otherwise obviously damaged components. And, while the board was in a mess, and some of the soldering associated with replaced

Serviceman

components left much to be desired, I could find nothing actually wrong.

One possible clue involved the line output transformer and a comment by the owner who had been looking over the serviceman's shoulder — literally — when he checked the set in his home. A possible fault with these sets involves the main EHT lead which is about 75mm long and carries around 9kV. It runs to a small sub-board which carries a coupling network to the tripler (R759, R760, and D760).

In some sets this lead has been left too long, so that it droops towards the board and nearby components. As the set ages the lead insulation deteriorates, cracks, and allows a flashover to the nearest component. In this case it appeared that R729, a 4.7kΩ resistor which takes a reference pulse from the line transformer and feeds it to the line control unit, may have been the victim.

The original resistor was still on the board and was fairly well blackened. Strangely enough, the previous serviceman had drawn the owner's attention to the resistor's condition and expressed the opinion that it was the cause of all the trouble. Yet he had not bothered to change it! In fact it checked out OK, but I changed it anyway, just to be sure.

Another symptom involved a 100μF, 25V electrolytic, C784. This is part of a decoupling network off the 25V rail which supplies the convergence board via plug and socket 705, pin 5. This had been replaced and, quite obviously, the previous one had exploded, because there were still scraps of aluminium foil and insulating material scattered around the component side of the board when I checked it. I imagine this was the "bang" the owner had heard when the set failed.

Considering the voltage now on the 25V rail it was little wonder that this capacitor had failed; the real wonder was that it was the only one, several other similarly rated electrolytics being in a similarly vulnerable position. I checked the replaced C784 and it appeared to be OK. Its near neighbour, C783, a 470μF electrolytic was also checked and found to have virtually no capacitance, so I replaced it.

One of the main 25V rail filter capacitors, C781 already mentioned, had been replaced. I checked both and found that the replacement was OK but that the original had little capacitance and had to be replaced.

But none of these observations or repairs had any significant effect on the gross overvoltage on the 25V rail, nor did they provide any inspiration as to the best means to track down the fault without doing more damage. After some thought I decided to disconnect the frame circuit from the 25V rail by removing R785, a 22Ω resistor.

This was, to some extent, a shot in the dark. I reasoned that, since the frame circuit was obviously faulty, there was a chance that it was the source of the rogue voltage. On the other hand, if it wasn't, it was still very vulnerable to damage from the excessive voltage. With it disconnected I could take a little more time to make tests, with at least a reduced risk of further damage.

In fact, disconnecting the frame circuit had little effect on the rogue voltage, except to raise it slightly due to the reduced load. But at least I knew it was not coming from that part of the circuit. (I had also disconnected the negative rail to the frame circuit, — 20Va, at R791.)

The next step was to go over the 25V rail system in detail and check as many components as possible without turning the set on. this part of the circuit is quite complex because, while at first glance it looks like a simple rectifier/filter system operating off a line transformer winding to provide the 25V rail, it is really much more complex than that.

The service manual refers to this part of the circuit as the east-west modulator. The main part of the line output stage provides only about 90% of the horizontal drive, the remaining 10% being derived from the east-west modulator which, in the process, provides pincushion and other corrections. The circuit is quite complex and I wouldn't attempt to explain it even if I understood it in detail, which I don't.

Suffice it to say that the vital signals for this function are derived from the junction of D776 and D777, the latter providing the final rectification for the 25V rail, which is filtered by C780/781. From the junction of the diodes modified line energy is fed into the deflection system via inductor L776, together with a 3.3μF capacitor (C759), capacitors C760/761, inductor L761, resistor R761, and transformer T761, to name the major components.

The other major section of the east-west modulator (moving downwards from the D776/777 junction) involves the variable inductor L779, a 1Ω (protective) resistor, and the network involving transistors TR688/690. This latter is fed from the vertical deflection system and TR690 acts as a variable load to vary the amplitude of the horizontal (east-west) deflection at the frame rate.

I went over all these components, and a few others as well, and checked each one either by substitution or measurement. In this respect I was fortunate. I happened to have on hand a junked Philips K9 chassis which, at least as far as this part of the circuit was concerned, was intact. Since it uses the same inductors it proved invaluable in enabling me to clear these components of suspicion. Specialised components like this can present serious problems. At best they may take time to obtain; at worst, for a set as old as this, they may not be available at all.

At the end of all this I had found very little wrong; resistors, capacitors, inductors and even the two diodes, which appeared to be functioning anyway, were checked and found to be OK. In the case of the diodes I pulled them out of the board to test them, a point of some significance in the end. The only fault I found was that the 1Ω resistor, R779, was open circuit, and I didn't even bother to replace it at this stage.

In fact, pressure of more immediate jobs compelled me to put the set aside for a while. To be truthful I was glad of the break and took the opportunity to study the circuit and manual at a more leisurely pace. I also consulted several colleagues in the hope that they might have encountered a similar fault, but drew a blank all round. So eventually I faced up to the monster again.

My first sign of progress came about entirely by accident. I had been over the board again, for the umpteenth time, checking components, and one of those involved was the 3.3μF capacitor, C759. Fortunately, as it transpired, I forgot to put it back in circuit before I switched the set on again. I realised almost immediately what I had done but, by that time, the set had warmed up and was displaying a much wider line scan; abut nine tenths of the total width, which is what it should be without the east-west modulator (R779 was still open).

Just as important was the fact that the rogue voltage on the 25V rail had dropped from around 70 to under 40; still much too high, but a lot easier to tolerate. Suspecting something funny about the 3.3μF I had taken out I replaced it with another one, but that put things back where they were before. So I left this capacitor out for the moment.

Continued on page 57

TRANSISTOR-FET TESTER

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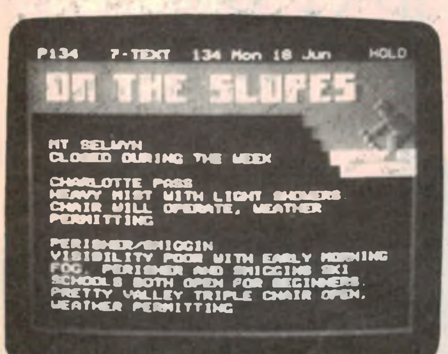
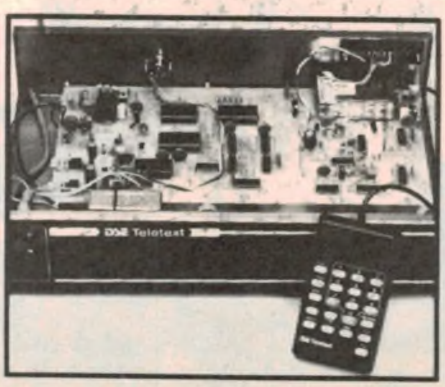
*Not all stations transmit Teletext. Stations in the 7 network (ie those taking Channel 7 news) do as well as ABC stations, and many others have some Teletext transmissions. Most stations transmit Teletext subtitles for deaf people. If in doubt, ring your local station.

Cat K-6315





A 823

Simple circuit uses low-cost ICs

Stereo Simulator for tuners & VCRs

Built around three low-cost op amp ICs, this simple circuit can produce simulated stereo sound from virtually any monophonic source. It can be built as a self-contained unit or installed inside an existing piece of equipment.

by COLIN DAWSON

Anyone who has built the Playmaster wide-band AM tuner (Dec, 1982 – March, 1983) will be aware that the quality of transmitted AM programs is much higher than generally accepted. In fact, it quite often approaches that of FM transmissions. But, after the initial euphoria of this discovery has subsided, the listener's satisfaction may be dampened by the inherent limitations of mono sound which, by comparison with stereo, can sound a little dull.

Our new Stereo Simulator was designed expressly to overcome this limitation, although it can also be used with other monophonic signal sources such as VCRs and TV sets. In fact, we made up two versions of the unit, and installed one permanently in the chassis of the AM tuner. The other version was fitted inside a small plastic case to serve as a self-contained unit, and features optional mono/stereo switching.

Actually it was only last September that we presented a stereo synthesizer using a bucket brigade device. Is this previous design superseded already? No. The new design has the attraction of much lower cost but it does not offer quite the same even stereo spread of the September 1982 BBD design. Even so, the effect is very worthwhile and certainly should contribute to your listening pleasure.

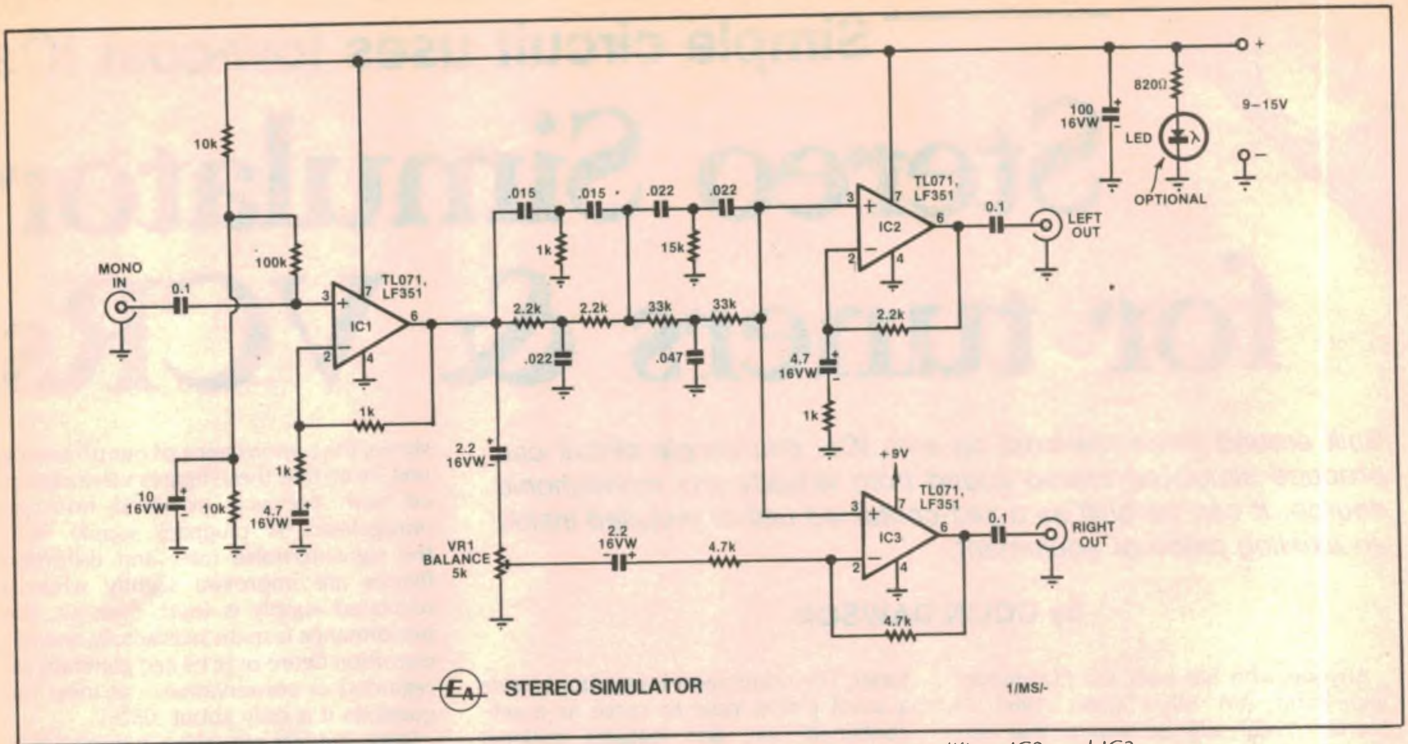
Another advantage of this particular unit is its small size which generally allows it to fit inside existing equipment (including the Playmaster AM Tuner).

The accompanying specifications panel shows the performance of our prototype unit. Note that these figures were obtained with the unit powered from an unregulated 9V plugpack supply. Both the signal-to-noise ratio and distortion figures are improved slightly when a regulated supply is used. Even so, the performance is quite satisfactory and the distortion figure of 0.1% can generally be regarded as conservative – at most frequencies it is only about .05%

Some readers may think it strange that the signal-to-noise ratio is different in the left and right channels, but this is simply a result of our having taken the measurements with respect to a 1kHz signal. At this frequency (and in fact at most frequencies), the left and right channels have different gain and hence different noise levels.

We can't claim to have derived genuine stereo from a mono recording – it is simply not possible to recover spatial information that was not recorded in the first place. In this respect, the term "stereo" is something of a misnomer since the simulator does not provide a signal with any directional information.

This self-contained version of the Stereo Simulator includes the LED power indicator and optional mono/stereo switching. It can be powered from a 9V plugpack or any convenient 9-15V DC supply.



The circuit consists of an op amp buffer (IC1), a twin-T filter network, and output amplifiers IC2 and IC3.

Stereo Simulator

(continued)

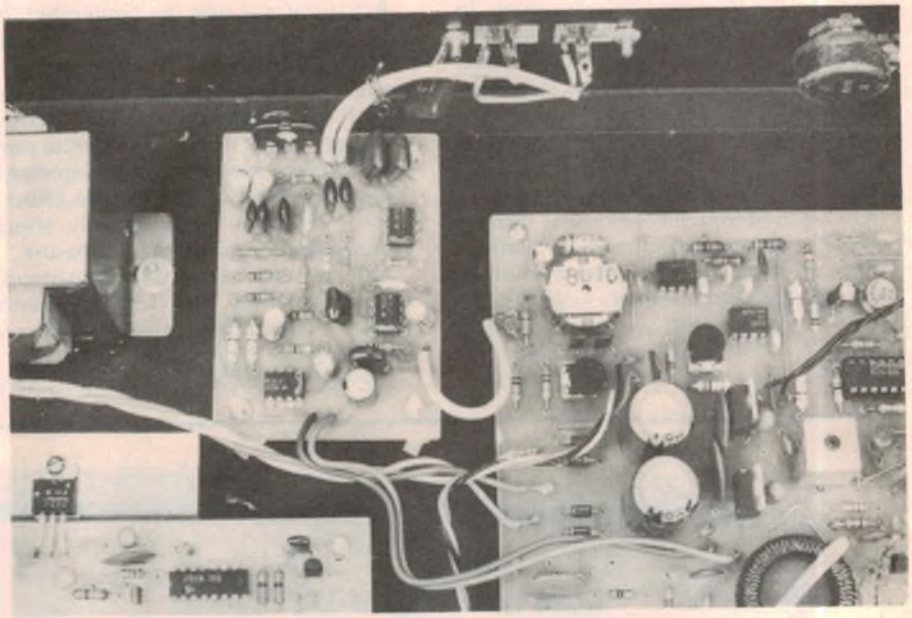
What it does do is diffuse the "point source" effect of normal mono, creating a certain amount of artificial separation or spread. The result is a signal which sounds as though it could be stereo — hence the term "stereo simulator."

How it works

The simulator creates "left" and "right" channels from the original mono signal by means of filters. This method has been used in many circuits over the years and in its crudest form is comparable to siting the tweeter of a speaker system on one side of the room and the woofer on the other.

Our circuit employs two twin T filters which cause notches in the frequency response at 200Hz and 5kHz in one channel. This is quite effective, but strictly conventional. The interesting aspect of this circuit is how the signal for the other channel is derived. Usually, this would simply be the unfiltered input signal, but in this circuit is the difference between the input signal and filtered signal. This is a far more realistic approach since the sum of the two outputs gives the original signal, yet the left and right channel signals are quite different.

Fig. 1 shows the response of the two



This photograph shows the assembled PCB mounted inside the chassis of the Playmaster AM Tuner. Power for the simulator is derived from the main tuner PCB at right.

SPECIFICATIONS

SIGNAL-TO-NOISE RATIO . . . 60dB (left channel); 56dB (right channel)

DISTORTION (both channels) . . . 0.1%

GAIN . . . (see graph)

CURRENT DRAIN . . . 6.5mA without LED, 17mA with LED

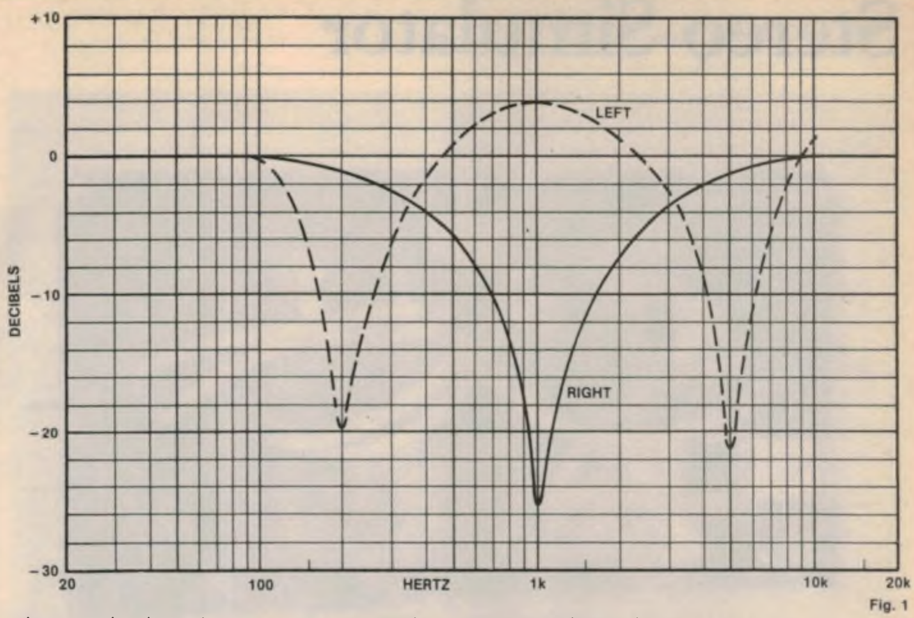
Measurements were taken with respect to 100mV output at 1kHz using an unregulated 9V plugpack supply. Signal-to-noise ratio and distortion figures can be expected to improve slightly with a regulated supply.

channels, with the notches at 200Hz and 5kHz appearing in the left channel. The right channel response features a single 25dB notch centred on 1kHz.

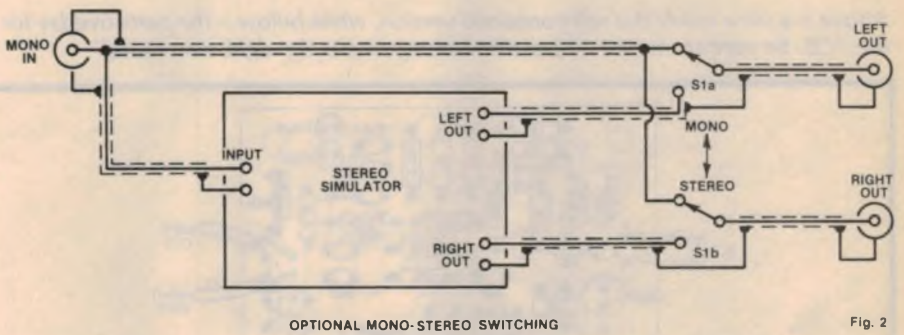
Twin T filters are so named because they consist of two T sections – one section uses an R, 2C network and the other an R/2, C network. When the values are chosen precisely, the filter gives a narrow notch with almost total cancellation at its centre frequency. Actually, the values used in our filter networks are not selected critically and this has resulted in notches of about 20dB. Although this could be improved by choosing "ideal" components, the degree of cancellation is already sufficient and any further improvement would be purely academic.

In fact, if the notches were made very deep and very narrow, the left channel would sound almost identical to the original mono input. On the other hand, we would get very little sound from the right channel since it would consist of just two very narrow bands of signal centred on 200Hz and 5kHz. This is clearly not what we want.

The response of the filters has also been modified to a certain extent by the interaction between stages, since the two filters are directly coupled. We have minimised this interaction, however, by placing the 5kHz filter first – it has a relatively low impedance and is thus not unduly loaded by the higher impedance of the following 200Hz filter. While interaction between the filters could have been completely eliminated by an op-amp buffer stage, the improvement would again be of only academic interest. And, as we've already seen, we don't want the filters to have a really sharp response.



This graph plots the response of the left and right channels.



Wiring details for optional mono/stereo switching. Note use of shielded cable for all input and output connections to the PCB and switch.

Circuit details

The filter network is driven by a Fet-input op amp buffer (IC1) which isolates it from the line output of the tuner or VCR, etc. A voltage divider consisting of two 10kΩ resistors sets the bias to the non-inverting input to half supply so that the op amp can function from a single supply rail. This bias is applied to IC1 via a 100kΩ resistor, with decoupling provided by a 10μF capacitor.

IC1 is configured as a non-inverting amplifier with unity gain and frequency roll-off below 40Hz set by the 4.7μF feedback capacitor. The mono input signal is AC-coupled to the non-inverting input (pin 3), while the output (pin 6) feeds directly into the twin T filter network and also, via a 2.2μF capacitor, to one side of a 5kΩ trimpot (VR1). The other side of the trimpot is grounded and the signal available on its wiper used to drive the following right channel output stage.

The left and right channel output stages consist of two more non-inverting amplifiers, again using Fet-input op amps (IC2 and IC3). The filtered signal from the twin T network is applied to the non-inverting input in each case. IC2 applies a gain of around two to this signal which subsequently becomes available as the left channel output. Note that since there is a DC path through the filter network, it is not necessary to provide biasing for IC2 and IC3.

IC3 is wired as a differential amplifier and functions rather differently to IC1 and IC2. In this case, different signals are applied to the non-inverting and inverting inputs – the signal from the twin T filter network appears on the non-inverting input, while the signal on the inverting input is derived from VR1 and is a buffered version of the original mono input. The output of IC3 represents the difference between these two signals.

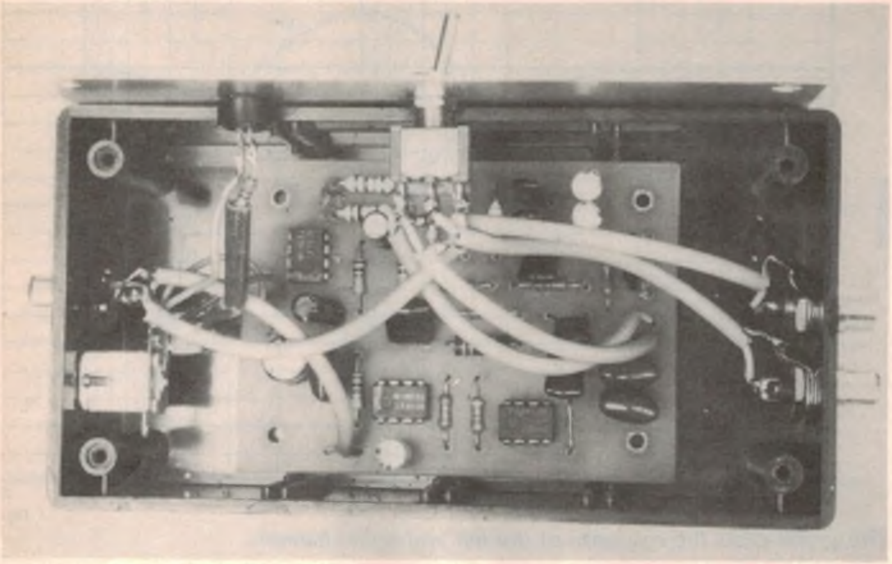
Thus, when the signals on pins 2 and 3 of IC3 are common (ie, they have the same phase and amplitude), they are cancelled and IC3 has no output. When the signals are no longer common, only partial (or nil) cancellation occurs depending upon the relative phase and amplitude differences between them.

Note that the gain of IC2 (as set by the ratio of the 2.2kΩ and 1kΩ feedback resistors) compensates for the inherently "lossy" nature of the twin T filter network, at least as far as the left channel is concerned. Trimpot VR1 adjusts the gain of IC3 in the right channel, and functions as both a "depth of stereo" control and a balance control. In fact, the actual setting of VR1 tends to be a compromise between these two functions.

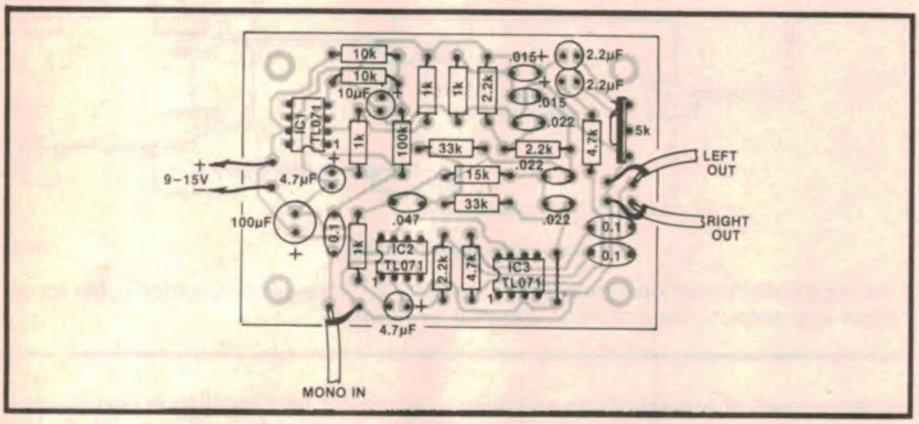
The response curves accompanying this article (Fig. 1) indicate that the output of IC3 has a very deep null at 1kHz. The depth of this null depends on the setting of VR1 and the results indicated are for what is considered an optimum adjustment.

Power for the circuit can be derived from any convenient 9-15V DC supply, eg a 9V plugpack, a 9V battery, or a 9-15V supply rail inside existing equipment. A 100μF electrolytic capacitor decouples the supply, while power in-

Stereo Simulator



Above is a view inside the self-contained version, while below is the parts overlay for the PCB. Be sure to mount all polarised components the right way round.



dication is provided by a LED wired in series with an 820Ω current limiting resistor across the supply rails. This indicator LED is optional and can be included if the circuit is to be built as a self-contained unit.

Finally, it is possible to include optional mono-stereo switching using a single DPDT toggle switch. Fig 2. shows the circuit details. In the stereo position, switch S1 selects the left and right outputs of the Stereo Simulator. In the mono position, the simulator is bypassed and S1 selects the mono input signal line.

Construction

The simulator is built on a small printed circuit board (PCB) measuring 80 x 57mm and coded 83ms4. Mount the parts on the PCB according to the parts overlay diagram, beginning with the resistors and then moving on to the capacitors and ICs. Don't forget the wire link adjacent to IC3, and make sure that you install the ICs and electrolytic capacitors the right way round.

We recommend that you use PC stakes for all external connections to the PCB – they make the job of wiring that much easier.

From here, the construction procedure depends on where you are mounting the board. Before mounting the unit inside an existing piece of equipment, check that it can be installed so that doesn't foul controls or cover ventilation slots, and that a 9-15V DC supply rail is available. You should also check that there is space on the rear panel to mount the extra output socket. In most cases, this will be an RCA socket but should, of course, match the existing socket.

In the case of the Playmaster AM tuner, the PCB is mounted towards the rear of the chassis between the power transformer and the main tuner board. The rear panel already has stereo output sockets, and it is a simple matter to rewire these for stereo. First, drill four mounting holes in the bottom of the cabinet, and install the PCB on 19mm stand-offs. The tuner output now becomes the input to the simulator, while the simulator's outputs are connected to the RCA sockets on the back panel of the tuner.

Power is derived from the main tuner board. This board has a +15V output which is used to power the alignment module during the alignment procedure. Once alignment is complete, this output is normally unused and thus provides a convenient point from which to derive the positive supply. The negative (earth) side of the simulator supply should be connected to the nearby "G" (ground) terminal on the tuner PCB.

If you wish to include the optional mono-stereo switching, we suggest that you mount the switch on the rear panel. Note that all signal connections to and from the simulator should be run in shielded cable to avoid hum pick-up. The indicator LED and its series 820Ω resistor are not needed in this application.

For the self-contained version, we mounted the PCB in a plastic utility box

PARTS LIST

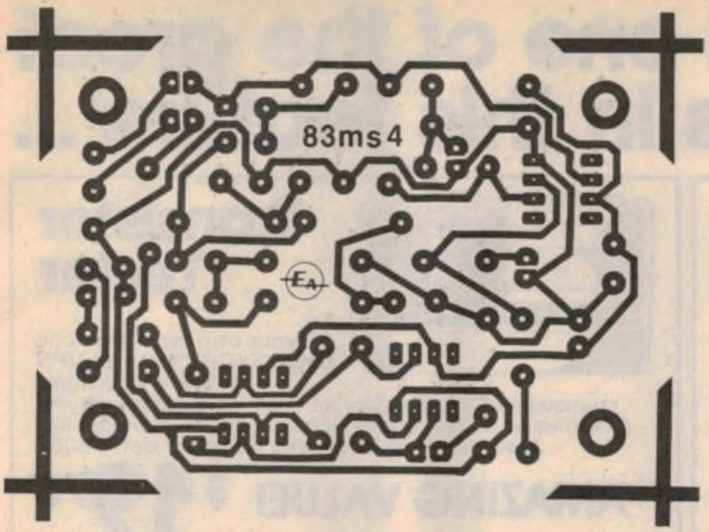
1 printed circuit board, code 83ms4, 80 x 57mm
4 19mm standoffs
3 TL071, LF351 Fet-input op amps

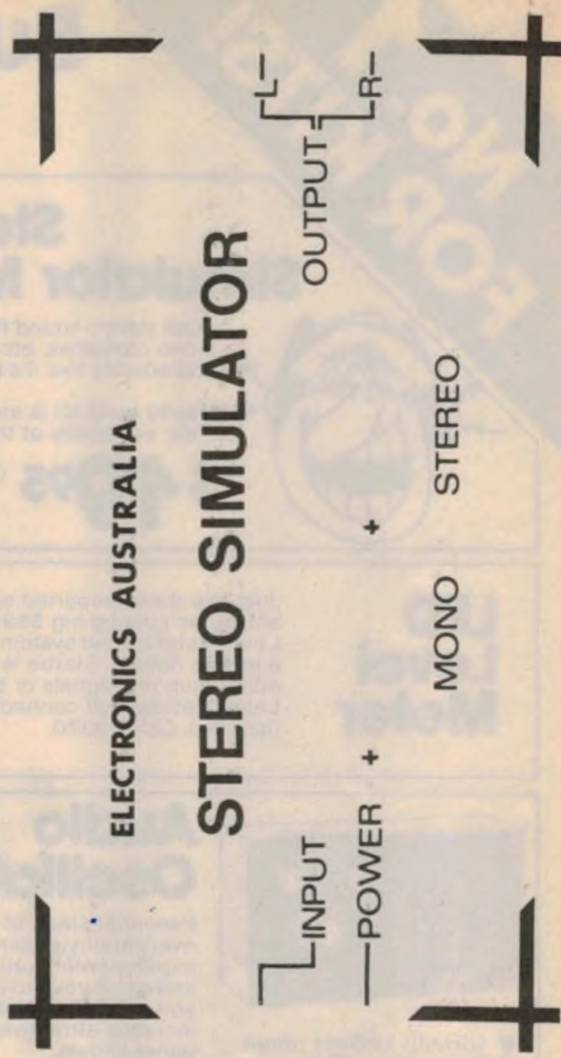
CAPACITORS
1 100µF/16VW electrolytic
1 10µF/16VW electrolytic
2 4.7µF/16VW electrolytic
2 2.2µF/16VW electrolytic
3 0.1µF greencap (metallised polyester)
1 .047µF greencap
3 .022µF greencap
2 .015µF greencap

RESISTORS (¼W, 5%)
1 x 100kΩ, 2 x 33kΩ, 1 x 15kΩ, 2 x 10kΩ, 2 x 4.7kΩ, 3 x 2.2kΩ, 4 x 1kΩ, 1 x 5kΩ 10mm vertical trimpot

ADDITIONAL PARTS FOR SELF-CONTAINED VERSION
1 plastic utility box, 130 x 67 x 40mm
1 Scotchcal front panel, 125 x 63mm
3 RCA sockets (screw-mound)
1 DPDT toggle switch
1 socket to suit plugpack supply
1 red LED and bezel
1 820Ω resistor (¼W, 5%)

MISCELLANEOUS
Machine screws and nuts, shielded cable, hook-up wire solder etc.





Here are actual size artworks for the PCB and front panel.

measuring 130 x 65 x 40mm. This is fitted with RCA input/output sockets and a power socket, together with the LED indicator and optional mono-stereo switching. A front panel made from self-adhesive Scotchcal material provides an attractive finish to the unit.

The first job is to affix the Scotchcal label to the lid of the box, and drill mounting holes for the switch and indicator LED. This done, mounting holes may be drilled in the box for the RCA sockets, power socket and PCB. As shown in the photograph, the RCA input socket and the power socket are mounted on the left hand side of the box, while the two RCA output sockets are mounted on the right hand side.

The various items of hardware may now be mounted in position and the wiring completed. As before, all input and output connections (including those to the switch) should be run in shielded cable. Connections to the power socket and LED can be run using multistrand hook-up wire. Don't forget to solder the 820Ω resistor in series with the LED.

It is a good idea to check the polarity of the power socket terminals with a multimeter before making the connections to the PCB. You will almost certainly damage the ICs if power is applied with reversed polarity.

To test the unit, first apply power and check that the LED illuminates. If all is well, disconnect the plugpack and connect the simulator into circuit. The mono input accepts the signal from the program source, while the left and right outputs go to the amplifier line inputs. If you have an integrated tuner/amplifier, the tuner signal will be available at the "Tape Out" outputs. The simulator outputs should then be connected to the "Tape Monitor" inputs on the amplifier.

Apply power and check that everything functions normally with switch S1 in the "mono" position. Finally, switch to "stereo" and adjust VR1 for the most satisfying sound. Your "Stereo Simulator" is now ready for use.

As explained earlier, this device will not endow the music with any directional information. For example, you will not be able to positively identify the lead guitarist as being right of centre. Nevertheless, the simulator has a satisfying "spread" effect and you will certainly know when it is working.

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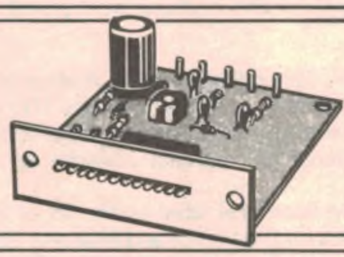

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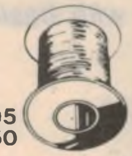

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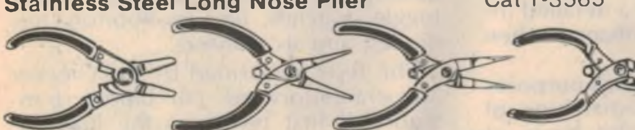

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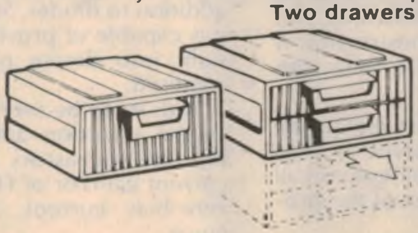

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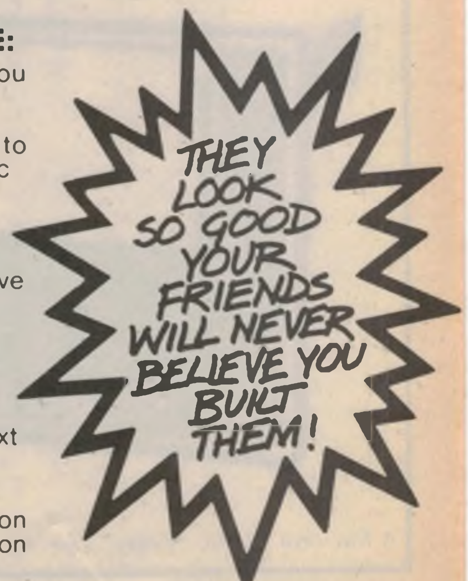


Check bipolars & FETs with this

Simple Transistor Tester

Intended mainly for checking bipolar transistors and FETs, this simple transistor checker can also be used to test most other discrete semiconductor devices. It is easy to build, low in cost, and provides an excellent way of becoming familiar with basic device operation.

by GREG SWAIN & DAVID EDWARDS

The design of this simple transistor/FET checker can hardly be considered new. It was originally described by Jim Rowe in August 1971 and, over the years, has proven an immensely popular project. Literally thousands have been built!

Recently, we decided to take another look at the unit with a view to updating it. The circuit is still perfectly valid, but the original method of construction is now dated and not quite in tune with '85.

In particular, the diecast metal box used to house the prototype is now quite expensive, its cost being out of all proportion to the total cost of the project!

Our approach has been to re-design the unit into one of the low cost plastic "zippy" boxes. At the same time, we have designed a small printed circuit board (the original used tagboard) and provided the unit with a front panel to match our recent RLC Bridge and Audio Oscillator projects. Total cost of the updated unit should be well below that of comparable commercial testers.

Despite is basic simplicity, the unit is capable of making most of the practical tests normally required when experimenting with transistors or servicing transistorised equipment. It can test both bipolar transistors and FETs, in addition to diodes, SCRs and PUTs. And it is capable of providing a detailed insight into device performance when required.

Thus it can be used for such purposes as the selection and/or matching of bipolar transistors on the basis of current gain, or of FETs on the basis of zero-bias current and transconductance.

Apart from its practical uses as a testing instrument, it also offers a simple and straightforward means whereby a beginner can gain a valuable first-hand insight into practical device operation. There is nothing quite as effective in dispelling some of the mystery of transistors or FETs as hooking a device up to the checker, and demonstrating to one's own satisfaction that it really does perform as the theory book describes!

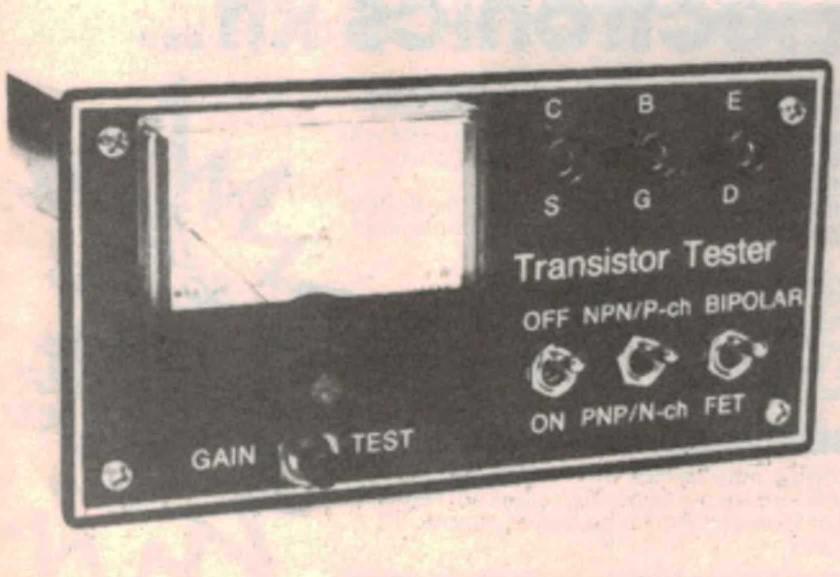
The checker can also be used to demonstrate what happens when a bipolar transistor is connected to the supply "the wrong way around", or when the drain and source of a FET are reversed, or the effect on leakage and saturation currents when the temperature rises. All this from only 17 basic parts: a meter, a battery, three toggle switches, one pushbutton, five diodes, and six resistors.

The tests performed by the checker are straightforward. For bipolar transistors, it first measures the leakage-saturation current Iceo, the collector-emitter current which flows when the base is left unconnected. It then applies a known base current to the device, and measures the resulting change in collector current. This gives an indication of the DC current gain, or DC beta.

The test for Iceo is a good preliminary check for bipolar transistors, because there are few faults in this type of device which do not cause a significant increase in Iceo. And those few faults which do not show up in this test will generally make themselves quite apparent in the gain test. Thus although an open circuit in the base, collector or emitter-lead will not show up in the Iceo test, it will certainly become evident in the gain test, as a zero reading!

Actually the checker is designed to test for both Iceo and gain at two alternative current levels. It can test for Iceo on a 0-1 mA scale, and then apply a 2-microamp base current to observe the current gain on what becomes virtually a 0-500 scale. Alternatively it can test for Iceo on a 0-10 mA scale, and then apply a 100 uA base current to observe current gain on what then becomes a 0-100 scale.

The advantage of the two current levels is greater flexibility. The lower current tests are appropriate for modern low power silicon transistors, which tend to have very low Iceo combined with quite high DC beta figures at low current levels. On the other



A low-cost plastic "zippy" case was used to house the prototype.

hand the higher current tests are more appropriate for higher power silicon transistors, and many of the older germanium devices. These tend to have a higher Iceo, and a lower DC beta. The higher power silicon devices also tend to display a more realistic DC beta figure when tested at the higher current level.

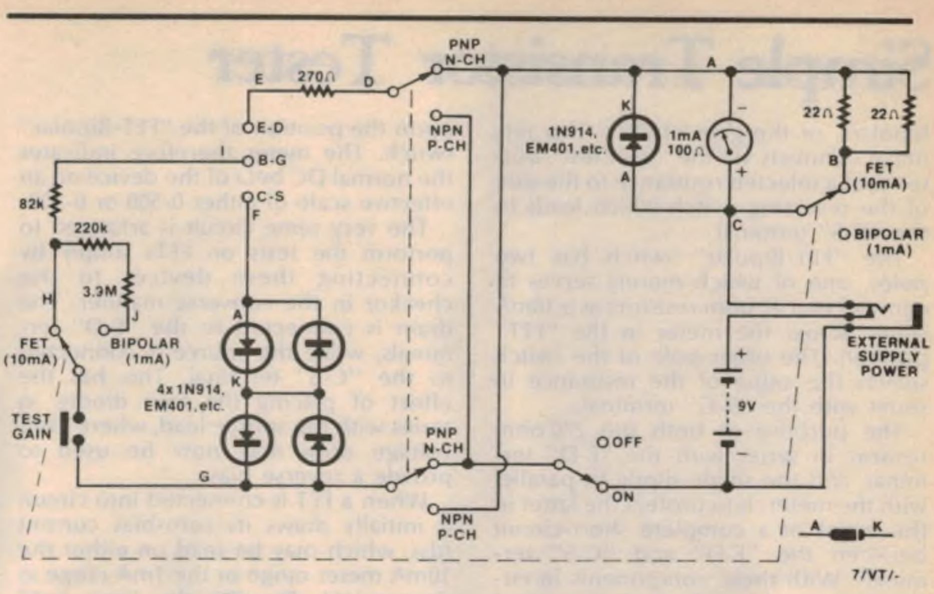
For FETs, the checker first measures the zero-bias channel current Idss, the current which flows between drain and source when the gate is either left open-circuited or connected to the source. A reverse gate bias of approximately 1.2 volts is then applied, and its effect in reducing the drain source current may be seen. This gives a measure of the device transconductance (gm). The transconductance is not indicated directly, but may be readily calculated by dividing the observed drop in channel current by 1.2.

The test for Idss is a very useful one for checking FETs, as Idss is one of the main parameters which determine the DC behaviour of a FET in most circuits. It is also a parameter which varies quite significantly among currently available devices, and is therefore an important one to be taken into account when selecting or matching FETs. The transconductance check is also a very useful test, both for straightforward "good-bad" testing, and for selection and matching.

As with the bipolar transistor tests, the FET tests may be performed at either of two current levels. These are in fact the same two current levels used for the bipolar tests, with a meter sensitivity of either 1 mA or 10 mA respectively. With most FETs the 10 mA range will be the more appropriate, as most of the useful devices currently available have an Idss falling within the range 1 mA-10 mA. However the 1 mA range may be useful for checking devices with a very low Idss, and/or a high transconductance.

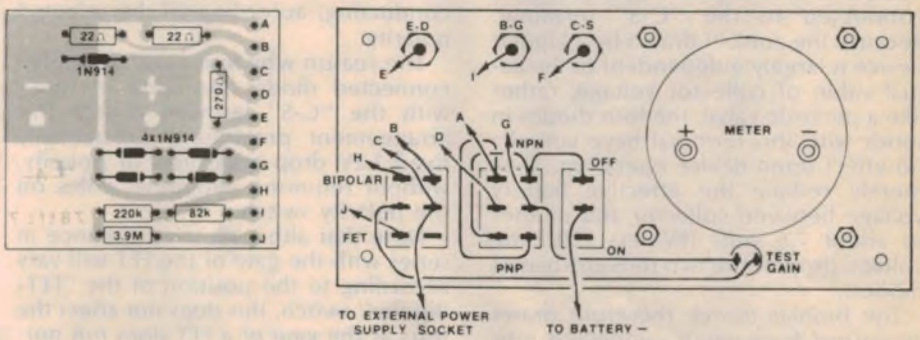
With the FET tests, the reverse gate bias voltage remains constant at 1.2 V for both ranges. This means that the ranges may be selected purely on the basis of convenience in reading the channel current. It is thus possible to switch from the 10 mA range down to the lower range if the transconductance of a device is sufficient to reduce its current from greater than 1 mA to well below this figure.

Diodes may also be tested on the checker, both for reverse leakage/saturation current Ir, and also for forward conduction. These tests are usually sufficient for "good-bad" testing. As before both a 1 mA and a 10 mA meter range are available for both tests. This makes it possible to test virtually any type of rectifier diode likely to be met, whether of silicon or germanium.



SIMPLE TRANSISTOR-FET TESTER

Despite its simplicity, the circuit will perform most of the useful tests on the majority of modern discrete semiconductor devices.



The component overlay pattern shows the PC board from the component side. Take care with the orientation of polarised parts.

Other types of diode may also be tested, such as varicap diodes and varactors. It will be possible to test "zener" diodes, but only those having a breakdown voltage above the 9 volts applied by the internal battery of the checker.

Although the checker has basically been designed to test bipolars, FETs and diodes, it can also be used to test various other devices if a little ingenuity is used. Thus it is possible to test sensitive low power SCRs, for example, by connecting them to the checker as for an NPN transistor (anode corresponding to collector, cathode to emitter, etc.), and noting if the device triggers into conduction when current is applied to the gate via the gain test button.

