SEPTEMBER 1984
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Australia's Top-Selling Electronics Magazine

Electronics Australia

Registered by Australia Post — publication No. NBP 0240

Breakerless ignition for Aussie cars

New pulse-power train control

New trends in video

Sanyo CP400 CD player reviewed

Big bands live again

Solar-powered house number

Electronics Australia

Volume 47, No. 9,
September 1984

Our artist has used a lot of licence in blowing up this shot of the new Lima XPT HO scale model train which was kindly loaned to us by Southern Model Supplies Pty Ltd. The model is Lynda Lewis and her outfit is from Speedo and Sea Folly.

Railmaster train controller

Here's one of the best train controllers available, regardless of cost. It features pulse power, inertia, full overload protection, and excellent low-speed running characteristics. Details page 34.

What's coming

Stereo AM broadcasts are now being transmitted in Australia. Next month we intend to describe a stereo AM decoder suitable for the Motorola C-QUAM system (see also page 73).

Electronic ignition for Aussie cars

This new electronic ignition is especially suitable for Australian six and eight-cylinder cars. It uses a Siemens Hall Effect device and a Bosch rotating vane assembly. Construction begins on page 52.

Features

Hifi, Video and Reviews

Projects and Circuits

Columns

Departments

Build a Teletext decoder

Last month we introduced our new Teletext Decoder and described the chip set used in the design. This month we present the circuit and give full construction details. Turn to page 76.

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Editorial Viewpoint

Should all cassette decks have Dolby?

Over the past decade or so, enormous strides have been made in the development of audio cassette decks. What started out as a positively low-fidelity medium has been refined and developed to the stage where the best cassette decks are unquestionably a high fidelity product.

A great many refinements have produced this very high standard with perhaps the most recent being the use of microprocessors to optimise the bias and equalisation for each and every type of tape. Of all the developments though, the most significant would have to be the inclusion of Dolby B noise reduction.

This simple and highly effective noise reduction system largely does away with tape hiss. During the recording process low level treble signals are boosted. Then during playback, the reverse process is applied and the treble signals below a certain threshold are cut by the same amount as they were previously boosted. This treble attenuation also reduces the tape hiss by a similar amount. The result is a large audible reduction in the amount of tape hiss on playback.

Since the introduction of Dolby B noise reduction into cassette decks, a number of Japanese companies have developed their own playback noise reduction systems, usually as a substitute for Dolby. Over the years though, Dolby has come to be acknowledged as the most common system. It is now incorporated as a standard feature on the majority of cassette decks intended for the high fidelity enthusiast.

In the last couple of years two even more effective systems of noise reduction have been developed and are now being incorporated into top-of-the-line cassette decks. The two systems are dbx, a compression-expansion system, and Dolby-C which can be regarded as a refinement of the Dolby-B system.

Be that as it may, the majority of pre-recorded cassettes are now being released with Dolby B processing. To be reproduced correctly, they must be played on a Dolby-equipped cassette deck.

So what happens with all those tens of thousands of cassette players which don't have Dolby? This includes the majority of existing car players, the larger transportables (the so-called "ghetto-blasters") and many of the small, personal portables. No matter what the user does with these players, Dolby tapes won't sound right. Even if the treble control is set to a minimum, the sound will still be shrill and seem to lack bass.

Lack of Dolby is not so important if you dub your own tapes from records. Then you can record and playback without using Dolby. The tapes will sound right even though they won't have the Dolby benefit of low hiss. But if you specifically buy the portable or car player to listen to pre-recorded cassettes, you are stymied.

It is understandable why so many cassette players are without the Dolby feature. The manufacturers don't want to pay the licence fees to Dolby and they perceive that they can sell the players without the feature anyhow. In the end, the consumer gets a product which is inferior.

It is about time the retailers stopped actively selling those players without Dolby. The advantage of the Dolby feature should be pointed out to every customer and the fact of Dolby pre-recorded tapes should be emphasised. Then, if the customer goes ahead and buys a player without Dolby he or she will at least be making an informed decision.

Leo Simpson

Alarmed by the cost of security?

It's so easy with these superb security system components from Dick Smith Electronics. Everything from the very latest in integrated circuit control units right through to the sensors you use to stop thieves **before** they get in!

Don't know what to do? No worries: our exclusive booklet 'How to intall your own burglar alarm' will tell you how easy it is! Yes, YOU can put in your own fully professional quality alarm system at a tiny fraction of the cost of professional installation.

Big screamers!

Know what a crook hates most? Noise! Scare the pants off them with this high efficiency horn speaker. Connects to alarm speaker output. Really loud. Cat C-2705

ONLY $10.25

Larger (127 x 200mm) horn with huge 15 watts rating. For the installations where a loud alarm is a must. Cat C-2718

Also ideal for PA use

ONLY $27.50

Give em the gong!

Ultra Loud Bell. A great new addition to our range. Huge 8 inch fire bell with massive gonger, 12 volts operate at 300mA. Suitable for most alarm systems. Cat L-5280

$34.95

Piezo Piercer!

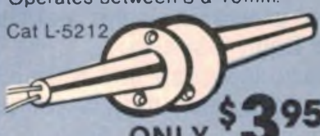
What an amazing sound from such a little gizmo! Piezo alarm unit features inbuilt driving circuit so it operates direct from 12 volt supply. Unbelievable 120dB @ 1m output. Cat L-7025

$14.95

Magnetic Switch

100% Hidden Magnetic (Reed) Door & Window Switches. What a great idea! Ideal for all alarm systems — usable in wood, aluminium & other doors/windows. They are covered by window/door when closed — no one knows they're there! Operates between 8 & 10mm.

Cat L-5212



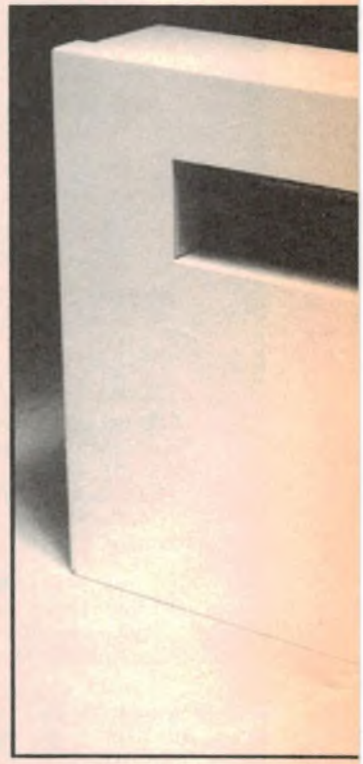
ONLY $3.95

Deterrent Sticker

Bright silk-screened inside adhesive sticker for your home. Great for warning off intruders: they're more likely to go to easier pickings! They don't know you haven't even got an alarm . . . or have you?

only $2.00 Cat L-5311

Professional Quality Security Centre



This is it! The most professional alarm system we've ever seen – and it's suitable for homes, offices, factories . . . you name it! With six individual sectors all full controllable for instant or delayed alarm, each able to isolate and each triggerable by a huge range of sensors: the type of alarm used by banks, etc where security is paramount.

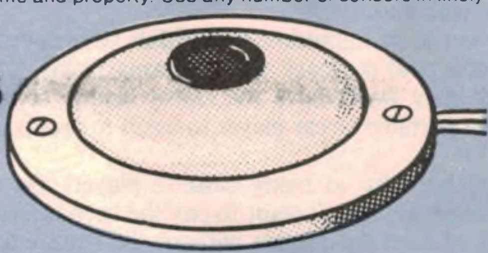
Imagine how it would protect your home!

The type of alarm system the professionals charge $1000 or more to install!

Protect against fire!

Most alarms have provision for a fire sensor. Take advantage of it and protect your home and property! Use any number of sensors in likely 'hot spots'. Cat L-5254

$7.95



One step — and they're gone . . .

Hide a pressure mat under the carpet, a rug — even the lightweight Bill Sykes can't get past this one! Put one in front of your safe! Normally open contacts.

Cat L-5270

ONLY $19.50

Plus! Everything you need for no-fuss installation of your alarm system . . . such as

Wire

Thin hook-up wire for easy concealment. Range of colours available. 10¢/metre or only $8.00 per 100m roll.

Light-weight 'figure 8' twin conductor cable. One cable marked with tracer for instant recognition. Cat W-2010, 20¢/metre or only $15.00 per 100 roll.

Tools

Standard Flat Blade or Philips Blade Screwdrivers at bargain prices: **Mini Size** – Flat Cat T-4010 @ 55¢. Philips Cat T-4020 @ 65¢. **Stubby Size** – Flat Cat T-4060 Philips Cat T-4065 Each $1.75. **Popular Size** – Flat Cat T-4085 @ 85¢ Philips Cat T-4030 @ 75¢. **Heavy Size** – Flat only, Cat T-4100 @ $1.95 each.

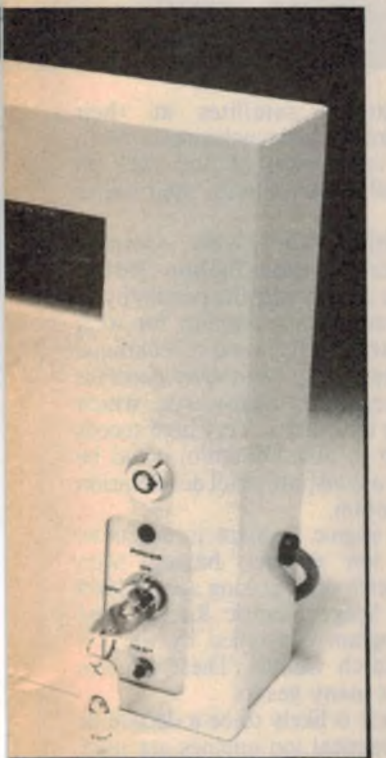
Soldering Irons:

240V 30W general purpose iron Cat T-1330 $9.95. 12V 25W general purpose iron T-1920 $9.95.
Solder to suit 1.25mm hobby pack Cat N-1638 $1.20.

Do it yourself and save a fortune!

★ ★ ★ ★ EXCLUSIVE ★ ★ ★ ★ ★

Our step-by-step guide makes it so easy to install your own alarm system to fully professional standards! Everything you need to know – and it's only $1.95 or FREE with any alarm system from Dick Smith Electronics.



Features:

- Heavy duty steel case with security key lock and tamper protection.
- Internal mains power supply plus charger for (optional) back-up battery: room inside the case for battery.
- Latest 'wire-out-proof' sensor circuitry – suits both n/o and n/c sensors!
- Use with any type of intruder detection sensors.
- Isolate any sector(s) you wish: you can have alarm on in rest of house while you're asleep at night.
- Comprehensive installation manual supplied!

Cat L-5100

$239

Top quality Swiss made infra-red people sensor

The very latest: Swiss made quality detector actually senses human radiation — even from across a room! Virtually no false triggering, ultra reliable. Simple connection to our Security Centre (L-5100) and Bookshelf Control Module (L-5102).
Cat L-5010

Two other models also available.

ONLY **$119**

Microwave Sensor

Want to catch them in the act? Silent, invisible microwaves detect any movement in the target area and trigger the alarm device. 12V operated. Range up to 15 metres, attaches to any alarm system!
Cat L-5000

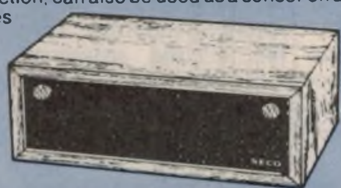
Latest technology!

$95

Ultrasonic Blaster!

The 'Claytons' alarm: the ideal alarm for those who don't want to put in alarms! This one is fully self contained, including siren speaker. Just place it on the shelf and its invisible ultrasonic rays detect movement. Fantastic for single room protection; can also be used as a sensor on a master alarm console. Includes sensitivity control, operates from external 12V battery, from mains via optional plug-pack with internal battery back-up. Has provision for external speaker, sensors, etc.

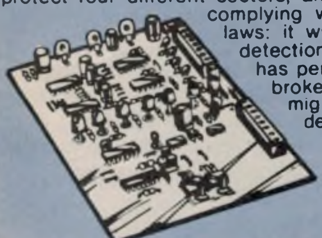
$99



Cat L-5108

4 Sector Control Module

The 'bare bones' alarm controller – for the do-it-yourselfer who wants to install a top quality system without paying a fortune. You can protect four different sectors, and this alarm features circuitry complying with the latest noise pollution laws: it will re-arm itself after an alarm detection, but will isolate a sector which has permanently tripped detectors (eg broken window foil). The intruder might think that the system has been defeated – but will be caught by the other three sectors still armed!
Cat L-5056



ONLY **$69.50**

Infra-red Beam

Burglar Alarms ... Door Minders ... People Counters ... the applications are endless!
Both infra-red transmitter and receiver are in the same unit, with a reflector supplied to send the beam back. A sensitivity control allows 'fine tuning' to suit the location. Mains (240V) powered, with a 12V DC @ 1A output each time the beam is broken. The unit can be set for two modes: 'instant' (output while beam is broken) and 'intermittent' (outputs for five seconds after beam is broken).

Cat L-5050

ONLY **$99**

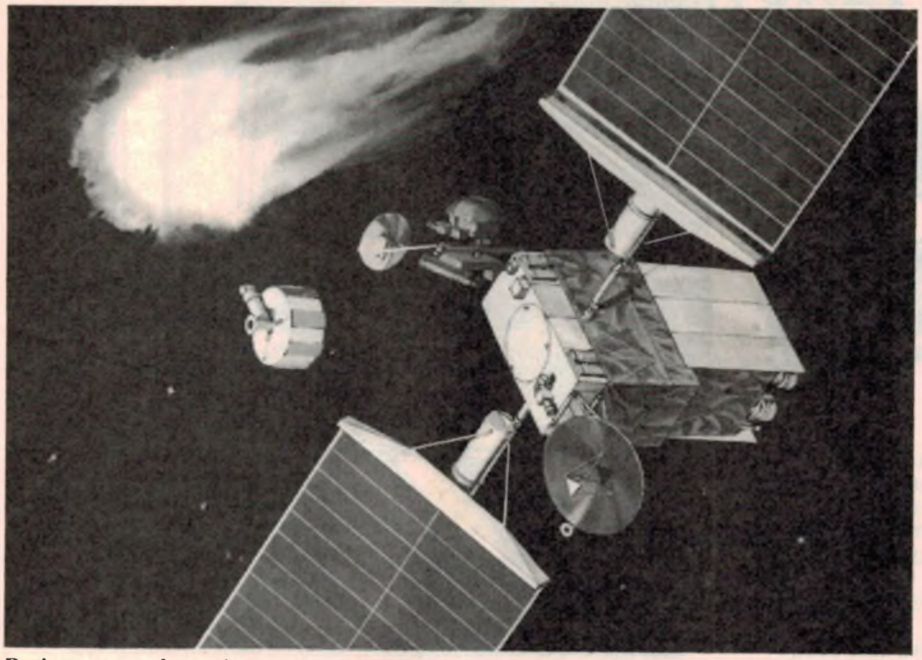
Stainless Steel Pliers/Nippers
Transistor Nipper Cat T-3205
Mini Flat Nose Cat T-3325
Mini Needle Nose Cat T-3570
Mini Long Nose Cat T-3565
And they're only $8.50 a pair!

See centre section for address details

DICK SMITH ELECTRONICS
PTY. LTD.

A824/JL

News Highlights



Design concept for an ion drive spacecraft for rendezvous with Halley's Comet.

Europe hopes to develop ion drive

The conventional method of propelling spacecraft by rockets using chemical fuel implies that all of the chemical energy required for the complete life of the spacecraft be contained in the fuel at lift-off. The need to minimise weight limits the amount of fuel which can be carried and hence the useful life of the spacecraft. What is really needed is a technique which will enable a spacecraft to collect its energy from sunlight as it moves in its orbit.

The ion engine is such a system. The spacecraft must first be lifted by a conventional rocket motor into the vacuum environment of Earth orbit, after which the solar energy collected by solar panels is used to accelerate heavy ions electrostatically to a very high velocity. These heavy ions are emitted into space in a certain direction and the craft is pushed forward in the opposite direction according to the momentum conservation law.

Unlike a rocket which quickly burns out, the ion engine can provide a small but continuous thrust for many years. The ions leave the craft with a velocity of some tens of km per second, or about 10 times the exhaust velocity of a conventional rocket. Hence a much smaller weight of fuel can be used to propel the craft.

The ion engine can also be quite compact and light in weight. The engine emits only a violet-glowing flameless and noiseless beam of high velocity ions which is quite unlike the spectacular nature of a conventional rocket.

Much work on ion propulsion had been carried out at the Jet Propulsion Laboratory in California for possible comet rendezvous voyages before it was curtailed by financial restraints. Marconi Space Systems and the United Kingdom Atomic Energy Authority's Culham Laboratory have now announced their interest in developing an xenon fuelled ion engine to keep communications satallites at their correct point in geosynchronous orbit, since the exhaustion of the fuel on conventional satellites limits their useful life.

In addition, the West German Messerschmitt-Bolkow-Blohm (MBB) Company is considering the possibility of using a mercury ion engine for long interplanetary flights using a technique in which the energy from solar panels is used to generate microwaves which produce the ion beams. Very high speeds (perhaps up to 500,000 km/h) could be built up by a constant small acceleration of long duration.

The ion engine concept is not new. Prototype ion engines having been placed in Earth orbit as long ago as 1969 during the Space Electric Rocket Test (SERT) program controlled by the US Lewis Research Center. These engines operated for many years.

Although it is likely to be a decade or so before practical ion engines are used to power many spacecraft, in principle they certainly offer an attractive alternative to the normal chemical rocket when long flights are involved.

— Brian Dance

CSIRO VLSI chip design goes commercial

The CSIRO has signed a licence agreement for the commercial development of its technology for designing advanced silicon chips. The agreement was announced recently by the chairman Dr J Paul Wild, and covers chip design software developed over the past three years by CSIRO's VLSI (very large scale integration) laboratory in Adelaide.

Under the licence, CSIRO will give exclusive rights to this software for two

Clamp down on bodgie cordless telephones

The importation of cordless telephones not approved for use in Australia has been prohibited, the Minister for Industry and Commerce, Senator John Button has announced. He said that an amendment to the customs regulations had been necessary because of the importation of a large number of cordless telephones which do not comply with Department of Communications specifications.

"These cordless telephones, which may not be legally used or attached to the Telecom network, will cause interference to television reception," he said. "More importantly, cordless telephones which use high power can cause interference to aviation communications and pose a threat to aviation safety."

Senator Button said the amendment would prohibit the importation of cordless telephones which either do not satisfy Telecom licensing criteria for guarding against radio frequency interference, or are not suitable for attachment to the Telecom network because of electrical safety or technical incompatibility.

years to a company formed by the staff of the VLSI laboratory. The new company, Austek Microsystems, will manufacture VLSI chips, each designed for a specific high-technology function and each containing as many as 100,000 transistors.

The company will be based in Adelaide. For trading and financial reasons ownership will be through a holding company incorporated in the United States, but Australian investors, including company employees, will hold a majority of about 60% of shares, the remainder being held by American investors.

New "de-gauss" system for Australian warships

Mr Ron Stewart (left), Group General Manager of AWA, presents a commemorative plaque to mark the commissioning of the de-gaussing system to Commodore Cooper, Deputy Chief of Naval Material.

A new magnetic ranging facility, valued in excess of $2.8 million, has been officially handed over by the contractors, AWA, to the Royal Australian Navy.

The function of the range, which is located in Sydney Harbour, is to permit effective "de-gaussing" of Australian warships to provide maximum protection against magnetic mines. The range itself is used to measure the "magnetic signature" of the ship, presented as a computer-drawn three dimensional model.

This model is then fed into a second computer, together with details of the particular ship's de-gaussing coils; number, location, electrical characteristics etc. From these data the computer calculates how each coil should be fed so that the ship produces a minimum of distortion of the Earth's magnetic field. (It is the distortion of the Earth's magnetic field, by a ship, which a mine senses in order to detonate).

The range is actually in three sections; a north-south deep array consisting of 18 sensors at a depth of 25m, a north-south shallow array of 12 sensors at 12.5m, and a similar east-west shallow array. The sensors are gimbal mounted fluxgates inside ruggedised, underwater housings which measure changes in magnetic field in three orthogonal axes as a vessel passes overhead.

An essential part of the system is a means of determining the ship's position above the sensor's with a high degree of accuracy. A laser based tracking system provides automatic facilities for tracking the bow and stern of any ship on the range. This provides instantaneous position and heading to a positional accuracy of better than 0.5 metres. Such information, plus automatic measurement of the depth of the sensors below the ship to compensate for tidal variations, are transmitted to the computer.

The new installation is said to be a considerable improvement over that currently in operation by the RAN in Sydney and indeed is among the most advanced systems of its kind in the world.

G.E. develops low cost printed board system

A major new printed circuit production process that combines low cost and high performance has been developed by the General Electric Research and Development Center in Schenectady, USA.

Covered by a number of patents, the new technology will enable printed circuit producers to realise cost savings ranging into the millions of dollars a year. The process is inherently simple, low in cost, and results in printed circuits that in many applications can directly replace those produced by conventional techniques.

Fundamental to the new process is a family of special metallic "inks" consisting of a liquid polymer (several different types can be employed) "loaded" with fine, powdered metals — a mixture of iron and nickel. To define a circuit pattern, the polymer ink is transferred to an insulating substrate (eg, circuit board) by screen printing; a standard technique for circuit patterning.

After the circuit board has been patterned it is run through an oven to harden and cure the ink. This takes about 20 minutes employing a conventional cross-flow oven or as little as one minute with an infrared oven. Then the circuit is plated with copper to make it electrically conducting by dunking it in a copper sulphate bath.

In this bath a chemical reaction is initiated because of the dissimilar metals — the iron and nickel in the cured pattern ink and the copper in the plating bath. As a result, some of the metal powder in the cured pattern ink dissolves (going into solution as ferric sulphate), and pure copper from the copper sulphate bath takes its place.

The plating process takes about five minutes (versus as much as eight hours for conventional plating techniques) and produces a continuous lay of copper along the conductor pattern. Extensive tests have established that it adheres tightly to the substrate, even under conditions of sustained high temperature and humidity.

To complement the new system, the GE researchers also have developed polymer-based resistor inks that, like the conductor inks, are screen printed on a circuit and then cured with heat. These low-cost inks make it possible to lay down hundreds of resistors with one pass of a screen printer — eliminating the need to drill holes for individual resistors and solder them in place.

News Highlights

More TV ads, more soaps for Perth viewers

The Government has approved a third commercial TV station in Perth. The Minister for Communications, Mr Michael Duffy, said studies by the Department of Communications revealed two options for a suitable frequency: VHF Channel 10 or an appropiate UHF channel.

Mr Duffy said use of the UHF would not delay establishement of the new station. It would also complement the multicultural television service scheduled to be introduced in Perth late in 1985 on UHF.

"If an applicant opts for VHF, however, this will require changes to the channels used by several national and commercial services so that interference can be avoided.

"Expenditure incurred as a result of the changes associated with the VHF option will be borne by the successful applicant for the Perth licence.". Mr Duffy added that he hoped the third service could be operating in 1986.

Auto instrument displays go electronic

According to one major instrument manufacturer, VDO Instruments Australia Pty Ltd, future automotive instrument clusters will feature state-of-the-art liquid crystal displays, bar graph displays and computer monitoring of many vehicle functions. The new technology is the result of a unique three nation joint venture that will have a significant impact in Australia's automotive, marine, aviation and defence support industries.

VDO Instruments Australia, VDO AG in West Germany and Yazaki Instruments of Japan form the tripartite arrangement. Alan Cheale, Joint Managing Director — Technical, of VDO Instruments Australia Pty Ltd, says the technology transfer is definitely in Australia's favour.

New LCD displays have the advantages of high visibility and readabilty, even in bright sunlight. They require lower operating voltages, cost less to manufacture than current vacuum fluorescent displays, and can be produced with varying functions depending on the requirements of each car maker. Typically they will feature a digital speedo with an adjacent analog bar graph tachometer indicating both revs per minute and optimum torque.

Easy to read bar graphs for voltmeter, fuel, water temperature and oil pressure would replace current needle gauges and warning lights and, on more expensive models, a vehicle monitoring system could include a picturegram of the car showing door openings, lights function and seat belt status. Air conditioning can also be more closely monitored with a picturegram display showing internal cabin temperature, air flow travel, and proportions of warm/cold air.

A resident engineer and technical advisor from Yazaki Instruments in Japan has been seconded to VDO's headquarters in the Melbourne suburb of Heidelberg. Mr Hari Muramatsu will provide VDO Australia with a direct link to the latest technology trends in Japan and the United States, and will commute regularly to both countries.

Semiconductor shortage looming — order now

According to Dick Smith Electronics, the ready availability and low prices of components, particularly semiconductors, which we have enjoyed in recent years is coming to an end.

The reason is that manufacturing industries in America and Europe are booming, creating a demand for components which the component manufacturers cannot, for the moment, satisfy. Some have increased production to 24 hours a day, seven days a week, but the lag continues.

Lead times are now being quoted as: CMOS ICs — 24 to 26 weeks; TTL ICs — 44 to 46 weeks; memory — 24 weeks; transistors — 12 to 16 weeks. A natural by-product of such shortages is an increase in prices, in this case up to 100%, with more to come.

Dick Smith Electronics say that they are doing their best to cope with the situation and are currently placing orders as far ahead as 1986! Even so, shorages would seen to be inevitable.

Bills won't be cheaper — just easier to read

Telecom has awarded a $US8.4 million contract to the American Telephone and Telegraph Company and A.T. & T International (Australia) for a computerised accounting system. Announcing this recently Telecom's Chief General Manager, Mr. Mel Ward, said this was a further step in Telecom's plan to give customers improved billing for telecommunications services.

The system allows more detailed presentation of billing information and will allow Telecom to respond rapidly to customers' inquiries. It will complement the call charge recording which is to be progressively offered to customers as an optional facility for STD calls.

APOLOGY

Due to a printing error, several headings were omitted from the Dick Smith Electronics advertisements on pages four and five of the August issue. We apologise to Dick Smith Electronics and to readers who may have been inconvenienced.

ACTIVE ELECTRONICS

289 LATROBE STREET, MELBOURNE 3000 PH. 602 3499

9am-5.30pm MON-THURS 9am-8.30pm FRIDAYS 9am-12noon SATURDAY

ACTIVE FOR LOWER PRICES

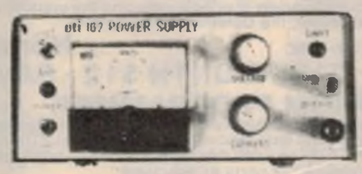
ALL YOU HAVE EVER WANTED IN AN ELECTRONIC STORE – AND MORE!

MAIL ORDER HOTLINE. (03) 67 1312

CS-1560A II **$570.00**

15MHz 2 CHANNEL OSCILLOSCOPE

- **Bandwidth** DC ~ 15 MHz
- **Sensitivity** 10m V/div
- **Sweep Time** 0.5μs/div ~ 0.5 s/div



POWER SUPPLIES

BENCH STANDARD

- 3-30v Output @ 1 Amp.
- Fully Regulated. Fully Protected from Thermal Overload and Short Circuits.
- ETI Design

K3205 (pictured) **$49.50**

HIGH CURRENT MICROCOMPUTER PS

- + 5 Volts @ 3 Amps.
- + 12 Volts @ 2 Amps
- 12 volts @ 200 milliamps

This universal design has enough grunt to power most disk drives.

K3350 **$59.50**

13.8 VOLTS @ 10 AMPS HAMS & CBER's. Save the expense of a Mains Powered Rig.

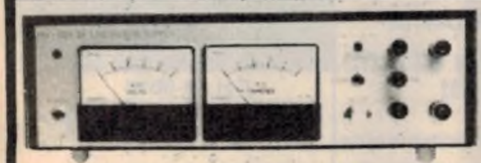
K3250 **$89.50**

WITH SWIVEL AND TILT BASE. BW - 20MHZ AND 12" SCREEN.

YANJEN MONITOR

GREEN **$179.00**

AMBER **$199.00**



HIGH CURRENT - DUAL METERING

EA SWITCH MODE DESIGN

- 2-50 Volts at massive 175 Watts
- CLEVER DESIGN - a fully mains isolated supply with a "Switchmode" low voltage circuit.
- Easy to build

K3300 (EA MAY, JUNE '83) **$139.00**
K3301 (10 TURN VOLTAGE CONTROL OPTION) **$10.00**
(± 12V OPTION)
K3302 EZ JULY '83 **$12.50**

7 DIGIT FREQUENCY COUNTER

UNBELIEVABLE 0.005% ACCURACY

Frequency and Period measurement to 500 MHz (with optional prescaler). High input sensitivity. Professional unit at a fraction of the cost of built-up units.

K2500 **$119.50**

PRESCALER
K2501 **$26.00**

DECIMAL POINT
K2502 **$7.50**

DIGITAL CAPACITANCE METER

with Deluxe Instrument Case

We are pleased to announce the release of the Digital Capacitance Kit housed in our Deluxe HO480 ABS Instrument Case. This superb Test instrument Kit now complements our top selling Digital Frequency Counter and function Generator Project Kit, Electronics Australia Project. Each kit includes precision measured capacitors for accurate calibration of each range.

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Junket to JAPAN

Journalistic junkets aren't all beer and skittles — or sake and saunas, as the case may be. Stewart Fist recently toured some Japanese video manufacturing plants together with a group of editors and journalists as guests of National Panasonic. We are surprised to find that Stewart actually remembers something!

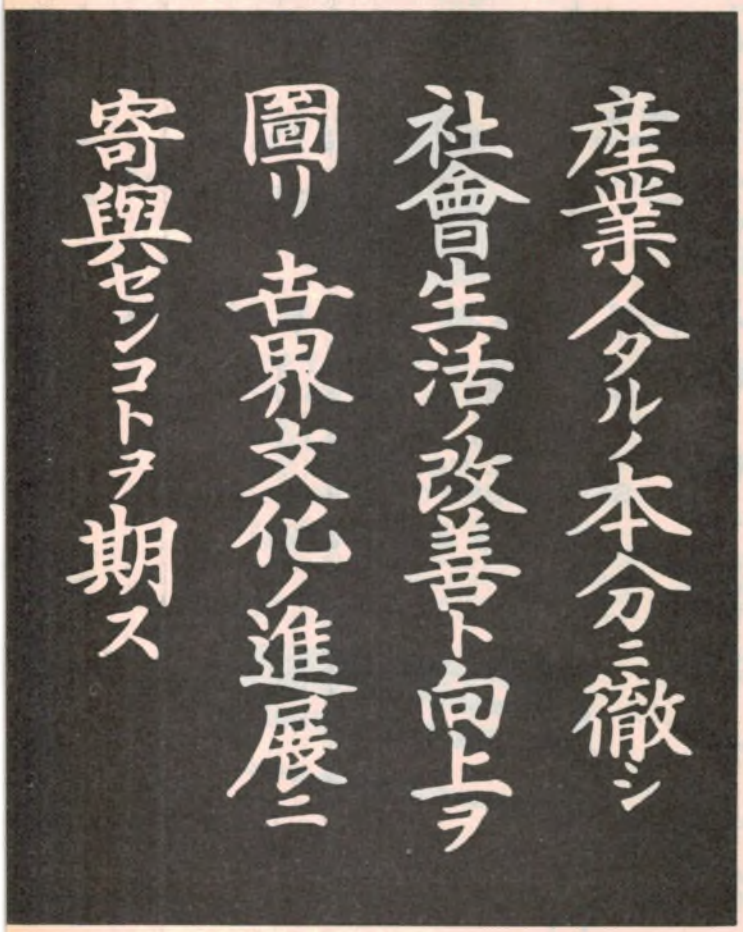
Being at the bottom of the world has its advantages, but keeping up with the latest technological developments, isn't one of them. So for all that might be said against journalist junkets, they do at least give technical writers the chance to meet the people developing much of the equipment we are going to see and buy in the next few years. Even more, we are able to question these experts about their research and follow up these questions when the answers aren't complete or comprehensible.

I suppose the headline story from the trip would have to be that 8mm video is sick — if not dying — for the moment anyway. In normal commercial terms it is certainly still a long way from our shops.

Only a couple of months back, Kodak, in a fit of corporate hysteria, announced the imminent release of the first 8mm video camcorders. The Japanese had been talking about 8mm video for years, and they have had international committees designing the standard — so how come the announcement from an aging American photographic company like Kodak?

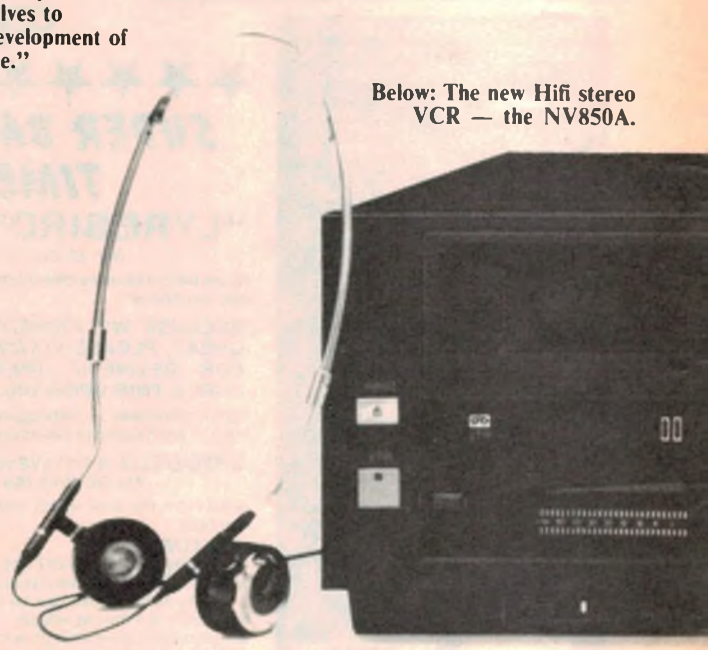
Everyone I talked to in Australia had theories, but no one had background facts. Like most video writers I have been watching the development of 8mm video with both interest and concern. There is often an element of consumer rip-off associated with too quick a change in electronic standards. We have also become familiar in recent years with the use of premature announcements of new standards, as a marketing ploy to confuse potential customers and kill the opposition sales while you finish your research.

Most video writers had assumed that 8mm video was many years away — not just from a technological point of view, but also from a marketing. It makes little sense for Sony or National to confuse the video scene with another new and incompatible video standard when the Beta and VHS half-inch systems are selling so well around the world — yet National



The Matsushita company creed (left) sounds pretentious to Australian ears, but obviously motivates the Japanese workers: "... we strive to foster progress, to promote the general welfare of society and to devote ourselves to furthering development of world culture."

Below: The new Hifi stereo VCR — the NV850A.



by STEWART FIST

were involved in the Kodak announcement.

Kodak's 8mm video was to be a one-hour camera-recorder (camcorder) unit with a playback "cradle" into which the camera fitted. Most interesting of all, was the news that the mechanics and electronics of the system were to be manufactured by Matsushita, the parent company of both National and JVC — the two prime-movers in the VHS field.

With VHS the clear market leader world-wide, it doesn't seem to make sense for Matsushita to become involved in promoting 8mm video at this stage. After all, when you're on a good think, stick to it. But perhaps there are other factors at work.

Retail outlets

There have been many theories as to why Matsushita signed the agreement with Kodak, but all have been guesses. The whisper from within the company is that top management of Matsushita (from well above the manufacturing level) signed the agreement with Kodak to get access to the 200,000 Kodak outlets around the world. The retail side of Kodak is simply too big for it to be allowed to fall into the hands of the opposition.

It is safe to assume that Matsushita wouldn't readily give away the prestige of first-release to an American company unless there were very good reasons or perhaps problems with the system — and so it appears to be.

Metal-particle or metal-evaporated tape is essential for the 8mm system and the standards have been formulated on the assumption that these tapes will be available. But at National's videotape factory, senior engineers admitted that they weren't expecting to have anything more than prototypes of the new metal-particle tape this year. We can be reasonably sure that tape production will come much later, so Kodak's claim of October 84 for the equipment release is unlikely — unless TDK are well ahead of National in tape technology.

There are a whole range of new problems associated with 8mm video, and most arise from the need for new types of tape. Two technologies are under development, both aimed at producing much thinner tapes. Metal-particle technology is the simplest development; it appears to require little more than an extension of the present videotape production techniques. But the future quality of 8mm depends on the development of metal-evaporated tape technology, and this is something completely new. It is a vacuum coating process, similar to the way the reflective surface is applied to an astronomical telescope mirror — but this has to be a production line process with the microscopic layer being added to a thin plastic base.

The tape makers have had to come up with a strong plastic backing only 10 microns thick (as against 15 to 20 microns for conventional videotape), and with a magnetic layer of only 0.1 microns (as against 5 microns). The magnetic coating must be kept to a much higher standard of quality than conventional coatings, both in terms of the evenness of the magnetic layer and in the number and size of random defects. When the magnetic coating is only 0.1 microns thick it doesn't take much in the way of thickness variation to play havoc with the video signal.

The Kodak/Matsushita deal suggests that the Japanese are unsure of being able to maintain quality with the 8mm system. In the area of home video photography, the smaller size and easier portability of 8mm camcorders might persuade buyers to ignore minor picture defects, so the video quality is not so much an issue. Kodak have had experience with this marketing philosophy

Junket to Japan

with their Instamatic still cameras. People are quite willing to accept the inferior quality of Pocket Instamatics when they could get 35mm pictures for about the same price.

It is now also obvious that the Japanese tape manufacturers have trouble cramming more than an hour of tape into the small cassette case. To record a feature film off-air you need to have at least a hundred minutes of tape, and to develop a pre-recorded film library system the tapes would need to be at least two hours long.

Looking at the problem from Matsushita's point of view, if it seems doubtful that you'll be able to get the tape that thin, or the recorder running that slow, the obvious move is to narrow down the consumer's expectations by releasing the tape (and the system) for home recording only.

Kodak can do this without questions being asked — National can't.

National are now saying outright that 8mm video may only be a camera/recorder standard, existing in parallel with the present VHS system. The message we received, loud and clear, was "Don't hang by your fingernails waiting for 8mm to oust VHS and Beta". My "educated" guess (if such a term can be applied to a journalist) is that the Japanese manufacturers will jointly hold off the development of eight millimetre as a major standard until they have refined vertical-recording techniques.

Vertical recording

If you haven't been getting your full dose of future shock lately, vertical-recording was developed initially for computer floppy-disks. It orientates the magnetic zones on a tape (or disc) vertically, rather than horizontally, and therefore can pack more magnetic zones into each square millimetre. National revealed that tests at their laboratories have increased packing densities up to 15 times over the conventional recording techniques.

The prospects for computer disk storage look good — megabytes of information on 5 inch floppies, but it isn't as straightforward for video recording; video heads spin on a drum. With a computer disk a head can be placed on either side of the disk so that the magnetic flux will pass vertically through. With video-heads spinning at 25 times a second, a second head is apparently impossible. The manufacturers have a problem here

The TC-C21AR television set is a semi-computer grade monitor suitable for home computers.

which they don't seem able to solve — hence the occasional claims that vertical-recording is only useful for digital (not analog) recording. This isn't the case at all — it's just this problem of spinning video heads. No doubt they will solve this eventually.

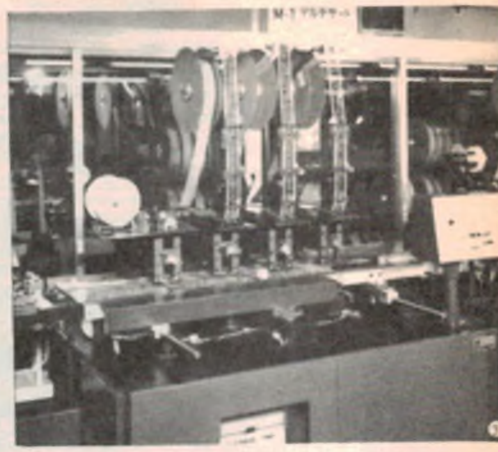
There is one other feature of vertical-recording that ties it in with the 8mm video problem — vertical-recording works best with a **thick** magnetic layer and the regularity of the magnetic layer is not as crucial, so current tape technology is probably quite adequate.

VHS Hifi

The release of the new National Hifi VCR (NV-850A) was the main reason for the trip to Japan, and by the time this article gets to print it will already be on sale in Australia. The Sony Beta Hifi goes on sale here at about the same time.

National claim that the VHS Hifi system gives stereo audio quality comparable with compact disc: a frequency response from 20Hz to 20kHz and a dynamic range of 80dB. We were given a demonstration of the sound quality at the factory and it certainly supported their claims.

They had set up a Technics compact disc player and a standard Technics cassette deck (with dbx noise reduction) together with the NV-850A (which has both the FM hifi and a mono linear sound track) so it was reasonably easy to switch between the sources for comparison. The switch shunted everything



Above: Automatic component insertion machinery at the National television factory.

through a Technics amplifier and speakers and all recordings were "mastered" from the same digitally recorded compact disc.

Even allowing for the likelihood that the master recording was chosen to emphasise the qualities of VHS Hifi, the results were still impressive. To my ears (and at my age, I must be suffering some high-frequency loss) the NV-850A was only marginally inferior to the compact disc master. It was certainly vastly superior to the conventional video linear track, and noticeably better than the cassette with dbx.

There is still some confusion about the VHS and Beta Hifi systems in Australia. The original Beta Hifi in Japan and the USA uses a recording technique not available to PAL system recorders. NTSC Beta video recorders have a gap in the video bandwidth into which Sony managed to insert dual FM sound signals — so the American Beta Hifi recorders lay down their sound signals as an integral part of the video signal.

NTSC VHS recorders don't have this gap, so National had to come up with a "depth multiplexing" technique which involves separate audio heads on the video drum which precede the video signal recording. These audio heads have a wider gap and they push the audio signal deep into the magnetic layer of the tape.

On replay the electronics are able to discriminate between the video and audio components of the signal because the audio heads have a wider head gap and are angled at a different azimuth setting to the video heads.

In Australia and other PAL television countries, the Beta camp has been forced to use virtually the same technology as VHS Hifi since there is no gap in the video bandwidth in Beta PAL recorders. In essence this means that both Beta and VHS Hifi in Australia are mere variations on the same technique — so don't

Left: The new WVP-A1N and A2N video cameras work well even at 7 lux.

Below: Few workers remain on these modern assembly lines. Those that do are usually involved in the final checking process.

expect to find more than marginal differences between the two.

Hifi is a dramatic improvement over the old audio systems, whatever the format. Both Beta and VHS Hifi standards are upwardly compatible with the old Beta and VHS since they retain the low-fi audio tracks as well. One disappointment with the NV-850A is that National has stayed with a mono head on the low-fi track, and have provided no noise reduction (they used to use Dolby B).

Other VHS manufacturers have provided stereo audio tracks for several years, and there are many pre-recorded stereo films available from rental libraries. Since National obviously have the stereo and noise-reduction electronics in the NV-850A, it is hard to understand why they chose not to feed the low-fi audio signals through this system. I am left with the suspicion that they wanted to emphasise the difference between the conventional low-fi track and the new Hifi — a good marketing ploy, but bad customer relations.

I know that companies like National are always fighting a competitive price war, and it is essential for them to constantly balance the need for more features with the extra costs involved. But there are some other minor disappointments with the NV-850A that wouldn't have cost much to rectify.

Hifi video is, at present, the only method of home sound recording that approaches the quality of compact disc. The NV-850A is equipped with a variation on the dbx compression system, but for some strange reason they have mounted the headphone socket at the back, so you need to pull out the machine to plug in your headphones. Very strange! Neither have National provided any way to switch the video off. In Japan, 30% of the first Hifi video owners used their machines as an audio tape deck only. Where else can you get a four-hour audio recorder of this quality?

The NV-850A doesn't have a long-play (half-speed) facility either although National have now introduced this on some of their other machines. Presumably they have trouble providing both half-speed and Hifi in the same system although Akai have now come up with one. National also haven't given much thought to those of us who want to use the recorders as part of an extended component system. You must connect your NV-850 to a good stereo amplifier to get the benefits of the high fidelity sound, but the National engineers apparently haven't heard of the 21-pin SCART plugs now becoming a de-facto standard for component linkage.

Despite these "niggles", the NV-850A is still a remarkable piece of engineering, and well worth further examination if you want to up-grade your video and/or audio system.

Digital Hybrid TV

At the TV manufacturing plant we were given a preview of National's new hybrid digital television set. It is NTSC-only at the moment, and it is hybrid in the sense that it has digital processing of the video stage only. The engineers revealed that they are moving towards a universal TV set capable of processing NTSC, PAL and SECAM signals.

The current NTSC model, which sells in the US for $US1100, is a 21-inch unit with "picture-in-picture" capability. As the Japanese explain it, this means that you can watch your adult drama while the kids watch cartoons. I can't think of anything worse!

Obviously this "picture-in-picture" facility would be useful in large blocks of flats or home-units. You could have a surveillance camera feeding to the inserted picture if you live in downtown Manhattan. Quite possibly some people

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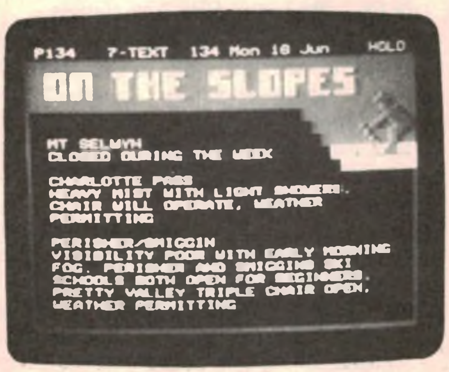
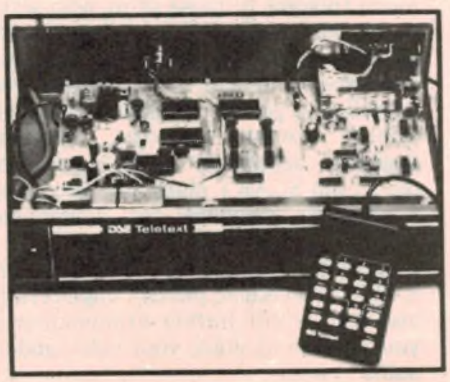
*Not all stations transmit Teletext. Stations in the 7 network (ie those taking Channel 7 news) do as well as ABC stations, and many others have some Teletext transmissions. Most stations transmit Teletext subtitles for deaf people. If in doubt, ring your local station.

Cat K-6315





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Junket to 

do like to watch two television channels at the same time: if your right hemisphere doesn't make ready connection to your left, this might be the TV set for you.

The inserted picture is about postcard size, and they have included a small amount of picture memory — enough to allow you to freeze frame on the inserted picture only. By November the engineers hope to have a built-in videotext decoder (using the Captain system in Japan) and a number of other unspecified "features". The main advantage of the digital processing seems to be the easy way in which these features can be added. There was nothing about the picture quality of the set that "grabbed" me.

The remote control for this set has a mind-boggling 48 keys, some with multiple functions. The idea behind having so many keys on the remote is excellent; they are trying to simplify things for you! With this remote you can operate your videotape and videodisc unit from the one controller — a worthy aim indeed. Presumably before National will let you buy the set, they will insist that you attend a short college course to learn how to operate it!

To me, the most interesting side of the digital TV development was the fact that it could be done at the cost. The electronics of this set must contain a video-speed analog-to-digital converter, and after processing there must be digital-to-analog conversion again. Within the digital circuits we know there is also enough picture memory for the small inserted picture anyway — and this is only a small part of a TV with a retail price of only $US1100. What we have here are the essential elements of a video time-base corrector (TBC), and so I would predict that within the next year we can expect to see built-in timebase correction in some of the National VCRs.

The last time I looked, even the cheapest video TBC on the market was in the $5000 region, at a level where only professional video production houses could afford them. But now, at last, it appears that we can expect TBCs for the domestic market — either as separate video enhancement units, or built-in to the VCRs.

Time-base correctors are the true video "enhancers". They restore the horizontal line stability when a video signal is replayed from a VCR and can, in fact, make the picture better than it was before. For the keen video photographer the TBC will also allow him to superimpose titles and mix (dissolve) between two sources of image during his editing, so quality home video production might shortly be within the grasp of the keen amateur.

While on the subject of new television sets, National will shortly be selling their new stereo 21 inch TC-C21AR (there seems to be a race on to devise the longest code numbers!) It uses conventional analog technology throughout. This set has a data-grade square-cornered picture tube which can handle 2000 (instead of the usual 1000) readible characters on the screen. The quality improvement for video games or computer word processing, is very obvious. We also saw a prototype colour monitor with a capability of 5000 characters per screen.

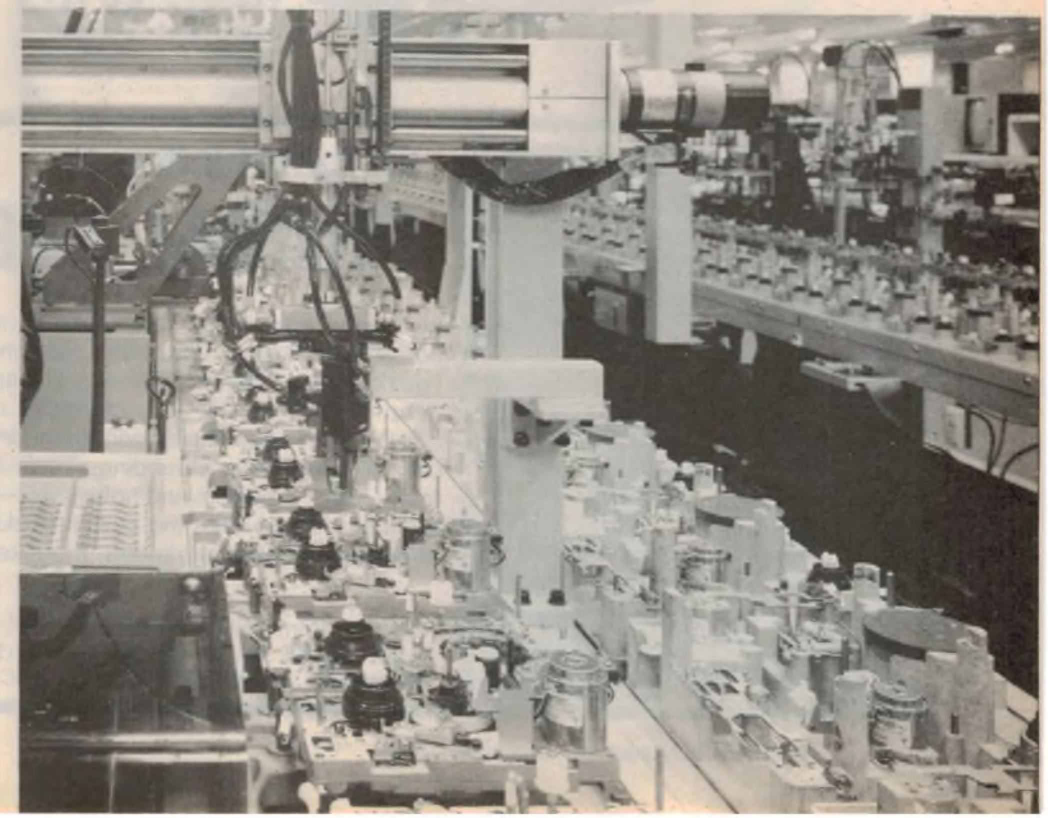
The TC-C21AR has a 21-pin (but not SCART) back socket with RF, composite video and RGB inputs. It is a step in the right direction for component system enthusiasts, but it doesn't go far enough. National and the other Japanese manufacturers seem to have the classic chicken-and-egg problem with component systems. Until they design and sell the necessary elements, there will be little demand — but without the immediate demand they are obviously loath to invest in the equipment.

National are very keen to talk about the concept of the "new media" — teletext, videotex, stereo broadcasting, high-definition TV, etc. But until they put their muscle behind creating plug and unit compatibility for component systems, buyers are going to be wary of buying any of the new equipment. I don't understand why all of the various systems of broadcast and cable videotex (Teletext, Telidon, Antiope, Captain) aren't available as plug-in boards for the new television sets. Apple Computers have been using this approach for many years — make a basic system and leave slots for future expansion. Why can't National?

New Cameras

Although National haven't shown any inclination to change from picture tubes to solid-state imagers, their new range of portable video cameras is excellent. We were loaned two of the new NV-180 light-weight portables with cameras, to play with during the visit. One was the top-of-the-line WVP-A2 camera with auto-everything including two pages of internally generated titles, and the other with the A1 basic camera.

There is little outstanding to report on the NV-180 recorder except perhaps for its weight — it is as small and as compact as the VHS-C compact recorders, but it



Right: The assembly of video recorders is now almost fully automated.

Junket to JAPAN

takes full size tape cassettes. There is a tuner/timer to go with this unit, so you can use it for off-air recording at home.

The WVP-A2 camera is a little beauty. I'm not talking about all the junk like titling, etc, that they've managed to cram inside. I just mean the feel of the camera from a cameraman's point of view and the quality of the pictures.

National, like most other Japanese camera makers, have now dumped the old pistol-grip-underneath concept of built-in camera instability, and gone for the side-mounted grip. It is a pity that they didn't think to ask professional cameramen ten years ago. It is widely accepted by the pros that the side-grip lets you lock the unit into the side of your head for added stability, while keeping the weight evenly supported on the wrist.

The weight of the A2 is evenly balanced but the A1 feels a bit too light for smooth operations. You need a bit of weight in a camera to give it some inertia. Both cameras have half-inch Newvicons tubes which, with their excellent 8.5 to 51mm, fl.2 zoom lenses, give good pictures at the low 7 lux light-level. Candle-light is generally taken to be about 10 lux, so the sensitivity of these cameras is starting to border on the ridiculous: they'll be selling them as "Peeping Tom specials" soon.

The new NV-180 lightweight portable recorder.

The auto-focus system of the A2 is a new "direct-image" technique. Infrared and ultrasonic are now passe, according to National. The A2 uses an array of 48 CCD sensors (behind a special condenser lens mounted beneath the main zoom) which actually read the edge contrast of images, and set the focus for maximum contrast (and therefore image sharpness).

I wasn't all that impressed with the focus system; it seemed to "hunt" (fluctuate) on either side of best focus, in some circumstances. Fortunately National have included an Auto-focus on/off switch, so you can take it out of the system. This is one of the features I really liked — National have given the operator manual overrides for most of the automatic circuits — so you can choose whether to use them or not. This is also one of the few of the modern designs where they have left space around the zoom lens for people (like me) who like to zoom and focus by hand.

Generally all controls on the cameras are well positioned and adequate, but they need to make the "feel" different so you can be confident of turning the control you want by Braille only — without taking your eye off the viewfinder. The A2 has all the expected bells and whistles — audio and video fade-out and fade-in, auto white balance (plus an override control) stereo mike inputs, and record/play, cue and review controls for the VCR, duplicated on the camera.

Most impressive of all, however, was the quality of the picture. It is the best that I've seen on a home portable, and it is outstandingly good at low light levels. Too good, in fact. One of the junket journalists was seen wandering around the sauna rooms with a camera in his hand . . . But that's another story.

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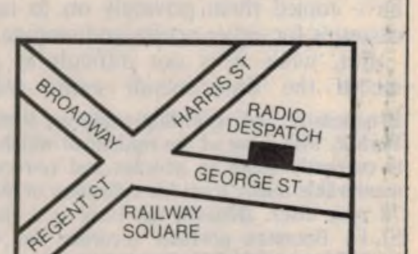

The 'Big Bands' live

New stereo LPs from noisy old mono 78s

Famous big-band leaders of the '30s and '40s are all set for a new lease of musical life in Australia, thanks to RCA and to broadcaster and recording engineer Robert Parker. For starters, 16 of Glen Miller's best-loved tracks have been digitally re-processed from the original 78rpm recordings into a brand new "stereo" LP album.

by NEVILLE WILLIAMS

The late Glen Miller, as pictured on the jacket of the new RCA Australian release, VPL1 0428.

On the display racks, the new Glen Miller release looks like any other stereo LP, except for the endorsement 1939-1942. And, inside, an information sheet gives details of each of the 16 tracks, including a list of the personnel involved: names that, in many cases, will be music to the ears of big band jazz enthusiasts.

On the turntable, the disc itself may lack the ultimate sparkle of a modern recording but it is certainly neither dull nor over-filtered. On the contrary, the sound has an unaccustomed degree of ambience and dynamic range, a fulsome bass, and is virtually free of the persistent crackle that has characterised many recordings dubbed from 78rpm originals.

Indeed, the sound quality available from this new Australian disc — the first of a planned series from the big-band era — is a tribute to the insight and patience of the recording engineer, Robert Parker. It is almost certainly better than would have been accessble to purchasers of even pristine examples of the original discs.

The transfer of historic 78rpm recordings to a more modern format is nothing new, of course. Any number of them have been copied for resale on long-playing albums, while enthusiasts have copied them privately on to tape cassettes for easier access and storage.

But, while it is not difficult to re-record the warts-and-all sound from typical 78rpm shellac pressings, it is quite another matter to create a new recording that is acceptable to modern ears. After 20 years or more of listening to relatively noise-free and distortion-free vinyl LPs, an unaccustomed background of snap, crackle and buzz can be disconcerting, to say the least, in 1984.

For sure, some vintage record buffs seem to derive a masochistic pleasure from preserving the faults and failings of the old discs, deploring any attempt to "doctor" them. One might reasonably ask, however, whether the purpose of the exercise is to experience a system, or to recreate, as closely as possible, the live sound of a musically important artist or group.

After all, the big bands did not normally play with "distorted" instruments, against a background of crackle, in an acoustically dead environment. Nor were they subject to inhibitions about the dynamics of their music. These were all limitations of the recording medium, which need to be

Broadcaster and recording engineer, Robert Parker, with some of the equipment which he is currently using to process and re-record memorable music from his collection of 8000 78 rpm discs. Beneath his hand is a Sony SL-F1 Betamax portable recorder and the PCMF1 portable digital audio processor.

again

Used in conjunction with the SL-F1 portable VCR, the PCMF1 digital audio processor adds up to a high performance audio recorder able to operate from AC mains, 12V DC supply or rechargeable batteries.

nullified if we are to get back to anything like the natural sound which gave them such wide acceptance.

To recapture that sound calls for adequate resources in at least three areas:

- A knowledge of what went on in the era of 78rpm recording; what to expect and how best to cope with it.
- An artistic appreciation of the program and sound, such that personal judgement can be exercised, especially in the absence of firm information about the recording characteristic, etc, of the particular source disc.
- Access to modern technical equipment which will provide adequate facilities for replay, re-balancing and re-recording.

Matters which may call for special attention include disc speed, frequency response and, as already mentioned, distortion and surface noise.

Surface noise, incidentally, is not just a special problem with very old discs. It became acute again for some manufacturers around 1940, when wartime restrictions interrupted the flow of shellac, forcing them to re-use materials recovered by grinding down stocks of unsold discs.

The question of disc speed can arise because, while 78rpm became a virtual standard later in the era, some earlier discs appear to have been recorded at quite different speeds, typically between about 74 and 82rpm. This must be identified and allowed for if the original musical pitch and tempo is to be retained, although caution is necessary in judging orchestral pitch because it, too, has been subject to change over the years.

In the matter of frequency response, EMI-sourced 78rpm records normally had a "turnover" point at 250Hz. Below the turnover frequency, the bass fell away by about 6dB/octave; above it, the response was nominally flat to about 6kHz. With magnetic pickups, this called for complementary bass boost below 250Hz.

American record manufacturers commonly selected a turnover point nearer 500Hz and some, in addition, included a degree of treble pre-emphasis. To replay such records accurately, one needed more extensive bass boost and a certain amount of treble cut.

Switchable pre-amps

A favourite pastime for perfectionists of the era was to keep track of what the various record manufacturers were doing and to have switchable preamplifiers able to complement the various recording curves. Hifi amplifier manufacturers commonly provided about four representative options, while even the simpler amplifiers carried at least two: 78A (American) and 78B (British).

The merit of such information, and of attempts at accurate compensation, was always debatable and it would be no less so at this remote point in time. The most realistic position for a modern re-recordist is to be aware that differences in recording characteristic did exist, and be able to effect the compensation which appears to be most appropriate in each case.

Similar confusion developed around 78rpm groove shape and dimensions, with some (notably American) manufacturers tending to favour wider grooves, with a more rounded bottom, than their British counterparts. The difference didn't matter much when using steel or thorn needles, because the tips rapidly assumed the shape of the groove they were playing — even if at the expense of groove wear and quality of reproduction.

However, with the appearance of jewel type styli, with polished hemispherical tips, groove/stylus dimensions and fit became critically important. An over-large tip would ride too high in many grooves, picking up surface imperfections and, at the same time, failing to resolve the highest frequency groove modulation. Conversely, a too-small tip would rest on the rounded bottom of other grooves, producing distortion because of poor tracking (groove "skating") and noise because of deposited dust particles.

Most pickup manufacturers at the time relied on a compromise stylus with a nominal tip radius of 2.5mil (0.0025 inch), leaving discs which had over-large round-bottom grooves to cop the blame for being "distorted". Some enthusiasts equipped themselves with a selection of styli having different tip radii, while Goldring came up with their "Headmaster" magnetic pickup with three interchangeable heads, each with a different stylus: 3.5mil for American records, 2.5mil for most others and 2.0mil for records with sharp V-bottom grooves which could be traced to advantage with a finer than normal stylus.

In any present-day effort to dub historic 78rpm records, it is vitally important to select a stylus to suit the individual disc, or even side. The basic guidelines are:

- The smaller the tip radius, the better

The 'Big Bands' live again

able the stylus will be to resolve the smallest serrations (the highest frequencies) in the recording. But the stylus must not rest low enough in the groove to touch the rounded bottom, because this will produce stylus "skating", with a sharp rise in distortion.

- Where the quality from a particular pressing seems to be especially poor, due to earlier groove wear, a stylus with a slightly larger or smaller tip radius will ride at a slightly different level on the groove wall and may conceivably be less affected by the wear.

In short, a careful choice of stylus, along with a flat-response, low-distortion pickup, and proper adjustment of tracking angle, playing weight, etc, are all important factors in lifting the best possible signal from the groove. From then on, it is a matter of electrical compensation, re-balancing and filtering to obtain the most acceptable end result.

In many of the early transfers from 78rpm discs, recordists relied too little on up-front precautions and too much on filtering, simply restricting the high frequency response until noise and distortion were no longer obvious. They would then reduce the bass response also, in an effort to re-balance the sound. The result was usually woolly, uninteresting — and commercially unacceptable.

Subsequently, some record companies had recourse to their archives, coming up with custom vinyl pressings from their original stampers, or master tapes dubbed directly from the metal "mothers". While a good starting point, the range of such material is limited. More than that, many such transfers appear to have been done as a routine assignment, without personal involvement and with elementary left-right bass-treble separation to support the promotional description "stereo".

Robert Parker's approach to historic recordings has been much more that of the enthusiast. He doesn't own archives stocked with metal mothers and stampers but he does have a personal collection of around 8000 78rpm records. What's more, he has had a lifetime involvement with radio broadcasting and recording.

His father was General Manager of Airzone Radio, at one time one of Australia's leading manufacturers of radio receivers and components. Advertisements and roadside hoardings used to proclaim the message: "Airzone's tone is Airzone's own". As far back as he

Sony in-car compact disc/player

At the recent Summer Consumer Electronics Show in Chicago, Sony announced the development of two compact disc players intended for in-car use and conforming to the latest DIN dimensional standards.

Both models were on display: the CDX-5 compact disc player and the CDX-7R, combining compact disc facilities with AM/FM radio.

Unveiling the new models, a Sony spokesman said:

"Introduction of our CD players represents much more than increased CD business for Sony. They also provide the first opportunity for car stereo listeners to enjoy the excitement and the sonic realism of compact disc in a single easy-to-use unit. It was Sony that co-invented the compact disc format . . . so it is not surprising that Sony is also leading the way with car CD players."

Sony claim that the CDX-5 and CDX-R7 "feature major technological advances that make them small enough for installation in a car and rugged enough to perform reliably, despite the shocks, shakes and temperature extremes of the car environment."

For example, the laser optical assembly used in the new players is only one-third the size of previous designs, employed in Sony home CD players.

In addition, Sony semi-conductor engineers have produced a new very-large-scale integrated circuit (VLSI) the CX-23035, that allows a dramatic reduction in the size and weight of the player electronics. The new VLSI performs such varied functions as control of motor speed, frame sync detection, error detection, error correction and data interpolation.

The CDX-5 and CDX-R7 conform to the same system standards as domestic players and have comparable performance specifications. Rated frequency response is from 12Hz to 20kHz, dynamic range and signal-noise ratio in excess of 90dB, channel separation more than 80dB and harmonic distortion at 1kHz less than 0.007%.

As might be expected of a unit for in-car use, operation has been designed to ensure minimum driver distraction. When a disc is inserted into the horizontal slot, it is automatically drawn into the play position. Controls are, for the most part, feather touch, with the most used buttons made larger for greater convenience.

In the CDX-5, a large AMS button (automatic music scan) makes it possible to skip quickly from item to item in either direction, while the "music scan" facility searches through the disc in forward or reverse mode at 10 times normal speed. Samples are heard at normal pitch but at reduced volume. There are two separate modes for uninterrupted music: one for any individual track and the other for the entire disc. As a visual reference, a fluorescent display can show either track number or elapsed time.

As a compact disc player, the CDX-R7 offers most of the facilities of the CDX-5, with automatic loading, automatic music scan, automatic music search and auto repeat for the whole disc. The fluorescent display can be switched to show time of day, track number, or can remember, the Parker home was crammed with sample receivers, prototypes, pickups, records and radio whatnots.

In 1948, and still a 12-year-old schoolboy, young Robert began to collect jazz recordings and, during his teenage years, his interest kept pace with his collection. Indeed, when he realised that, in current LP re-issues, music was being filtered out along with the noise, he went right on collecting originals while he had the opportunity to do so.

In 1953, he went into commercial radio, working first as a presentation engineer and later as a drama writer for radio plays. When radio drama folded, under the impact of television, he sought work in the film industry, moving to London in 1965.

A few years on and Robert Parker co-founded Molinaire Sound Recording Studios, primarily to service the then-new commercial radio system in Britain with programs and advertisements. Molinaire also gave him the opportunity to pursue his interest in winning the best possible sound from his growing collection of historic discs. He reasoned that they had all come from "direct-cut" masters and that, with modern technology and care, it should be possible to win better sound from them than was commonly realised.

A series of jazz and nostalgia programs was presented through the London Broadcasting Company from 1978 but, as it turned out, the most promising project from Parker's point of view was a commission from ABC FM in Australia to produce a series of jazz classics in stereo. Its success was such as to encourage him, last year, to pack up his 8000 records, move back to Sydney and set up Vintage Productions Pty Ltd "devoted to full time audio restoration of archive sound material for institutions, record companies and private collectors." [Based in Sydney, their phone number is (02) 387 4593].

Above is the new CDX-5, with volume, bass and treble knobs grouped at the left of the panel and the Play/Pause/Scan pads on the right. In the CDX-R7 (below) the player controls are somewhat smaller, to make room for the tuner controls along the bottom.

frequency when in tuner mode.

Push-button presets provide for the selection of 18 stations: 12 AM and 6 FM. In addition, manual tuning and automatic scan tuning is provided for, along with switching for FM stereo/mono and FM local/distant. AM and FM coverage is standard, with a quoted sensitivity on AM of 30uV and on FM of 15dBf (75 ohms).

Both models conform to the new DIN standard for in-car stereo units, with easy mounting in most vehicles. Dimensions are quoted as 178(W) x 50(H) x 155(D)mm with detachable DC converter 120(W) x 43(H) x 25(D)mm. The weight is 1.6kg approx.

The players do not include an in-built power amplifier, being intended for use with a separate amplifier and loudspeaker system. They do, however, provide the essential user controls on the front panel, including volume, bass and treble, and a reference level (0dB) output signal of 775mV into 10kΩ.

It is expected that both units will be available for worldwide release by the end of this year. For further information contact Garry Beauchamp, Sony (Aust) Pty Ltd, Sydney, on (02) 887 6690.

AUDIO VIDEO ELECTRONICS

The 'Big Bands' live again

This is the man — and the company — behind the new RCA release "The Two Moods of Glen Miller", VPL1-0428. How does he go about the mastering for such an album? What equipment does he use?

Currently, most of his work is done with Stanton cartridges, a range of styli with different tip radii, an SME arm and a Scottish FONS belt-driven turntable — the latter preferred because it is a high performance 3-speed unit with an effective means of varying turntable speed over the range required for nominal 78rpm records.

To dub a record, the first step is to examine the groove under a microscope and, by inspection and listening test, to select a stylus which best matches the groove dimensions and condition.

Robert Parker says that, when it comes to actual playback, he does not set too much store by the compensation and frequency response that any particular disc is supposed to have. He normally starts off with EMI 78rpm compensation, which provides basic bass boost and a flat treble response, relying thereafter on subjective judgement to steer him towards whatever supplementary bass and overall compensation is required for the most acceptable balance.

As distinct from the usual approach, Robert Parker does not work with a monosignal, obtained by commoning the two outputs from a stereo cartridge. He is at pains to work with separate balanced output signals from the respective groove walls, which he feeds to the two channels of a Packburn dynamic noise suppressor.

The point in so doing is that the clicks and crackles may not be symmetrical on the respective channels, giving the de-noising equipment a much better chance of deriving from them an uninterrupted mono signal. The Packburn, Parker says, is far and away the best de-noiser currently available.

To offset the very dead acoustics which were customary for 78rpm recording sessions, a suitable amount of artificial reverberation is added. Parker says that, having had experience with a range of mechanical and electronic reverberation devices, his current "affordable" preference is for a professional spring system.

Does he vary the gain setting during the dubbing to increase the apparent dynamic range?

Yes he does, where it appears to be called for. Knowing from past experience where an old-time recording engineer might have been obliged to reduce gain to stay within the limits of the system, he tries discreetly to restore it.

Simulated stereo is provided by an Orban "Parasound" which splits the final mono sound into five overlapping spectra, dispersed between the right-hand and left-hand channels. It obviates the hole-in-the-wall effect of straight mono, and gives an acceptable sense of spread, without the risk of disembodied overtones dominating one channel.

For monitoring purposes, Robert Parker uses a "Beard" valve amplifier driving a pair of Quad ESL-63 electrostatic loudspeakers — the latter preferred because, in judging the subjective quality of the sound, he needs to be assured of the least possible colouration from his own system.

For the same reason, he has chosen to record the rebalanced sound through a Sony PCMF1 digital processor on to an SL F1 Betamax recorder. He maintains that all quarter-inch (6.35mm) analog tape recorders produce some colouration, whereas the digital system is subjectively completely neutral. Says Robert Parker:

"When you're listening repeatedly to a program and making small adjustments to arrive at what you judge to be the best end result, you simply can't have the tape deck imposing its own sound on what it's recording!"

(The PCM-F1 processor is functionally similar to the Sony PCM-701ES processor reviewed in our December '83 issue but is styled for portable operation.)

Recordings in the PCF1/BETA format are used for broadcasting the "Jazz Classics in Stereo" series through ABC FM, as well as providing the source signal for mastering the new RCA Great Band series.

FOOTNOTE: "The Two Moods of Glen Miller" is currently available from record shops. Track titles are as follows:

When Johnny Comes Marching Home — Boulder Bluff — Pennsylvania 6-5000 — Runnin' Wild — Chattanooga Choo Choo — Moonlight Serenade — Kalamazoo — Stardust — Sliphorn Jive — The Spirit Is Willing — Johnson Rag — Melancholy Baby — I Want To Be Happy — In The Mood — Elmer's Tune — Farewell Blue.

The second record in the series, featuring Duke Ellington, may also be available by the time you read this.

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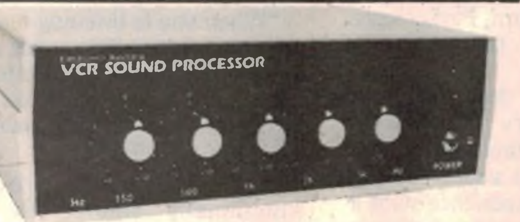

Lets face it, the mono sound you get from your typical VCR is dull, colourless and boring. This is a crying shame, as these days, movie makers invariably add outstanding stereo sound and sound effects to the movies they produce. **Next time you visit a modern movie theatre you will see (hear!) what we mean.** Now a quite phenomenal enhancement to your VCR audio quality and impact realism can be achieved by feeding the Video sound O/P through your home HiFi system via **EA's simply brilliant VCR Sound Processor.** Not only does it give simulated stereo but the inbuilt 5 stage graphic equaliser provides tonal depth for added realism and listening enjoyment.

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Input Impedance
Approx 10M ohm, 3M ohm at 300mV range
Rated Accuracy
2.5% DC, and 3.5% AC. full scale on all ranges.

AC VOLTS
Ranges
RMS 0-3, 12, 30, 120, 300, 1200V
Peak-peak, 0-8.4, 33, 84, 330, 840, 3300
Input Impedance
Approx 1M ohm 80PF, 2.5M ohm on 3V Range
Rated Accuracy
50Hz - 5MHz + 3%
dB
- 10dB — +63dB at all AC ranges.

DC CURRENT
Ranges
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Potential Drop
300mV

Rated Accuracy
Within + 2.5% full scale, all ranges

AC CURRENT
Ranges
0-12A

DC RESISTANCE
Ranges
Rx1 0-1K ohm (Centre 10)
Rx10 0-10K ohm (Ctr.100 ohm)
Rx100 0-100K ohm (Ctr.1K ohm)
Rx10K 0-10M ohm (C 100K ohm)
Rx1M 0-1000M ohm (C 10M ohm)
Accuracy
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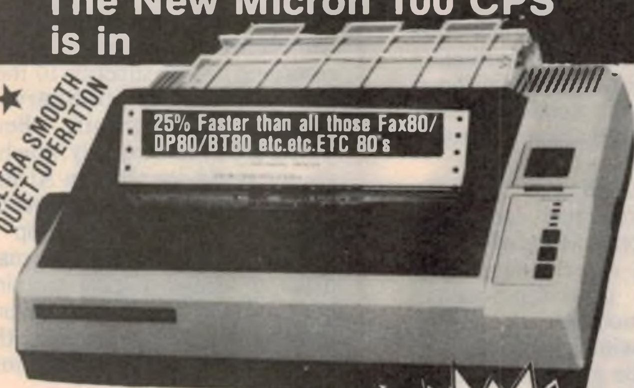

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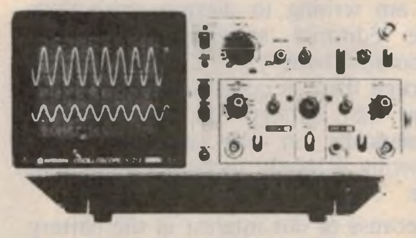

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SPECIFICATIONS:
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Two Types Available.

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NEW MODEL DATA CASSETTE

UNCONDITIONALLY GUARANTEED TO SAVE/LOAD THE RAWEST OF DATA EVERYTIME!

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- SLIDE VOLUME CONTROL **a must** for quick checking of levels
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We searched for nearly a year to find quality tape web for our Micron Data Cassettes. The criteria fo data tape is of course, very exacting with many computers available today. Our D 1141 data tape is in our humble opinion one of the finest available today — anywhere! O.E.M. customers, Mytek Computing, is reporting 96% success rate with High Speed Data Dubbing. This is of course quite phenomenal when one considers the dubbing speed is 30 times normal!!!

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Letters to the editor

Battery life: better than ever

I am writing to disagree with your June editorial statements regarding automotive battery life. Contrary to your editorial there is conclusive evidence to show that battery life has increased dramatically in the last six years following a steady increase before that time.

Because of our interest in the battery market we at the Australian Lead Development Association conducted a number of battery life surveys and discovered that battery life had increased from 32 months in 1978 to 43 months in 1982. These figures are confirmed by a comparison of battery sales and the vehicle population.

During this period automotive batteries have been redesigned to provide other benefits: reduced self-discharge; reduced or no maintenance; and increased cranking performance.

This considerable improvement has been achieved despite the following factors: decreased weight (demanded by car makers); increased under bonnet temperature; increased off-key loads; increased starting loads (due to anti-pollution gear); and reduced care by motorist (due to the advent of self-service petrol stations the battery is rarely if ever checked).

Studies overseas have shown that battery life in Europe, Japan and the US is similar to Australia (3-4 years), while battery life in much of Asia is about half this figure. Incidentally, imports from Asia are now at an all time high.

Contrary to your assertion, it is clear that car makers have made the operating conditions of the battery more difficult and if, as likely, these trends continue, then we may see a reduction in battery life in years to come.

Your misdirected editorial bears the hallmark of the frustrated car owner who suffers the inconvenience of a failed battery. We all agree that it is infuriating, but a commonsense approach is for motorists to replace ageing batteries as winter approaches.

Perhaps, given the great advances in electronics, you should instead exhort your industry to develop a viable battery condition meter so that the motorist won't be left stranded.

Norman H. Rickard,
Market Development Manager,
Australian Lead Development
Association, Melbourne, Vic.

Comment: We did not assert that car makers have made battery operating conditions easier. We did say that new cars should have better batteries.

Contented Beta owner

As a contented Beta format video owner for almost three years, I believe some points were missed in your Editorial Viewpoint, *EA*, July 84. The three Beta manufacturers — Sony, Sanyo and Toshiba — would not have continued with the format this long if it were not for the lucrative US market, where Beta format is the more popular.

With the development of the Betamovie camera and Beta hifi systems its survival is assured on the US market where the "big bucks are". The Beta hifi system is used in the US sometimes exclusively for audio recording as it is superior to the sound reproduction of ordinary audio cassettes. Consequently, Beta hifi VCRs are in short supply which is why we are yet to see them in Australia.

Can VHS manufacturers risk financial outlay to develop similar systems without an assured market to make it viable? I have certainly not heard of any such proposals from VHS manufacturers. So it looks like the good old porta-pak will be around for a few years yet.

It may be that video rental shops are capitalising on the video recorder rental industry which uses mainly VHS machines, but the larger established video libraries usually supply all movie titles on both formats — besides they have a far bigger range than my local chemist shop.

A. H. Newham,
Bassendean, WA.

VHS vs Beta: a conspiracy

I have been purchasing *Electronics Australia* every month for the last 14 years. I have learnt much from your magazine and have built several projects. Rarely have I disagreed with your editorial comment, however your July '84 Editorial Viewpoint entitled "VHS has won the battle against Beta" did annoy me.

I disagree that "the writing is on the wall for Beta format video machines". Certainly VHS outsells Beta in Australia, and particularly in Sydney, but in Melbourne the gap is smaller, I believe, and in the USA the situation is reversed — Beta outsells VHS. I do not believe that the non-introduction of BASF premium grade L830 cassettes (who uses L830s anyway?), or the fact that Sony now package their Dynamicron tape in VHS cassettes spells "the end for Beta". I believe Sony are simply capitalising on the lucrative market of blank tape sales.

I quote from page 28 of the June issue of *EA:* "According to Mr Haranobu Murakami, Managing Director of Sony Australia . . . Not only is Betamovie proving popular in its own right, but it has helped to boost the Beta format's share of the Australian home video market by 8% during the last quarter of 1983. He stressed Sony's continuing commitment to the format, its acceptance in commercial and Government circles and the impending introduction of Beta hifi stereo sound." How and why do you ask: "How much longer will they continue to sell Beta VCRs?"

As you probably know, the Federation of Australian Commercial Television Stations has endorsed the Beta format for the exchange of non-broadcast preview copies of programs and commercials. I work for a commercial TV station, and I know that many of the executives and most of the producers have Beta machines in their offices. Also, I believe there is only one VHS machine in any of the offices.

You concede that Beta machines give a slightly better picture and generally more features for a given price. I have driven machines in both formats and all VHS machines frustrate me with the delay there is between pushing a button (eg, "Picture Search Forward") and the machine entering that mode. All Beta machines are instantaneous in their response and therefore quicker and easier to operate (particularly when cueing up a specific point on a tape). Remember also that the VHS manufacturers had to change the format specifications to give "Picture Search"

A collection of irrelevant facts

Re your editorial in the July 1984 issue titled "VHS has won the battle against Beta".

The whole article is based on a collection of unrelated and irrelevant facts from which misguided conclusions have been drawn. In layman terms you are saying that Mercedes and BMW are doomed because more people buy Holdens and Fords.

I formed Beta Audio Video because there is an increasing awareness among discerning buyers of the superior quality and performance of the Beta format. In any society the more common products are purchased by the majority but, as in hifi systems, the serious music lover will search out and find the quality components; so it is with any commodity.

Beta and VHS will both be superseded one day with, most probably, a recordable and erasable disc or module; but until that day both formats will continue to share the market place.

Your article does not enhance your magazine's credibility. A pity, because it has had an excellent record to date.

D. Cale,
Beta Audio Video (Aust) Pty Ltd,
Malvern, Vic.

Sleight of hand

Congratulations on Bryan Maher's excellent series explaining op amps. Part 5 on differential amplifiers brought back fond memories of some delightful arguments. All the textbooks and teachers (and, alas, Bryan) make the statement that, in Bryan's Fig 9, "the impedances of the two inputs are different." What a beautiful piece of verbal sleight of hand this is! It is indeed true that if you measure the impedance from the V(IN)+ terminal to earth with the V(IN)− terminal open-circuited you get a different answer from measuring that at the V(IN)− terminal with V(IN)+ open-circuited. But of course the circuit is never used that way.

As Bryan points out, the circuit is used correctly in his Fig 5, wherein V(IN)+ and V(IN)− are connected to a voltage (ie, zero impedance) source. So if we short V(IN)+ to V(IN)− and impose a voltage to earth, the currents in RiA and RiB are identical if RiA and RiB are identical. So the impedances of the two inputs to earth must be identical. Indeed, it is this identity of impedance that makes the circuit work and gives it its high CMRR. In real life, if the source has a finite impedance in the V(IN)− lead an equal impedance must be added in series with the V(IN)+ lead to compensate.

Consequently the statement that the impedances are different, though correct when the circuit is isolated, is never correct when the circuit is actually used! Having set up this purely imaginary fault, the textbooks now proceed to "fix" it by adding the two voltage followers shown in Fig 11. If you must have a high impedance, fine. But otherwise the followers are completely unnecessary and simply add cost and noise.

J. Middlehurst,
Wahroonga, NSW.

The splinter in your eye

It is with amazement that I read your first item in July's editorial. In fact I had to check whether I had mistakenly bought a copy of *TV Week.*

While I can accept some comment in this column concerning the technical quality of ABC transmissions, I consider criticism of the content of those transmissions to be far removed from the pages of this magazine.

Although I hold no firm view one way or the other on the programs in question, one is reminded from the type of criticism given of the proverbs concerning the splinter in your neighbour's eye and the plank in your own, and let him without sin (fault) cast the first stone.

While the programs in question may go through good times and bad, so has *EA*. However, to Nationwide's credit we don't have to watch this program to find *EA*'s failings.

In summary I can only suspect editorial content at *EA* has reached desperate times.

P. A. Ward,
Marion, SA.

On the other hand . . .

I write to thank you for so expressing my opinion of "Nationwide" (*EA*, July 1984).

As the ABC had continued to parade this program after I had ceased to watch it, I was plagued by the feeling of being the odd one out.

(Name and address supplied, but withheld by request).

capability. How long will it be before VHS manufacturers can match Betamovie?

I believe that the reason VHS outsells Beta in Australia is that when the two formats were introduced there was a conspiracy between VHS importers, major retailers, and major rental companies, that right from the start they would only push and stock VHS machines. It has always been nearly impossible to rent a Beta machine. Also, I am sick of the "untruths" that VHS retail salespeople disseminate to prospective customers. The latest one is: "you won't be able to buy blank Beta tapes after 1984." Surely this type of slanderous comment and conspiracy are close to breaches of the Trade Practices Act.

If you read through back issues of your magazine, you will find several articles along the lines "Beta manufacturers announce new development: VHS manufacturers hard pressed to follow suit." I give full credit to Sony for their continuing pioneering work in videocassette technology which saw the wide acceptance of the Umatic ¾-inch format (still used by TV production houses throughout the world), the introduction of its little brother, the ½-inch Beta format, and the refinements of picture search, noise-bar free variable speed play, Betamovie, and now Beta hifi.

Finally, I am sure you are aware of Sony's heavy commitment to Betacam, the professional version of Beta. With Sony recently releasing "Betacart" to replace TV stations' ageing Ampex ACR Cassette and RCA Cart machines used to play commercial breaks to air, I can't see them suddenly saying "sorry folks, no more tapes or developments after 1984". I know Betacam uses six times higher tape speed and component video recording, but the cassettes are the same, and I believe research and development in Betacam will flow on to Betamax home machines.

Ultimately of course, both VHS and Beta will be replaced by a digital ¼-inch system, and hopefully commonsense will prevail and there will be only one format, as we thankfully have with compact discs.

A. Ryan,
Mount Eliza, Vic.

P.S. I was at a friend's place last night viewing tapes he had recorded during his 12 month stay at Casey base in Antarctica. Using a National portable camera and VHS recorder, he shot about 100 hours of tape in temperatures as low as −40°C. Is this a record for videotape? Technically the tapes are superb. He had no problems with the camera or recorder freezing up.

Sanyo CP400 compact disc player

Sanyo has two attractive CD players on the Australian market. Here we review the up-market CP400 which has a comprehensive array of operating features, plus infrared remote control.

The Sanyo CP400 is an attractive unit which measures 420mm wide by 88mm high and 320 deep. It is finished in satin aluminium with a dark grey front panel.

As with most CD players, the CP400 is not light. It weighs in at 6.8kg.

Sanyo has adopted the now popular front loading drawer system for disc loading: just press the open/close button and the drawer slides out, ready to receive the disc. The disc can be dropped into the drawer without any need to locate it precisely and in doing so, the user can avoid placing fingers on the mirror-finished recording side.

The CP400 has a number of transport locking screws which must be removed before the unit can be played. These screws should be stored in a safe place so that they can be used at a later date, for transporting the deck.

Once the drawer is closed with the disc inserted, the "Disc In" LED lights and both the *Real Time Counter* and *Multi Display* digits light up.

The Real Time Counter can display one of two functions: either "each time" or "remaining time". The "each time" reading indicates the elapsed time of the particular track being played while the "remaining time" shows the track time remaining.

Several options are available when playing a disc. Firstly, the programming facilities can be ignored and, by simply pressing the *Play* button, the entire disc will be played from start to finish. The *Repeat* button restarts the sequence of play.

At any time during play, *Pause* or *Stop* can be pressed. The player can be stepped to the start of the preceeding track or to the beginning of the next track by use of the *Back* or *Forward* access switches. Alternatively, by pressing the *Fast Forward* the disc can be heard at a faster rate than normal.

An *Intro Scan* facility is also available which plays only the first 11 seconds of each track. This is useful to quickly introduce the content of an unknown disc.

The *Multi Display* indicates one of three display modes. These are the Track No/Index No, Track No/Next No and Track No/Program No. These are selected in a cyclic fashion via the Program Write/Display switch.

Note that track number refers to the individual tracks recorded onto the digital audio disc, while the index number refers to subdivisions within a track. The program number refers to the sequence of programmed instructions. For some discs, indexing is not available and the index number will remain at 00.

Programming can be performed at the Track No/Program No setting. Up to 16 tracks can be programmed to play in any order and are entered via the track program memory switches. To remove memorised selections one at a time the user has to press the Clear switch, while to erase the entire programming sequence, the All Clear button must be pressed.

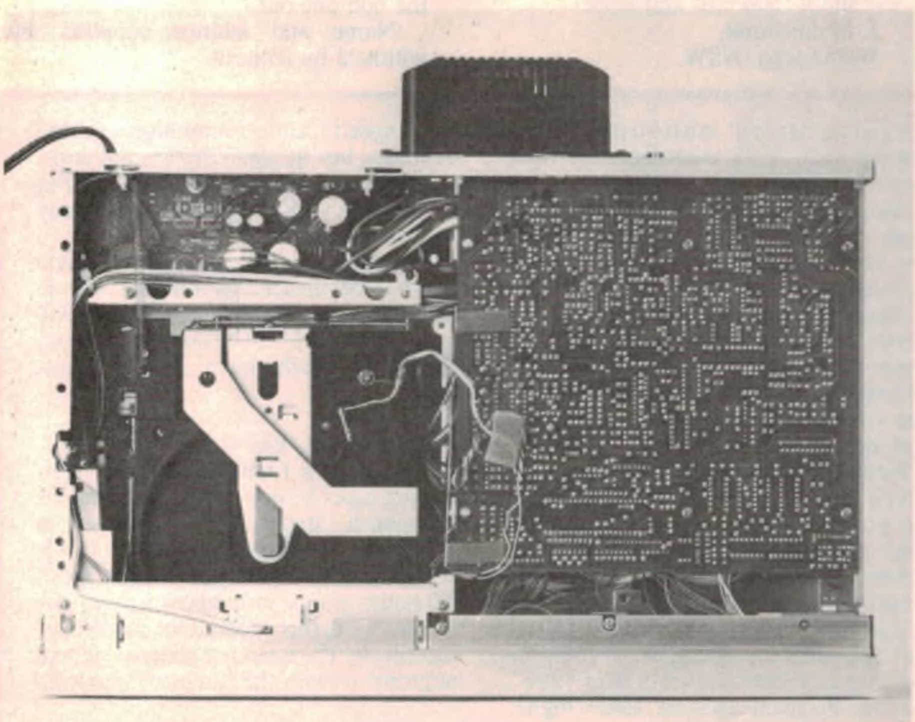
The disc will play the tracks in program order when the Program Play switch is depressed.

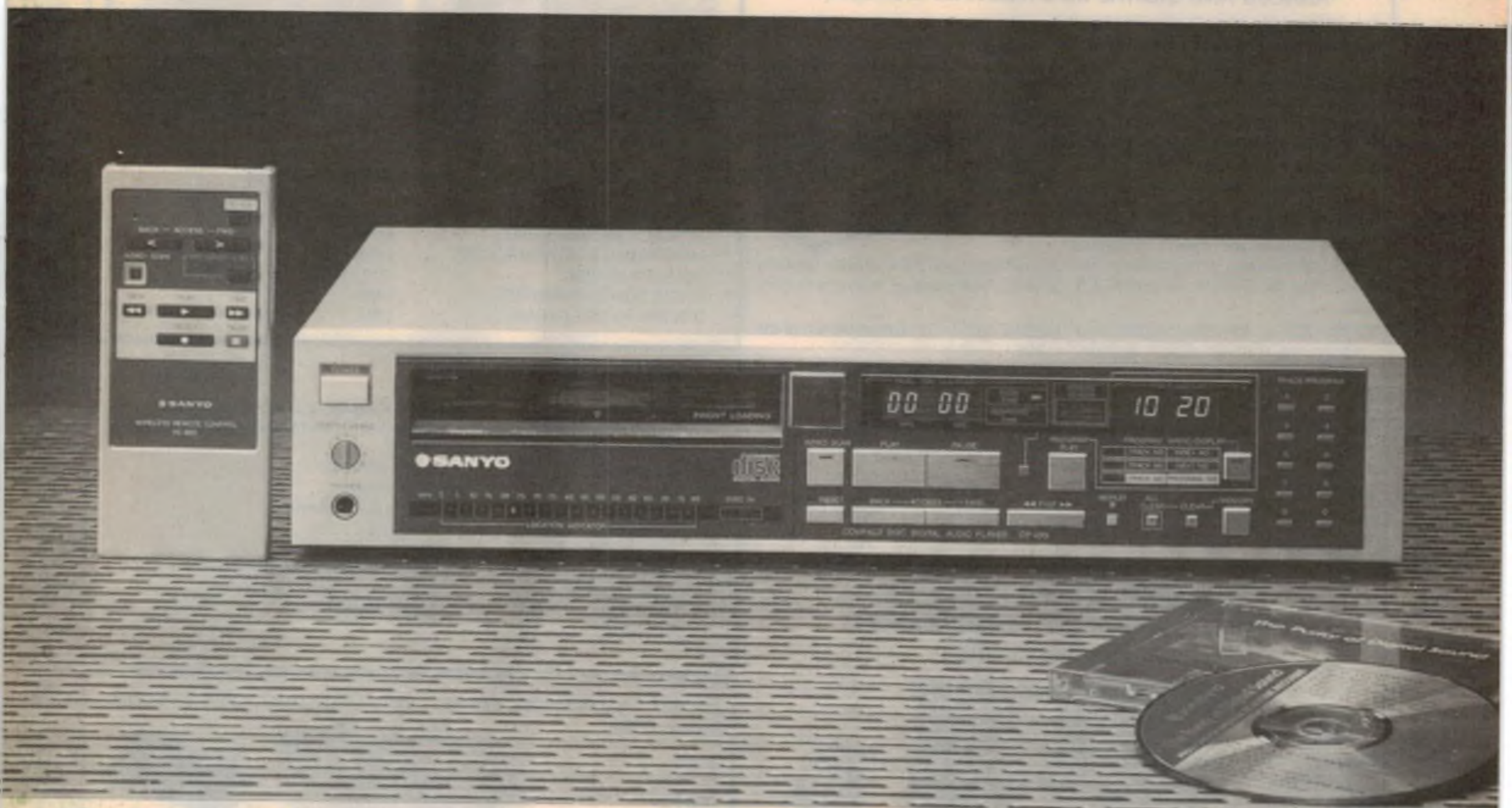
The Multi Display also doubles as an alphanumeric display to indicate player modes. These are search error, program end, disc end, disc loading incorrect and program full.

A stereo jack socket and an output level control is provided for headphone listening. At the rear of the player are two RCA sockets for the left and right channel outputs.

Internally, the CP400 is well constructed and is packed full of both mechanical and electronic components.

Interior of the CP400, showing disc mechanism and printed board.





Front view of the Sanyo CP400, showing the cordless remote control. Note track selection buttons on the right.

Quoted Specifications

Number of channels	2
Frequency response	5—20,000Hz
Dynamic range	More than 90dB
S/N ratio	More than 96dB
Channel separation	More than 92dB (1kHz)
Distortion	0.003% (1kHz)
Wow & flutter	Quartz crystal precision
Sampling frequency	44.1kHz
Quantization	16 bits linear
Bit rate	4.3218 million bits/sec
Dimensions (WxHxD)	420x88x320mm
Weight	6.8kg

The disc driver and laser assembly occupies approximately 25% of the internal space. Most of these mechanical components are constructed of plastic with the exception of the central support arm for the disc spindle and drive.

Several large printed circuit boards are used for the electronic circuitry. Two of the major PCBs are mounted one above the other and are located to the right of the disc drive. As may be noted from the interior photo, there is a lot of inter-board wiring within the unit. The power transformer is mounted behind the rear panel of the unit and is shrouded in a plastic shield.

Like many other Japanese CD player manufacturers, Sanyo have opted for 16-bit analog to digital conversion with a sample and hold circuit and multi-pole analog filtering.

The very steep rolloff provided by the analog filter reduces the residual 44.1kHz and subsequent harmonics of the digital sampling frequency to a very low level, however, it does have one drawback. A multi-pole filter by its very nature introduces large amounts of phase shift particularly at the high frequency end of the audio spectrum. Whether this phase shift is audible though, is yet to be proven.

Performance tests

The first test we performed was linearity. This involves the use of a 1kHz tone which is stepped down in level in 10dB steps to minus 90dB. The idea is to check how the output level changes compared with the recorded levels. The CP400 had a 1.5dB discrepancy at −80dB and 4dB at −90dB. These results are good and the very slight errors are completely undetectable in listening tests.

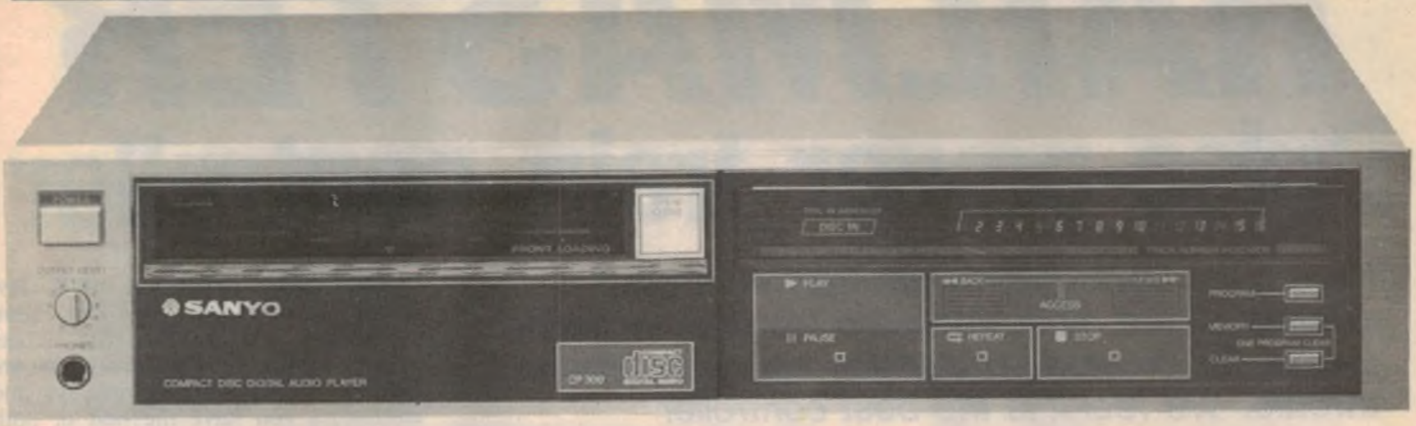
Frequency response tests reveal that the Sanyo CP400 is similar to most disc players with multi-pole filtering. The response is flat from 20Hz to 10kHz and rolling off to −1dB at 20kHz.

Signal-to-noise ratio was measured at 90dB with respect to a 0dB reference level of 2Vrms.

Total harmonic distortion at 1kHz and 0dB level was .0065%, rising to 0.1% as levels fall to −40dB. A distortion against frequency test revealed that THD remained relatively constant at .0065% from 20Hz up to 15kHz, rising to .02% at 18kHz and 0.4% at 20kHz. This rise in distortion at 20kHz is not purely harmonic distortion, but includes a beat frequency (44.1 − 20kHz) of 24.1kHz. This is a common phenomenon with some CD players and is not audible in the slightest.

Intermodulation Distortion, with a test signal of 400Hz and 7kHz at 0dB was measured at .008%, a good result.

Measurements of separation between channels yielded readings of −74dB at 100Hz, −71dB at 1kHz, −55dB at 10kHz and −50dB at 20kHz. In practice this order of separation is considerably better than that obtainable with a traditional cartridge and analog record combination but is not as good as the −92dB figure claimed in the specification panel.



Slightly less elaborate than the CP400, the Sanyo CP300 CD player retails for $699.

We also tested the CP400's handling of defects on the disc surface using the Philips No.4A test disc. This disc comprises an opaque wedge of interruption in the information layer to simulate scratches of increasing severity, black dots up to 600 microns diameter simulating dirt and finally a simulated fingerprint.

The CP400 was able to correct or substitute for the missing data when confronted with scratches or fingerprints. The dot interference did, however, cause some problems. The player began late on one track and after completing the track began again at the correct beginning. Music content appeared unaffected. Apart from this one defect, the CP400 handled this test disc well.

Some CD players are very sensitive to the slightest bump and will jump tracks easily. The CP400 was very good in this respect and required a fairly deliberate bump to make it jump tracks. We would rate it as one of the better players in this regard.