Higher power SCRs may be tested in a similar fashion, but in this case an external resistor may have to be connected between the anode and gate to provide sufficient triggering current to initiate conduction.

Programmable unijunctions or "PUTs" may be checked in much the same way as low power SCRs, but with the anode and cathode reversed so that they correspond respectively to the emitter and collector of a bipolar. The polarity switch in this case should be set to the "PNP" position.

Refer now to the circuit diagram of the Transistor Checker.

Basically, the unit consists of a 9V battery and a 1mA meter movement in series, connected via a polarity reversing switch to the pair of terminals marked "E-D" and "C-S". The first of these terminals connects to the emitter of bipolar transistors, or alternatively to the drain of FETs; similarly the other terminal connects to the collector of bipolars, or the source of FETs. Note the converse way in which the terminals are used for the two different types of device. The reason for this will be explained shortly, along with the reason for the four diodes in series with the "C-S" terminal.

The third terminal is that marked "B-G", intended to connect to the base of

Simple Transistor Tester

bipolars, or the gate of FETs. This terminal connects via the "gain test" button and a selected resistance to the side of the reversing switch which leads to the "C-S" terminal.

The "FET-Bipolar" switch has two poles, one of which merely serves to connect two 22 ohm resistors as a 10mA shunt across the meter in the "FET" position. The other pole of the switch selects the value of the resistance in series with the "B-G" terminal.

The purpose of both the 270 ohm resistor in series with the "E-D" terminal, and the single diode in parallel with the meter, is to protect the latter in the event of a complete short-circuit between the "E-D" and "C-S" terminals. With these components in circuit the meter is effectively protected from any possibility of electrical damage due to shorts either in the device tested, or due to accidental touching of the test leads.

When a bipolar transistor is connected to the checker, its collector is connected to the "C-S" terminal. Because the current drawn by a bipolar device is largely independent of the actual value of collector voltage, rather like a pentode valve, the four diodes in series with this terminal have virtually no effect upon device operation. They merely reduce the effective battery voltage between collector and emitter to about 7.8 volts (9V less 1.2V, the voltage drop of the two forward-biased diodes).

The bipolar device therefore draws its normal Iceo when connected into the checker with the polarity switch set to the correct position and the battery switch moved to "ON". The current will be read on the meter either on the basic 1mA scale, or on an effective 10mA scale if the "FET-Bipolar" switch has been set to the FET position.

Then when the "gain-test" button is pressed, the base of the device will be connected to the collector supply rail via a resistance producing either 2uA or 100uA of base current, depending upon the position of the "FET-Bipolar" switch. The meter therefore indicates the normal DC beta of the device on an effective scale of either 0-500 or 0-100.

The very same circuit is arranged to perform the tests on FETs simply by connecting these devices to the checker in the converse manner. The drain is connected to the "E-D" terminals, while the source is connected to the "C-S" terminal. This has the effect of placing the four diodes in series with the source lead, where their voltage drop may now be used to provde a reverse bias.

When a FET is connected into circuit it initially draws its zero-bias current Idss, which may be read on either the 10mA meter range or the 1mA range as appropriate. Pressing the "gain-test" button then has the effect of connecting the gate to a point which is reverse-biased with respect to the source, by the substantially constant 1.2V drop across whichever two of the diodes in series with the source are conducting, according to the selected polarity.

The reason why four reverse-parallel connected diodes are used in series with the "C-S" terminal is that this arrangement provides a substantially fixed 1.2V drop regardless of polarity, without requiring additional poles on the polarity switch.

Note that although the resistance in series with the gate of the FET will vary according to the position of the "FET-Bipolar" switch, this does not affect the tests as the gate of a FET does not normally draw significant current. The function of the "FET-Bipolar" switch is only to adjust meter sensitivity and the series resistance in the base/gate lead, for base current adjustment in the case of bipolar transistors.

The "Bipolar and "FET" positions marked for this switch are those that will normally be the most appropriate for the majority of devices of each type. However, as explained above, both positions can be used for either device type, depending upon requirements.

PARTS LIST

1 case, 130 x 68 x 41mm
1 screen-printed front panel
1 1mA meter, 52 x 49mm rectangular
1 9V battery, Eveready 216 or similar
2 DPDT miniature toggle switches
1 SPST miniature toggle switch
1 momentary contact pushbutton switch
1 PC board, 58 x 51mm, code 78tfc7
5 1N914, EM401 or similar silicon diodes
1 2.1mm DC input jack socket plus suitable metric screws
6 resistors: 2 x 22 ohm, 1 x 270ohm, 1 x 82k, 1 x 220k, 1 x 3.9M (all ½W)
3 banana-type sockets and plugs, for test leads
Hookup wire, PCB pins, battery clip solder, tinned copper wire

NOTE: Components with lower ratings may be used provided their ratings are not exceeded. Components with higher ratings may also be used if physically compatible.

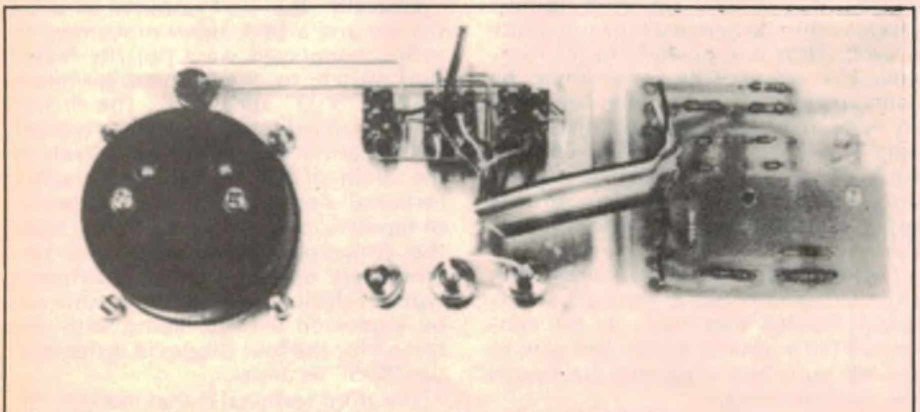
Diodes are tested on the checker by connecting them between the "C-S" and "E-D" terminals. The way in which they are connected is not important. In one position of the polarity switch the diode will be forward-biased, and the meter should accordingly give a full-scale reading — unless the diode is defunct. In the other position of the switch the diode will be reverse-biased, and the meter will read the reverse current Ir. With most diodes this should be a very low reading, even on the 1mA range.

As can be seen from the photographs, construction is quite straightforward. All components, with the exception of the switches and input sockets, are mounted on a small printed circuit board measuring 58 x 51mm and coded 78tfc7. The board, in turn, mounts directly across the meter terminals.

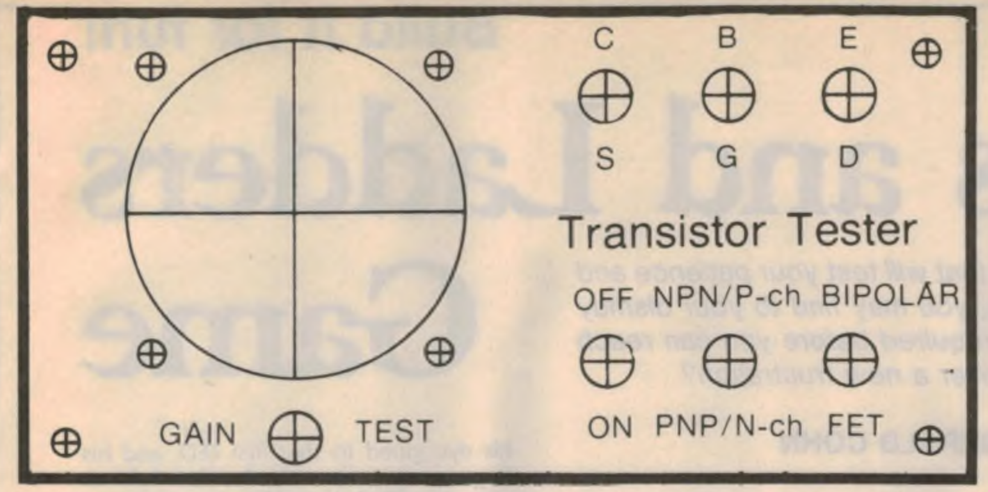
Commence construction by fitting all the hardware to the front panel. The front panel of the prototype was made from photosensitive aluminium, but we assume that commercial panels will be available shortly after this article appears. The battery sits directly under the front panel switches, and is packed in pieces of scrap foam to prevent short circuits and to hold it in place.

Refer to the combined overlay and wiring diagram when wiring up the unit. PC stakes are used to facilitate connections from the board to the front panel switches and sockets. The connections are run in rainbow cable, while tinned copper wire is used for inter-switch wiring.

The meter used is a Japanese made 52mm rectangular movement of a type which is widely available (model



The PC board mounts directly across the meter terminals.



Here is an actual size reproduction of the front panel artwork.

MRA45B). It is mounted directly on the front panel, with the "gain-test" pushbutton immediately beneath it.

Since the circuit runs from a 9V supply rail, it can be also powered from one of the now commonly available "plugpack" power supplies. A special input jack socket is used for the external power supply, and this should be mounted in the end of the case furthest from the meter. Constructors may, however, consider this feature as optional.

Operating the checker when it is completed should present few problems, as the control switch markings clearly show the various functions. However, one type of testing situation where the user may need guidance is where the polarity of the device to be tested is not known.

The circuitry of the checker is such that checking a device with the polarity switch in the incorrect position will generally not cause damage to either the device or the checker. However, there is still the problem of interpreting the readings obtained, in order to decide the correct polarity.

In most cases the readings given by the checker are themselves the best guide to the correct polarity. With bipolar transistors, incorrect polarity is usually indicated by an abnormally high Iceo reading, together with a DC beta reading which is either very low or effectively zero. Hence, if this combination of readings is obtained, the idea is to change to the other polarity and see if the results improve. If they do, then the original polarity was clearly wrong; but if the results are the same as before, then either the device is a dud or you have its connections jumbled.

With FETs an incorrect polarity setting generally does not show up in the Idss test, because the channel of most FET devices is symmetrical and conducts equally in either direction. However, incorrect polarity will immediately show up when the "gain-test" button is pressed: the meter reading will increase rather than decrease, revealing that the gate is being forward-biased instead of reverse-biased. This effect should always be taken as a sign that the polarity switch has been set to the incorrect position.

There may be some occasions, when testing bipolar transistors, where it is difficult to decide whether the leakage/saturation current Iceo is acceptably low, or "too high". This matter is one for which there is no simple answer, because a "good" germanium device may have an Iceo many times higher than a "faulty" silicon device — particularly if it is a high-gain power type.

Temperature also plays a part. With germanium devices Iceo roughly doubles for every 8-10 degrees C rise in temperature, while with silicon devices it doubles for every five degrees C rise. Also the Iceo of a device is roughly proportional to its gain, so that the gain should also be taken into account.

In general any silicon bipolar transistor which produces a significant Iceo reading on this checker, at any normal temperature, should be regarded as suspect. All except the very high-gain, high-power types should give virtually zero reading, even on the 1mA range.

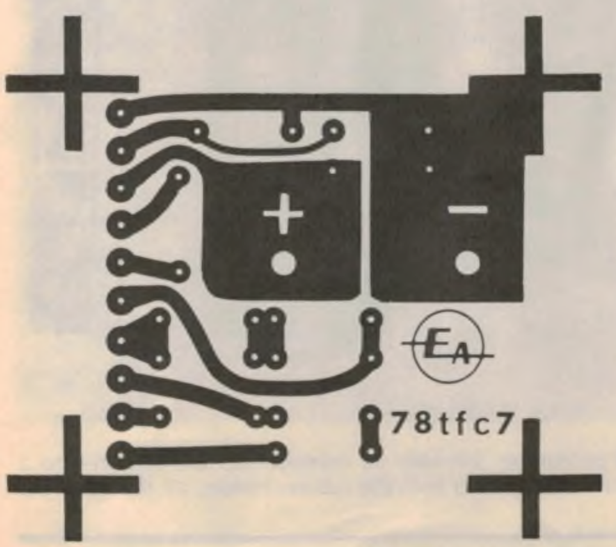
Unfortunately no similar rule-of-thumb can be given for germanium devices, some of which may exhibit quite a high Iceo. The best plan with these is to compare them with a known good device, if one is available. Failing this, all you can do is make the decision on the basis of the gain check. If the current increases quite substantially when you press the gain button, then the device is probably a good one.

Whether the device is a silicon or germanium type, make sure that it is cool before testing it. A device just unsoldered from a circuit and still quite warm can give an abnormally high leakage reading, even though it may be quite normal.

Finally, a brief note about comparing the device parameters as measured by this checker with those given in manufacturers' data. If you want to do this, and there is no reason why you should not, the main thing to watch is the symbols used.

For bipolar transistors, if you cannot find Iceo listed for the device you are concerned with, trying looking for Ico' — the two are identical. If this is not listed either, the data may alternatively give Icbo or Ico, the collector-base saturation current. But as this is equivalent to Iceo divided by the gain of the device, it is not hard to convert between the two. Most manufacturers use the symbol hFE to represent DC beta, so that it is the figure or figures listed under this symbol which should be used for comparison.

Where FETs are concerned, the symbol Idss is almost universally used for zero-bias drain current, so that there should be no problem with that parameter. But be careful where transconductance is concerned, as two different symbols are used: Yfs and gmo. Fortunately, the definitions of both are sufficiently close to the test performed by our checker to make the figures comparable in practice.



At left is an actual size reproduction of the PCB pattern.

Build it for fun!

LEDs and Ladders Game

Here is a low cost electronic game that will test your patience and sense of timing. Seemingly simple, you may find to your dismay that literally hours of patience are required before you can reach the top. Why not build it and discover a new frustration?

circuit design by GERALD COHN

The idea for this fiendish device was originally hatched in the fertile imagination of one David Edwards, and a suitable circuit published in our March 1976 issue. Now, nine years later, the time has come to present an updated version that is both lower in cost and easier to build.

As you can see from the photographs, the game consists of a small box, fitted with a switch, 16 small light emitting diodes (LEDs), and an illustrated front panel. The illustration is a schematic drawing of a well, with a ladder reaching from the bottom to the top. The LEDs are arranged on the rungs of the ladder, representing successive foot positions as the ladder is climbed, with the topmost LED on the ground at the top of the well.

When the CLIMB switch is pressed, the bottom LED commences flashing at a 0.75Hz (approx) rate. The object of the game is simply to light successive LEDs on the ladder by appropriate manipulation of the CLIMB button. Success is signified when the topmost LED is illuminated.

The trick in the game is that the CLIMB switch can only be operated when a LED is on. When this condition is satisfied the LEDs illuminate in turn, to simulate the effect of a light climbing the ladder.

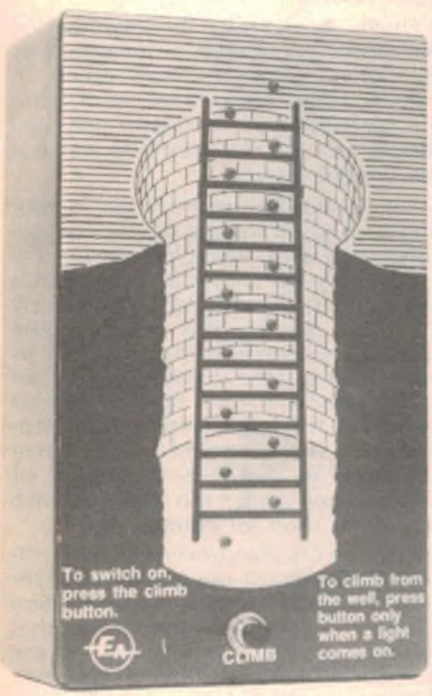
If, however, the CLIMB switch is pressed when no LED is illuminated, the player is surprised and infuriated to find that when a LED comes on again he has slipped back towards the bottom of the well. Just how far down the well the player slips depends on how long the button is pressed while the LED is off, and how far he has progressed up the ladder!

So, having limbered up his wits, as well as his switch operating finger, our player attacks the infernal machine again. With his eye glued to that first LED, and his finger poised, he waits for that light to come on. Flash! the LED emits, his finger stabs the button, and the light commences to climb!

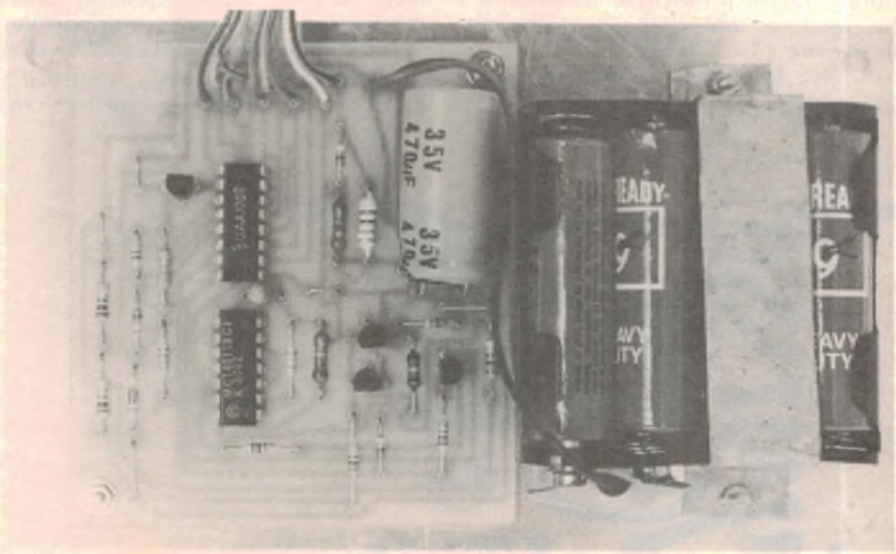
One! two! three! four LEDs emit in turn, the button is released, and a fraction of a second later, the LED goes out. With bated breath, our player scans the LEDs, and is rewarded by seeing the fourth LED come on again. Once more he stabs at the button, once again the light commences to climb.

Some time later, the 15th LED casts a ruddy glow over the perspiring face of our player, who decides to stop for a short time to wipe his brow. Those last few steps had seemed to be harder to climb than the earlier ones; in fact, he'd only just managed to go from the 14th to the 15th rung in one go.

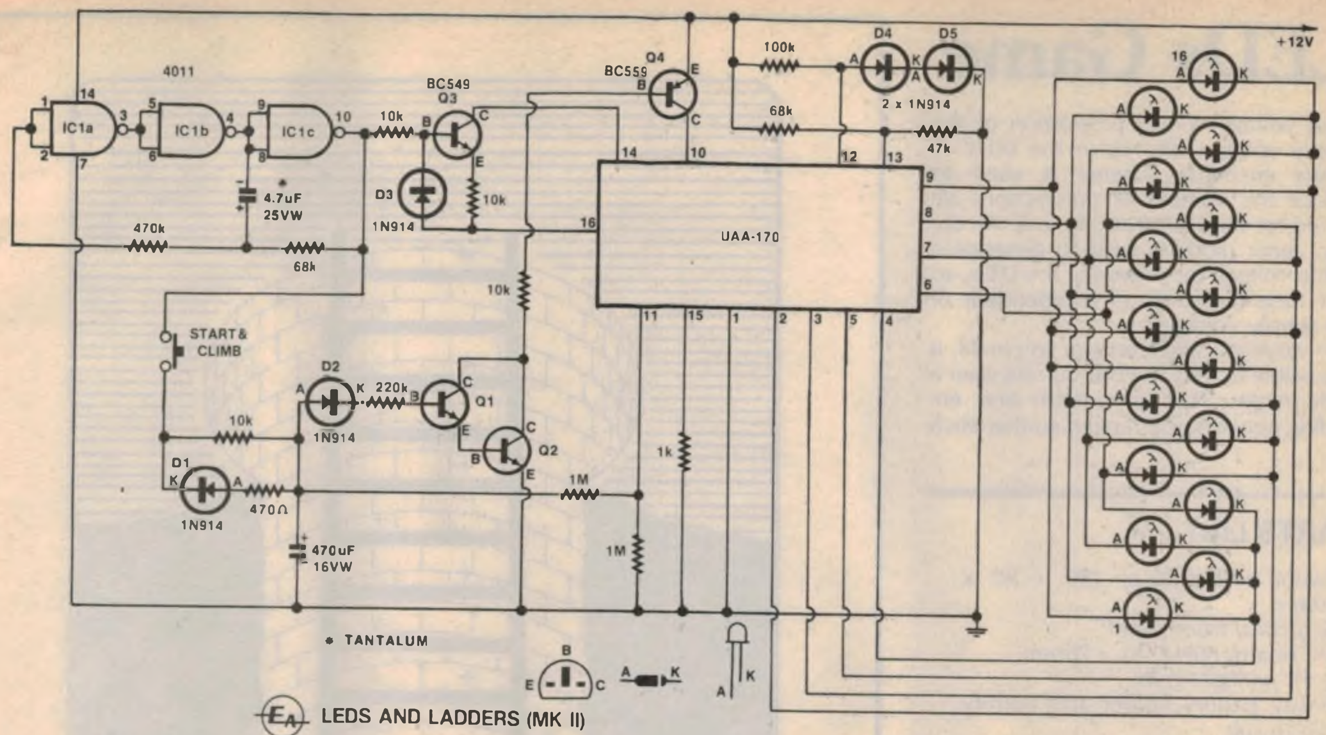
Directing his attention back to the game, our hero is horrified to find that he's slipping back down the ladder. Now only the 14th LED is alight. Desperately, he punches mindlessly at the button, the LED climbs up higher, just reaches the top, and then goes out. And he's still



What could be easier? Just press the CLIMB button to light successive LEDs on the rungs of the ladder.



View inside the completed prototype. Virtually all components are soldered to a small PC board which is mounted, together with the battery holder, on the lid of the case.

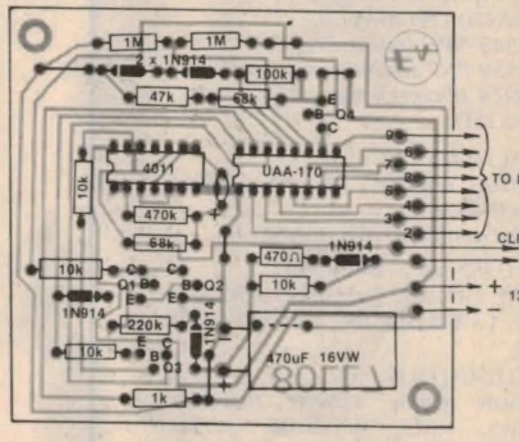


The circuit basically consists of a CMOS clock oscillator (IC1a, IC1b and IC1c) and a UAA170 LED driver IC.

pressing the switch!

With a heart-rending groan, he releases it, and then watches dejectedly as a LED near the bottom of the ladder flashes merrily. Some minutes later, he musters his courage, and once more commences to climb.

Just in case you're wondering whether or not it is possible to reach the top, we can assure you it is. In fact, the 1976 version had a little man at the top waving to show that he had managed it. We haven't been quite so corny this time!



This wiring diagram shows the PC board as viewed from the component side. Make sure that all polarised components (ICs, transistors, diodes & electrolytic capacitor) are correctly oriented.

HOW IT WORKS

Let's now take a look at the circuit diagram and see exactly how the game operates. It's really very simple and consists essentially of a CMOS clock oscillator and a UAA170 LED driver IC.

The clock circuit uses a 4011 quad NAND gate IC with gates IC1a, IC1b and IC1c arranged as a standard three-inverter CMOS oscillator. The frequency of oscillation is set by the 68k resistor and the 1uF tantalum capacitor and is about 0.75Hz. Output from the oscillator is derived from pin 10 and takes the form of a square wave with an amplitude only slightly less than the supply voltage.

This signal is fed to a large (470uF) electrolytic capacitor via the CLIMB switch and a diode/resistor network.

The charge on the capacitor is used to represent the distance up that ladder that the player has climbed. It works like this: If the CLIMB button is pressed when the oscillator output is high, the diode is reverse-biased and the 470uF capacitor is charged via the 10k resistor. When the button is released, the capacitor slowly discharges through the two 1M resistors and the base-emitter junctions of the Darlington transistor pair (the time constant is very long so that, for the moment, we will assume that the capacitor retains its charge indefinitely when the button is released).

If, on the other hand, the CLIMB button is pressed when the oscillator output is low, the diode is forward biased, and the capacitor discharges rapidly through the 470 ohm resistor.

Since the capacitor is charged from a constant voltage, the voltage across the capacitor follows an exponential law with respect to time. This means that the initial rate of change of voltage is much higher than the rate towards the end of the charging period.

Thus a given closure time of the CLIMB switch will propel the "player" quite a few rungs up the ladder if he is near the bottom, but only one rung or less if he is near the top. This is why our hypothetical player found the going harder towards the top of the ladder.

A second feature arising from this exponential curve is that the rate of discharge is greatest at the top of the ladder, so that an error in timing there produces a greater fall down the ladder than a corresponding mistake at the bottom. Now you can begin to see why the game is so infuriating.

The second section of the circuit monitors the capacitor voltage and uses this information to drive a LED display. Heart of this is the UAA170 IC, a 16-pin DIL plastic encapsulated device distributed in Australia by Siemens Industries. It should be readily available from your usual components supplier.

Internally, the UAA170 consists of a set of 15 comparators. These compare the

LEDs Game

input voltage with a proportion of the supply voltage, and drive the LEDs. A matrix encoding scheme is used to reduce the number of connections required for the LEDs from 32 to 8. An on-chip zener diode is used to generate a stable voltage for powering the LEDs, so that their brightness is independent of the supply voltage.

By varying a single resistor to pin 15, it is possible to vary the LED current over a wide range. The comparator and encoding network is arranged so that each

PARTS LIST

1 plastic utility case, 150 x 90 x 50mm
1 Scotchcal front panel
1 PC board, 80LL7, 81 x 76mm
8 1.5V penlight cells
1 8-way battery holder and battery clip to suit
1 N/O pushbutton switch

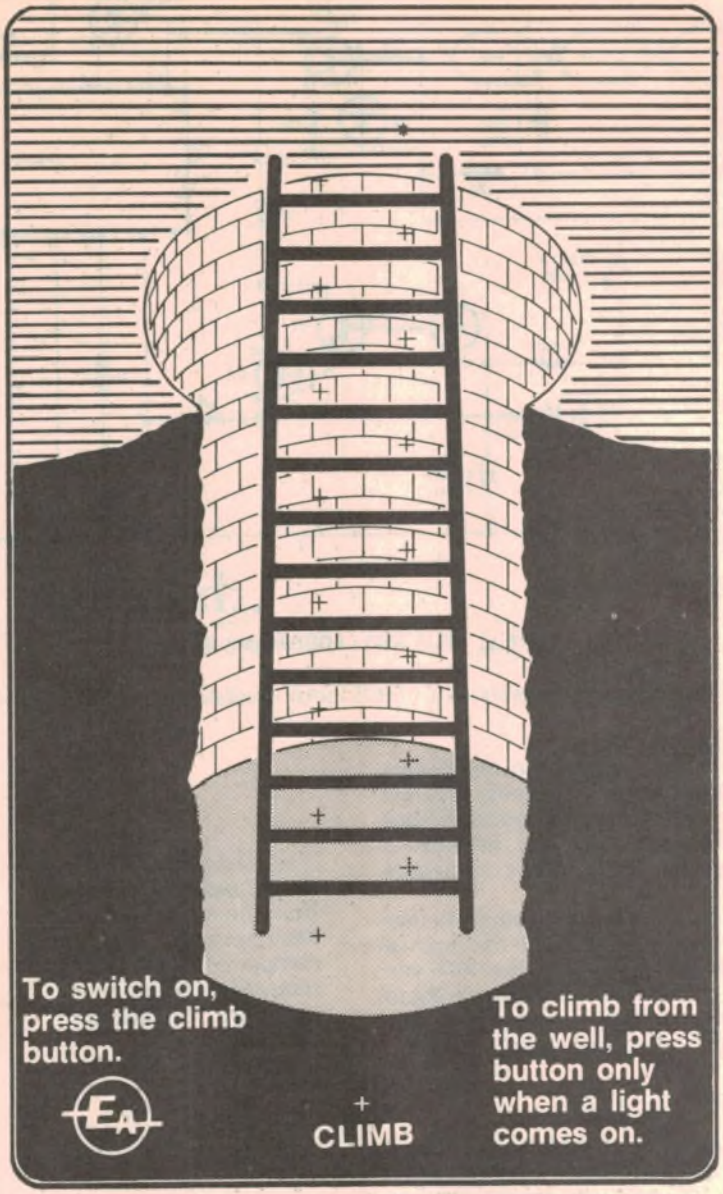
SEMICONDUCTORS
1 4011 quad NAND gate IC
1 UAA170 LED driver IC
3 BC549 NPN transistors
1 BC559 PNP transistor
5 1N914 silicon diodes
16 red LEDs

CAPACITORS
1 470uF 16VW PC mounting electrolytic
1 4.7uF tantalum electrolytic

RESISTORS (all ¼ watt, 5%)
2 x 1M, 1 x 470k, 1 x 220k, 1 x 100k, 2 x 68k, 1 x 47k, 4 x 10k, 1 x 1k, 1 x 470 ohms.

MISCELLANEOUS
Rainbow cable, solder, machine screws, nuts, washers, scrap aluminium etc.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible.



Here is an actual size reproduction of the front panel artwork.

LED is illuminated in turn, so that when they are arranged in a line, the effect is of a point of light moving along the line.

Pins 12 and 13 are the reference inputs to the comparators. The voltage applied to pin 12 becomes the lower threshold, while the voltage applied to pin 13 becomes the upper threshold. We have referenced pin 12 to 1.2V by means of diodes D4 and D5 to compensate for the turn-on voltage of Darlington transistor pair Q1 and Q2. This means that the first LED will turn off only when the voltage on the control input (pin 11) exceeds 1.2V.

The 16th LED will be illuminated when the voltage on the control input exceeds the voltage on pin 13, while for voltages in between these two extremes, corresponding LEDs will be illuminated. Note that when the threshold between two LEDs is being crossed, both LEDs will be partially illuminated.

The control voltage is applied to pin 11 from the voltage divider formed by the two 1M resistors. These values have been chosen in conjunction with the values for the divider connected to pin 13 to ensure that it is possible to turn on the 16th LED.

Although we stated earlier that the loading on the 470uF electrolytic capacitor was negligible, this is not strictly so. The two 1M resistors, in conjunction with the impedance presented by pin 11, plus the input resistance of the Darlington pair as well as the leakage resistance of the electrolytic itself, combine to slowly discharge the capacitor. This discharge is most noticeable when the capacitor is highly charged, and accounts for the "slipping back" observed by our hypothetical player. This adds to the difficulty of the game.

The stabilised LED driving voltage is made available at pin 14, and is normally connected to pin 16 via a suitable resistor. In this case, transistor Q3 is included in series with a 10k resistor, and the output of the CMOS oscillator used to switch the transistor on and off. This, in turn, pulses the LEDs, eliminating the

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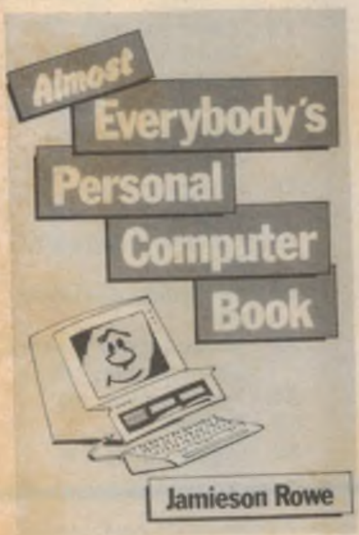

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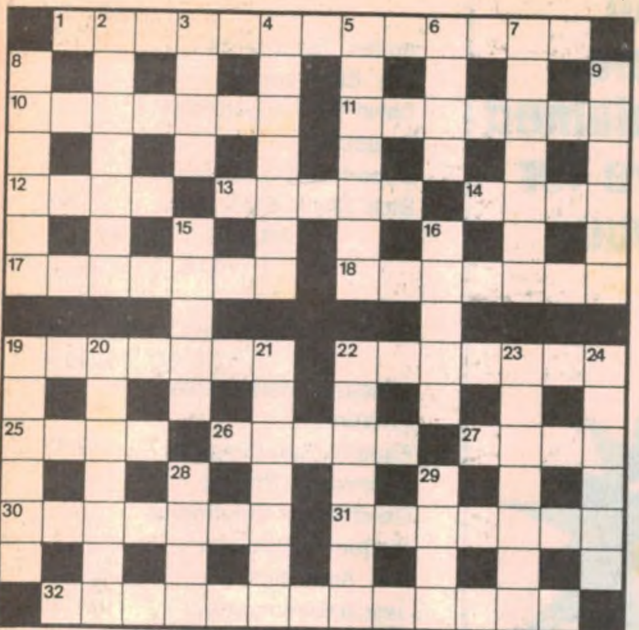
JANUARY CROSSWORD

ACROSS

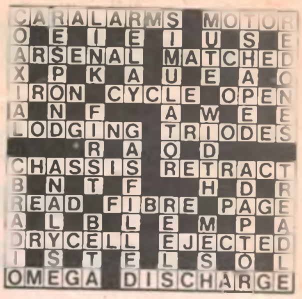
1. *An increase in signal strength. (13)*
10. *Lightning arrestors may have these. (3,4)*
11. *Kind of inductor. (7)*
12. *Tonal range. (4)*
13. *Frequencies of about 1 gigahertz. (1-4)*
14. *Not impecunious. (4)*
17. *Inverter. (3,4)*
18. *Who produced the FET in 1958? (7)*
19. *Cut a female thread. (4-3)*
22. *Type of amplifier. (5, 1, 1)*
25. *Toroid core. (4)*
26. *Electrical pioneer. (5)*
27. *Elementary particle. (4)*
30. *Record-making unit. (7)*
31. *CRT fault. (3,4)*
32. *Said of many iron alloys. (13)*

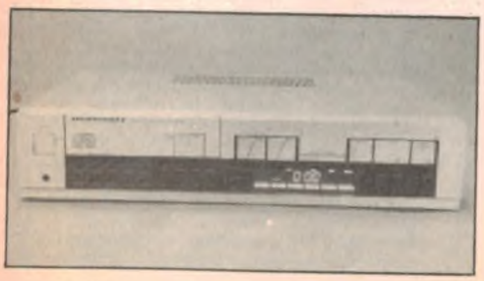


DOWN

2. *Navigational satellite. (7)*
3. *Solder constituent. (4)*
4. *Type of link. (7)*
5. *Enclosure for your stereo, TV, etc. (7)*
6. *Type of switch. (4)*
7. *Enthusiastic reception. (7)*
8. *Common electrode. (6)*
9. *Pattern-maker. (6)*
15. *Electrical units. (5)*
16. *Word of the phonetic alphabet. (5)*
19. *Sensitive meters can measure its symptoms. (6)*
20. *Interconnected magnetic flux. (7)*
21. *Computer software. (7)*
22. *Recording operation. (7)*
23. *These trigger a sensible response. (7)*
24. *Type of plug. (6)*
28. *Crystal. (4)*
29. *Capped joint. (4)*

SOLUTION FOR NOVEMBER





Next month in Electronics Australia *

Philips Stereo TV Receiver

TV receiver design has come a long way in the last few years. Next month we will detail all the new circuit techniques and features of the Philips stereo TV receiver.

Marantz CD player reviewed

The Marantz CD-84 is an up-market CD player with full programming facilities and infrared remote control. February Electronics Australia carries a detailed review. (Note: review held over from January due to space restrictions).

Low-cost Door Minder

Just starting out in electronics? Here's a project designed especially for beginners. When someone interrupts a light beam, it sounds a warning buzzer.

Busker's Amplifier

This handy amplifier is completely portable and is capable of operating from either the mains or a 12V battery. It features guitar and high-level inputs, 17W RMS output power, an in-built loudspeaker, and bass and treble controls. It's just the thing for busking or for guitar practice at home.

** Although these articles have been prepared for publication, circumstances may change the final content.*

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projects & circuits

Number 3

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Battery Saver for Personal Portables; Dual Tracking ±22V Power Supply; 3½-Digit LCD Capacitance Meter; In-Circuit Transistor Tester.

Miscellaneous
Nail Finder; Portable 3½-Digit Heart Rate Monitor. 10 Year EA Project Index.

Available from "Electronics Australia", 140 Joynton Avenue, Waterloo, Sydney. 2017, **PRICE $4.50** OR by mail order: Send cheque to "Electronics Australia", PO Box 227, Waterloo, 2017, **PRICE $5.40.**

1983 issue of this magazine. It would seem from the portion of the circuit diagram that you sent that your set is an ideal candidate for this conversion.

Infrared TV remote control

I recently completed construction of your Infrared TV Sound Control but have encountered difficulties. After a number of tests on the transmitter board, I have come to the conclusion that all three oscillators are running at several times the quoted frequencies. Using the specified 10kΩ resistor and .0082μF capacitor, the 10kHz oscillator (IC1d) has a frequency of 50kHz.

Changing the timing capacitor to .047μF or the resistor to 56kΩ gives the required 10kHz frequency.

Similarly, the 5ms and 1ms oscillators give negative-going pulses of about 1ms and 0.1ms respectively every 42ms. I have not experimented with changing component values here as I would like to ask if you can shed any light on these results and confirm that 10kHz is the correct transmitter frequency.

I also note that the signal pulse on the base of the Darlington transistor is about twice what it is on the collector, which again appears to be incorrect unless the current drawn by the infrared LEDs causes this low reading. (K.F., Albion Park, NSW).

● Your problem lies with the 4093 NAND Schmitt trigger IC. It seems that the hysteresis of a 4093 varies according to the manufacturer, something that we were unaware of at the time of publication.

If you were 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 resistor 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 4093B and SGS HCC/HCF4093B types.

The voltage reading recorded at the collector of the BD681 is correct and is simply the saturation voltage of the transistor.

Flickering digits on capacitance meter

Some time ago I built your Digital Capacitance Meter (EA March 1980) and have found it to be a very useful piece of equipment indeed. However there is one annoying little problem. The right hand digit flickers rapidly between zero and one. When a capacitor is attached the flickering ceases and all is well, but remove the capacitor and away she goes. This fault only shows up on the Microfarad range; on the other two ranges the display is rock steady.

I have noted the errata and made the changes you recommend. I see that I am not the only one who has this problem and I refer to a letter from R.E. of Panawonica, WA in the Information Centre on page 141 of November 1981 EA. I followed your suggestions to that writer and would swear that everything relating to switch S1b is OK. Can you help me with this please. (W.Y., Belmont, NZ).

● The flickering of the least significant digit which you describe is quite normal for this project. This only happens when there is no capacitor connected to the Cx terminals, and only when in the μF range. This occurs because the auto nulling circuit is switched out when this range is selected.

While we agree that this may be mildly annoying, be assured that it is not due to a fault of any kind. We feel that the minor nature of the problem does not warrant any modifications being made. If the flickering becomes annoying, why not turn the meter off, or on to another range?

Autodim affected by control tones

I have been reading over the last few issues of people having problems with the Autodim project (Jan, 1981). I have built 14 of these dimmers and not had any problems yet, but one!

All 14 of these dimmers have worked successfully first time, though when dimming from full brightness to "off" at some stages the light would fluctuate, not flicker. This occurred at different times during the dimming cycle. This light fluctuation lasted approximately 5-10 seconds: "not much to worry about" you say, but I am using the dimmers to create a false sunrise and sunset in bird avaries and need a stable effect.

I borrowed an oscilloscope from work and checked all waveforms listed in the article; they were found to be correct. Next step was to watch the mains waveform for any deviation: shock horror. At precisely the time when the lights acted up, the mains waveform took on a ripple effect, though still maintaining a 50Hz sine wave.

Since the sync signal is taken directly from the mains could this be upsetting the circuit? I noted that the output of IC1a changed its high & low periods during this time. Is this the carrier signal used by the council to switch hot water services? Would the problem be within the dimmer or could it be the mains? Is there anything else I could check for? (E.B., Busby, NSW).

● The effect that you decribe is indeed due to the control tones used by the supply authorities to switch off-peak hot water systems. The control tones have a frequency of about 1kHz and an amplitude of around 20 volts peak-to-peak.

While we have not had any complaints about tones affecting this circuit before, it should be reasonably easy to de-sensitise the circuit. One suggestion (which we have not tried) is to connect a 10kΩ resistor in series with the signal line from D3 and a shunt .033μF capacitor from pin 9 of IC1a to the neutral line.

The extra parts can be easily added to the back of the PC board.

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Information centre

Problems with 40W inverter

Recently I bought a 12/240V 40W inverter (EA, May 1982) kit and find some problems which I hope you may help overcome. Firstly, I was supplied with a PL18/40VA transformer which had two 9V windings. I wired the transformer in and, on turn-on, had severe voltage drop problems.

With an 11W 240V fan the voltage was 190V and with a 30W TV 185V. With the frequency switch set to variable the voltage increased by 20V. In the fixed mode one 2N3055 runs warmer than the other. After checking the circuit I changed the transformer to a PL12/40VA and noticed, with the 11W fan, that the voltage rose to around 230V. With the TV, the voltage was the same.

In the fixed mode the voltages drop to 220V and 210V respectively. I used a Tandy colour burst crystal and changed both ICs, as well as checking all the other components. I would like some advice on the problem of voltage drop, and would welcome suggestions. (D.F., Marsden, Qld).

● First of all, we recommend that you return to using the original transformer for this project. If the rest of the circuit is working properly, and the input voltage is correct, this transformer will provide the correct output voltage.

Make sure that the battery or power supply that you are using is capable of providing 12V at 3 or 4 amps. If this is OK, run the inverter in the fixed mode and measure the voltage across the transformer primary. This should be about 24V AC. Under these conditions the unloaded transformer secondary voltage should be about 275V AC.

Similar results should be obtained using the variable frequency oscillator. If there is still a significant difference, it is most likely due to a fault in this oscillator, since there is nothing to go wrong in the fixed one — either it will work properly or it will not work at all.

It is normal for one transistor to run warmer than the other in the fixed mode due to the slightly uneven duty cycle at the output of IC2 (5369).

EA Car Burglar Alarm

In the May 1984 edition of *Electronics Australia* you published a Deluxe Car Burglar Alarm project, which I have built and find excellent. This alarm is set to sound for two minutes and then reset. Could you please tell me if there is any way to modify the circuit or change component values so that the alarm would sound for more than two minutes and then reset.

The two minute alarm may be adequate for some but for someone like myself, who is a fair distance from his car most of the day, a longer alarm period gives the owner more chance to hear it. Keep up the good work as we do appreciate it. (J.G., Thornbury, Vic).

● It is quite easy to increase the alarm time for the Car Burglar Alarm. All you have to do is increase the value of either R3 or C2 on the Q output of IC3a. For example, increasing R3 to 1.5M should increase the alarm time by 50%.

There is a limit to how far you can go though. If the capacitor leakage current is greater than the charging current, the alarm will never shut off

VHF-UHF conversion for B&W TV set

I have a Princess colour TV set which I was told will not work in conjunction with a computer as it does not have UHF channel selection. I would like to modify the antenna board and/or the VHF tuner to accommodate a computer input without the expense of removing the existing VHF tuner and substituting a UHF tuner. Could you advise me if this is possible and provide me with a schematic diagram for this alteration. (H.P., North Ryde, NSW).

● It is not practical to convert your VHF only television into a combined VHF/UHF receiver. By far the simplest solution is to purchase a ready made UHF-VHF down converter. This could then be connected between the television set and your computer.

A more satisfactory result could be obtained by feeding composite video directly into the TV. This was explained in some detail in the article on the video amplifier which appeared in the August

Notes & Errata

BEACHCOMBER METAL LOCATOR (December 1984, 3/MS/111): the power supply section of the circuit diagram (top right) incorrectly shows −9V at the top and +9V at the bottom. The polarities should be transposed.

STRESS MONITOR (May 1984, File 3/EG/28): the meter specified for this project was 0-250µA. This should have been 0-1mA, although any meter of up to 2.5mA would be acceptable.

DECODER FOR AM STEREO (October 1984, 2/TU/54): the two 0.47µF capacitors must be tag tantalums, not PC electrolytics as listed in the parts list.

16K RAM CARD FOR APPLE II (November 1984, 2/CC/91): pin 5 of IC1b and pins 1 and 13 of IC6a should all be tied to Vcc instead of as shown on the schematic on page 37. Also, pin 1 of IC3b should be shown connected to pin 13, not pin 12.

Other corrections to the article are as follows:

Equation 3 on page 39 should read

$$A'12 = \overline{\overline{A13 \oplus BANK} + A12}$$

Equation in Table 4 should read

$$R(tn + 1) = \overline{(A0 \oplus A1)}\,(tn)$$

Lines 7 and 8 in column 3, page 39, should read

If A3 is logic 0 then BANK = 0
If A3 is logic 1 then BANK = 1

Equation 4 should read

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

Under the heading *Boolean algebra* on page 41, all equations are missing either the complementary symbols or the exclusive circle around the OR symbol to make it XOR. These equations should read as follows:

$$a.\bar{a} = 0 \quad (1)$$

$$a + \bar{a} = 1 \quad (2)$$

$$(a.\bar{b}) + (\bar{a}.b) = a \oplus b \quad (3)$$

$$\bar{a} + \bar{b} = \overline{a.b} \quad (4)$$

$$\bar{a}.\bar{b} = \overline{a + b} \quad (5)$$

Finally, readers are advised that the author has changed his address to PO Box 167, Ascot Vale, Victoria 3032.

broadcaster Robert Parker has managed to win from his collection of historic 78s. While not without his critics, he certainly has my support.

This Duke Ellington recording opens with "East St. Louis Toodle-oo", "Black and Tan Fantasy" and "Creole Love Call", all from 1927 originals; then follows "Saturday Night Function" and "Cotton Club Stomp" (1929), "Mood Indigo" (1930), and an ear-catching "Daybreak Express" (1933). Four more tracks follow from the '40s, the album ending up with an 18-minute suite under the collective title: "Black, Brown and Beige" (1944).

As with the Glen Miller album (Sept '83) and New Orleans Jazz Classics (Dec '83), the sound on this one is virtually free from 78rpm surface noise, but with enough treble, bass, dynamics and reverb to give the old tracks a totally new lease of life.

Which of the records you buy can be governed purely by your partiality to artists and titles. (W.N.W.)

made its debut in London, followed by appearances in Canada, France, Scandinavia and the Far East.

Recorded in the Oldcatholic Church, in Utrecht, Holland, during October 1983, the sound is very clean, with glass-hard transients, and a touch of building ambience to add warmth to sound. The playing itself is first-rate.

As a first choice, I imagine that most would prefer an orchestral version of the work as, for example, the commendable Delos recording featuring Gerard Schwarz, Elmar Oliveira and the Los Angeles Chamber Orchestra. (The digital LP and CD versions were reviewed in Feb. '81 and Aug. '84).

But, popular as the "Seasons" may be, one might hesitate to invest in more than one orchestral version, whereas the guitar group can offer a quite different sound. The themes are the same, but it is left to the trio to interpret, on their most percussive of instruments, the birdsongs, the summer breezes, the north wind, the thunder and the lightning.

A word of advice: set the volume to a level that your amplifier will handle comfortably, but move your chair a little closer than normal to the stereo speakers. The whole performance will take on a more intimate, more vivid quality. Alternatively, try listening to it on a good pair of headphones.

In short, well worth a hearing if you're at all partial to the sound of the classical guitar. (W.N.W.).

DEVOTIONAL ALBUM

WORSHIP II. Church in the City. Stereo LP. Star Song SSR-0046. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135.]

As might be imagined, Worship II is a sequel recording to an earlier and successful release from Star Song entitled simply "Worship". The music itself is provided by a group of gifted musicians and singers attached to Church in the City, Houston, Texas — affiliated with the Assemblies of God.

The title of the album may not be very imaginative but it is certainly appropriate. In keeping with the generally fundamentalist approach of the affiliated group, the lyrics are either scripture paraphrases or direct expressions of devotion and worship. They are set out in full on the inner sleeve and can be followed easily, throughout.

However, while the lyrics are conservative, the musical treatment is contemporary, without being extreme. Backing includes guitars, pianos, trumpet, flute, recorder, percussion and bass, with strings over-dubbed later.

Many of the songs appear to have been composed by members of the group and, while their titles may be unfamiliar, their themes will be self-evident:

Lord, I've Got a Song — Jesus Is the Name I Love — Fixing Our Eyes on Jesus — Your People Thank You — Hear, Oh Israel — June 24 and 25 — Glory to God in the Highest — Life-Giving Blood — Isaiah 43 — The Wind of the Spirit — Worthy is the Lamb — If It Had Not Been the Lord.

The sound quality is well up to normal standards and, all told, it adds up to a pleasant album of contemporary group/congregational singing which should find ready family acceptance. (W.N.W.)

RECORDS AND TAPES

GOSPEL PIANO

Dino: Chariots of Fire. Stereo LP, Liht LS-5819. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.]

In the September issue, I expressed some reservation about Dino's "Majesty" album on the grounds that the Title Track (not "little" track, as printed) did not "hang together too well" as pure audio, even though possibly very successful as a stage presentation.

This album has much the format, with featured tracks at the beginning and end of each side, separated by long medleys of Gospel themes, old and new, on solo piano. The essential difference is that this is a studio performance, unbroken by applause or comment. Indeed, the medley on each side blends naturally into the final track, lending considerably more cohesion to the presentation.

Side one opens with an ambitious arrangement of "Chariots of Fire", mainly with synthesiser backing. It closes with the popular and tuneful "Exodus" theme, with orchestra and chorus. In between is a medley of nine well known hymn tunes, improvised and ornamented in the Dino manner.

Side two begins with "We Shall Behold Him", with orchestral backing, followed by another presentation on solo piano, described as a "Praise Medley". The closing track is "I'm So Glad That Jesus Lifted Me", done with instrumental backing and with progressive key changes, finally accelerating to full take-off speed!

The surface is quiet and the sound well balanced but, on peaks, it lacks the subtle "unstressed" quality that distinguishes the latest generation of audiophile LPs. That apart, Dino's "Chariots of Fire" has what it takes to make it a favourite for family listening. (W.N.W.)

JAZZ LIVES AGAIN

Duke Ellington: A Memorial. The Great Bands in Digital Stereo — Vol. II. RCA Victor LP VPL1-0436.

In a moment of inattention, I put this disk on the turntable under the impression that it was an American re-release. My immediate reaction, a few bars into the first track, was that they hadn't taken long to copy the techniques being used by Robert Parker to re-record and revitalise old 78s, as per our story on page 20 of the September '83 issue.

A few moments later, I looked again at the jacket and the reason for the sonic similarity was obvious: it was a Robert Parker transcription on a local RCA release and is, in fact, the second in the series specifically mentioned in our September article.

I recount the incident, not to draw attention to my own lapse of memory, but to emphasise the distinctive quality that recording engineer and ABC

GUITAR TRIO

Vivaldi: The Four Seasons. Played by the Amsterdam Guitar Trio. Stereo LP, RCA Red Seal VRL1-7474.

In his jacket notes, John W. Duarte points out that these popular, pictorial works were originally the first four in a set of twelve violin concertos, published in Amsterdam in 1725. As such, he suggests, Vivaldi would be unlikely to have objected to their adaption for three guitars, especially when played by a trio as capable as the one featured here.

Comprising Johan Dorrestein, Olga Franssen and Helenus De Rijke, the Group was formed in 1978, after the members had completed their studies at the Sweelink Conservatorium. The Trio then, despite an obvious discontinuity, a quite surprising strength and consistency of tissue") but to my ear these pieces reflect a mighty respect for Schumann rather than hint at the later composer of those three great operas, Salome, Elektra and the Rosenkavalier.

To me their only interest is historical. The Sonata is as early as Op. 5, the Five Piano Pieces still earlier. Gould offers them in minutely controlled playing. Great variety of inflection is delivered with unquestionable authority. Certainly all pieces show unusual understanding of the piano's capabilities. And the digital recording makes the piano tone very faithful indeed.

A funeral march owes much to Beethoven and, as well as the very noticeable Schumann influence, there are also hints of Brahms. Of the best of Richard Strauss there is no sign, though there is a nice tune in the fourth of the Five Pieces. (J.R.)

MAKROPOULOS

Opera founded on the play by Karel Kapek. Elisabeth Soderstrom, Peter Dvorsky, Vladimir Krejcik, Anna Czakova, Vaclav Zitek, Beno Blachut and others with the Chorus of the Vienna State Opera and the Vienna Philharmonic Orchestra. Conducted by Sir Charles Mackerras. Two Decca analog discs in box with annotations by John Tyrrell. D44D2.

I must start by saying the translation of the Czech title into The Makropoulos Case leaves one with the wrong impression of the libretto of Janacek's opera which, by the way, he wrote himself. The notable Janacek scholar, John Tyrrell, who writes a splendid account of the work taking up five odd pages in the brochure accompanying the two-record set, suggests that William Mann's version of the Makropoulos Document gets much closer to the composer's meaning.

I must warn readers that a first run through will confront the listener with some puzzles, and perhaps a second one too. Before either I recommend reading Tyrrell's notes with great care. It will pay great dividends.

The Makropoulos Case makes the fifth and last Mackerras Janacek recording of what can be regarded as the composer's five current operas in the international repertoire.

I first met the work in Paris in the late '60s when Mackerras conducted the Sadler's Wells Opera Company in it with the great late Marie Collier in the name part at the Chatelet theatre — the old Sarah Bernhardt. When I went behind to see him after the show he was engaged in a loud altercation with the representative of the French Radio, forbidding him to broadcast the performance as it was so badly performed.

The stage manager, who was translating Mackerras' expostulations into fluent French, answered my statement that I hadn't noticed anything go wrong with I thought rather cryptically: "You would have done if you knew it as well as you know Madam Butterfly." I had never met him before. That my wife and Mackerras' wife had to scour Paris the next morning to rescue his tail suit from a locked theatre and get it to Orly airport in time for Mackerras to use it in Prague that night is another story.

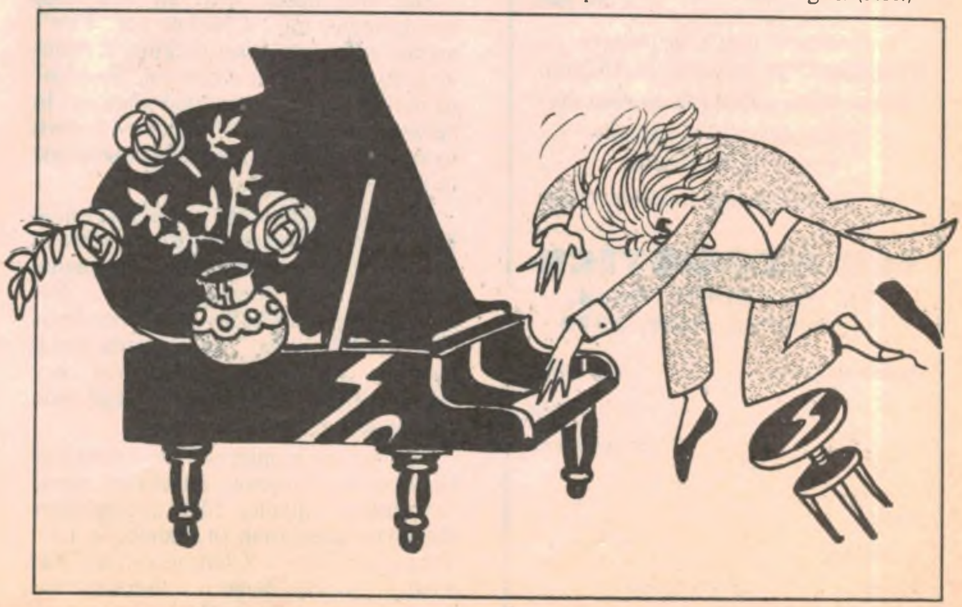
There is a habit among Czech singers to distort lines. In spoken Czech the accent always falls on the first syllable of the word with an unaccented lengthening of the second syllable and all this made more difficult in the Moravian accent of the language. I am explaining all this at such length in the hope that it might help you through the first few tries to unravel the problems in this elusive work and that you will find it as rewarding as I did.

Among Tyrrell's extensive notes is a description of Czech pronunciation. This will be valuable to any libretto follower since the unfamiliar clusters of consonants has the accent almost always on the second syllable. Mackerras explained to me at supper after the show that the real difficulty in getting a perfect performance was in the rhythmic complexity of Janacek's vocal lines. Mackerras, by the way, had spent many years in Czechoslovakia and had learned to speak fluent Czech — even Janacek's provincial Moravian dialect.

The story is based on a novel by the writer Karel Kapek who became world famous with two plays, RUR Rossum's Universal Robots and The Insect Play. Both are politically slanted.

The Makropoulos Case, in brief, deals with the subject of longevity, The heroine is 300 years old, has acquired great riches, had a long list of lovers ("one cannot love for ever") and is now thoroughly fed up with life. The account of what happens to her I will leave to Janecek's eloquent music which indulges itself in many interesting side tracks, all in the composer's inimitable short ejaculated phrases and skilful assembling of them into a smooth and logical whole. I cannot praise this music too highly.

The music is splendid to my, nowadays, more tutored ear and the recording brilliant. The main themes are illustrated in Tyrrell's splendid notes and there should be nothing left, after two or three tries, to give you anything but very much pleasure — even delight. (J.R.)



REVIEWS OF RECENT RECORDS AND

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RAVEL

Scheherazade, Three poems of Mallarme, Madagascon Songs, Five Popular Greek Melodies, Song of the Lentisque Gatherers, and Don Quixote to Dulcinea. With the BBC Symphony Orchestra and Members of the intercontemporary Ensemble Conducted by Pierre Boulez. CBS Masterwork Analog Disc M39023.

Heather Harper strikes 12 at once with a rivetting performance of Ravel's Asia, as fine a song as any written this century. It is so dominating that it makes the other two in the trio sound modest, fine as they are, by contrast. She is in great voice.

That she takes it at such a steady tempo adds to its majesty. The emotion changes as the singer goes through a long list of what she would love to see and experience in Asia. In her opinion Asia is a "wonderful old land of nursery-tales where fantasy sleeps like an empress in her enchanted forest" to the penultimate sinister stanza where she would like to see "a smiling headsman cut an innocent neck with his great curved oriental sword".

Slow sensuous phrases alternate with gorgeous bursts of music, and a studious veiled tone gives way to full throated thrusts, leading to the shattering climax.

I am not exaggerating when I write that the effect is overwhelming. So much so that the older two beautifully delivered songs in the bracket sound like vocal etudes.

Not the least surprising is the amount of passion Pierre Boulez evokes in the BBC Symphony Orchestra. I have always regarded him as a very cool gentleman, rather more like a bureacrat than an ardent voluptuary. The orchestra provides exactly the right background for all the many varied Ravel songs, perhaps the most pendious ever to be recorded on one disc.

Of the other items in the Scheherazade Suite, of which Asia is the first, there is the tranquil atmosphere of the Enchanted Flute, its beautifully played flute solo, and the subtly androgynous The Indifferent One in which sex of the "invited one" is quite plainly male while that of the host who importunes the him to enter and stay is never made clear.

Heather Harper shares the other Ravel songs with soprano Jill Gomez, Jessie Norman — who I think is the most glorious soprano to be born on this planet since Kirsten Flagstad — and baritone Jose Vin Dam. All sing attractively, thoughtfully paying devoted attention to French style with its difficult long legatos and light, almost flippant, interludes. This is a disc that I can recommend with great enthusiasm, especially to those who love French music as much as I do.

A list of the songs included is contained in the titles above the review. (J.R.)

LISZT

Piano Concerto in E Flat. Piano Concerto in A Major. Svjatoslav Richter (piano) with the London Symphony Orchestra conducted by Kiril Kondrashin. Philips Sequenza Analog Disc 412 006-1.

The photograph of Richter on the sleeve shows a balding man with white sideboards, very different from the sturdy, tough-looking fellow of some 20 years ago when he was welcome with worldwide acclamation. He was recording in London when I was there in the early 1960s and, as the PR man at Philips, Leslie Gould, was a friend of mine, I learned a lot about him.

He was never allowed out of sight by a sort of keeper, a fellow-Russian. He never left the recording studio for meals; all were sent in and carefully examined by his "companion". No alcohol was allowed and it was rumoured that drink was one of his problems. He remained a firm favourite for years. Other great pianists came but Richter remained peerless in the piano music of Schumann.

There is much reverberation in the opening bars of the E Flat Concerto and Richter's interpretation is very romantic indeed, with many rubatos and hesitations against a background of dazzling technique. It could be described as "gamey" — what the French mean by the word "faisande," with an acute accent on the last letter — in short, hung till high.

But even with the rubatos thrown in his statements remain masterful, though the style would be more appropriate to Chopin.

Liszt created a new form in this concerto, a fact skillfully explained in the sleeve notes and which lack of space prevents me from quoting here. Richter retains his beautiful touch, though some of his rubatos become irritatingly beyond credibility, torturing the line quite out of shape.

One novelty in interpretation occurs in the very first bars of the introduction which is taken majestically instead of vigorously — quite largo, in fact. The famous triangle notes in the finale, from which the concerto takes its name, go unheard on my very good equipment. Where they should be heard as a solo there is just silence.

Whenever Richter increases his speed he scintillates. The orchestra, except when it disappears under a long piano trill, is always in good balance. Inexplicably, this trill dominates to such an extent that the band, which has a dainty theme, seems to suddenly get modest, at least for a while at any rate.

As to the A Major Concerto, after several years away from it the first lovely theme still worked its magic on me. But it is taken so very slowly — I know it is marked "sustained adagio" — that it sacrifices some of its beauty. The horrid march sequence towards the end has lost none of its vulgarity but by contrast Richter takes the quicker portions at a dazzling speed. Despite this fleetness each note receives its correct value.

In the middle of the work, the cello solo of the main theme is most beautifully played. On the whole the orchestra plays very well and there are always Richter's sparkling runs. Incredibly, it gets still faster to a glorious finish. (J.R.)

STRAUSS (RICHARD)

Sonata in B Minor, Op 5. Five Piano Pieces Op 3. Glenn Gould (piano). CBS Masterworks Digital Disc D38659.

This is the late Glenn Gould's last recording and it is a pity that this eccentric but highly gifted artist is wasted on such trivial material. But such was the nature of Gould who, controversially, warmly supported the student Strauss' trivialities.

True and notable English critic, the late Ernest Newman, mentioned them with some respect ("There is now and

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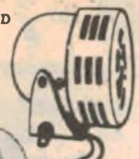

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ONLY $6.95

AUTOMOTIVE KEYSWITCH

This special automotive unit features a rugged neoprene rubber boot that clips over the weather-exposed part of the switch - even the keys are special tube types. Size of hole required only 12mm.
Cat. SM-1032

ONLY $4.95

'THE RED FLASHER'

Is your car safe? Well why not make sure by installing the Red Flasher. Thieves stay away from cars with flashing lights and this unit looks so good they're bound to think you have an alarm fitted, whether you have or not!

We suply a quality Swiss pushbutton illuminated square switch and electronics to make it flash plus 2 deterrent stickers.

Cat. KJ-7000 **ONLY $20.95**

30V 1 AMP POWER SUPPLY KIT

Brand new design with two ranges of current limit in special plastic case.
Cat. KA-1574 Ref: EA January 1985

$64.50 Ref: EA Jan 1985

NEW

QUALITY PROBE CASES

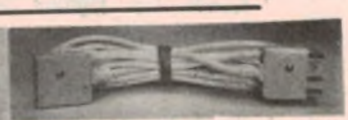
We have secured a small quantity of probe cases. They can be used for digital (i.e. logic probes, pulsers etc) or for analog purposes (signal injectors etc).

PROBE CASE 1: Measures 155(L)x25(D)mm. It has a chrome metal body tube. A stout insulated probe is fitted at one end with a grommet/cap on the other. Weight 88 grams.

PROBE CASE 2: Identical to the above except that the body is a clear acrylic tube. Overall length 135(L)x25(D)mm. Weight 25 grams.

Probe 1 Cat. HB-6310 **$8.95**
Probe 2 Cat. HB-6311 **ONLY $6.95**

AT LAST! LOW COST TELEPHONE EXTENSION CORDS!



5 metre extension cord Cat. YT-6010 **WAS $14.95 NOW $12.95**
10 metre extension cord Cat. YT-6012 **WAS $19.95 NOW $15.95**
20 metre extension cord Cat. YT-6014 **WAS $24.95 NOW $22.95**
NEW! 15m cord reel Cat. YT-6018 **ONLY $19.95**
Telephone socket double adapator Cat. YT-6020 **WAS $19.95 NOW ONLY $12.50**

Jaycar ELECTRONICS

NOW OPEN BURANDA QUEENSLAND

LOW COST STEREO HEADPHONES

Ideal replacement for walkie stereo units. Hi Fi sound.
Cat. AA-2015

ONLY $6.95 **NEW**

LOW COST QUALITY MICROPHONE

NEW

Looks like the $70 plus units but at a staggering price. Unbelievable sound quality. Low impedance.
★ Supplied with 2.9 metre of cord and ¼" phone plug
★ Attractive silver colour
Cat. AM-4090

GRAB THIS! $19.95

THE ULTIMATE AMPLIFIER?

The staff of "Electronics Australia" have been working for over 12 months now on an ambitious project. The project? An integrated amp with input facilities for wide dynamic range sources such as compact discs and the new stereo Hi Fi VCR's.

Apart from this the amp has incredible features. Among them:
★ Torodial power transformer for very low hum radiation
★ Virtually ZERO screened wiring (almost no other wiring as well).
★ Massive heatsinks
★ Electronic input switching
★ Almost all parts mounted on one giant PCB so assembly is enormously simplified
★ Over 100 watts per channel genuine

Here is what EA (a conservative bunch usually) say about their new amp -
"The best integrated amplifier design ever published".
"A no compromise design. . .".
"Here is a stereo amplifier that will equal or better any commercial amplifier design regardless of price".
(Quotes from EA December 1984 Page 95)

Right now Jaycar is tooling up for this project. We will have a full kit available in MARCH. As you have come to expect from Jaycar our kit will reflect the **"no compromise"** philosophy. You will not be disappointed.

VCR STEREO ADAPTOR

NEW

★ Converts mono sound of standard VCR's or TV's, AM radio etc to pseudo-stereo signal
★ 1 x RCAS socket input, 2 x RCA socket output
★ NOT A KIT, built, tested and guaranteed
★ Complete with plug-pack
★ Dimensions: 110 x 130 x 32mm
Cat. AV-6506

ONLY $37.50

Jaycar ELECTRONICS
Incorporating ELECTRONIC AGENCIES
NUMBER 1 FOR KITS

NSW: SYDNEY 117 York St. Tel. (02) 267 1614
CARLINGFORD Cnr. Carlingford & Pennant Hills Rd. Tel. (02) 872 4444
CONCORD 115/117 Parramatta Rd. Tel. (02) 745 3077
HURSTVILLE 121 Forest Rd. Tel. (02) 570 7000
QLD: BURANDA 144 Logan Rd. Tel. (07) 393 0777
MAIL ORDERS: P.O. Box 480, AUBURN NSW 2144. Tel. (02) 643 2000
For all other information (i.e. P&P, shop hours etc) see other ads.

MAIL ORDER VIA YOUR PHONE

VISA MasterCard AMERICAN EXPRESS Cards Welcome

START YOUR OWN BUSINESS!

Many people will come back from their X'mas holidays to find their house has been burgled. They do not know that they can have electronic burglar alarm protection at a modest cost. Modern burglar alarm components from Jaycar enable you to easily make domestic premises more secure.
So why not use your technical skills to install alarms in your neighbourhood in your spare time. You will make money and provide a community service as well.

★ ★ ★ PRODUCT OF THE MONTH ★ ★ ★

ACP-2 LOW COST STEEL ALARM CONTROL PANEL

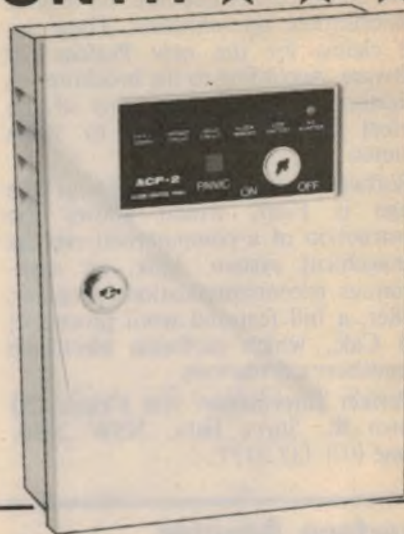
This is the first low-cost but professionally made steel encased unit that we have seen. It has most of the main features of professional control boxes including:-

- ★ Lockable baked enamel steel box. Tamper switch can be fitted.
- ★ Space in box for back-up rechargeable batteries.
- ★ Facility to connect remote key switch. (Alarm will latch if remote key wiring is cut, whether alarm is "on" or "off").
- ★ Built in siren driver
- ★ Relay output control provides 12V DC for sirens, bells etc.
- ★ N.O. instant and N.C. delay alarm loops for perimeter protection.
- ★ Will operate as fire alarm as well. (Has fire/smoke sensor inputs)
- ★ Different siren tone for fire/burglary
- ★ Diagnostic audible and visual alarm circuit status indicators
- ★ Simple one-key operation. Ideal for non-technical people to operate once installed
- ★ Built in PANIC button
- ★ Separate timing and latching relay outputs with high current contact ratings
- ★ (The above could be used to operate automatic telephone dialler etc.)
- ★ Dimensions 230(H) x 170(W) x 70(D)mm
- ★ Weight 1.5kg without standby batteries.

This unit would normally cost at least $200 elsewhere (even WITHOUT steel box). Jaycar has secured this product for you at a fantastic breakthrough price.
Cat. LA-5165

DON'T PAY $199

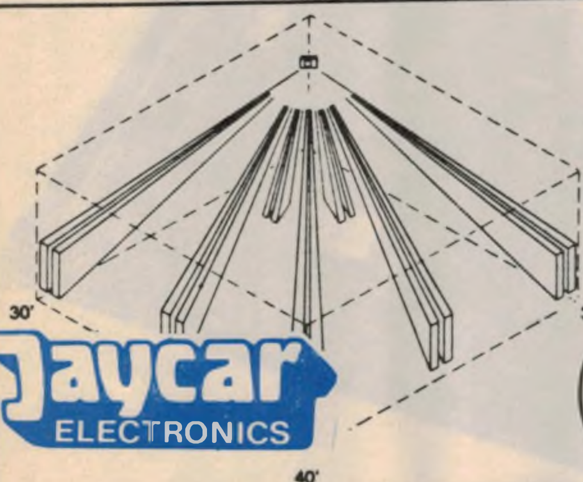
NEW



Believe it or not the ACP-2 is only $119!

Power supply with facilities to recharge Gel battery.
Cat. MP-3018
$34.90

Gel battery to suit
Cat. SB-2480
$24.50



PASSIVE INFRA-RED DETECTOR

Jaycar breaks the $100 price barrier. Bulk buying by Jaycar has enabled us to pass on large savings on popular Passive Infra-Red detectors. PIR's (as they are known in the trade) are the most popular method of detecting movement in open areas. They are very reliable and being passive (i.e. they are not transmitters like microwave or ultrasonic sensors) they false trigger a lot less. For a technical description see page 21 of our 1984 Catalogue. The only drawback in the past was their fairly high cost. Now you have no excuse to install one (or two) as part of your alarm system.
(Please note that the illustration is indicative of PIR. We reserve the right to ship units of similar performance but possibly different physical appearance)
Cat. LA-5015

Jaycar ELECTRONICS

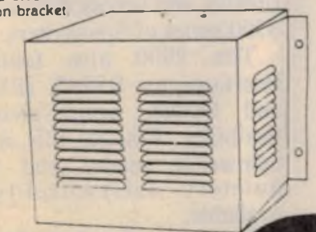
ONLY $99

SECURITY CABLE - 4 core, flexible stranded conductors (7 x 0.18) in tough outer sheath

Cat. WB-1590
60¢/metre - 100m roll $38.00

EXTERNAL SIREN COVER

Louvred painted steel. Size for 5" horns or sirens. Special tamper switch on bracket (included).
Cat. LA-5110



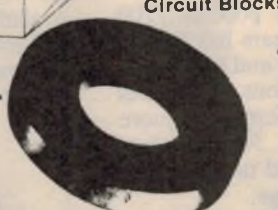
$23.50

PRESSURE MATS - A very underrated & reliable sensor.

Once installed (we admit that lifting carpet can be a hassle) they can usually be forgotten about forever. Ideal for placing at vunerable window locations. 800 x 520mm.
Cat. LA-5002
ONLY $16.95 - N.O. contacts

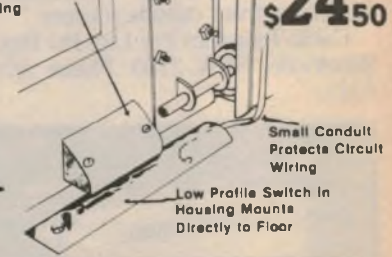
WINDOW TAPE & BLOCKS

Simply stick tape in place and terminate with circuit blocks. 32 metre roll 6.4mm wide.
Cat. LA-5050
ONLY $7.50 per roll
Circuit Blocks Cat. LA-5060 **ONLY 45¢ ea**

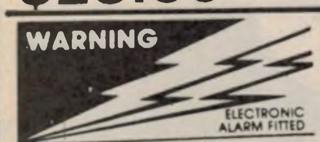


HEAVY DUTY REED/MAGNET

Used for roller-shutter doors, tilting garage doors or any wide-gap application. Supplied with strong magnet, flexible conduit connector etc.
Cat. LA-5073

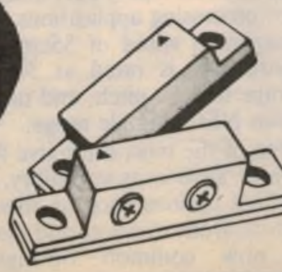


$24.50



ALARM STICKER - A durable self adhesive

sticker that clearly tells a would be thief that an alarm is fitted. Does not refer to a particular type of alarm - creats more doubt in the thieves mind.
Cat. LA-5100
95¢ each or 85¢ for 10 or more



REED SWITCH & MAGNET

Complete assembly of a reed switch and powerful magnet. Can be screw mount or self-adhesive.
NORMALLY CLOSED (when in proximity of magnet)
Cat. LA-5070
NORMALLY OPEN (when in proximity of magnet)
Cat. LA-5071
BOTH TYPES SAME PRICE
$2.95 ea or $2.50 ea for 10 or more

Perfect Software — it's easy!

No complicated directions, no tedious memorisation, no confusion. These are the claims for the new Perfect 2.0 Software. According to the brochure, an operator can learn to use any of the Perfect programs in two to three minutes.

Software currently included in the range is Filer, which allows the construction of a computerised records management system; Link, an asynchronous telecommunications program; Writer, a full featured word processor; and Calc, which performs electronic spreadsheet calculations.

Perfect Information: 1st Floor, 480 Crown St, Surry Hills, NSW 2010. Phone (02) 332 2177.

Interface Adapter

Cable-Tectonics are now manufacturing a range of RS-232 Adapter Units designed to interface with various type of computer and peripheral equipment. They eliminate the need for operators to make changes to the cable connecting the equipment where standard and null conditions are required.

The unit which is small and designed to be fitted in-line with the cable is available with or without a null selector switch. The switched model can be used either "as-is" (wiring pins one to one) or by using the switch to change pins 2 and 3 so that they are in a null condition.

Three models are available with either male pins at both ends, female pins at both ends or male and female pins at either end. The housing is all metal which consequently minimises interference from outside sources.

Cable-Tectonics Pty Ltd: PO Box 126, Brookvale, NSW 2100. Phone (02) 938 5211.

Single card CMOS system

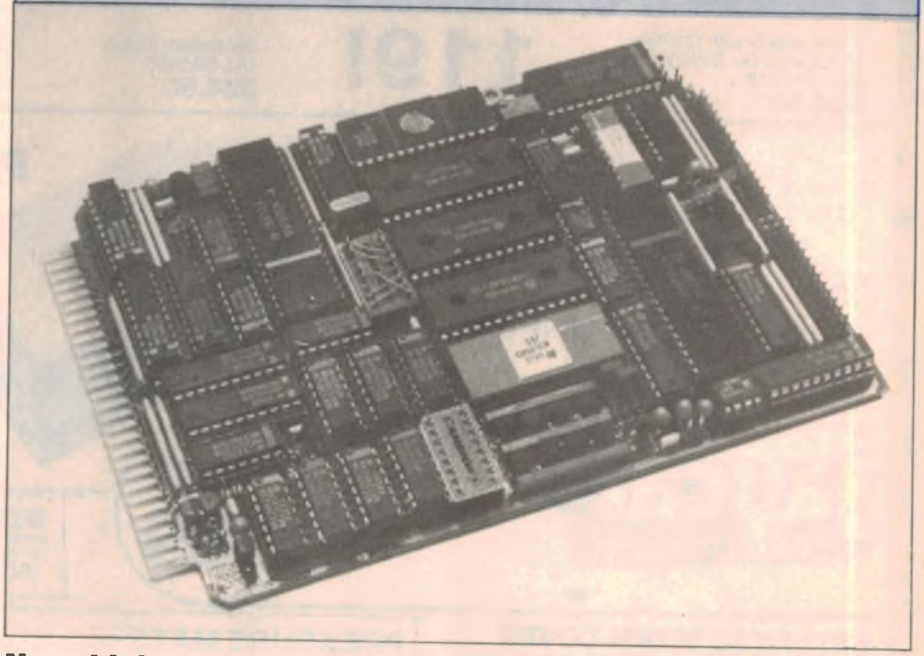
JED Microprocessors report that, in the first two months of production, over 50 of their single board computers have been sold. The computer is designed and built in Australia and is aimed at data logging and control applications.

It is a completely CMOS design, compatible with the STD bus and uses the National NSC800 CPU. This allows it to take advantage of the Z80 instruction set. It can also be programmed in XTBASIC, a version of BASIC generated by JED and tailored for control applications.

The board if particularly suitable for applications where low power consumption and small size are important — the CMOS logic means that the board has a power consumption of only 0.5W.

Only a single JED STD/800 card is needed for up to 56K of memory, RS232 serial I/O, 30 bits of parallel I/O, two 16 bit counter/timers, eight analog inputs (8 or 10 bit) and a real-time clock.

JED Microprocessors Pty Ltd: PO Box 30, Boronia, Vic 3155. Phone (03) 762 3588.



New high speed printer from NEC

Datascape, the largest Australian distributor of NEC printers, have just announced the release of the new high speed Spinwriter — the model 8800.

The 8800 replaces the popular 7700 series which for many years has been a workhorse for heavy duty and high speed word processing applications. It features a maximum speed of 55cps and, more importantly, is rated at 50 cps using average text 12 pitch, and uses the well known NEC thimble range.

One of the most attractive features of the new 8800 is its versatility. All paper handling options such as sheet feeders, tractors, front inserters and many others are now common throughout the Spinwriter range. It uses the same ribbons and accessories as the 2000 and 3500 series of Spinwriters.

The 8800 also features plug-in interfaces for RS232, IBM, Centronics and Diablo, again giving the user flexibility. Finally, this is the quietest Spinwriter made, and possibly the quietest daisywheel-type printer available.

Datascape Pty Ltd: 44 Avenue Rd, Mosman 2088. Phone (02) 969 2699.

Adam computer now stands alone

Following the sales success of the Module 3 Adam home computer, Computer Distributors Australia have announced the release of a stand-alone Adam. It will be targeted at the small business and office market, but will be available through department stores and electrical retail outlets.

The standard Adam has 80K of memory and 36 columns configuration, although 114K and 80 columns are available as an option. This option, together with the daisywheel printer and high speed digital cassette drive as standard inclusions position the package ideally for the small business computer market. A CP/M dedicated disk drive is to be released during 1985, together with 20 CP/M software titles.

Besides the printer and cassette drive, the stand-alone Adam package includes processor, keyboard and interfaces necessary to have the system fully operational — there are no additional expenses.

Computer Distributors: 26 Cross St, Brookvale, NSW 2100.

2 Gigabytes on laser disc

New technology from France offers a solution to the problem of accumulating libraries of data disks and tapes for Australian computer users.

Distributed in Australia by Pulsar Electronics, the new Gigadisc uses solid-state laser technology and will store 1000 Megabytes (one Gigabyte) of data on each single or double-sided disk cassette.

Gigadisc can be connected to almost any computer via the Small Computer System Interface (SCSI), and allows the direct accessing of any record.

Developed by the French company Thomson-CSF, the computer peripheral can record and store data, text, digital images and speech for a period of at least 10 years.

A computer interface controller can be integrated into the Gigadisc unit, which can handle up to eight Gigadisc units. Associated with this controller is an automatic error detection and correction module.

With the use of the innovative laser technology, writing on the Gigadisc is achieved by the thermal alteration of a metallic film on the disc while reading is done by a laser diffraction technique.

Pulsar Electronics: Catalina Drive, Tullamarine, Vic 3043. Phone (03) 330 2555.

Apple launches computer service plan

Apple Computer Australia Pty Ltd announced a local "AppleCare" service plan for its range of personal computers. It is intended to provide an alternative, low-cost, extended warranty and service plan for Australian Apple buyers. It will be available immediately from more than 100 Apple dealers around Australia, and is designed to cover all Apple systems locally available.

The plan provides cover against unexpected repair costs, no matter how many times these might arise during the term of the agreement. Modular repair systems and careful qualification by Apple of repair centres are expected to result in fast repair service.

The annual cost of an AppleCare carry-in service plan contract will vary from about $72 per year on an Apple IIe to about $156 on a 512K Macintosh. Older Apple products, such as the Apple II+, will also be eligible for cover.

Further information can be obtained from Apple Computer Australia Pty Ltd, 37 Waterloo Rd, North Ryde, NSW, 2113. Phone (02) 888 5888.

IRH to handle Seiko components

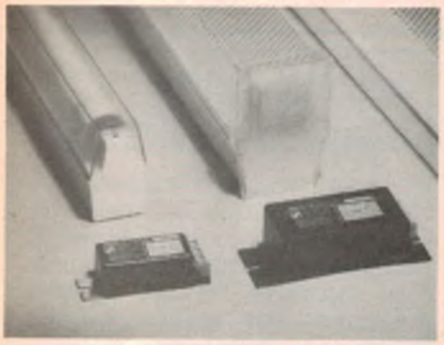
IRH Components has been appointed Australian agents for Seiko Instruments and Components. Seiko products now available from IRH include liquid crystal displays, fibre optics and thermal printers.

Seiko Instruments and Components are specialists in the production of liquid crystal displays including modules providing up to 80 characters per line and multicolour displays using electro-deposited colour filters.

Seiko also produce a wide range of quartz crystals and crystal oscillators using a photolithographic process which reduces the effect of ageing.

Further information on the Seiko range of products is available from IRH Components, 53 Garema Circuit, Kingsgrove 2208. Tel (02) 750 6444 or (03) 484 5021.

12 and 24V fluoros



Selectronics, manufacturers of a wide range of transformers and wound components, have just released a series of low voltage fluorescent lamps designed to operate from 12V and 24V DC supplies.

Powered by the Selectronics designed Invert-A-Lite, these new lamps are available in 13W, 18W and 36W ratings. All units are complete and fully wired ready for installation and have been exhaustively tested in a wide range of lighting environments.

Diffusers are available as optional extras for the 18W and 36W models and the 13W model is supplied complete with a diffuser. Tubes are supplied with all models.

As well as industrial, commercial, general and emergency lighting, the lamps are ideal for domestic, caravan, camping, boating and solar applications.

Selectronic Components Pty Ltd: 25 Holloway Dr, Bayswater, Vic 3153. Phone (03) 762 4822.

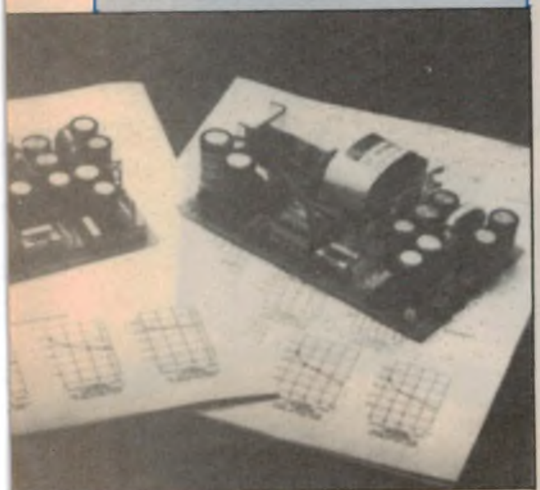
High efficiency switchmode power supplies

A new family of triple- and quadruple- output 50 and 65W switchmode power supplies is now available from Semiconductor Circuits, Inc. Fixed voltage output combinations include triples of +5V/±12V, +5V/±15V, and quads of +5V/±12V/−5V and +5V/±15V/−5V with model-defined output current levels.

The CF Series is designed to furnish cost-effective, reliable power for microprocessor, associated memory and interface chips, disk drives, and video display terminals. Ten models achieve verified minimum Mean Time Between Failures (MTBF) of 100,000 hours. Operating efficiency of 75% (type) over the entire input range enhances reliability by maintaining cooler operation despite input voltage variations.

All models can be configured to operate from either 90 to 130VAC or 180 to 230VAC inputs at 47 to 63Hz. Input protection includes surge limiting of inrush current and on-card fusing of the AC input. All outputs are free of chip-damaging overshoots for specified operating conditions. The outputs are overvoltage clamped and short-circuit protected to output common. Total output power is limited to 150% of full rated output, and output hold up time is 16 minutes.

Further information from The George Brown Electronics Group, 174 Parramatta Road, Camperdown, NSW, 2050. Phone (02) 519 585.

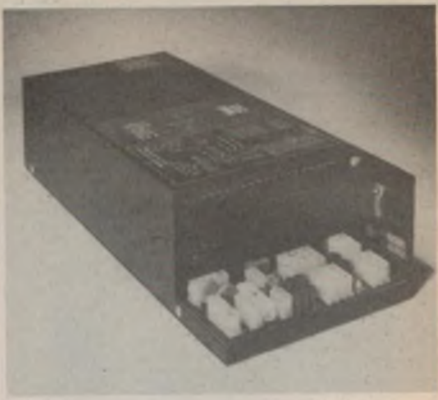


Minicomputer power supply

Scientific Electronics advise the availability of a new switchmode power supply specifically designed for a wide range of minicomputers and peripherals. Designated the SM350AE4, it is the latest in a broad range of switchmode models for the computer industry.

The SM350AE4 has five output rails: +5.2V at 25A; +12V at 6A; +2V at 6A; — 5V at 2A; and — 12V at 2A. Input is 180-280V AC 45-65Hz and 90-140V AC 45-65Hz. It incorporates overvoltage protection on the 5V and 12V rails. Other features are reset and power fault signals, remote on-off facility, remote input voltage selection, and overvoltage protection on the 5V and 12V rails.

Designed and manufactured in



Australia by Scientific Electronics, the SM350AE4 is fully supported by a five-year guarantee and complete local technical back up.

Further information from Scientific Electronics, PO Box 127, Bayswater, Victoria, 3153. Phone (03) 762 5777.

Function generator from Elmeasco

Elmeasco Instruments advise that Exact Electronics has just announced the Model 627 13MHz Function Generator. The unit offers sine, square and triangle waveforms, inverted waveforms, variable symmetry waveforms and DC offset. Frequencies from 100 microhertz to 13MHz may be selected using nine overlapping ranges. Within each range the frequency may be varied over a ratio of 1300:1 either remotely, from the front panel or using an external VCF voltage.

Operating modes include: Run (continuous waveform), Gate (continuous only while gated), Trigger (single cycle waveform with each trigger) and Inhibit (no waveform at output except during GPIB trigger commands; ie, external and manual triggers are inhibited).

All numerical parameter values are selected and displayed on a 3½-digit LED display. These parameters are: frequency, amplitude, offset, symmetry and calibration sequence number. A decimal point and range LEDs determine the multiplier. Amplitude range is 10mV p-p to 10V p-p into 50Ω, offset range is to ±5V peak into 50Ω, and symmetry range is 5%:95% to 95%:5% with 1% resolution. Additional front panel LEDs annunciate the non-numerical parameters which are selected.

Operational parameters current when the unit is powered down are stored in non-volatile memory and recalled when the generator is powered up.

Further information from Elmeasco Instruments Pty Ltd, PO Box 30, Concord, NSW 2137. Phone (02) 736 2888.

Solid aluminium capacitors

Philips Electronic Components has released a new range of long-life solid aluminium capacitors.

These single-ended capacitors are potted in a square epoxy resin case with tightly controlled dimensions. This means that the capacitors sit flush on a PCB surface, enabling them to withstand severe shock and vibration. They are intended to replace tantalum capacitors in applications where high reliability is required.

The 124-series is for filtering, smoothing, coupling and decoupling in general and industrial applications — especially in automotive and mobile equipment. Capacitance range is 0.1 to 68μF, with a tolerance on nominal capacitance of ±20% (or ±10% on request). Rated voltage range is 6.3 to 40V. The capacitors have a basic specification to IEC384-4 (long-life grade), with a category temperature range of −55 to +85°C, and climatic category of 55/085/56 (to IEC68).

Further information from Philips Electronic Components and Materials, PO Box 50, Lane Cove, NSW, 2066. Phone: (02) 427 0888.

Wheelchair batteries

The most commonly heard complaint about electric wheelchairs concerns the restriction of mobility caused by either poor battery performance and/or the problems associated with the handling, maintenance and charging of that battery. Recent developments in lead acid battery technology have largely overcome these difficulties.

One of the companies at the forefront of these developments over the last decade is Gates Energy Products, an American manufacturer whose products are distributed in Australia by Warburton Franki.

Central to the new technology is the recombining electrolyte principle — developed entirely by Gates — which is a process where the majority of the active gassing is kept within the battery. User advantages that result from this process are: no maintenance, no corrosive gassing, no terminal corrosion and air transportation with no restriction.

The two additional areas in which Gates have significantly improved lead acid battery design are in the use of pure lead grids and cylindrical plate construction.

With the greater need to provide disabled persons expanded mobility, especially in electric wheelchair applications, Gates batteries provide far greater range and power. Combined with this advantage is the airline industry acceptance of these batteries for unrestricted carriage with commercial airlines.

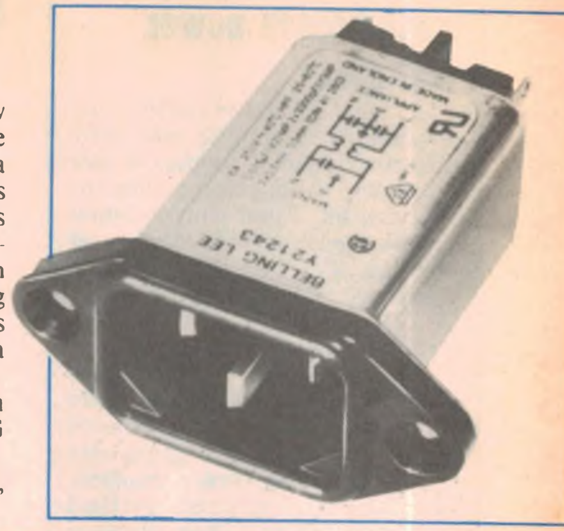
Warburton Franki: 7 Birnie Ave, Lidcombe, NSW 2141.