The remote control unit provides comprehensive playing facilities. Apart from the expected play, stop, pause, forward and reverse scan and the forward and back access, there is intro scan, program play and repeat. The unit performed well throughout tests and is a very pleasant-to-use accessory.

As we have come to expect with CD players, the Sanyo CD400 performs and sounds very well. For those wanting a player with remote control facilities it certainly warrants strong consideration. Recommended retail price of the CP400 is $899.00 (J.C.).

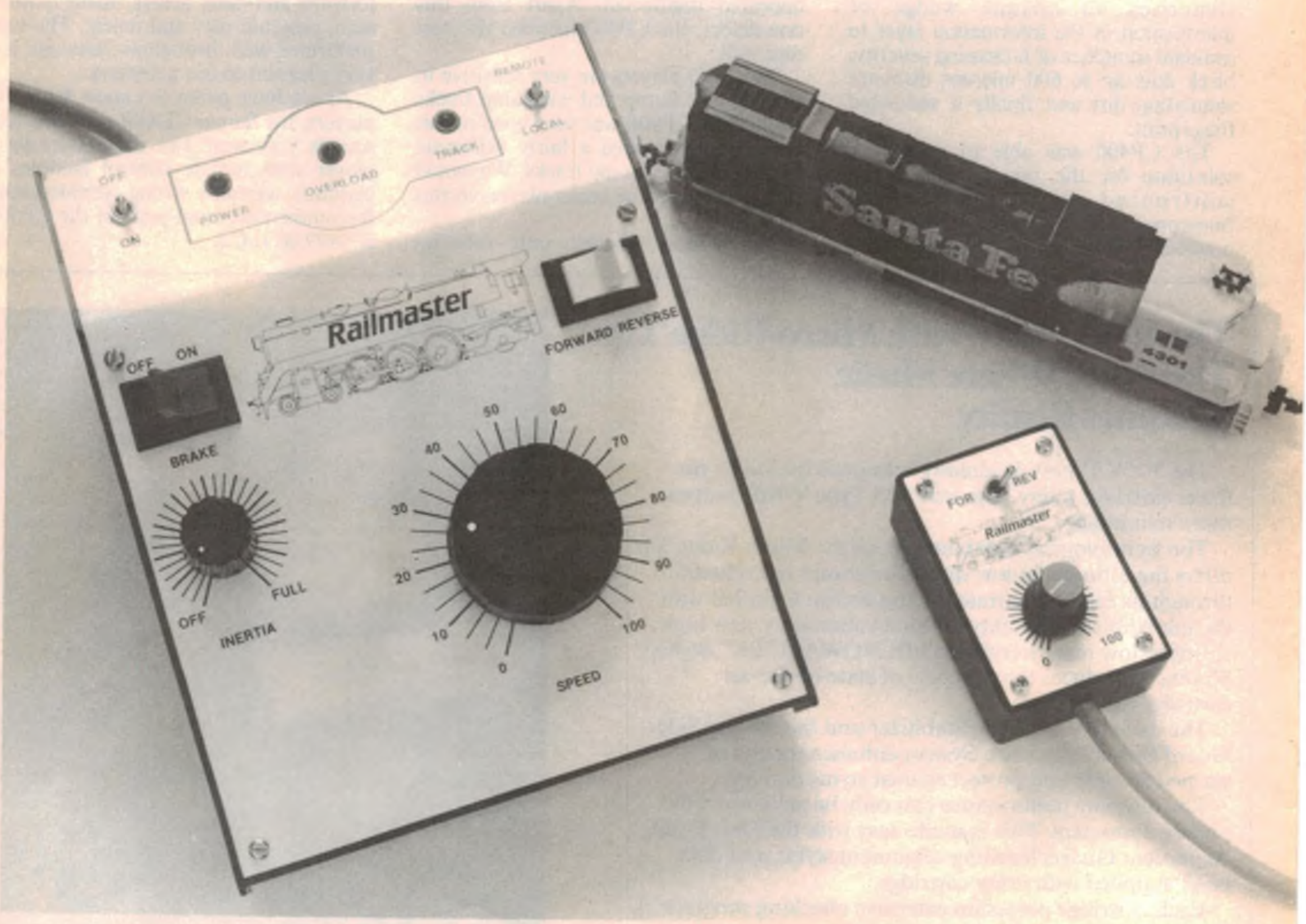
RAILMASTER

Pulse-power train controller

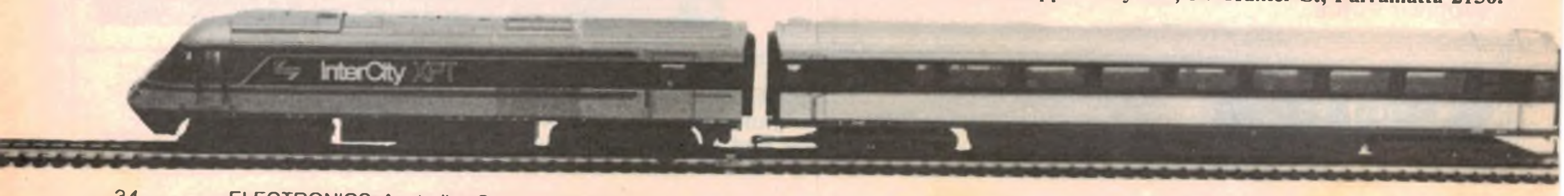
Here is an up-to-the-minute train controller offering all the most desirable features including inertia, full overload protection and walk-around throttle. We feel it is the best controller available, regardless of cost.

by LEO SIMPSON & JOHN CLARKE

Apart from electronics itself, few hobbies can match the long term satisfaction enjoyed by keen model railway enthusiasts. Of course if you are involved in both model railways and electronics you have the best of both worlds. The model railway enthusiast with an electronics background is able to provide many of the circuits which do so



XPT model courtesy Southern Model Supplies Pty Ltd, 5-9 Hunter St, Parramatta 2150.



much to add realism to model railway operation.

This applies particularly to our new *Railmaster* Train Controller which offers a wide range of operating features but with emphasis on ease of use. With this train controller you'll not only find that the trains operate more reliably but they also operate more realistically. And the *Railmaster* is very easy to drive.

Witness the operation of a real train such as a diesel loco with a long rake of loaded goods wagons. It starts off very slowly and almost imperceptibly accelerates its heavy load up to speed. Once up to speed, which may only be 40km/h or so, it will then maintain that rate consistently until the brakes are called upon. Braking is no sudden matter either. It takes a lot of track, maybe as much as a kilometre, to bring a heavy goods train to a halt.

Ask a model railway enthusiast to duplicate this and he will probably shake his head. With most controllers it is no easy task to reliably produce realistically smooth stops and starts and jerk-free and stall-free slow running. That is where this new controller excels.

The new controller includes a circuit which causes the model to operate as if it had the sizeable inertia of a real train. Winding the throttle up to maximum causes the model to move off very slowly without jerking or momentarily stalling. Acceleration is then smooth and progressive. Similarly, winding the throttle back causes the model train to lose speed slowly, gradually coming to a complete stop.

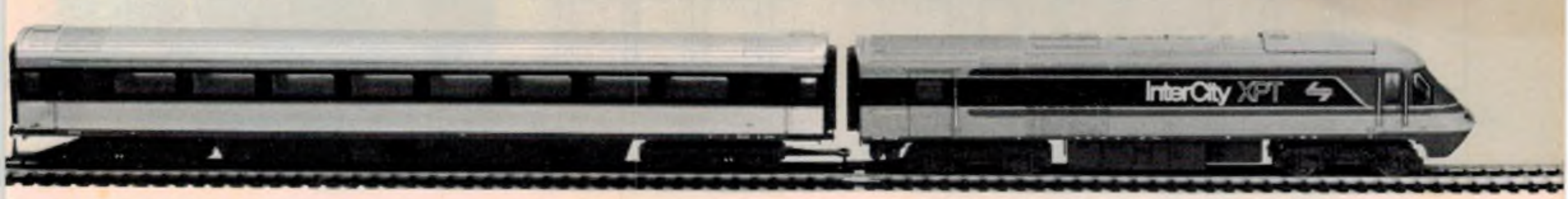
The amount of simulated inertia is variable. A long goods train can be made to accelerate much more slowly than a loco running without any load. Or, if you like, you turn the inertia off.

But simulated inertia is only part of the appeal of this new circuit. It also has two features to give enhanced low speed running. First, it works on the pulse width modulation principle and second, it monitors the speed of the loco motor and varies the drive voltage to compensate for speed variations.

Before we go into the way in which the controller actually provides these benefits let us look at the other features of the controller. They are as follows:

- Full short circuit protection including audible and visible short circuit indicators.
- Power and track monitor indicators.
- Provision for walkaround throttle.
- Adequate power for double and triple heading of locos.
- Fixed 12VDC and 15VAC for lighting and accessories.

Let's discuss these additional features. The comprehensive short circuit protection is provided for a number of reasons. Short circuits in model train layouts may often be hard to detect — often it is thought that something is wrong with the loco if it is not moving but the reason may well be an



RAILMASTER

inadvertent short circuit elsewhere in the track.

In any case, if children are to use a train controller it must be short-circuit proof. They will often short out the tracks from sheer devilment, just to stop the train or to see the sparks fly!

Our new *Railmaster* controller can not only withstand short-circuits indefinitely, but also has a loud buzzer and a LED indicator to draw attention to the short circuit in no uncertain terms. This is desirable because many locos will briefly short out the supply as they cross the points. This is a problem of compatibility between rails and wheels and often causes jerky running which would otherwise be blamed on the loco or controller.

Even the briefest of short circuits will cause the buzzer to sound and the LED to flash. So even if you are deaf the short circuits will be brought to your attention. Once you become aware of momentary short circuits as the train goes around the track you can remedy them and get better overall operation.

Other LED indicators are provided for power and track voltage. The track voltage LED gives a good indication of the average voltage actually being applied to the track which is handy if you are having trouble with a particular locomotive.

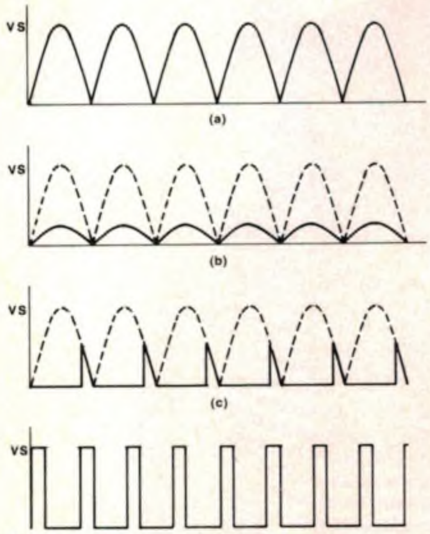


FIG. 1

Fig.1: (A) full-wave rectified sinewave; (b) transistor controller output; (c) thyristor controller output; (d) pulse controller output.

Walkaround throttle

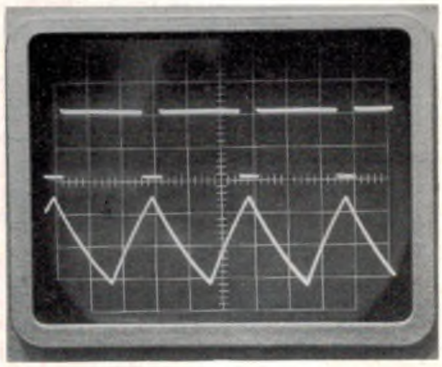
What's a walkaround throttle? It's a throttle you can walk around with. It's fun to be able to follow a train around a layout, controlling it as you go. This new controller circuit has provision for such a walkaround throttle which includes a forward/reverse switch. If you have a large layout you could install sockets at several points so that the control lead is not unnecessarily long.

A local/remote switch on the Train Controller selects either the main controller or the walkaround throttle function.

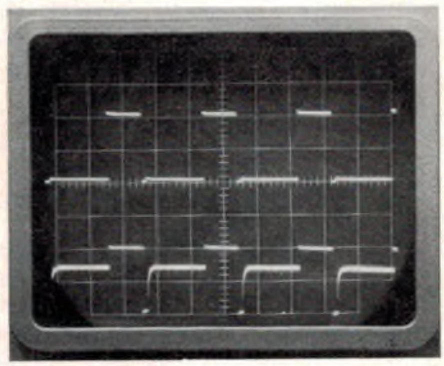
A walkaround throttle is particularly handy when you are carrying out fiddly shunting manoeuvres. (In fact, railway modellers often refer to their shunting yards as fiddle yards).

Power output

How many locos can the Controller power at the same time? Railway modellers often wish to double-head or even triple-head locos to pull long trains. The answer to the question depends on the locos. If they have inbuilt lighting or smoke generators then two locos is probably the limit before the short-circuit indicator will sound. If the locos do not



Upper trace: output voltage at pin 1, IC2a; 10V/div. Lower trace: ramp voltage at pin 6, IC2b; 1V/div. Timebase: 2ms/div.



Upper trace: output voltage at collector of Q2. Lower trace: voltage across loco motor. Both traces 10V/div; 2ms/div.

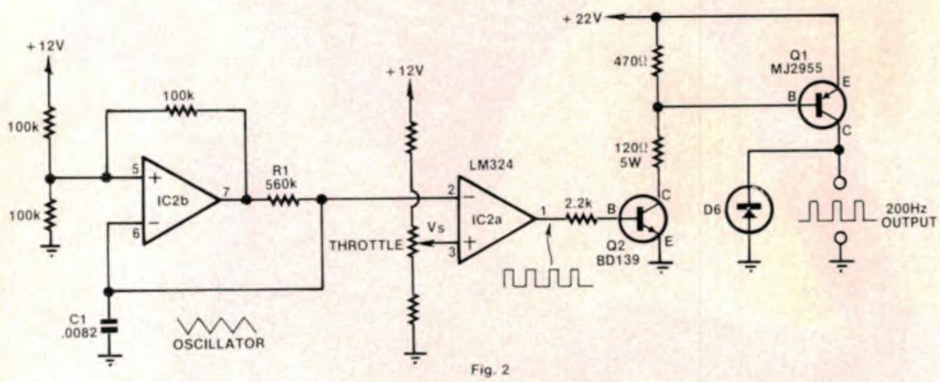


Fig. 2

Fig.2: basic train controller circuit. IC2b works as a triangle wave generator while comparator IC2a delivers square wave pulses to buffer stage Q2 and Q1.

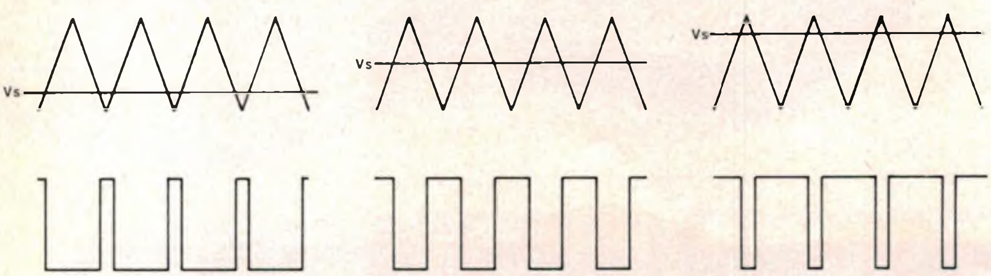
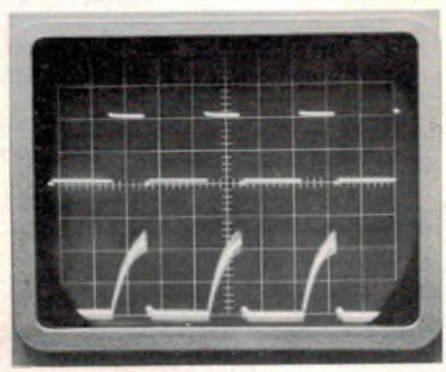


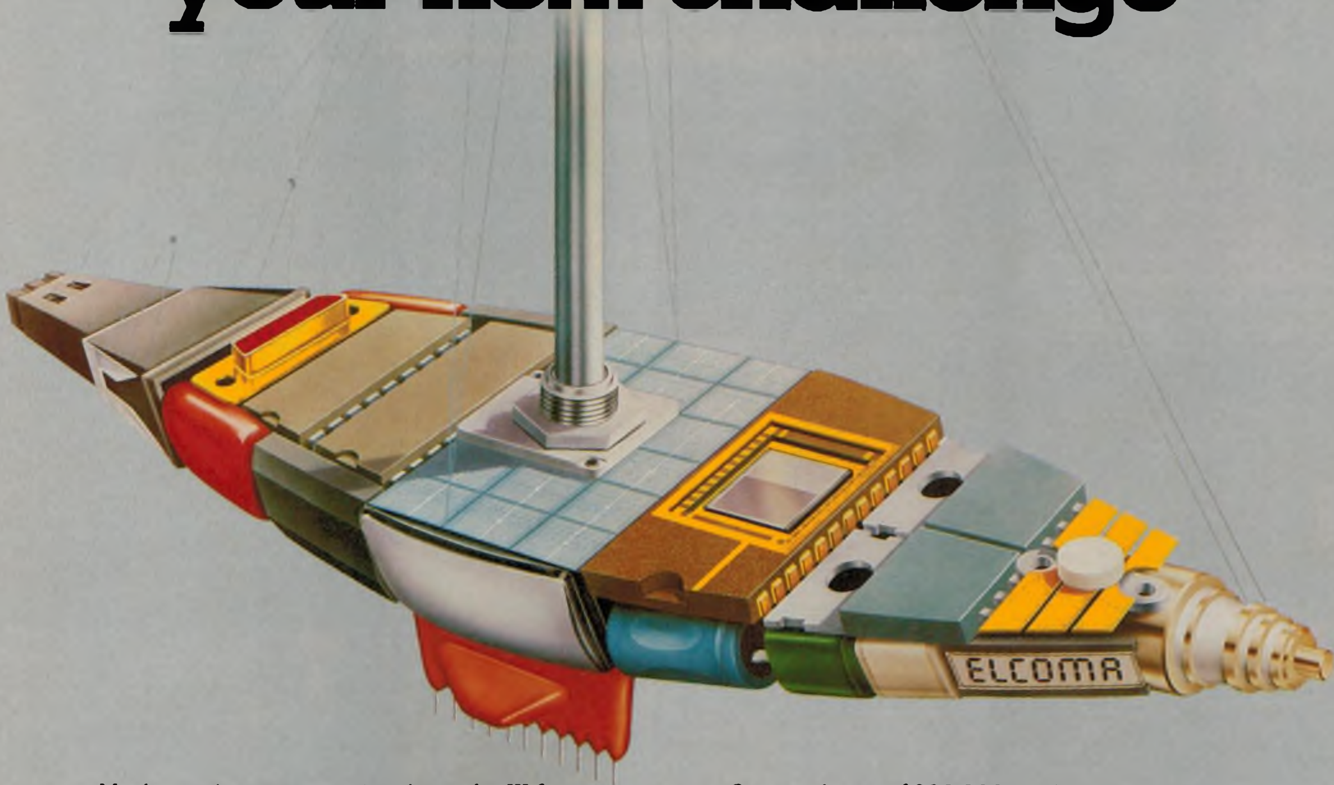
FIG. 3

Fig.3: how the output of comparator IC2a varies. The control voltage (VC) is set by the throttle and compared with the triangular waveform from the oscillator.



Upper trace: output voltage at collector of Q2; 10V/div. Lower trace: loco current across 0.1Ω sense resistor; 50mA/div.

Smart electronic components for your next challenge



Maybe you're not preparing Australia III for the next cup challenge, but if you're an Australian manufacturer you are well aware of the international competition that you face. Their strategy and techniques to drive you out of the race will be very crafty indeed.

Perhaps you're wondering, "What could electronics really do for my product?" Up to this point, you've got by very nicely with conventional solutions. But just for a moment, think about the benefits you could offer your customers. If you build a unique product that has intelligence and is better suited to your market requirements, your product could stand head and shoulders above the rest.

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TAW P001-253

The audio giant scores 10 out of 10.
System 330 Hi-Fi Component System.
1 A full 35 watts RMS/channel power, drives the system's stereo units, delivering life-like sound through 3-way speakers.
2 Servo-controlled motor with belt drive assures constant, accurate speed. Cue control on turntable gently lowers tonearm into groove, preventing possible damage to the record or the stylus.
3 Built-in 5-band graphic equalizer enables you to custom contour the system's sound at 5 critical points along the audio spectrum by as much as 10dB.
4 A/B speaker switching enables you to connect two sets of speakers to your system and listen to them separately or together.
5 The tuner with its 3-segment LED signal strength indicator lets you know when you're receiving a weak or distant station.
6 Two 5-segment LED VU meters on the cassette deck provide precise, easy-to-read record levels and help to prevent distortion.
7 Dolby* noise reduction circuit minimises distracting tape hiss and allows you to record and playback crisp, clean sound.
8 3-way, 3 speaker systems each containing 25cm woofer, 10cm midrange and a 2.5cm dome tweeter.
9 Audio component rack with attractive wood-grain finish includes record storage facility. Castors for easy mobility, glass door and hinged glass turntable dust cover.
10 The tenth feature is the price and Sanyo has taken care of that too, but that's life.
*Dolby is a registered trademark of Dolby Laboratories.
SANYO
That's Life!

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have lighting or smoke, three can be powered.

As an additional feature the controller has fixed 12VDC and 15VAC outputs which can be used for powering point motor circuits and layout lighting. However, we should make the proviso that if these outputs are heavily loaded the controller capacity will be correspondingly reduced. This is fixed by the transformer rating which is 30VA.

Pulse width modulation

Over the years a number of electronic circuits have been devised to overcome the difficulties of slow speed running referred to earlier. These have included thyristor and transistor controllers.

Although these are a big improvement on simple rheostat (variable resistor) controllers they still leave a lot to be desired when it comes to starting and slow speed running. This is because they use the voltage waveform derived from a full wave rectifier and low voltage transformer, from the 50Hz mains supply. This waveform is depicted in Fig. 1(a) as a typical full-wave rectified sinewave.

Fig. 1(b) shows the output of a typical transistorised controller at a low speed setting and Fig. 1(c) shows the output of a thyristor controller for the same low speed setting. It can be seen that the peak voltage of both waveforms is quite low and would be inadequate where there are problems of contact resistance.

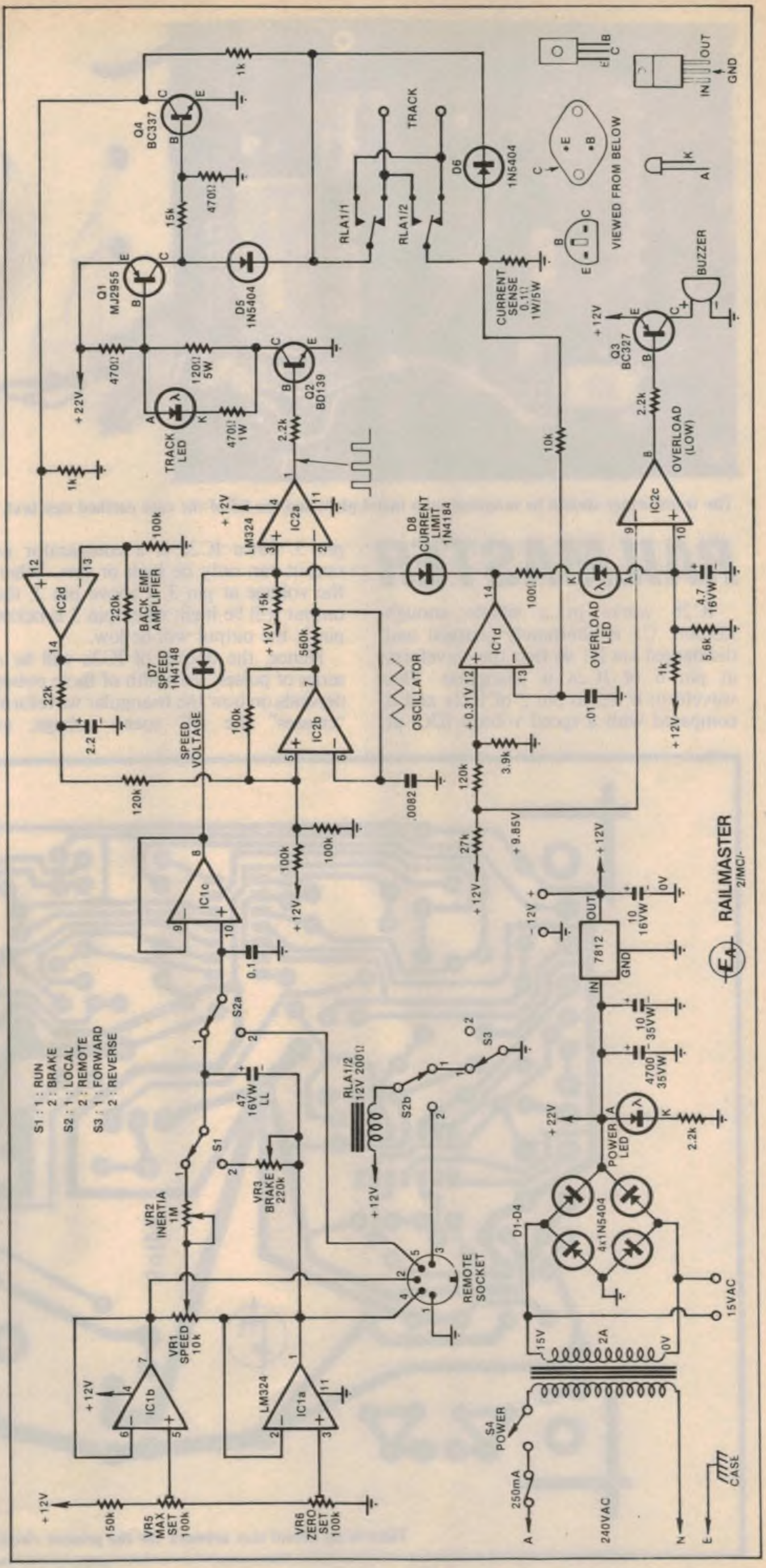
The solution is to supply the loco with the full voltage output regardless of the speed setting; the idea is to feed a series of pulses to the loco and vary the width of the pulses to vary the power delivered. The waveform is depicted in Fig. 1(d).

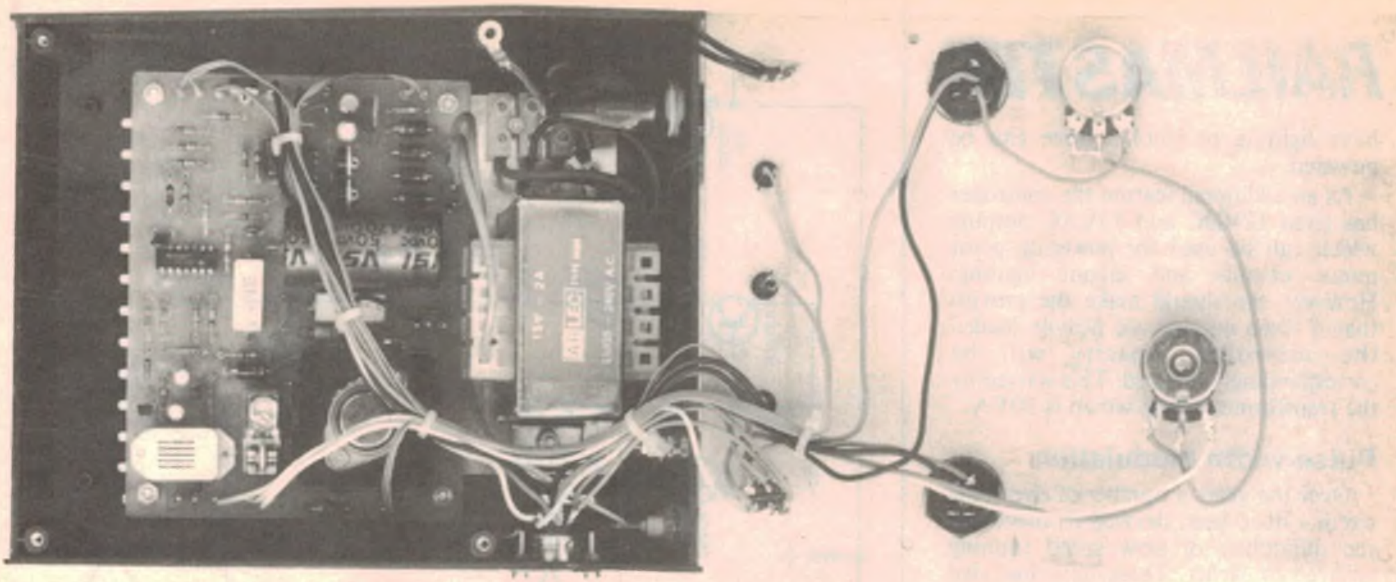
The advantage of a pulse width modulation circuit is that, even at low power settings, the voltage applied to the track is high. In this circuit, the track voltage is about 20 volts DC, depending on the load conditions. Such a high voltage is better able to overcome contact resistance and thus give much better low speed running.

Nor is the frequency of the pulses set by the 50Hz mains supply. Instead it is set at about 200Hz which gives much smoother operation with most motors.

Operating principles

Rather than try and glean the operating principles from the complete circuit, let us extract the core components instead. These are depicted in Fig. 2 and comprise IC2a and IC2b. IC2b is an op amp wired as a Schmitt trigger oscillator while IC2a is wired as a comparator.





The transformer should be mounted on a metal plate and the lid of the case earthed (see text, page 49).

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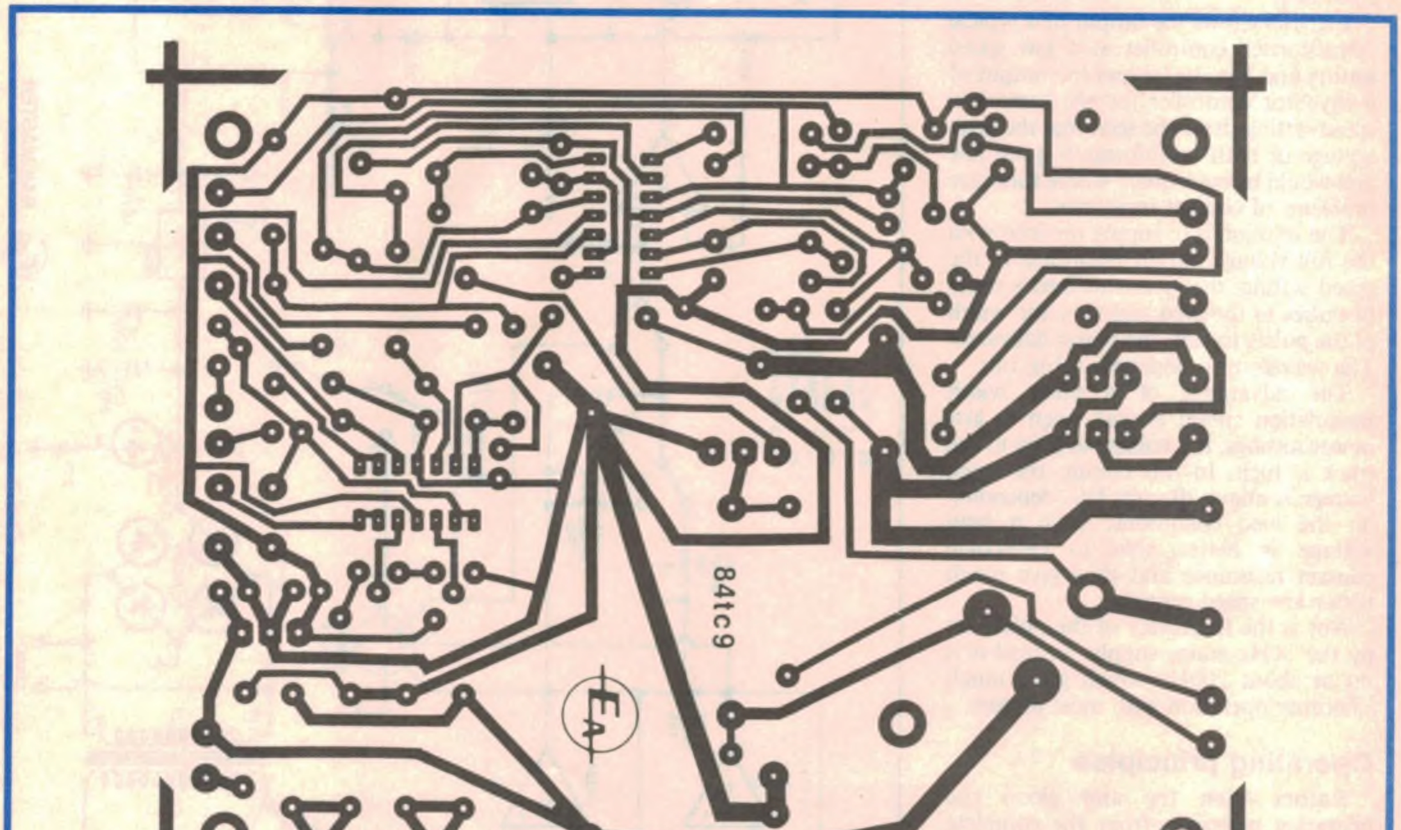
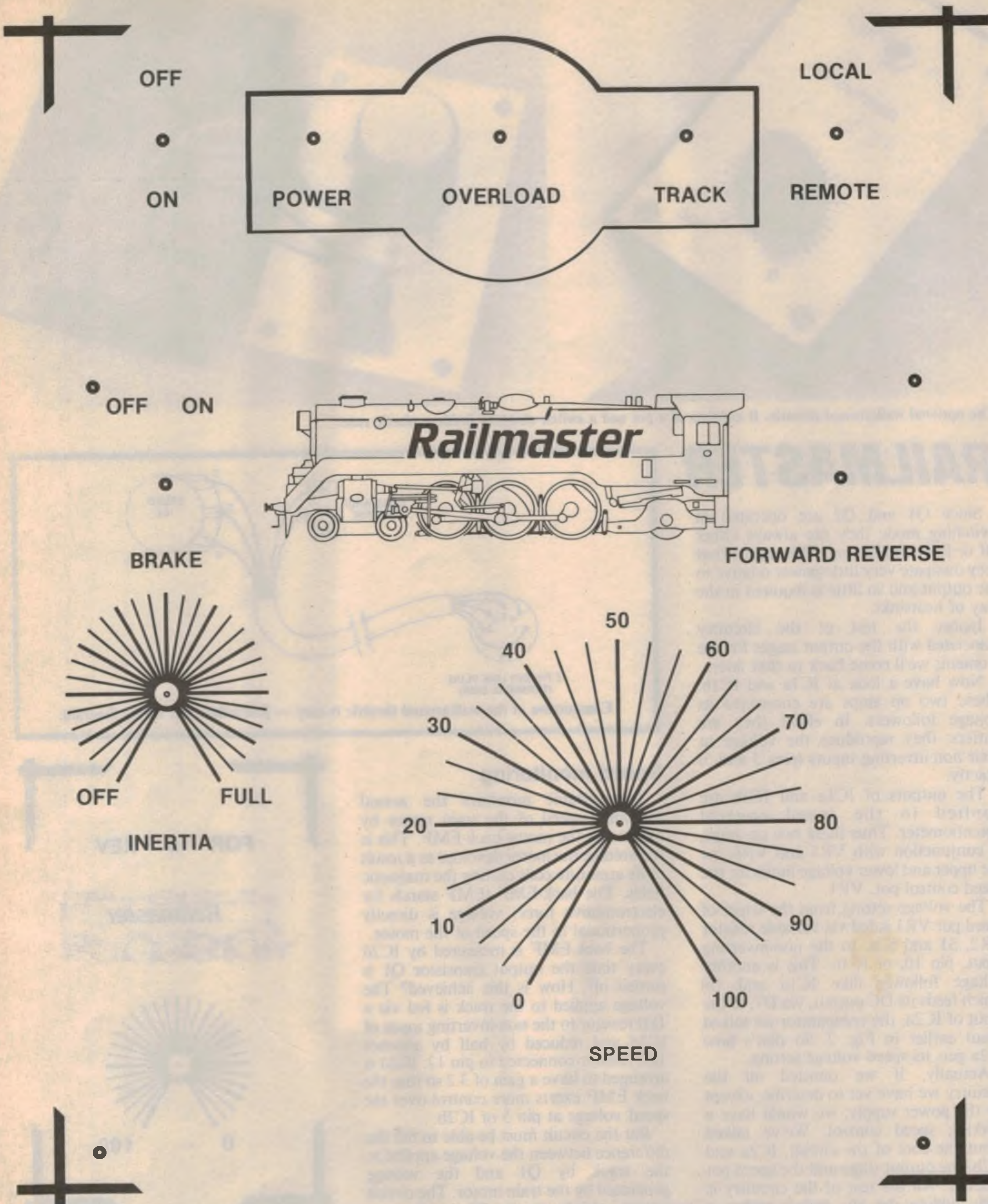
IC2b works in a simple enough fashion. C1 is alternately charged and discharged via R1 so that the waveform at pin 6 of IC2a is triangular. This waveform is fed to pin 2 of IC2a and is compared with a speed voltage (DC) at pin 3. Since IC2a is a comparator its output can only be high or low. When the voltage at pin 3 is above pin 2, the output will be high; when pin 3 is below pin 2, the output will be low.

Hence, the output of IC2a will be a series of pulses; the width of these pulses depends on how the triangular waveform "crosses" the DC speed voltage, as shown in Fig. 3. Therefore, when the speed voltage fed to pin 3 is high, the output is high most of the time and we get wide pulses. When the speed voltage is low, we get narrow pulses. These pulses are fed to the motor via a transistor buffer stage Q1 and Q2.

D6 protects Q1 against the nasty spikes generated by the train motor each



Here is an actual size artwork for the printed circuit board.

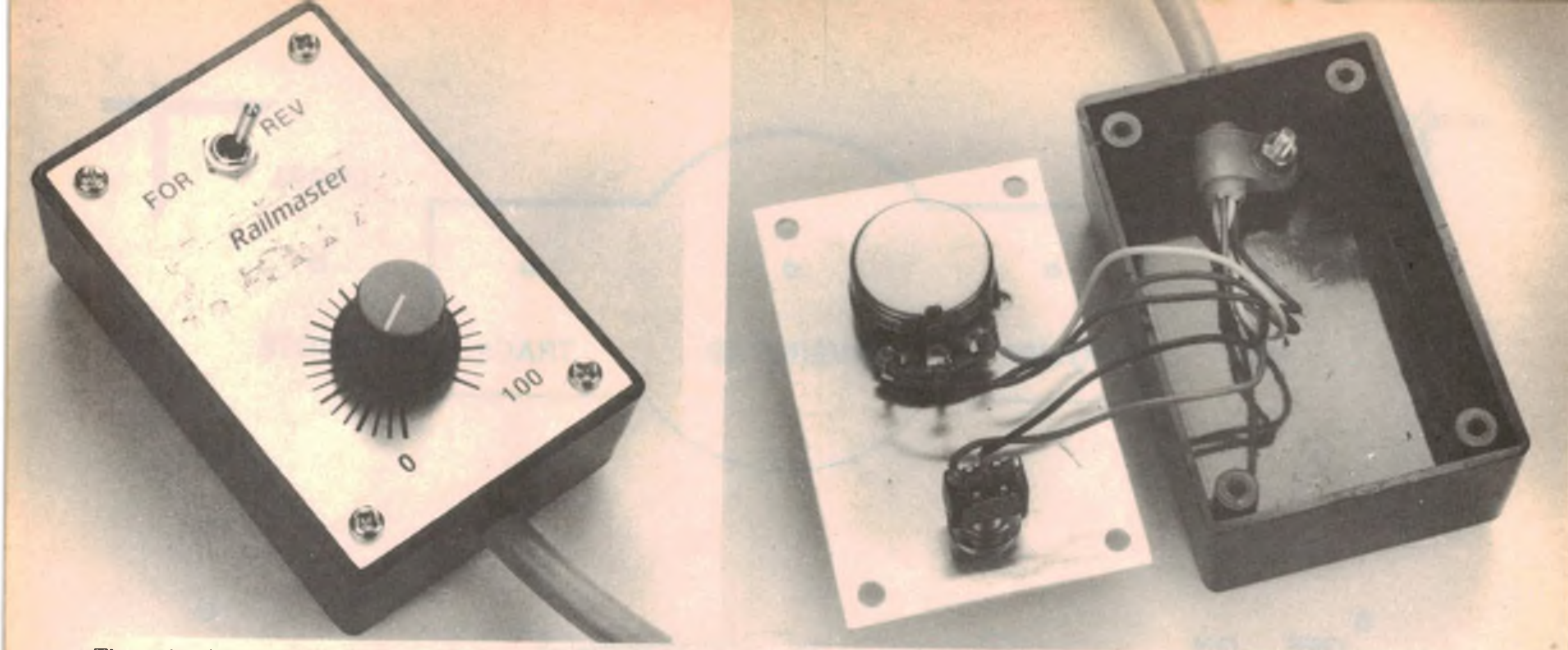


Actual size front-panel artwork. Ready-made PCBs and panels are available from parts retailers.

time Q1 is turned off. These spikes are clamped by D6 to the 0V rail.

Relating all this to the main circuit diagram may seem a big jump but don't be overawed. IC2a and 2b are slap bang in the middle of the circuit diagram, performing the same function.

The output of IC2b is fed via a 2.2kΩ resistor to Q2 which is turned on or off by the voltage pulses. In turn, it turns Q1 on or off. So the voltage pulses are fed from the collector of Q1, via D5 and the relay, directly to the rails and eventually to the train motor. Q1 and Q2 can be regarded as a switching power amplifier.



The optional walkaround throttle. It consists of a pot and a switch mounted inside a plastic case.

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Since Q1 and Q2 are operated in switching mode they are always either off or fully conducting. This means that they dissipate very little power relative to the output and so little is required in the way of heatsinks.

Ignore the rest of the circuitry associated with the output stages for the moment; we'll come back to that later.

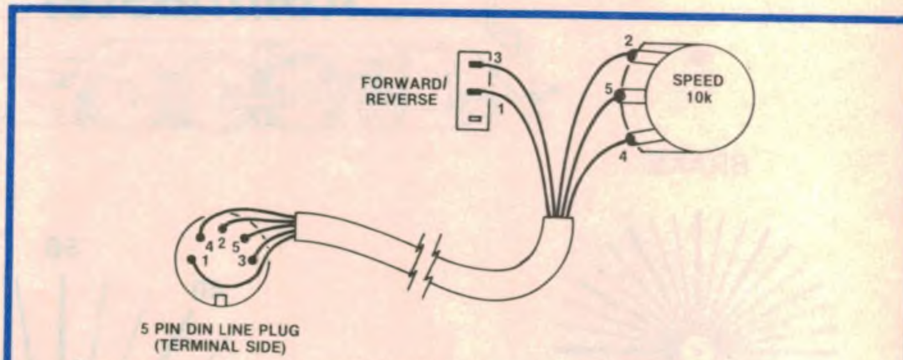
Now have a look at IC1a and IC1b. These two op amps are connected as voltage followers. In effect they are buffers; they reproduce the voltage at their non-inverting inputs (pins 3 and 5) exactly.

The outputs of IC1a and IC1b are applied to the speed control potentiometer. Thus these two op amps, in conjunction with VR5 and VR6, set the upper and lower voltage limits for the speed control pot, VR1.

The voltage setting from the wiper of speed pot VR1 is fed via variable resistor VR2, S1 and S2a, to the non-inverting input, pin 10, of IC1c. This is another voltage follower (like IC1a and 1b) which feeds its DC output, via D7, to the input of IC2a, the comparator we talked about earlier in Fig. 2. So that's how IC2a gets its speed voltage setting.

Actually, if we omitted all the circuitry we have yet to describe, except for the power supply, we would have a working speed control. We've talked about the core of the circuit, IC2a and IC2b, the output stage and the speed pot circuitry. All the rest of the circuitry is really gilding the lily, but it makes it work a lot better.

A LED connected across the 120Ω collector load resistor for Q2 gives a visible indication of the voltage being applied. It is quite progressive in effect and a useful feature of the controller.



Constuction of the walkaround throttle is easy — just follow this wiring diagram.

Speed monitoring

This circuit monitors the actual rotational speed of the train motor by measuring the motor back-EMF. This is the voltage the motor develops as a result of its armature coils cutting the magnetic fields. The back-EMF (EMF stands for electromotive force) voltage is directly proportional to the speed of the motor.

The back-EMF is measured by IC2d every time the output transistor Q1 is turned off. How is this achieved? The voltage applied to the track is fed via a 1kΩ resistor to the non-inverting input of IC2d and reduced by half by another 1kΩ resistor connected to pin 12. IC2d is arranged to have a gain of 3.2 so that the back EMF exerts more control over the speed voltage at pin 5 of IC2b.

But the circuit must be able to tell the difference between the voltage applied to the track by Q1 and the voltage generated by the train motor. The circuit achieves this by turning Q4 on whenever Q1 is on. This means that whenever Q1 is applying voltage to the track, Q4 is turned hard on and thereby prevents any voltage being fed to the input of IC2d.

Diode D5 is required to isolate the collector of Q1 from the train load. If D5

This artwork for the walkaround throttle fits a standard UB5 zippy box (28 x 54 x 83mm).

was not included, Q4 would be turned on by the motor back-EMF and thus defeat its purpose. The result of Q4 turning on

Continued on page 47

What's new in electronics distribution today?

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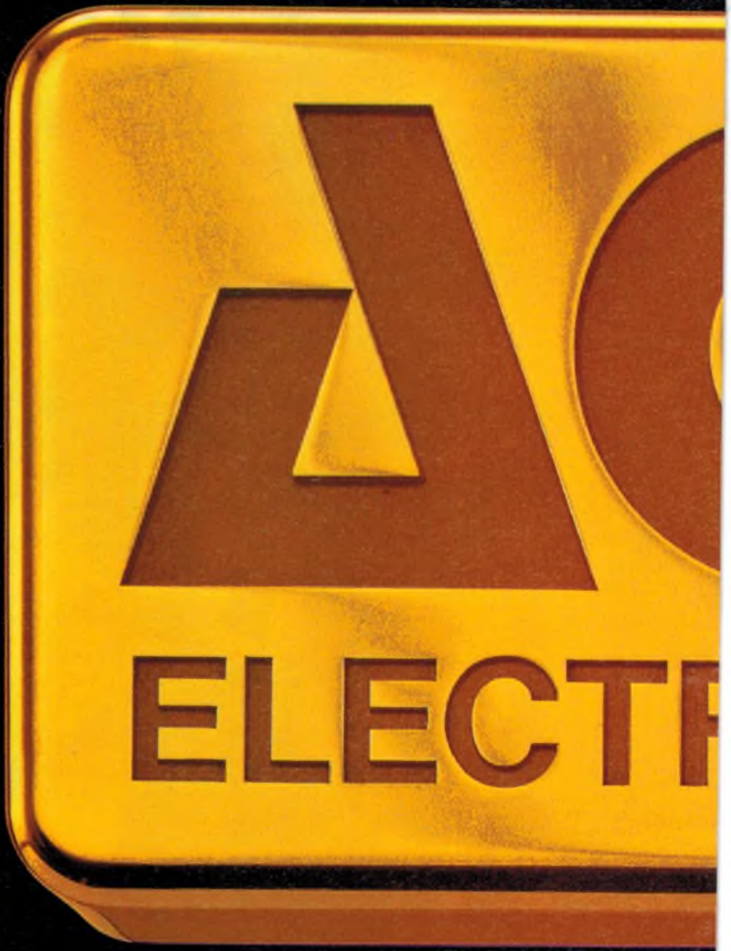
Impressive track record in the industry since he gained college qualifications in Electronics and Communications. From Purchasing Officer in Mining and Manufacturing, spent 11 years with AWA and EMI in electronics, and a further 9 years with RIFA as a sales representative before joining Ace Electronics.



LYNNE LEVERTON
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NARELLE BOWER
Hails from Dubbo and, post studies at a metropolitan business college, gained 3 invaluable years experience in customer liaison with an import, manufacturing and distribution company as a Secretary and Administrator.

SUE TINYOW
A Sydney Accountancy student with already more than 4 years experience with import and export companies in the electronics industry. Handles Ace Electronics extensive stock control and other computerised systems like a veteran.

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whenever Q1 turns on is that the output of IC2d is a pulse waveform. This is filtered to produce pure DC by a 22kΩ resistor and 2.2μF capacitor.

This DC voltage is then fed to the non-inverting input, pin 5, of IC2b, to effectively raise its DC reference voltage level. This has the effect of raising the overall DC level of the triangular voltage waveform at the output of IC2b, pin 7. When this "raised" triangular waveform is fed to the comparator, IC2a, the effect is to reduce the pulse width output.

So that is how the circuit provides good speed regulation. It measures the back-EMF of the motor; if the speed is tending to rise the pulse width output will be reduced and so bring the speed back to the desired setting.

Short circuit protection

As already mentioned, there are several short-circuit protection features. Two op amps are involved: IC1d and IC2c, both wired as comparators.

The current pulses drawn by the motor are sensed by the 0.1Ω/5W resistor connected to the anode of D6. These pulses are fed to IC1d via a 10kΩ resistor and filtered by a .01μF capacitor to obtain a small DC voltage at pin 13.

This voltage is compared with the voltage appearing at pin 12 of IC1d. Normally, pin 12 will be above pin 13 and the output of IC1d will be high and so nothing will happen. But if an overload occurs, large pulses will occur across the 0.1Ω/5W resistor. This will develop a relatively large voltage at pin 13 and so the output of IC1d will suddenly go low. This does several things:

First, D8 conducts and pulls down the reference voltage on pin 3 of IC2a. This greatly reduces the output pulse width and thereby prevents very large short-circuit currents from flowing. Note that this does not totally remove the output from the track — it reduces it.

Second, IC1d turns on the overload LED which also discharges the capacitor at pin 10 of IC2c. This causes the output of IC2c to go low and turn on Q3 which energisers the buzzer, a piezolectric device with inbuilt circuitry.

Inertia and braking

Now let's return to the speed control potentiometer and associated circuitry. Inertia is provided by VR2, a 1MΩ pot wired as a variable resistor. Depending on the setting of VR2, the voltage from the speed pot VR1 will build up gradually on the 47μF capacitor and so too will the speed voltage from IC1c which is fed to IC2a.

Braking is provided by VR3 and S1. When S1 is switched into circuit, VR3 discharges the 47μF capacitor at a rate dependant on its setting.

Note the use of a relay to provide the forward and reverse function. If it were not for the need for a walkaround throttle, the relay could be replaced by a double-pole double-throw switch (DPDT) of suitable current rating. Since a relay is used, there are two forward/reverse switches, S3 on the main control console and a remote SPST (single-pole, single throw) switch in the walkaround throttle. One or other of these switches is selected by S2b.

> We estimate the current cost of parts for this project to be
>
> **$75 – $80**
>
> This includes sales tax.

Walkaround throttle

The walkaround throttle or handheld speed control is brought into circuit by the double pole switch S2 (local/remote). S2a switches out the inbuilt speed controls (ie, VR1, VR2 etc) and switches in the external speed control which may be a simple pot like VR1 or may duplicate the entire inertia and braking features.

Note that if more than one walkaround throttle socket is required on the layout they can be simply wired in parallel.

Power supply

The power supply uses a mains transformer with a 15V/2A secondary to drive a bridge rectifier and 4700μF filter capacitor. This provides about 20 to 22VDC, depending on the total load, and this unregulated DC is fed to the output stage Q1 and to a three-terminal 12V regulator. The 12V DC feeds all the circuitry with the exception of Q1.

Op amp peculiarities

Before leaving the circuit description we should point out a feature of the op amps used, the LM324 quad types. This quad op amp has been used for several reasons. First, its inputs can be connected directly to the negative supply rail. This feature is used in the current sensing amplifier IC1d and in the back-EMF amplifier, IC2d.

Second, when operated as a comparator, the output of the op amp

PARTS LIST

- 1 PCB, code 84tc9, 107 × 140mm
- 1 Scotchcal front panel, 216 × 166mm
- 1 console box 170 × 214 × 32 × 82mm (W × D × HF × HR)
- 1 mains transformer, 15VAC at 2A, Arlec 5504 or equivalent
- 1 relay, 12V/200Ω DPDT 5A contacts (DSE Cat No. S-7130)
- 2 paddle switches (DSE S1393)
- 1 SPDT mains toggle switch
- 1 DPDT toggle switch
- 1 3AG panel mount fuse holder and 250mA fuse
- 6 binding post terminals, 2 green, two white, 1 black and 1 red
- 1 3-way mains terminal block
- 1 1-metre length of mains cord and plug
- 1 mains cord grommet
- 1 mains cord clamp
- 1 mini buzzer
- 1 heatsink, 50mm square × 25mm high drilled for TO-3
- 1 6-pin panel mount DIN socket
- 2 knobs
- 2 solder lugs
- 4 6mm standoffs
- 1 piece of aluminium sheet, 120 × 60mm
- 25 PC stakes

Semiconductors

- 3 5mm red LEDs plus bezels
- 2 LM324 quad op amps
- 1 7812 3-terminal positive 12V regulator
- 6 1N5404 3A rectifier diodes
- 2 1N914, 1N4148 diodes
- 1 MJ2955 PNP power transistor
- 1 BD139 NPN transistor
- 1 BC327 PNP transistor
- 1 BC337 NPN transistor

Capacitors

- 1 4700μF/35VW axial electrolytic
- 1 47μF/16VW RBLL (low leakage) electrolytic
- 1 10μF/35VW PC electrolytic
- 1 10μF/16VW PC electrolytic
- 1 4.7μF/16VW PC electrolytic
- 1 2.2μF PC electrolytic
- 1 0.1μF metallised polyester
- 1 .01μF metallised polyester
- 1 .0082 metallised polyester

Resistors (¼W, 5% unless stated)

1 × 560kΩ, 1 × 220kΩ, 1 × 150kΩ, 2 × 120kΩ, 4 × 100kΩ, 1 × 27kΩ, 1 × 22kΩ, 2 × 15kΩ, 1 × 10kΩ, 1 × 5.6kΩ, 1 × 3.9kΩ, 2 × 2.2kΩ, 3 × 1kΩ, 2 × 470Ω, 1 470Ω 1W, 1 × 120Ω 5W, 1 100Ω, 1 × 0.1Ω 5W, 1 × 1MΩ linear potentiometer, 1 × 10kΩ wirewound potentiometer, 1 × 220kΩ miniature vertical trim pot, 2 × 100kΩ miniature vertical trimpots.

Miscellaneous

Screws, nuts, heatshrink, tubing, solder, assorted hook-up wire.

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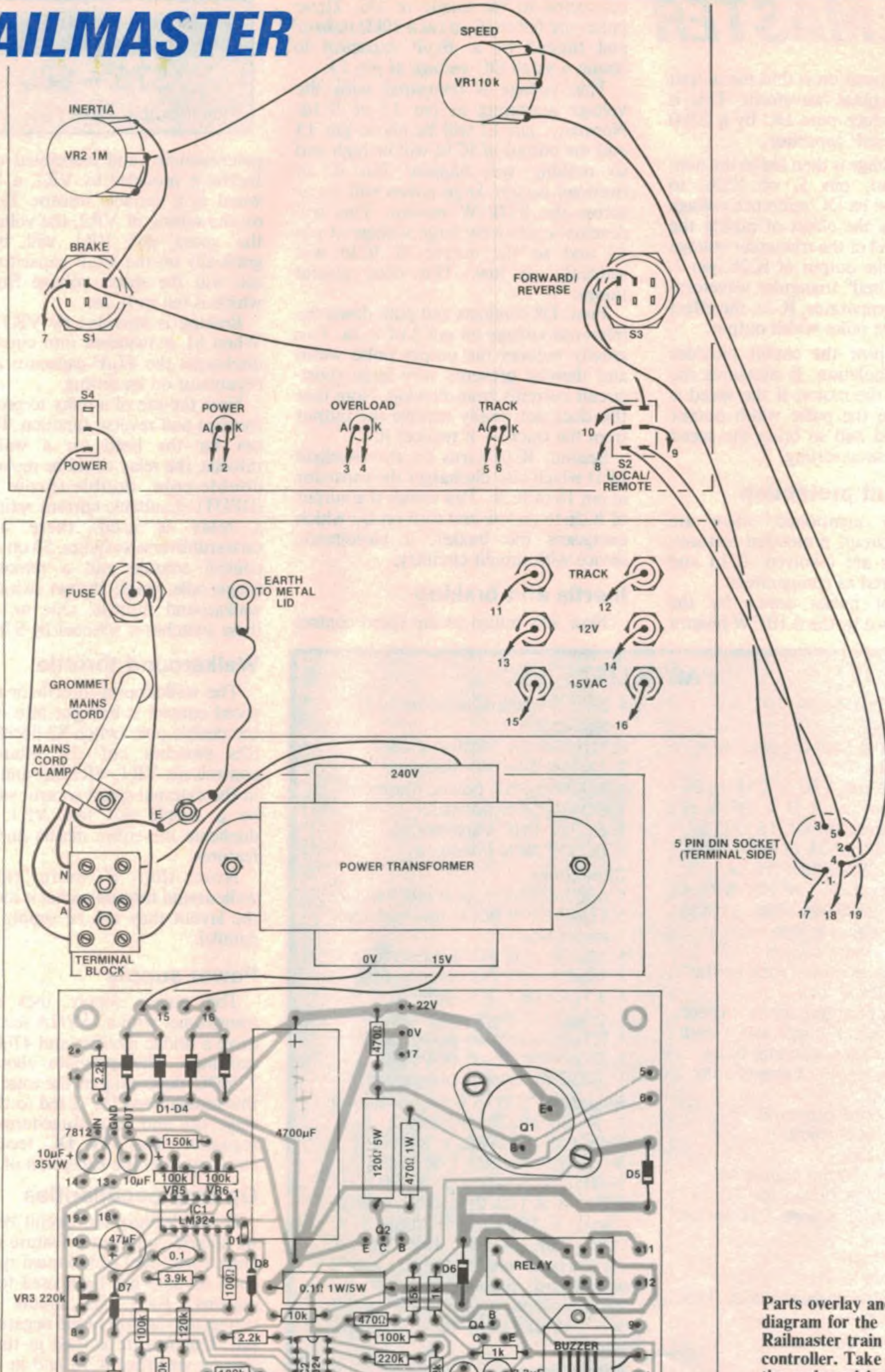

Parts overlay and wiring diagram for the Railmaster train controller. Take care with the mains wiring.

will go to either rail potential. This feature is used in the overload buzzer driver, IC2c and in the driver for Q2, IC2a.

Construction

The Railmaster controller is housed in an attractive sloping front case with aluminium lid. We have produced artwork for the lid which features a representation of one of the most popular steam locos, the NSW "Pacific" class C.38. Lest readers in other states feel disgruntled, we should point out that all Australian states had Pacific class locos at some time during the steam era.

The console case is available in blue, grey or black and measures 170mm wide and 214mm deep. It is available from Jaycar stores.

All the circuitry, with the exception of switches, potentiometers and LEDs, is accommodated on a printed circuit board measuring 107 x 140mm and coded 84tc9.

No special procedure need be followed when assembling the PC board although we suggest that small components be installed first. Leave the larger components such as the 4700μF filter capacitor, buzzer, relay, power transistor and heatsink till last.

Note carefully the orientation of diodes, transistors, electrolytic capacitors and semiconductors when they are being installed. Note that D5 and D6 should be 1N5404 types, to give a generous current rating.

The two wirewound 5W resistors should be raised slightly off the PC board to avoid the possibility of charring if they are overheated. Normally this should not happen.

The buzzer may be secured by two small self-tapping screws or with double-sided adhesive tape.

No heatsink is required for the three-terminal regulator if it is merely used to power the internal circuitry of the controller. If additional load is connected, a flag heatsink may be required.

We suggest the use of PC stakes to make the job of connecting leads to the board easy.

The MJ2955 must be fitted with a heatsink. We used a multiple-finned type which is supplied ready drilled for TO-3 transistors. No mica washer is required but heatsink compound should be smeared on the transistor mounting surface before assembling.

When the PC board is completely assembled, your attention can be turned to the console box. This should be drilled to take all the hardware before the components are installed. Similarly, the Scotchcal panel, if used, should be attached to the lid before the panel is drilled.

Myths of pulse power

Some rail modelling enthusiasts are not keen on the concept of "pulse power". They claim that it makes motors run hot and can lead to burnouts. In theory this is right but in practice it does not matter.

The torque developed by a permanent magnet motor is directly proportional to the average current whereas the heat dissipation in the motor is proportional to the RMS current. On this basis, the amount of heat produced at a given speed setting on a pulse DC supply will be higher than for the same speed setting from a pure DC supply.

However, virtually all commercial train controllers do not use pure DC. They use rectified but unfiltered DC. So the difference in motor power dissipation between an unfiltered DC supply and this pulse-width modulated supply is small. Nor is there any likelihood of motor burnout unless the gear system is binding. Under this latter condition there is a danger of motor burnout even with a pure DC supply.

Do not apply full power to a loco which is stalled. (Sometimes the gears do bind). This would invite a motor burnout.

Some commercial train controllers have had a "pulse power" feature whereby the motor is fed with half-wave rectified DC. This is a crude system whereby the peak voltage applied to the motor is higher for a given setting than for a full-wave rectified DC. This system also makes the motor and gearbox very noisy.

The Railmaster pulsed output will become audible with some locos but this depends on the quality and amount of wear in the motor and gearbox train. Sometimes the loco can be adjusted to minimise this noise which is really only evident at low speed settings.

The three LEDs were affixed to the panel using bezel mounts made for the purpose. The large paddle switches are available from Dick Smith Electronics (Cat No. S-1393). We used a red paddle for the brake switch and a white paddle for the forward/reverse switch. They have the advantage that they are easy to mount, requiring a round hole with a small locating notch.

We used a wirewound pot for the main throttle control. This has a smaller "dead band" than carbon pots and thus gives a more progressive control action.

The transformer should be mounted on a metal plate measuring about 120 × 60mm. The three-core power flex should be brought through a grommetted hole in the rear of the console and secured with a suitable cord clamp. The active and neutral wires should be terminated in a three-way terminal block, as per the wiring diagram. The mains earth wire should be connected to the metal plate mentioned above and the case lid.

Sleeving should be pushed over the mains fuseholder after wiring it. This prevents accidental contact with the mains while the unit is being worked on. All the rest of the wiring details can be obtained from the accompanying wiring diagram.

Setting up

When the assembly has been finished and double-checked you are ready to apply power but don't, whatever you do, connect a train at this stage.

Check all the voltages shown on the circuit diagram and verify that they are in the right ball park, ie, within ±10% of marked values.

Now advance the throttle fully clockwise and adjust VR5 to give a DC voltage reading (using an analog or digital multimeter) across the output terminals of no more than 12V DC. Note that this is actually a pulsed DC waveform with a peak value of about 20V DC.

Now rotate the throttle anticlockwise and check that the output voltage decreases progressively towards zero. The actual zero setting can be adjusted by VR6. This should be adjusted so that, with the throttle at minimum setting, there is a very slight voltage of, say, 0.5V DC. This value can be decided finally when you run trains with the controller.

All the other controller features should be checked, including the short circuit protection. Even on brief short circuits the buzzer should sound and the overload LED should light.

Note that the buzzer will sound briefly at switch-on because of the charging time for the 4.7μF capacitor at pin 10 of IC2c.

As an audible check on the operation of the Railmaster you can listen to its output via a loudspeaker and a 100Ω resistor. Do not connect the loudspeaker directly across the output otherwise you will be deafened by the racket. You will also run the risk of damaging the voice coil.

At low throttle settings the speaker should give out a "thin, spiky" sound which becomes louder and more mellow as the throttle is advanced.

Now connect the unit to the track of your layout and run your trains to your heart's content.

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A service to the Professional

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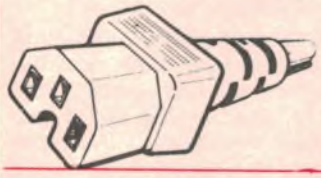

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For technical details see the latest Jaycar catalogue - page 19.
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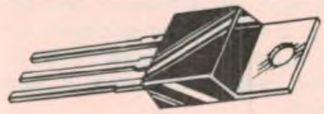

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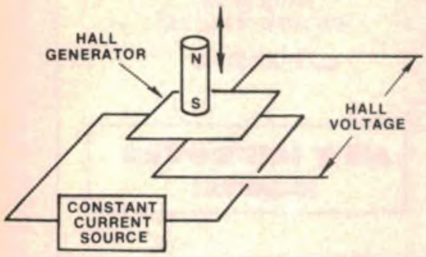


FIG. 1: HALL EFFECT PRINCIPLE

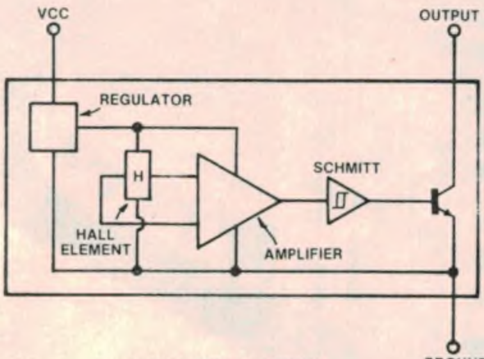


Fig. 2 HALL EFFECT SWITCH

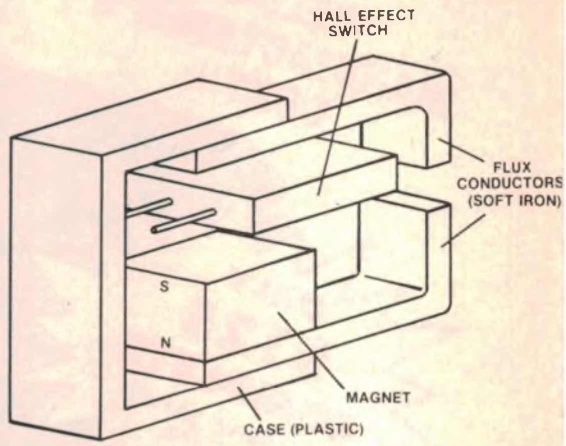


Fig. 3

by JOHN CLARKE

Breakerless ignition for your car

Designed specifically for Australian-made cars, this breakerless ignition system employs a commercial Hall Effect trigger and rotating vane assembly. It can be used with both transistor switched and capacitor discharge systems.

In December last year we provided details of a Hall Effect trigger modification for the EA Transistor Assisted Ignition and CDI units. This utilised a Hall Effect distributor kit made by EDA Sparkrite of the UK and marketed by Jaycar. Although the modification proved very popular, it had the drawback that it was not suitable for many Australian-made four, six and 8-cylinder vehicles, including the much beloved Holden Kingswood.

This dreadful omission has now been rectified with our new breakerless ignition system. It is suitable for most Holden, Ford, Chrysler and some Japanese makes which use Bosch, Delco, Lucas, Disilea, Nippon Denso and various other distributors. Included are typical Australian six and 8-cylinder cars, as well as most of the popular 4-cylinder models.

The basic mechanical concept is simple. It is based on a Hall Effect vane switch manufactured by Siemens of West Germany, and a rotating vane assembly from Bosch Australia. The Siemens device comprises both a Hall sensor and integral magnet in a slotted plastic housing which mounts in place of the contact points.

The Bosch rotating vane assembly replaces the original rotor button in the distributor. It contains a rotor button and soft iron vanes. The vanes are spaced equally and pass between the magnet and Hall effect sensor. This, in turn, provides appropriate pulses to the following electronic ignition circuitry.

The Siemens vane switch is stocked by Jaycar while the Bosch rotating vane assembly is available from Bosch automotive retail outlets such as Bennet and Wood and Repco. The latter is actually used in the Bosch Electonic Ignition system and is sold separately for about $30. Before embarking on this project, readers are advised to contact their local Bosch outlet and verify that a rotating vane assembly can be supplied to suit their particular type of vehicle.

Installation of the rotating vane assembly is very simple — just remove your rotor button from the distributor and replace it with the rotating vane assembly. It is located and held in exactly the same manner as the original rotor button.

The Hall Effect sensor, however, requires several hours of work to install. This mainly involves the fashioning of a suitable mounting plate for the vane switch, which is located on the vacuum advance plate of the distributor. It must be located so that the rotating vane assembly passes through the slot of the sensor without scraping (see installation).

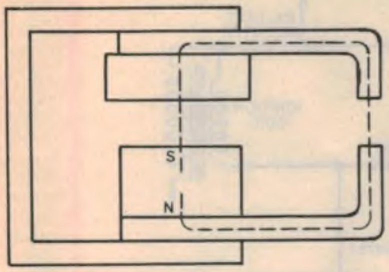
When complete, you will have the many advantages available from solid state triggering. Once set the ignition timing will always be correct. It will not vary due to the gradual wearing down of the contact breaker rubbing block and there will be no "timing scatter" due to distributor cam wobble or wear in the bearings. The engine should also run noticeably smoother, especially at idle speeds.

The Hall Effect

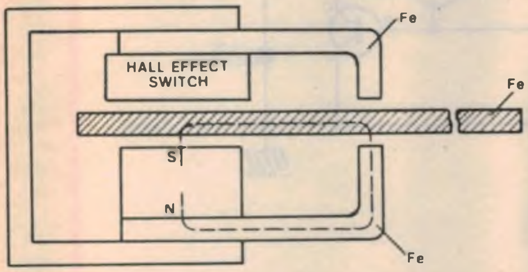
What is the Hall Effect?

The Hall Effect sensor principle is shown in Fig. 1. It consists of a thin strip of semiconductor material through which a current is passed. When a magnet is brought near, such that its field is directed at right angles to the face of the semiconductor, a small voltage appears at the contacts placed across the narrow dimensions of the strip. As the magnet is removed the voltage drops to zero.

A practical Hall Effect device is depicted in Fig. 2. This comprises a voltage regulator, a Hall cell, an



(a) MAGNETIC FLUX THROUGH THE HALL EFFECT SWITCH WITH NO VANE IN GAP



(b) MAGNETIC FLUX SHUNTED BY FERROUS VANE

Fig. 4

amplifier connected across the Hall cell, and a Schmitt trigger which drives an open collector transistor.

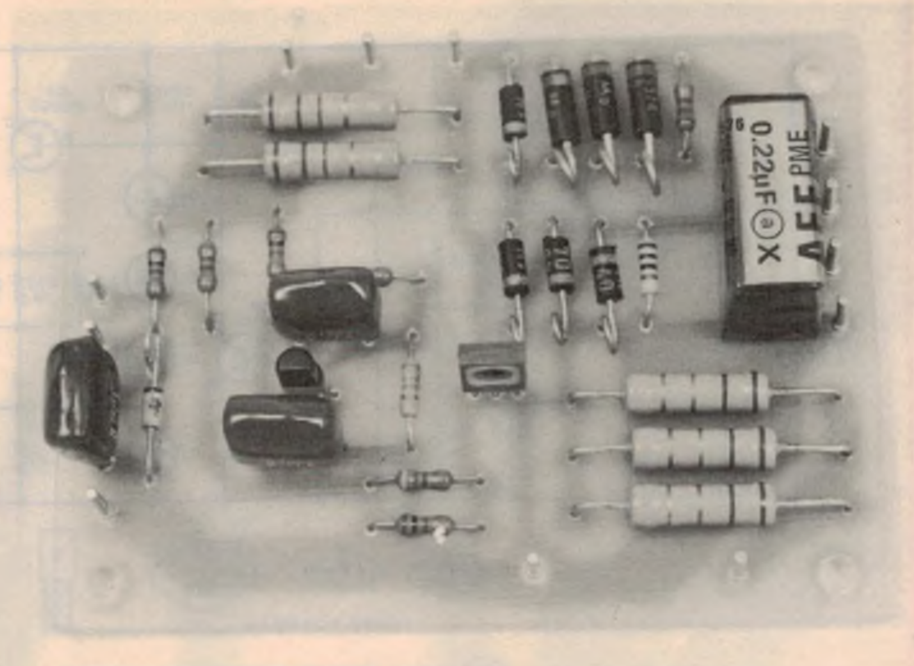
Fig. 3 shows the general construction of the Siemens Hall Effect sensor. A Hall Effect device similar to that of Fig. 2 is positioned near a permanent magnet. Magnetic flux conductors made of soft iron extend out from the magnet and the Hall Effect device to create a magnetic flux path.

Fig. 4 shows how the rotating vane assembly is used to interrupt the flux path to the Hall Effect device. When there is no vane in the air gap, the magnetic flux passes through the Hall Effect device and switches on its internal transistor. When the vane is present, the flux path is shunted away from the Hall Effect device and the output transistor switches off.

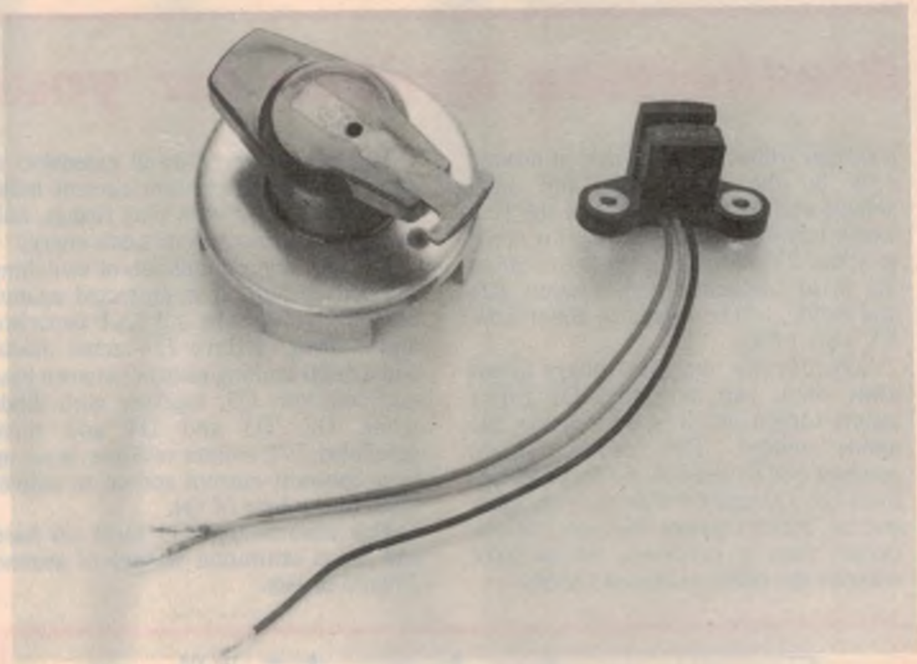
The Siemens device, designated HKZ101, is rated from −30 to 130°C and can sink up to 40mA. It is hermetically sealed, resistant to petroleum products, and incorporates two tubular rivets to facilitate mounting onto a carrier plate. Three flexible leads provide the power supply and output connections.

The circuits

Two circuits are shown, one using the Hall Effect sensor to trigger the Transistor Assisted Ignition first described in December 1979 and subsequently updated in February 1983, and the other showing adaptation for the Capacitor Discharge Ignition first described in July 1975. We shall discuss the modification to the Transistor Assisted Ignition first.



View of the assembled PCB. Note the shock relieving loops in the diode leads.



New distributor parts: Bosch rotating vane assembly (left) and Siemens Hall Effect sensor.

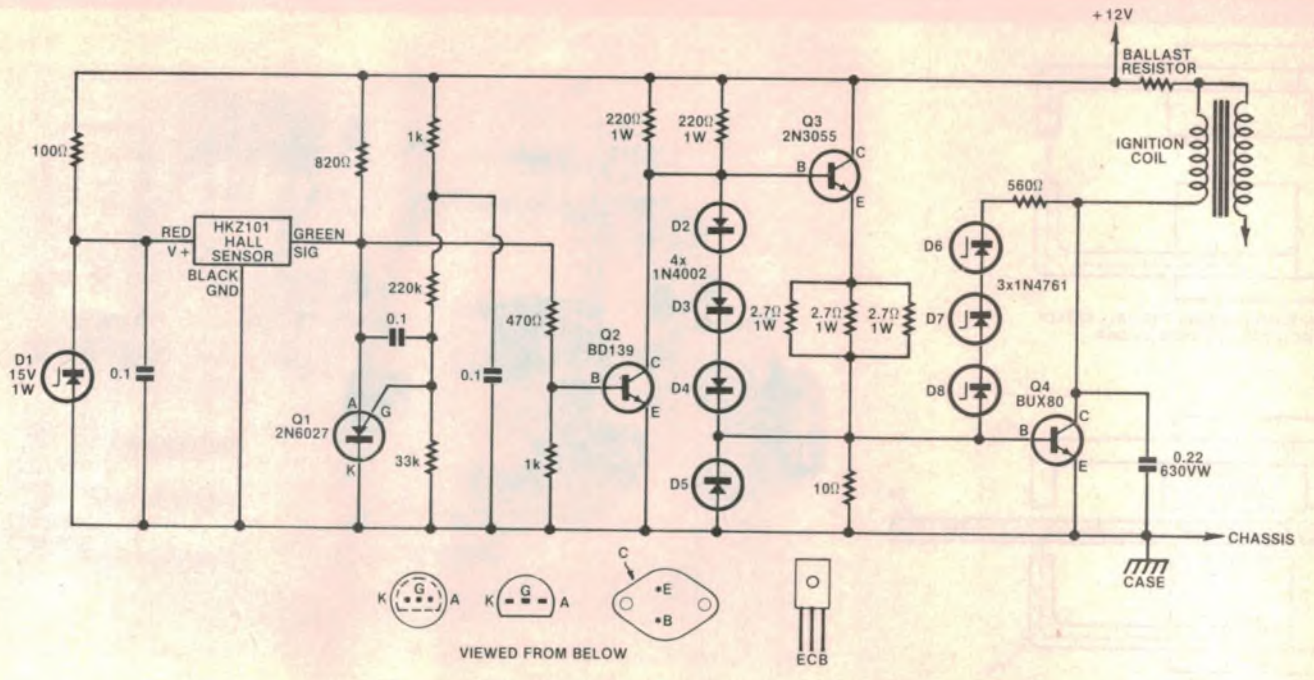
D1 is a 15V zener diode which protects the Hall sensor from the high voltage spikes that are normally evident in an automotive electrical system. The 100Ω resistor from the 12V rail and the 0.1μF capacitor in parallel with D1 provide the necessary decoupling of the supply.

With no iron vane in the Hall sensor air gap, the output of the sensor is low and so Q2 is off. This, in turn, means that Q3 and Q4 are conducting and current is flowing through the ignition coil.

When an iron vane subsequently moves into the air gap, the Hall sensor turns off and transistor Q2 turns on by virtue of current flow via the 820Ω and 470Ω resistors. This turns off Q3 and Q4 which allows the coil to fire the spark plug.

Q2 does not remain in conduction for the entire time that the Hall sensor is off, however. This is because of the dwell extension feature provided by programmable unijunction transistor (PUT) Q1. This operates as follows:

When the Hall sensor output is low, the anode of Q1 is held close to chassis



HALL EFFECT TRANSISTOR IGNITION

Breakerless ignition for your car

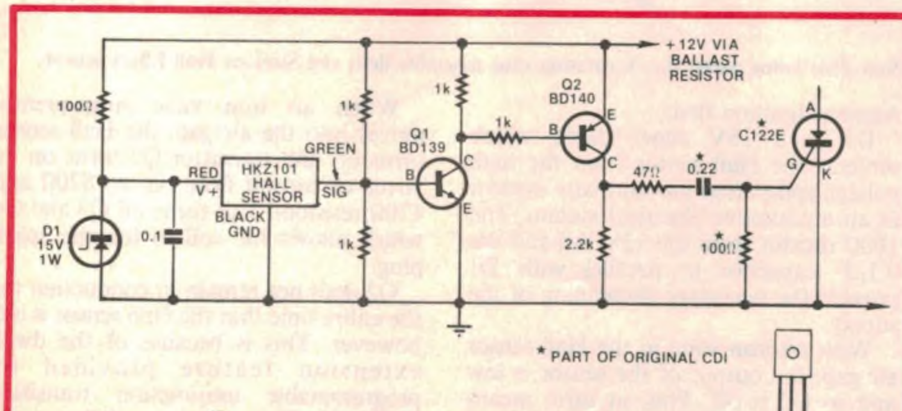
potential while its gate is held at around 1.6V by the 1kΩ, 220kΩ and 33kΩ voltage divider network. When the Hall sensor turns off, the anode of Q1 is raised to about 5V while the gate, by virtue of the 0.1μF capacitor tied between gate and anode, will be forced to about 6.6V (5V plus 1.6V).

Subsequently, the gate voltage bleeds away until, 1ms after the Hall Effect sensor turned off, it is 0.6V below the anode voltage. This causes Q1 to conduct and so remove the forward bias from Q2. Q3 and Q4 thus turn on again and so current passes through the coil earlier than it otherwise would have without the dwell extension facility.

The advantage of dwell extension is that it ensures maximum current build up in the coil between plug firings, and thus a useful increase in spark energy.

Q4 does the arduous job of switching the coil current. It is protected against excessive voltages by a 0.22μF capacitor and a string of three 75V zener diodes and a 560Ω limiting resistor between base and collector. Q3, together with diode string D2, D3 and D4 and three paralleled 2.7Ω emitter resistors, is set up as a constant current source to deliver 1.3A to the base of Q4.

This ensures that Q4 turns on hard and has a saturation voltage of around 300mV or less.



HALL EFFECT TRIGGERING FOR CDI

The only remaining components requiring comment are diode D5 and the parallel 10Ω resistor. The resistor effectively ties the base of Q4 to its emitter and thus improves its ability to withstand high voltages. D5 protects the base-emitter junction against reverse biasing.

The CDI version

As mentioned in the February 1983 issue, we no longer recommend Capacitor Discharge Ignition (CDI). It has a nasty tendency to make the engine crossfire and in any case, the spark duration is too short for modern engines fitted with anti-pollution gear. For those CDI stalwarts who fail to be convinced, we have developed an adapter circuit for the CDI published in our July 1975 issue.

As with the Transistor Assisted Ignition, the Hall sensor is zener protected and the supply is decoupled using a 100Ω resistor and a 0.1μF capacitor. With no iron vane in the air gap, the signal output of the sensor is low and Q1 and Q2 are off.

When an iron vane moves into the air gap, the Hall sensor switches off and Q1 turns on. This turns on Q2 which delivers a pulse of current to the gate of the SCR via the 0.22μF capacitor, thereby triggering the SCR (C122E) into conduction.

The remainder of the CDI circuit functions as described in July 1975.

TAI Adapter kit

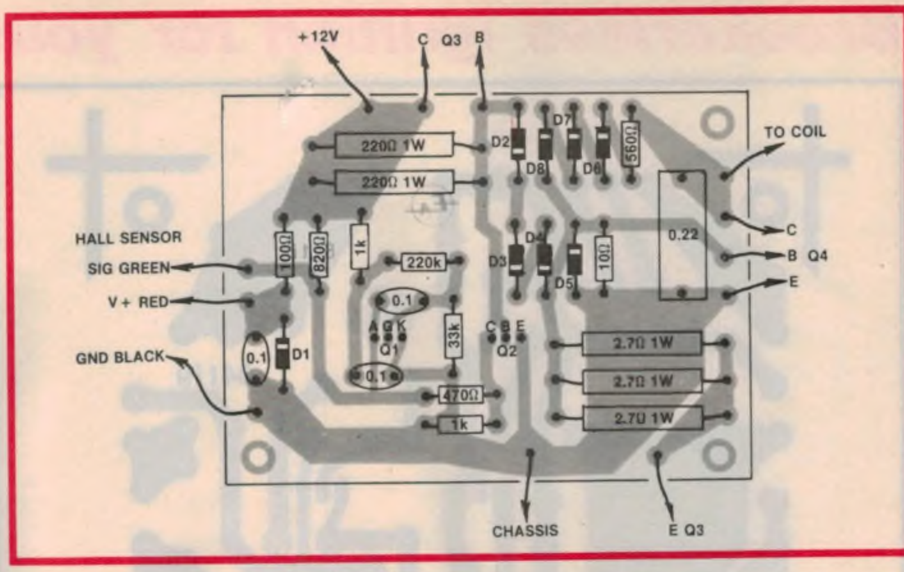
1 Hall Effect vane switch, Siemens HKZ101 (Jaycar)
1 Rotating vane assembly (Bosch, see text)
1 printed circuit board, code 84ti9, 93 x 69mm
1 15V 1W zener diode
1 0.1μF metallised polyester capacitor

Resistors (¼W, 5%)
1 x 220kΩ, 1 x 33kΩ, 1 x 820Ω, 1 x 470Ω, 1 x 100Ω

CDI Adapter kit

1 Hall Effect vane switch, Siemens HKZ101 (Jaycar)
1 Rotating vane assembly (Bosch, see text)
1 piece of stripboard (see text)
1 15V 1W zener diode
1 0.1μF metallised capacitor
1 BD139 NPN transistor
1 BD140 PNP transistor

Resistors (¼W, 5%)
1 x 2.2kΩ, 4 x 1kΩ, 1 x 100Ω, 1x 47Ω



Construction

As far as construction of these circuits is concerned, we have developed a PCB (code 84ti9, 93 x 69mm) for adapting the transistor ignition to Hall Effect triggering. Some readers, however, may prefer to modify their existing PCB by removing the unwanted parts and stringing the new parts across convenient vacant positions.

For the CDI version, we will leave it to readers to add the extra circuitry using Veroboard or matrix board.

The new Transistor Assisted Ignition PCB is very similar to the previous PCB and is only modified for the input circuitry. Consequently, readers will find it easy to remove the components from the old PCB and install them on the new PCB without changing lead spacings.

Follow the parts overlay diagram carefully and make sure that all polarity conscious components are correctly oriented. Note the heat expansion and shock relieving loops in the diode leads (see photograph of PCB).

The remainder of the construction is exactly as detailed in the February 1983 issue.

Modifying the distributor

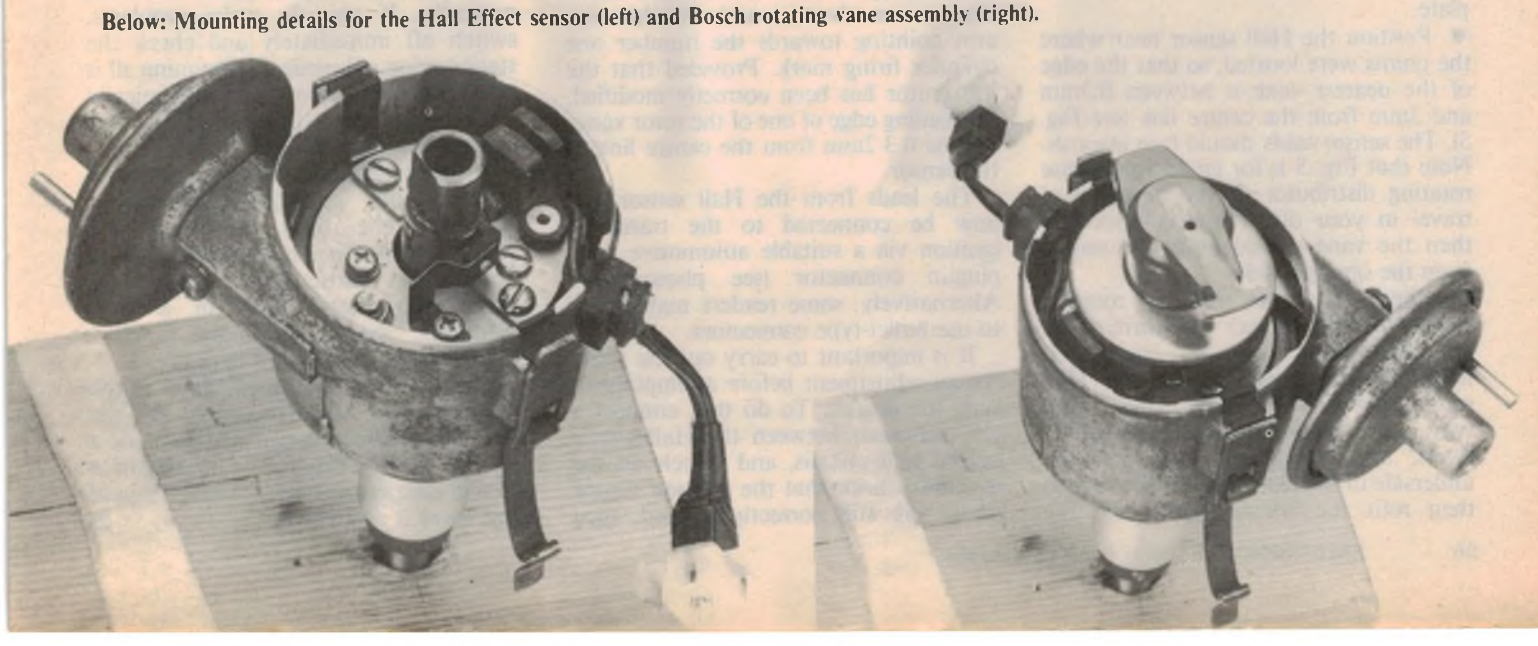
The job of modifying the distributor is straightforward enough. What you have to do is remove the points and the existing rotor button, and replace them with the Hall sensor and the Bosch rotating vane assembly. The Hall sensor must be positioned so that the rotor vanes pass freely through the air gap at a depth of 8-11.5mm (see Fig. 5).

In order to achieve the correct depth, it will usually be necessary to mount the Hall sensor on an adapter plate. This is then attached to the breaker plate (or vacuum advance plate) using machine screws.

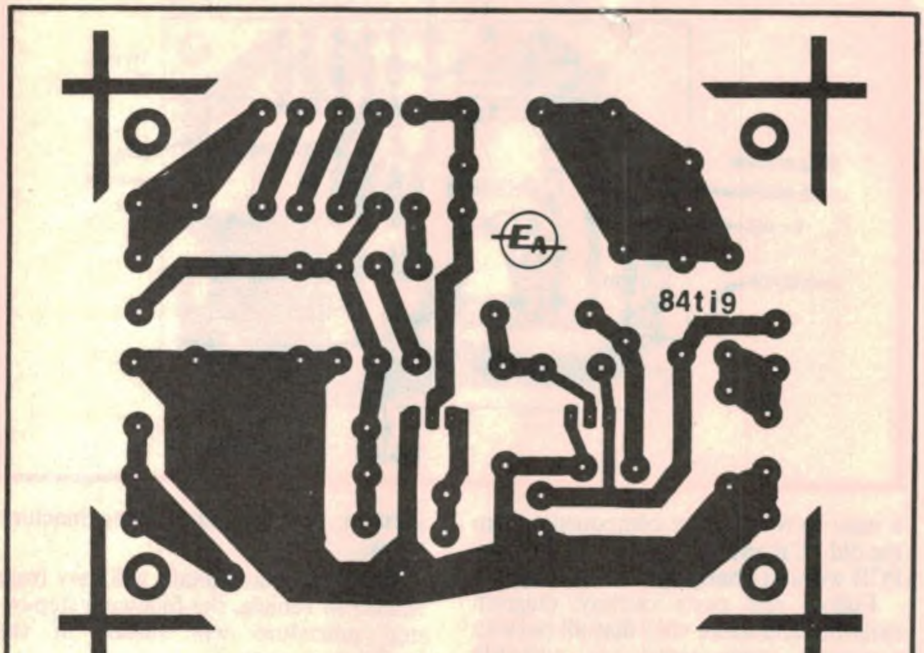
While the exact details will vary from vehicle to vehicle, the following step-by-step procedure will suffice in the majority of cases:

- Remove the distributor cap and crank the engine until the rotor button points to the high tension terminal for number one cylinder and the timing marks are aligned at the static timing setting. Check that the points have just opened or are about to open.
- Locate the number one cylinder firing mark on the distributor body (the rotor button will now be pointing towards it). This mark will usually take the form of a small arrow. If your distributor doesn't have this mark, scribe a suitable mark in the appropriate position.
- Remove the distributor from the engine block and remove the following surplus components: rotor, contact breaker points and capacitor. Some distributors have a damping rubbing

Below: Mounting details for the Hall Effect sensor (left) and Bosch rotating vane assembly (right).



Breakerless ignition for your car



Above is an actual size artwork for the PCB.

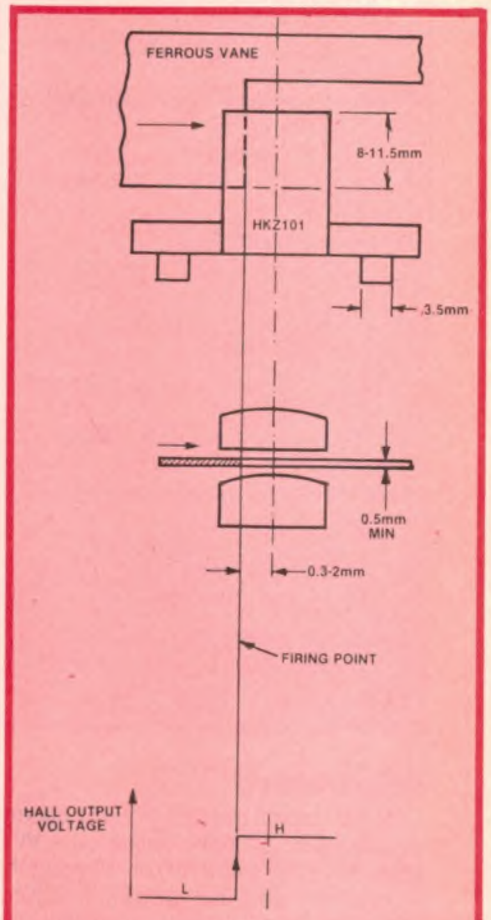


Fig. 5

block — this should also be removed for the time being.

Important: do not disturb the engine once the distributor has been removed from the block.

● Fit the Bosch rotating vane assembly to the distributor cam and rotate the cam in the normal direction of travel so that the rotor arm points to the number one cylinder firing position. Temporarily secure the arm in this position using an elastic band.

● Measure the vane to breaker plate distance and calculate the adapter plate thickness required so that the vane will pass through the sensor at a depth of 8-11.5mm. This done, fashion a suitable adapter plate (see photograph) from scrap aluminium (you may need to use two layers) and attach it to the breaker plate.

● Position the Hall sensor near where the points were located, so that the edge of the nearest vane is between 0.3mm and 2mm from the centre line (see Fig. 5). The sensor leads should face inwards. Note that Fig. 5 is for an anti-clockwise rotating distributor. If the direction of travel in your distributor is clockwise, then the vane should enter the sensor from the opposite side.

● Check to ensure that the rotating vanes will pass through the centre of the air gap, then carefully mark the mounting hole positions for the Hall sensor. Remove the adapter plate, drill two 3.5mm holes to accept the sensor rivets, and countersink them on the underside of the plate. Mount the sensor, then refit the adapter plate and the rubbing back (where used) in the distributor.

● Feed the leads from the Hall sensor through the original grommet used for the points lead. Check that there is no fouling of the distibutor cam and that the breaker plate can move over its full range of vacuum advance. Check also that the rotating vane assembly passes freely through the Hall sensor gap at the required depth.

Refitting the distributor

That completes the distributor modification. All that remains now is to refit the distributor and carry out the timing adjustments.

The distributor must be refitted with the same orientation as previously (otherwise you won't be able to connect the vacuum advance), and with the rotor arm pointing towards the number one cylinder firing mark. Provided that the distributor has been correctly modified, the leading edge of one of the rotor vanes will be 0.3-2mm from the centre line of the sensor.

The leads from the Hall sensor can now be connected to the transistor ignition via a suitable automotive style plug-in connector (see photograph). Alternatively, some readers may prefer to use bullet-type connectors.

It is important to carry out the static timing adjustment before attempting to start the engine. To do this, connect a DC voltmeter between the Hall sensor output and chassis, and switch on the ignition. Check that the ignition timing marks are still correctly aligned, then loosen the distributor clamp and rotate the distributor body in the direction of rotor travel until the meter reads 0V.

Now rotate the distributor body in the opposite direction until the meter suddenly reads 5V. This 0V to 5V transition represents the firing point for number one cylinder.

Finally, refit the distributor cap and check that the engine starts and runs normally. If you do strike problems, switch off immediately and check the static timing adjustment. Assuming all is well, the engine should be dynamically timed according to the procedure set out in the workshop manual.

Before concluding, it may be as well to consider the reliability implications. Although the odds of failure are probably fairly long, it does bear thinking about. In particular, it must be emphasised that failure in a fully electronic system precludes a quick change back to standard ignition.

Fairly obviously, a breakdown in the bush could be embarrassing to say the least. Our advice, particularly if you do a lot of country driving, is to obtain a second distributor from a wrecker's yard and carry it as a spare.

The Serviceman

A fault I never saw before!

Why is it that the faulty component is always the last one you test? There's a logical answer to that, of course, but I think readers will know what I mean. The faulty component is seldom the first one tested and, very often, really is the last one tested on the basis that there are no others left to test!

Such was the case with my main story this month and I must admit that I allowed myself to be sidetracked on the basis that, because the symptoms suggested a certain fault, I persisted with this theory for rather longer than I should have. Anyway, here's how it happened.

The set was a Sharp model CX2220, a portable of around 35cm which, by all accounts, is quite prolific and very popular. On the other hand, I had never encountered one for service before (perhaps that's why they are popular) and so had to start from scratch. It started when the owner rang me and complained that his set "... was doing funny things."

Asked to elaborate, he went on to describe what I took to be a form of picture breakup. I suggested he bring it in and let me see it, since it was a small set, and that this might keep the cost down somewhat. This he duly did and I set it up while he was there. Sure enough, the picture was breaking up, and my immediate reaction was that it was most likely an AGC fault.

In greater detail the picture was suffering from localised tearing, although there appeared to be no loss of sync on the whole, and there was smearing, loss of definition, and some distortion in the sound. I discovered that the sound quality could be restored by adjusting the fine tuning control, but only at the expense of picture quality.

All this was rather puzzling and I tried to recall whether I had experienced any symptoms exactly like it before, and in what circumstances. The nearest I could get was sets which were suffering from gross overload, usually due to loss of the AGC system in strong signal areas. In fact, I formed the tentative theory that this could be an AGC problem.

Unfortunately, the effect didn't last long. Quite suddenly it came good and nothing I could do, at least superficially, would induce it to misbehave again. So I suggested that the owner leave it with me for a few days in the hope that the fault would appear again. It would also give me time to obtain a circuit which, up until now, I had not needed.

So over the next few days, but still without a circuit, I ran it for long periods, tried it on both strong local signals and weak nearby country stations, and tried all the tricks I knew to try to induce the fault. All to no avail.

Finally I rang the owner and suggested that he take the set home and run it until it failed again perhaps, hopefully, on a more permanent basis. So he duly called to pick the set up and only then did he volunteer the information that the set had been intermittent for some considerable time, but had been getting progressively worse. Information of this kind can often be extremely valuable, yet is so often overlooked by the customer.

the set returns

Several weeks went by and then the owner was on the phone again. As he put it, "The set's really gone haywire this time. Its gone into the fault condition and it won't come out of it." "Right", I replied, "That's the best news yet. Bring it in and we'll have another look at it."

So he brought it in and once again we set it up and tried it. There was no doubt about this time; it was well and truly into the fault condition I didn't imagine that the fault would be all that difficult to find, assumed it stayed around long enough, and I now had a circuit which I had sent for after the first episode.