New releases from Technico

Technico have just released three new mains filters from Belling Lee. Available in 1, 2, or 4 amp versions, the L2144 is a switched filter incorporating a fuse. It is suitable for use with business machines or microcomputers. The Y2127 is a high-performance filter intended for use in data processing and has a current rating of 1mA. Where low earth leakage is important, the Y23243 filter with a current rating of 6A would be suitable.

Also new to Technico are Bussmann fuses and fuse holders and EG & G Wakefield heatsinks.

Technico: 67 Mars Rd, Lane Cove, NSW 2066. Phone (02) 427 3444



Desoldering unit from Cooper Tools

A particularly versatile desoldering unit manufactured by Cooper Tools at Albury, Australia, has been released by Weller. The DS600 is a temperature controlled desoldering device which is completely self-contained, requiring only a 240V AC power source for operation.

Designed for the service industry, the DS600 has a number of features, including a built-in air supply, a unique pushbutton vacuum control built into the desoldering tool handle, and a temperature controlled desoldering head to 370°C.

The DS600 is housed in a lightweight all metal case, fitted with a carry handle. A convenient power cord storage area is included with a quick connect/disconnect locking plug on the iron lead.

Further information from The Cooper Tool Group Limited, PO Box 366, Albury, NSW 2640. Telephone (060) 21 5511 or telex AA56995.

NEW PRODUCTS . . . PRODUCT

Versatile Eprom programmer

A powerful and versatile intelligent EPROM Programmer has been launched and is available from Elmeasco Instruments.

Called the XP640, the unit has been designed to provide advanced programming and editing facilities for all EPROMs and most EEPROMs in common use, but without the addition of personality cards or modules which are so often required with other programmers currently on the market.

The XP640 boasts a whole host of facilities.

Its multi-page video output and 16-character display enables editing and programming data to be presented as comprehensive visual displays. Memory is a massive 64K x 8 RAM and both 8 and 16-bit programming can be accommodated. The RS232C interface supports 16 formats with transmission rates of 19.2K band.

Amongst other facilities the comprehensive RAM editor features ASCII display, RAM editor, page select, define/shift/copy/fill block, split, shuffle, insert, delete, search and replace.

Elmeasco: 15 McDonald St, Mortlake, NSW 2137. Phone (02) 736 2888.

New arc welder from Arlec

Arlec Pty Ltd has introduced a new, improved version of the Weldmate 140 arc welder: The Weldmate model 240. The Weldmate model 240 portable arc welder is designed to operate from any standard domestic 240V power supply through a 15A outlet.

The Weldmate is designed to enable an inexperienced operator to achieve professional results after relatively little practice. It will weld steel up to 8mm thick.

Among the many features is a graduated scale to indicate the most suitable current for a particular size of welding electrode. The current is simply adjusted by means of a handwheel on the front of the unit.

Supplied complete with everything needed to immediately tackle construction and maintenance jobs in the home and workshop, the Weldmate kit contains a face mask, electrode holder, earth clamp, cables, wire brush, chipping hammer, a selection of electrodes, operating instructions and a 32-page illustrated "Guide to Welding" manual.

It may also be used on thin sheet metal for brazing and spot welding in conjunction with the carbon arc torch, specifically designed for use with the Weldmate.

The BK130 carbon arc torch produces an "electric flame" which is ideal for brazing thin, worn or rusty steel and non-ferrous metals and functions as a practical alternative to an oxy-acetylene torch for those applications where arc welding is unsuitable.

It is available from Arlec as a complete carbon arc brazing kit and includes a carbon arc torch, carbon rods, wrap-round headshield, flux impregnated abrazing rods and an attachment enabling the torch to be converted for spot welding.

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

RS-232C fibre optic link

Data Cable Pty Ltd has introduced a new fibre optic RS-232C data link which has many advantages over traditional coaxial cable including the elimination of electromagnetic and radio frequency interference.

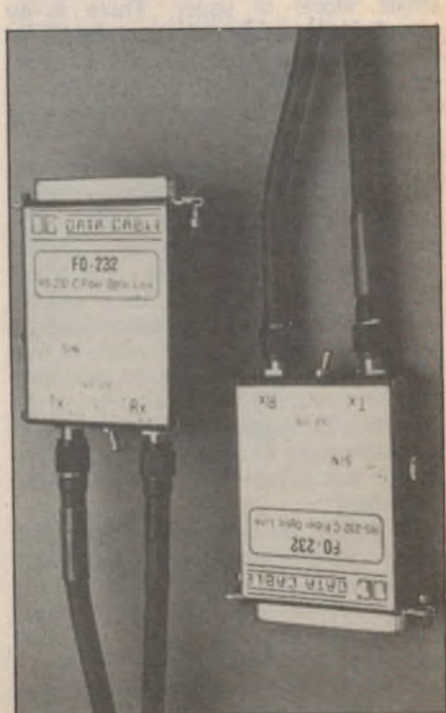
Called FO-232, it is a full duplex optical modem designed for the transmission of asynchronous data via fibre optic cable.

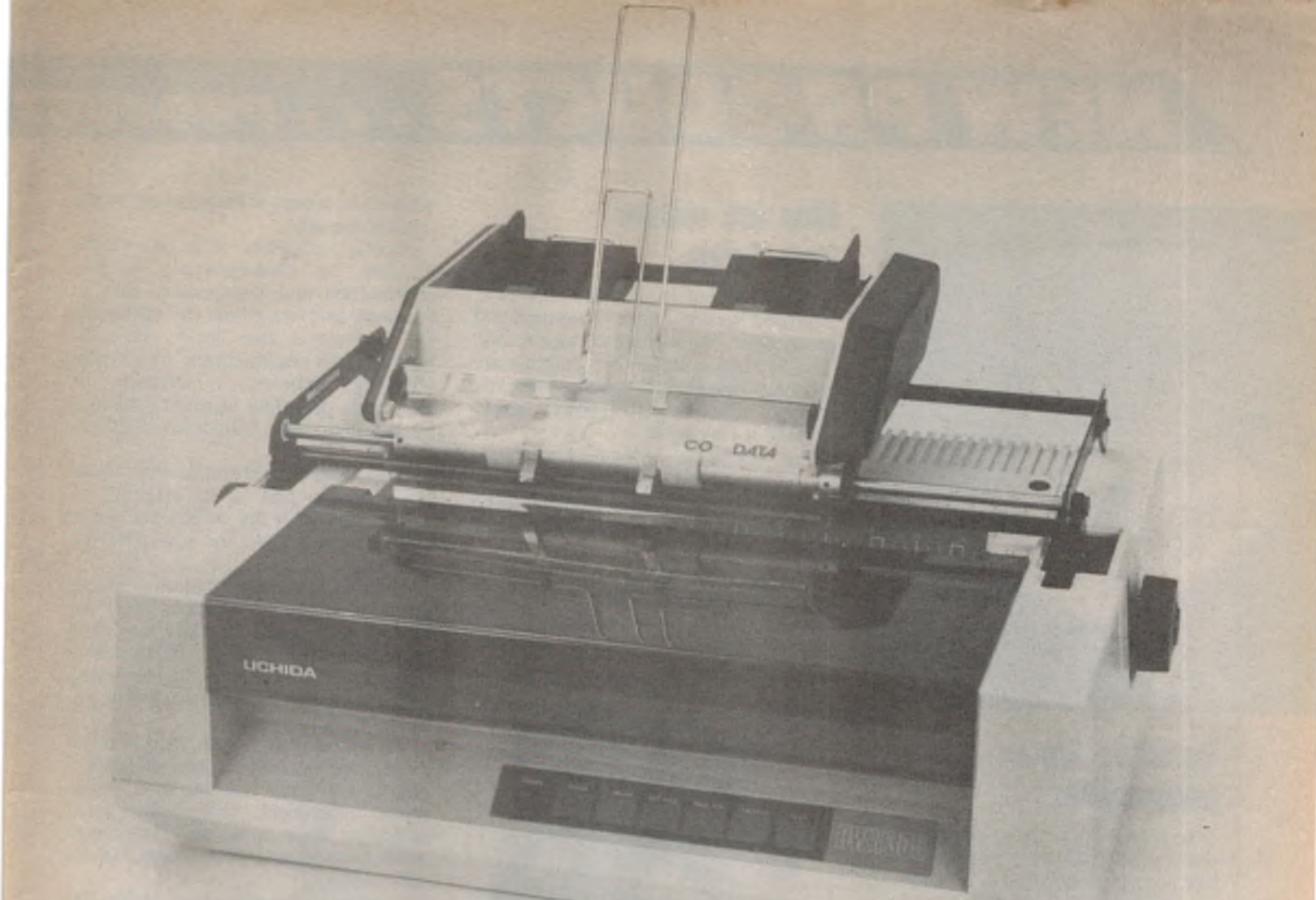
The FO-232 can transmit data up to two kilometres at a full bit rate of 19.2Kb per second or greater, and has absolute electrical isolation.

Data Cable's new FO-232 is used for linking peripherals, remote terminals and process multiplexers to computers, and for inter-building, interconnections and local area networks.

The FO-232 from Data Cable is completely plug to plug compatible with existing RS-232C 25 pin connectors meeting EIA RS-232C and CCITT V.24.

Data Cable: Cnr Croydon & Lincoln Rds, Croydon, Vic 3136. Phone (03) 725 0933.





This view shows the Uchida DWX305 with the optional cut-sheet feeder attachment.

By the way, the basic DWX-305 is friction feed and really handles only single sheets of paper. There is an optional forms tractor attachment, for continous stationery, and also a cut-sheet feeder — although these may not be available from all suppliers. You may have to shop around.

I've been using the sample machine with an IBM PC and Wordstar, and its seems quite compatible with both. Probably the only comment I should make is that like most daisywheel printers, the DWX-305 isn't exactly quiet; the noise level is quoted at 60dB (A scale). So unless you can place it well away from you, a sound-deadening enclosure is really very desirable. At the very least I'd suggest that you place it on a suitable piece of thick industrial felt, to reduce transmission of vibration to the work table.

All in all, the Uchida DWX-305 is a pretty solid little machine and good value for money. If you can't afford one of the faster daisywheels, and don't mind waiting that little bit longer, it would make a good choice for home or office.

As noted earlier, the review machine came from Electrical Equipment Ltd, Measurement and Control Division, at 192 Princes Highway, Arncliffe NSW 2205. Telephone (02) 597 1155. The quoted price is $450 plus 20% sales tax.

A cut-sheet feeder attachment is available for an additional $299 plus tax, and as shown in the picture a feeder was actually supplied with the printer sent for review. It clips quite easily into the top of the printer, having a gearwheel which meshes with an existing gear on the typing platen shaft.

The feeder is a fairly simple affair, and has fixed mechanical gearing. This means that it automatically loads in a new sheet when the printer platen has turned to advance the paper by 12 inches (305mm) — regardless of the actual length of the paper. Note that this doesn't mean that you can only use paper sheets cut to 305mm long, just that this is the maximum length of paper you can use with the feeder. So standard A4 letterhead paper is fine, or smaller sheets, but F4 "foolscap" is too long.

Unlike the DWX305, the feeder is actually made in Germany, and has an operator's manual written in rather clipped "German English". Most of it is fairly easy to follow, although I found the part on setting the "Top of Form" rather glib and superficial. This is unfortunate since this setting is actually rather tricky — you have to synchronise the feeder's mechanical top of form setting (ie, the point when it has just stopped feeding in a new sheet) with the top of form setting in the printer's electronics.

It's not too difficult to do this once you get the hang of it, but the manual isn't too helpful. You also have to make sure that the printer's rear DIP switch is set for 12 inches of paper feed in response to a form-feed control character, and then enusre that your computer software does in fact send form-feed characters. I found this out the hard way — my version of Wordstar was set to send repeated line feeds instead of a form feed, and I couldn't get it to work properly with the feeder until I changed it to send form feeds!

Despite these minor hassles, the feeder does seem to perform quite well. It should be quite valuable when the printer is to be used in an office environment, although the limitation on maximum paper length seems unfortunate in view of its price. (J. R.)

Uchida DWX305 daisywheel printer

Uchida's DWX305 is one of the "new breed" of daisywheel printers, priced at below half the cost of earlier models. Jim Rowe has been putting it through its paces, and in this review he explains the features and performance you can expect — together with those you can't.

Japanese manufacturers have tended to dominate the "small computer" printer market for the last four or five years, with a string of models offering more features and better prices than those from other countries. However this dominance has been more in the dot-matrix area than with letter-quality printers. Although their daisywheel printers have generally been cheaper than the competition, their price tags have still tended to put them out of reach of most personal computer buyers.

Until recently, that is. In the last year or so a "new breed" of low-cost daisywheel printers has emerged from Japan, with retail prices well below the thousand dollar mark. The Uchida DWX-305 is one of the new breed, being currently sold by a number of local firms at prices varying quite considerably but averaging around $550. The machine for review actually came from the importers and distributors, Electrical Equipment Ltd.

The obvious question to ask about this kind of low-cost printer is what you miss out on, compared with the more expensive models. It is print quality, speed, features, reliability — or what?

Having used the sample DWX-305 for a while now, it seems to me that the main thing it sacrifices is speed. While advertised by some firms as capable of 20 characters per second, its actual printing speed in practice seems to be closer to 15 cps on normal text. This rises to about 18 cps when repeating characters. The 'carriage return' and form feed functions are also relatively slow, although in the case of carriage returns this is partly compensated by the fact that it can print bi-directionally.

Of course the average printing speed is still about 40% faster than all but the quickest human typists, so it's not exactly crawling along. In fact it's probably quite OK for most normal correspondence printing — particularly if your computer or word processor has a print spooler of some kind. But if you're used to one of the faster (and more expensive) daisywheels, you'll certainly notice the drop in speed.

When it comes to print quality, reliability and features, the Uchida seems to compare quite closely with its more expensive brothers. Print quality with a standard multi-strike carbon ribbon is very crisp and even, although just noticeably lighter than the output from a golf-ball typewriter. It seems to be quite sturdily made, and the sample has done a lot of printing so far without missing a beat.

The features it offers include a choice of either bi-directional logic seek printing or proportional printing (standard 1/120 inch increments), choice of three pitches (1/10, 1/12 or 1/15 inch), fractional line feed (1/48 inch increments) for superior and inferior figures, and a choice of four levels of print impression. The maximum paper width is 330mm (13 inches).

The DWX-305 responds to standard 7-bit ASCII code, and accepts the standard control codes. This includes the "escape sequence" extended control codes now used on most ASCII printers for setting printing mode and fractional control of both print head and paper feed.

There are six membrane-type pushbuttons and four LED indicators on the printer's front panel. the pushbuttons are for online/offline switching, error reset, setting top of the page, form feed, line feed and test print. The last four only operate when the printer is set to offline status. The four LEDs indicate power, online, error status and test mode.

There are two 8-way DIP switches on the rear of the printer, which are scanned by the inbuilt microprocessor when power is first applied and when a specific escape code sequence is received (ESC-SUB-I). Only one bank of switches is functional on the Centronics-interface model, the switches being used to set it for various functional options: serial or line-print mode, auto linefeed with carriage return or not, line feed pitch (6 lpi or 3 lpi), page length select (11 or 12 inches), printing pitch (10/12/15 cpi) and hammer impact (three settings).

The DWX-305 measures 550 x 365 x 162mm (lxdxh) and has a mass of 9.5kg. Its power consumption is 20 W when idling and 80-100 W when printing. It is rated to operate at temperatures up to 40° C, and up to 85% relative humidity (non condensing).

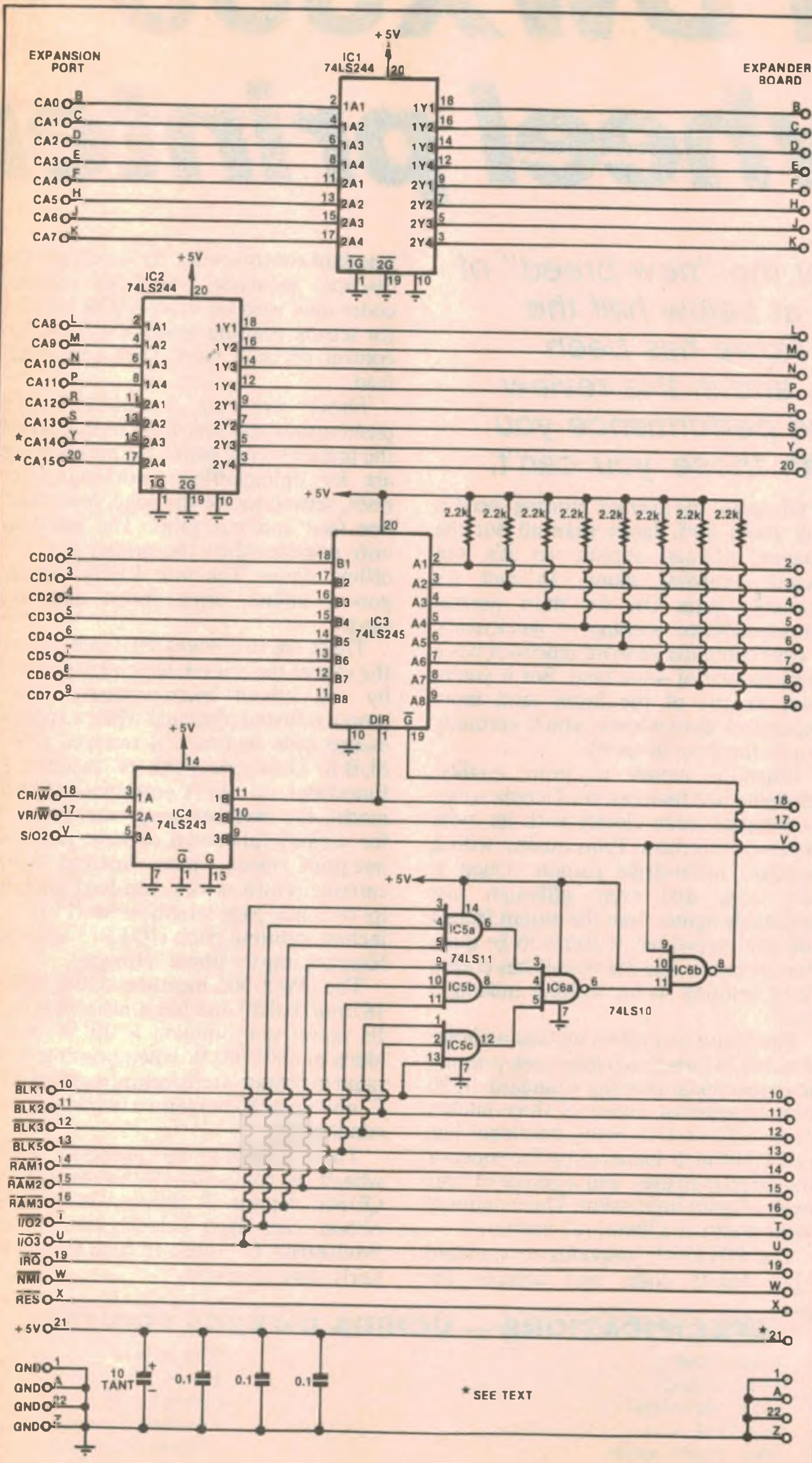
The Uchida's 96-character print wheels are compatible with those for the QUME 'Sprint 3' printer, as are the ribbon cartridges (which are of the 'Multistrike IV' type), so both should be fairly easy to obtain.

SPECIFICATIONS — UCHIDA DWX305 PRINTER

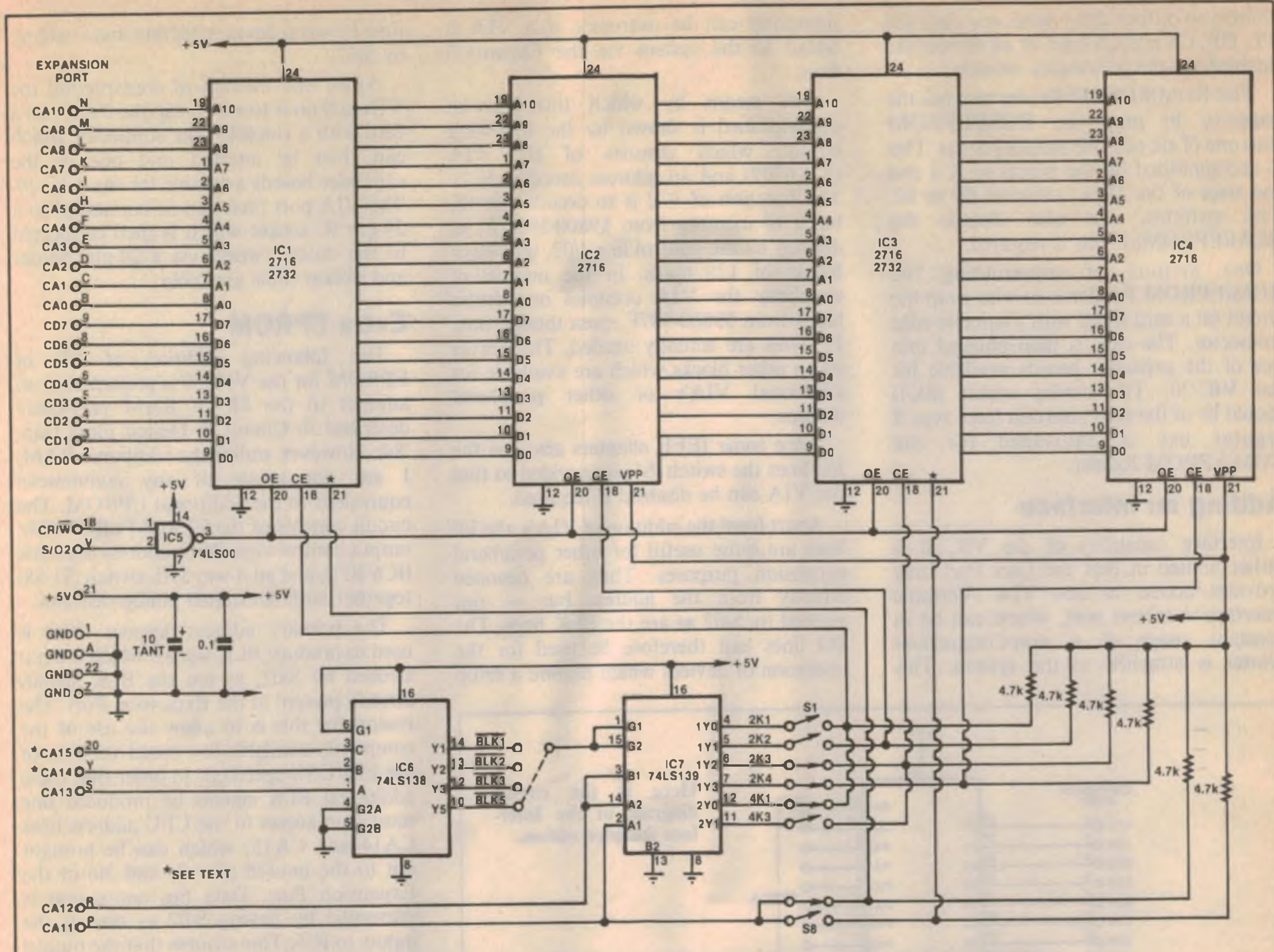
Print head	Daisywheel
Print speed	15cps
Print direction	Bidirectional
Interface	Centronics parallel
Max paper width	330mm (13 inches)
Line feed pitch	6 lpi or 3 lpi
Printing pitch	10, 12 or 15 cpi
Price	$450 plus sales tax

this case the +5V line of the expansion port must be isolated from the expander board supply.

A methold of constructing the buffer circuit is to use a double sided printed circuit board which is housed in a spare cartridge case. The unit can then be plugged into the VIC-20 expansion socket and connected to the expander board by ribbon cable and edge connector.



This diagram shows the Expansion Port Buffer add-on. It can be built into a spare expansion cartridge case.



The Extra EPROM add-on. Use ZIF sockets if the EPROMs are to be changed frequently.

VIC-20

with a circuit diagram of the VIC-20. A circuit diagram can be found in either "VIC Revealed" or the "VIC-20 Programmer's Reference Guide".

The address bus is buffered by IC1 and IC2 while the commonly used control lines CR/W, VR/W and S/02 are buffered by IC4. The control lines BLK1 to I/03 are not buffered since they would not be heavily loaded by devices on the expander board. The contol lines IRQ, NMI and RES are also not buffered in order that their "wire-OR" capability is maintained.

In contrast to the previously mentioned unidirectional buffers the data bus uses a bidirectional buffer (IC3). This is necessary since the CPU (6502A) is capable of both reading from and writing to devices located on the expander board. The direction of data transfer being controlled by the CR/W line. The CR/W is used instead of VR/W so that the data direction is established independently of the enabling of IC3.

The enabling of IC3 is controlled by IC5 and IC6 to ensure that only valid data is placed on the CPU data bus. The enabling of IC3 must only occur when the address bus is stable and when a device on the expander board is being addressed. Address bus stability is ensured by strobing with S/02 while expander board selection is defined by the state of the memory select lines BLK1 to I/03.

The control lines BLK1 to RAM3 are strobed by S/02 within the VIC-20. The I/O lines are not, hence the presence of S/02 as one of the inputs to IC6b. One could replace IC5 and IC6a by a 74LS133 but this device is expensive and difficult to obtain. The pullup resistors ensure that the state of the expander board data bus is always defined.

The address lines CA14 and CA15 have been added so that the entire address bus is available at the expansion port. To add these address lines the VIC-20 must be dismantled and the circuit board removed. Direct connections can then be made underneath the circuit board from the CPU address lines A14 and A15 (pins 24 and 25), to the unused pins (Y and 20) of the expansion port.

The buffer circuit can be powered from the VIC-20 but for improved reliability of the VIC20 power supply, a separate supply should be used for the expander board. In

address to output delay time, and that the CE, OE, CS and CS lines of all devices are enabled via the personality module.

The ROM/EPROM Reader also has the capacity to map the ROM/EPROM into one of six possible memory areas. This is accomplished by the inputs to IC3 and the state of the D.I.L. switches S0 to S2. The switches can also disable the ROM/EPROM, if this is required.

One method of constructing the ROM/EPROM Reader is to wire-wrap the circuit on a card fitted with a suitable edge connector. The card is then plugged into one of the expander boards available for the VIC-20. The device socket (SK1) should be of the zero insertion force type if regular use is envisaged for the ROM/EPROM Reader.

Adding an interface

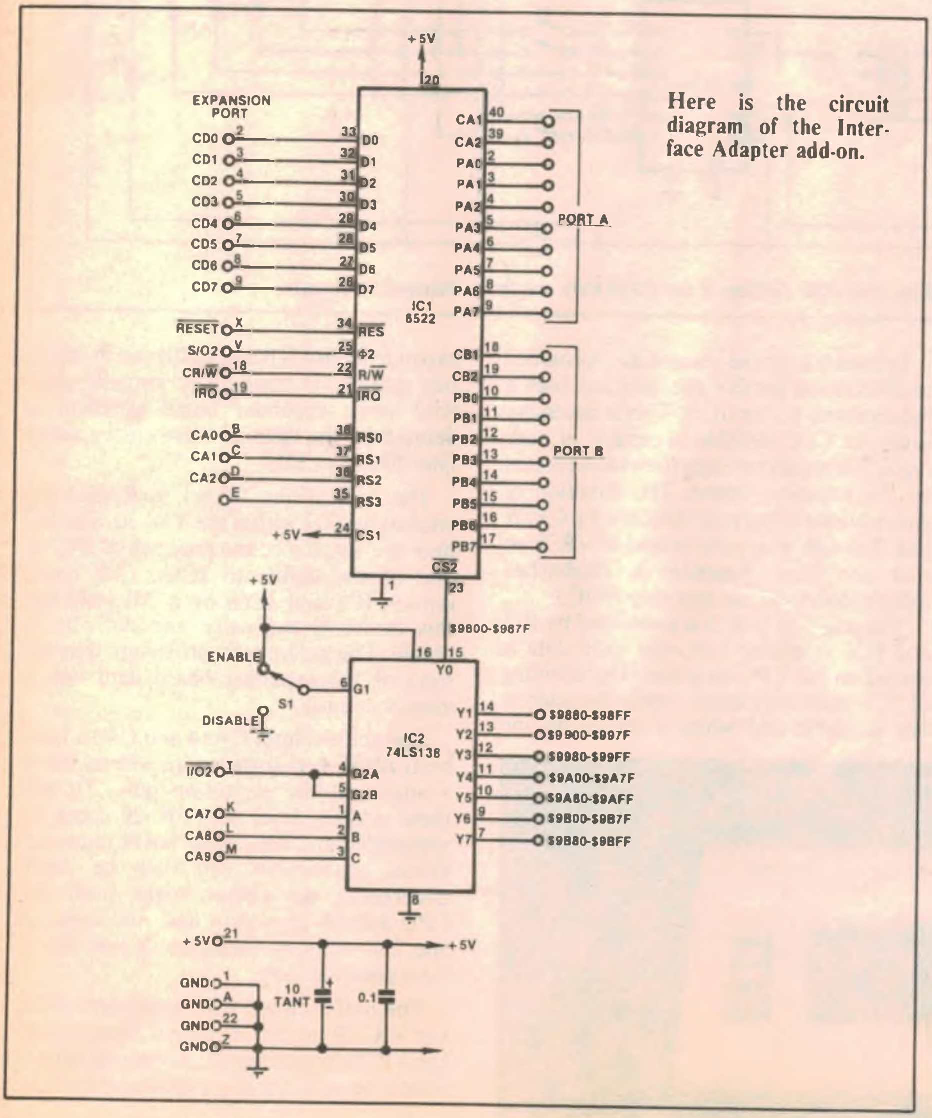
Interface capability of the VIC-20 is rather limited in that the User Port only provides access to one VIA (Versatile Interface Adapter) port, which can be in constant usage if a non-Commodore printer is attached to the system. This limitation can be overcome if a VIA is added to the system via the Expansion Port.

One means by which this can be accomplished is shown by the following circuit, which consists of the VIA (IC1,6522) and an address decoder (IC2). The function of IC2 is to decode the 1K block of memory from $9800-$9BFF, as defined by the control line I/02, into eight blocks of 128 bytes. In the interest of simplicity the VIA occupies one entire block from $9800-987F, even though only 16 bytes are actually needed. This leaves seven other blocks which are available for additional VIA's or other peripheral devices.

Since some IEEE adapters also use the I/O lines the switch (S1) is provided so that the VIA can be disabled if required.

Apart from the addition of VIA's, the I/0 lines are quite useful for other peripheral expansion purposes. They are decoded directly from the address bus — not strobed by S/02 as are the BLK lines. The I/O lines can therefore be used for the operation of devices which require a setup time between device selection and enabling by S/02.

Again one method of constructing the VIA add-on is to wire wrap the circuit on a card with a suitable edge connector which can then be inserted into one of the expander boards available for the VIC-20. The VIA port lines can be connected to a 24-pin IC socket which is then connected to the outside world via a 24-pin header and ribbon cable assembly.



Here is the circuit diagram of the Interface Adapter add-on.

Extra EPROM

The following addition of 8K of EPROM for the VIC-20 is presented as an adjunct to the 8K of RAM previously described in Circuit & Design Ideas (Jan. '84). However, unlike the additional RAM, I am not aware of any commercial equivalent to the additional EPROM. The circuit consists of the EPROM's (IC1-IC4), output control logic (IC5), address decoders (IC6-IC7), and an 8-way DIL switch (S1-S8) together with associated pullup resistors.

The primary address decoder (IC6) is used to produce BLK signals which are not strobed by S/02, as are the BLK signals already present at the Expansion Port. The reason for this is to allow the use of the commonly available low speed versions of the EPROMs specified. In order that these additional BLK signals be produced one must gain access to the CPU address lines CA14 and CA15, which can be brought out to the unused pins (Y and 20) of the Expansion Port. Data bus contention is prevented by having S/02 as one of the inputs to IC5. This ensures that the output lines of the EPROMs will only be enabled when a data-read operation, under the control of S/02, is in progress.

The secondary address decoder (IC7) is enabled by the relevant BLK signal (link selectable), and uses the address lines CA11 and CA12 to produce two 4K memory block selects as well as four 2K memory block selects. The 4K and 2K block selects allow for a mixture of 4K (2732) and 2K (2716) EPROMs. It should be noted however that IC2 and IC4 can only be 2716s, whereas IC1 and IC3 can be of either type.

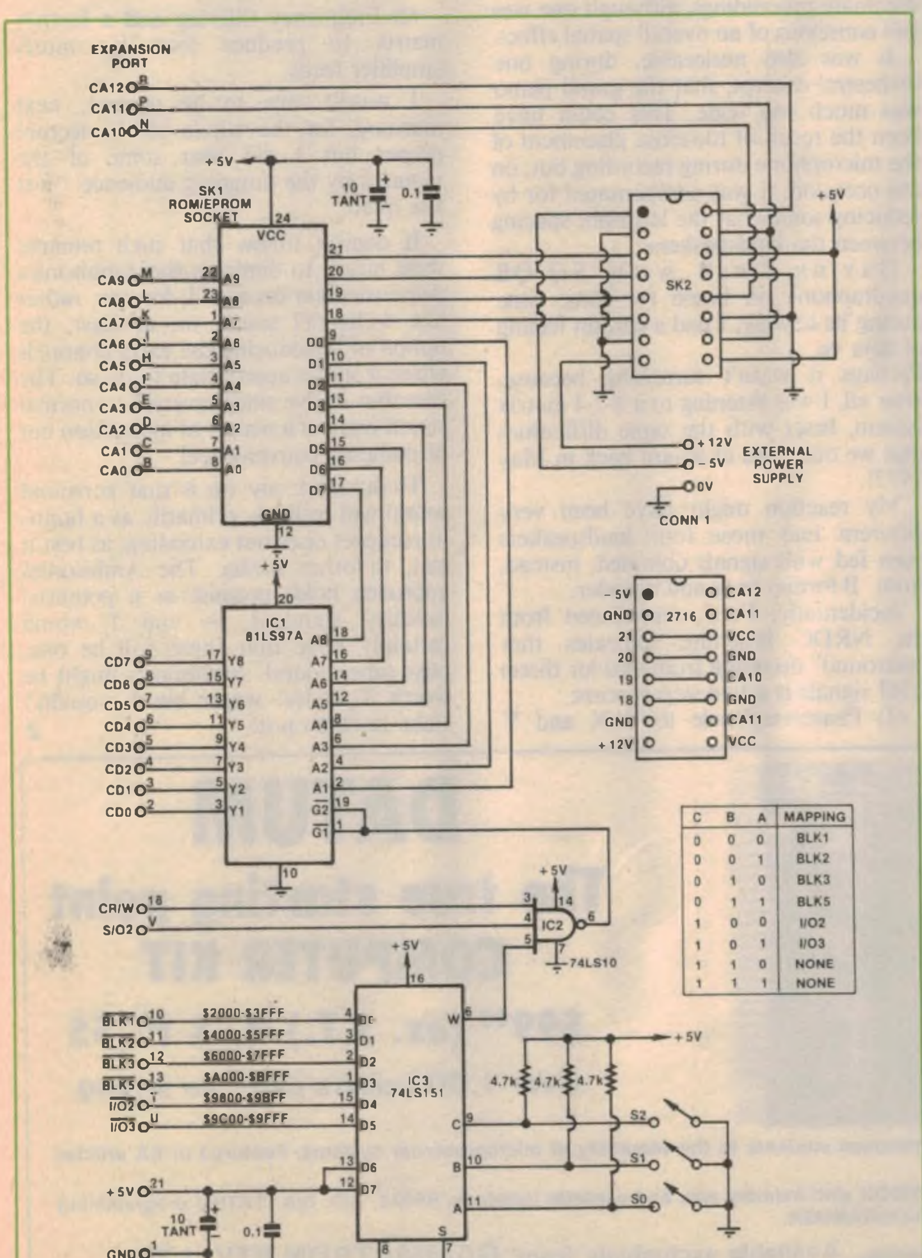
The device type which is to be used for IC1 and IC3 is established by the state of the DIL switch (S1-S8). As shown IC1 is a 2732 while IC4 is a 2716. The switch states must be such that memory overlap does not occur, which is why IC2 is not selected in the given example.

Expansion port buffer

There are numerous expander boards available for the VIC-20. However, some of these boards are not buffered. Should one desire to add buffering then the following approach presents one method whereby this can be accomplished. Operation of the circuit is the best understood when studied in conjunction by L. Murakami

ADD-ONS for the VIC-20

Attention VIC-20 owners! Want to build a ROM/EPROM reader? How about an extra PIA? These circuit ideas and two others are described in this VIC-20 'special'.



C	B	A	MAPPING
0	0	0	BLK1
0	0	1	BLK2
0	1	0	BLK3
0	1	1	BLK5
1	0	0	I/O2
1	0	1	I/O3
1	1	0	NONE
1	1	1	NONE

This is the circuit diagram of the ROM/EPROM Reader add-on for the VIC-20.

First let's take a look at the ROM/EPROM reader. This was designed to meet the following objectives: 1. Read devices having different pinouts; 2. Read devices having different functional behaviour; 3. Read the commonly available low speed versions of many devices; 4. Map the devices anywhere in the available memory space (necessary with devices having the auto-start facility).

In order that the ROM/EPROM Reader can accommodate devices having different pinout configurations, "personality" modules are employed. The personality module consists of a 16-pin header which has been hard-wired for the ROM/EPROM that is to be read. This module is inserted into the personality module socket (SK2), thereby configuring the ROM/EPROM socket (SK1) for that particular device. The module shown has been strapped for an Intel type 2716 EPROM for which the CE and OE lines are permanently enabled. The reason for this course of action is twofold.

Successful reading

Firstly the CE line is enabled so as to ensure the successful reading of the slower versions of ROM/EPROM devices which incorporate a power down feature. This approach overcomes the maximum CE to output delay time, which would be a problem if the BLK lines were used to enable these devices directly. The BLK lines are unsuitable since they are active only when S/02 is active: its duration is too short for the above timing parameter. With the device permanently enabled, the power down feature cannot be utilised, however this is not of major consequence as only one device is affected.

Secondly the OE line is enabled since IC1 is used for output data control. IC1 is needed for those devices which have a common chip enable/output control line eg, 2532. IC1 serves to isolate the VIC-20 data bus from the output lines of the ROM/EPROM which are now continually active due to the permanent device enabling, as mentioned above. The enabling of IC1 is controlled by IC2 which ensures that IC1 will be enabled only when the ROM/EPROM is being addressed and a data-read operation is in progress.

The conclusions to be derived from the above discussion are that ROM/EPROM read timing is now substantially that of

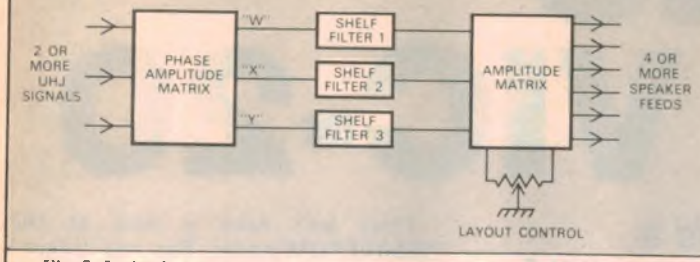


Fig 5: **In its least pretentious form, Ambisonics offers four outputs from two input channels. They claim superior results, presumably because their decoding involves phase, amplitude and frequency.**

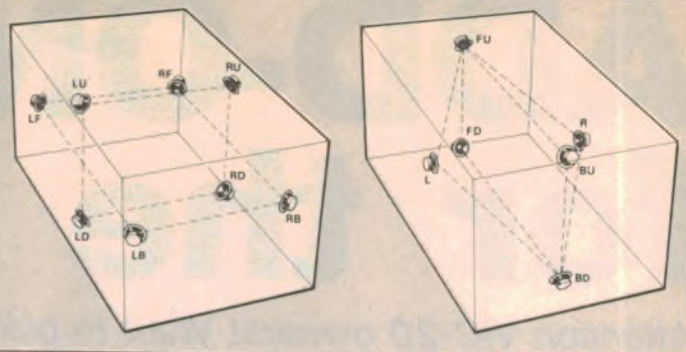


Fig 6: **If the Ambisonics group have their way, you may end up with four signal channels from, say, compact disc, decoded to feed six or eight loudspeakers in a "periphonic" array!**

and acoustics".

For the demonstration, the lecturer used recordings which had been made with a Calrec Mark IV microphone, encoded into 2-channel UHJ and recorded on Beta cassette in a Sony F1 portable digital recorder. The recordings include a carol service in the Guilford Cathedral plus orchestral excerpts from Elgar's "Gerontius" and the Moussorgsky/Ravel "pictures at an Exhibition".

The demonstration equipment, set up in the ballroom of the Melbourne Hilton, included a 2-channel to 4-channel decoder, four power amplifiers and four Quad ESL-63 loudspeaker systems — spaced out from the corners of the seating area, as in Fig.4.

By chance, I happened to be around during the previous evening, when the equipment was being set up by Robin Maconie and his assistant, Erdo Groot, a graduate of the Tonmeister course.

Moving around the room, it was immediately apparent that one needed to be somewhere near the centre of the listening area to experience good all-round balance. Moving towards any one of the loudspeakers caused its output to dominate proceedings, although one was still conscious of an overall spatial effect.

It was also noticeable, during one orchestral excerpt, that the grand piano was much too wide. This could have been the result of too-close placement of the microphone during recording but, on the occasion, it was compensated for by reducing somewhat the left/right spacing between the loudspeakers.

Having lived with SQ/QS quadraphonic in home for some time during its heyday, I had a certain feeling of deja vu.

Perhaps it wasn't surprising because, after all, I was listening to a 4-2-4 matrix system, beset with the same difficulties that we discussed at length back in May 1972!

My reaction might have been very different had those four loudspeakers been fed with signals obtained, instead, from B-format tape and decoder.

Incidentally, Fig.5, reproduced from the NRDC brochure indicates that "surround" decoding from two (or three) UHJ signals is a two-step process:

(1) Phase/amplitude to W,X and Y resultants, followed by

(2) Frequency filtering and a further matrix to produce four (or more) amplifier feeds.

I wasn't able to be present, next morning, for the whole of the lecture proper but I did hear some of the remarks by the outgoing audience: "just like quad!"

It doesn't follow that such remarks were meant to diminish the Ambisonics demonstration because I, for one, rather like 4-channel sound or, at least, the option of introducing the extra channels when it seems appropriate to do so. The fact that I have since reverted to normal stereo was not a matter of inclination but of domestic convenience!

To sum up: my tip is that surround sound will be back, primarily as a bonus in compact discs but extending, as best it can, to other media. The Ambisonics approach holds promise as a potential industry standard — and I would certainly hope that there will be one, next time around. Ambisonics might be worth a modest wager but I wouldn't stake my life on it!