According to the circuit the set was a fairly conventional one. It used a mechanical tuner feeding a first IF stage consisting of a 2SC2216 transistor (Q202), then via a SAW filter into an IC type 0062CE (IC201) which was the video IF strip and from which was obtained the video signal and several AGC voltages, AFT voltage, etc.

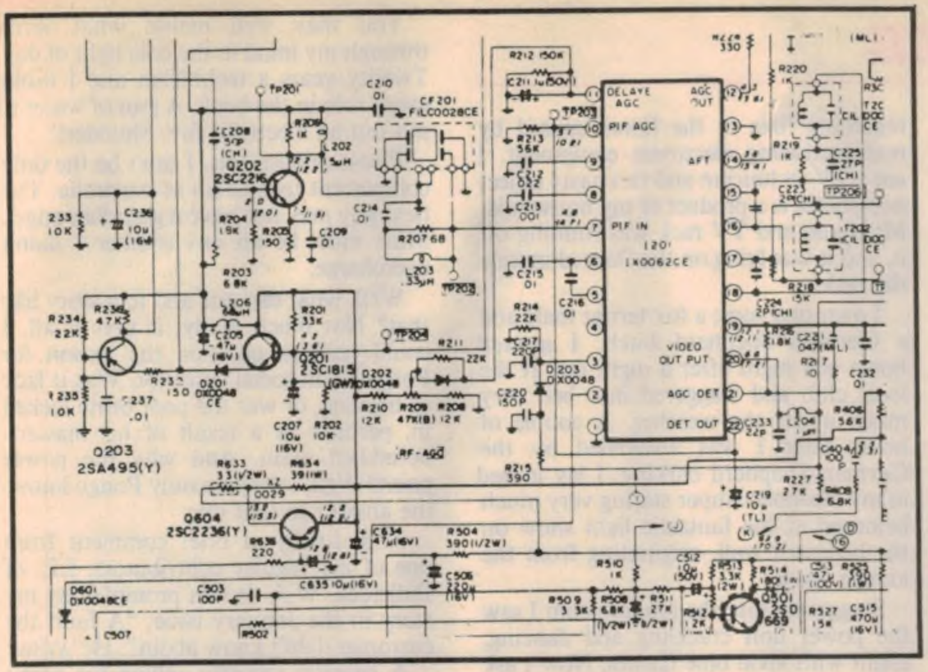
As I mentioned earlier, I had formed the impression that the fault was an ACC problem and this was my first line of attack. The only snag was that the fault was just as evident on weak signals as it was on the powerful local ones, which didn't support the theory.

As a further check I connected the CRO to the video out terminal (pin 20, IC201), mainly to see if I could detect any crushing of the sync pulses. This didn't help much, except in a negative way, because there didn't seem to be any crushing of sync pulses, while both the video and sync pulses were broken up.

By now it was fairly evident that the AGC theory was not very tenable, but I was not much closer to finding the real culprit. The only useful information was that it was somewhere ahead of pin 20 where I had made the CRO observations.

Nevertheless, I went over the AGC line, which includes a couple of amplifier stages, Q201, Q203, and various associated components, all of which seemed to check out OK. Nor did a thorough voltage check around the IC and the transistor stages reveal anything abnormal.

So what did that leave? The tuner? It so happened that I had a spare tuner on



The faulty IF stage in the Sharp CX2220 colour TV receiver.

hand which, while not identical, I felt would be compatible. And with only a few connections involved it was an easy job to swap them. But again, no joy. Results were exactly as before. The only consolation was that I had eliminated one more possibility.

Next on my suspect list was the IF amplifier transistor, Q202. I didn't have an exact replacement type on hand, but decided to settle for a Philips BF180. But again, no joy. The subsitute transistor worked all right, but the signal break-up was still there.

By now I seemed to be running out of possibilities. I was beginning to fear that the IC was at fault, but I didn't want to go to the trouble of changing it unless I had to. For one thing I didn't have a spare on hand, plus the fact that it is always a rather messy business.

So I went over the minor components again, measuring or substituting as appropriate, with particular attention to a couple of low value electrolytics, which are always suspect devices in my book. But it was all wasted effort; the fault persisted.

Finally, I decided that the IC would have to be replaced, put one on order, and put the set aside while I caught up on some other jobs which had been neglected while I had been struggling with this monster.

In due course the new IC arrived, I stoked up the solder sucker, and set to work. The job went off without any serious hitches and then came the big switch-on. Imagine how I felt when the set warmed up and exhibited the fault exactly as before. It wasn't the IC after all.

I looked at the circuit and realised that, by a process of elimination, there was really only one component left; the SAW filter. I had taken it for granted on the simple basis that I had never ever had to replace one before. As far as I was concerned, they just worked.

But now I faced further frustration. I had no spare with which to test this theory. Then I had what was probably the only sensible piece of inspiration during the whole frustrating exercise. Why not by-pass the filter? The set may not perform perfectly, but it should work well enough to prove or disprove my theory.

The filter is mounted on six fairly rigid pins, so it was another solder sucker job. Then came the question; how best to by-pass it. Inasmuch as the input terminal was connected directly to the collector of transistor Q202, at around 12V, and the output was similarly coupled to pin 7 of IC201, a coupling capacitor seemed to be called for.

The big test

But what would be reasonable value of capacitance? As I was pondering this question I idly switched the set on again, curious to see how it would behave with no filter. To my surprise it worked — and worked surprisingly well. How? I'm not sure, but can only speculate that there was enough stray capacitance between the board conductors to provide at least some signal. To be truthful, the set appeared to be as sensitive as ever.

But that wasn't all. The fault had now completely vanished and, while it was too early to start doing somersaults, the change in behaviour was so clear cut that I felt pretty confident that I had found the trouble. More or less as a matter of interest I fitted a 10pF capacitor but, to be honest, I wasn't sure I could pick any difference.

I let the set run on the bench for the rest of the day, and the next day, while waiting for a replacement to arrive, and it didn't miss a beat during that time. Any doubts I had about my diagnosis were dispelled by that time. And during that time I could not help being impressed by how well the set performed without the filter. Had it been necessary I could have returned it to the owner on an emergency basis and I'm sure he would have been quite happy with its performance. (In some locations, with likely adjacent channel interference, it could be a different story).

But that wasn't quite the end of the story. When I rang my parts supplier for a replacement filter, I happened to mention that I had some trouble in tracking it down as faulty. Whereupon he asked me the symptoms and, when I described them, he casually remarked, "Oh yes, that's quite a common problem. We sell about 20 of these a month for that fault." Now they tell me!

From readers this month I have a couple of stories worth passing on, one in particular being worth digesting in that it involves a safety issue, albeit, in this case, from an unusual cause. But first, a follow up on a letter I published in the May issue.

Readers may recall that this was from J.A. of Inverell, NSW, describing an elusive fault in an EA Effects Unit. The cause turned out to be a wrongly colour coded resistor, and I commented on the rarity of such a phenomenon, and the possible manner in which it might have been created. Now, from another reader, J.D. of Ballarat, Victoria, comes a very interesting follow-up.

It was with great interest that I read the story by your "Serviceman" in the May 1984 issue, where he described a fault in the Effects Unit of June 1983, constructed by an amateur such as myself.

Being a musician of sorts and interested in sound recording and reproduction I eagerly purchased and constructed this unit. My expertise as a kit constructor has at times been questionable so, neat appearance and meticulous care notwithstanding, the usual anti-climactic "power-up" was not unexpected.

While there was no smoke or sickening blurts, the unit did not seem to work according to my expectations. The signal by-pass was operating effectively, as was the single echo function, but the reverb system was not operating at all. I suspected that the fault was probably to do with my clumsy soldering (shorts or dry joints). I checked these and also replaced a few components, including the cheaper ICs. This trial and error approach proved fruitless for a period of about six months.

Finally I became obsessed with the idea of solving the problem myself, rather than resort to the experts, so I mustered all my resources and began to check vital components in a more logical manner. I soon located the 22kΩ feedback resistor associated with IC5 and found it measured low, around 2kΩ. I assumed that it had been incorrectly coded.

Replacing this immediately improved output signal level and also provided the elusive echo. I wonder how many other such resistors lead to similar situations of frustration?

Thank you J.D. Your story is certainly a most interesting coincidence. While J.D. indicated that the kit came from one of the well known suppliers in Victoria, I omitted this reference as I doubt whether it would serve any purpose. Unfortunately, the previous contributor, J.A., did not indicate where the other kit had originated. But, like J.D., I can't help wondering how many more wrongly coded 22kΩ resistors there are floating around.

Pongo's fireworks

And from another reader, Mr. K.A. of St Peters, NSW, comes another strange story. In fact, I think it would be fair to say that it is, in many ways, one of the strangest I have ever had submitted to these notes. I suppose it has its humorous side too, although I doubt whether the writer saw anything funny about it at the time. This is how he tells it, warts and all.

I have been noting with interest articles on electronics magazines regarding fires in the home caused by malfunctioning electronic equipment. I am a TV technician and this nasty object (see photo) is a product of my household. My audio and TV rack was running off it, and it was lying on the floor alongside the rack.

I own two dogs; a fox terrier male and a German Shepherd bitch. I arrived home one night after a night out at the local club and staggered into bed very much under the weather. A couple of hours later I was awakened by the German Shepherd barking. I lay in bed in my alcoholic stupor staring very much bemused at the fantastic light show on the bedroom wall, originating from the lounge room.

Staggering into the lounge room I saw the power unit crackling and dancing, alight with vivid blue flashes. Now I ask you; what do you do when, after sinking a disgusting number of schooners of beer, you get rudely awakened two hours later and find this horrible object waltzing on your living room floor?

I'll tell you what you do. You stand there like a zombie. the main fuse won't blow because it's too damn big, you can't unplug it because the wall switch is too deep behind the rack, and your brain won't function because it's too befuddled.

Suddenly the carpet catches fire. So I head for the sink, and grab a saucepan to fill with water and throw on it. I really did. I didn't make it though. The main fuse finally blew. The fire went out immediately, approximately five seconds from disaster.

How did it start? The fox terrier piddled on it. Dry dog food has a high salt content. The urine seeped under the plug and arced across the pins. This took time, so the dog didn't get zapped.

Pongo's legacy — the blackened power distribution panel.

You may well realise what went through my mind in the cold light of day. Twenty years a technician and I broke every rule in the book. A pan of water to put out an electrical fire. Shudder!!

Please publish this. I can't be the only complacent technician in Australia. The next guy may not have a guardian angel. Mine must be an ex-customer I didn't overcharge.

Well, what can one add to a story like that? Not much really, it says it all. I could perhaps question the reason for Pongo's anti-social behavior. Was it lack of training, or was the poor brute locked in, perhaps as a result of his master's befuddled brain. And why the power point? Well, I suppose only Pongo knows the answer to that one.

And, finally, a brief comment from one of my regular contributors, J.E. of Bullcreek, W.A. It was prompted by my story in the January issue, "A fault the customer didn't know about". He writes:

A cassette recorder selling for about $35 "on special" was brought to me by a lady who stated that "it doesn't go". The fault was a defective IC costing about $12.50 and involved a trip to the agents. When repaired, a check showed that the "auto stop" was unreliable and could not be remedied by cleaning and lubrication.

Perhaps in this case I should have checked before commencing repairs, but in other cases it is not possible to do this until you have remedied the most obvious fault. (Your January item was a good example of this). I returned it to her and explained that it was not really worth repairing fully, so I had made it "usable" which, it transpired, was all that she wanted.

Another lady (no, I'm not an M.C.P., even if I may occasionally allow a pretty face to override my better judgement on whether a piece of equipment is worth repairing) asked me to repair a mains operated radio which "kept cutting out".

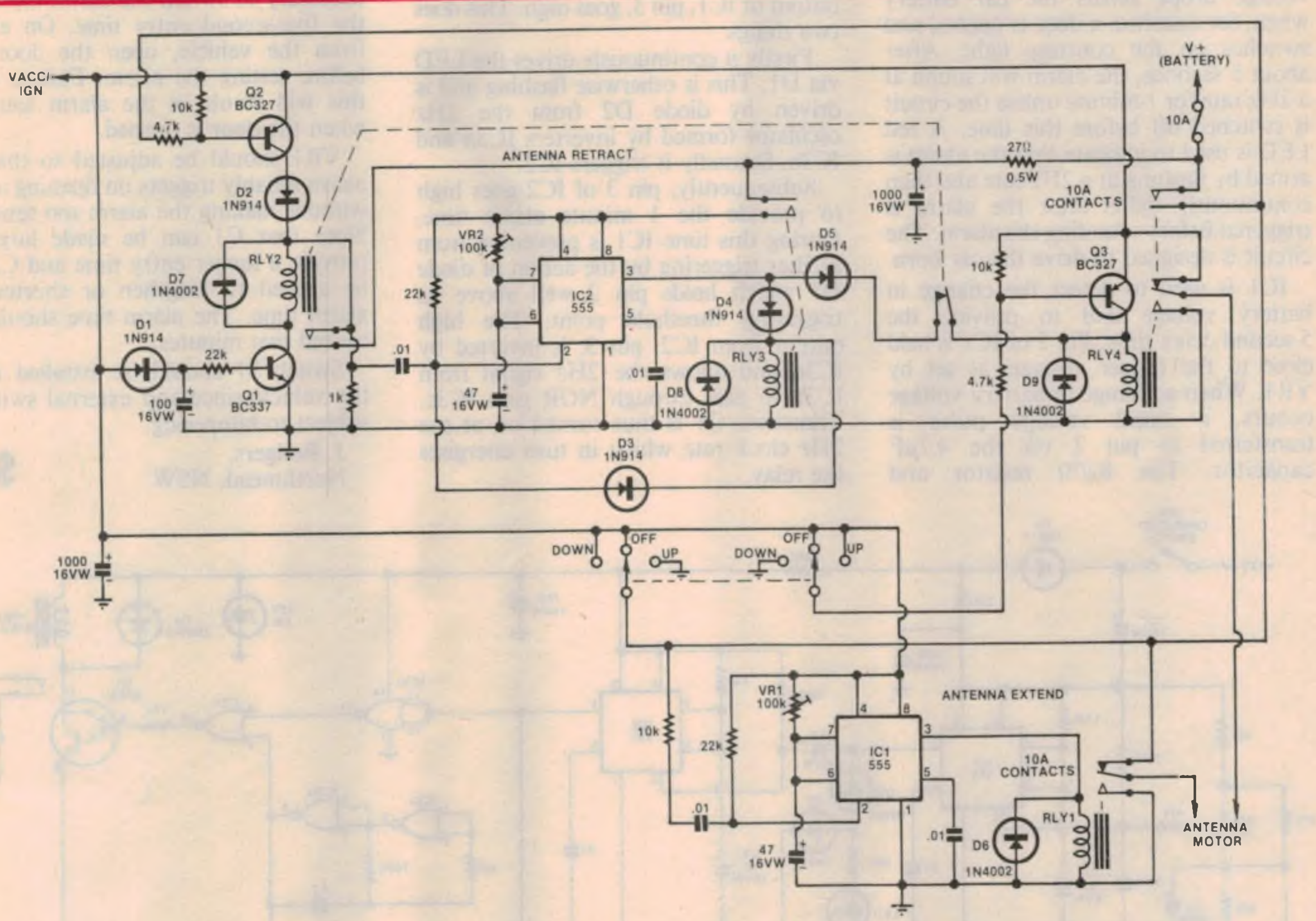
When tested all I could get was a loud hum with weak stations in the background. This turned out to be due to a shorted rectifier diode. When this was replaced the receiver obligingly demonstrated the intermittent as described by the owner.

My guess is that the set had been intermittent for some time before the diode failed, but whether the owner realised that it now had two faults I do not know. All I do know is that I seem to be getting more than my fair share of repairs which turn out to be unprofitable because of "the fault the customer didn't know about".

That you J.E., I think your experiences very ably confirm a situation which can turn out to be quite sticky on a customer/serviceman relations basis. Being aware of it, and how best to avoid it, is all part of the servicing scene.

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.



Automatic antenna retraction

Many late-model cars are fitted with power antennas but not all automatically retract when the ignition is switched off. This automatic extend and retract circuit is relatively simple, reliable and easy to install.

In the Honda Accord, for example, a 3-position rocker switch, spring-biased to centre off, is used to extend and retract the antenna. The antenna motor has two leads which are reversed by the switch to determine the direction of motor rotation. With the ignition switch on and the switch in the off position, both motor leads are connected to battery positive, so providing an electric brake.

In some cars, however, the off position simply disconnects the antenna motor from the power supply. This has no effect on circuit operation.

To extend the antenna the ignition switch is turned on and the up side of the switch pressed momentarily. This also arms the retract circuit so that, when the ignition switch is turned off, the antenna automatically retracts after a short delay. The delay is necessary because most modern cars shed the accessory load when the ignition switch is in the start position.

The extend circuitry is quite straightforward. When the rocker switch is closed, pin 2 of 555 monostable IC1 goes low and its output goes high. This energises relay 1 and so current flows to the antenna motor via the normally open contacts. At the end of the monostable period, the relay turns off (pin 3 low) and the motor stops.

IC2, a 555 timer wired as a monostable, forms the heart of the retract circuit. When the ignition switch is turned on, power is applied to the base of Q1 which provides the return for relay 2. When the UP switch is closed, a low is applied to the base of Q2. This low is also used to trigger IC2 (555) in the extend circuit.

When Q2 is turned on, relay 2 will be energised and latched through its normally open (N/O) contacts. Relay 3 is now energised via D3 and V(BAT) is available to IC1. When the ignition switch is turned off, Q1 turns off after a delay of about six seconds, relay 2 is de-energised, and a low is applied to the pin 2 triggered input of IC1 via the 1kΩ resistor and .01μF capacitor.

Relay 3 is now engergised via D4 from the pin 3 output of IC1 (ie, the relay remains on), while relay 4 is turned on via D5 and the normally closed (N/C) contacts of relay 2. This supplies power to the antenna motor via the N/O contacts of relay 4 and the N/C contacts of relay 1. Hence the antenna retracts.

Trimpots VR1 and VR2 set the monostable periods and are adjusted so that the antenna fully extends (VR1) and retracts (VR2). Note the 10A fuse in the V(BAT) supply.

A. Spooner,
Mt Eliza, Vic.

$30

Circuit & Design Ideas

Car alarm

This simple car alarm detects small voltage drops across the car battery when, for instance, a door is opened and switches on the courtesy light. After about 5 seconds, the alarm will sound at a 2Hz rate for 1 minute unless the circuit is switched off before this time. A red LED is used to indicate that the alarm is armed by flashing at a 2Hz rate and then continuously lights after the alarm is triggered before sounding the alarm. The circuit is designed to drive the car horn.

IC1 is used to detect the change in battery voltage and to provide the 5-second delay time. Pin 2 of IC1 is held close to the trigger voltage, as set by VR1. When a change in battery voltage occurs, a small voltage pulse is transferred to pin 2 via the 4.7μF capacitor. The 820Ω resistor and .0033μF capacitor filter out fast electrical disturbances which may falsely trigger the alarm. Once triggered, the output of IC1, pin 3, goes high. This does two things:

Firstly it continuously drives the LED via D1. This is otherwise flashing and is driven by diode D2 from the 2Hz oscillator formed by inverters IC3a and IC3b. Secondly it triggers IC2.

Subsequently, pin 3 of IC2 goes high to provide the 1 minute alarm time. During this time IC1 is prevented from further triggering by the action of diode D3 which holds pin 2 well above its triggering threshold point. The high output from IC2, pin 3, is inverted by IC3d and allows the 2Hz signal from IC3b to pass through NOR gate IC3c. Transistor Q1 is thus turned on at the 2Hz clock rate which in turn energises the relay.

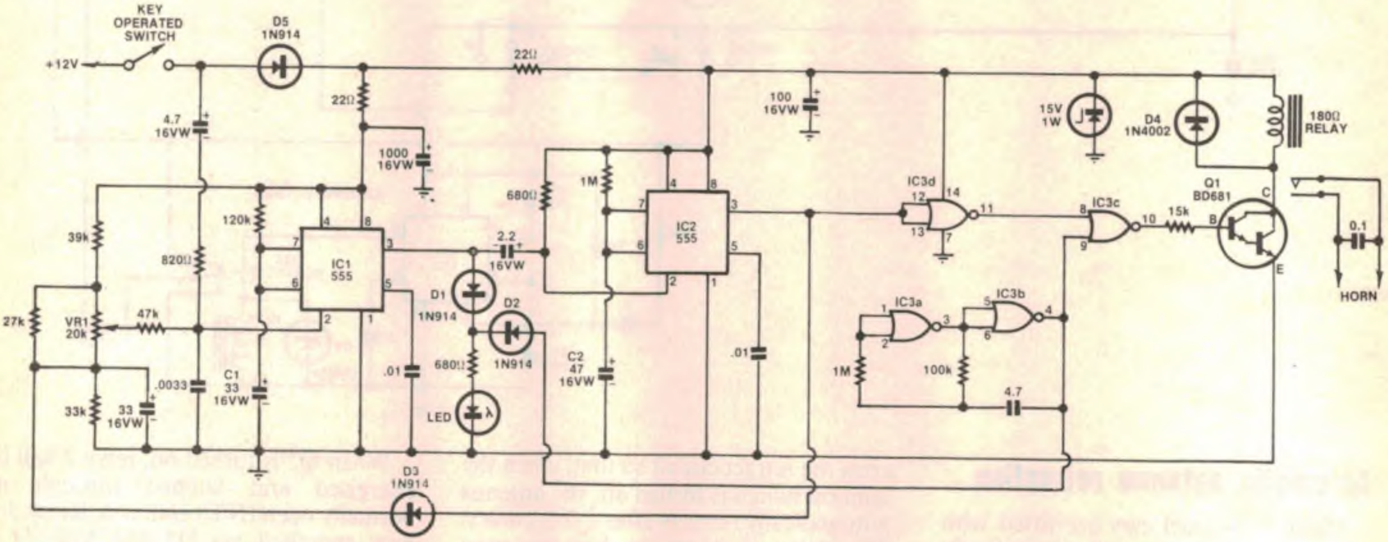
After the one-minute alarm time, pin 3 of IC2 goes low and the alarm stops. The circuit is now ready to detect another voltage drop. Note that switch S1 will deactivate the alarm circuit at any time. After a valid entry to the vehicle it is necessary to switch the alarm off before the five-second entry time. On exiting from the vehicle, open the door first before setting the alarm. Failure to do this will result in the alarm sounding when the door is opened.

VR1 should be adjusted so that the alarm reliably triggers on opening a door without making the alarm too sensitive. Note that C1 can be made larger to provide a longer entry time and C2 can be altered to lengthen or shorten the alarm time. The alarm time should not exceed two minutes.

Switch S1 should be installed inside the vehicle since and external switch is subject to tampering.

J. Rodgers,
Northmead, NSW.

$25

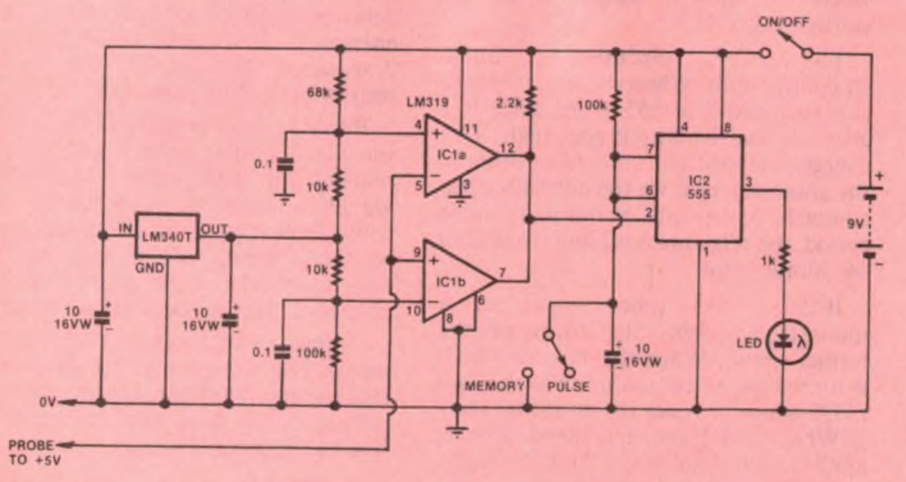


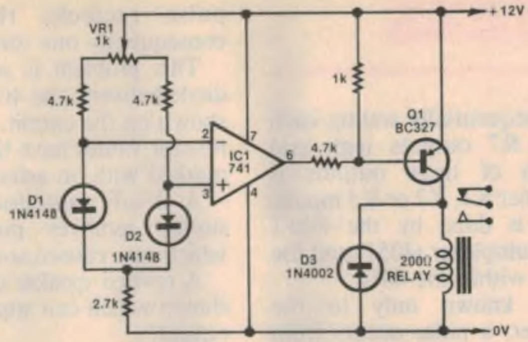
Glitch catcher and line filter

Power line glitches or spikes can be a problem in some computer systems where they can result in unexplained resets, garbled discs etc.

To find out whether you actually have a problem with supply line glitches try this simple glitch catcher. It can also be used to check the operation of commercially available line conditioners designed to remove glitches and also the filter described here.

The glitch catcher circuit utilises a very fast window comparator that determines if the +5V logic supply for the computer exceeds the ±10% limits. This glitch is indicated by a LED which can be selected to show either a short flash for each glitch or set to remain lit





Thermal balance switch

Originally designed to compare the temperature of one chemical chamber against another in an industrial control application, this circuit should prove useful for many temperature control systems.

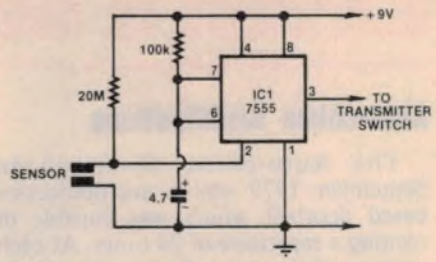
The relay will only be energised when the temperature at diode D1 is higher than the temperature at diode D2. The relay can then be used to remove power to a heater which controls the temperature measured by D1. The temperature at D1 will thus closely follow the temperature measured by D2.

Circuit operation relies upon the temperature coefficient of the silicon diodes D1 and D2. As the temperature rises, so does the voltage drop across the diode. Initially trimpot VR1 is adjusted so that the output of op amp IC1 just stays low when the temperature at both diodes is the same. The diodes are connected so that the non-inverting input, pin 2, measures the voltage at D1.

When the voltage at the inverting input of IC1 becomes greater than the voltage at the non-inverting input, the output of IC1 goes low, turning on Q1. This in turn switches the relay. Diode D3 is used to short-circuit the back EMF developed by the relay coil when power is removed.

J. Date,
Maharashtra, India.

$15



CMOS touch switch for Infrared TV Sound Control

This simple circuit is designed to replace the mechanical switches in the Remote Infrared TV Sound Control (Jan '83) with the convenience of touch switching. It consists of a 7555 timer IC (the CMOS equivalent of the 555) wired as a monostable. When the sensor plates are touched, the pin 2 input is pulled low and the output (pin 3) switches high for 0.5s (approx).

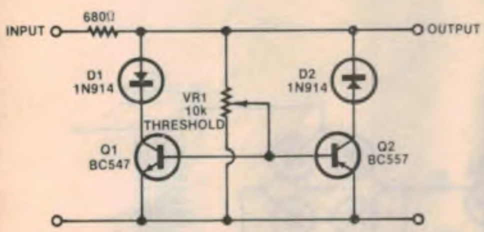
Note that two such circuits will be needed: one to replace the UP button and one to replace the DOWN button. The two 0.1μF switch debounce capacitors should be removed from the existing circuit.

D. Thornton,
Magill, SA.

$10

Adustable peak limiter

This adjustable peak limiter will symmetrically limit a signal input from 450mV RMS upwards over a frequency range from DC to several hundred kilohertz.



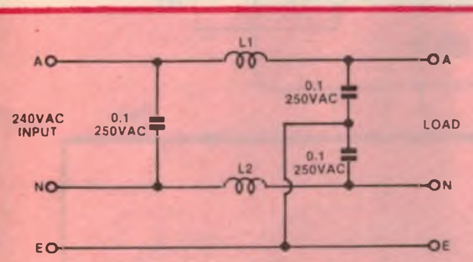
When the output voltage, or fraction thereof set by VR1, exceeds about 0.6V, Q1 or Q2 conducts and limits the output to this level. Diodes D1 and D2 prevent base-collector conduction in Q1 and Q2 which control the positive and negative signal peaks respectively.

The circuit was designed to limit an audio signal feed to a high-power amplifier to prevent it damaging a relatively low-power loudspeaker. The limiting action is quite positive but without the hard clipping of many other circuits. It can be used in a balanced line as it is completely floating with respect to ground.

Note that resistor R1 should be chosen to suit the drive capabilities of the source. Most op amps will drive 680Ω without problems.

P. Allison,
Summer Hill, NSW.

$15



after a glitch.

An LM340 positive 5V regulator is used to derive a 5V reference to within 0.5V. If the logic supply at the probe input exceeds these limits one of the wired-OR comparator outputs will go low and trigger the 555 timer and the LED will light.

If the Memory/Pulse switch is off, then the LED will remain on only for the time it takes the 10μF capacitor at pins 6 and 7 to charge via the 100kΩ resistor to 2/3rds the supply voltage (about 1 second).

If the switch is on, the LED will remain on since the capacitor cannot charge.

The circuit is powered by a 9V transistor battery and on standby draws about 18mA. It can be housed in a small plastic utility case with power and memory/pulse switches and LED on the front panel.

The circuit should detect pulses as narrow as 40ns.

The line filter circuit is designed to filter out signals other than the 50Hz mains frequency and this includes glitches. It comprises a passive filter using inductors and capacitors. Note that the capacitors must be rated at 250VAC.

The inductors are made by purchasing two plastic bobbins of 1mm diameter enamelled wire and rewinding each one so that each layer is separated by two layers of insulating tape to reduce the interwinding capacitance.

Mount the components in a large diecast case using tagstrip to terminate the components. Use a grommet for the incoming mains lead, which should be securely clamped with a mains cord clamp. Solidly earth the case and bolt a surface-mount general purpose mains outlet on the case for the filtered outlet.

You will be able to test its operation with the glitch catcher.

R. de Jong,
McMahons Point, NSW.

$25

Circuit & Design Ideas

Auto-chime modifications

The Auto-chime described in September 1979 was a microprocessor based doorbell which was capable of reciting a repertoire of 24 tunes. At each pressing of the doorbell, the next tune in the sequence would be played except for one peculiar quirk. Sometimes a tune would be skipped.

The MPU decides which tune should be selected by sequentially setting each of the R0 to R7 outputs high and checking which of these outputs is connected to either K1, K2 or K3 inputs. The switching is done by the 8-to-1 multiplexer/demultiplexer (4051) and the analog switches within the 4016.

For reasons known only to the software designer, a pulse occurs from inputs K1, K2 and K4, when R0 is connected to one of these inputs. This pulse reclocks the counter and consequently one tune is skipped.

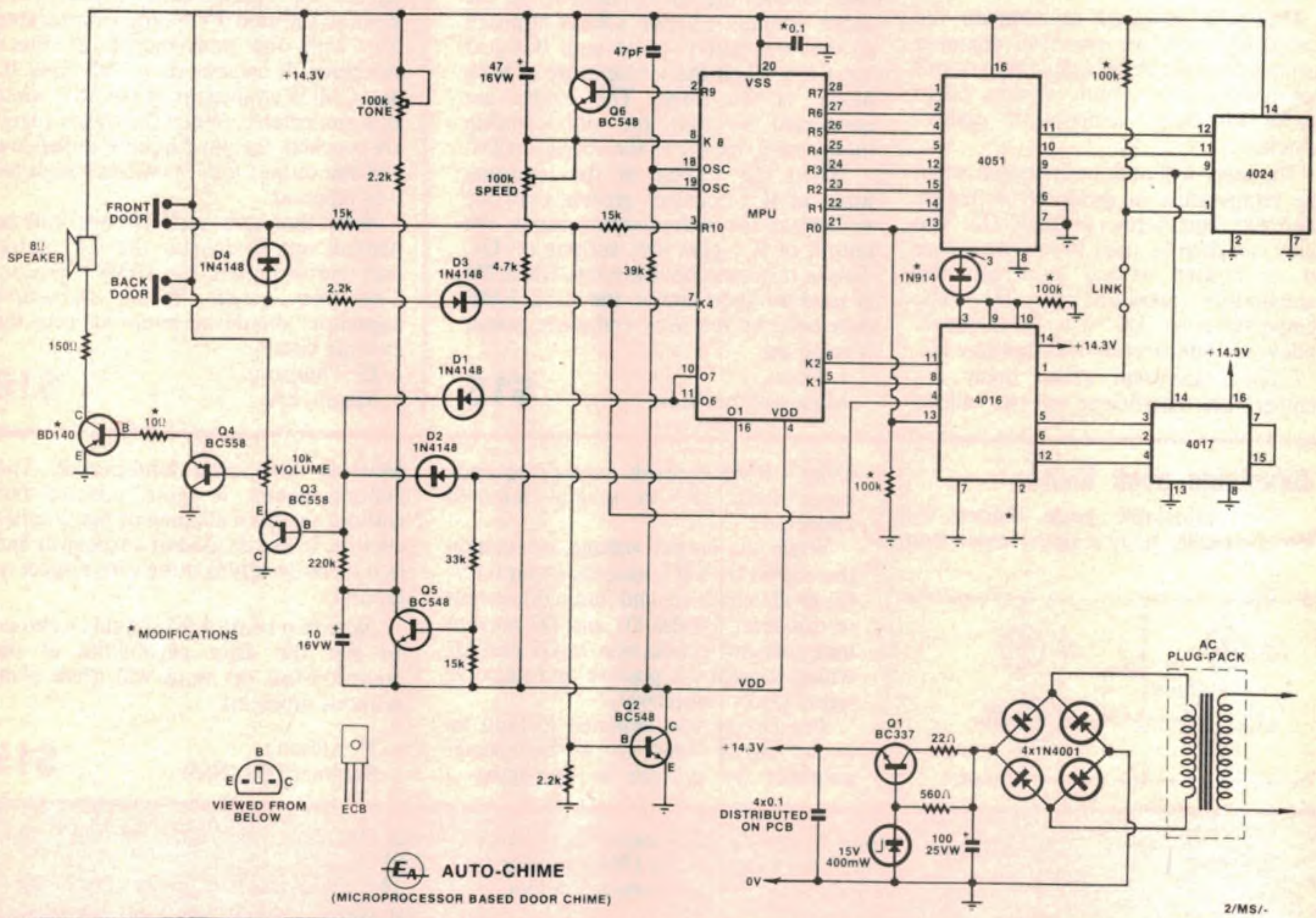
This problem is solved by adding a diode between the 4051 and the 4016 as shown on the circuit. Also several of the resistor values have been altered and are marked with an asterisk.

A 0.1μF capacitor across the MPU supply removes pushbutton bounce, which also caused some problems.

A revised speaker driver circuit is also shown which can supply a higher sound output.

D. Pilkington,
Kurralton Pk, SA.

$12



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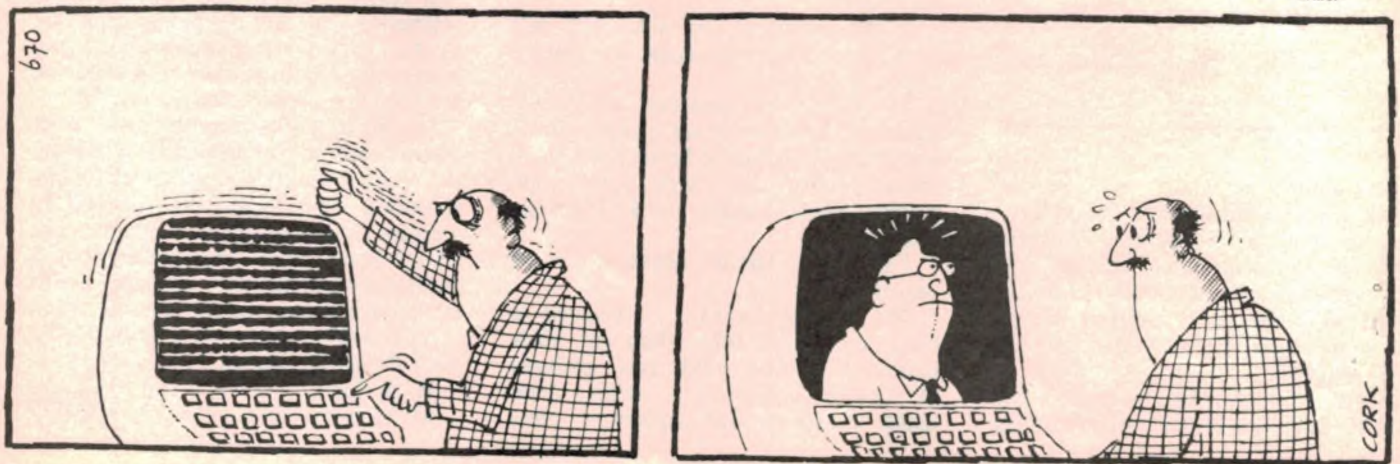

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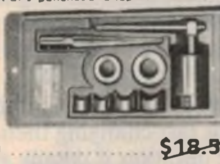

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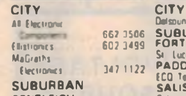

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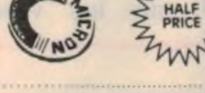

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by BRYAN MAHER

OP AMPS Explained

Part 7

Many electronic measurements require the conversion of units to voltage or current. In this chapter we show how op amps can convert voltage to current and current to voltage.

The ability of operational amplifiers to perform many "conversion" functions sets them above and beyond ordinary amplifiers. We have taken a great leap forward, no longer considering the simple task of amplifying a voltage signal; we are actually asking op amps to convert one quantity into another!

Many quantities are involved on the electronic scene, aren't they? Signal voltage is probably mentioned most often, but many times signal current should be considered, measured, or otherwise known. Or sometimes the information output from an industrial or scientific process is actually contained in the frequency, pulse rate, period or risetime of a signal.

In this digital world, the ability to easily convert analog signals to digital and vice-versa would be a nice addition to our repertoire. As each conversion scheme is a world of its own, let us begin with the easiest. This month we devote ourselves to the conversion of a signal current to a proportional voltage; and the obvious inverse function.

Why?

In many electronic, scientific or industrial processes the rate of some vital quantity depends on the value of a current, with no easy relation to the associated voltage. Examples are:

1. The deflection angle of a moving coil galvanometer is truly proportional to its current; its voltage characteristic is uncertain due to the back EMF generated while the coil is moving.
2. The signal at the collector of a junction transistor is more a function of base current than base voltage.
3. The transport rate of ions in the scientific process "electrophoresis" is a function of a current, not a voltage.
4. The light output of a semiconductor laser is a function of the current applied, rather than the voltage.
5. The electrical output of a photosensitive diode is truly measured by the current provided, not the voltage.

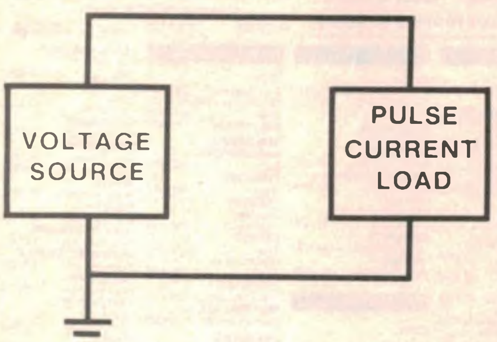
"Why not just use a milliammeter or ammeter to measure your precious current" you interject! Well — the answer is "yes — by all means do that", if it's possible, or convenient. But if not, what then?

Other reasons

Steady currents can be simply read on a digital or analog current meter in many cases with no hassle. But there are exceptions. Difficulties may arise if the current is extremely small, or if the system is such that other effects forbid the use of a current indicator of high resistance.

In some important processes, many different currents are flowing in different circuits, and what is required is a single indication of their algebraic sum. Try doing that with your DVM!

Of course, if the current to be measured is fast-changing then a meter is out of the question if details are sought, unless all that is wanted is some average or RMS value. Recourse to an oscilloscope may then be mandatory, but the CRO only has voltage input



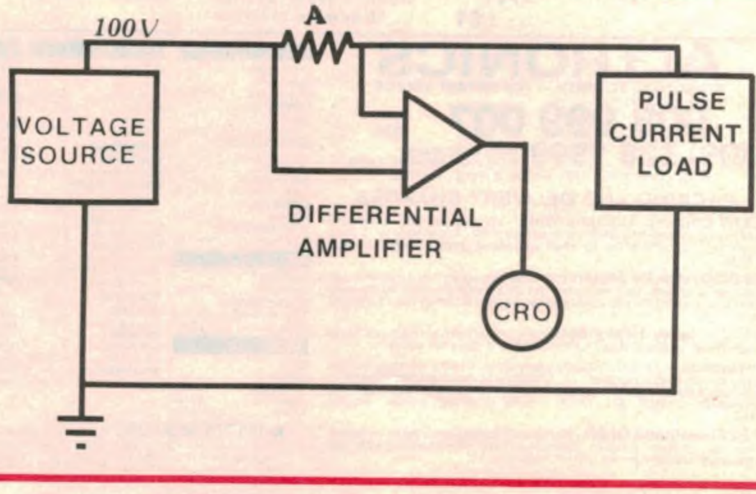


Fig. 1a: regulated voltage source supplying a load taking pulses of current.

Fig. 1b: one possible measurement technique. The common mode voltage makes things difficult, however.

terminals! Obviously what's needed is a voltage proportional to that current to be measured. We need some sort of **current to voltage converter**.

You're objecting again! Murmurings can be heard that sound like "What's wrong with simply passing your precious current through a resistor, and let the CRO measure the voltage drop?" Good question, and the answer is yes, provided the circuit will permit a resistor large enough to give a measurable voltage drop. An example will illustrate.

Fig.1(a) shows a regulated 100V constant voltage supply for a load which takes long pulses of small current. An oscilloscope is necessary, but how will we connect it? A Hall effect current probe would be ideal here, but if we do not own one we must settle for a voltage dropping resistor. But where will we place it?

If at A in Fig.1(b) a differential amplifier or oscilloscope is needed. But what about that 100 volt common-mode potential? Well — not impossible, only difficult. Then of course, the voltage at the load is no longer regulated; the resistor at A has spoilt that.

Let's try placing the resistor at B as in Fig. 1(c). Now we don't need a differential amplifier, and a single-sided CRO will suffice. The fly in the ointment is that some regulated voltage supplies are unstable if one side of their output is not connected directly to ground. Often you will get away with a low-value resistor in the ground line as at B, but a high value will give trouble. The problem is that if those current pulses to be measured are small, then you need a fairly high-value resistor at B to produce a measurable voltage drop.

A better way

We can place any value resistor we like in the earthed end of the current path, then use the virtual earth of an op amp to appear to short circuit it to ground.

Consider, if you will, Fig.2(a), an ordinary operational amplifier. Recall that the now-famous virtual earth at X isolates all voltages from the integrated amplifier input pin (2−). (The "virtual earth" at X is the result of feedback preventing much voltage appearing even though considerable current is fed to that point. X looks and acts like a low impedance.)

Only the signal current i remains at X. Therefore if we do a "stretch" as at Fig.2(b), and put Ri some distance away, we have not changed anything. V(in) and V(out) remain the same. Now stretch further as in Fig.2(c). Here Ri has moved right over into the left box, but current i is still the same and V(out) remains unaltered!

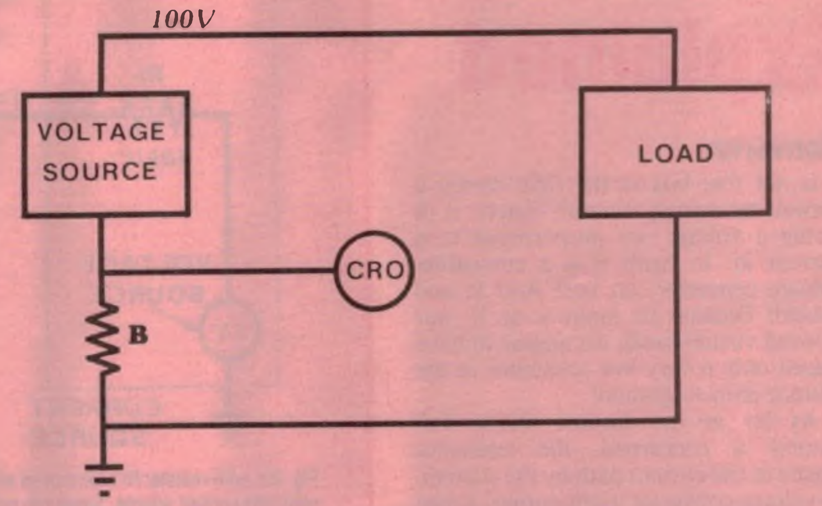


Fig. 1c: at first sight, this looks to be a better method for our pulse current load measurement. However, some regulated supplies are unstable if there is too much resistance in their ground return path.

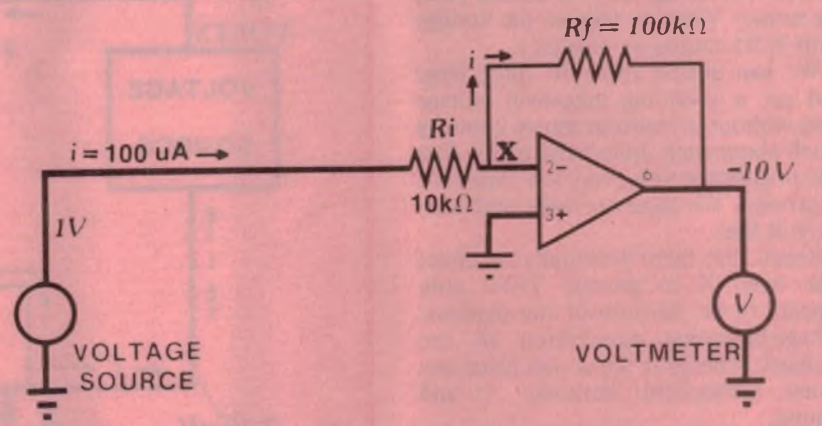
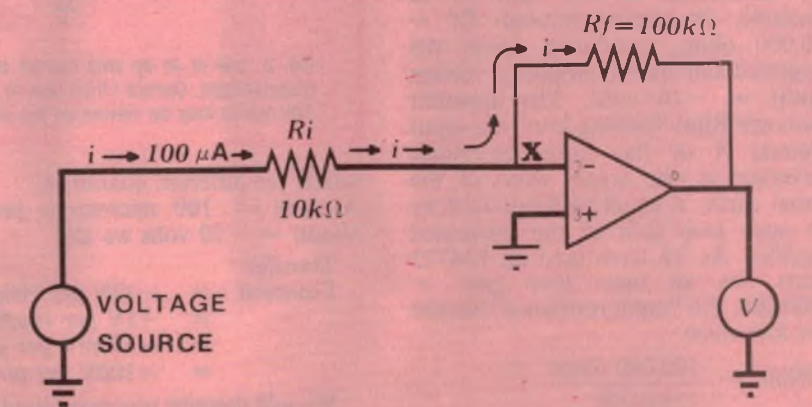


Fig. 2a: common op amp configuration. The virtual earth at X means that very little voltage appears at pin 2 (ie, X looks like a low impedance).



Fog. 2b: "stretch" version of Fig. 2a. The circuit is electrically identicial to Fig. 2a — all we have done is to move Ri closer to the voltage source.

Sure, it's only a matter of viewpoint, but can't we call that box on the left a current source? It is, in fact, our voltage source in series with a resistor Ri. Such a combination resembles a current source.

It slowly dawns upon us that Fig.2(c) is a picture of a source of current, i, (in the left corner), and (in the right corner) something which is giving a voltage V(out) proportional to current i.

OP AMPS Explained

Converter

Is not that box in the right corner a current-measuring circuit? Surely it is giving a voltage out proportional to a current in. In truth it is a **current-to-voltage converter**, no less! And lo and behold! Because its input is at X, our beloved virtual earth, we appear to have placed only a very low resistance in the current path to ground!

As far as the current source (left corner) is concerned, the resistance placed in the current path by the current-to-voltage converter (right corner) is just the very low resistance of the virtual earth. But current i still flows through Rf, because there is nowhere else for it to go. As the voltage at X is almost zero, the output V(out) is (minus) the voltage drop in Rf caused by current i.

We can quietly make Rf quite large and get a good big (negative) voltage drop without the current source knowing much about such underhand tricks. X is still an apparent very, very low resistance to ground. We have our cake and have eaten it too!

Recall that there is actually no direct path from X to ground. There only appears to be, because of the dynamic voltage-balancing equilibrium of the feedback. Therefore we do not place any actual component between X and ground.

Let's be quantitative about Fig.2(c). The left current source sends current i = 100 microamps to the right to be measured. In passing through Rf = 100,000 ohms, current i causes the integrated amplifier to produce a voltage V(out) = −10 volts. The apparent resistance R(in) "looking into" the input terminal X of the current-to-voltage converter, ie, the actual value of the virtual earth, is equal to Rf divided by the open loop gain of the integrated amplifier. As we have used an LM725 which has an open loop gain = 1,000,000, this "input resistance" has the very low value:

$$R(in) = \frac{100{,}000 \text{ ohms}}{1{,}000{,}000}$$

$$= 100 \text{ milliohms}$$

Transfer function

We cannot say our circuit has a "closed loop gain" as that would make no sense. Instead we speak of a *transfer function*. Such an expression suits any converter circuit with inputs and outputs which are different quantities.

As i(in) = 100 microamps produces V(out) = −10 volts we say:

Transfer Function = −10V per 100μA
= −1V per 10μA
= −100mV per μA
= −100V per mA

We will describe our new-found-toy to others as a *Current-to-Voltage Converter* and quote its Transfer Function and value of R(in).

Pulse currents

Now we can easily cope with that pulse current measurement problem. Fig.3 shows our pride-and-joy connected to display, on the CRO, **voltage pulses** proportional to the **current pulses** we wished to measure. Knowing the Transfer Function of our current-to-voltage converter, we simply calibrate the CRO screen graticule in microamps and measure directly. And we remember that the current measured at the bottom of the supply is the negative of the value flowing to the top of the load.

As the voltage source sees only the 100 milliohm virtual earth resistance between its zero terminal and true ground, we would be unlucky to run into instability problems.

You, most valuable reader, have probably already foreseen a possible problem in the hairy situation that would occur should the current-to-voltage

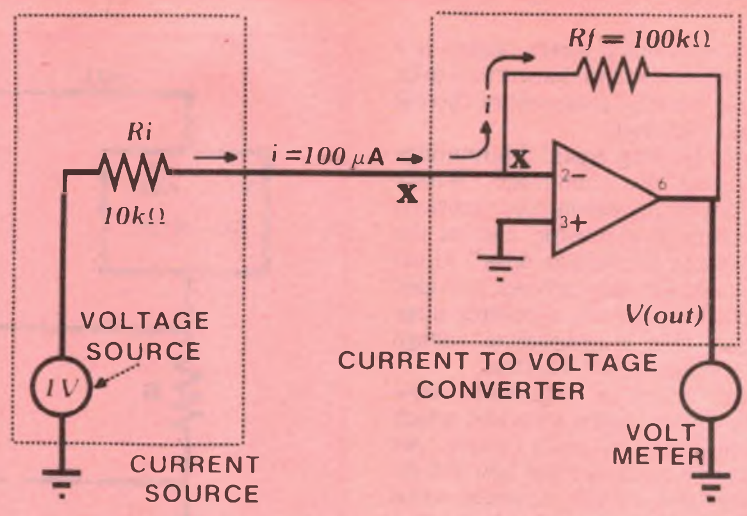


Fig. 2c: with resistor Ri now moved all the way to the left, we can regard the left hand box as a constant current source. Since the output of the op amp is a voltage (−10V in this case), the circuit behaves as a current to voltage converter. Note that Figs. 2a, b, c are all electrically identical.

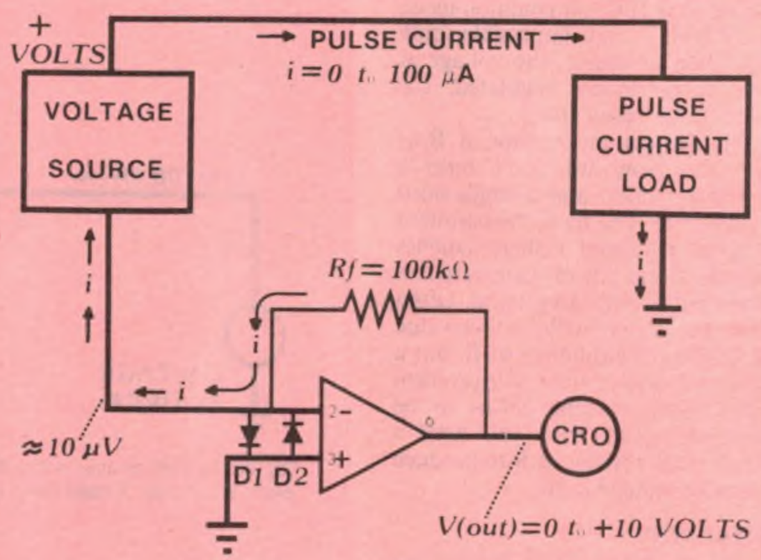


Fig. 3: use of an op amp current to voltage converter to perform a difficult pulse current measurement. Current i from 0uA to 100uA gives a corresponding op amp output from 0V to 10V which may be viewed on the oscilloscope.

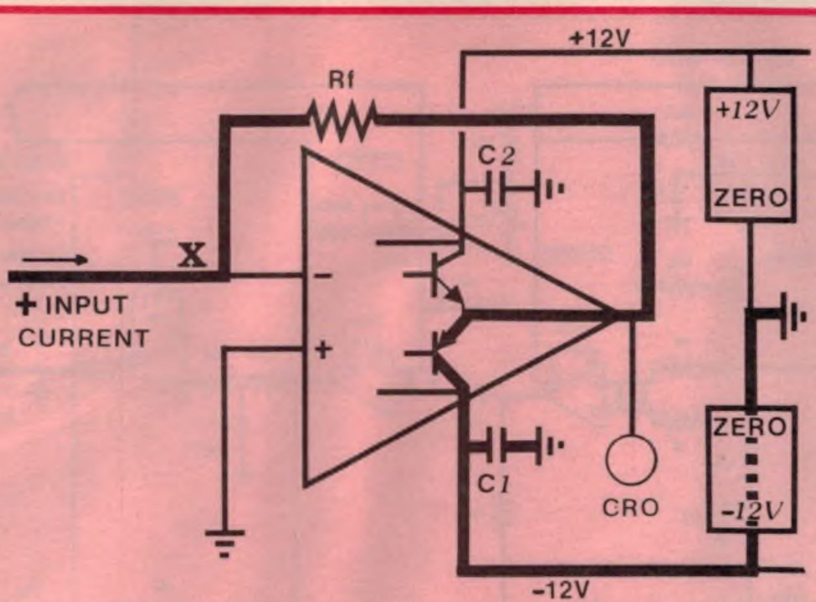


Fig. 4a: op amp current to voltage conveter. The heavy line shows the path of the positive input signal current.

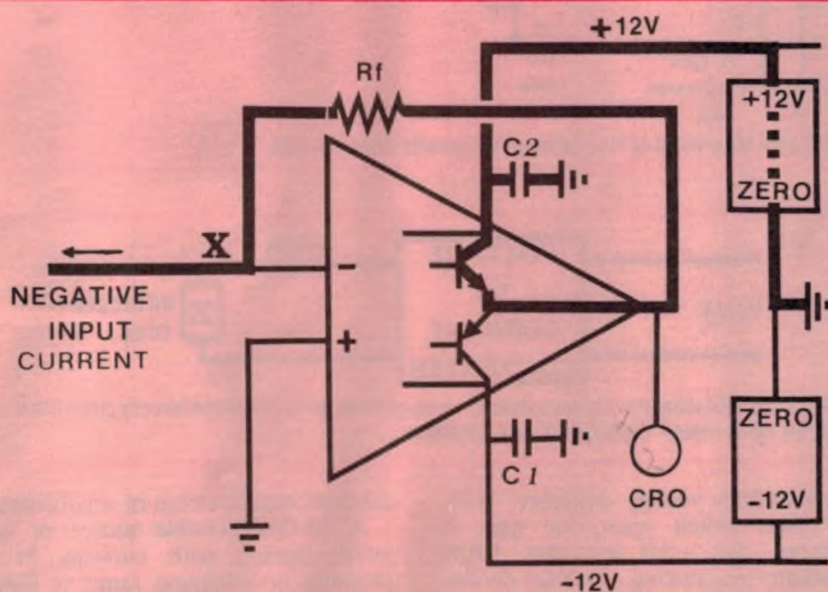


Fig. 4b: negative input signal path for our op amp current to voltage converter.

Fig. 6: full size PC pattern for current to voltage converter of Fig. 5 (see page 70).

converter cease to function for any reason. But do not fret . . . just connect two back-to-back diodes D1 and D2 to ground.

In normal operation, the few microvolts occurring at the virtual earth will never turn either diode on; except for their junction capacitance they are effectively not there. Only in case of failure of the op amp will they conduct and render the circuit safe.

Current path

To do the right thing we really ought to look into the question "where does the input current go?". Recall that while the virtual earth at X does provide a very low effective impedance to ground, there is no current path to ground there.

Fig.4(a) shows the actual current path as the heavy line in the case of positive signal current (inwards), while Fig.4(b) shows the picture for negative (outwards) signal currents.

Alternating input current, AC, of course flips about from one path to the other each half cycle. High speed changes in current find a path through the bypass capacitors C1 or C2 (as shown) while low speed changes and the DC component must flow through the power supply. Either way the signal current is heading for ground.

Limits

Readers who couldn't sleep will have observed that Fig.4 implies a limit to the value of current that can be measured by the current-to-voltage converter. Not only does the current flow through Rf, but it must also flow via the amplifier output transistor and the power supply. But no problem — we only want this circuit for the measurement of small currents anyway!

Large currents can always be done the conventional way by a simple series resistor in the current path, when a low value resistor will fill the bill without problems.

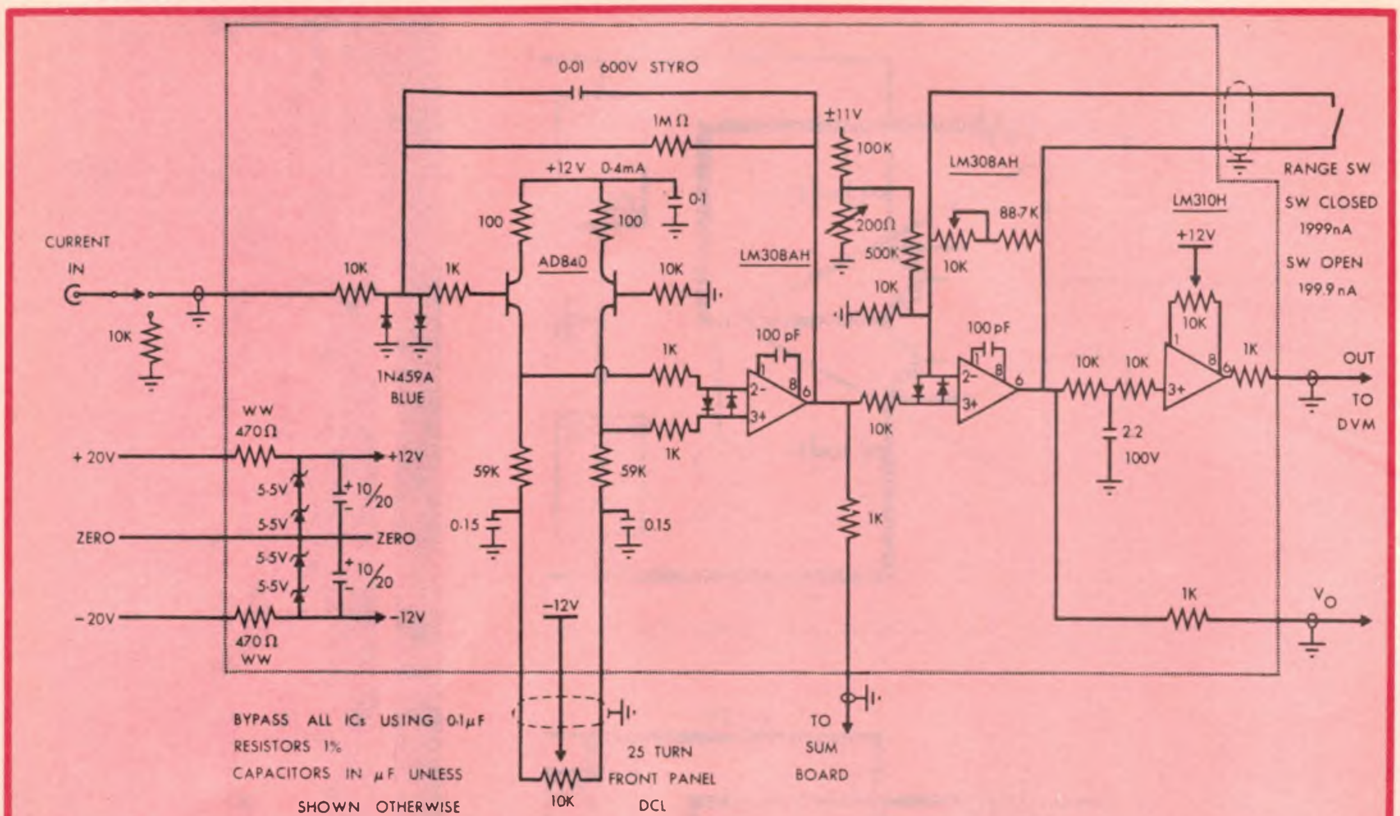


Fig. 5: professional current to voltage converter used at ANU Department of Pharmacology for currents 100pA to 2uA.

OP AMPS Explained

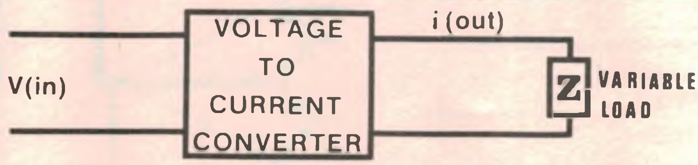


Fig. 7: an ideal voltage to current converter would generate an output current directly proportional to the input voltage, regardless of load variations.

Real application

An application in a scientific research laboratory, ANU's Department of Pharmacology, called for a number of current-to-voltage converters each capable of accurately measuring DC currents from ± 100 picoamps to ±2 microamps. The circuit used for each is shown in Fig.5. The current-to-voltage converter consists of the AD840 dual FET source follower and the first LM308AH acting together as an amplifier with the 1MΩ resistor above as the feedback resistor Rf. This composite amplifier was chosen to give high gain with very low noise.

As any DC input gate leakage current to the FET gate terminal (ie, to the amplifier) constitutes an error in the current measurement, the use of the AD840 with its low gate current kept overall accuracy high. A small capacitor across the one megohm Rf reduced noise while the back-to-back safety diodes used are blue 1N459A's chosen for lowest leakage. The multiturn potentiometer is to trim output to zero with no input.

The second LM308AH is an in-phase (non-inverting) voltage amplifier. With the range switch open, the gain is adjusted to +10 by the 10kΩ potentiometer, making a voltage divider (10kΩ:90kΩ). Closure of the range switch reduces the gain to +1. The 200Ω trimpot adds a tiny current to balance the LM308AH offset to zero.

The last stage, based on an LM310H voltage follower, is a bidirectional low pass noise filter of 22 milliseconds time constant and DC gain = +1. Its purpose is to prevent noise going to or returning from the digital voltmeter load. All integrated circuits on the board are double bypassed on positive and negative rail pins (pins 4 and 7) using 0.1μF ceramic capacitors.

Accuracy and stability are ensured by the use of 1% stable metal film resistors throughout and the use of very stable ±12 volt supply rails. Input power is from a stable regulated ±20V DC supply. All trimpots are 25-turn cermet or wire wound types. Such precautions in design are essential for the stable and accurate measurement of small currents.

A further possible source of error when dealing with currents in the picoamp or nanoamp range is leakage across the PC board surface from the supply rails or other live points to the amplifier input. As a preventative, the amplifier front end is surrounded by earth copper on both sides of the board as in Fig.6.

Voltage to current

For most conversion functions an inverse exists. This raises the interesting question "Can we dream up a method to convert a voltage into a current?" Using op amps can we generate a curent signal directly proportional to a given input voltage signal? Fig.7 illustrates the question.

We are asking for a circuit capable of sending a current i(out) through a variable load Z, with i(out) proportional to V(in), irrespective of what the load may be or how it may change. The mind boggles at the implications!

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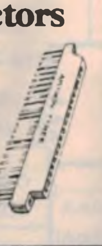

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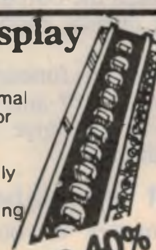

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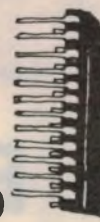

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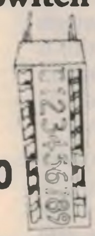

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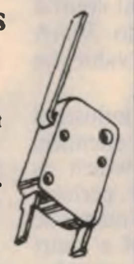

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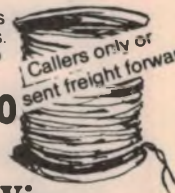

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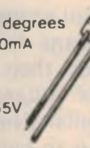

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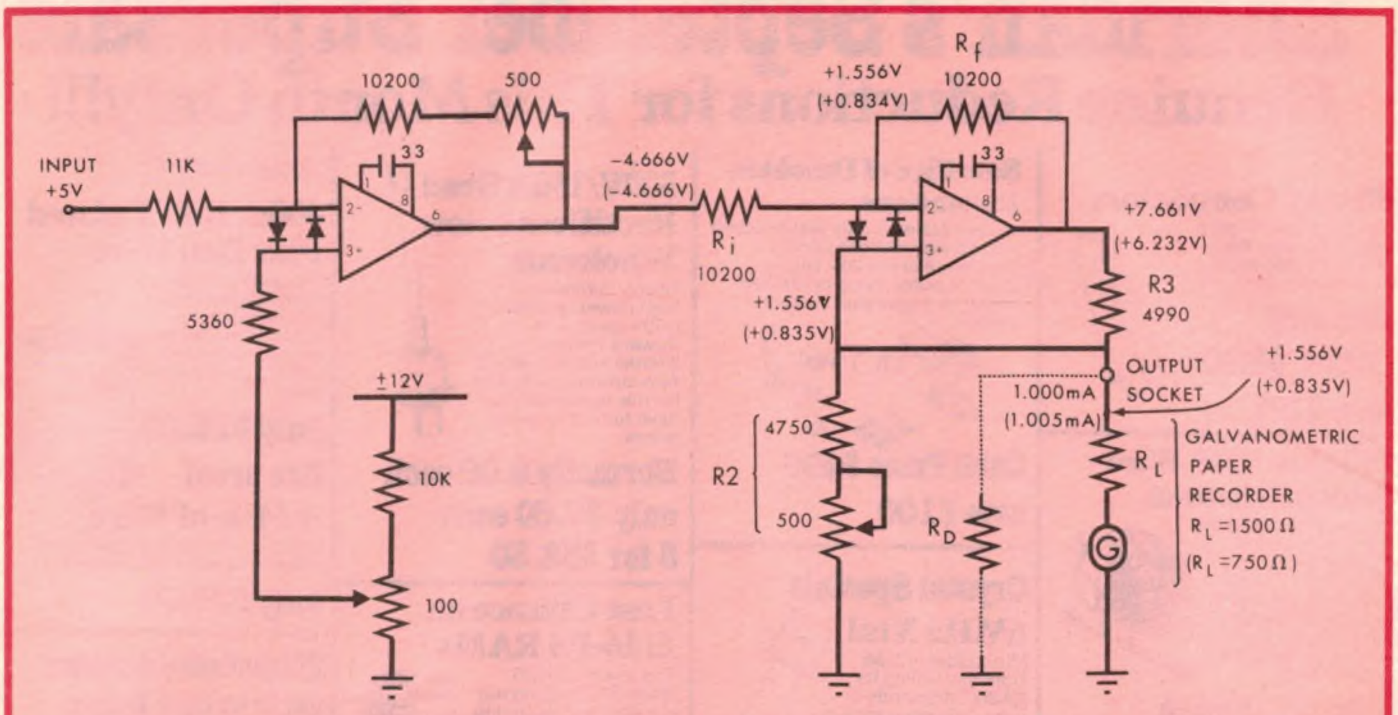

Fig.8: practical voltage to current converter with transfer function 0.2mA/V (range 1μA to 1.3mA).

OP AMPS Explained

If V(in) swings positive then negative, that means i(out) is required to flow outwards then inwards. If V(in) is a string of voltage pulses, then i(out) is to be a similar string of current pulses. And all this is to happen despite any changes that may occur in the load Z. If V(in) is held constant, then i(out) must remain constant; even if the resistance of the load Z were to double, or treble, or halve.

Such a circuit would have a Transfer Function expressed as so many "milliamps per volt". For example, if the transfer function is 20mA per volt and an input signal V(in) varies from zero to 1.5 volts, then the output current i(out) is required to vary from zero to 30mA simultaneously no matter what value the load impedance may be.

An example could be an industrial process where the load Z is a chemical solution, the resistance of which is subject to erratic changes. Or perhaps the load Z is a moving coil in a magnetic field (say a large pen motor of a chart recorder). Then Z will be a complex active impedance which also generates a back voltage of its own with movement.

Even with such a load, the current should continue to be proportional to V(in).

Voltage compliance

It's not hard to see that in making such a demand we imply that our proposed voltage to current converter must automatically adjust its output voltage continually to make up for any changes in the load. Such self-adjustment of output voltage is called the "voltage compliance" of the converter. If Z were to change to higher impedance, then the voltage provided by the converter would have to rise to keep the current output to the stated value.

There must be some limit to such action, and it is called the "maximum voltage compliance" of our design. If the impedance of Z were to rise higher still, then our circuit could no longer follow; it would have reached the "limit of its variables".

The proposed circuit will somehow sense the load current, perhaps by using the voltage drop in a series resistor to provide feedback for some sort of op amp circuit. The output impedance of the unit should also be high, so that changes in load impedance will appear insignificant. (We recall that a circuit's output impedance is the rate dV/di, the small change in output voltage divided by the small change in output current which caused it.)

Practical circuit

The accurate practical circuit, Fig.8, has for its first stage a buffer amplifier, gain −0.95, driving the second stage, the actual voltage-to-current converter which supplies output current to a load consisting of a galvanometric paper recorder pen motor shown as G and R_L. We see that i(out) flows from the integrated circuit pin 6 through sampling resistor R3.

The voltage and current measurements shown on the figure are for +5 volts input and a (nominal) 1500Ω galvanometer as load. Also shown in brackets are readings measured at similar circuit points for same input but for a 750Ω load.

Observe that for either value of load resistance the output current through the load is almost the same, changing only by 0.5%. To accommodate the changed load and keep the same current the voltage at the output socket has automatically changed itself from +1.556V to +0.835V. Normal operational amplifier feedback changes the voltage at the second integrated circuit pin 6 until the input voltages at pins 2 and 3 almost equal. Therefore the voltage drops across Rf and R3 are equal.

We will skip over any urge for a detailed analysis, except to say that of those aforementioned voltage drops, the first is a function of V(input) while the second is a function of output current. It is this relationship by which the whole circuit keeps the output current through the load directly proportional to input voltage.

The transfer function of the circuit Fig.8 is 0.2mA/V and better than 0.1% accurate in the range 1.0 microamps to 1.2 milliamps.

Output impedance

The matter of output impedance

should be considered. Remember the quantity is defined as

$$R(out) = \frac{dV(out)}{di(out)}$$

But for a constant input we would like constant i(out), meaning no change in current, ie:

Ideal di(out) = 0

But this ideal division by zero implies that the ideal R(out) should be infinitely large. Our real circuit, Fig.8, should then be constructed and set up so that R(out) is as high as possible. The circuit accomplishes this by adjustment of the 25-turn wirewound 500Ω trimpot forming part of R2.

The output impedance of the circuit is resistive in nature at DC or low frequencies, and its value is a maximum when:

$$\frac{R3}{R2} = \frac{Rf}{Ri}$$

Practical values for this ratio will only hold good following adjustment if all resistors retain their values at all ambient temperatures. Therefore only 1% low drift metal film or wire wound resistors and 25-turn trimpots are used throughout and the circuit is operated from well-bypassed very stable ±12 volt rails.

Actual R(out) values achieved as a function of adjustment of R2 can easily reach a few megohms as shown in Fig.9. Sceptical readers may jump up and down a bit at the negative values of R(out) indicated but your author (bless him) swears that these readings are real and honest. Negative values of R(out) are easily achievable.

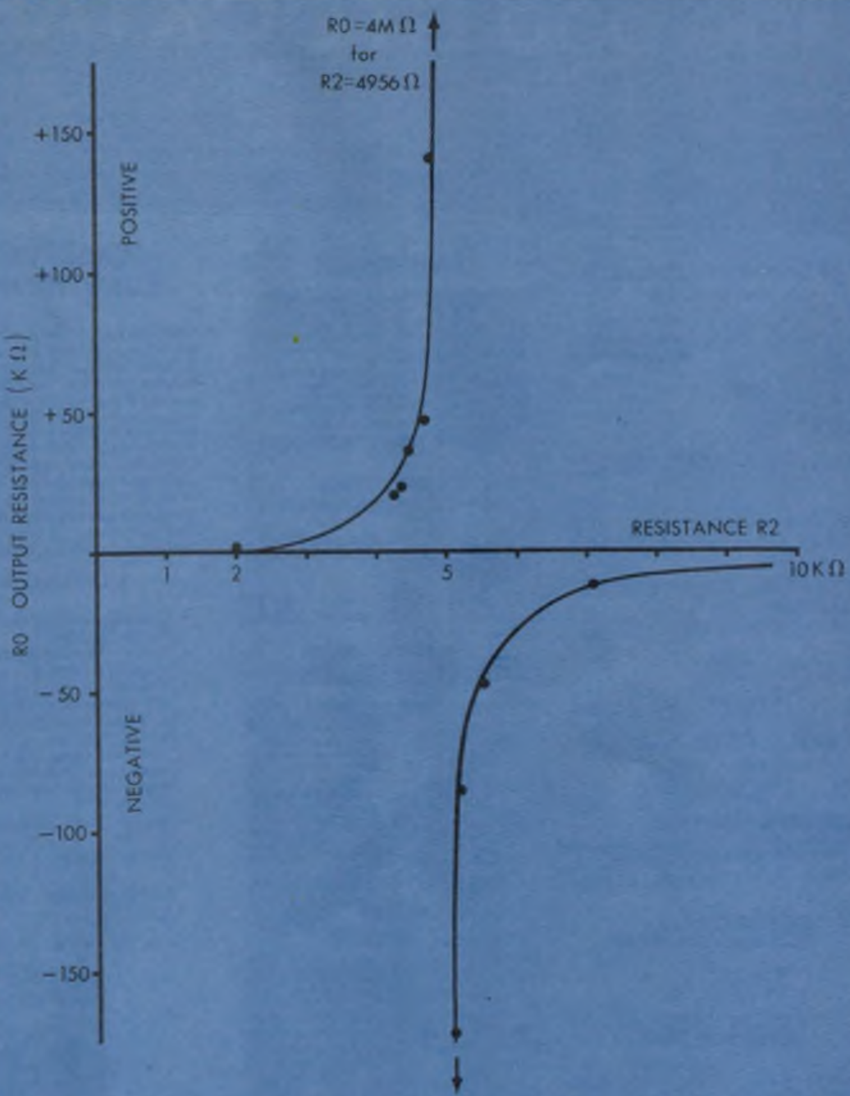

Fig.9: output impedance of the voltage to current converter shown in Fig.8 as a function of R2. Positive and negative values are equally possible.

Damping

Voltage-to-current conversion circuits are often designed for driving moving coil instruments, galvanometers or loudspeakers. For some of these, infinite or very high source impedance is not the ideal, as this leads to overshoot and undamped oscillations in the response. Rather, a particular value of source impedance is sometimes wanted to give the deisred damping characteristics.

This circuit provides for any nominated source impedance to be achieved by inserting a damping resistor of that value in the position marked R_D in the diagram. The source impedance, as far as the load is concerned, is now a few megohms in parallel with R_D which is approximately the same as R_D. For the case of galvanometers, sometimes $R_D$is chosen to give critical damping, ie, fastest movement without overshoot.

Next month we continue this series looking at designs converting random pulse rates or frequencies to voltages and vice-versa.

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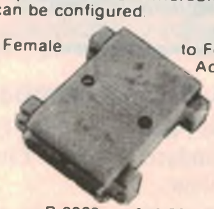

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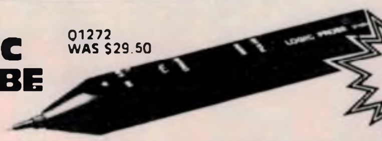

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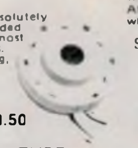

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Part 2

Build a Teletext Decoder

Last month we introduced our new Teletext Decoder and described the LSI chip set used in the design. This month we present the full circuit diagram and detail the construction.

by ANDREW LEVIDO

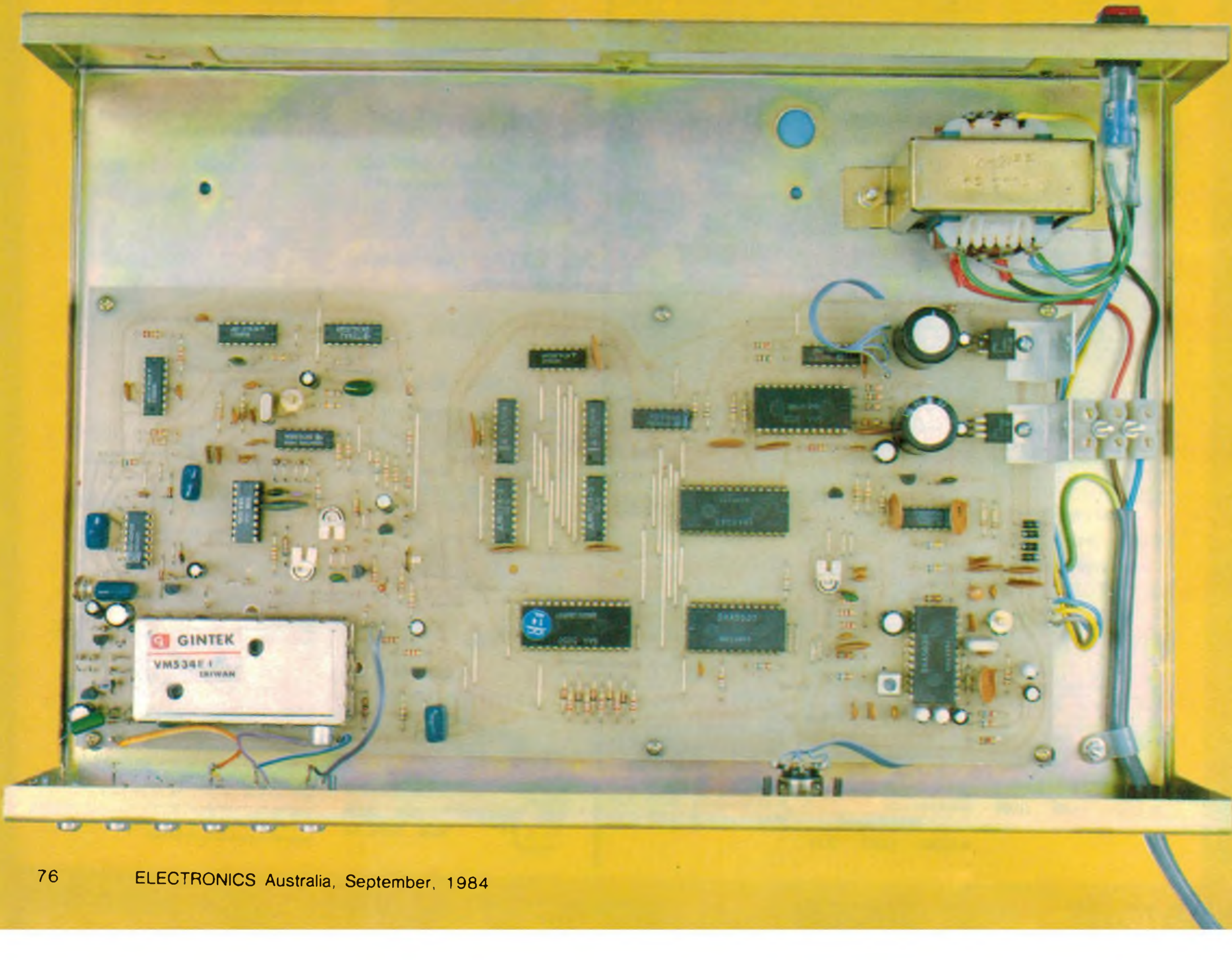
There's just one way to get hold of the parts for this project and that is to buy the complete kit from Dick Smith Electronics. This will include everything necessary to assemble the decoder as well as the ready-made remote control unit. Also included is an assembly manual which details construction on a step-by-step basis.

Before we move on to discuss the construction of the Teletext decoder it would be a good idea to have a closer look at the circuit.

How it works

Since this circuit is quite complex, a detailed description of its operation would take up an inordinate amount of space. Hence, only a brief outline of the function of the circuit will be given. The Teletext chips themselves were discussed in last month's issue, and we will proceed on the assumption that the reader is familiar with the contents of that article.

The remote control receiver (IC1) accepts serial data from the remote control handset, checks it for errors, and outputs a 7-bit serial code onto the CONT line (pin 5, IC5). A clock for this data is also generated and this appears on the DLIM line (pin 5, IC5). This data is



decoded and used by IC5 and IC12 as discussed below.

A "message received" signal and a 62.5kHz squarewave are provided to IC2 which is a dual D-type flipflop. The 62.5kHz signal is divided by four and gated by the "message received" signal to provide drive to the beeper in the remote handset.

Video from the VCR is applied to IC10, the video input processor, which strips the Teletext data from the video waveform as discussed last month. The tuned circuit on pin 21 of this IC is used to derive a 6.937MHz clock from this data. The data emerges on pin 19 and the regenerated clock on pin 18.

The network containing crystal X1 sets the frequency of the internal clock to 6MHz. The output of this clock is fed to IC11 which divides it down to provide field and line sync signals. These sync signals are returned to IC10 where they are compared with the incoming video waveform. In this way the 6MHz oscillator is phase locked to the incoming video signal.

The network connected to pin 14 of IC10 forms an integrator for the field sync separator. Note that the adjustment of VR1 is non-critical if a reasonable video waveform is applied to the chip.

Both the Teletext data and the remote control data are supplied to IC5, the Teletext aquisition and control circuit. The remote control data is decoded and the selected function is stored. When the data for the selected page is received it is converted to 7-bit words and written into the page memory. This only occurs during the period when no picture is being displayed, ie, during the vertical blanking period, as discussed last month.

This period, known as the data entry window, is defined by the timing integrated circuit IC11. IC7, a dual monostable, and Q1 and Q2 are used to slightly change the length of this data entry window and the associated write signal.

As well as this, IC5 provides four control outputs depending on the mode selected by the user. These are: a picture on (PO) output which is high when the TV picture is to be displayed; a display enable (DE) output which is high when Teletext is to be displayed; a big character select (BCS) output which is high when large characters are to be displayed; and a top/bottom (T/B) output which defines which half of the page is to be displayed.

The page memory consists of two 2114 1024 by 4-bit word static RAMs and ICs 6, 8 and 9. These last three ICs are used to change the address format from that generated by IC11 to one suitable to the 2114s.

During the display period the 7-bit words are read out of the page memory

into the TROM, IC12. This IC generates red, green and blue outputs as well as a luminance (Y) signal, and a blanking signal. Timing for these signals is derived from IC11.

Remote control data is also supplied to this IC in order to control the blanking and RGB signals. The blanking signal is used in those modes where text is set into the TV picture on a grey background. The signal is high when the TV picture is to be blanked out. During this and the MIX mode, only white text is required, so the RGB signals are cut off.

The red, green and blue signals are inverted by IC15a, IC15c and IC15d and the positive and negative signals are mixed to produce an R-Y signal at pin 13 of IC13 and a B-Y signal at pin 9. The DC level of these two signals is variable via VR2 and VR3.

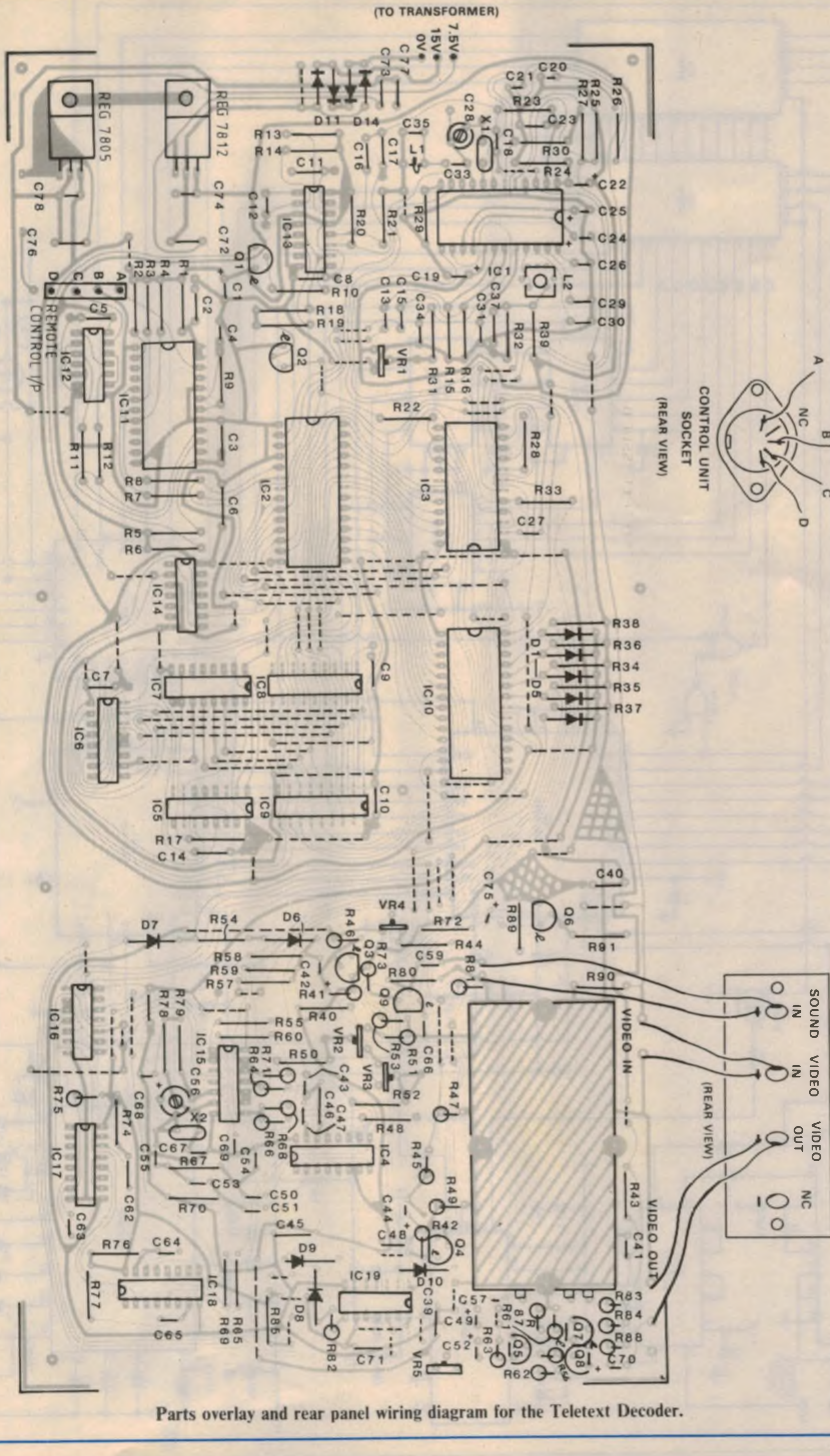
IC13 is used as a colour encoder to generate the chrominance signals and the colour burst. A 4.43MHz oscillator is formed by IC15b and associated components. A phase shifting network ensures that the two oscillator inputs (pin 2 and pin 8) to the modulator are 90 degrees out of phase.

ICs 17 and 18 are driven from the composite sync signal and shift the inputs of IC13 to provide the colour burst at the appropriate time.

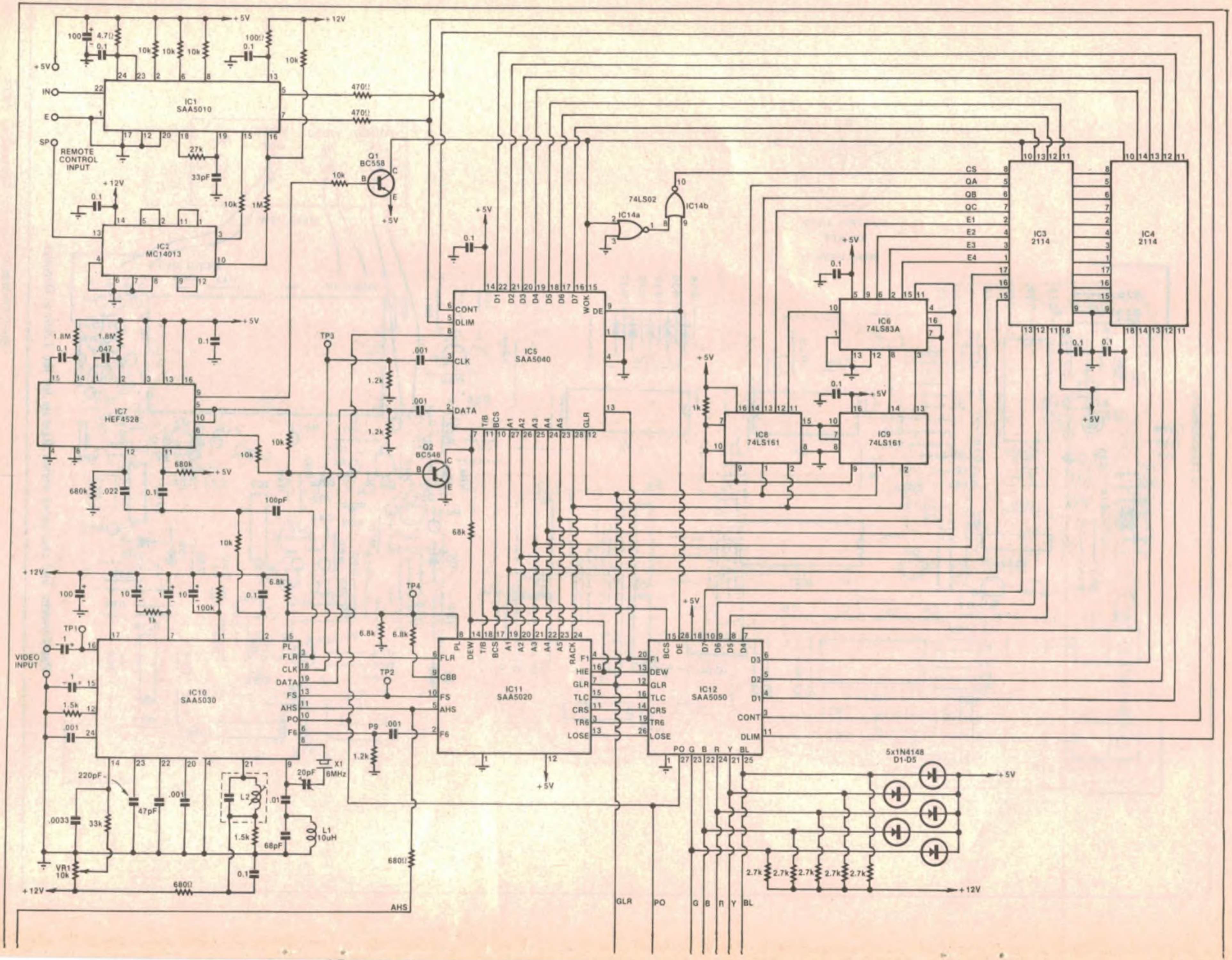
Luminance signals are amplified by Q3 and the chrominance signal from IC13 (pin 5) is added. Sync signals are also added via the 12kΩ resistor and the resulting composite colour video signal is amplified by Q4.

In the Teletext mode the PO signal is low, so the 4.43MHz oscillator is on. IC19d is on and IC19c is off so only the Teletext signal is applied to the modulator and the video amplifier (Q7, Q8 and associated components). Since the output of IC16d is high the audio amplifier (Q9) will be also cut off. Thus Teletext only will be displayed on the TV.

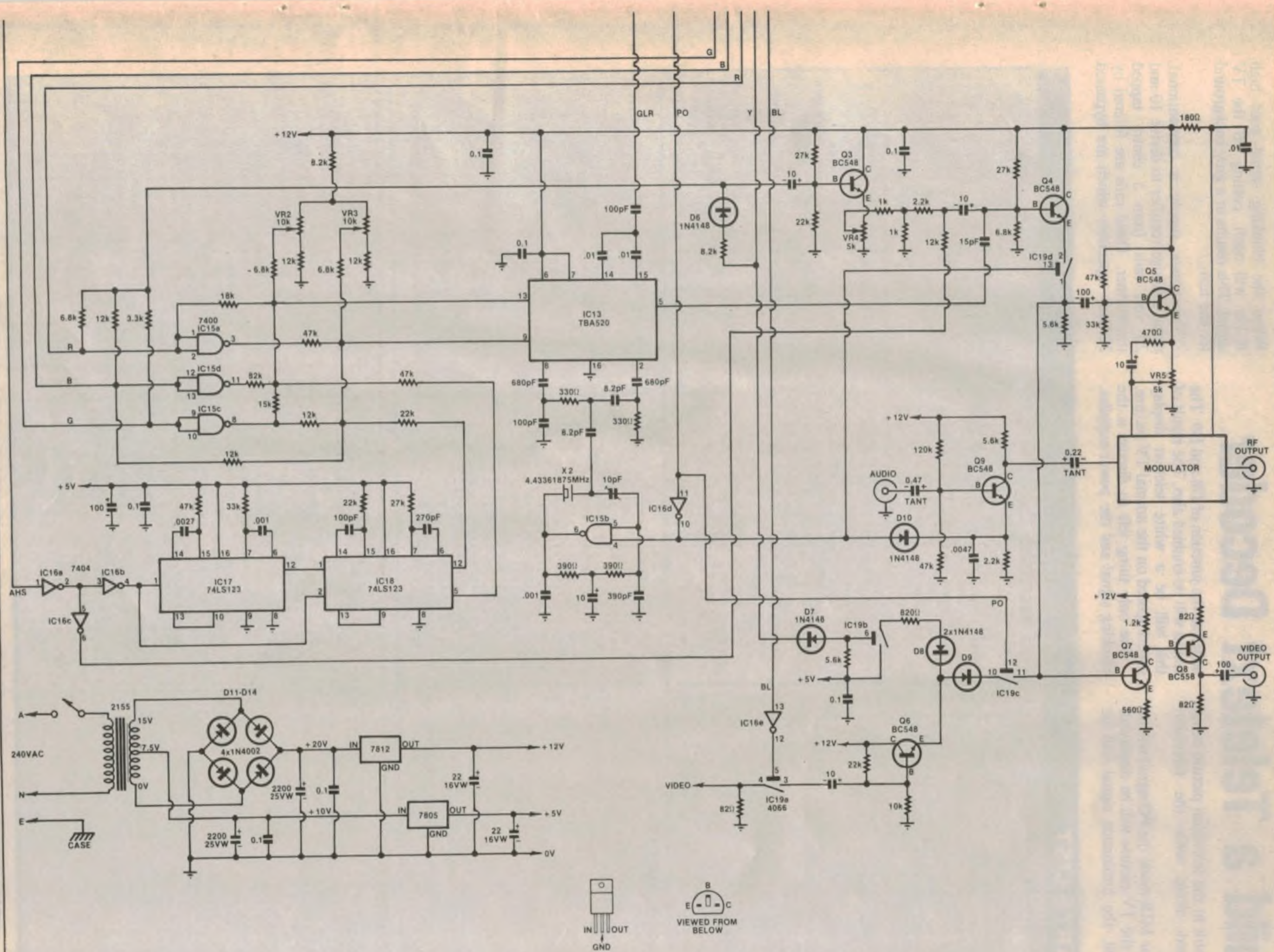
In the television mode the PO signal is high, so IC19c will be on and IC19d will be off. The audio amplifier will operate and the 4.43MHz will be disabled. This



Parts overlay and rear panel wiring diagram for the Teletext Decoder.



IC1
SAA5010
IC2
MC14013
IC3
2114
IC4
2114
IC5
SAA5040
IC6
74LS83A
IC7
HEF4528
IC8
74LS161
IC9
74LS161
IC10
SAA5030
IC11
SAA5020
IC12
SAA5050
74LS02
IC14a
IC14b
Q1
BC558
Q2
BC548
5x1N4148
D1-D5
REMOTE
CONTROL
INPUT
VIDEO
INPUT
X1
6MHz
L1
10uH
L2
VR1
10k
TP1
TP2
TP3
TP4
P9
+5V
+12V
IN
E
SP
CS
QA
QB
QC
E1
E2
E3
E4
GLR
PO
G
B
R
Y
BL
AHS



TELETEXT DECODER

Build a Teletext Decoder

will result in the television picture being displayed along with the television sound.

In the MIX mode the PO signal will be on, so the TV picture will be displayed. As well, the luminance signal will be added at the junction of D8 and D9. The sound will be enabled also. The result of this will be a white teletext display superimposed on the normal TV picture.

The only thing left to discuss is the blanking signal and the power supplies. When the blanking signal goes high IC19a will open, cutting off the TV signal. This results in a grey background for the text.