Fig 3: **The Ambisonics system as envisaged by NRDC. Signals from a soundfield mic., pan-pot system, &c, are mastered as W,X,Y and Z components, then decoded into software to meet requirements. Note that the UD-4/CD-4 "discrete" type disc is included in their options.**

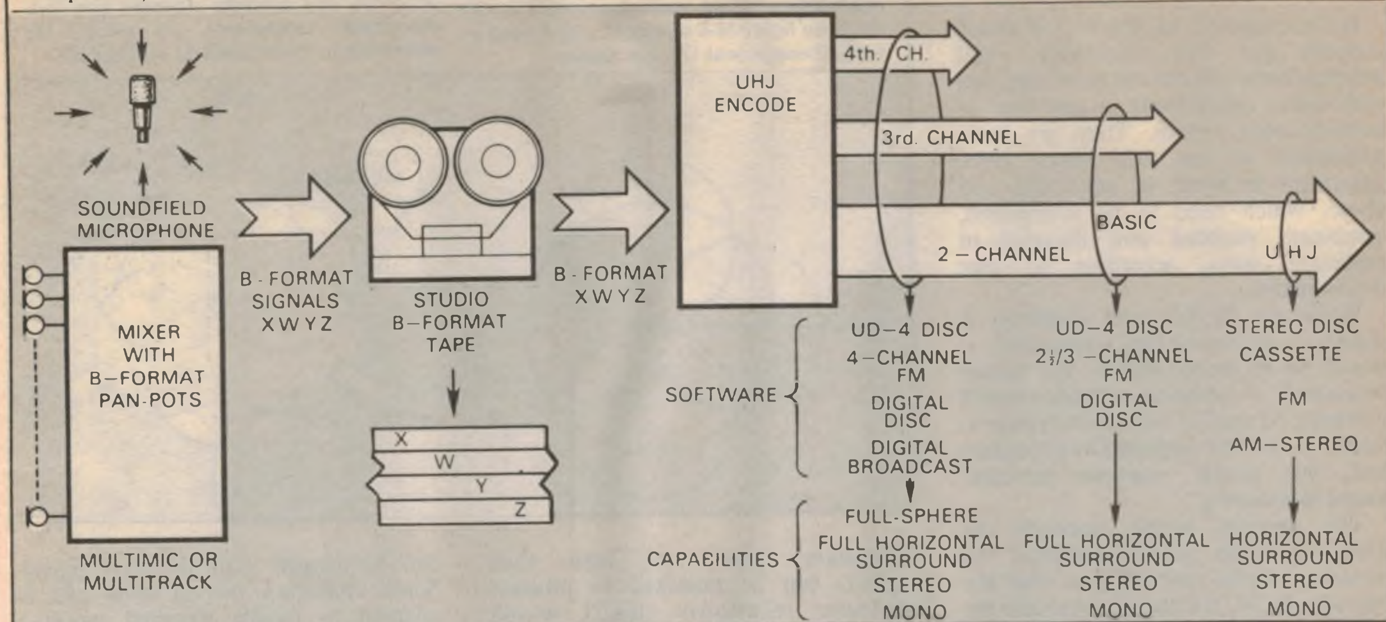
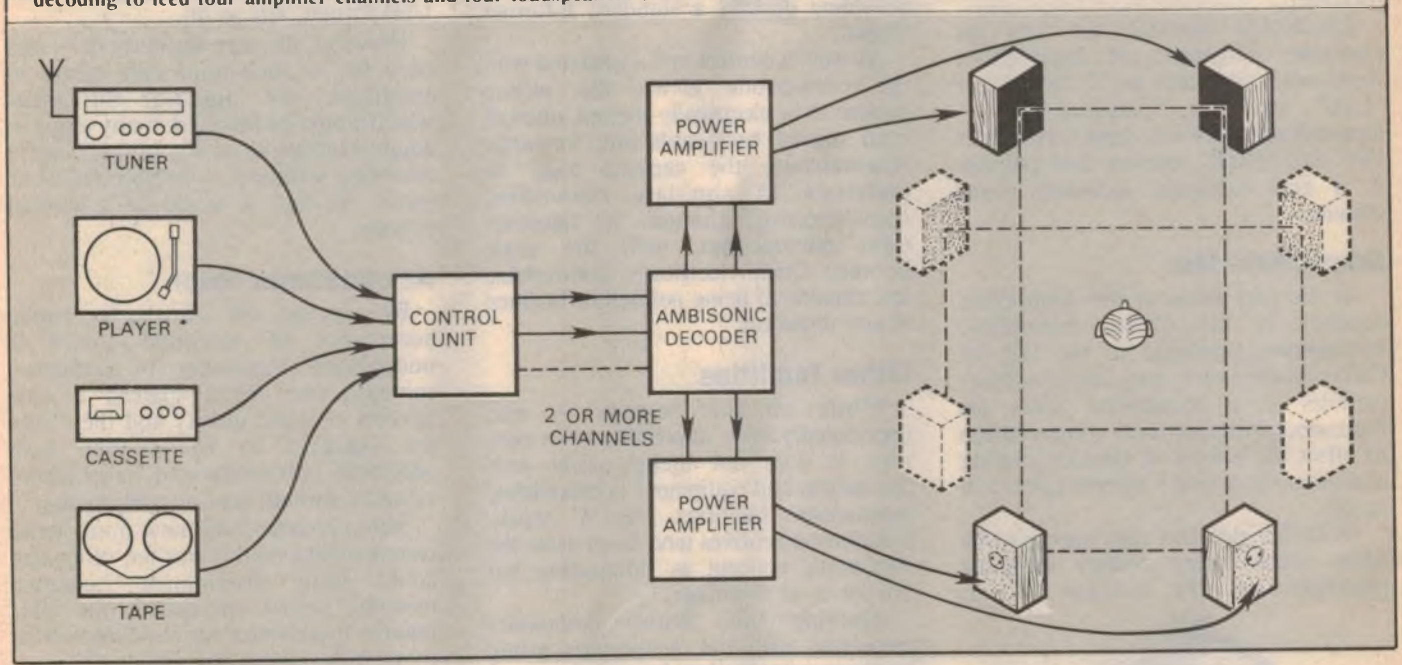


Fig 4: **In Melbourne, the system was set up as per this NRDC diagram, using two UHJ inputs from a Sony digital cassette source, with decoding to feed four amplifier channels and four loudspeakers (drawn solid).**



Ambisonics

small labels, have the market to themselves.

That the Ambisonic group has all this in mind is evident from the accompanying diagram (Fig.3) from NRDC, which currently holds the international patent rights for Ambisonics technology.

And therein lies the logic of the Ambisonics system. It offers a master recording standard which can reputedly capture on digital tape the "total sound" parameters of any given performance. In real time, or at any time, that basic B-format information can be converted by standardised procedures into any form required by the consumer market: from 6-channel periphonic through to humble mono.

Is it the best way of accomplishing that end result, without getting bogged down in patent rights and liabilities? The answer to that, I imagine, will depend very largely on the tractibility or otherwise of the NRDC!

Back to Melbourne

At the AES Convention, the Ambisonics demonstration was presented by Robin Maconie, MA (Hons), composer and lecturer in music and technology at the University of Surrey, UK.

While emphasising the logic and the merit of digitally based Ambisonics technology, both for mastering and consumer UHJ derivatives, he pointed out that his principal involvement was in connection with the "Tonmeister" course at the University of Surrey. Based on a German concept, it is described as "a first degree music course combining traditional studies in music theory and history with a full training in practical sound recording with associated physics

Ambisonics

It is emphasised that the W,X,Y and Z signals are not normally used independently and are not to be confused with direct signal feeds to any kind of multi-channel system. They are basic parameters of the total sound field, significant in terms of amplitude and phase, which need to be interpreted, combined, encoded and decoded in particular ways, according to user requirements.

While the W,X,Y and (possibly) Z signals — the sound field parameters — would be recorded directly for future processing, an ambisonic decoder would normally be used in the control room to feed four suitably dispersed loudspeakers and thus permit real-time surround sound monitoring.

The decoder would normally be provided with panel controls to introduce further decoding, so that the operator could, if need be, evaluate the sound as it would be in consumer 3-channel, 2-channel or even mono formats.

Recordings suitable for use on consumer equipment are described in Ambisonics literature as "C-format" or "UHJ", short for "Universal HJ" — terminology which has carried over from BBC and NRDC research into possible 2, 3 and 4-channel surround sound systems.

Soundfield Mic

At the very heart of the Ambisonics concept is the Calrec Soundfield microphone, produced in the UK by Calrec Audio Ltd. It uses four condenser capsules in a tetrahedral array (as illustrated) with electronic compensation to offset the effects of element spacing and simulate a single listening point in space.

While the elements may appear to be oddly placed, they occupy sampling positions on the surface of an imaginary sphere. As such, their outputs can be matrixed to produce multiple resultants (fig.2) which correspond to the polar responses and signals of Fig.1: W,X,Y and Z, thus providing directly a standard B-format output.

Fig 1: In the Ambisonics system, the original soundfield is recorded as a combination of an omindirectional signal (W), two figure-of-8 signals (X and Y) and a vertical component (Z), not shown.

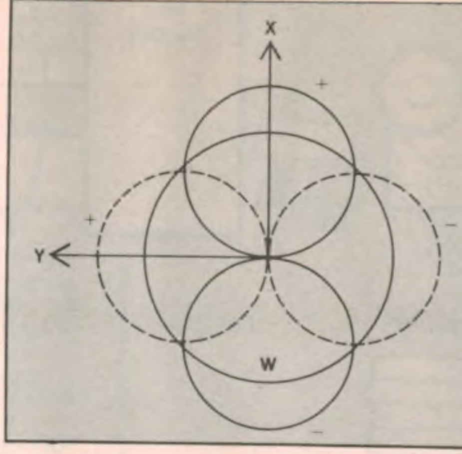
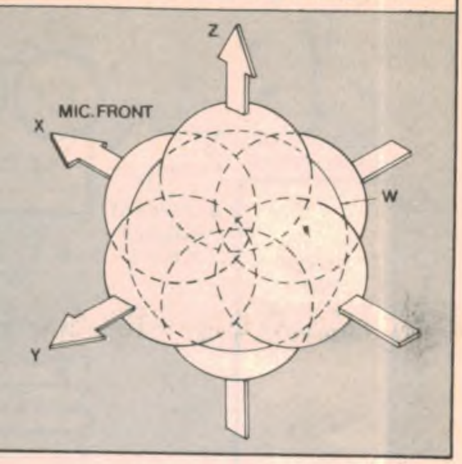


Fig 2: Reproduced from the Calrec brochure, this diagram indicates how four directional components are created by matrixing in the Soundfield microphone.



The Calrec Mark IV Soundfield microphone, with outer cover removed. Outputs from the four capsules are normally multi-matrixed to produce signals in accordance with Ambisonics B-format requirements.

As well, a control unit associated with the microphone allows the pickup pattern to be electrically rotated, tilted or even moved backwards and forwards. Alternatively, the capsules may be matrixed to simulate coincident omnidirectional through to figure-of-eight microphones, with the angle between them electrically controllable and capable of being pointed or inclined in any direction.

Other facilities

While all this sounds — and undoubtedly is — impressive in its own way, it does not merge easily with procedures and equipment in established production facilities. As a result, recording executives tend to set aside the Ambisonic concept as "interesting but not for us at this stage".

Realising this, British companies associated with the Ambisonics group have recently developed and announced equipment which may help bridge the gap. Apart from Ambisonic monitor/decoders, mentioned earlier, they list a pan rotate unit, B-format converters, UHJ encoder/transcoders, &c.

With such units, monitoring facilities in a control room can be expanded to cope with B-format surround sound and its UHJ derivatives. Signals from conventional mono microphones, &c. can be merged with B-format signals. Some multitrack mixing desks can be adapted to handle B-format working. Conventional stereo and quadraphonic signals can be transcoded into simulated UHJ format, and so on.

However, the very existance of — and need for — such units only serves to emphasise the practical difficulties which would be involved in any move to adopt Ambisonics as the primary world recording standard — irrespective of its merit. At best, it would be a gradual process.

At consumer level

By contrast, the climate for public acceptance of surround sound is undoubtedly improving. In particular, compact discs have sparked a new interest in sound quality and they have the potential to be encoded with additional surround-sound information, virtually without cost or compromise.

Stereo broadcasting, now much more commonplace than it was ten years ago, could easily disseminate 2-channel material, matrix encoded in the UHJ manner to provide a surround illusion for those with suitable equipment.

FM broadcasters would have the further advantage of being able to transmit a supplementary signal which, while offering only a modest response, could substantially improve the surround effect, using so-called 2-1/2 channel UHJ encoding.

Interestingly, hifi VCRs, with their FM-stereo plus analog tracks, would also appear to be candidates for 2-1/2 channel surround encoding.

And who knows? Given a substantial move in these areas, black discs and stereo cassettes could easily reappear in quantity with surround sound encoding — this time in UHJ. At the moment, Nimbus in the UK, and one or two other

by NEVILLE WILLIAMS

But things didn't work out that way. With all the doggedness and detachment of an academic group, proponents of Ambisonics kept plugging away, with practical assistance from the BBC and ITA and sympathetic input from overseas sources.

From material picked up at the Melbourne AES Convention, it is apparent that the attention of the Ambisonics group is currently focused on recording studios, rather than consumers. Their prime objective, right now, is to see the format adopted as an industry standard for all future master recordings.

From Ambisonics masters, engineers would then hopefully produce compatible Ambisonics style derivatives in whatever format market requirements might dictate: mono, 2-channel stereo, 2-1/2 or 3-channel surround, 4-channel surround, or full sphere "periphonic" involving six channels or more!

The job ahead of Ambisonic proponents is therefore to convince recording interests, recording engineers, producers and anyone else who matters in that area, that they should begin to draw on Ambisonic techniques and a growing inventory of Ambisonic hardware to produce future recordings.

That, by so doing, they would not only enhance the quality of normal stereo or mono software, but they would also be building an inventory of master recordings against the day when true surround or even periphonic sound is introduced once again to the domestic scene.

In short, that Ambisonic technology is unrivalled in what it has to offer, in terms of planning for the future.

Old-style 4-channel

A brochure from the British National Research Development Council (NRDC) re-affirms the objections of the Ambisonic group to old-style quadraphonic sound, claiming it to be an unacceptable extension of ordinary stereo.

Conventional 2-channel stereo, they say, relies on fairly critical placement of the loudspeakers for an acceptable aural illusion. They must not be too close together but, equally, the illusion suffers if the angle subtended at the listening position is too great.

Again, stereo works well only when the listener is facing the loudspeakers. If the listener turns his or her back to them, the aural illusion of direction and spread normally suffers. Side-on to the loudspeakers, the illusion is usually quite poor.

According to the Ambisonic group, these observations are crucial to the evaluation of an old-style quadraphonic system as, for example JVC/RCA's CD-4 "discrete", which is credited with better inter-channel separation than any of its contemporaries.

To localise a sound in the frontal sector, signals of appropriate relative amplitude are fed to the LF (left front) and RF (right front) loudspeakers. For a sound on the listener's right, signals are fed to the RF and RB (right back) loudspeakers. Similarly for the remaining sectors.

Unfortunately for any such system of "four way stereo" or "surround stereo", the loudspeaker pairs must subtend an average angle of 360/4 or 90-degrees at the listening position — too large for a satisfactory inter-speaker, amplitude-based phantom image. Says the NRDC brochure:

"This is true even in the front sector; it is worse for a pair of speakers behind, and is worse still for a pair at either side".

The brochure goes on to claim that the system is really limited, at best, to signals which can be manually pan-potted into the various stereo pairs.

"No practical directional microphone can perform this switching between pairs of speakers accurately. Thus it is impossible to realise 'discrete quadraphony' from any natural sound field".

Then follows a huge jump in logic, which has tended to characterise Ambisonics literature through the years — to the detriment of its credibility:

"A system of direct sound which is able to reproduce the directionality of indirect reverberant sounds, as well as direct sources, is termed 'Ambisonic'.

"Ambisonics is based upon encoding a directional pattern of sound, and decoding in the listening room an illusion of the intended directional effect. . ."

Very similar observations could probably be found in the literature on the various other — and now discarded — systems but the reader is left to assume that the newest system is the one which best meets the objective — presumably by making more effective use of frequency, amplitude and phase relationships. Charitably, with the benefit of years of additional research, the assumption could well be valid.

Recording format

In a recording situation, what Ambisonic literature describes as the "total directional sound field" is defined by four separately recorded signals conforming to their so-called "B-format", as illustrated in Fig.1. (It obviously provides the basis for the Ambisonics logo).

The four signals involed in the B-format are designated by the letters W,X,Y and Z.

"W" is described as an omnidirectional or "pressure" signal, which represents the summation of all incident sounds at the microphone position, irrespective of direction.

"X" is a version of the program as would be intercepted by a figure-of-eight microphone, coincident with source "W". Its two lobes, forward looking (+) and rearward looking (−), each have a gain of 3dB relative to the omnidirectional pattern.

"Y" is a similar figure-of-eight pattern, at right angles to "X" and nominally oriented between left (+) and right (−).

"Z" is orientated vertically and intended to sense the "height" component of incident signals. Whether or not the Z signal is required or appropriate depends on the nature of the sound being recorded.

AMBISONICS AT THE AES MELBOURNE CONVENTION

To many audio enthusiasts, the term "Ambisonics" will suggest little more than an obscure system of surround sound that the British have talked about for years but done little with, outside the laboratory. There's more to it than that, however.

Right: Robin Maconie presenting his lecture at the AES Melbourne Convention: "Digital Ambisonic Recording at Surrey University".

Below: Erdo Groot, a graduate of the University of Surrey Tonmeister Course, was responsible for the technical arrangements at the presentation.

Back in the early '70s, the audio industry decided that the time had come to introduce listeners to a new and exciting concept: 4-channel, quadraphonic "surround" sound.

All agreed that any such system should be compatible, to the extent that 4-channel recordings must be directly playable in stereo or mono mode on existing equipment. But, instead of settling on a common encoding system for the additional two channels of signal information, individual companies opted for their own varient, which they then set about promoting at the expense of all the others!

To add to the confusion, a small but influential group, headed up by JVC and RCA, rejected the simpler matrix encoding method altogether, promoting instead the CD-4 "Discrete" system, with the rear channel information modulated, in part, on to a supersonic carrier, which they recorded in the groove, along with the regular stereo audio signals.

In a two-part article in the May and June '72 issues, we listed no less than thirteen major Japanese companies and the thirteen names by which their respective 4-channel systems were currently identified. These were subsequently rationalised down to three or four but, by then, the damage had been done and, in the minds of the public, a large question mark hung over the whole idea of surround sound.

Whether the marketing chaos was responsible for buyer rejection of surround sound has long been a matter for debate, but the very idea of four loudspeakers in the living room was sufficient to prompt plenty of opposition at a domestic level. Confusion about systems could easily have been an excuse, rather than a reason for not buying!

Ambisonic system

It was into this unreceptive situation that Ambisonics was born, with reports from the UK suggesting (as I remember it) that a research team from Reading University had come up with a radically new approach to surround sound. It avoided many of the shortcomings of existing systems and offered improved spatial perception, with the further option of using extra loudspeakers on either side of the listening position — and overhead!

To an industry which had recently been exposed to exaggerated claims from countless sources, reports from an academic group in Britain about yet another system were scarcely exciting. Even less so was the prospect of stringing still more loudspeakers around the walls and ceiling of the listening room.

So, when "quadraphonic" sound was effectively laid to rest by the consumer hifi industry, one might have expected that Ambisonics would have been interred along with SQ, QS, and CD-4.

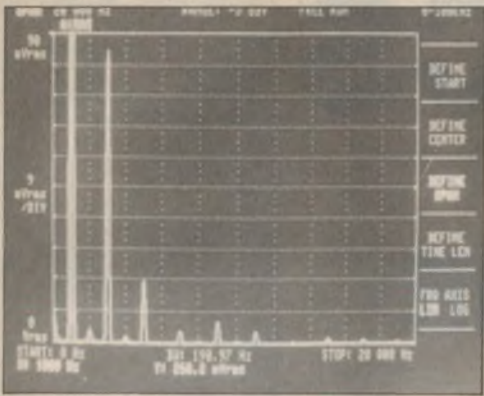
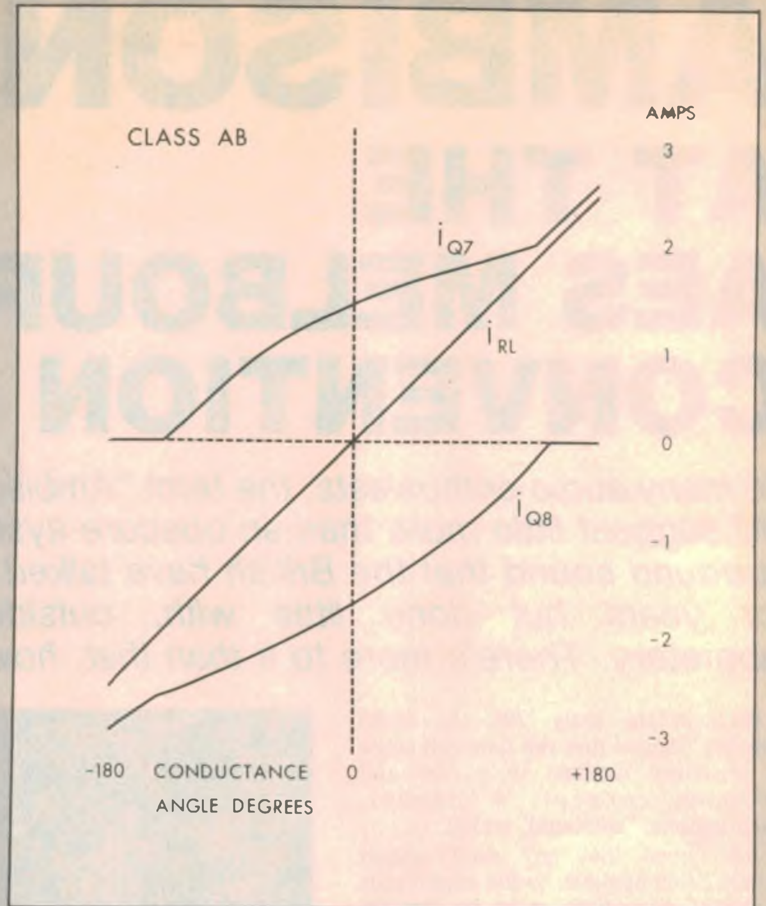


Fig. 9: output from the harmonic wave analyser is in the "frequency domain". The amplitude of the fundamental and each harmonic can be read directly. Scales are linear; 9.0mV (RMS) per division vertical. The horizontal scale (2kHz per division) gives the actual frequency of each harmonic.

Fig. 10 right: same load current i_{RL} as Fig. 5 but now supplied by a class AB output stage wherein each output transistor Q7 and Q8 conducts for approximately 318°; ie (138° + 180°) per cycle. The sum ($i_{Q7} + i_{Q8}$) equals the output current i_{RL}.



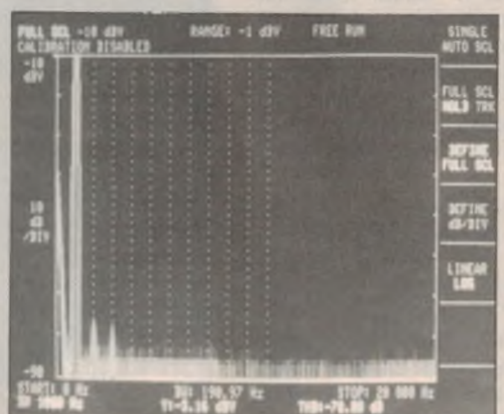


Fig. 11: frequency domain output from the harmonic valve analyser of class AB output stage. Log scale vertical shows each harmonic amplitude at 10dB per division. Linear horizontal frequency scale is 1kHz per division. Second and third harmonics are clearly seen at −75dB, others lost in noise.

Class AB amplification is an intermediate state of operation in between class A and class B wherein each transistor conducts for less than a full cycle, but for more than half of every cycle. It conducts over some angle between 360 degrees and 180 degrees. This is illustrated in Fig. 10 where an output ramp current (RL) and resulting transistor currents are shown. This class is known for efficiency which is better than class A, but less than that of class B. Class AB is a whole range of operating conditions satisfying: $180° < \text{conducting angle} < 360°$.

For the 318° per cycle class AB output stage, as Fig. 10, the distortion levels are quite low as shown by the output of the harmonic waveform analyser Fig. 11. In this last figure log scales in dB are used as the harmonic amplitudes are small. The THD is −73dB or, if you like, .03%. The horizontal axis is still linear in frequency, this time with dotted vertical lines each at 1kHz. The fundamental is off scale at the top, the 2nd and 3rd harmonics about equal in amplitude, and other harmonics present but blurred by noise. No feedback was used here.

Next month we shall discuss the various bias systems used for amplifier output stages and the ways in which negative feedback is applied.

OP AMPS Explained

Just what conducting angle and class is achieved by a given circuit is determined by the bias for the output transistors. The bias voltage is added in with the signal to drive points P and Q in Figs. 2, 3 and 4. The class has far reaching influence upon the available power output, the type and percentage of distortion, the amplifier efficiency and heating. Personal opinions run strong in some quarters, each class having it's own devotees among the faithful. Before we detail the bias circuits let's define the classes.

Class-A amplification means that the transistor is conducting continuously even when there is no output. Figs. 1 and 2(a) are Class A, and this class is well known as historically the oldest. Of all transistor circuits, those in class A give the least distortion (before feedback is applied).

Unfortunately this is at the price of lowest efficiency as much power is wasted in simply heating the transistor because it is conducting even when not producing any useful output.

Class-B amplification is a circuit bias condition such that each transistor conducts for exactly half the time, and we say each has a conducting angle of 180° every cycle. Fig. 5(a) shows a ramp output current (RL) changing from negative to positive as the transistors conduct in turn. That small area in the centre is enlarged in Fig. 5(b) to show that because transistors cannot turn on abruptly, there is a small part of the input voltage cycle time when neither output transistor is conducting. The result is that the output current is not an image of the input voltage; ie, we have distorted output at the cross-over points. This class is more efficient as the conducting transistor produces output.

The art of power amplifier design centres around:

(a) Methods devised to provide the exact bias.

(b) How to minimise crossover distortion.

(c) Minimisation of another cause of distortion — the nonlinearity of transistors.

Fig. 6 shows a fundamental class-B stage before any corrective measures against crossover distortion are applied, while Fig. 7 shows its output voltage in response to a sine wave input voltage. The resulting distortion is severe. In this case, the input is swinging between 1.0 volt and −1.0 volt.

For conduction, the NPN transistor base is always 0.55 volts more positive than its emitter (in this case). Therefore, while the input is +1.0 volt, output is +0.45 volt, and output follows input faithfully all the way down the sine wave until input is 0.55 volts, at which point the output has slid down to zero. While the input continues on down to zero, the output cannot do anything but stay at zero because the transistor is cut off.

Similar remarks may be made about the bottom PNP transistor. The overall result, as Fig. 7 displays, is an output which is part of a sine wave some of the time, and zero and remainder.

For this reason crossover distortion sounds worse at low volume output, and not so bad at high power output. Fig. 7(b) shows a little less distortion resulting from a somewhat larger signal input.

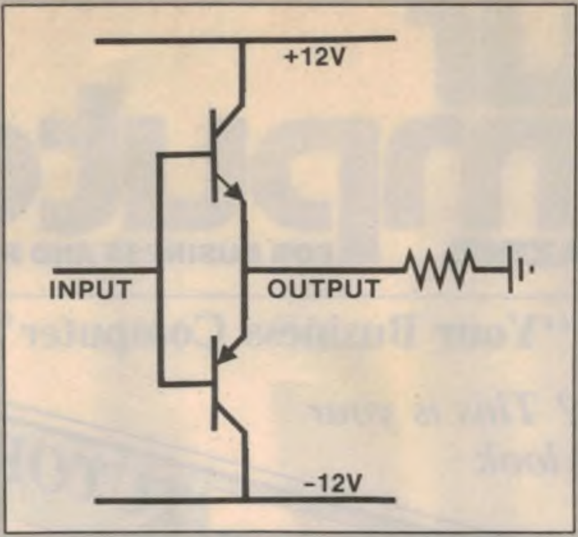
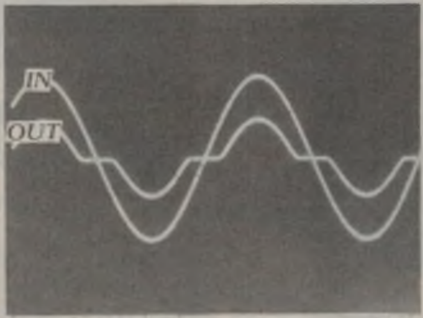


Fig. 6: fundamental class B output stage before any distortion-prevention steps are added.



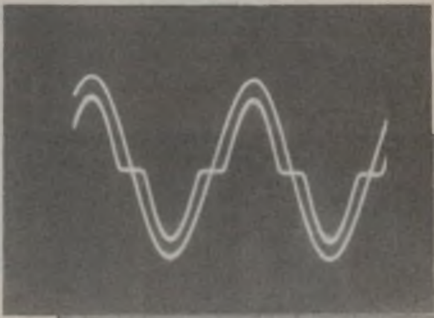


Fig. 7a: sinewave input to a fundamental class B output stage before any precautions against crossover distortion are applied. The output is very distorted at each zero crossing. $V_{in} = \pm 1.0$ volt; $V_{out} = \pm 0.45$ volt; frequency = 1.0kHz; and THD = 33%.

Fig. 7b above, right: same output stage as in Fig. 7a, but somewhat larger input signal resulting in a little less distortion.

Fig. 8: the test bench, with test amplifier constructed on breadboard in centre, Tektronix and BWD sinewave oscillators at left, dual power supplies centre. At right is a frequency counter (top), oscilloscope (centre), and a HP Harmonic Wave Analyser.

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OP AMPS Explained

However the most important point against such a choice would be thumps in the loudspeaker on switch-on. These are caused by the coupling capacitor charging currents.

The design of Fig. 3(b) using collector output (common emitter configuration) gives:

(a) Voltage gain in the output stage.

(b) Easy design of overcurrent protection (by insertion of a current sense resistor in the emitter lead).

(c) If live mounting of transistor is desired, both can be mounted on one common heatsink.

(d) Less DC drift [as consequence of (c)] because the transistors will be at same temperature.

(e) Easier integration onto one silicon wafer [as consequenc of (c) and (d)] and high voltage gain make this scheme a natural for power integrated circuit operational amplifiers (eg, National's LH0021).

About the only limitation on the above advantages incurred are:

(a) Somewhat higher output impedance, (so heavier feedback needed to compensate).

(b) If live mounting of transistors is used, the body of the heatsinks adds to the collector output capacitance (an embarrassment in power op amps where heavy feedback is used).

Quasi-Complementary designs are an attempt to obtain the advantages of the fully complementary arrangements without using a large PNP transistor. Fig. 4 illustrates a double emitter follower or Darlington (a), using two NPN transistors, and an "augmented emitter follower", (b), sometimes known as a "compound pair".

The Darlington of Fig. 4(a) acts as one NPN emitter follower with voltage gain about 0.85, high input impedance, very low output impedance and low distortion.

The compound emitter follower of Fig. 4(b) appears to the user somewhat like a Darlington made of two PNP transistors yet is not. It is useful only when large enough PNP transistors are not available, yet NPN types are. Such a situation applied years ago to domestic size transistors, but not now. However the same situation applies still to the commercial or industrial world when very large output currents of the order of a kiloamp are needed.

Fig. 4(c) is a quasi-complementary output stage. For hifi amplifiers, its characteristics were never the best for a number of reasons:

(a) Impedance looking into P is lower than that looking into Q.

(b) Output impedance from the bottom section is not quite as low as from the top section, and the top and bottom voltage gains are different.

(c) Because of the foregoing statements, it is difficult to reduce distortion to very low levels no matter what drive circuits or feedback systems are employed.

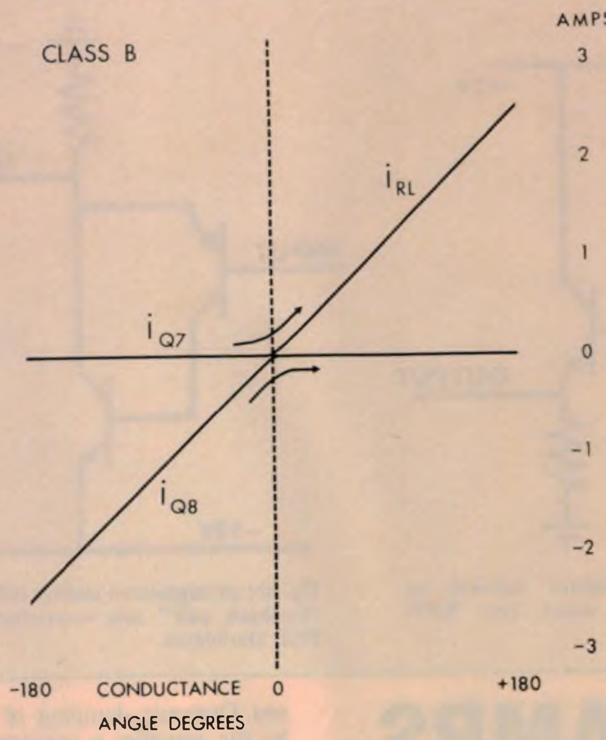

Fig. 5a: when a class B amplifier with output transistors Q7 and Q8 supplies a linear ramp waveform current to a load resistance R_L the current i_{RL} is composed of two components i_{Q7} and i_{Q8} as the transistors take turns in supplying the current. Imperfect crossover at the centre, shown enlarged in Fig. 5b, is the cause of crossover distortion.

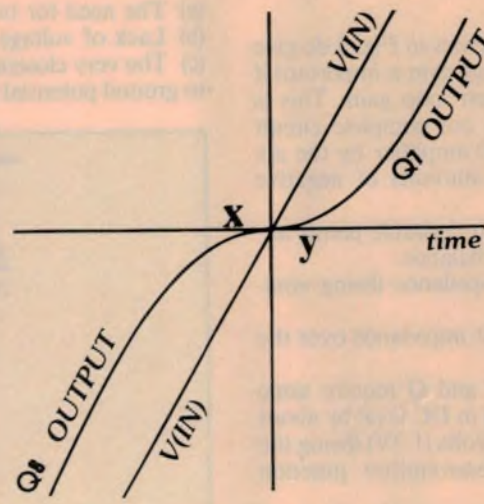

Fig. 5b: enlarged centre section of Fig. 5a shows crossover distortion caused by the inability of transistors Q7 and Q8 to turn on or off abruptly.

Class of amplification is defined by considering one full cycle of the input signal. If an output transistor is biased to conduct continuously, we say it is conducting over 360° of every cycle. If a different transistor is arranged to conduct only for part of each cycle, we say its conducting angle is less than 360° each cycle. Class names are given to denote such different conditions.

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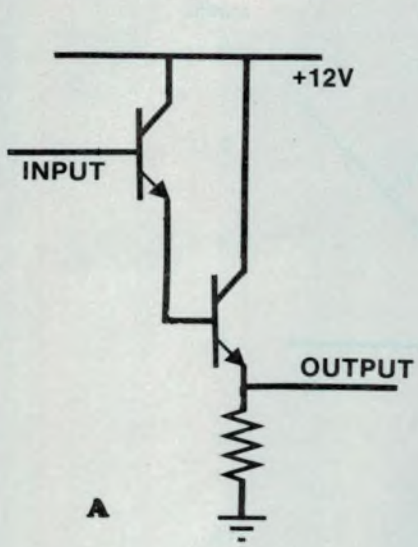

Fig. 4a: double emitter follower or Darlington stage using two NPN transistors.

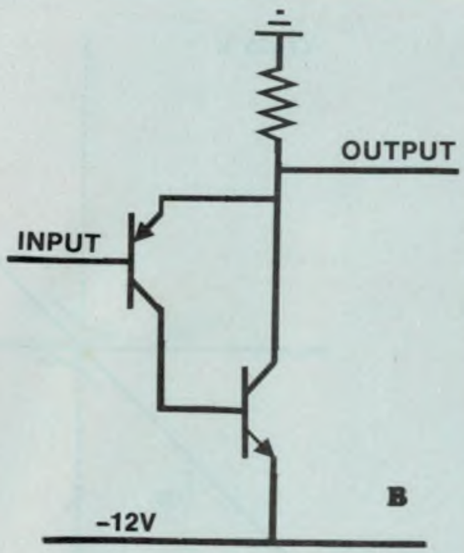

Fig. 4b: an augmented emitter follower or "feedback pair" acts somewhat like a PNP Darlington.

OP AMPS Explained

But all three schemes in Fig. 3 do give current gain. Voltage gain is important if we desire high open loop gain. This is necessary to make our complete circuit one big operational amplifier by the application of large amounts of negative feedback.

Fig. 3(a) has such desirable points as:
(a) Symmetry and balance.
(b) Low output impedance (being emitter followers).
(c) Constant output impedance over the whole cycle.
(d) Drive points P and Q require same signal, but differing in DC level by about plus and minus 0.6 volts (1.2V) (being the sum of the two base-emitter junction voltages).
(e) Drive requirements balanced about ground potential.
(f) Moderate input impedance to bases (because they are emitter followers).
(g) DC coupled, ie, pass band extends down to zero frequency.
(h) Although two power supplies are required, they each need only moderate voltage.
(i) Useful current gain.
(j) Can drive motors, coils, lamps, heaters and any other DC loads.
(k) Very heavy feedback can be used (if desired) as the DC coupling causes no phase shift at low frequencies.
(l) The low output impedance is not degraded at very low frequencies.
(m) Dynamic damping of loudspeakers by the amplifier is not degraded at very low frequencies.
(n) Little or no trouble in switch-on conditions (due to dual power supplies).

Criticisms levelled at the circuit Fig. 3(a) are:
(a) The need for two power supplies.
(b) Lack of voltage gain.
(c) The very closeness of the drive points to ground potential (claimed as an advantage above) may be embarrassing to the designer of the over-current protection section.

And as a consequence of the DC coupling:
(d) Any drift in the DC level causes erroneous output; for example, causing a shift in loudspeaker cone resting position.
(e) Failure of an output transistor or its drive circuits can apply full rail DC voltage to the output, possibly burning out a very expensive loudspeaker.
(f) If you wish to use live heatsinks (ie no insulation between transistor and heatsink) for optimum cooling, Figs. 3(a) and (c) require two separate insulated live heatsinks.

A circuit designer who chooses Fig. 3(c) rather than 3(a) probably makes this choice because:
(a) Most of the advantages of an emitter follower output stage will apply.
(b) It will need only one power supply rail.
(c) DC drift problems can be largely disregarded.
(d) An amplifier malfunction won't damage the loudspeakers.
(e) As the left side of the capacitor rests at about half the positive rail voltage, a polarised electrolytic capacitor, large enough for adequate bass response, can be used.
(f) The capacitor can be placed inside the main feedback loop (not usually done), thus removing any effects of capacitor impedance at low frequencies.

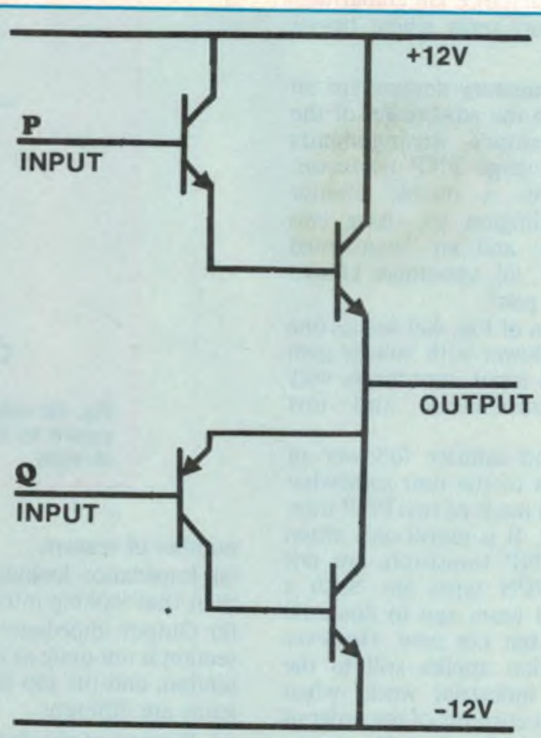

Fig. 4c: quasi-complementary output stage. Note that the impedance looking into point P is lower than looking into point Q, while the top and bottom voltage gains are different.

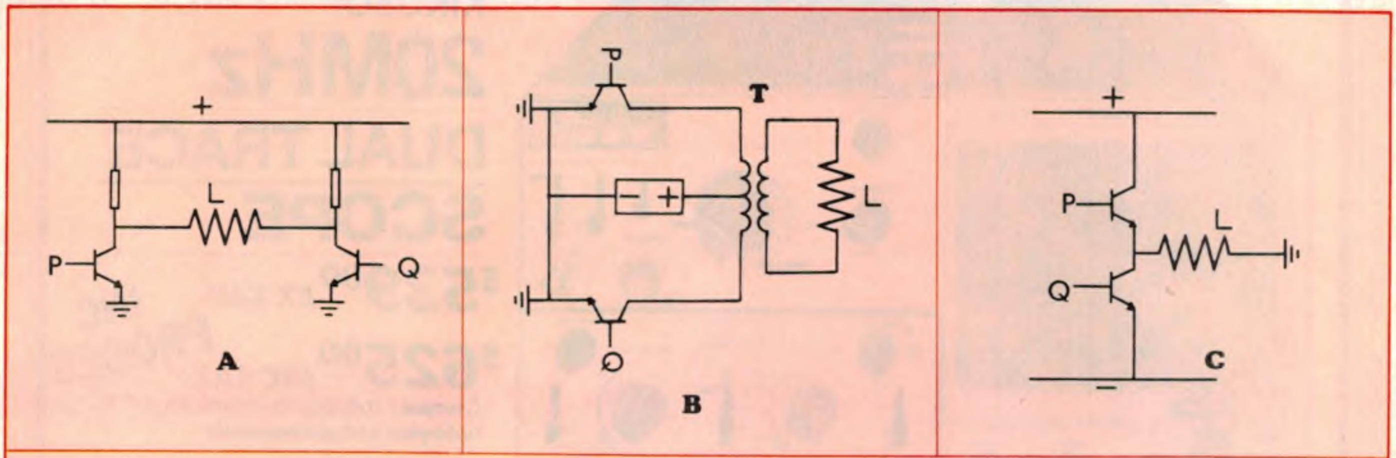

Fig. 2a, b, c: Three examples of output stages using all NPN transistors. In each L is the load, and + or − indicates a power supply rail.

MT6010 rated at 450 volts/500 amps (peak values).

Such a two kilowatt transistor is an example of a range of NPN transistors with current ratings all the way up to 1.2 kiloamps. Yes, gentle reader, the days when electronics was falsely labelled "light current work" have now passed into history — today we have users asking for power operational amplifiers of kiloamp (1000 amps) output capability.

Each design in Fig. 2 does, unfortunately, carry a few penalties if our love is hifi music, DC coupling or simplicity with low voltage output. The transformer T in Fig. 2(b) is a problem by dint of its weight, cost and introduced distortion. In addition, it prevents DC coupling. The configuration of Fig. 2(c) certainly can be DC-coupled but is non-ideal on three counts:

(a) Inputs P and Q must be out of phase.

(b) Inputs P and Q are at very different levels, and worse — the level of P follows the output voltage but the level of Q does not.

(c) Output impedence is different on each half cycle, being lower when the upper transistor is conducting (emitter follower configuration), and higher when the lower transistor is supplying output (common emitter configuration). This non-symmetry can be a designer's headache when either DC drift or a large feedback factor are critical considerations. Certainly feedback can be (and is) used to smooth out this difficulty, but many designers prefer to have one less problem to solve.

A design philosophy attributed to J. S. Coombs is: "Let's not use feedback to make a poor design acceptable; rather we should apply feedback to a good design to make it excellent". For all medium voltage, medium current, AC- or DC-coupled or hifi applications then consider:

Complementary Symmetry types, ie one NPN and one PNP as in Fig. 3, so-called because the NPN and PNP transistor pair complement each other in all their characteristics. At least we hope they do. Many manufacturers produce such transistors expressly for this purpose. Examples include 2N5686 (NPN) and 2N5684 (PNP), both with 50 amp ratings and having similar power gain and bandwidth figures.

All circuits in Fig. 3 are at least symmetrical because they use complementary transistors. Positive and negative output signals experience the same open-loop output impedance. Fig. 3(a) has low output impedance from the emitters, Fig. 3(b) higher output impedance from the collectors and both may be DC-coupled. Fig. 3(c) cannot be DC-coupled because it uses a single power supply.

Possibly the biggest question facing a designer of modern power amplifiers is which of Fig. 3 should be used: a, b, or c? The figures are fundamental only, and to implement a design we will need to add many embellishments, such as balancing resistors, current limiters, and any one of a host of different drive arrangements.

In each version, the top transistor provides the positive half-cycle of load current and the bottom transistor provides the negative half. First let us compare the three basic ideas.

Fig. 3(a) and (c) are perhaps the most popular at the present state of the art. This is because between them they satisfy all requirements save one if large enough complementary pair transistors are available. Of course, we can always connect transistors in multiple parallel groups to achieve higher current rating, paying due attention to the added problem of equal current sharing.

The one characteristic not provided by Fig. 3(a) or (c) is that of voltage gain. As all their output transitors are connected as emitter followers (otherwise known as the common collector configuration), the output transistor voltage gain is slightly less than one. Contrast this with Fig. 3(b) where the "common emitter configuration" or "collector output" gives worthwhile voltage gain.

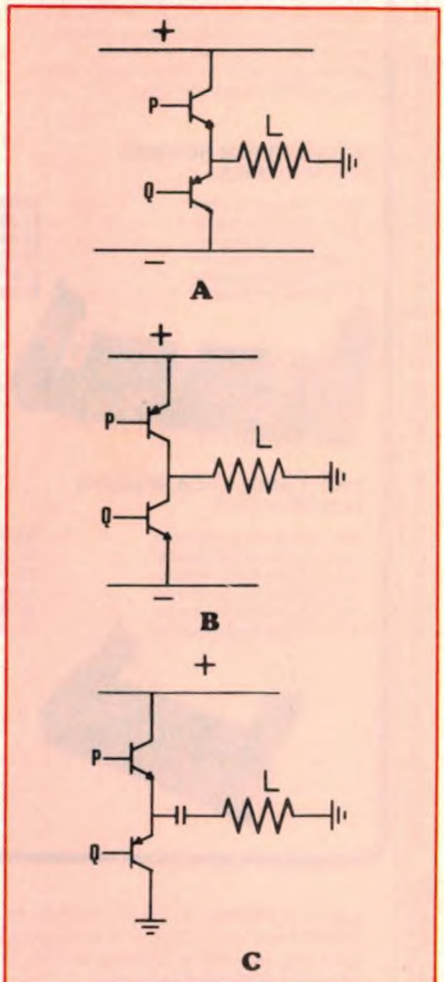

Fig. 3a, b, c: Three schemes commonly used in power amplifiers employing complementary output transistors.

by BRYAN MAHER

OP AMPS Explained

Part 10

Whether it is obvious or not, most power amplifiers are in fact operational amplifiers. They have large open-loop gain and a high degree of negative feedback applied to keep distortion to a low value.

The loads driven by early power amplifiers were almost entirely loudspeakers, but in our modern electronic age many other devices require driving with considerable power. As well as the desire to fill our homes with many watts of pure clean hifi sound from multi-way loudspeaker systems, we now also need to drive many other devices.

Early power amplifiers used a small amount of negative feedback to reduce errors and distortion. Modern amplifiers may use DC-coupling throughout and, because of their open-loop bandwidth, lots of negative feedback can be a feature. Many are in fact power op amps, consisting of early stages with large signal gain followed by output stages capable of high current.

Considering power amplifiers in general, we meet a collection of special terms which may be new to some readers. Let us amuse ourselves by defining these. Considering output stages and their properties (before any feedback is applied) we have:

Single sided output: illustrated in Fig. 1, uses one output power transistor which must be conducting continuously. Current through the load flows from the +12V supply or "rail", via transistor collector and emitter, thence through whatever emitter circuit Z is chosen, to ground or zero. Considering only linear systems, we are interested in cases where the current varies in amplitude but does not stop flowing. Because there is only one supply and the load L is connected to it, current through the load can only be in one direction, ie, downwards in this figure.

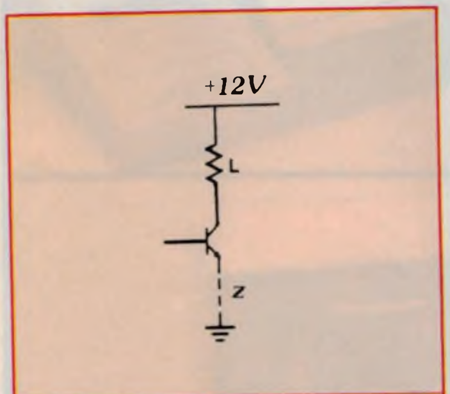

Fig. 1: L represents the load in this "single sided" or "single ended" amplifier which is restricted to class A, unidirectional load current, and low efficiency.