The power supply is conventional, using a bridge rectifier to derive 10 and 20 volt rails from a centre tapped transformer. These rails are filtered by 2200μF capacitors which are bypassed

PARTS LIST

HARDWARE

Item	Qty
4 Way RCA Socket	x 1
5 Pin Din Socket	x 1
Heatsink Bracket	x 2
Illuminated Mains Switch	x 1
H/U Wire	x 1
Tin/Cu Wire	x 2
Molex Pins	x 180
Rubber Feet	x 4
Screws	x 12
Nuts	x 12
Washers	x 18
Solder	x 1
Circuit Board Supports	x 6
Cable Grip Grommet	x 1
Spaghetti Tubing	x 1
Heat Shrink Tubing	x 1
PCB	x 1
Hand Controller	x 1
Modulator UM1285/LVM2AU01	x 1
Metalworks	x 1
Front Panel	x 1
Back Panel Label	x 3
3 Core Mains Plug	x 1
Transformer DSE2155	x 1

RESISTORS

R1	4.7R	R24	100K	R47	1K	R71	12K
R2	10K	R25	6.8K	R48	12K	R72	120K
R3	10K	R26	1K	R49	6.8K	R73	5.6K
R4	10K	R27	6.8K	R50	6.8K	R74	47K
R5	100R	R28	6.8K	R51	12K	R75	33K
R6	10K	R29	1.5K	R52	6.8K	R76	22K
R7	470R	R30	1.2K	R53	12K	R77	27K
R8	470R	R31	33K	R54	8.2K	R78	390R
R9	27K	R32	1.5K	R55	18K	R79	390R
R10	10K	R33	680R	R56	47K	R80	47K
R11	10K	R34	2.7K	R57	6.8K	R81	2.2K
R12	1M	R35	2.7K	R58	12K	R82	820R
R13	1.8M	R36	2.7K	R59	3.3K	R83	1.2K
R14	1.8M	R37	2.7K	R60	47K	R84	82R
R15	1.2K	R38	2.7K	R61	5.6K	R85	5.6K
R16	1.2K	R39	680R	R62	33K	R86	NOT ALLOCATED
R17	1K	R40	8.2K	R63	470R	R87	560R
R18	10K	R41	27K	R64	82K	R88	82R
R19	10K	R42	27K	R65	47K	R89	22K
R20	680K	R43	180R	R66	15K	R90	82R
R21	680K	R44	1K	R67	330R	R91	10K
R22	68K	R45	2.2K	R68	12K	VR1	10K TRIMPOT
R23	10K	R46	22K	R69	22K	VR2	10K TRIMPOT
				R70	330R	VR3	10K TRIMPOT
						VR4	5K TRIMPOT
						VR5	5K TRIMPOT

SEMICONDUCTORS

Q1	BC558/DS558	D1	1N4148/1N914	IC4	TBA520
Q2	BC548/DS548	D2	1N4148/1N914	IC5	74LS161
Q3	BC548/DS548	D3	1N4148/1N914	IC6	74LS83
Q4	BC548/DS548	D4	1N4148/1N914	IC7	74LS161
Q5	BC548/DS548	D5	1N4148/1N914	IC8	2114/TMS4045/C10615
Q6	BC548/DS548	D6	1N4148/1N914	IC9	2114/TMS4045/C10615
Q7	BC548/DS548	D7	1N4148/1N914	IC10	SAA5050
Q8	BC558/DS558	D8	1N4148/1N914	IC11	SAA5010/5012
Q9	BC548/DS548	D9	1N4148/1N914	IC12	4013/14013
X1	6MHz (xtal)	D10	1N4148/1N914	IC13	HEF4528
X2	4.433MHz (xtal)	D11	1N4002/EM401	IC14	74LS02
L1	10uH Choke	D12	1N4002/EM401	IC15	74LS00
L2	CL-2100 Can	D13	1N4002/EM401	IC16	74LS04
7805	Volt. Reg. 7805/LM340T05	D14	1N4002/EM401	IC17	74LS123
7812	Volt. Reg. 7812/LM340T12	IC1	SAA5030	IC18	74LS123
		IC2	SAA5040/5043	IC19	4066
		IC3	SAA5020	M1	Modulator UM1285/LVM2AU01

CAPACITORS

C1	100uF	(electro)	C26	0.001uF	(ceramic)	C53	8.2pF	(ceramic)
C2	0.1uF	(ceramic)	C27	0.001uF	(ceramic)	C54	100pF	(ceramic)
C3	0.1uF	(ceramic)	C28	1-20pF	(trimcap)	C55	8.2pF	(ceramic)
C4	33pF	(ceramic)	C29	220pF	(ceramic)	C56	1-10pF	(trimcap)
C5	0.1uF	(ceramic)	C30	47pF	(ceramic)	C57	0.22uF	(tantalum)
C6	0.1uF	(ceramic)	C31	0.001uF	(ceramic)	C58	NOT ALLOCATED	
C7	0.1uF	(ceramic)	C32	NOT ALLOCATED		C59	0.47uF	(tantalum)
C8	0.1uF	(ceramic)	C33	0.01uF	(ceramic)	C60	NOT ALLOCATED	
C9	0.1uF	(ceramic)	C34	0.0033uF	(ceramic)	C61	NOT ALLOCATED	
C10	0.1uF	(ceramic)	C35	68pF	(ceramic)	C62	0.0027uF	(greencap)
C11	0.1uF	(ceramic)	C36	NOT ALLOCATED		C63	0.001uF	(ceramic)
C12	0.047uF	(ceramic)	C37	0.1uF	(ceramic)	C64	100pF	(ceramic)
C13	0.001uF	(ceramic)	C38	NOT ALLOCATED		C65	270pF	(ceramic)
C14	0.1uF	(ceramic)	C39	0.1uF	(ceramic)	C66	0.0047uF	(greencap)
C15	0.001uF	(ceramic)	C40	0.1uF	(ceramic)	C67	0.001uF	(ceramic)
C16	0.022uF	(ceramic)	C41	0.01uF	(ceramic)	C68	10uF	(electro)
C17	0.1uF	(ceramic)	C42	10uF	(electro)	C69	390pF	(ceramic)
C18	100pF	(ceramic)	C43	100pF	(ceramic)	C70	100uF	(electro)
C19	100uF	(electro)	C44	10uF	(electro)	C71	0.1uF	(ceramic)
C20	10uF	(electro)	C45	0.1uF	(ceramic)	C72	2200uF	(electro)
C21	1uF	(electro)	C46	0.01uF	(ceramic)	C73	0.1uF	(ceramic)
C22	10uF	(electro)	C47	0.01uF	(ceramic)	C74	22uF	(electro)
C23	0.1uF	(ceramic)	C48	15pF	(ceramic)	C75	10uF	(electro)
C24	1uF	(electro)	C49	100uF	(electro)	C76	2200uF	(electro)
C25	1uF	(electro)	C50	680pF	(ceramic)	C77	0.1uF	(ceramic)
			C51	680pF	(ceramic)	C78	22uF	(electro)
			C52	10uF	(electro)	C79	0.1uF	(ceramic)

Build a Teletext Decoder

by 0.1μF capacitors. Three terminal regulators are used to stabilise the 10 volt rail at 5V and the 20 volt rail at 12V. 22μF capacitors are used on the outputs of the regulators to ensure stability.

Construction

Although the Teletext decoder circuit is complex, construction should present no problems providing care is taken. All components except the mains transformer are mounted on a large single-sided circuit board. Very little other wiring is required.

Begin construction by assembling the circuit board. The board will be supplied with a screen printed component overlay and a solder mask which will simplify construction considerably. Start assembling the board by mounting the wire links and other small components. Use a small soldering iron and a minimum of solder since many of the pads are very small.

The voltage regulators must be mounted on the small heatsinks which are provided in the kit. They are bent to lie flat along the board and a nut and bolt is used to fasten them to the heatsink on the circuit board.

When the board is complete carefully check all that all parts have been properly located, paying particular attention to all polarised components. Turn the board over and check your soldering. Resolder any suspect joints at this stage. If all is OK, put the board aside and turn your attention to the case.

Mount all the connectors on the rear panel of the case, and the mains switch on the front. The front panel label should be applied at this time. The six tapped spacers which support the circuit board should be installed also.

The mains transformer and terminal strip can now be mounted in the chassis. The mains cable must enter through a grommet and be firmly clamped to the case. Complete the mains wiring according to the wiring diagram. Make sure the solder tag for the mains earth is securely bolted to the chassis.

Connect short leads to the circuit board in the places indicated by the wiring diagram and install the board in the case. The wiring can now be completed. Keep the leads to the RCA sockets on the rear of the case as short as possible. Make a final check that everything has been put together properly and the Teletext decoder is ready to test.

Alignment

To set up the Teletext decoder you will need a small screwdriver and some kind of non-metallic alignment tool. We used a piece of blank PCB material filed to a screwdriver point. Set up the decoder near the VCR and TV so that you can see the TV screen while you are working. Make sure that the VCR is properly tuned to those of your local TV stations which transmit Teletext.

Connect the VCR to the Teletext decoder with screened cable. The video and audio outputs from the VCR connect to the video and audio inputs of the Teletext decoder. The output of the video modulator connects to the antenna socket of the TV via a suitable cable.

If your TV has a video input socket you can use this instead of using the modulator. Simply connect the video output of the decoder to this socket. This will give you a better picture but you will need modulator signal connection for the sound output from the VCR since this provides the sound in the TV mode.

Begin the test procedure by making sure that all the trimpots on the circuit board are set to the mid position. Switch on and select the TV mode using the remote control. Tune the VCR to a Teletext station. Adjust the trimpot VR5 for the best picture. This pot sets the video level into the modulator and this first adjustment just sets the amount of drive roughly.

Select the MIX mode and adjust the trim capacitor next to the 6MHz crystal until a stable Teletext image appears over the picture. Switch to the Teletext mode and adjust L2 until correct Teletext information appears. When this coil is properly tuned there will be no errors in the displayed text and the on screen clock will update continually.

Now adjust the other trim cap until colour appears. Do not worry if the colours are not right at this stage. It may be necessary to adjust VR5 slightly to improve the picture. Adjust VR2 and VR3 together to achieve a neutral, dark background, and the best colours on the text. Use VR4 to set the desired contrast level between the text and the background.

Select the TV mode and check that the picture is of good quality, then check the Teletext mode again. Readjust VR5 again as necessary. If you are using the direct video output there will be no need to adjust VR5, and the setting up procedure will be significantly simpler.

Try all channels which are transmitting Teletext, and check all the modes and functions. If any incorrect or corrupted data is displayed the fine tune control on the VCR must be adjusted. The VCR is properly tuned when the clock updates continually.

Reader reactions to the

Continuing the recent hifi "golden ear" debate, a Victorian reader has a "bob each way". He comments on several of my observations without really disagreeing with them yet, at the same time, hastens to accommodate the "golden ear" set — all with his tongue "firmly in cheek". The man should have been a politician!

FORUM

Conducted by Neville Williams

The letter comes from North Balwyn, Victoria and, while the writer's name is well known to me, and possibly to others, I shall identify him simply as A.F.

It's a fairly long letter and, to obviate the need for a feat of memory, I have chosen to break it up into segments and to intersperse comment, as appropriate. The contents of the letter appear throughout in italics, somewhat abbreviated to conserve space. It opens on a personal note:

Firstly, I would like to wish you well in your retirement and to thank you for the help you have been over the years. I have been reading EA and its predecessors for a long time and I doubt that I've missed an issue in forty years. The original "Radio & Hobbies" sparked my interest in electronics while at school and I subsequently qualified as a professional engineer. Since then, EA has been a major source of information during my career and there is no doubt that your personal efforts in the magazine have had a significant affect on several generations of electronic engineers and technicians.

COMMENT: Thank you, A.F. but I must share any credit with other members of the team.

You seem to be enjoying your retirement with, hopefully, more work than you know what to do with. But, just in case you've run out, let me take up your comments in the May issue on loudspeaker cables, etc. It's a long time since I've had an active involvement in audio systems, so some of the following may be a little rough around the edges.

In the first place, if critics insist that they can detect a difference in listening tests, either it's all in the mind (in which case it's a matter for psychologists to assess) or there really is an electrical effect that can be measured. If there is and it can't be measured by present techniques, we are probably using the wrong approach.

Frankly, most of the arguments sound very much like triode versus pentode, or direct coupling versus capacitance coupling of the 1940/50 era. Do you remember when an amplifier with about 3% THD was regarded as magnificent?

COMMENT: There was certainly a lot of spontaneous argument, in the early days days, on triode versus pentode output valves but no great mystery at an engineering level. One of the leading exponents of output valve behaviour at the time was the late Fritz Langford-Smith, editor of "Radiotronics" and the "Radiotron Designer's Handbook". I prepared most of the graphs and diagrams for his papers on the subject so that — if I may mix a couple of metaphors — I got the good oil straight from the horse's mouth!

As for the direct coupling, I could hardly forget that either. This very column was born as "Let's Buy an Argument" in September 1950 when, in sheer exasperation, I took to task the editor of "Australasian Radio World" for perpetuating what I considered to be a myth: namely that a dramatic improvement in performance could be obtained by simply eliminating the coupling capacitor to the grid of the output valve (see "Where it All Began", EA Sept '83, page 36).

I considered it a myth on the grounds that any advantage that one stage of direct coupling could conceivably have over the properly designed alternative would be totally negligible, especially in the context of very serious distortion from other sources. The claims as published simply didn't make sense — which gave rise to the above heading.

It's one thing to have an open mind; it's quite another to have a hole in the head where your brain should be!

As you obvserve, A.F., an amplifier in those days was doing very well indeed to offer its full rated power with no more than 3% THD. And no wonder: even the glamour power triode of the era, the 2A3, had an intrinsic THD rating of 5% at full output, single-ended, and between 2.5% and 5% in push-pull. THD with pentodes and tetrodes was generally higher, particularly into reactive loads, with one set of operating conditions for the 6L6 offering 10.8W in single-ended class-A at 15% THD!

It was largely due to negative feedback that we managed to get the distortion down to the "respectable" small-digit range, as mentioned. However, it is necessary to keep in mind that available signal sources at the time were pathetic by modern standards, with 78rpm equipment users often referring enviously to the clean, crackle-free sound in theatres! But, back to the letter:

You say that "as a rule of thumb, it is commonly accepted that the DC resistance of the leads and connections should not exceed 5% of the DC resistance of the loudspeaker system". I learned early not to trust "rules of thumb" because people often forget how they were derived. They may have been valid originally but, when the situation changes, they may not apply any more.

If the 5% was based on acceptable power loss, it's probably a reasonable figure but is power loss the most important consideration? Modern amplifiers, with an output impedance of around 0.1 ohm, provide a reasonably "stiff" supply to the loudspeaker. If we add a cable resistance of 5% or 0.4 ohms to an 8-ohm system, the source impedance seen by the loudspeaker will be 0.1 + 0.4 ohms. How will this 500% increase in source impedance affect damping and transient response?

COMMENT: The rule of thumb was not quoted as a recommendation but as a limit figure which could hopefully be bettered. It carries the same connotation in what follows.

A.F's reference to a 500% effective increase in amplifier output resistance sounds horrendous at first encounter but I suspect that it was typed with tongue in cheek because, considered alone, it is meaningless.

That statement calls for an explanation:

In normal mode, a dynamic loudspeaker operates as a motor, absorbing drive from the amplifier.

Conversely, when the voice coil/cone assembly tends to overshoot, by reason of its mass and momentum, or to oscillate because of mechanical resonance, it behaves more like a generator, feeding current back into the output system. If this unwanted

'golden ear' debate

Weird ideas about copper cable

Dear Mr Williams,

I fully agree with your remarks in the May issue of EA. Some of those "Pom" boys certainly get weird ideas about copper wire, etc.

You may recall that, in the mid '60s, you published an article about my own system. At the time, I lived at Nowra, NSW, and had built a huge pair of horns into one wall of my studio to reproduce the bass.

I lived in Nowra until five years ago and the horn system went through many changes, ending up as a complete JBL combination, with very good results. Mostly, I used an Amcron 300A amplifier, with Amcron preamp. I also used a state-of-the-art amplifier (still do) made by my friend Ralph McIlwraith.

Following a move to Melbourne for family reasons, my new studio is acoustically much better, with high "cathedral" roof, concrete floor and brick walls. My present system consists of JBL 4350 studio monitors and, recently, a pair of 4430 Bi-Radial studio monitors. These are bi-amped, with a McIlwraith mosfet amplifier for the high frequencies and an Amcron 300A-II for the bass.

This brings me to a query about some of the blokes who write in the hifi journals. I read them all.

In a recent issue of "Australian HiFi", Neil Sudbury states that his loudspeaker protector would not allow him to play the compact disc version of Saint Saens' Organ Symphony No. 3, on Telarc. He said that it would not allow his straining amplifiers to deliver the signal to his speakers and he claims that it needs 10,000 watts to accurately reproduce music peaks.

Well, I've been blissfully playing that disc on both my systems and on both sets of loudspeakers. So far, I have had no need to duck for cover, nor have I blown anything up, even when playing it at a pretty brisk level.

I'm blowed if I can understand the bitching that is going on about compact discs. To me, they sound fantastic and leave conventional old discs for dead.

I've been a dedicated hifi butt for a long time and while I'm 73 years old now, I can still hear those lovely highs and lows, thank the Good Lord! I have an extensive record library of about 2500 recordings and still play some of them, despite C.D.

I've used all sorts of pickup heads and turntables, current equipment including Revox B790 and Thorens TD115, Denon 1000 MC cartridge, Shure V, Ortofon, Stanton, etc, along with two Nakamichi tape decks.

I've read so much junk about turntables giving this and that better sound, a lot of which I think is absolute rot.

Mr Williams, I hope you are well and happy in your retirement but please: more commonsense articles like the May instalment. I had a darned good laugh!

L.L. (Donvale, Vic)

mechanical energy can be dissipated quickly as heat (I^2R) the system is considered to be suitably damped.

Both modes (motor and generator) are a function of ampere-turns, or the current through that portion of the voice coil which is passing through the magnetic gap. This, in turn, is the Ohm's Law resultant of E (the voltage from whatever source) divided by the sum of ALL resistance in the current path — and that includes the resistance of the voice coil itself.

By way of example, A.F. suggests 0.1 ohm for the amplifier output resistance, 0.4 ohm for the leads and 8.0 ohms for the voice coil — a total of 8.5 ohms. While this may be an over — simplification, it will serve to illustrate three points:

- The output resistance of a modern amplifier is likely to be so small, relative to the total, that it could be (say) doubled or reduced to virtual zero, without much affecting either drive or damping current and, therefore, either transient response or system damping.
- Lead (and contact) resistance is likely to be a more significant quantity in a typical system but its influence on voice coil current (and performance) can only be small if it is kept below 5% of the resistance or — to be more precise — the impedance of the loudspeaker system.
- The ratio of lead to amplifier resistance is incidental; what really matters is their sum. This should be kept as small as practicable and, again, should not exceed 5% of the load impedance.

Perhaps one should ask what happens if you drive a loudspeaker from a perfect voltage source? Or a perfect current source? What source impedance is a loudspeaker designed to operate from? Do any manufacturers tell you?

COMMENT: These are valid queries, primarily because the input impedance of most loudspeaker systems varies widely across the audio spectrum — often by 2:1 or more, either way, from the published value. An 8-ohm system, for example, may dip to 4 ohms at some frequencies and rise to 16 at others.

Loudspeaker manufacturers are seldom very explicit about the conditions under which they test and calibrate their products. However, most of the set-ups I have come across involve placing the system out-of-doors, or in an anechoic or other chamber, with the amplifier and test equipment in a booth about 10 metres away. As such, the signal drive conditions have been generally similar to accepted (good) practice in studio or home, and a fairly close approach to low-resistance, constant-voltage feed. In other words, they use an amplifier with a typical modern amplifier which has very low output impedance.

Whether or not so intended, A.F's question about a "perfect voltage source" prompts a rather mischievous thought: what happens when a super-buff drives a "normally designed" loudspeaker with a super-power, super-low impedance amplifier, through super-low resistance leads? Does he/she further improve the performance or do they simply exaggerate the drive, beyond the manufacturer's expectation, at the impedance minima?

It would be strange indeed if some of the differences which golden-ear buffs hear and cherish are prominences rather than plateaus!

"Yesterday, in hi-fi fare,
I heard a peak that wasn't there!"

You mentioned skin effect. The skin depth in pure copper is about .06mm at 1MHz but about 9.5mm at 50Hz. As a rule of thumb, it is probably all right to dismiss skin effect at audio frequencies. But is it? At 10kHz, the skin depth is about 0.6mm. Therefore in a cable like "Absolute", with conductors about 7mm in diameter, skin effect will significantly increase the resistance at high frequencies. For an isolated wire in free space, the AC resistance at 10kHz will

probably be two or three times the DC resistance. Where the wire is one of a pair, the current will tend to concentrate on the adjacent surfaces, further increasing the AC resistance to perhaps 3 or 4 times the DC figure.

COMMENT: When preparing the earlier article, I had a quick look through available textbooks to get some idea of the likely significance of skin effect at high audio frequencies. It became obvious, however, that I was not going to find any instant answers, because skin effect involves the nature of the individual conductors, the number, proximity and spiral pattern in a multistrand conductor, the nature of insulation between strands and so on — details that I did not have on hand.

The indications were, however, that skin effect could be at least marginally significant, which was why I mentioned it. A.F's observations strengthen that impression and suggest, further, that the most cost-effective loudspeaker cable may not be one that simply boasts the greatest weight of copper, the largest number of strands — or the fanciest configuration that someone has been able to dream up!

If it hasn't already been done, there would appear to be a place for a technically valid research project which will identify an acceptable order of DC resistance (therefore copper content) and a physical form that will best look after inductance, capacitance, skin effect and any other characteristics that might emerge. A.F. continues:

Mr Swann may not be so stupid in using lead tubing. Indeed, there could be an advantage in using tubing rather than a solid conductor to keep the AC resistance reasonably constant over the audio range. Perhaps, for the sake of flexibility, he should have used conductors wound on a 6mm nylon core! Perhaps he could do so using insulated wires. Have you ever seen braided cable carrying a very high RF current? It doesn't follow the wires; it jumps across the joints and may even weld them where they touch!

COMMENT: If A.F. is not careful, he will go down in history as the man who invented the use of RF coaxial cable for hifi loudspeaker leads! Or is he cautioning against its use because of erratic current flow along the braid?

Looking at another possible problem, the output transistors in a modern audio amplifier often have a very good performance at radio frequencies. The description of the "two metres" of cable is starting to sound very much like a pair of Lecher bars, with a funny looking short circuit (the speaker) across one end. How will these affect the HF stability of the amplifier and its performance?

There's also the matter of "directional" cable. Suppose a cable has plugs at each end and that the amplifier and loudspeaker have similar sockets. Suppose that certain of the mating contacts are at maximum dimensional tolerance, others at minimum. Depending on which way round the cable was connected, the connections might make good contact, or one might be loose enough to make poor contact and affect results. Don't laugh; I'm serious. Stranger things have happened.

COMMENT: Ever since the days of the (in)famous Williamson, amplifiers with a high order of multistage negative feedback have tended to be touchy about what was hung on their output terminals. Years ago, in the EA lab, we had the experience of seeing amplifiers become unstable when connected to a length of one particular out-of-this-world cable. They sounded "different" but for the wrong reason!

As to a possible Lecher bar effect, who knows? And the same profound remark is probably appropritate for A.F's theory about possible plug and socket problems.

As for computer and long distance telecommumications engineers being clued up on cable technology, perhaps you might like to think again. I've known a lot of them in my time and I've interviewed many of them for jobs. I think you'll find that the only ones who have any kind of understanding of the problems and effects are those working on that specific problem. It's not surprising when you consider the scope of electronic engineering. Although they may have covered the topic briefly during class lessons, there is so much else to learn that the details are usually forgotton very quickly.

If you want a good example, have a look at a selection of PC boards for digital circuits. How many of them have been laid out with a proper earth plane or, at the very least, with the power supply rails forming a grid on the board

Continued on page 115

Why Sydney's music sounds better

Dear Mr Williams,

You are quite rightly questioning your own audio "faith" after reading "sermons" in Hifi News & Record Review *on the special properties of some loudspeaker cables and their "directional" musicality.*

I would like to offer my own findings on the effect of directivity of jumper wires, leads, etc on the quality and enjoyment of music, based on specific local observations, as follows:

- *It is a recognised fact that the Robert Blackwood Hall in Melbourne has the finest acoustics of any such hall in the whole known world.*
- *Any Melbournite can tell you that the Sydney Opera House Concert Hall has never had its reverberation time adjusted correctly.*
- *Having never visited either hall, I can only speak, personally, of what I hear through headphones, via FM radio.*
- *Concerts from Sydney all sound more alive and vibrant than those from Melbourne which, to me, sound a bit on the "dry" side.*

Puzzled, I began making inquiries from ABC engineers, Telecom engineers and even from the Post Office technical staff as to the ways and means of microphones, mixers, line amplifiers, senders, etc . . . as to how they were interconnected. I was all set to discover phase reversal somewhere in that complicated hook-up, but no go!

I was assured from all responsible — and irresponsible — quarters that everything has been connected the right way round They could find no explanation for why music from Sydney should sound better than that from Melbourne.

In due course, I managed to obtain two large, glossy photographs, one of Mr Charles Mackeras conducting in Sydney, and the other of Mr Hiroyuki Iwaki doing the same in Melbourne. In case the answer to my dilemma should be hidden in these pictures, I studied and compared them in the smallest detail.

And just when I had given up all hope of finding the answer, there it was, staring at me, and for all the world to see:

*It was *Hiroyuki Iwaki* pointing at the orchestra — with the wrong end of his baton!*

C.N (Salisbury Downs, SA)

** With apologies to Hiroyuki Iwaki.*

SMOKE DETECTORS

The consumer flop that should never have flopped!

One of the greatest consumer flops of the last decade was the ionization-type smoke detector.
Even though it was a brilliant product (see box), is reliable, compact, easy installation, fail safe etc., it just did not sell. Apparently human nature being what it is finds safety-oriented products just not worth the investment however modest. We all know, for example, that accidents and fires never happen to **US!!**

We all know also, that smoke is the greatest killer in a fire. Many fires smoulder for hours before catching alight and causing physical damage.
The US market research gurus thought that a cheap, compact smoke detector would be a mass consumer item. But boy, were they wrong! When they sold for **$49.50** no one wanted them. The price fell to a very reasonable **$29.99** and still they stayed on the supplier's shelves. Jaycar was called in.
We have now been instructed to sell them for less than ½ this amount!!
Now no-one, no-one has an excuse. You owe it to yourself, your children and family to afford them this simple, reliable and low cost protection. If you are a Hotel, Motel or Lodge operator don't miss this wonderful opportunity to install smoke detectors at a never-to-be-repeated price.
Cat LA-5090

ONLY $14.98

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For those unfamiliar with the product, a brief description: A minute speck of the rare element Americium 241 is enclosed in a sealed metal chamber within a compact plastic case that contains control electronics, battery and solid state alarm. A very small ionised field is set up within the chamber. When smoke enters the case and then the chamber, the chamber changes electrical state and the external circuit switches on the alarm. The chamber detects down to very low smoke levels. The electronics circuit is run by a 9V battery. When the battery is getting towards the end of its life the circuit automatically gives you up to two weeks warning by emitting distinct beeps.
If the idea of a radioactive device concerns you, don't worry because this device emits less radiation than your average clay-fired housebrick!!
The "Smoke Sentry" is completely self-contained, is round and measures a compact 115mm diameter and 40mm deep. Fixing screws (even masonry plugs!) are provided as well as 9V battery and very comprehensive instruction manual.

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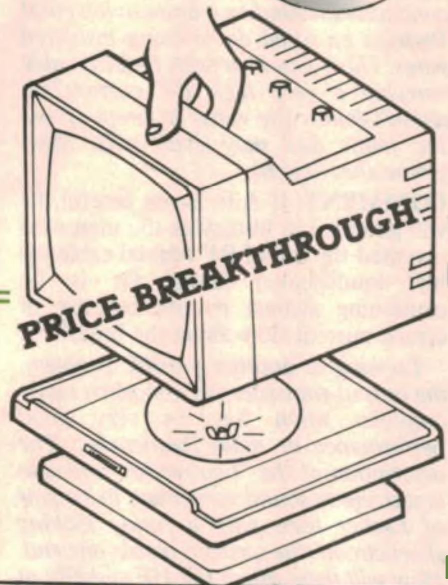

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Now you can mount your monitor on a swivel/tilt base to maximise the viewing angle (and reduce glare) of your computer monitor.
Until now tilt bases were expensive or only fitted to expensive monitors. Now you can have one in your home for under $30!!!
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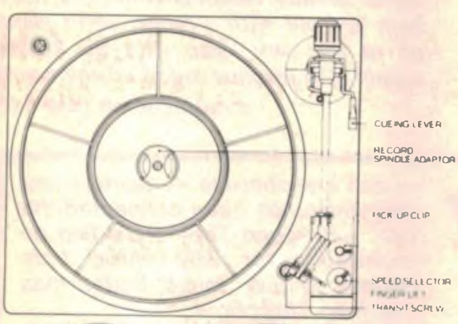

ELECTRONIC BELT DRIVE TURNTABLE

Jaycar has made a sensational scoop purchase of BSR belt drive turntables from England at below manufacturers cost!
Two models available AA-0290 works from 9-12V DC and the AA-0292 from 240V AC (includes 12V 500mA adaptor). The DC motor drive is electronically controlled.

SPECIFICATIONS:

- ★ Dimensions 330(W) x 285(D) x 60(H)mm overall
- ★ Platter diameter 280mm
- ★ 2 speed - 33 & 45 rpm (internally adjustable)
- ★ Pick-up arm counterbalanced type with cueing facility
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- ★ Turntable operation - auto stop, will return to rest automatically. Turntable chassis is sprung on all corners with transit screws & clips ★ Weight 1.5kg
- ★ Output stereo RCA sockets underneath unit

Check the price! Cat. AA-0290
(Requires 9-12V DC @ 500mA)

ONLY $29.95

240V version -
(Includes 12V 500mA adaptor)
Cat. AA-0292

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(Due to the weight of the unit post and packing is $5 NOT $4.50)

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HUNDREDS OF APPLICATIONS
FROM ONLY 75¢!!!!

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Cat. LA-5270

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Each unit is individually calibrated and comes complete with data.

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"T" piece for fuel bypass systems.
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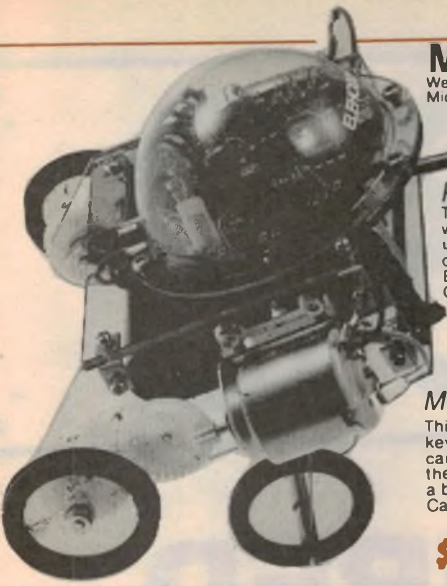

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We have secured another shipment of the two most popular Micro Robot kits. **SEE REVIEW IN EA MARCH '84!**

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This robot is controlled by a keyboard (which is supplied). The keyboard plugs into the robot. Up to 256 discrete commands can be entered into the robots memory (RAM). The robot will then move according to programmed instructions. Lights and a buzzer can also be programmed to operate as well.
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- IDEAL FOR AIR TRAVELLERS!!

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They are uncomfortable (in our opinion) and unless you get a good fit, the sound quality is poor. Wouldn't it be nice to be able to use your OWN high quality headphones in flight?

NOW YOU CAN!!

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

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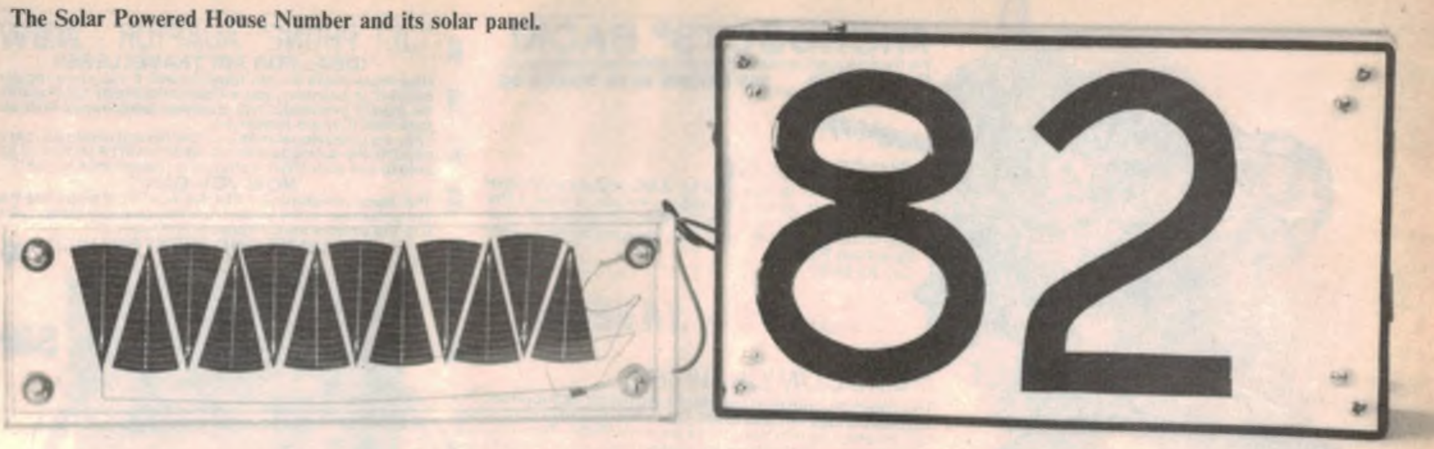
The Solar Powered House Number and its solar panel.



SOLAR POWERED HOUSE NUMBER

by COLIN DAWSON

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.

Illuminated house numbers are a great idea but they invariably have one drawback — you have to remember to switch them on at dusk and off again when you retire. They also tend to be expensive. Any system powered directly from the mains must be installed by a licensed electrician although it is possible to use a low-voltage lamp with a step-down transformer.

By contrast, this project is completely automatic in its operation and provides an illuminated house number that is independent of the mains supply. Two rechargeable batteries, topped up during the day by solar cells, provide power for up to 30 high-brightness LEDs. These, in turn, backlight a number mask attached to a tinted plastic backing.

The project operates by using a light dependent resistor (LDR) to monitor the ambient light level. As dusk falls, the LDR resistance increases until, at a certain critical level, the circuit triggers and illuminates the LEDs. A second LDR controls the LED brightness while a timer switches the LEDs off after six hours to minimise battery drain.
An optional "retrigger" switch can be used to reset the timer circuit for a further six hours of operation if required.

A feature of the circuit is that it is very easy to build. Most of the components are mounted on two printed circuit boards (PCBs) and housed in a plastic zippy case that can easily be waterproofed. The solar cells are wired in series and sandwiched between two sheets of perspex to protect them from the weather.

Use of the solar cell array dictated that the circuit be carefully designed to minimise current consumption. Apart from the timer circuit already mentioned, the LEDs are driven in series pairs, a technique that enables two LEDs to be driven with the same current as a single LED. In addition, a multiplexer ensures that no more than three LED pairs (out of a total of 15) are turned on at any given time.

Finally, we have the automatic dimmer circuit which gradually reduces the drive to the LEDs as it gets darker.

Batteries

Initially, we had proposed a simple solar-charged battery circuit consisting of three or four small nickel cadmium (NiCd) cells and a preassembled solar panel costing about $30. Unfortunately, both of these choices proved unsuitable. The solar panel simply lacked capacity and a NiCd battery of suitable capacity turned out to be more expensive than we had anticipated. The alternative was a new sealed lead-acid cell manufactured by Gates Energy Products, USA. These are available in several sizes, with the smallest (illustrated) equivalent in size to the familiar "D" cell. Strictly speaking, this is larger than necessary for this project — two such cells, wired in series, could run the circuit for at least a week without re-charging. Whilst this in itself is desirable, it also meant that the preassembled solar cell package lacked sufficient capacity to take full advantage of the batteries.

Another impressive specification of the Gates cells is their low internal resistance and consequent high discharge capability. The application manual lists the D cell as providing a maximum power transfer of 130W at 130 amperes! Whilst this is of no particular advantage in the Solar Powered Street Number, there are no doubt many situations where it could be used to advantage.

Solar cell array

Having settled on the batteries, the next task was to devise a suitable solar cell array. Preliminary tests had already indicated that the preassembled array lacked sufficient capacity and, in any case, was not really waterproof. Eventually, we decided that a more suitable unit could be built "from the ground up".

What we wanted was an array completely sealed against the weather and capable of supplying at least 20mA at 5V in indifferent sunlight. Most of the cells we tested had a useful output in bright sunlight towards the middle of the day. It's outside of these circumstances that the cell's performance is critical.

We eventually chose cells rated at

The two LDRs are on the right.

78mA and 0.45V. These are 30° circular segment types, available from Jaycar (Cat Zm9004). Twelve are required in all, giving a nominal voltage of 5.4V when connected in series.

This may seem excessive for a battery voltage of 4.2V, but remember this is only the strong sunlight rating. It will be somewhat less during the early morning and late afternoon.

The actually charging rate will vary from about 20mA up to a maximum of 50mA in reasonably bright sunlight, with an average somewhere around the 30mA region. Assuming that this average rate is available for six hours, a daily charge of 180mAh would be accumulated.

In calculating the necessary solar panel capacity, we have assumed that the circuit will operate for six hours per night, althought this can easily be altered. The circuit draws only about 80μA during the standby mode, increasing to a maximum of 60mA just after sunset (LEDs at maximum brightness), and then reducing to about 8mA in total darkness due to the action of the dimmer circuit.

The total amount of power consumed during the six hours of operation thus depends upon the length and brightness of the twilight period. Generally, 110mAh will be the greatest demand.

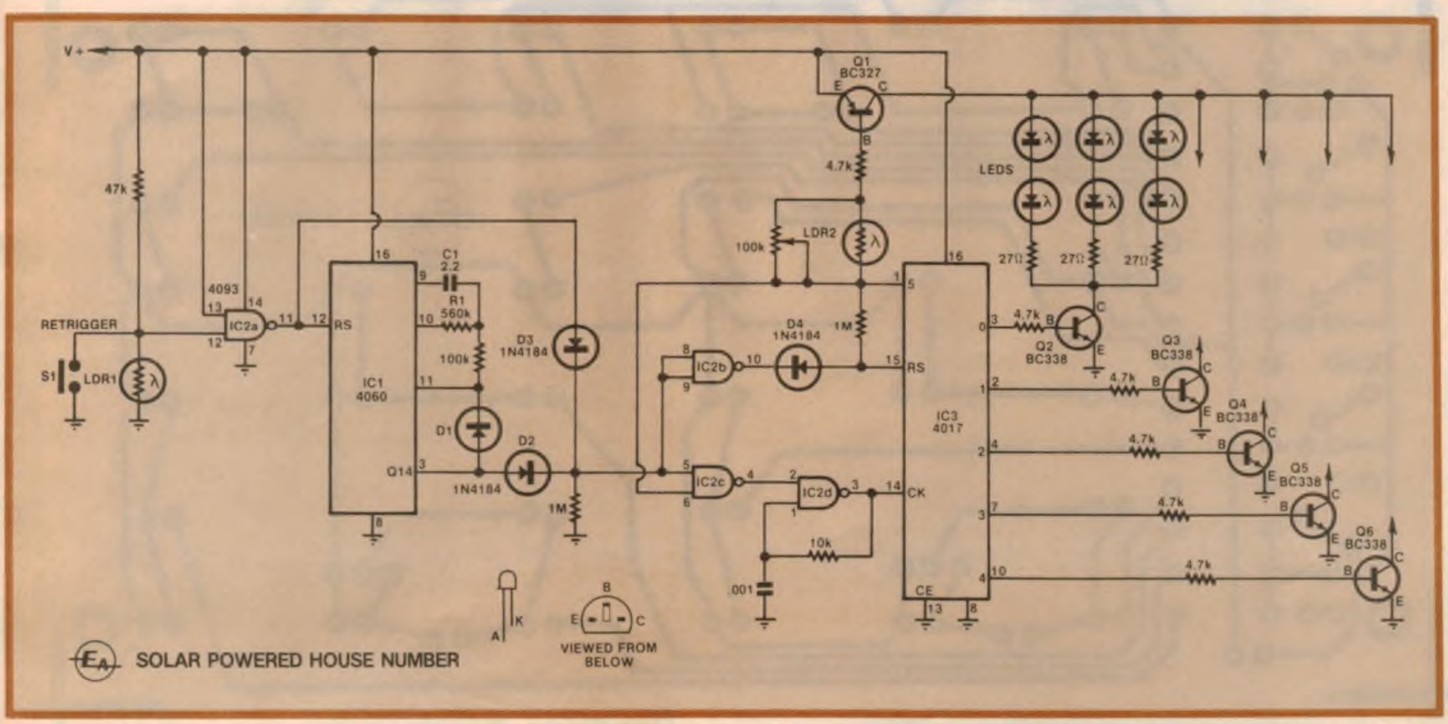
With charging losses generally accepted as 10% of the total charge, a typical daily demand on the solar cells would be thus about 120mAh. The difference between this figure and the actual capacity of the solar cells (180mAh) is important for two reasons: first, and primarily, it ensures that the batteries will eventually be restored to full charge when the sun does shine after several overcast days. Second, the number of days on which a full charge can be acquired is greatly increased because less than six hours of sunlight is needed for this charge.

Circuit operation

The circuit can be divided into five sections: a light detector/switch (LDR1 and IC2a); a timer (IC1); a multiplexer (IC3); a LED driver stage (Q2 to Q6); and a dimmer control circuit (LDR2 and Q1). Let's see how it all works.

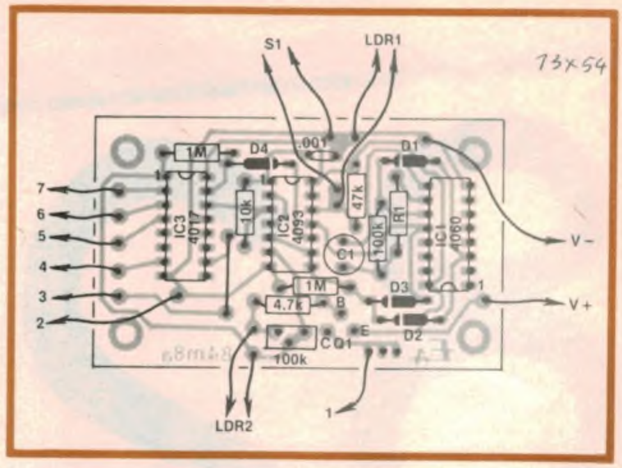
LDR1 is the circuit enable "switch". Together with a fixed 47kΩ resistor it forms a voltage divider, the output of which varies according to the amount of light falling on the LDR. This voltage controls IC2a. At sunset, the LDR resistance (and hence the voltage divider output) increases until, at a certain critical level, IC2a toggles and its output switches from high to low.

The output of IC2a (pin 11) is connected to the reset (pin 12) of IC1, a 4060 14-stage binary counter. As soon as the high to low transition occurs, the



SOLAR POWERED HOUSE NUMBER

The Gates sealed lead-acid cells. They are "D" size, 2.5AH, at 2V.



Control board layout from the component side.

SOLAR POWERED HOUSE NUMBER

reset of IC1 is released and it begins to count.

Clock pulses are provided by IC1's internal oscillator, the frequency of which is set by external components R1 and C1. With R1 = 560kΩ and C = 2.2μF, the clock operates at only one cycle per 1.3s. Since the 4060 divides by 2^{14}, or 16,384, it takes about six hours for its Q14 output to go high (the other outputs are not connected).

By altering the value of either R1 or C1, the six-hour time period can be varied as required. The optional retrigger switch allows the timer to be manually reset for a further six hours of operation at any point in its cycle. Diode D1 stops the clock at the end of the six-hour period by pulling pin 11 of IC1 high.

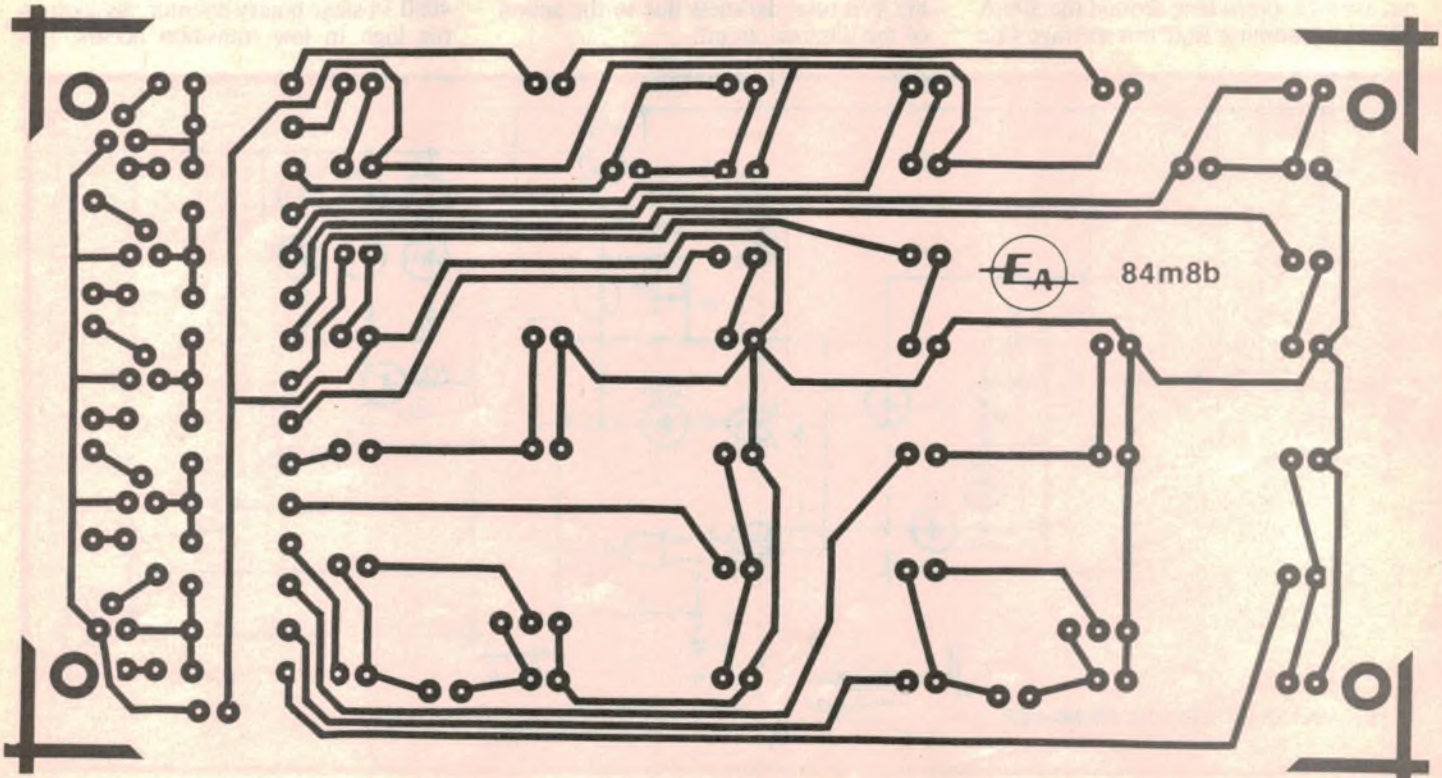
If it were not for D1, IC1 would simply commence a second six-hour period at the expiry of the first. This is due to the fact that it will still be dark after the first six hours which means that the reset of IC1 (pin 12) will still be low.

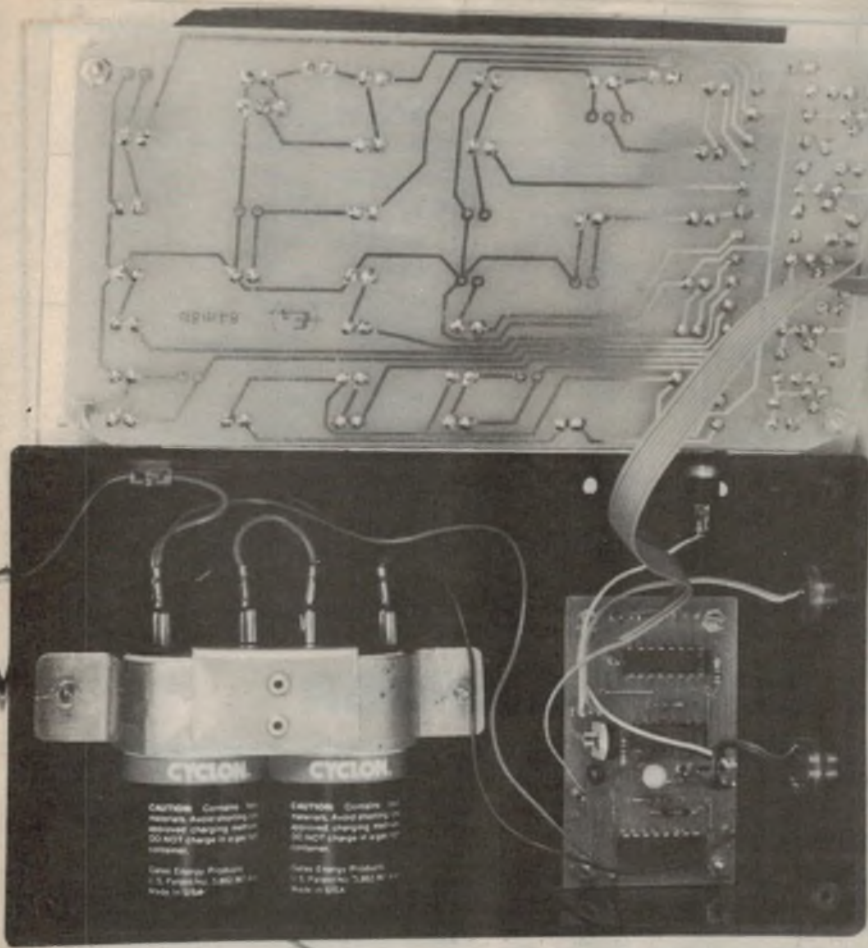
The output of IC2a is not only connected to the reset of IC1, but also to diode D3. Another diode (D2) is connected to Q14 (pin 3) of IC1, while the cathodes of both diodes connect to a common control point. The polarities of D2 and D3 are such that whenever either of their inputs (anodes) is high, the control point is also high. At other times, the control point is held low by a 1MΩ pull-down resistor.

In order for the multiplexing and LED driving circuitry to be enabled, the control point must be low. It follows, therefore, that in the period between IC2a being triggered (sunset) and IC1 completing its count (Q14 high), the display is operating.

IC3, a 4017 decade counter, is used to multiplex the display. Because this circuit only calls for a five-way multiplexer, output 5 (pin 1) is connected to reset (pin 15) via a resistor. IC3 resets almost immediately when pin 1 goes high so, effectively, one of IC3's five output lines (0 to 4) is high at any given time, while ever it is operating.