This simple configuration could operate a controlled heating element where the inability to pass current in the reverse direction is of no consequence. However it is inadequate for loads such as loudspeakers or DC motors.

Push-pull output: uses two (or more) power transistors. This allows current to be driven either way through the load L as in Fig. 2. By definition, push-pull designs are driven by two equal but out-of-phase signals at the base circuits, P and Q. Predating transistor circuits by about 30 years when first applied to valve circuits, the name "push-pull" was originally borrowed from Welsh narrow gauge railway terminology.

Historically, valves could only be made to pass current in one direction using electron flow. No one ever got around to inventing a valve for reverse current direction using positron flow. Because of this, the configurations in Fig. 2 were easily carried across to transistors of one type, shown here using all NPNs. By reversing supply polarity, PNPs transistors could be accommodated.

Fig. 2(b) is adapted from the most popular valve design but the need for a transformer was always a problem, being costly, heavy and a prime source of nonlinearity distortion.

However the transformer has desirable properties like step-up voltage ratio and primary-secondary isolation, so Fig. 2(b) is still used for many high voltage output requirements. Outstanding among modern uses are the DC-to-DC and DC-to-AC inverter circuits.

Same polarity types, ie both NPN or both PNP, may also form a design known as "single ended push-pull" [Fig. 2(c)]. Only a single end of the load is connected to the amplifier, yet current can flow both ways through the load and push-pull (ie, out-of-phase) drive is required for each transistor base P and Q. When drive P is negative and Q is positive, load current flows form ground through the load via the bottom transistor to the negative rail.

There is a one possible danger; if any circuit delays ever cause both transistor bases to be simultaneously driven positive (even for a few microseconds) a destructively large current would flow from the positive rail straight down through the low impedance path of both transistors to the negative rail. Design precautions to prevent this are mandatory.

Both Figs. 2(b) and (c) are suitable for very large power amplifiers and DC to AC inverters because they require only NPN transistors. In the present state of transistor manufacturing technology, the highest-rated transistors are manufactured only in NPN types. For example, consider the Toshiba 2SD698 rated at 200 volts/600 amps or the Power Tech

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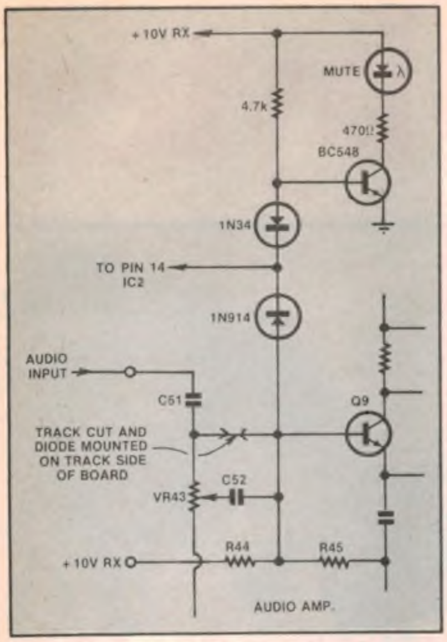

Inserting a 1N914 diode in the circuit as shown here will reduce hiss when the transceiver is muted.

Receiver alignment: When using a two-metre transceiver to align the 70cm receiver the original instructions recommended that the two-metre set be placed alongside the 70cm set and the two-metre transmitter operated into a dummy load.

In some cases where this procedure has been followed it has been found difficult to adjust helical resonators H1 and H2. The problem appears to be due to too strong a radiated signal which reaches the base of Q7 directly, thus swamping the signal coming via the antenna circuit.

If such difficulty is experienced it is recommended that the two-metre set be moved well away from the 70cm set (possibly 30 metres or so) and operated on minimum power so that there is little or no direct pickup. The signal should then be brought into the 70cm set via a simple antenna. This will ensure that the only signal reaching Q7 will have to pass through the helical resonators.

VHF Transceiver

Circuit error: The connection between IC6 (TC5082) pin 5 and the junction of C160 and X2 does not exist on the PC board. The circuit diagram is in error.

Symptom: Low RF output (10W maximum).

Cause: L26 has insufficient inductance.

Cure: Rewind L26 on 7/16in diameter mandrill. (Previously ⅜in.)

Symptom: Low RF output.

Cause: Capacitors C111 and C112 are physically too large.

Cure: Replace with physically smaller capacitors of the same value.

rie

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How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms. (ETI Nov. '81)

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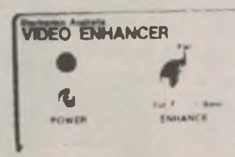
MOSFET POWER AMPLIFIER

Employing Hitachi Mosfets, this power amplifier features a 'no compromise' design, and is rated to deliver 150 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion. (ETI Jan. '81)

Cat. ETI 477 **$63.00**



VIDEO ENHANCER 100's SOLD

Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct. '83).

83VE10 **$35.00**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

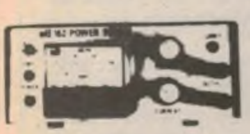
Have your computer print the latest news from the international shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too.

(ETI Apr. '83) **$20.00**

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**



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**

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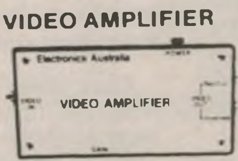
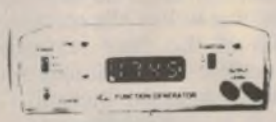


Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead, it's much better! The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugback supply. (EA Aug. '83)

83VA8 **$15.00**



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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)

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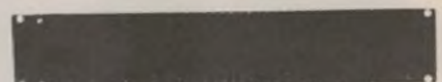

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INPUT SENSITIVITY: 1 V RMS for 100 W output
HUM: 100 dB below full output (flat)
NOISE: [illegible] dB below full output (flat, 20 kHz bandwidth)
2nd HARMONIC DISTORTION: 0.001% at 1 kHz (0.0007% on Prototypes) at 100 W output using a ±56 V SUPPLY rated at 4A continuous. 0.003% at 10 kHz and 100 W
3rd HARMONIC DISTORTION: 0.0003% for all frequencies less than 10 kHz and all powers below clipping
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above)
INTERMODULATION DISTORTION: 0.001% at 100 W (50 Hz and 7 kHz mixed 4:1)
STABILITY: Unconditional

Cat. K44771 Normally $319, **$299**
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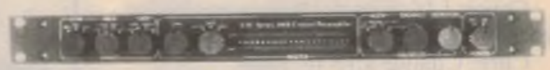

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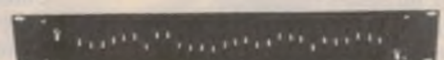
SPECIFICATIONS:
FREQUENCY RESPONSE: High level input: 15 Hz-110 kHz +0 -1 dB Low Level input: conforms to RIAA equalisation ±0.2 dB
DISTORTION: 1 kHz < 0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N NOISE: High Level input master full with respect to 300 mV input signal at full output (1.2V) >92 dB flat >100 dB A weighted MM input master full with respect to full output (1.2V) at 5 mV input 50 ohms source resistance [illegible] >86 dB flat 92 dB A weighted MC input master full with respect to full output (1.2V) and 200 uV input signal >71 dB flat >75 dB A weighted

Cat. K44791 Normally $289, **$259**
PACKING AND POSTAGE $10



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SPECIFICATIONS:
BANDS: 28 Bands from 31.5 Hz to 16 KHz
NOISE: <0.008 mV, sliders at 0, gain at 0 (-102 dB0)
20 KHz BANDWIDTH DISTORTION: 0.007% at 300 mV signal, sliders at 0, gain at 0; maximum 0.01%, sliders at minimum
FREQUENCY RESPONSE: 12 Hz-105 KHz, +0, −1 dB, all controls flat
BOOST AND CUT: 14 dB

1 Unit... **$199**
Cat. K44590 2 Units... **$379**
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SERIES 4000 SPEAKERS

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Errors and Ommissions Excepted

UHF Transceiver

Symptom: PLL will not lock.
Cause: Switching diodes D20, D21, D23, do not saturate as their internal impedance is too high at this frequency (40-50MHz).
Cure: Replace with BA244 diodes. Later kits supplied with BA244 diodes.

Symptom: PLL will not lock.
Cause: L16 (base Q23) incorrectly supplied as 10mH.
Cure: Change L16 to 10μH.

Symptom: PLL will not lock.
Cause: Capacitors C78, C79 (5.6pF), C80 (4.7pF) and C81 (3.3pF) supplied for VCO physically too large.
Cure: Replace with physically smaller capacitors.

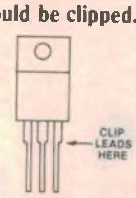
Symptom: PLL will not lock. VCO will not run.
Cause: Statically damaged Q18, Q19.
Cure: Replace Q18, Q19.

Symptom: Low RF power output.
Cause: Transmitter high pass filter operating at incorrect frequency.
Cure: Rewind L19, L20, L21 with 5mm diameter, not 10mm.

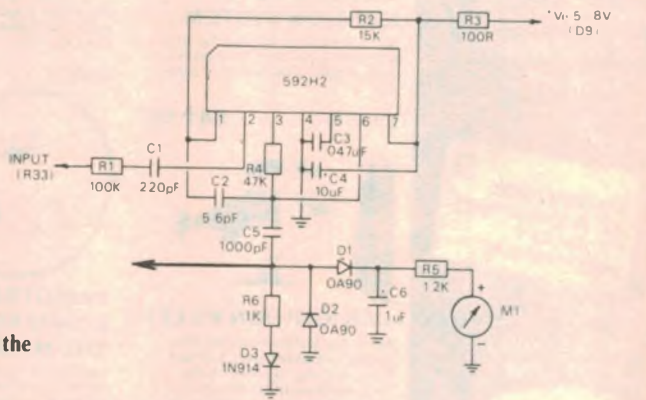
Symptom: Low RF power output.
Cause: Poor or no earthing of predriver and driver transistor cases (Q25, MRF629; Q26, MRF629.)
Cure: Use PCB pins to earth predriver and driver transistor cases. PC board provides for this. A good low impedance earth is essential for correct operation. Solder the pin to the metal case of the transistor. Use plenty of heat.

Symptom: Low RF output from transmitter tripler (Q24, 2N3948).
Cause: (a) Component leads too long; (b) L18 does not have enough inductance to resonate.
Cure: Shorten all component leads around tripler to minimum. Increase the diameter of L18 from ⅛in to 9/64in.

Below: this diagram shows how the leads of the RF output transistor should be clipped.



Right: adding an RF power meter. Position the extra wire near the antenna socket.



Symptom: Low RF power output (2W).
Cause: Excessive collector and emitter lead lengths on RF output transistor Q27, MRF660.
Cure: Collector and emitter leads must be clipped at lead width "step" (see diagram above).

Symptom: Receiver very unstable.
Cause: BRF90 (Q7) has excessive gain.
Cure: Change R20 bias resistor from 10kΩ to 15kΩ.

Symptom: When the receiver is muted, but operating with a high volume level setting, a faint hiss can be heard from the speaker.
Cause: Audio leakage through the audio amplifier.
Cure: Add a 1N914 diode in series with the squelch output (pin 14) of the MC3357 and rewire as shown in the accompanying circuit. Note, however, that this causes the squelch to open and close with a "thump". (See diagram next page.)

General comments

Voltage regulators: zener diodes D22 and D19 should be 400mW types. Early kits were supplied with 1W types, but these do not regulate correctly due to low idle current. One symptom of this poor regulation is that, if a mains power supply is used, hum may appear on transmit unless the supply is particularly pure.

RF power meter: It is possible to add an RF power output indicator with very little effort. Connect a piece of single conductor cable (bell wire) from the vicinity of the antenna socket to the junction of C5 (1000pF) and R6 (1kΩ) on the S meter circuit board. Position the antenna socket end of the wire to give full scale reading on transmit (when correctly loaded) and secure to the circuit board using spare wax from the VCO or some other suitable adhesive.

Coax cable: The piece of coax cable from the transmitter output to the antenna socket can be replaced with a piece of tinned copper wire. This is easier, and may increase the transmitter power output marginally. It may also increase the spurious radiation slightly, but this may be regarded as inconsequential at this frequency.

FEEDBACK ON THE UHF/VHF Transceivers

Two of the most popular projects described in this magazine in recent years have been the two amateur transceivers available in kit form from Dick Smith Electronics: the "Explorer 1" UHF (70cm) transceiver in September, October, and November 1983 and the "Commander" VHF (2m) transceiver in June and July 1984. Over 700 UHF and 400 VHF sets have been built at the time of writing.

Naturally, with projects of this complexity, there will always be a small proportion of builders who encounter problems. Fortunately, Dick Smith Electronics provided a backup service whereby these problems could be sorted out and, at the same time, categorised for the benefit of other constructors. The following is a summary of the problems prepared by Garry Crapp, VK2YBX/T, General Manager of DSE Research and Development Division.

By far the most predominant reason for non-operation is dry solder joints. It should be stressed that most semiconductors can withstand 300°C at 1.5mm from the junction for 10 seconds. They are rarely destroyed by excessive heat. Constructors should not be scared to use adequate heat when soldering.

At the risk of repeating what has been said many times before, a proper soldered joint can only be made when the pieces of metal to be joined are heated to a temperature which will melt the solder. It is not sufficient to melt the solder with the iron; the joint must be hot enough to do this also.

Some constructors have changed components in an attempt to achieve better transmitted audio, easier VCO lock, extra transmitter power etc. In this regard it should be appreciated that the transceiver was designed to satisfy the Department of Communications Radio Bulletin RB250. There are no specifications covering amateur equipment, but RB250 covers UHF CB equipment, and it was felt that this was a suitable standard to adopt.

In all the cases investigated so far, such modications have caused the set to transgress the RB250 specifications. For this reason, modifications are not recommended unless the builder is fully aware of the RB250 specifications and has the facilities to make the appropriate measurements.

Apart from poor soldered joints and other assembly faults, the following less obvious problems were encountered.

8 SECTOR BURGLAR ALARM KIT...

REF: EA Jan 1985

★ 2 delay sectors ★ 6 instant sectors ★ Steel box ★ Price includes battery ★ Siren driver ★ Variable exit/entry delay ★ Can use N.C. & N.O. on the one circuit!!
Cat. KA-1580

NEW KIT

ONLY $139

NOW OPEN BURANDA QUEENSLAND

ELECTRIC FENCE

Ref: EA September 1982

$15.00

Mains or battery powered, this electric fence controller is both inexpensive and versatile. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian standard 3129. (Kit does not include automotive ignition coil which is required).
Cat. KA-1109

CQAM STEREO DECODER KIT - Ref: EA October 1984
Set of parts for this project including PCB, 10uH choke, MOC13020 IC. (Whistle filter coil extra - Cat. EE-3814 ONLY $19.95)
Cat. KA-1555 **ONLY $19.95**

DRILL SPEED CONTROLLER

NEW

This brand-new design gives you better speed regulation over previous drill controller designs. It's also easier to make as all parts are mounted on the PCB. All parts supplied including special high voltage MR754 diode.
Cat. KA-1555 **ONLY $24.95**
Ref: EA Dec 1984

ETI 446 AUDIO LIMITER - This simple project is used as a volume compensator for P.A. etc.
Cat. KE-4092
GREAT VALUE AT $12.00

Fast talker with all the right answers

MultiModem

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 ★ Telecom approval C84/37/1135
Cat. XC-4820

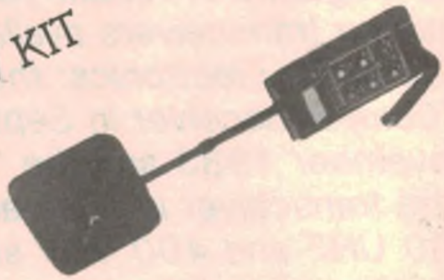
only $349 INCLUDING TELEPHONE

DELUXE METAL DETECTOR

NEW KIT

REF: EA December 1984

This very sensitive unit works as well as units costing hundreds more! Features special English-made quality case and pre-wound and sealed head assembly. Looks just like the $700 plus units! (All parts supplied).
Cat. KA-1554

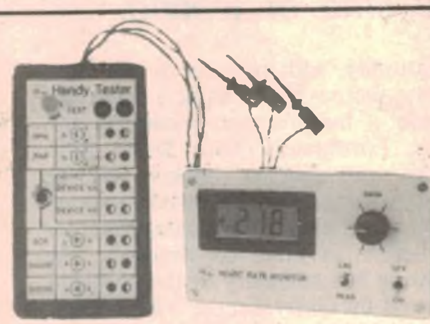


$239

Jaycar ELECTRONICS

IN-CIRCUIT TRANSISTOR TESTER - Ref EA September 1983
When built this simple kit will enable you to TEST IN-CIRCUIT transistors, SCR's and diodes without the need to desolder!
Cat. KA-1119
ONLY $15.00 GREAT VALUE

LCD THERMOMETER - Ref. EA Feb 82
15mm high 3½ digit readout unit that can measure from around 100 degrees C to below freezing. Very accurate - supplied with 2 sensors.
Cat. KA-1404
NORMALLY $74.50
A FEW LEFT AT ONLY $64.50



LCD HEARTRATE MONITOR
If you are concerned about the condition of your heart then this is the unit for you. Large liquid crystal readout and all readings are taken by optical sensors - great value to those who exercise!
Cat. KA-1466
TREMENDOUS VALUE AT $69

ETI 1515 MOTOR SPEED CONTROLLER - This kit enables you to control the speed of electric motors such as found in drills, saws, grinders, blenders etc. Reasonably constant speed over verying loads.
Cat. KE-4031
NORMALLY $19.95 NOW $14.95

NEW

NOW OPEN BURANDA QUEENSLAND

STEAM SOUND SIMULATOR
Ref: EA December 1984
Features infra-red optical switch to synchronise "chuffs" with wheel rotation.
Cat. KA-1562
$15.95

OUT THEY GO!!
SUBWOOFER AMP SPEAKER CABINET - Ref. EA July 1982
We have a few left of these quality speaker box cabinet kits. The kit is finished in an attractive black vinyl with a modern speaker clothe cover, factory mounted on a frame. The specially made port tube is provided along with speaker connector etc.
NORMALLY $79 SAVE $30
THIS MONTH $49
(Please allow $8 for post & packing as they are fairly heavy)
Cat. KA-1454 (Subwoofer speaker extra)
Subwoofer speaker to suit Cat. CW-2119 **$89.50**

Jaycar ELECTRONICS

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.
Cat. KA-1560

$79.95

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

SEE OUR OTHER ADS ON PAGE 13 FOR ADDRESS PANEL AND OTHER INFORMATION

UNBELIEVABLE KIT CLEARANCE SALE

JAYCAR IS CLEARING THE DECKS FOR NEW KITS IN '85

SENSATIONAL PRICES ON 5000 AMP-SYSTEM KITS

Check the SPECIAL PRICES for the famous ETI 5000 series deal of a lifetime.

FAMOUS JAYCAR "BLACK MONOLITH" SERIES AMP - NORMALLY $319.00
THIS MONTH

$295 SAVE $24.00

For further savings check the package deal below

FAMOUS JAYCAR "BLUEPRINT" 5000 SERIES PREAMP - NORMALLY $299
THIS MONTH

$265 SAVE $34.00

Check below for package price FURTHER savings!

FAMOUS JAYCAR 1/3 OCTAVE GRAPHIC EQUALISERS! (5000 SERIES) NORMALLY $199 EACH
THIS MONTH

2 FOR $300!!

For FURTHER savings check

★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★
THIS SPECTACULAR PACKAGE DEAL
★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★

PACKAGE DEAL No.1

Buy the 5000 Black Monolith Power Amp and 5000 Blueprint Preamp TOGETHER for only $498!
That's right, save over $120 on normal prices or over $60 if bought separately from this months SPECIAL prices!

PACKAGE DEAL No.2

Buy the following:

	NORMALLY
Power Amp 5000 "Black Monolith"	$319.00
Preamp 5000 "Blueprint"	$299.00
Graphic 5000 Equalisers (2 off)	$398.00
	NORMALLY $1016.00

THIS MONTH YOU GET THE LOT FOR ONLY $699!!!

THAT'S A MASSIVE SAVING OF $317 (i.e. YOU VIRTUALLY GET THE "BLACK MONOLITH FREE) EVEN AT THE SPECIAL INDIVIDUAL PRICES IN THIS AD IT IS STILL A MASSIVE SAVING! - Special freight deal: anywhere in Australia $12!!
REMEMBER! WE TAKE NEARLY ALL THE CREDIT CARDS & FINANCE CAN BE ARRANGED ON THE SPOT.

ARE WE FAWLTY?

WE'RE DOING IT ON PIANO KITS TOO!

FAMOUS JAYCAR "LYREBIRD" 73 & 88 NOTE PIANOS AT THE LOWEST COST EVER

Even lower than our low, low prices in September last year. We are phasing these kits out now for new lines in '85. They are still technically superior to many more expensive ready-builts AND have better tone, touch sensitivity etc for **FAR LESS MONEY.**

73 NOTE: NORMALLY ______ $475
ON SPECIAL LAST SEPT. $375
THIS MONTH ______ $325
SAVE AN ASTOUNDING $150!!

88 NOTE: NORMALLY ______ $589
ON SPECIAL LAST SEPT. $425
THIS MONTH ______ $399
SAVE AN UNBELIEVABLE $190!!

Remember each kit is the same quality as our normal kits. The kits contain a stand (similar BUT NOT THE SAME) as the one shown in the illustration. A beautifully imported Italian keyboard is part of each kit as well as a realistic looking soft (sustain) pedal (imported from England) is also supplied. All pre-cut woodwork is supplied.

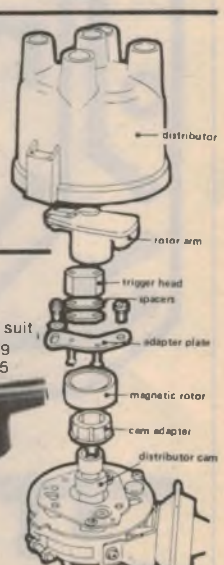
GAD! they've never been cheaper!!

Jaycar ELECTRONICS

ARE WE BALMY? IS THE SUMMER SUN GETTING AT US?

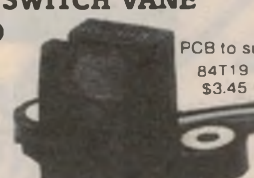
This month you can grab the KJ-6655 Hall Effect kit for - wait for it - ONLY **$19.95!** That's right! $10 off normal low price!

NOW SAVE $10
ONLY $19.95



HALL EFFECT SWITCH VANE INTERRUPTED

NORMALLY $19.95
THIS MONTH $16.95



PCB to suit 84T19 $3.45

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

NOTE: If demand temporarily exceeds our ability to supply kits we may part ship. This will get you started on what is after all a fairly ambitious project. We will only honour the prices, however, if you order NOW. . .

the load switch. If all is well, the power LED will light and you will be able to vary the output voltage from 3V to 30V using the range switch and the voltage control pot.

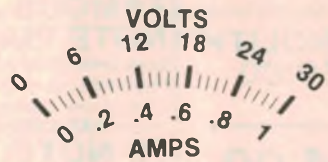
Check that the voltage reading on the supply meter and on your multimeter are the same. Note the vacant component position adjacent to the 330kΩ and 33kΩ resistors. This will allow you to trim the voltage readings by adding a high value resistor if necessary.

Assuming that all is well, open the load switch, select the 0-15V range and wind the voltage control fully anticlockwise. Now set the current limiting control to about half way on the 1A range, select the 1A range on your multimeter and close the load switch.

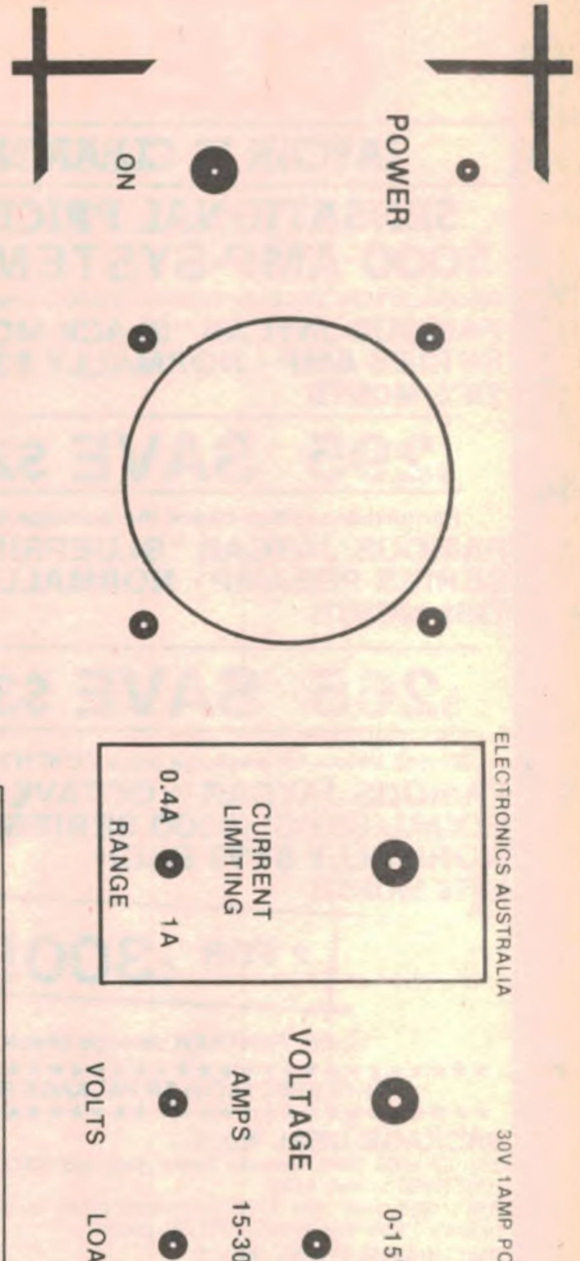
The multimeter should indicate a current of about half an amp, although the supply's meter will probably show something quite different at this stage (don't forget to switch the meter to "amps"). Adjust the current limiting control so that the multimeter reads 1A, then adjust trimpot VR3 so that the supply's meter reads the same.

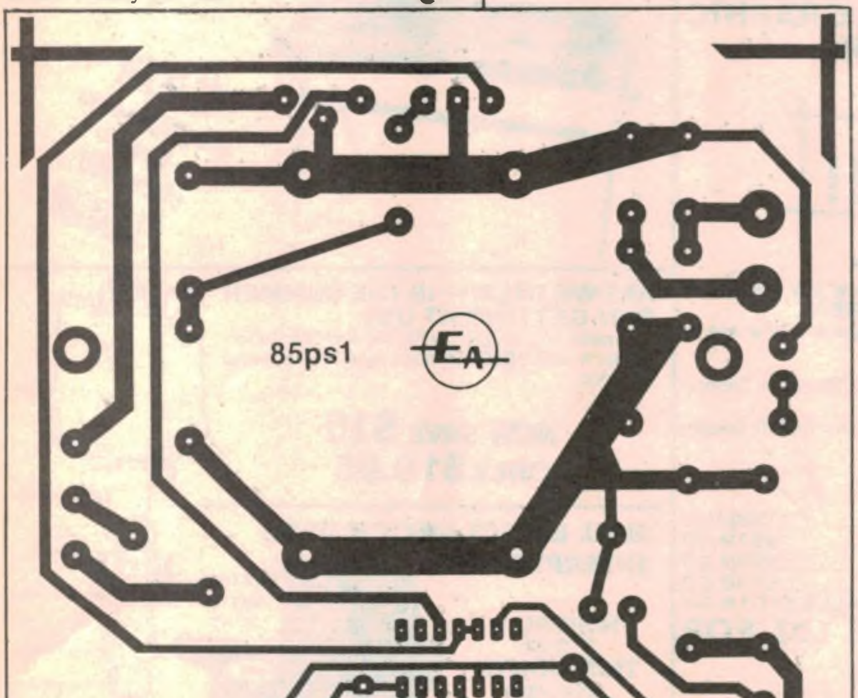
Finally, vary the current limiting control and check that the meter reading corresponds closely to that on the multimeter. Your 30V/1A Power Supply is now ready for use.

Below, right: actual size reproduction of the front panel artwork. Finished boards and panels will be available from parts retailers.



Use this actual-size artwork to re-calibrate the meter.





At left is an actual size reproduction of the PC artwork.

Benchtop power supply

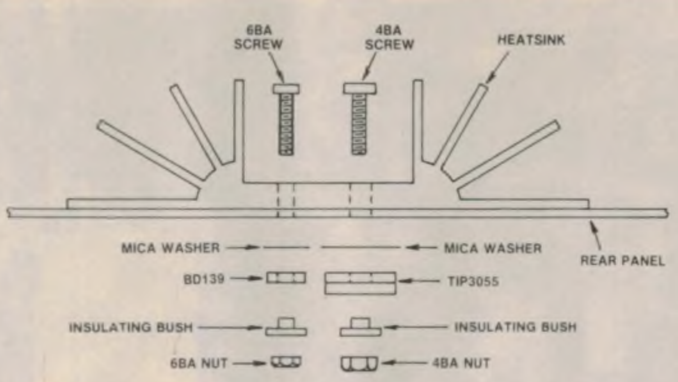


Fig. 2: mounting details for the power transistors and heatsink.

to the rear panel using a cord clamp grommet and the active and neutral wires terminated at the fuseholder and power transformer respectively. The mains earth wire should be connected to one of the solder lugs and a separate earth lead run to the rear panel.

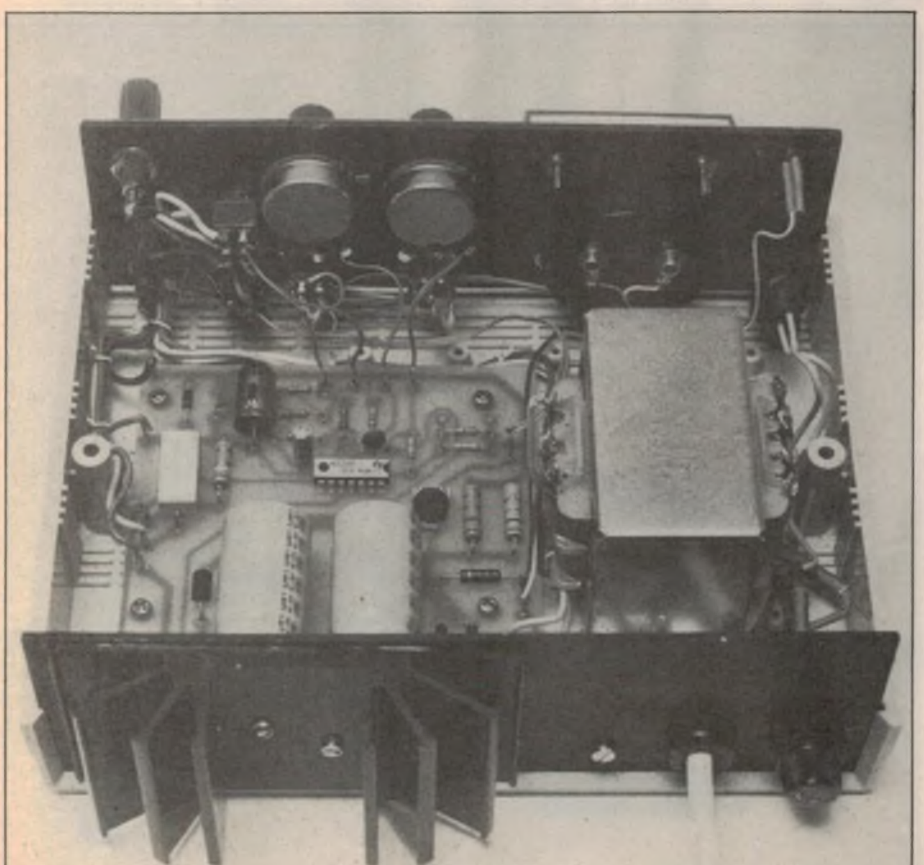
We recommend that heat shrinkable tubing be fitted to the fuseholder, transformer and mains switch terminations. This will prevent accidental contact with the mains while the unit is being worked on. Make sure that you use mains-rated hookup wire for the connections to the mains switch.

Note that the mains switch must be of all-plastic construction and should not be a miniature type.

Finally, go over your work and make sure that all the wiring is correct. Everything OK? You are now ready for the smoke test!

Setting up

Connect your multimeter across the output, switch the supply on and close



View showing the multi-finned heatsink and the front panel wiring.

PARTS LIST

- 1 PC board, code 85ps1, 105 x 111mm
- 1 plastic case, 200 x 160 x 70mm (W x D x H), with metal rear panel, Altronics H0480
- 1 Scotchcal front panel artwork, 195 x 65mm
- 1 mains transformer, 30VAC and 24VAC at 1A, Arlec 6672 or equivalent
- 1 SPST 240V 2A toggle switch, all plastic construction (not miniature type)
- 3 DPDT miniature toggle switches
- 1 SPDT miniature toggle switch
- 1 MU45 0-1mA panel meter
- 3 binding post terminals: 1 red, 1 black, 1 green
- 1 mains cord and plug
- 1 cord clamp grommet
- 1 fuseholder, panel mount type
- 1 150mA fuse
- 1 heatsink, high efficiency fan type, 105 x 58mm
- 4 solder lugs
- 15 PC stakes
- 2 plastic knobs (black)
- 1 metre mains rated cable
- 2 metres hookup wire (10 x 0.2mm)
- 4 stick-on rubber feet

Semiconductors

- 1 TIP3055 NPN transistor plus mounting hardware (mica washer and insulating bush)
- 1 BD139 NPN transistor plus mounting hardware
- 5 1N4002 diodes
- 1 33V 1W zener diode
- 1 red LED plus mounting bezel
- 1 LM723, μA723 voltage regulator IC

Capacitors

- 2 2500μF 50V axial electrolytics
- 1 100μF 50V axial electrolytic
- 1 4.7μF 16V PC electrolytic
- 1 0.1μF metallised polyester (greencap)
- 1 820pF ceramic

Resistors (¼W, 5% unless stated)
1 x 330kΩ, 1 x 33kΩ, 1 x 4.7kΩ, 1 x 2.2kΩ 1W, 1 x 1.8kΩ, 1 x 1.2kΩ, 1 x 1kΩ, 1 x 470Ω ½W, 1 x 270Ω, 1 x 100Ω, 1 x 3.9Ω 1W, 1 x 1.5Ω 5W, 2 x 1Ω 1W.

Potentiometers

- 1 5kΩ linear potentiometer
- 1 1kΩ miniature horizontal trimpot
- 1 500Ω linear potentiometer

Miscellaneous

Machine screws and nuts, heat shrinkable tubing, cable ties, etc.

We estimate that the parts for this project will cost

$60-65

This includes sales tax.

when they are being installed. Transistors Q1 and Q2 should be mounted at full lead length.

We recommend that PC stakes be used to terminate all external lead connections. You will require 15 PC stakes in all.

Once the PC board has been completely assembled, attention can be turned to the case. Spray the Scotchcal artwork with a hard-setting clear lacquer (eg, Estapol) to prevent scratches, then carefully affix it to the front panel. The artwork can then be used as a template for drilling holes for the front panel hardware.

You will also have to drill holes in the rear panel for the fuse holder and for mains cord entry. The wiring diagram and the photographs show the positions for these holes.

The major items of hardware can now be positioned in the case. The PC board is secured to four internal mounting posts using self-tapping screws while the power transformer is bolted to the case using machine screws and nuts. Note the solder lug under the nut nearest to the rear panel.

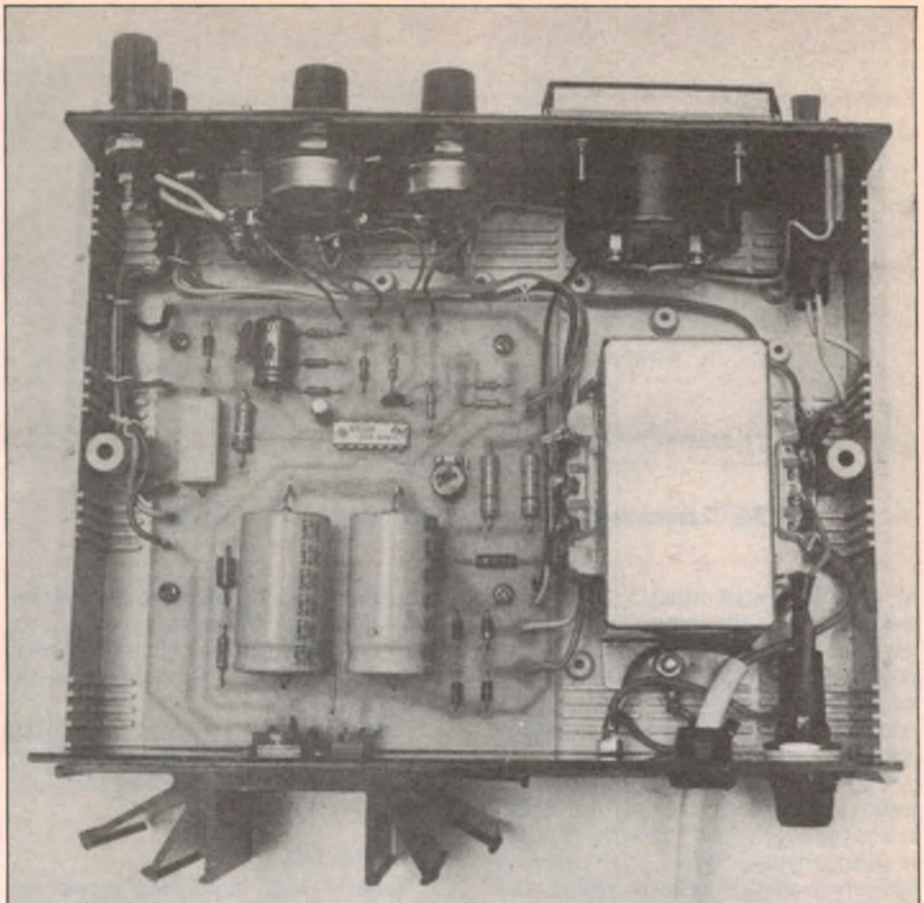
We used medium duty hookup wire (10 x 0.2mm) for all the wiring which carries the full supply current, and light duty hookup wire for the pot, meter and LED wiring.

Heatsinking for the power transistors is provided by the rear panel and by an external multi-finned heatsink. The heatsink used in the prototype is a standard high-efficiency fan type measuring 105 x 75mm. This must be trimmed to a length of 58mm before installation.

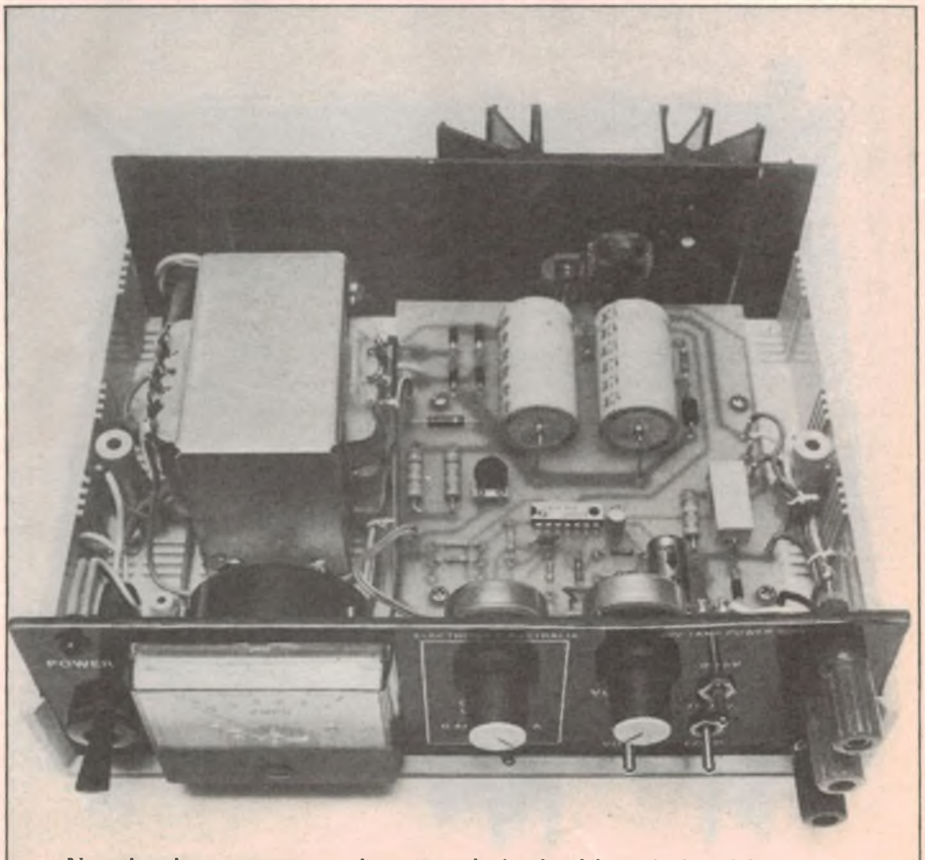
The procedure is to install the rear panel and to then mark and drill the mounting holes for the power transistors. This done, the rear panel can serve as a template for the heatsink mounting holes.

Both transistors must be insulated from the rear panel using mica washers and insulating bushes (see Fig. 2). Smear heatsink compound on all mating surfaces (including the rear of the heatsink), then bolt the assembly together using machine screws and nuts. Finally, use your multimeter to check that the metal tag of each device is indeed isolated from the rear panel and the heatsink.

The three-core power flex is anchored

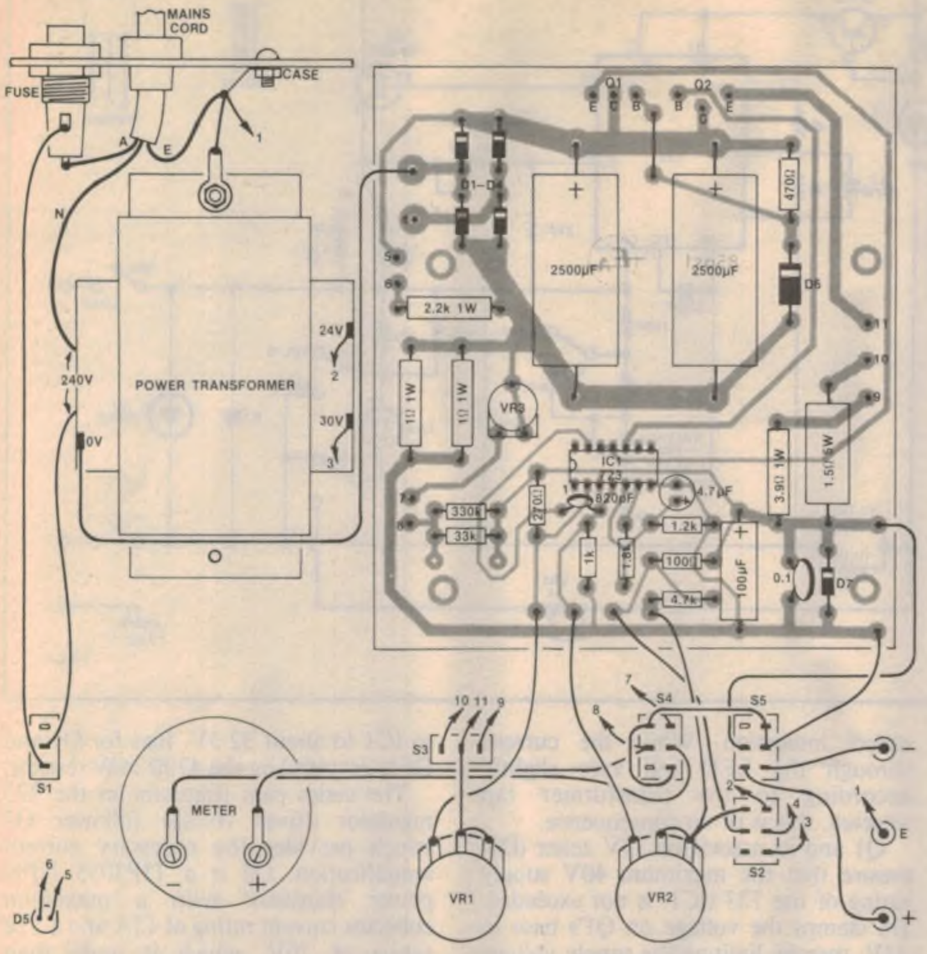


Use heat shrinkable tubing to sleeve the transformer, mains switch and fuse terminals.



Note that the two power transistors must be insulated from the heatsink.

Benchtop power supply



Use medium duty hookup wire (10 x 0.2mm) for all wiring which carries the full supply current (see text). Take care with the orientation of the semiconductors and electrolytic capacitors.

adequate for the job at hand.

Unfortunately, having set the input voltage on Q2's collector to obtain a maximum 30V output, there is a potential dissipation problem when drawing high current at low voltage. This problem was overcome by switching the secondary winding of the transformer.

Thus, for output voltages above 15V, S2a selects the 30V tap on the transformer. For outputs less than 15V, the 24V tap is selected to reduce the dissipation in Q2.

Voltage regulation

Let's now take a look at how the voltage regulator works.

The error amplifier in the 723 is connected as a non-inverting amplifier with variable gain. The input to this amplifier is fixed at about 2.8V by the potential divider formed by the 1.8kΩ and 1.2kΩ resistors. The input to this divider is the reference voltage source built into the 723 chip. A 4.7µF capacitor is included to improve the output noise characteristic.

On the 0-15V range, switch 2b is closed, so the feedback resistance (the resistance between the output of the supply and the inverting input of the error amplifier) can be varied between 100Ω and 5kΩ. This corresponds to an amplifier gain of between 1.1 and 6.1, or an output voltage of between 3.1V and 17.4V.

With switch 2b open, the gain of the amplifier is adjustable between 5.8 and 10.8, corresponding to output voltages of between 16.5V and 30.8V.

Depending upon the position of S3, the load current from the emitter of Q2 flows through either a 1.5Ω or 3.9Ω resistor to derive a voltage for the current limit function. The resulting voltage is applied to a potential divider network (VR1 and 270Ω in series) and thence to the base of the internal current-limit transistor in the 723.

As we've already seen, the current-limit transistor controls the series pass transistor in the 723 regulator. This, in turn, controls voltage-follower Q2. When the current reaches a preset level, the drive to Q2 is reduced and current limiting takes place.

S5 is the load switch and is used to switch the lines leading to the output terminals. This facilitiy is particularly handy. It allows us to remove the load voltage without having to switch the supply off or adjust the voltage setting.

The 0.1µF capacitor prevents switching transients from being delivered to the output while D7 provides protection in the event that a reverse voltage (eg, from a charged capacitor) is applied to the output terminals. The 100µF capacitor ensures stability of the supply under all conditions.

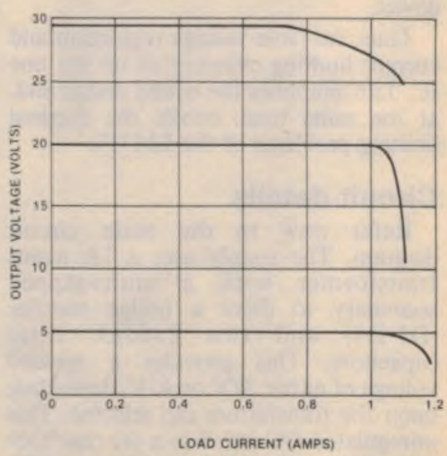
The metering circuitry is quite straightforward. In the voltage mode, a 30kΩ resistor formed by the parallel combination of a 330kΩ and a 33kΩ resistor is switched in series with a 1mA meter across the supply. This means that the meter will read 30V full scale. In the current mode, the meter is connected across a 0.5Ω resistor (made up from two 1Ω resistors connected in parallel) in series with the negative supply line. A 1kΩ trimpot is used to adjust the meter so that it reads 1A full scale.

Construction

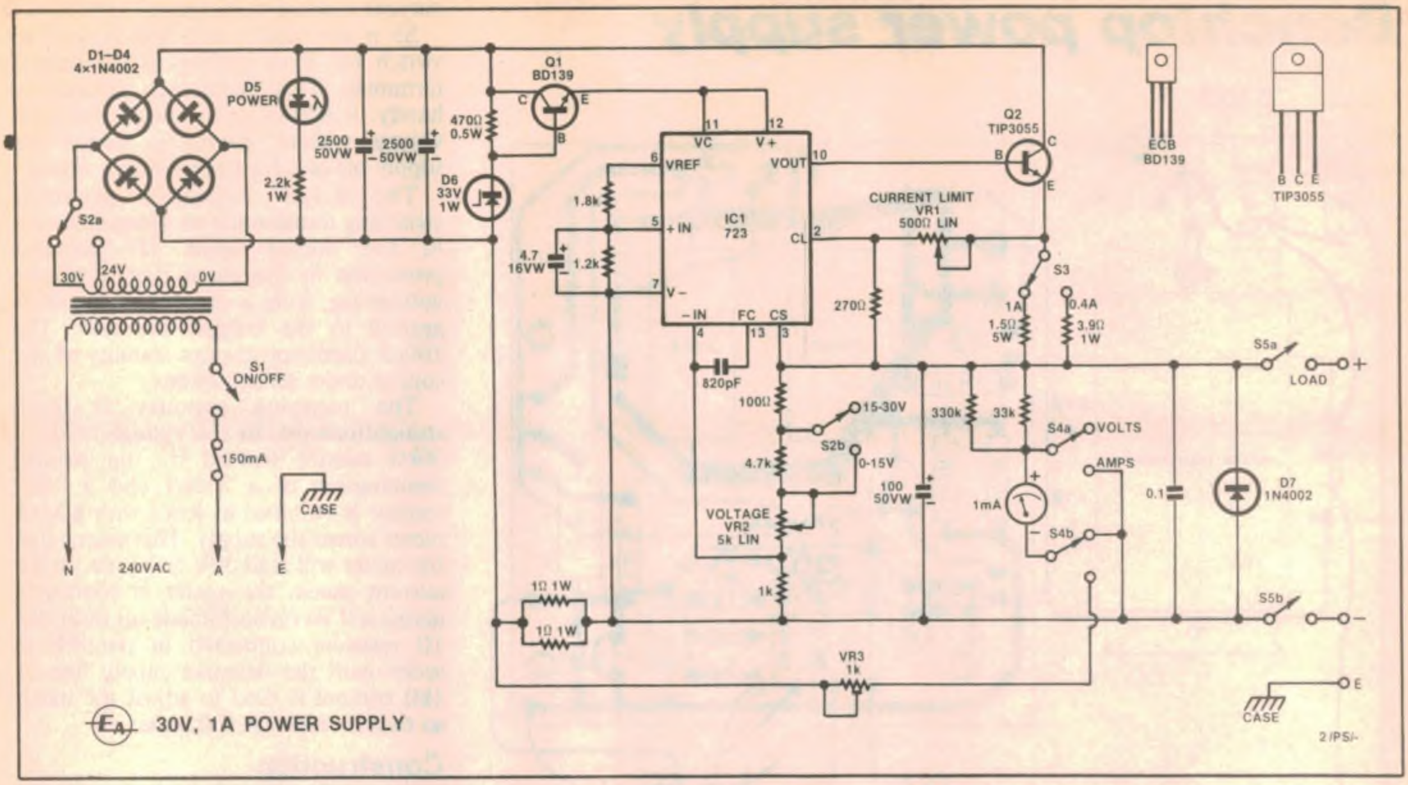
The 30V/1A Power Supply is housed in an attractive plastic instrument case measuring 200 x 160 x 70mm. This should come supplied with a PVC front panel and a 2.5mm black anodised rear panel for heatsinking. A Scotchcal front panel was fitted to the prototype but some kit retailers may prefer to supply screen-printed panels.

All the circuitry, with the exception of the major hardware items (switches, pots, transformer, etc) is accommodated on a printed circuit board measuring 105 x 111mm and coded 85psl.

No special procedure need be followed when assembling the PC board although the job will be much easier if the smaller components are installed first. Note carefully the orientation of the diodes, transistors, IC and electrolytic capacitors



These load curves plot the performance of the prototype. The maximum load current is maintained at 1A for voltages up to 27V.



30V, 1A POWER SUPPLY

Fig. 1 shows the internal workings of the 723 regulator. It consists of a series pass transistor, an error amplifier and a voltage reference source. The error amplifier compares a proportion of the output voltage with the internal reference voltage source and continually adjusts the base current to the series pass transistor to provide a regulated output.

The maximum current rating of the series pass transistor is 150mA, so some form of external current amplification is required to provide a reliable 1A supply.

One particularly attractive feature of the 723 is the in-built current limiting circuitry. When the output current reaches a preset value, the internal current-limit transistor turns on and reduces the base drive to the series pass device.

Thus, we have voltage regulation and current limiting circuitry all on the one IC. This simplifies the circuit design and, at the same time, avoids the thermal limiting problems of the LM317.

Circuit details

Refer now to the main circuit diagram. The supply uses a 1A mains transformer with a multi-tapped secondary to drive a bridge rectifier (D1-D4) and two 2500μF filter capacitors. This provides a no-load voltage of either 37V or 47V, depending upon the transformer tap selected. This unregulated DC is fed to a pre-regulator stage (Q1) and to the output stage (Q2).

LED D5 and its associated 2.2kΩ current limiting resistor provide power on/off indication. While the current through the LED will vary slightly according to the transformer tap selected, this is of no consequence.

Q1 and its associated 33V zener (D6) ensure that the maximum 40V supply rating of the 723 (IC1) is not exceeded. D6 clamps the voltage on Q1's base to 33V, thereby limiting the supply voltage to IC1 to about 32.3V. Bias for Q1 and D6 is provided by the 470Ω ½W resistor.

The series pass transistor in the 723 regulator drives voltage follower Q2 which provides the necessary current amplification. Q2 is a TIP3055 NPN power transistor with a maximum collector current rating of 15A and a Vce rating of 70V, which is more than

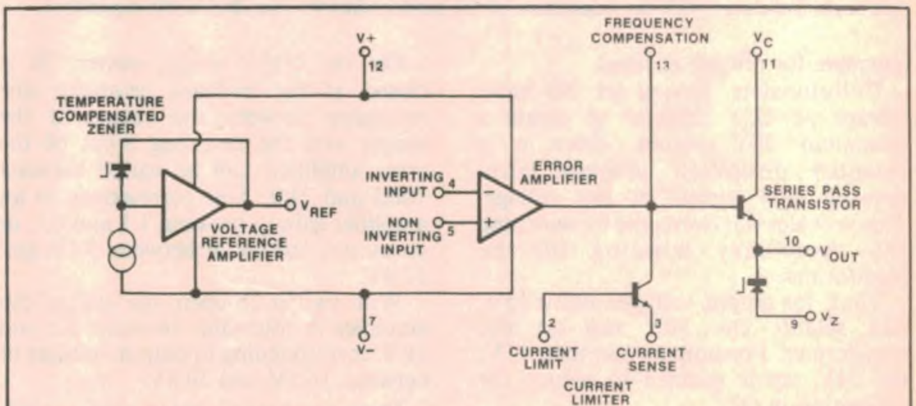


Fig. 1: the 723 regulator IC contains a series pass transistor, an error amplifier and a voltage reference source.

SPECIFICATIONS — EA 30V/1A SUPPLY

Output voltage	3-30V variable over two ranges, 0-15V and 15-30V
Output current	0-1A up to 27V (see load curves) with variable current limiting
Load regulation	Better than 0.2% from zero to full load
Output ripple	Less than 2mV RMS at full load

New design features current limiting

30V/1A benchtop power supply

This 30V/1A power supply features variable output voltage from 3 to 30V, variable current limiting over two ranges, overload protection and switchable voltage/current metering.

by GREG SWAIN & FRANCO UBAUDI

According to kit retailers, the most popular power supplies with hobbyists are the 30V/1A models. That's not surprising when one considers that most solid state circuitry only requires a single-sided supply of between 5V and 30V at currents up to half an amp or so.

The truth is, most hobbyists don't need an all-singing, all-dancing supply with digital readouts and other fancy whatnots. They do, however, demand a few refinements such as metering, load switching, short-circuit protection and adjustable current limiting. All of these features have been included in this new design.

If you're in the market for a 30V/1A power supply, this is definitely the one to go for. Most of the circuitry is built onto a single PC board, the parts are all readily obtainable and it's easy to build.

With this power supply, you get superior specifications for very little extra money. This unit is capable of providing a full 1A output over virtually the entire voltage range. Other kit designs currently on the market provide a 1A output over only part of their voltage range due to inherent thermal limitations.

Other features of this new design include load switching, power on/off indication, and the provision of a separate ground terminal. There are two ranges for current limit plus two voltage ranges, all selected by means of toggle switches. The current limit ranges are 0.15-0.4A and 0.4-1A, while the voltage ranges are (nominally) 0-15V and 15-30V.

In practice, the current limit and voltage ranges overlap slightly to ensure continuity.

Current limiting

The adjustable current limiting facility is particularly useful. It offers two main advantages: first, it protects the supply in the event that the output is short-circuited; second, it protects any circuitry run from the supply from damage by excessive current due to a fault condition. There's nothing worse than having circuitry go up in smoke while you're trying to troubleshoot a tricky problem.

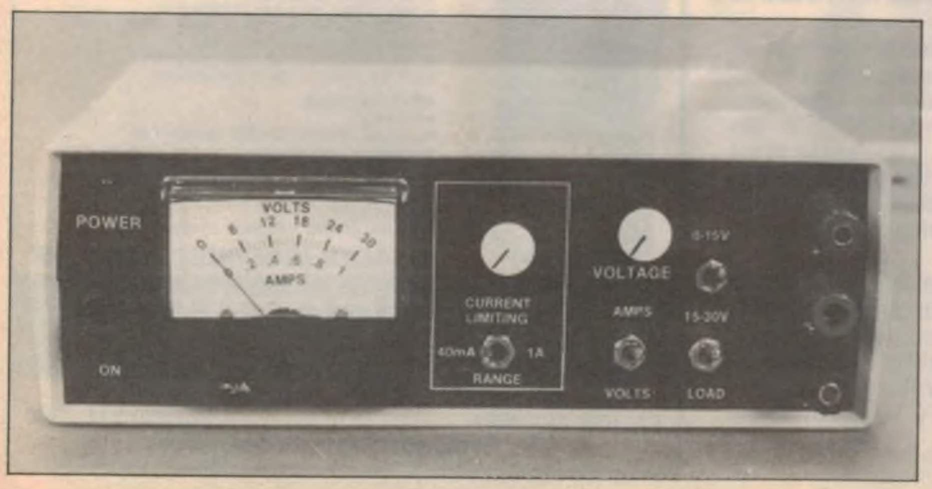
In the interests of economy, we elected to use a single meter and switch between voltage and current measurements. Admittedly, it would be nice to have dual meters but, unfortunately, the cost is prohibitive. Meters are expensive and, in addition, we would require a much larger (and more expensive) case to provide the necessary front panel area.

The accompanying graph and the specification panel document the performance of the prototype. As can be seen, the load regulation is better than 0.2% from zero to full load while the output ripple is less than 2mV RMS. The maximum load current is maintained at 1A right up to 27V output, after which the load curve falls away due to transformer losses.

Design considerations

Initially, we considered using an LM317 three-terminal regulator as the basis for the design but soon ran into difficulties. Despite various approaches, we were unable to come up with a cost-effective circuit that would deliver 1A over the full range due to thermal limiting in the LM317. Another drawback was that an additional op amp was required to provide current sensing, thereby adding to the circuit complexity and cost.

Eventually, we rejected the LM317 in favour of the 723 regulator IC. Originally introduced by Fairchild as the uA723, this device is also available from National Semiconductor as the LM723 and from other manufacturers with similar "723" designations.



Left: this new 30V supply provides a 1A output over virtually the entire voltage range. The meter is re-scaled by removing the plastic cover and attaching new artwork.

should have been 25V, and a width control which didn't work.

I decided to stoke up the CRO and check some waveforms. Of particular interest were waveforms 81 and 90, 81 being at the junction of L779 and C778, and 90 being at the emitter of TR690. Waveform 81 is shown as a negative going spike, at the horizontal rate and about 150V, and it showed up as the right shape but closer to 200V. Waveform 90 was supposed to be a rather peaky sine wave of about 8V p-p, at the vertical rate, but was actually a miniature replica of waveform 81, at about 20V p-p.

Unfortunately, apart from confirming that something was wrong, this didn't help much. I went back to the 25V rail, confirmed that it was still at 28V, and began to make some other measurements. I was particularly interested in the voltage at the junction of D776/777 which is not given anywhere on the circuit or in the manual. As measured, it read a little over 2V (DC) which, intuitively, I felt was suspect.

It was at this stage that somebody up there smiled on me. I had to leave the set to answer a house call involving loss of sound in, would you believe it, a Kriesler 59-1 chassis. The fault was easily fixed but I could hardly wait to get my meter on that diode junction. It read 12.5V.

Back at the shop I took another long hard look at the circuit. I had tested virtually every component which might be pertinent, and there was still something wrong. Which could only mean that I had not tested a vital component, or that one of my tests was inadequate.

Eureka!

My gaze fell on the two diodes. I had pulled them out and tested them with a meter, which had given conventional readings. But could one of them have a "funny" in it? I pulled them both out again and fitted two new ones. And that was it. Everything came back to normal. The 25V rail was spot on and the width, initially inadequate because I had left the control in its minimum position, responded immediately when I adjusted it.

And that was the last fault. It remained only for me to tidy up the mess on the deflection board, give all the adjustments the once over, and I had a set which was virtually as good as new. The owner was delighted, in spite of the fact that the cost, as I had warned him, was pretty substantial. (I didn't charge for changing the line output transformer, and it wasn't worth changing it back again).

As for the theory behind the various component failures, and which came first and started the whole sequence of events, I'm afraid I pass. I did establish fairly conclusively that it was diode D777 which had failed, and that it was apparently breaking down at voltages above those which I used to test it. (A lesson to be learned there).

But whether it was the primary failure, and the cause of all the other failures must remain in doubt. Frankly, I think it was the main offender, but as to the mechanism of the subsequent failures, or how the rogue voltage was developed in the convergence section, I cannot offer any very convicncing theory. One point to note, however, is that the set's behaviour on the bench indicated that it could have been working in an acceptable (to the customer) form for a long time with the faulty diode.

I am also convinced that the flashover from the EHT lead to the 4.7kΩ resistor was a furphy as far as the other faults were concerned. There is little doubt that it happened and that, if allowed to continue, it would have created its own chain of failures, but it wasn't the cause of the other faults.

So, as I said at the beginning, it was not a very satisfactory "apples bit".

But if anybody out there has any ideas . . .

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Serviceman

I also decided to take a punt on reconnecting the frame circuit, in the hope that I could get it working. After what I had been through so far, finding the frame fault was a breeze. It was transistor TR651, a BD235 and the "top" one in the frame outpout pair. Since its collector was connected almost directly to the spurious 70 volts, it was not surprising to find that it had broken down.

A replacement was quickly fitted and I switched on again. And this time things started to work; I had frame deflection and I had a picture. It was a good picture too, considering everything, and provided final confirmation that the picture tube was in excellent condition. It was a great morale booster, and I felt, for the first time, that it was worthwhile pushing on with it.

But there was still a lot to be done. Quite apart from the rogue voltage, the horizontal scan had dropped back when the frame circuit came good, and I began to wonder about the line output transformer. As I mentioned at the beginning, this had been replaced by the previous serviceman, but it was a different brand from the original.

This was not necessarily wrong. The particular make, of German origin, is used in a number of continental sets and is sold as a replacement for the Philips and similar type transformers. On the other hand, my own experience with them has not been the happiest. Some have failed after quite short periods, and they have proved to be incompatible with some circuits using the Philips type.

Since I had the correct transformer type in the junked K9 I decided to fit and restore this part of the set to original condition. After all, there just could be something funny about the replacement unit. Alas for my hopes. The set performed exactly as it had before. Oh well, it was worth a try.

So it was back to the east-west modulator. Looking at the circuit again I realised that there was a section I had tended to ignore; a winding on the line transformer labelled "Y" and "Z", the "Y" connecting to the modulator circuit and the "Z" connecting to the convergence board via pin 4 of plug and socket 705, and pin 3 of plug and socket 802. Could the rogue voltage be coming back from the convergence board?

It was easy enough to check. I simply pulled the plug PL802, reasoning that temporary lack of convergence was of little importance at this time. And this was when things started to happen. The behaviour looked so promising that I was encouraged to refit the 3.3μF capacitor, C759, and try again. This brought the set almost back to normal. Horizontal deflection was now about nine-tenths of the screen width (R779 was still open) and, most important, the 25V rail had now dropped to about 28V; nearly right but not quite.

So what was wrong on the convergence board? Access to this is from the front of the set, below the tuner, and one glance was enough to confirm that all was not well. The blue radial convergence coil, T820, was well and truly cooked and this prompted me to check its associated components. A 22Ω resistor, R820, was also visibly cooked and a 33Ω variable resistor, R817, went "crunch, crunch" when I tried to adjust it.

Once again the old K9 came to the rescue with a good T820 and I soon had the board back to normal. I re-fitted plug 802 and switched on, with the happy result that the set worked as before, but for the first time with the convergence board connected.

But there were still convergence problems. Neither the blue radial or blue lateral convergence adjustments had any effect. The first point to be checked was whether the correct waveforms were being fed to the convergence board and a quick check on the red/green adjustment, T815, indicated that they were working as they should. So, for the moment, I assumed that it was not lack of signal.

On this basis the next check was at the convergence yoke on the tube and, in particular, the blue coil assembly connected to plug and socket 953. These are clipped into the scan coil assembly and are quite easily removed. And one glance was enough; it, too, had been cooked. Only one of the windings, the blue lateral, or static, winding (shunted by two resistors) had been affected, but severely enough to distort the end of the former.

So I delved into the K9 again, fished out another coil, and clipped it into place. And that fixed that; the blue convergence snapped back into place almost spot on. It needed only a touch to complete the correction.

But that was not all. When I replaced the 1Ω resistor, R779, the horizontal scan expanded until it neatly filled the screen. In fact, the set looked as though it was behaving normally and I might have been pardoned for believing that it could go back to the customer.

The only snag was that the width control, a 22kΩ pot, R679, in the base circuit of TR688, wouldn't work. Nor could I work out why it wouldn't work. As far as I was concerned all the components in that part of the circuit, including the two transistors, TR688/690, had been thoroughly checked and pronounced OK. So the two symptoms I had were a 28V rail which

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Car Ignition Killer

entry of the connecting leads. This hole should be fitted with a small rubber grommet to prevent damage to the lead insulation.

Installation of the unit is probably the most important part of the construction. To enable the unit to function effectively, it must remain undetected by the potential thief. This not only means hiding the unit itself and disguising any exposed wiring, but locating the unit so that the sound of the relay operating cannot be heard.

The best place for the unit is probably in the engine bay against the firewall. Power for the unit should be taken from the ignition wire, preferably at a point remote from both the ignition switch and the coil. This reduces the chances of a thief spotting the extra lead when "hotwiring" the car. A single-pole on-off switch, accessable from the driver's position, should be placed in the power lead running to the unit so that the unit can be disabled and the car driven normally.

It goes without saying that this switch should also be well hidden.

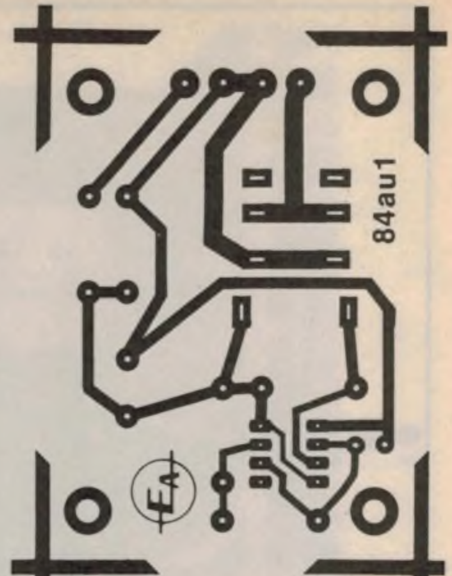
The earth wire should be connected to the nearest earth point, which may actually be inside the case if this is electrically connected to the vehicle chassis (say via self-tapping screws). The most exposed connection is the wire leading to the negative or points side of the coil. This connection should be disguised by using wiring similar in appearance to the existing coil leads, and by bundling the leads together.

Once the unit is installed, it can be checked for correct operation. First, switch the unit off and check that the car can be started and that the engine runs normally. Now switch the unit on – the engine should run normally for a few seconds, then cut out. It should now be possible to restart the engine after a short delay, whereupon the engine should again run normally for a few seconds before cutting out.

If your car's engine is very easy (or very hard) to start you may wish to alter the engine run and stop times we have chosen. This can be done quite easily by changing either of the two timing resistors or the timing capacitor. The formulae for the time periods in seconds are:

- Engine run time = $0.685(R_A + R_B)C$;
- Engine stop time = $0.685(R_B)C$.

In our circuit, $R_A = 220k\Omega$, $R_B = 2.2M\Omega$, and $C = 2.2\mu F$. By substituting these figures into the above equations, we get an engine run time of 3.6 seconds and an engine "kill" time of 3.3 seconds.



Above is the actual size PCB artwork.

PARTS LIST

1 PCB, code 84au1, 69 × 48mm
1 aluminium case, 102 × 70 × 51mm
1 4-way PC-mounting terminal block
1 DPDT 12V relay with 10A 120VAC contacts
1 SPST toggle switch
4 6mm or 8mm spacers
1 small rubber grommet

SEMICONDUCTORS
1 555 timer IC
1 15V 1W zener diode
1 1N4001 diode

CAPACITORS
1 1000µF 25VW PC electrolytic
1 2.2µF 16VW PC electrolytic

RESISTORS (¼W, 5% unless stated)
1 x 2.2MΩ, 1 x 220kΩ, 1 x 22Ω ½W

MISCELLANEOUS
Machine screws and nuts, self tapping screws, automotive hook-up wire, solder etc.

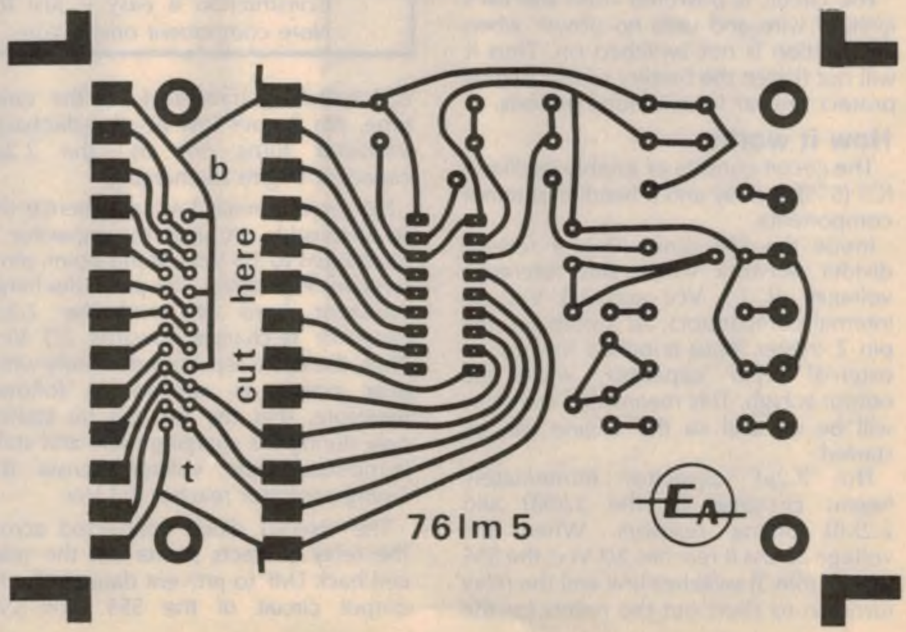
LED Level Meter

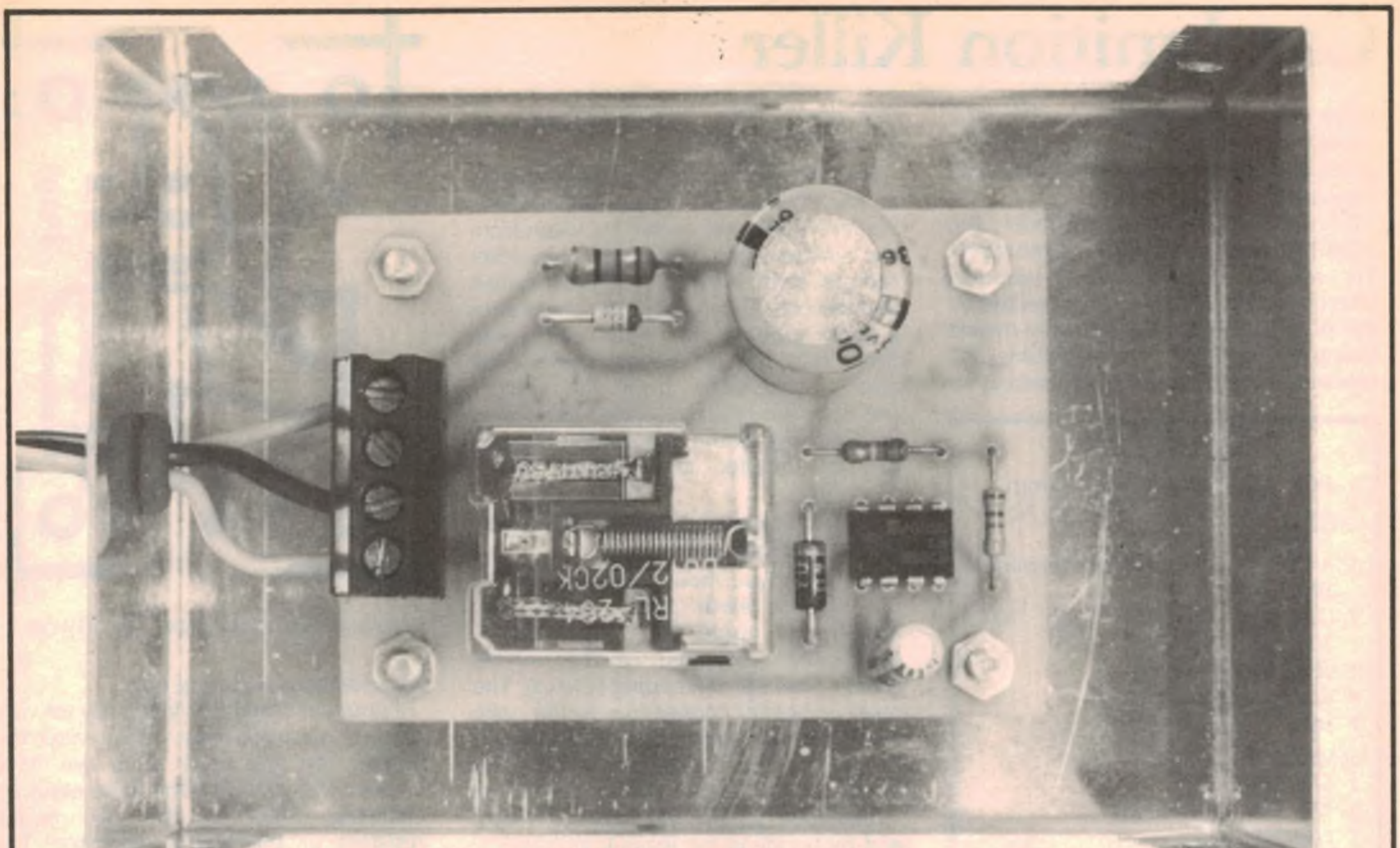
CONTINUED FROM PAGE 27

mally, for a stereo deck, two of these amplifiers would be required, each driving a separate LED array. The 10k trimpot is used to adjust the gain of the amplifier. The 100k trimpot in the LED Level Meter should be adjusted for maximum sensitivity, allowing the gain of the amplifier to be set as low as possible.

The amplifier operates from a nominal 12V DC supply, the same as that produced by the 9VRMS transformer and rectifier combination in the LED Level Meter. As the current drain is only of the order of 10mA, the amplifier can be simply connected in parallel with the meter.

The amplifier gain should be adjusted so that 0VU corresponds to the red LED just emitting. If you are replacing a mechanical movement, simply adjust the gain so that both the meters read the same on a sine wave signal with a frequency of about 1kHz.





Larger than life size photo of the assembled unit. The three leads go to the disable switch, chassis and coil negative.

the oscillator output goes low, causing the relay to operate and short out the car's points. With no points signal the ignition system cannot produce a spark and so the engine dies. A few seconds later the oscillator output returns to the high state, the relay turns off and the contacts open. The engine can now be started and will run for a few seconds until the next low cycle of the oscillator.

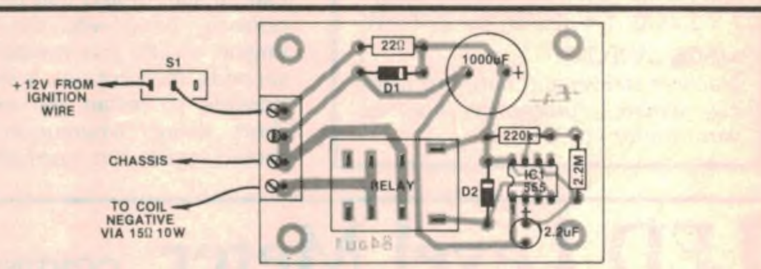
The circuit is powered from the car's ignition wire and uses no power when the ignition is not switched on. Thus it will not flatten the battery when used to protect the car for extended periods.

How it works

The circuit consists of astable oscillator IC1 (555), a relay and a handful of minor components.

Inside the 555 timer IC is a resistor divider network which sets reference voltages of 1/3 Vcc and 2/3 Vcc on internal comparators. At switch on, the pin 2 trigger input is pulled low by an external 2.2μF capacitor, while the output is high. This means that the relay will be off and so the engine can be started.

The 2.2μF capacitor immediately begins charging via the 220kΩ and 2.2MΩ timing resistors. When the voltage across it reaches 2/3 Vcc, the 555 output (pin 3) switches low and the relay turns on to short out the points (or the coil switching transistor). At the same time, pin 7 goes low (ie, the discharge transistor turns on) and the 2.2μF capacitor begins discharging.



Construction is easy — just follow this parts overlay diagram. Note component orientation.

Pin 3 will remain low, and hence the relay remains on, until the capacitor is discharged to 1/3 Vcc. At this point, pin 3 switches high again, the pin 7 discharge transistor turns off, and the 2.2μF capacitor re-charges towards 2/3 Vcc. Thus, the cycle repeats indefinitely while ever power is applied. It follows, therefore, that the car can be started only during the charging cycle and stalls immediately the voltage across the timing capacitor reaches 2/3 Vcc.

The 1N4001 diode connected across the relay contacts shorts out the relay coil back EMF to prevent damage to the output circuit of the 555. The 22Ω resistor, 15V zener and 1000μF capacitor provide supply line filtering and decoupling. The 15V zener clamps supply line transients to 15V, thus protecting the 555 from excessive voltages.

Construction

Construction is straightforward with all parts except the switch mounted on a small printed circuit board (PCB) coded 84au1 and measuring 69 × 48mm. This is housed in a metal case measuring 102 × 70 × 51mm, although any similarly-sized plastic case would also be suitable.

We mounted the PCB assembly on the lid of the case using four 6mm brass spacers and machine screws and nuts. A small hole was drilled in the end of the lid closest to the terminal block to allow

Sneaky anti-theft device to build

Car Ignition Killer

Car burglar alarms are fine except that most are easily circumvented. This cunning anti-theft device is cheap, easy to fit, and effective.

We may be in the midst of an economic recession, but no such recession has been reported in the car theft "industry". Last year, more than 70,000 cars were stolen in Australia, this despite the existence of car steering locks and the increasing use of car burglar alarms.

A problem concerning the car alarm concept is how to make it most effective. One philosophy – usually expounded by the commercial alarm manufacturers – is that the alarm is most effective if its presence is clearly advertised and made obvious. The thief will then, according to theory, bypass that vehicle and attack one whose owner has not been astute enough to fit the "Little Beaut Red and Green Flashing Car Alarm". (What would happen if everybody fitted the "Little Beaut . . . etc" is not clear).

But that question aside, the opposite alarm philosophy contends that a warning sticker only makes the thief aware that there is an alarm to be circumvented. And professional thieves are not above familiarising themselves with the various commercial alarms and how best to disable them.

In fact many car alarms can be effectively disabled by the simple measure of disconnecting or cutting the horn wires without lifting the bonnet. It is not generally realised that most horns can be reached without much effort from underneath the vehicle. An experienced thief can pull this trick in a few seconds.

Even if the alarm does sound, the thief usually has sufficient time to disable it. Surveys have shown that people tend initially to disregard a car burglar alarm, assuming that the owner has set it off accidentally. Provided he keeps his "cool", the thief has only to cut the wires to the horn or siren and drive away.

One of the worst thieves, as far as the car owner is concerned, is the "joyrider". This is the person who grabs your lovingly cared for Ford, Holden, Porsche, etc and takes it for a "spin around the block" to see for himself just how fast it will go. If the owner is lucky, the car will be found intact a day or so later, usually minus the radio-cassette player and any other valuable accessories that may have been fitted.

But even this can have a sting in the tail, with the real damage to the car often unseen. After all, the thief doesn't care two hoots about your property. The engine could well have been overheated or had the inside revved out of it. Or the car could have been used to show off innumerable "wheelies" to the detriment of the tyres and suspension.

Often, of course, the car will not be recovered or will be damaged beyond repair. Many cars are stolen by professional thieves to be stripped and used for spare parts. But whatever the circumstances, car theft causes the owner a great deal of expense and inconvenience.

Ignition killer

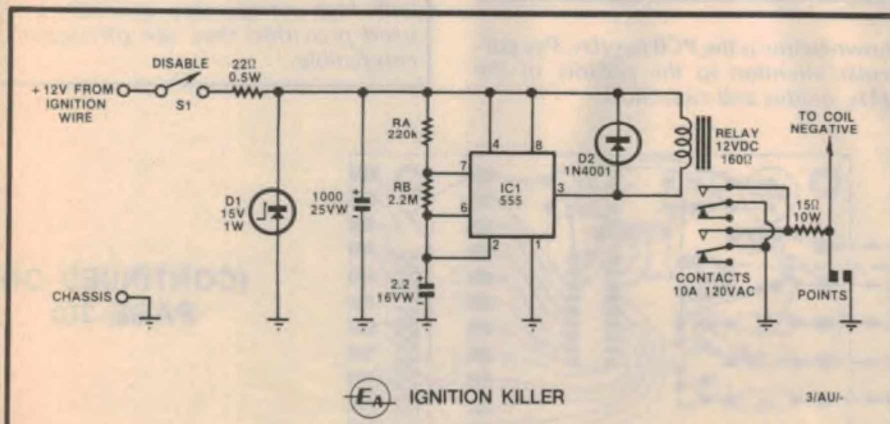
In order to protect your car against the above situations we have devised a rather cunning little circuit. We've christened it the "Ignition Killer".

It works like this: imagine a thief has just broken into your car. He starts the engine and begins to drive off. Just as he does, the engine dies. He immediately cranks the engine and a few seconds later it starts. Again he begins to drive off and again the engine dies. In desperation he tries a third time only to have the engine die again.

The above sequence of events should automatically deter any joyriders and many so-called professional thieves as well. After all, it is difficult to get any joy out of the car that only moves a few metres at a time. In this situation, most thieves will simply assume that the car has an engine problem and will abandon it for easier "game".

The simple circuit that creates this mayhem is simply an astable oscillator based on the ubiquitous 555 timer IC. The output of the 555 oscillator is connected to a relay which in turn has its normally open contacts wired in parallel with the car's points or coil switching transistor (see Fig. 1).

A few seconds after the car is started,



The circuit consists of a 555 timer IC driving a relay.

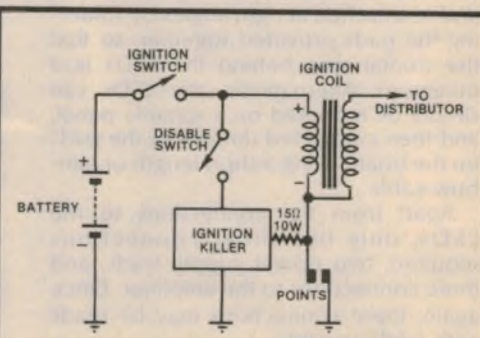
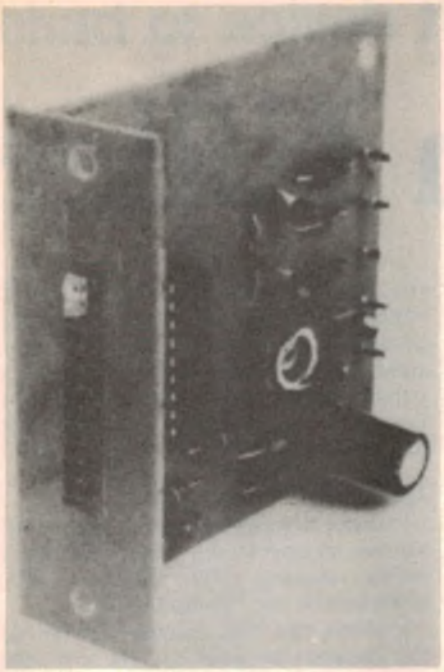


Fig. 1

The Ignition Killer is simply connected in parallel with the points (or the coil switching transistor).



Here is a photograph of the finished unit, showing how the LEDs are mounted at right angles to the main board.

electrolytic capacitor, acts as a half-wave rectifier. A transformer with a secondary voltage of about 9VRMS, and capable of supplying the required current, should be used. Suitable types include the DSE M2840, from Dick Smith Electronics, the 6155 type from A & R, or the PL1.5 - 18/20VA type from Ferguson Transformers Pty Ltd.

The components are assembled on a small printed circuit board, coded 76lm5, measuring 96 x 69mm. This is designed for use with the Siemens miniature LED array, which consists of ten green LEDs in an array. Matching yellow and red LEDs complete the dozen. They are spaced on 2.54mm centres, and have leads on 2.54mm centres.

As you can see from the photographs, the LEDs are mounted on one end of the board. This end can be carefully separated from the main section of the board, and re-attached at right angles by soldering the pads provided together, so that the frontal area behind the LEDs is a minimum. Alternatively, the LEDs can simply be mounted on a suitable panel, and then connected directly to the pads on the board using a short length of rainbow cable.

Apart from the connections to the LEDs, only five other connections required, two power supply leads, and three connections to the amplifier. Once again, these connections may be made with rainbow cable.

Construction should present no difficulties. The components are simply mounted on the circuit board sections, which are then carefully soldered together. To provide mechanical strength, the joint can be reinforced with a quick setting epoxy cement. Take care that the LEDs are oriented correctly, with the ten green ones at the bottom (marked "B" on the PCB), and the red LED at the top (marked "T").

The completed assembly is then secured behind an appropriately shaped slot in the front panel, using the mounting holes provided. All that remains is to set the trimpot to the correct value.

There are two posssible settings of the trimpot, giving two interpretations of the display. In the first mode, the trimpot is adjusted so that the uppermost red LED is illuminated when the amplifier is just clipping on both channels. The number of LEDs illuminated at any time is then related to the power output of the amplifier.

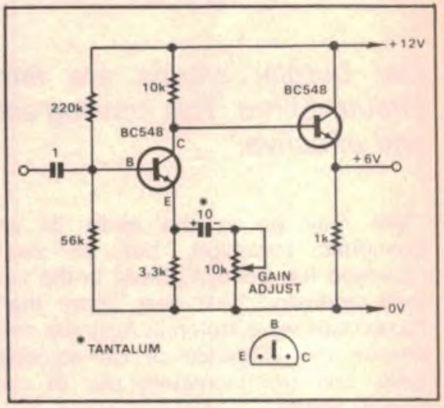
This mode, however, does not give a visually interesting display at normal listening levels. So if you want to impress visitors by making the display flash more, simply adjust the trimpot so that at your highest listening level a visually satisfying display is obtained.

To set the uppermost LED to correspond to clipping level, simply insert a 100 ohm 5 watt resistor in series with each speaker, and apply a sine wave signal at about 1kHz to both channels at once. Advance the volume control till audible clipping can be heard, and then set the trimpot so that the top LED is only just emitting.

In case you are wondering whether or not this procedure will damage your equipment, we can assure you that with modern solid-state amplifiers it will not. The 100 ohm resistors will prevent excessive power dissipation in the amplifier output stages and in the speakers. But note that this does not apply with older valve-type amplifiers, which should not be set up using the 100 ohm resistors.

As mentioned earlier, the LED Level Meter can also be used to replace the mechanical VU meters commonly fitted to cassette recorders. However, the input sensitivity needs to be increased to allow the unit to function with input signals of the order of tens of mV rather than volts.

The accompanying diagram gives details of a small variable gain amplifier, using two readily available transistors, which is quite suitable for this role. Nor-



Above is the circuit diagram for a small auxiliary amplifier, to increase the input sensitivity when required.

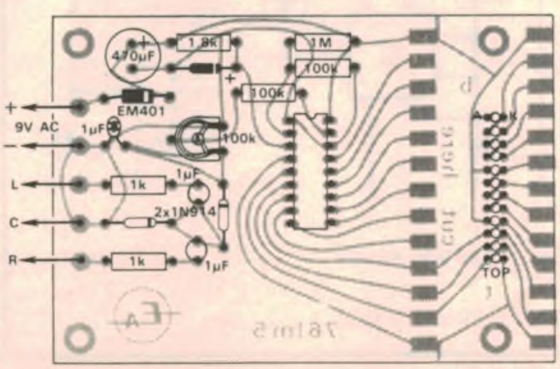
PARTS LIST

- 1 UAA180 LED driver IC
- 12 miniature LEDs, matched (see text)
- 1 4.7V 400mW zener diode, 1N750, BZY88C4V7 or similar
- 2 silicon diodes, 1N914, 1N4148
- 1 silicon diode, EM401, 1N4002
- 1 470uF 16VW PCB mounting electrolytic capacitor
- 2 1uF/50VW bipolar electrolytic capacitors
- 1uF tantalum capacitor
- 2 1k, 1 1.8k, 2 100k, 1 1M ¼W resistors
- 1 100k miniature trimpot
- 1 printed circuit board, 96 x 69mm, coded 76lm5

PC board stakes, mounting screws, connecting wire, solder, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with high ratings may generally be used provided they are physically compatible.

Shown below is the PCB overlay. Pay particular attention to the polarity of the LEDs, diodes and capacitors.



(CONTINUED ON PAGE 30)

Build this simple

LED Level Meter

This simple LED audio level indicator can be used to monitor the output from your amplifier. A column of twelve LEDs gives a "bar of light" display proportional to the output voltage, and lighting of the uppermost LED can be made to correspond to clipping level.

by DAVID EDWARDS

Using only a single IC, a special LED array and a handful of other parts, this solid state level meter is easily assembled on a printed circuit board. It is designed mainly to be connected directly onto the speaker leads of a stereo amplifier, and displays the sum of the peak channel voltages.

By adding a simple transistor amplifier to increase the sensitivity, the unit can be used as a solid state VU meter, to replace the mechanical types commonly used in tape recording equipment. Details of how to do this, as well as other possible uses, will be given later in the article.

Turning now to the circuit diagram, we can see how the input voltages are converted into a column of light. At the heart of this process is the 16 pin DIL Siemens IC, the UAA180. This is distributed in Australia by Siemens Industries Limited, who have offices in all major states. Order it from them via your usual supplier.

A DC voltage applied to pin 17 is decoded by the UAA180 to drive a column of twelve LEDs. The length of the column of light produced is directly proportional to the applied input voltage. The upper and lower points of the light bar are set by the voltages applied to pins 3 and 16 respectively. If the input voltage is below that on pin 16, all LEDs are out, while for input voltages exceeding that on pin 3, all LEDs are on.

The size of the voltage difference between pins 3 and 16 determines whether or not the transition between individual LEDs is abrupt or gradual. A difference of 0.5V gives a gradual transition, a difference of about 4V or more gives an abrupt transition, while differences in between these give corresponding transitions.

Control of the LED intensity is obtained by varying the voltage applied to pin 2. A potential divider across the supply rail is used, with the lower leg variable. In the circuit we have used a 10 to 1 divider formed by a 1M and a 100k resistor. This gives maximum intensity. To achieve lower intensities, the 100k resistor may be reduced in value.

The LEDs are connected in series, in groups of four. Thirteen connections to the IC are required, twelve cathode connections and one power supply connection. The LEDs should all be matched, as otherwise the column of light will not be evenly illuminated.

The input signals are coupled into circuit via two 1k isolating resistors in series with 1uF bipolar electrolytic decoupling capacitors. A voltage doubling rectifier is used with the output voltage, which is nominally equal to half the sum of the peak to peak input voltages, appearing across the 1uF tantalum capacitor.

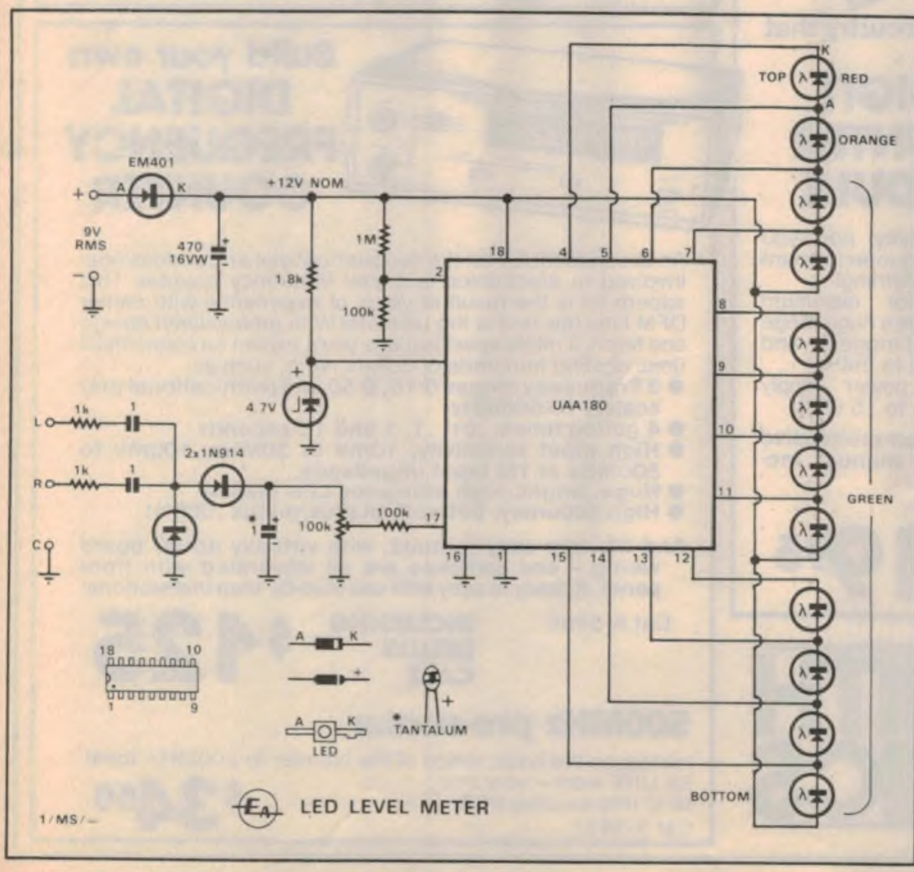
This voltage is fed to the UAA180 via a 100k trimpot and a 100k isolating resistor. The attack time is determined by the 1k/1uF RC combination, while the decay time depends on the 100k/1uF RC combination.

The common terminal for both inputs is intended to be connected to the chassis of the amplifier. This will avoid any complications with DC offsets between the two amplifiers. If required for use with a four channel amplifier, two more input coupling networks can simply be added in parallel with the two already provided.

The reference voltage for the UAA180 is provided by the 4.7V 400mW zener diode. Pins 3 and 16 are simply connected directly to either side of the zener. Filtering of the supply rail is provided by the 470uF 16VW electrolytic capacitor. The unit will operate with a supply rail between 10 and 16V. The maximum current drawn is about 50mA.

For operation on DC supplies, the diode in series with the + input is replaced with a link, and the appropriate voltage applied. If a well regulated supply is used, the 470uF electrolytic may be reduced in value.

The unit will also operate satisfactorily directly from an AC supply. The EM401 diode, in conjunction with the 470uF



Shown at left is the circuit diagram. The heart of the unit is the UAA180 integrated circuit.

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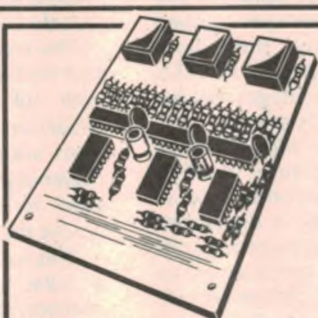

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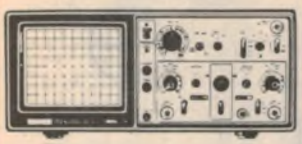

You'll never believe how much use a CRO can be until you own one. But don't go for a half baked five meg job: get the big gun: famous brand Hitachi goes to 20MHz, dual trace – and is small enough to go where you go.
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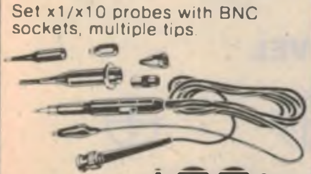

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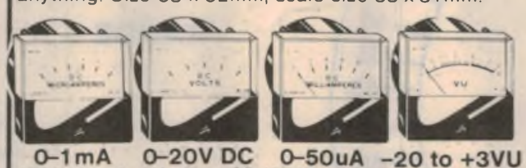

0–1mA	0–20V DC	0–50uA	-20 to +3VU
(200 ohms)	(1k ohms/V)	(3500 ohms)	(1.228V/0dB)
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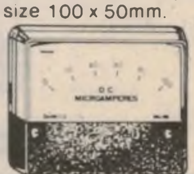
(200 ohms)
Cat Q-2060

0–100ua
(3500 ohms)
Cat Q-2070



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On the level, this lot. Choose the type you require – or add a series multiplier or parallel shunt to suit your particular circuit.

Signal Strength
250uA FSD
scale labelled 1-10
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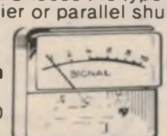
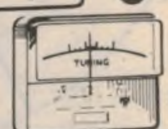


$5.55

Tuning Centre Zero
Sensitivity is 250uA half FSD (in either direction).
Cat Q-2095



$5.55

Edge Level Meter
Scale size 32 x 10mm, it is ideal for a fine level adjustment meter, audio or battery level, etc.
Cat Q-2110

$4.95

available in due course. The battery is clamped to one end of the case with a small piece of scrap aluminium, while the PCB is simply screwed to the bottom of the case using additional nuts as spacers.

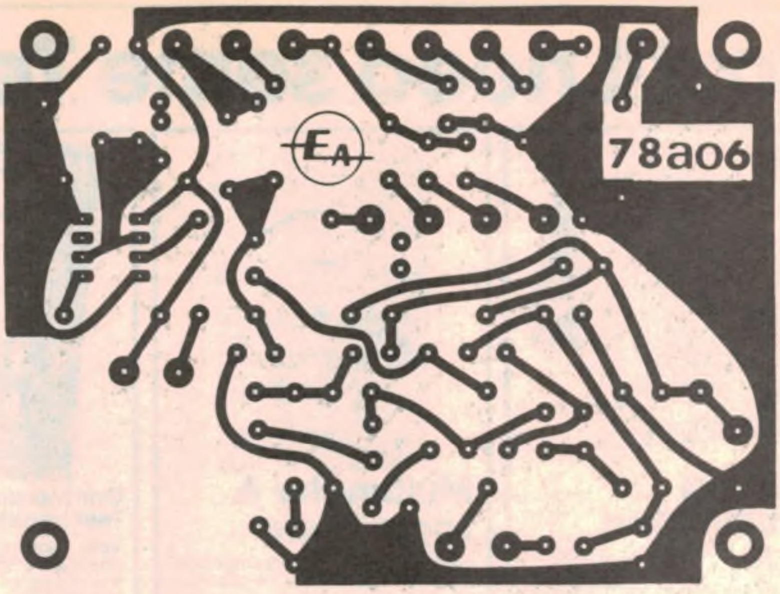
Use the combined overlay diagram and wiring diagram to aid in placements of the components. Remember to ensure that the electrolytic capacitors and transistors are oriented correctly. The output coupling capacitor and attenuator resistors are wired between the front panel components as shown.

Use shielded cable as shown to connect the sine and square wave signals to the function switch (S2). The shield of the cable carrying the square wave signal is used to make the earth connection to the COM terminal. Remember to earth the front panel itself to this point also.

Use rainbow cable for the remaining connections to the front panel, and to the power input socket and the battery terminals. Keep these leads as far as possible away from the output terminals.

Once construction is complete, operation can be checked using some sort of audio level indicator. A CRO is ideal, with an audio millivoltmeter the next best thing. If necessary, an audio amplifier can be pressed into service, so that you can listen to the output.

Check operation over all frequencies, and in both sine and square wave positions. Do not forget to check for correct operation using both the internal battery and the external plugpack.



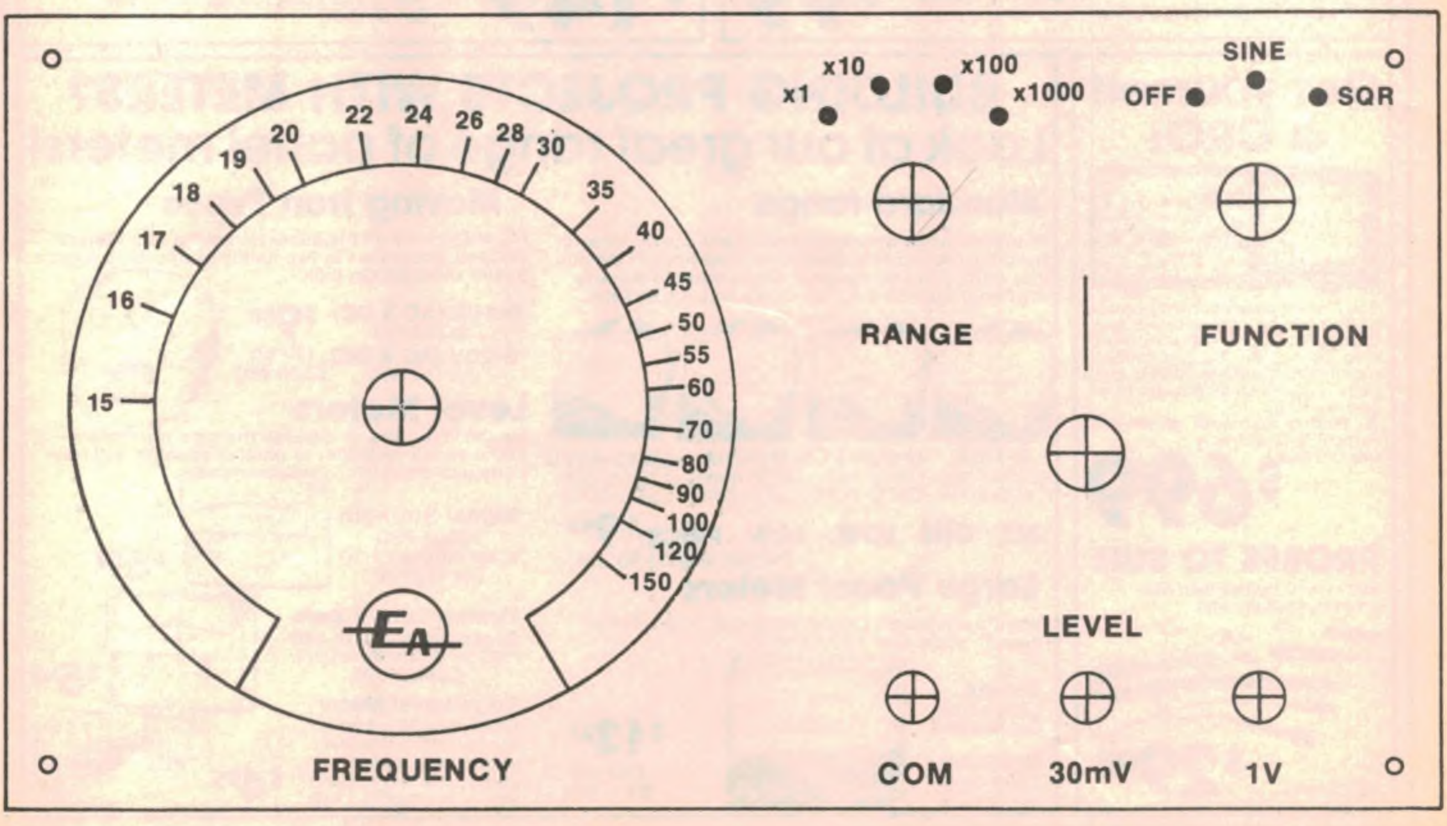
If you make your own printed circuit boards, then this full sized reproduction can be used as a drawing guide.

Calibration of the completed unit is quite simple. If you have access to a frequency meter, simply set the dial at the correct point while the oscillator is producing about a 3kHz tone.

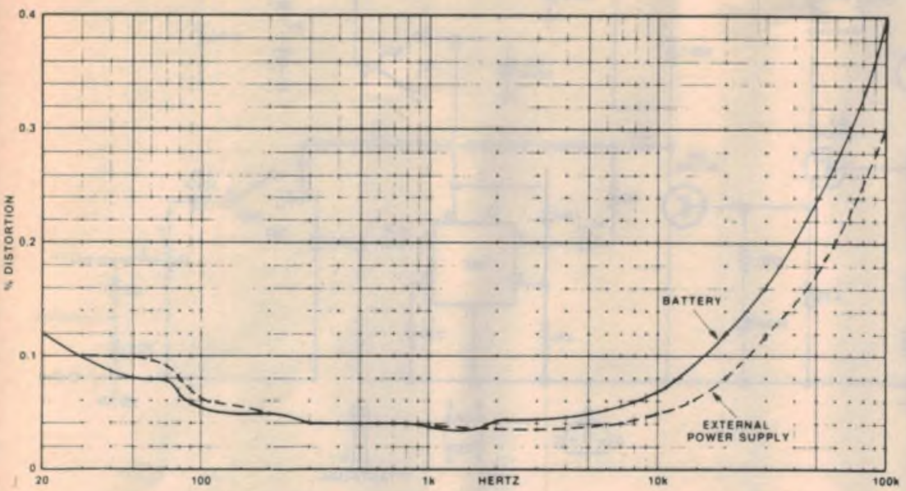
You can then check accuracy on the remaining ranges, padding the appropriate capacitors if necessary. The actual scale calibrations were determined experimentally, and were made using a potentiometer supplied by Dick Smith Electronics, marked "JP-7G" and "B10k". For maximum calibration accuracy, readers should endeavour to use the same type of pot.

On an instrument of this type, however, accuracy of calibration is not essential, and any 10k dual ganged linear pot should give accepable performance.

This full sized reproduction of the front panel can be used directly, or copied.

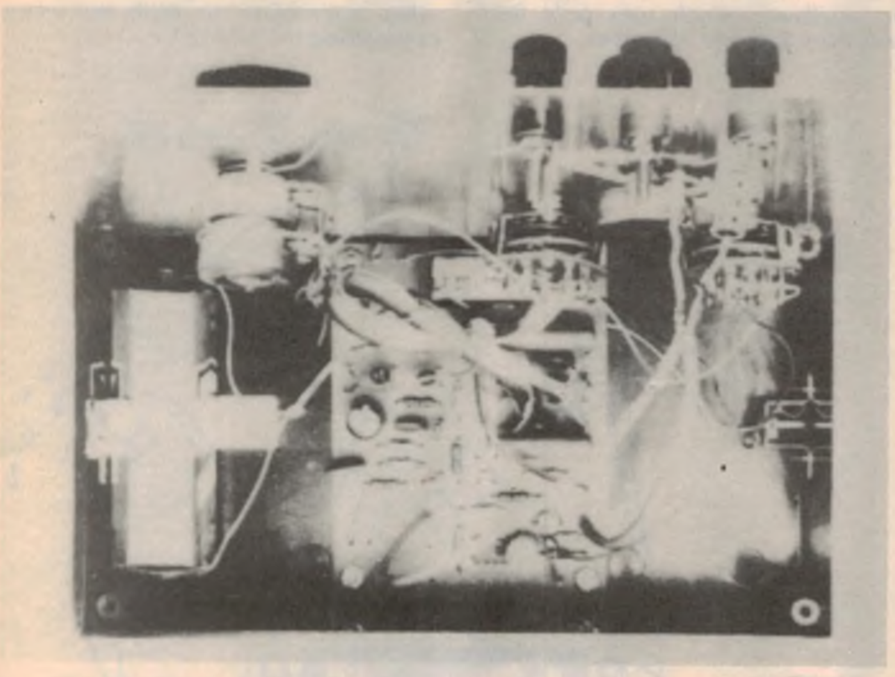


Sine/square wave Oscillator



ABOVE: Graph showing how the distortion of the prototype varies with the oscillator frequency.

BELOW: The internal layout of the prototype can be seen in this picture. Note the battery clamp.



ed, and two inputs are biased at approximately 1.5V by the 220k and 47k resistors. The 2.2k resistor connected to pin five is used to lower the input thresholds to 2V and 1V, so that an approximately even duty cycle square wave is obtained.

Switch S2a is used to select either the sine or square wave signal, with the latter being attenuated to a 1V RMS level by the 3.3k resistor in series with pin 3. A coupling capacitor is provided, with a 1k potentiometer used as an output level control. To faciliate the generation of millivolt-level signals, a fixed divider is provided across the output terminals, to give a nominal signal of 30 mV maximum.

Filtering of the supply line is provided by a 1000uF capacitor. A 100uF capacitor is used to remove glitches from the supply line to the 555, and a 100 ohm resistor inserted in the negative lead of the plugpack input reduces the effects of mains ripple to insignificant levels.

Construction of the unit is quite simple, and should be within the capabilities of even inexperienced constructors. Most of the components are mounted on a single printed circuit board, measuring 101 x 76mm and coded 78ao6.

Commence construction by fitting all the hardware to the case. The front panel of the prototype was made from photosensitive aluminium, but we hope that commercial panels will be

PARTS LIST

SEMICONDUCTORS
2 BC549 or similar NPN transistors
2 BC559 or similar PNP transistors
1 555 timer IC

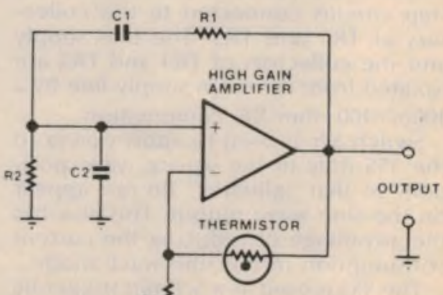
CAPACITORS
1 1000uF 16VW axial lead electrolytic
5 100uF 16VW radial lead electrolytics
1 2.2uF tantalum
2 1uF polyester
2 0.1uF polyester
2 0.01uF polyester
2 0.001uF polyester
1 470pF polystyrene or ceramic
1 100pF polystyrene or ceramic

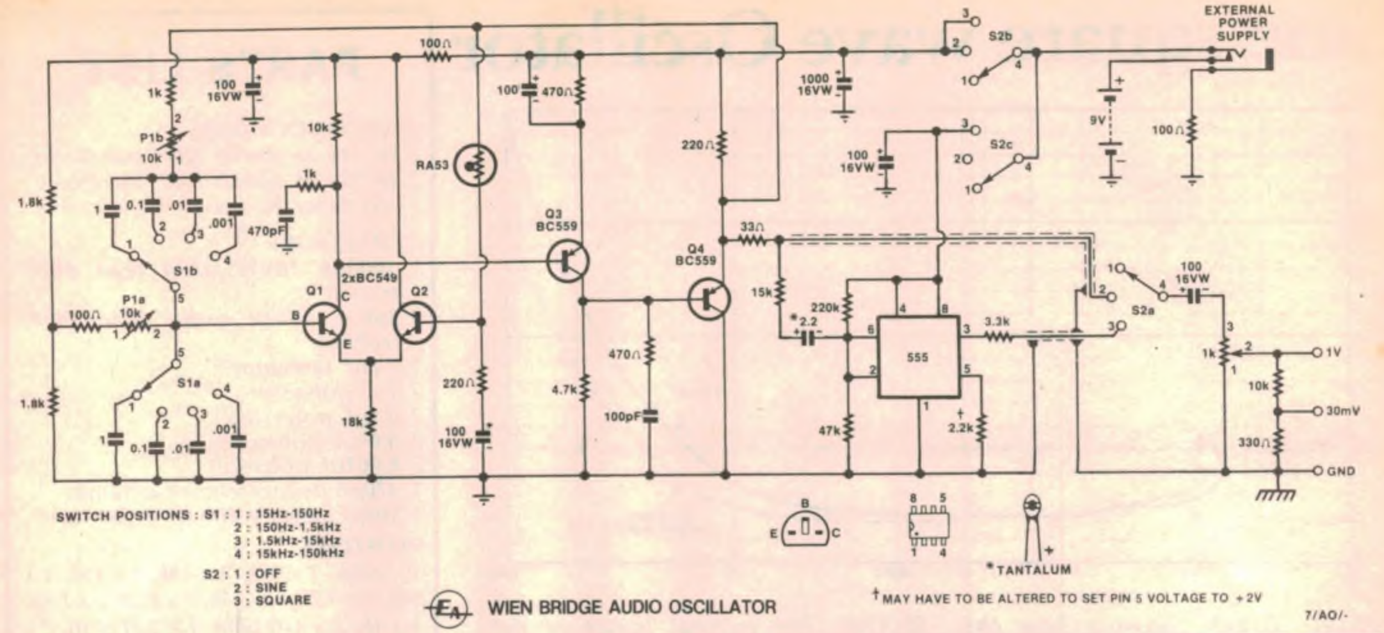
RESISTORS
1 x 220k, 1 x 47k, 1 x 18k, 1 x 15k, 2 x 10k, 1 x 4.7k, 1 x 3.3k, 1 x 2.2k, 2 x 1.8k, 3 x 1k, 2 x 470 ohm, 1 x 330 ohm, 2 x 220 ohm, 3 x 100 ohm, 1 x 33 ohm.
1 dual 10k linear potentiometer
1 1k linear potentiometer
1 RA 53 thermistor

MISCELLANEOUS
1 2 pole 4 position rotary switch
1 3 pole 3 position rotary switch
1 case, 197 x 60 x 112mm
4 knobs
3 terminals, 2 red, 1 black.
4 rubber feet
1 Eveready 2362 or similar battery and suitable connecting clips
1 front panel (see text)
1 A&R PS309 or similar 9V plugpack
1 2.1mm DC input jack socket and metric screws to suit
1 printed circuit board, coded 78ao6, 101 x 76mm
Rainbow cable, shielded cable, printed circuit board pins, machine screws and nuts, scrap aluminium, perspex, solder

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible.

Fig. 1: This circuit shows the basic principles of the oscillator, whose frequency is determined by the RC network.





ABOVE: This is the circuit diagram of the oscillator, which uses only four transistors and one 555 timer.

final output amplitude is just a little over 1VRMS.

Turning now to the main circuit diagram, we can discuss the circuit in more detail. TR1 and TR2 form a differential pair, with the output taken from the collector of TR1. TR3 amplifies this signal further, while TR4 buffers the signal at the collector of TR3. Positive feedback is applied from the emitter of TR4 to the base of TR1 via the Wien network, while negative feedback is applied to the base of TR2 via the thermistor.

The base of TR1 is held at half the supply voltage by the two 1.8k resistors, and since 100 per cent DC feedback is applied via the thermistor, this fixes the output DC voltage at half the supply rail also. Switch S1 is used to select one of four pairs of capacitors, to give the four frequency ranges provided, while ganged potentiometer P1 provides the frequency selection within each range.

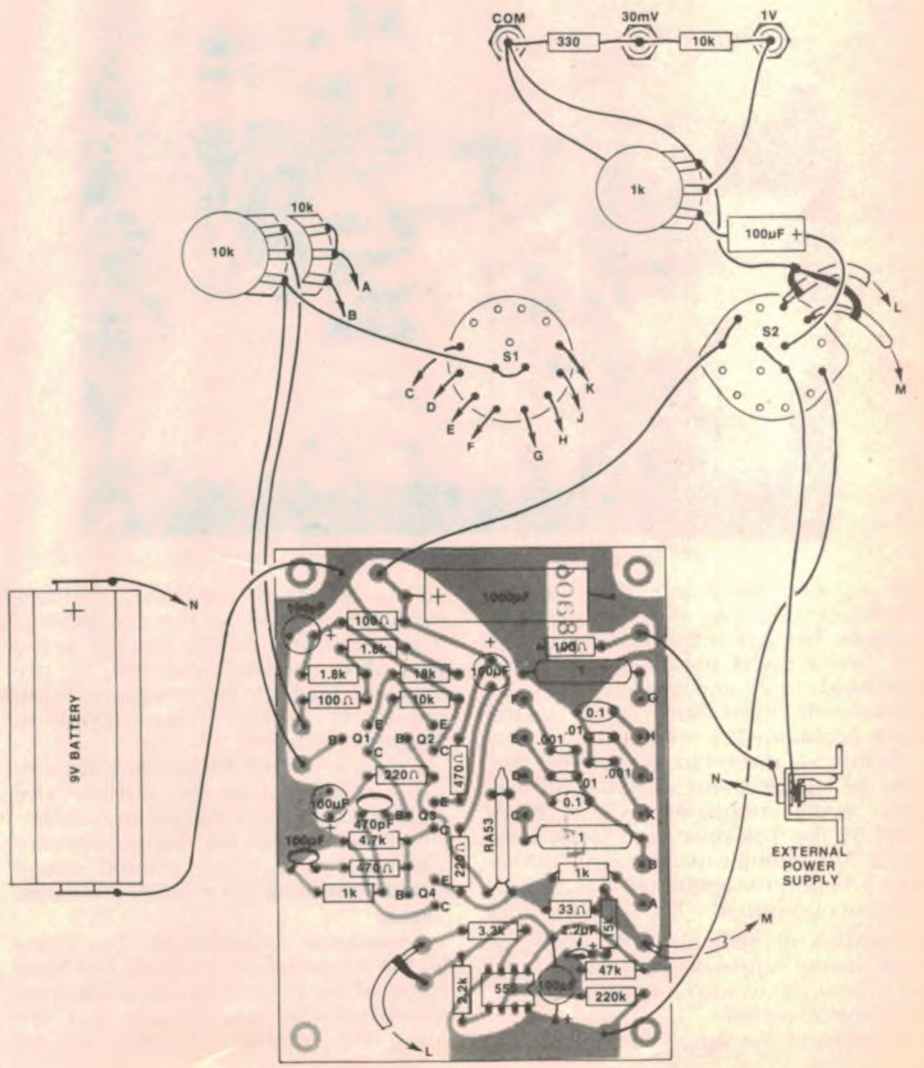
1k stopper resistors are included in series with the two sections of P1 so that overlapping of the ranges is obtained by about five per cent. The stopper in series with P1a is formed by the series parallel combination of the 100 ohm and 1.8k resistors.

High frequency stability of the amplifier is ensured by the use of RC step circuits connected to the collectors of TR1 and TR3. The bias supply and the collectors of TR1 and TR2 are isolated from the main supply line by a 100uF/100 ohm RC combination.

Switch S2c is used to apply power to the 555 only in the square wave position, so that "glitches" do not appear on the sine wave output. This also has the advantage of reducing the current consumption in the sine wave mode.

The 555 is used as a Schmitt trigger by applying the sinewave signal to the two trigger inputs. This signal is AC coupl-

BELOW: Use this diagram as a guide when assembling the PCB, and when completing the wiring.



It runs from a 9V supply! Wien bridge

Sine and Square Wave Oscillator

This new audio oscillator is simple to construct, covers frequencies from 15Hz to 150kHz in four overlapping ranges, and runs from an external power supply or an inbuilt battery. In the important midband region, distortion of the prototype was less than 0.05 per cent. Both sine and square wave outputs are available.

by DAVID EDWARDS

One of the most useful pieces of equipment on an experimenter's bench, apart from the ubiquitous multimeter, is usually some form of audio oscillator. In the past, we have presented a number of designs for such instruments, including designs both simple and complicated.

The unit described in this article is fairly simple, but still designed for serious work. Performance wise, it is quite respectable, with a nominal maximum output of 1V variable down to zero with a potentiometer and a preset divider. It has quite low distortion figures. As you can see in the accompanying graph, between 20Hz and 20kHz distortion is less than 0.1 per cent, with a minimum distortion centred about 1kHz of about 0.04 per cent. Yet at the same time it is low in cost.

Only four low cost transistors are required for the basic oscillator, along with a thermistor (negative temperature coefficient resistor). A 555 timer is used as a Schmitt trigger to provide a square wave output. The unit has been purposely designed to run from a 9V supply rail, allowing the use of a single 9V battery, or one of the now commonly available "plugpack" power supplies.

Use of a plugpack, rather than an inbuilt mains supply, is not only cheaper but avoids the problems of magnetic induction from the transformer field into sensitive portions of the circuit. In addition, a single plugpack can be used to power several units (not at the same time of course), leading to a further reduction in cost.

The new instrument has been designed as a companion for the RLC Bridge described in the March 1978 issue. As you can see in the photographs, the unit is mounted in a plastic "zippy" box, with a black front panel having white lettering.

Turning now to Fig. 1, we can discuss the operation of the basic Wien bridge oscillator circuit. A frequency selective network is used to apply positive feedback to a high gain amplifier. This network is formed by R1, C1, R2 and C2.

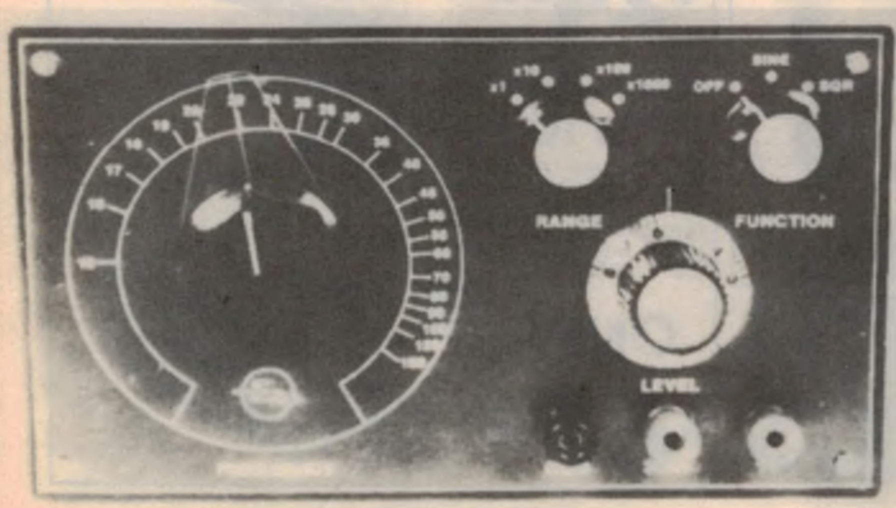
At a particular frequency, this network has a "pseudo-resonance", where a signal applied to R1 at the output of the amplifier is transmitted back to the amplifier input without any phaseshift, and with a minimum of attenuation. In fact, if R1 is made equal to R2, and if C1 is made equal to C2, this frequency is given by the reciprocal of 2piR1C1, and the feedback transmission loss falls to a minimum of 3.0.

For a feedback amplifier to produce sustained and steady oscillations, there must be positive feedback with zero phase shift at a particular frequency, while at the same time the overall loop gain must be unity. We can achieve these conditions in the present case by applying negative feedback to give the amplifier a gain of 3.0.

This is the purpose of the network formed by R3 and the thermistor. The thermistor serves a second purpose in this case though, and that is to stabilise the amplitude of the oscillations. If the thermistor was replaced by a fixed resistor equal in value to 2R3, the circuit would oscillate, but the oscillations would continue to increase in amplitude until clipping occurred.

This is obviously undesirable. The thermistor acts to prevent this however, because as the output signal rises the power dissipated in the thermistor increases, and its temperature increases. This causes the resistance of the thermistor to reduce, (it has a negative temperature coefficient), so that the the amount of negative feedback is increased, and hence the gain is reduced.

The thermistor also ensures reliable starting of the oscillator, because when there is no oscillation, there is minimal power dissipation in the thermistor, so that the gain of the amplifier is quite high. As the signal level then increases, the thermistor acts to stabilise the amplitude. With the thermistor specified, and the value of R3 used, the



Use this photograph of the completed unit as your guide in the choice of knobs. Make a pointer for the frequency dial with a piece of perspex or clear plastic.

Want to build a kit you can *really* get your teeth into? Try one of these value-packed kits from the Dick Smith Electronics range....

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Build these two fantastic kits and turn your parties into a blast!

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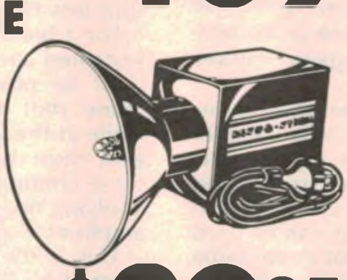

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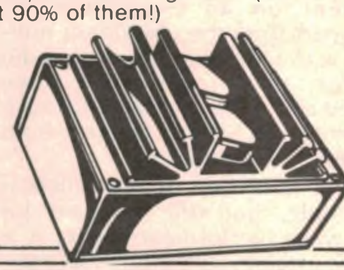

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- Service Work
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6A continuous (10A Pk) Cat M-2000 $24.95

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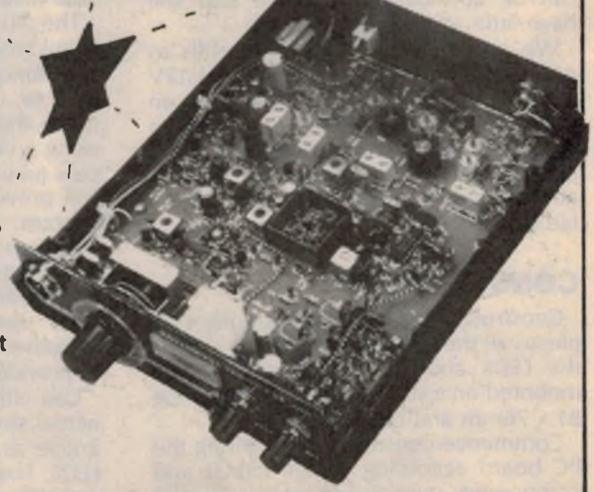
AT LAST! You can build an amateur transceiver AND save money over the commercial units AND have equal performance to the commercial units!

YES – the days of home brew are back: many hundreds of these kits have now been built and everyone has said 'Isn't it great to build something again!'

But it's even better when you can build it yourself and $ave!



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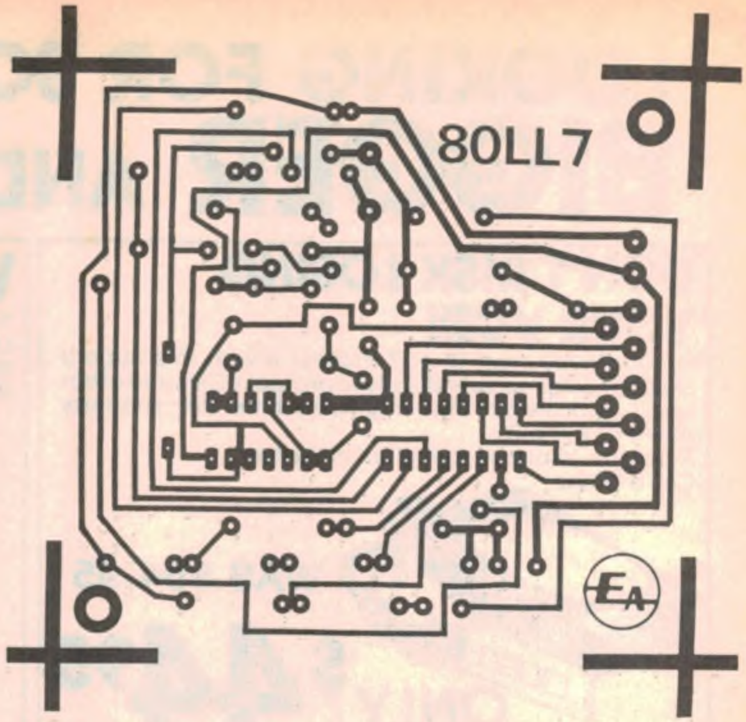
need for a separate flasher circuit.

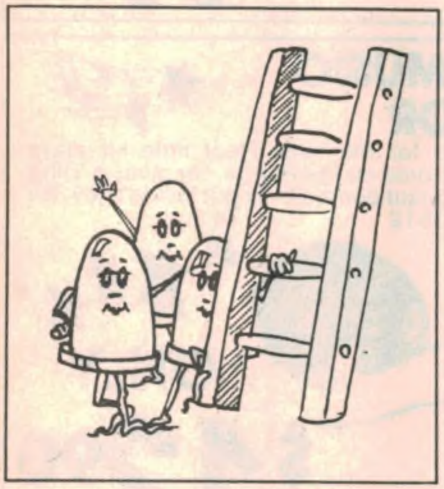
Transistors Q1, Q2 and Q4 form a solid state on/off switch, and save money by eliminating the need for a conventional mechanical switch. The way in which this part of the circuit operates is quite simple: When the CLIMB button is initially pressed (ie circuit off), the voltage on the 470uF capacitor rises and turns on Q1 and Q2. These two transistors then provide forward bias to Q4, which turns on and supplies power to the UAA170 IC.

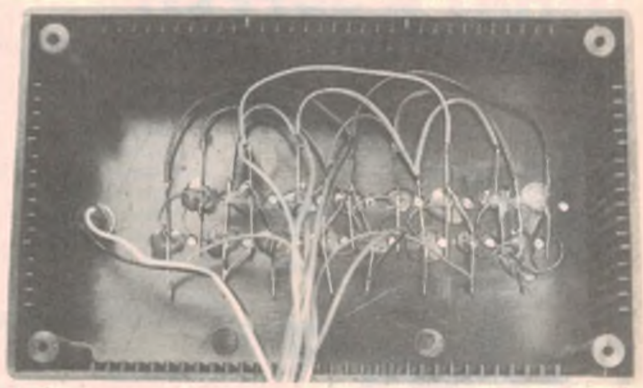
The game is turned off by deliberately pressing the CLIMB button while the LED display is off. This discharges the 470uF capacitor into the output of the CMOS oscillator cutting off forward bias to Q1 and Q2 and turning off Q4 to remove power from the UAA170. It will usually be necessary to press the CLIMB button two or three times in order to discharge the capacitor sufficiently for the game to turn off.

Note that power is removed only from the UAA170 and the LED display. The 4011 IC is left permanently powered,



ABOVE: actual size reproduction of the PC pattern.





RIGHT: the LEDs can be held in position using epoxy adhesive. Arrange them so that their anodes and cathodes are all oriented in similar fashion, to make wiring easier.

while the voltage divider networks on pins 12 and 13 of the UAA170 also draw current on a continuous basis. Even so, total current consumption in the off-state can be considered negligible and will have little effect on battery life.

We used eight 1.5V penlight cells to power the circuit, giving a nominal 12V supply. The batteries are mounted in an eight-way battery holder, as shown in one of the photographs. Average current drain of the circuit in the "on" state is about 28mA, giving an estimated battery life of 40 hours.

CONSTRUCTION

Construction of the game is quite simple, as all the major components, except the LEDs and the CLIMB switch, are mounted on a small PC board measuring 81 x 76mm and coded 80LL7.

Commence construction by wiring the PC board according to the circuit and component overlay diagrams. Fit the passive components (resistors and capacitors) first, followed by the transistors and the UAA170 IC. Make sure that all polarised components are correctly oriented, and don't forget the six wire links.

The 4011 IC is a CMOS device and should be left till last. Take the usual precautions when soldering CMOS devices. Connect the soldering iron barrel to the earth track on the PC board, using a clip lead, and solder the supply pins (pins 7 & 14) first. These measures will prevent damage to the IC by static charges.

We mounted the game in a plastic utility box measuring 150 x 90 x 50mm and fitted with an aluminium lid. The box is used upside down, with a Scotchcal adhesive label glued to the plastic base to provide an attractive front panel.

Use either the Scotchcal panel or the actual size artwork reproduced with this article as a drilling template for the 16 LEDS. The LEDS are then pushed into the mounting holes and glued at the rear with epoxy adhesive. Arrange them so that the anodes and cathodes are all oriented in similar fashion, to make wiring easier.

The wiring from the PCB to the LEDs and the switch is best done with rainbow cable, as this makes for easy identification of the different leads. Complete the interconnections between the LEDs first, using the circuit diagram as a guide, and then connect them to the PCB. The completed circuit board is fastened to the lid of the box using machine screws and nuts, together with the battery holder which is held in place by an aluminium clamp.

We attached four rubber feet to the bottom of the case to prevent scratches to table tops etc. Stick-on rubber feet are available from Dick Smith Electronics.

Construction is then complete, and you can attempt to climb the ladder. If the LEDs do not come on in order, it is likely that the connections to them are in error. Any LEDs failing to emit will probably have anode and cathode transposed.

Sound facts in detail.

Ortofon have always dedicated themselves to pursuing the world's finest sound reproduction.

So when they discovered that the existing moving magnetic systems missed much of the sound detail, they did something about it.

They designed, developed and patented a new cartridge principle that could pick up as much detail as possible, accurately, from the record groove.

(Of course, as one of the recognized world leaders in sound reproduction, Ortofon were well-qualified in this area.)

They called it the VMS Principle.

The VMS Principle (Variable Magnetic Shunt) utilizes a light tubular armature of magnetic conducting material.

This is attached to the cantilever and encircled by a powerful ring magnet. When the cantilever moves the armature closer to the ring magnet, the armature short-circuits part of the magnetic field, generating a voltage in the coils.

And the result is an increased high frequency tracking ability, low distortion and superb transient reproduction – right down to the very last detail.

As if that wasn't enough, the VMS also reduced sensitivity to hum pick-up and minimized distortion and non-linearity in the magnetic system.

Presumably, the cost of an Ortofon VMS Magnetic Cartridge would be high.

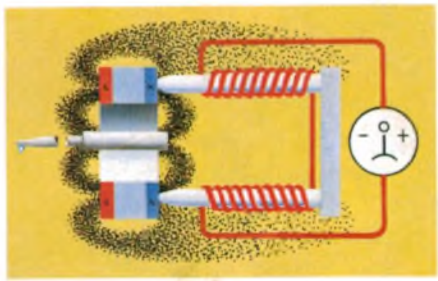
Surprisingly, it's not.

In fact, it's especially affordable.

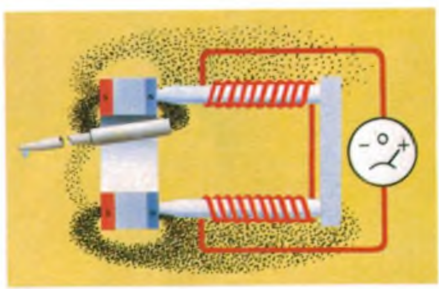
Check the facts on the VMS 10E MK II, 20E MK II and 30 MK II at your hi-fi or Ortofon dealer.

And while you're there, find out how to home-test your stereo equipment with the Ortofon Pick-up Test Record.

It's another sound fact in detail.

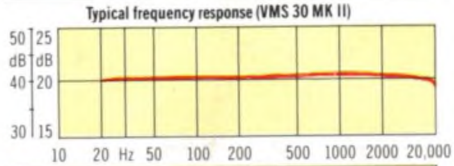


Symmetrical flux fields with the armature in the central (neutral) position. These flux fields emanate from the magnet positioned in front of the pole pins. As the fields are in balance, there are no changes in flux around and inside the coils. Therefore, no voltage is generated.



When the cantilever moves, the armature is brought closer to the ring magnet and acts as a shunt, short-circuiting part of the magnetic field. As a result, the flux field in front of the pole pins varies, and a voltage is generated in the coils.

Typical frequency response (VMS 30 MK II)



Technical data	VMS 30 MK II
Weight	5 g
Type of stylus	Fine Line
Equivalent stylus tip mass	0.45 mg
Frequency response	20-20,000 Hz
Output voltage at 1000 Hz per 5 cm/sec.	5 mV
Channel separation at 1000 Hz	27 dB
Channel balance at 1000 Hz	2 dB
Compliance static. vertical	28 µm/mN
Compliance dynamic. lateral (10 Hz)	22 um/mN
Recommended tracking force	13 mN (1.3 g)
Tracking force range	10-16 mN (1.0-1.6 g)
Tracking ability at 315 Hz lateral	90 µm
Vertical tracking angle	20°
FIM distortion	1% (13 mN)
DC resistance	800 ohm
Inductance	600 mH
Recommended load resistance	47 kohm
Recommended load capacitance	400 pF

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