Notice that the number five output (pin 1) is connected to the reset (pin 15)





Interior view showing control board (right), battery (left), and display board (top).

via a 1MΩ resistor and that the reset is also connected to the anode of diode D4. This means that normal resetting can only occur when D4 is reverse biased. At other times, the reset pin will be held low and IC3 prevented form resetting.

To appreciate the significance of this, it is necessary to consider the circumstances whereby this diode will be forward biased.

The cathode of D4 is connected to the output (pin 10) of IC2b, whose inputs are connected back to the D3/D4 junction. Recall that when this control point is high, the multiplexing circuitry is disabled. As IC2c is connected as an inverter, a logic high at the control point is translated into a low on the cathode of D4. The diode is thus forward biased, inhibiting the reset function of IC3.

Clock pulses for IC3 are supplied by IC2d, a simple Schmitt oscillator with a nominal output frequency of 110Hz. This is enabled by a logic high from IC2c which has one of its inputs connected to the D2/D3 control point and the other to the number 5 output (pin 1) of IC3.

Thus, the clock will be inhibited when both inputs to IC2c are high, ie, when the D2/D3 junction is high (multiplex inhibit) and the number 5 count has been reached.

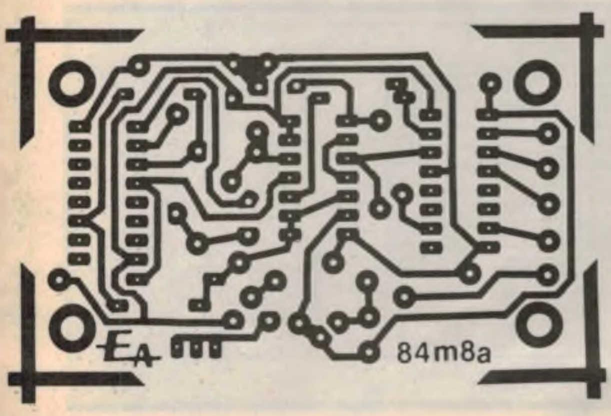


TABLE: OPTIMUM INCLINATION FOR SOLAR ARRAYS

Darwin	17°
Cairns, Broome	22°
Rockhampton, Alice Springs	28°
Brisbane, Geraldton, Broken Hill, Perth	37°
Sydney	39°
Canberra, Adelaide	40°
Melbourne	43°
Hobart	48°

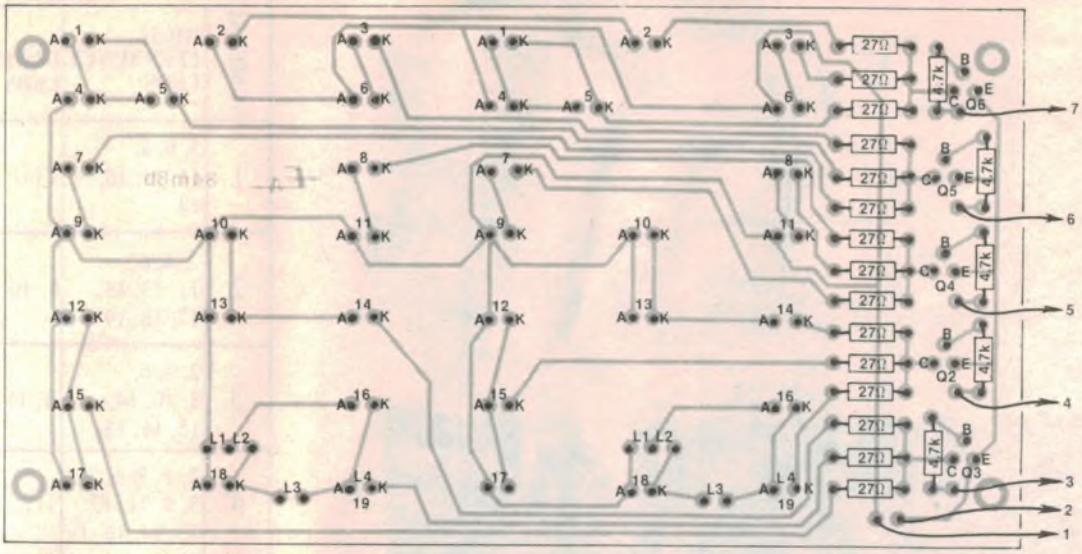
TABLE 1

NUMERAL	HIGH EFFICIENCY LEDS	DUMMY LEDS	L1	L2	L3	L4
1	3, 6, 8, 11, 14, 16, 19	13	●			
2	2, 4, 6 11, 13, 15, 17, 18, 19,	1, 10			●	
3	2, 4, 6, 8, 10, 14, 15, 16, 18	1, 11, 17		●		
4	2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14, 16, 19	1, 2*, 15	●			
5	1, 2, 3, 4, 7, 9, 10, 14, 15, 16, 18	2*, 6, 17		●		●
6	2, 5, 7, 9, 10, 12, 14, 15, 16, 18	1, 2*		●		●
7	1, 2, 3, 6, 8, 11, 14, 16, 19	2*, 4, 10	●			
8	2, 4, 6, 7 8, 10, 12, 14, 15, 16, 18	1, 2*, 3 9, 11		●		●
9	2, 3, 4, 6, 7, 8, 10, 11, 14, 16, 19	1, 2*, 9	●			
0	2, 4, 7, 6, 8, 9, 11, 14, 15 16, 18	1, 2* 3, 10		●		

**Install at second digit position.*

Normally, a number 5 count will reset the multiplexer. However, at the completion of the six hours, Q14 (pin 3) of IC1 goes high and prevents IC3 from resetting. At the same time, the multiplexer clock is stopped (due to the multiplex inhibit and number 5 count), and so the 4017 ceases counting. The number 5 output (pin 1) thus remains high while all other outputs remain low. This keeps all display drivers turned off.

The display drivers (Q2-Q6) are driven by the 0-4 outputs of IC3 via 4.7kΩ base current-limiting resistors. Up to three LED chains can be driven by each transistor, each chain consisting of two LEDs wired in series with a 27Ω current limiting resistor. The chains are connected between the collectors of their



Component layout for the display board from the component side, superimposed on the wiring pattern.

SOLAR POWERED HOUSE NUMBER

respective display driver transistors and the collector of Q1 which forms part of the dimmer circuit.

The dimmer circuit consists of PNP transistor Q1, LDR2, VR1, and Q1's associated 4.7kΩ base resistor. Q1 has its emitter connected to the positive supply rail and its collector to all of the LED anodes. The LDR simply provides base current for the transistor. During twilight, more base current is provided for the transistor so that the LEDs operate at maximum brightness. As the level of ambient light falls, less base current is provided for Q1 and the LEDs dim.

VR1 is adjusted after installation to provide a suitable minimum level of brightness, according to the installation.

Note that the drive current for Q1 is not derived from the negative supply rail as this would result in a wasteful base current flowing during the day when the LEDs are not operating. Instead, the base current is derived from output 5 (pin 1) of IC3. When the multiplexer operation is inhibited, output 5 remains high and thus no current flows to the base of Q3.

Construction

Construction can be divided into four main areas — the solar panel, display, control electronics and preparation of the box to house the project. Because the solar panel will have to be sealed after assembly and then left to dry, it should be attended to first. You should have the following parts handy before beginning: two pieces of perspex or Lexan (about 195 x 60mm), 12 solar cells, 300mm of enamelled copper wire, four machine screws and nuts, eight washers, four solder lugs and a 1N4001 diode.

Actually, it is unlikely that the perspex will be supplied as 195 x 60mm pieces. We obtained a 300 x 300mm sheet from Radio House (760 George St, Sydney. Phone 212 3810) and cut it to size. This meant that there was more than enough left over to use for the display.

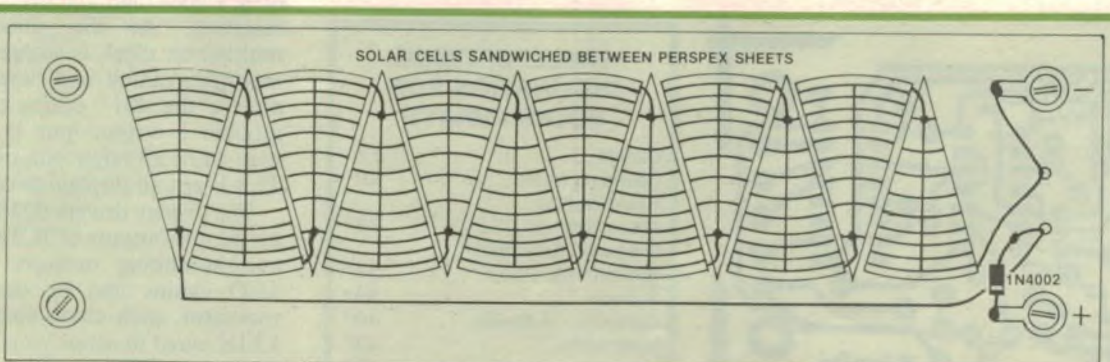
Having trimmed the two pieces of perspex to size, clamp them together and drill a hole in each corner to accept the machine screws. This done, drill two smaller holes at one end of one sheet to provide access for the output wires.

> We estimate that the current cost of parts for this project is approximately
>
> **$75-80**
>
> This includes sales tax.

The solar cells should now be connected in series using small lengths of the tinned copper wire. Two longer lengths (about 200mm and 40mm) are used for the output connections.

Note that the cells are extremely brittle and will crack if mishandled. They can also be damaged by excessive soldering time, so treat them gently.

Once the cells are all interconnected, smear a dab of silicone rubber compound on the back of each and lay them out on the lower perspex sheet as shown in the diagram. Feed the output wires through



Physical layout and cell interconnections for the solar panels.

their respective holes in the lower perspex sheet and connect the positive lead to the anode of the 1N4001 diode. This done, terminate the cathode and negative leads with solder lugs.

Construction of the array can now be completed by running a fillet of silicone rubber compound around the edge of one of the perspex sheets, and then fastening the two sheets together using machine screws and nuts. Note that spaces should be inserted between the two sheets to prevent them from crushing the cells. Two small washers stacked together at each screw location should do the trick.

We also used solder lugs to terminate the external leads and these should be added during the final assembly. Don't forget to seal the holes for the output wires from the cells.

The circuit itself is built on two printed circuit boards (PCBs): a control board coded 84m8a and measuring 73 x 44mm; and a display board coded 84m8b and measuring 180 x 95mm.

Begin by assembling the control board according to the parts overlay diagram. Note that the ICs are CMOS devices so be sure to solder their supply pins (7 and 14, 8 and 16) first to enable the internal static protection diodes. We used PC stakes to terminate the external wiring connections (nine in all).

The display board (84m8b) has been designed to accommodate various LED combinations to form any one or two digit number. If you require a three-digit number, then you will have to wire the display using matrix board or Veroboard.

low efficiency types. In use, they are simply blocked from view by the number mask on the display panel.

Do not omit the dummy LEDs. They are necessary because all LEDs must be connected in series pairs to avoid variations in brightness.

All that remains now is to mount the various parts into the plastic zippy case. First, cut a piece of perspex to replace the original aluminium lid and attach to it a cardboard number mask representing your street number. The display board can then be mounted behind the number mask using 25mm screws as stand-offs.

If you like, you can use a coloured filter behind the mask to improve its daytime visibility.

The control PCB is mounted on the base of the case, at one end, and secured using machine screws and nuts. As shown in the photograph, the two LDRs are mounted on the end of the case, adjacent to the PCB, and secured using epoxy adhesive. We also mounted the optional retrigger switch adjacent to the LDRs.

The battery holder can be manufactured from a piece of scrap aluminium. Make sure that it is reasonably substantial and that the batteries are firmly secured. Should the battery terminals happen to contact the holder or some other mounting hardware, there will certainly be a spectacular display — at least for a few seconds.

To test the Solar Powered House Number, temporarily alter the values of R1 and C1 so that a much shorter time

PARTS LIST

1 PCB, code 84m8a, 73 x 44mm
1 PCB, code 84m8b, 180 x 95mm
1 perspex sheet, 300 x 300mm (see text)
2 2V/2.5Ah sealed lead-acid batteries, D-size, Gates Cyclon or equivalent
1 plastic zippy case, UB2, 60 x 113 x 196mm
4 spade connectors (to suit batteries)
4 solder lugs
1 SPST momentary contact pushbutton switch (optional, see text)
1 sheet of red tinted plastic, 200 x 110mm

Semiconductors

5 BC338 NPN transistors
1 BC327 PNP transistor
4 IN4148 diodes
1 1N4001 diodes
1 4060 14-stage binary counter
1 4017 decade counter
1 4093 quad NAND Schmitt trigger
12 solar cells, 0.45V/78mA (see text)

Capacitors

1 2.2μF bipolar electrolytic
1 .01μF metallised polyester (see text)
1 .001μF metallised polyester

Resistors (¼W, 5% unless noted)

2 x 1MΩ, 1 x 560kΩ, 1 x 100kΩ, 1 x 56kΩ (see text), 1 x 47kΩ, 1 x 10kΩ, 6 x 4.7kΩ, 15 x 27Ω, 1 x 100kΩ 5mm vertical trimpot, 2 x ORP12 light dependent resistors

Miscellaneous

Machine screws and nuts, tinned copper wire (300mm x 0.5mm), silicone rubber sealant, rainbow cable, scrap aluminium, high-efficiency and low-efficiency LEDs (number to suit)

INSTALLATION

The solar cell array should be mounted on the roof of your house and tilted towards true north to ensure maximum solar illumination. Make sure that you choose a spot that will not be shaded by trees or other objects at any time during the day. If the solar cells are shaded, their output will be drastically reduced and the panel may not recharge the batteries.

Note that the optimum angle of inclination of the cells varies according to the latitude of your town or city. This needn't be too accurate, as a few degrees either way won't make all that much difference. Table 2 lists the optimum angle of inclination for various Australian towns and cities.

Perhaps the best way of mounting the solar cells panel is to attach it to the top of the TV antenna mast. The leads can then be run down the mast, adjacent to the entenna lead-in, and routed to the control unit.

Because the number required will vary, the LED locations are represented by numbers on the parts overlay diagram. To select a certain number, all you have to do is install LEDs and wire links at the locations indicated by Table 1.

For example, to make up the number "5", install high efficiency LEDs at locations 1, 2, 3, 4, 7, 9, 10, 14, 15, 16 and 18; dummy LEDs at 2, 6 and 17; and links at L2 and L19.

The dummy LEDs, by the way, are

period results. Substituting 56kΩ and .01μF will give a period of about 10s.

Once power is connected, cover the LDRs or turn the room light off. the circuit should now trigger for the duration of the time interval, provided that darkness continues. Turning the lights on during this time should cancel the cycle immediately.

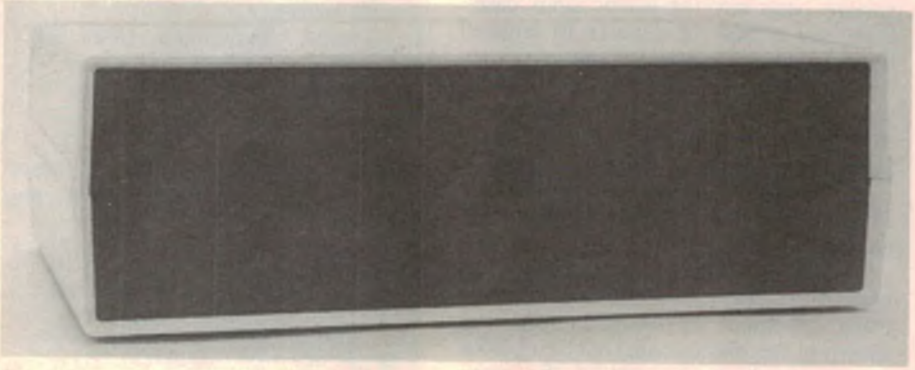
While the circuit is operating, try altering the level of light falling on LDR 2. This should alter the brightness of the display. Calibration of this control. however, can only be carried out properly with the unit in situ.

Allow the circuit to go through one cycle, then press the retrigger switch. This should cause another cycle to commence. Resetting should occur after LDR 1 is exposed to light, irrespective of whether the switch is fitted or not.

Provided that the circuit appears to be working properly, restore R1 and C1 to their normal values. The solar panel can now be connected, but make certain the diode on the panel is installed with correct polarity. If the Gates cells are heavily discharged, it may be advantageous to leave them charging for a few days before connected to the rest of the circuit. Otherwise, the circuit is ready for permanent installation.

New Products...

Product reviews, releases & services

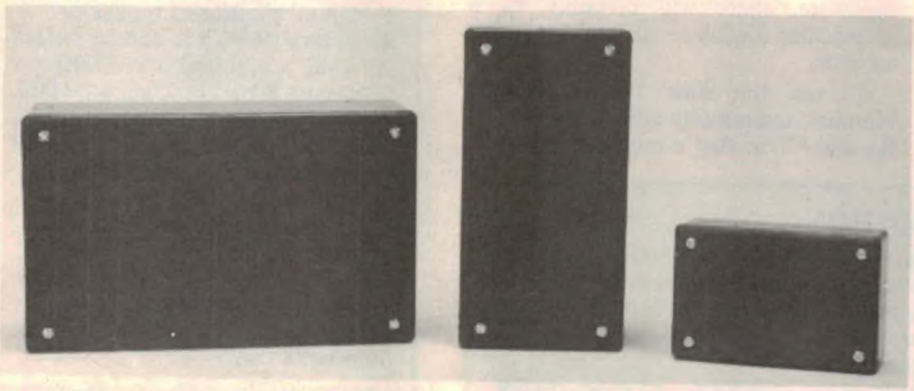


Additions to Altronics range

Altronics are now carrying a new range of plastic project boxes similar to the "zippy" types except that they have an attractive plastic lid. Also stocked by Altronics is a large instrument case. Measuring 190 × 260 × 80mm, the case has ventilation slots, a speaker cut out, rubber feet and numerous PCB mounting slots.

Another new product in the Altronics line up is the Micron fixed temperature soldering iron. The 20W iron operates at a temperature of 370°C and features a plated tip.

Details from Altronics, 151 York St, Subiaco, WA 6008. Phone (09) 381 7233.



New audio gear from Hughes

Hughes Communications recently announced that the company has been appointed sole Australian distributor for the entire range of "TRP Spectrum" audio components.

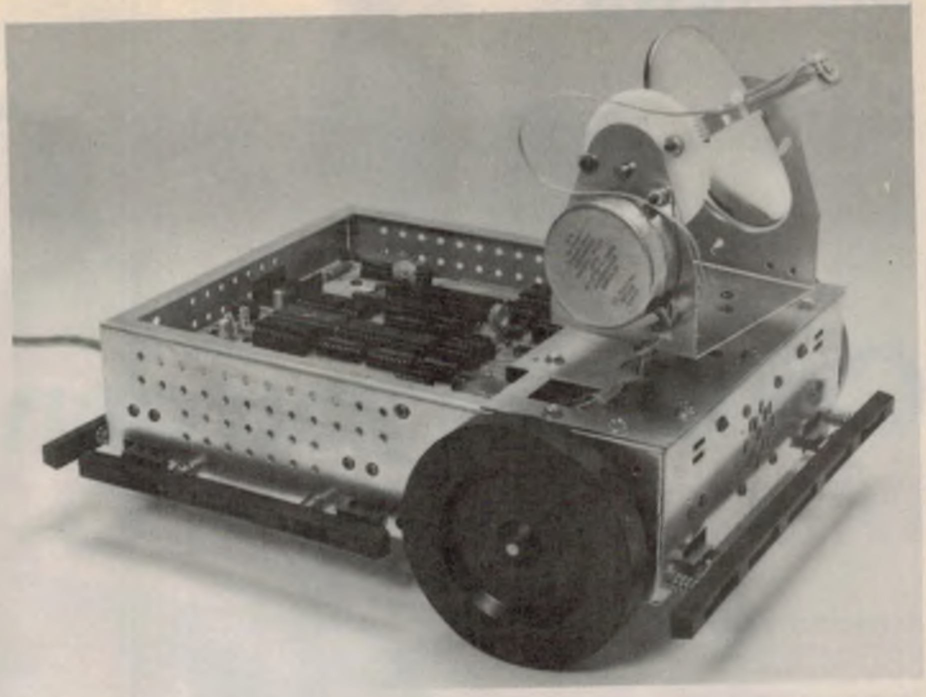
First shipments of the hand-made audiophile equipment will include the full range of "TRP Spectrum" loudspeakers, with models ranging from a diminutive bookshelf unit, to professional studio monitors.

Each model in the range has been designed to maintain "phase coherency" of the wavefront over the entire operating frequency range. Careful attention is also paid to matching each crossover unit to the component loudspeakers, and of course, matching the actual chassis loudspeakers to the enclosures.

Prices for the new range of quality loudspeakers range from $549 for the bookshelf Model (TRP Spectrum VIII); $1179 for the larger model VII, and $1799 for the studio monitor, the TRP spectrum VI.

For further information, Hughes Communication, 2/58 Moonya Rd, Carnegie, Vic 3163. Phone (03) 568 0612.

Rhino Robots from World of Electronics



World of Electronics (Aust) have recently secured Australian rights for distribution of products manufactured by the American company Rhino Robots.

Two robot kits are presently available — the XR Series and the Scorpion. Both are microprocessor controlled via an RS-232C interface. Instructional software is available for both TRS-80 and Apple computers.

The XR Series are "arm" type robots having 6 axes of movement and stand 82cm high. Accessories available for this robot include an 8-axis controller, triple finger attachment, magnetic pick-up, voice actuator and X-Y table base.

A microprocessor control pendant is also available for the XR robots — this permits control of the robot without the use of a host computer. The pendant is suggested for use in instructional situations.

The Scorpion is a mobile robot incorporating an optical receiver. Its 28 × 36cm carriage houses four motors, a speaker, two eyes and two ground tracks. Eight bumper-mounted microswitches enable the Scorpion to navigate through an obstacle course. In fact, the robot can learn the position of various obstacles and avoid them in subsequent excursions.

Initially, the Scorpion communicates via 32 I/O lines, although this can be expanded by a further 16 lines. Other options are also available, including expansion up to a 64K system.

Details are available from World of Electronics, PO Box 148, Fairfield, Vic 3078.

Ultra-thin toroidal transformer

ILP Transformers have produced a new slim-line transformer which fits in a single unit 19" rack. The transformer pictured had a rating of 160VA at 60V. Diameter is 155mm and thickness of less than 35mm. Mounting is by 20mm M8 central insert.

Details from ILP Distributor Electromark Pty Ltd, 43 Anderson Road, Mortdale 2223.

New range of rechargeable batteries

Australian Security Electronics Pty Ltd has been appointed the exclusive Australian agent for the Energy-pak range of low maintenance rechargeable batteries and is currently seeking distributors.

Energy-pak batteries are available in a range of 20 sizes and capacities with nominal six and 12V outputs.

The sealed lead-acid type batteries are designed for cyclic or float operation and use an electrolyte suspension system which recombines free gas in normal operation. Low discharges allow a charge/discharge cycle of over 1,000 according to the manufacturers, while float life is an estimated three to five years.

Applications for the batteries include fire and security alarm systems, emergency lighting, point of sale terminals, electronic cash registers, portable video, communications and photographic equipment, and computer peripherals. Further information is available from Australian Security Electronics Pty Ltd, PO Box 118, Paddington, NSW, 2021.

SIEMENS

Contacts you can rely on: Miniature relay D 2

No operating comb prevents wear on the contact blades

Permanent magnet system ensures maximum operate sensitivity

Laser welding offers high reliability

Laser adjustment guarantees precise contact positioning

actual size
Miniature relay D2
(20.2 x 10.2 x 10 mm)

The present day relay market insists on miniaturization and highest possible reliability. Siemens, as a relay user, measures up to these demands.

In the miniature relay D 2 we present a product designed to meet precisely the market requirements.

- DIL pin arrangement
- With two changeover contacts
- Contact force approx. 8 cN
- High test voltage
- Getter-protected contact chamber
- No operating comb

New manufacturing techniques such as laser welding and laser-adjustment prolong relay life and improve reliability, offering the user a new dimension in cost-effectiveness.

The miniature relay D 2 can be used in a variety of applications such as measuring circuits, control-, regulating- and process systems, entertainment industry, telecommunications, signal systems and medical equipment.

Siemens Ltd. (Incorporated in Victoria)
544 Church Street, Richmond, Vic. 3121
Melbourne: 420 7111 Sydney: 436 8711
Brisbane: 369 9666 Perth 362 0123

667/1170

Electromechanical components from Siemens

New Products...

Low cost troubleshooter

A low-cost, easy-to-use troubleshooting tool for microprocessor board failures has always been desirable. Applied Microsystems Corp, represented in Australia by Warburton Franki, now has available a microprocessor-based, portable instrument dubbed the ET-2000 Microtroubleshooter.

The troubleshooter uses emulation technology and offers a unique "Signal Identification" capability which allows comprehensive testing to be performed easily. With "Signal Identification," a technician can sense signal activity by using a "Magic Probe". Those signals and the location of the probe are displayed on the unit's built-in 2 x 40-character LCD display. An optional voice package can describe the signal and location, allowing the technician to keep at his work without glancing at the display.

Besides the "Signal Identification" capability, the ET-2000 offers signature analysis for troubleshooting boards beyond the I/O section at 25MHz, twice the speed of other analysers and ideal for troubleshooting faster peripheral components like video boards.

Designed for troubleshooting all popular 8-bit and 16-bit microprocessors, the system can be customised to different microprocessors by using an appropriate personality pod. Initially, Applied Microsystem will offer support for the Zilog Z-80, Motorola 6502 and 68000 and Intel 8080 and 8086 microprocessors.

Warburton Franki, PO Box 117, Lidcombe, NSW 2141.

New switchmode power supplies

Power supply manufacturer, Scientific Electronics, has just released the DK48AC series of switch mode power supplies which have been specially developed to power floppy and Winchester disc drives.

The DK48AC1 was designed to power 5¼" Floppy and Winchester disc drives with their attendant controllers and/or logic whilst the DK48AC2 is intended for powering one or two 8" floppy disc drives with a small amount of logic.

Features of the DK48 series are: low cost, 3-rail 48 watt output, 240/110 volt input and high efficiency and reliability.

As with all power supplies from Scientific Electronics, the new units are fully supported with a five year warranty and complete local technical back up.

Further details: Scientific Electronics, 6 Holloway Drive, Bayswater, Vic 3153. Phone (03) 762 5777.

Computer grade electrolytics

Elna Ltd, have introduced their new LB series computer-grade electrolytics through their sole Australian agent Soanar Electronics Pty Ltd. These LB series capacitors are particularly suitable as power source filters for computers, inverters, high current power supplies, high output power amplifiers and control equipment.

Despite their small size, these capacitors have exceptionally large capacity and are capable of handling high ripple currents.

Soanar Electronics' initial stock covers the range 10,000µF to 100,000µF in voltages from 16V to 35V.

Data sheets, listing current stocks and specifications, are available on request from Soanar Electronics, 30 Lexton Rd, Box Hill, Vic 3128.

New Products...

Alarms for industry and commerce

Wattmaster Alco Pty Ltd has announced a new range of visible and audible alarms, among them the most advanced products of their kind in Australia.

The well established flashing rotating alarm, Rotalarm, is now joined by the more advanced "Multi-Stack" Rotalarm. This is a weather proof rotating alarm encased in a square housing, enabling Rotalarms to be purchased in modules of one, two or three. A choice of red, amber and green can be invaluable in industrial applications (such as monitoring factory machines); in car parks; and in virtually any situation requiring visual signals. An added feature is a short-range audible signal (a "bleep") accompanying the flashing light.

Another product is a cylindrical tower array which comprises five light configurations (blue and white in addition to red, amber and green), and which flash or light continuously in any combination. This gives well over 3000 possible combinations, each of which can be interpreted as a "code" for a different signal.

For further information, contact Wattmaster Alco Pty Ltd, 11 Rachel Close, Silverwater, NSW 2141. Telephone (02) 648 1322.

200W power supply from HP

A new 200 watt, constant-voltage/constant-current (CV/CC) DC power supply has been added to Hewlett Packard's extensive line of laboratory and industrial power supplies.

Ten turn potentiometers allow the user to precisely set the output voltage and current from 6.7V at 30A to 20V at 10A. Dual range digital meters clearly display the output voltage and current.

Pressing the Display Settings button causes the digital meters to display the selected voltage and current limits without removing or short curcuiting the load.

Many protective features are included in the HP 6023A, as well as a remote control facility.

For further information: Hewlett Packard, PO Box 36, Doncaster East, 3109 (03) 895 2895.

Peripherals for Apple

Australian Video Presentations announce two new peripheral cards for the Apple computer: the Chip Checker and the Sprite Graphics Card.

The Chip Checker verifies and identifies all TTL IC's. It is connected via a ribbon cable to a zero insertion force socket placed outside the computer. Used in conjunction with the software provided the Chip Checker will test standard TTL (54/7400 Series), low power Schottky TTL (54/74LS Series), Schottky Clamped TTL (54/74S Series), low power TTL (54/74L Series), high speed TTL (54/74H Series) and TTL equivalent CMOS devices (54/74C Series).

The Chip Checker not only tests for complete failure within the operation of the IC but will also test for chip instability. It can also identify unmarked ICs.

Recommended retail price for the Chip Checker is less than $300.

The Sprite Graphics Card generates 16 colours over 32 planes. The Sprite planes can be envisaged as 32 pictures sandwiched together, the front picture having priority over the second and so on. This priority structure automatically creates three dimensional graphics.

The Sprite Card is available in any of the three main video standards and are supplied with all necessary software. Recommended retail price is $280.

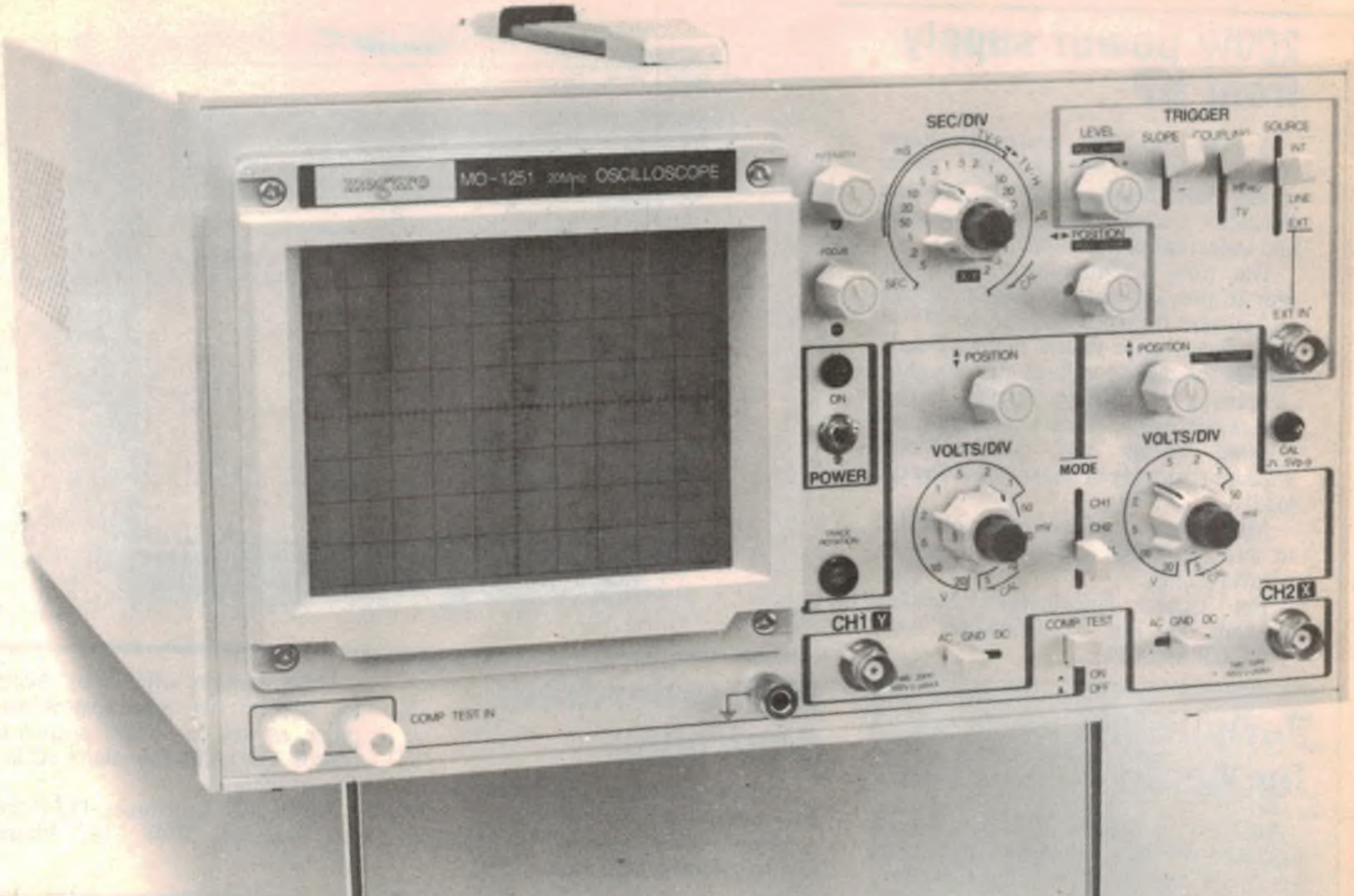
For details: Australian Video Presentations, 325-327 Bank St, South Melbourne, Vic 3205.

Mail order from Acetronics

Acetronics are now able to offer a post free mail order service for all their products. This includes all EA and ETI printed circuit boards from 1976.

Other services offered by Acetronics are stickers and name plates made to order, as well as one-off printed circuit boards. Car and house alarm stickers are also available.

For details: Acetronics, 112 Robertson Rd, Bass Hill, NSW 2197. Phone (02) 645 1241.



Meguro MO-1251/2 dual-trace oscilloscopes

Here we review two interesting new oscilloscopes from the Meguro company of Japan. Both are dual trace units which should suit both professional and hobby users alike.

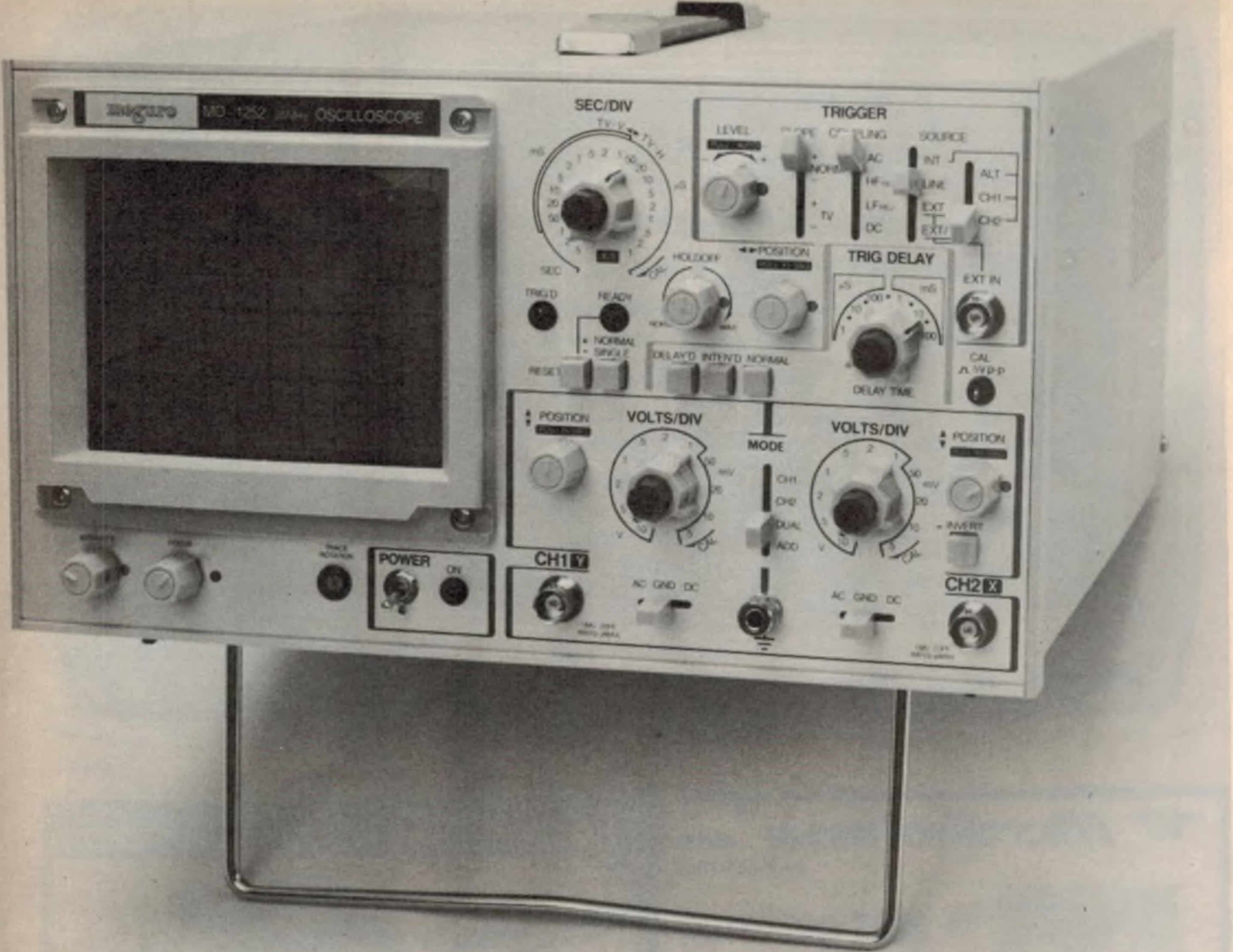
by ANDREW LEVIDO

The two models we reviewed are the MO-1251 which has a 20MHz bandwidth and the MO-1252, with a bandwidth of 35MHz. The MO-1252 also has a delayed trigger facility and a few other features not found on the less expensive model. These differences will be discussed in detail below.

The CROs come complete with a pair of MP-3050 probes which are switchable x1/x10 and have a bandwidth of 40MHz on the x10 range. Spare fuses are also supplied, as well as the mains cable and instruction manual. All this comes securely packed in a cardboard box with polystyrene foam mouldings supporting and protecting the CRO.

The instruction manuals supplied with each CRO are comprehensive and appear to be well written. A list of the chapter headings follows to give an idea of the material covered: Introduction, Specifications, Operation, Circuit Description, Maintenance and Adjustments, Parts List, Parts Location and Schematics.

Both CROs are the same size; 295 x 165 x 355mm (W x H x D), and their style and layout are similar. They both use the same CRT which is a 15cm internal graticule model with a blue phosphor. The CROs use different acceleration voltages (6kV for the 1252 and 2kV for the 1251) since their



Specifications: MO-1251

Sensitivity	5mV-20V per division ±3%
Bandwidth	DC-20MHz (within −3dB)
Risetime	17ns or less
Input impedance	1MΩ ±2%, 20pF ±3pF
Maximum input voltage	600V p-p or 300V (DC+AC peak)
Sweep time	0.2μs-0.5s per division ±3%
Trigger sensitivity	1 division or more (20Hz-20MHz)

Specifications: MO-1252

Sensitivity	5mV-10V per division ±3%
Bandwidth	DC-35MHz (within −3dB)
Risetime	8.8ns or less
Input impedance	1MΩ ±2%, 20pF ±3pF
Maximum input voltage	600V p-p or 300V (DC+AC peak)
Sweep time	0.1μs-0.5s per division ±3%
Trigger sensitivity	0.3 division or more (DC-10MHz) 1 division or more (10-35MHz)

maximum writing speeds are different.

The graticule itself has 10 x 8 divisions and features markings at 0, 10, 90 and 100%. Each division measures 10 x 10mm. The use of an internal graticule has become standard these days and has the advantage of eliminating parallax error when taking readings.

The front panels are well laid out, although there is less finger room around the controls on the 1252 than on the 1251. This is because of the extra controls provided on this model. The only complaint we have about the front panel layout is the location of the trigger holdoff knob on the model 1252. This knob has not been included with the other trigger controls, but has been located next to the horizontal timebase switch.

The vertical sensitivity controls comprise the usual 5-2-1 stepped attenuators and concentric variable attenuators with detented calibrate positions. Both CROs have a maximum sensitivity of 5mV per division although the 1252 has a x5 magnification facility which is operated by pulling the vertical position control. Minimum sensitivity is 10V per division on the 1252 and 20V per division on 1251.

Other controls in the vertical section include: input coupling switches (AC, DC, GND); a mode selection switch (CH1, CH2, DUAL, ADD); and a facility to invert channel 2. With this last

Meguro MO-1251/2 dual-trace oscilloscopes

control it is possible to use the ADD facility to subtract channel 2 from channel 1.

The horizontal sweep speed is selected by the usual rotary switch and concentric variable control arrangement. Sweep range is variable in 5-2-1- steps from a minimum of 0.5s. Maximum sweep speed is 0.2μs on the 1251 and 0.1μs on the 1252. Both CROs have a x5 magnification facility on the horizontal axis.

Triggering facilities

Triggering controls on the 1251 are fairly simple, consisting of a source switch, a coupling switch, a slope switch and a trigger level control. Four trigger sources are available (INT, CH2, LINE, EXT) and these are coupled into the CRO through the 3-position coupling switch (AC, HF reject, TV). The TV position allows triggering at either the line or frame frequency of a video signal, depending on the timebase setting.

The trigger level control allows either normal or automatic triggering to be selected. The slope switch permits triggering from either the positive or negative slopes of the chosen waveform.

Triggering controls on the 1252 are a little more sophisticated and will allow more complex waveforms to be easily displayed. There is an additional switch to select the type of internal triggering (CH1, CH2, ALTERNATING). This last position allows two signals which are not harmonically related to be displayed simultaneously. There is also an EXT/10 position on the source switch which attenuates the external triggering signal.

Other features exclusive to the 1252 are: the option of DC coupling of the trigger signal; an LF (low frequency) reject position on the coupling switch; provision for triggering on the positive or negative slopes of a TV signal; a single sweep mode to capture non-repetitive waveforms; and a trigger holdoff control.

The trigger holdoff control is useful for obtaining a stable display of non-periodic signals. This feature is a particularly useful one which we are pleased to see incorporated.

One of the main selling points of the MO-1252 is the delayed trigger facility. This feature works by delaying the trigger signal so that a portion of the waveform which occurs after the trigger point can be displayed.

The trigger delay function is controlled by a delay time switch which allows a delay of between 1μs and 100ms to be selected. There are also three pushbutton switches to select the operating mode, (DELAYED, INTENSIFIED, NORMAL). In the intensified mode, that part of the display which is to be magnified is shown at a higher intensity than the rest of the display. This makes it a simple matter to select the part of the waveform which is to be magnified.

Other front panel controls include: a power switch and indicator LED; focus and intensity controls; and a screwdriver adjustment for trace rotation. Both CROs also have a calibration signal source built in. This source provides a 1kHz squarewave at 0.5V p-p for calibration and compensation adjustments.

The last feature worth a mention is the component test function of the 1251. In this mode, the CRO displays the voltage-current characteristic of the component or network connected across the two banana sockets provided. Although this feature is interesting we feel that it is of limited practical use.

Test results

Our tests showed that both instruments lived up to the manufacturer's claims, and in some cases exceeded them. We found the bandwidth of the 1252 to be spot on, while the 1251 exceeded its bandwidth specification with a reading 3dB down at 24MHz. Both CROs were able to trigger on waveforms with frequencies as high as 75MHz. In the X-Y mode, the bandwidth of channel 2 is 2MHz for the 1251 and 1MHz for the 1252.

Accuracy of both vertical amplifiers and horizontal timebases was within the manufacturer's specified ratings of 3%. All other functions worked as described in the manuals and were up to specification.

Internal construction of these CROs is of a high standard. Most of the wiring between the circuit boards is terminated at plugs and sockets which would simplify servicing. In addition, many of the components used are readily available types such as common CMOS gates and passive components.

In conclusion, with a price tag of $525 for the Model 1251 and $749 for the 1252 (plus sales tax), these CROs represent good value for money. They offer a comprehensive range of features, are well made, and meet the manufacturer's specifications. What more can we say?

For further information contact Geoff Wood Electronics, 656 Darling St, Rozelle 2039. Telephone (02) 810 6845.

Books & Literature

Mospower & fet selector

TOWERS' INTERNATIONAL MOSPOWER & OTHER FET SELECTOR: by T. D. Towers and N. S. Towers. Published by W. Foulsham & Co Ltd, London. Soft covers 175 x 247mm, 103 pages, illustrated with outline drawings. ISBN 0-572-01230-6. Recommended retail price in Australia, $31.97.

This book is devoted to the FET (Field Effect Transistor) in all its forms; simple FETs, JFETs, MOSFETs, etc, in their numerous variations. Basically it is a list of type numbers, some 6000 in all, with form of construction, case and lead details, electrical characteristics, typical use, supplier, and possible substitute or replacement. American, British, European, and Japanese types are covered.

There is also a two page "Introduction to the FET" which is a very clearly and concisely written account of this device; a brief history, its evolution from the original single version to the many modern variations, a concise but very useful technical discussion, and even an attempt to clarify the various numbering systems adopted by different countries or manufacturers.

For the beginner it will provide a useful starting point; for the advanced student or technician it will serve as a refresher and/or update for those who need it.

There are four appendices: Explanatory Notes to Tabulations (ie, how to use the book), Package Outline and Lead Terminal Diagrams, Manufacturers' House Codes, and Manufacturer Listing.

To sum up this would seem to be a useful reference for the laboratory or service department, particularly where the suitability of substitute types is an important consideration.

Our copy from Australian & New Zealand Book Co Ltd, PO Box 459 Brookvale, NSW 2100. Phone (02) 454 4411. (P.G.W.)

RTTY for radio amateurs

RTTY TODAY by Dave Ingram, K4TWJ. Published by Universal Electronics Inc, Ohio, USA. Soft covers 215 x 280mm, 111 pages illustrated with photographs and diagrams. Recommended retail price $13.95.

This book is directed at the radio amateur who aspires to join the radioteletype (RTTY) ranks. It is intended to provide information as to how to go about it, the type of equipment available, and the RTTY services, both amateur and commercial, which are available for actual communication, or interception for test purposes.

Unfortunately, for the raw beginner, it is likely to prove disappointing. The author is evidently much too close to his subject and has failed to appreciate that the various technical terms, jargon, etc, associated with this discipline constitute a foreign language to the newcomer.

As a result, the reader is given the impression that he has been pushed in at the deep end and left to learn to swim. No doubt all the information he seeks is there, somewhere, in the book and if he has the patience he will eventually find it; that is if he doesn't (mentally) drown in the meantime.

Having said that it is only fair to add that, for those who already have some RTTY background, the book undoubtedly contains a lot of useful data. It is concerned mainly with commercial equipment — which is nothing unusual these days — and how the wide variety of units can be used and interconnected in almost unlimited combinations.

Computers play a large part in the RTTY scene today, and the book deals with these devices extensively in their RTTY role. On the other hand there is one chapter devoted to home construction of RTTY ancillary devices.

There are eight chapters in all. (1) The exciting world of RTTY; (2) Operating parameters and concepts of RTTY; (3) Straight talk on home computers; (4) RTTY converters you can build; (5) RTTY systems for home computers; (6) Dedicated RTTY terminals and systems; (7) Mini RTTY systems; (8) A guide to RTTY action on shortwaves.

In summary, a useful book for any enthusiast already familiar with elementary RTTY concepts, or who is prepared to expend some effort to dig the fundamentals out of this text. Otherwise, be prepared to seek out more elementary literature before tackling this one.

Our copy from Technical Book and Magazine Co Pty Ltd, 289 Swanston St, Melbourne, Victoria 3000. (P.G.W.)

Radioteletype frequency lists

WORLDWIDE RADIOTELETYPE NEWS SERVICES FREQUENCY LISTS by Thomas P. Harrington, W8OMV. Published by Universal Electronics Inc, Ohio, USA. Soft covers, 215 x 280mm, 84 (unnumbered) pages, illustrated with photographs and diagrams. Recommended retail price $13.95.

In some ways this would appear to be a companion book to "RTTY Today", reviewed above. It is, primarily, a listing of worldwide RTTY news stations transmitting in English. This includes most of the better known commercial news services — Reuters, AP, Tass, VOA, etc — as well as numerous smaller ones.

The listing is presented in three formats: by time, by frequency, and by country. (Australia doesn't exist, by the way.) These occupy the latter half of the book, the first half being devoted to the selection of RTTY equipment, news service abbreviations, and general teletype information. The author also salves his conscience by issuing a warning about the need to observe the secrecy of any intercepted commercial messages.

For those whose ultimate joy is to log a hitherto unknown press service — and doubtless boast about it among their peers — this book may well prove to be a bible. Similarly, if you aspire to join this exclusive club, it could provide a good start. In short, it all seems highly specialised.

Our copy from Technical Book and Magazine Co Pty Ltd, 289 Swanston St, Melbourne, Victoria 3000 (P.G.W.)


MICROPROCESSOR INTERFACING TECHNIQUES
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SYMPHONIC WINDS

HOLST: Suite No. 1 in E flat. Suite No. 2 in F. HANDEL: Music for the Royal Fireworks. BACH: Fantasia in G. Frederick Fennell conducting the Cleveland Symphonic Winds. Telarc compact disc CD-80038. [From P.C. Stereo Pty Ltd, PO Box 272, Mt Gravatt 4122. Phone (07) 343 1612].

This is vintage Telarc in two respects: (1) it was originally recorded in April 1978 and (2) it displays to the full the company's penchant for sonic spectacle. Neither observation should be interpreted as a criticism, however, because their decision about that time to favour digital mastering, no-nonsense mic. placement and high dynamic range put the then small company a jump ahead of their competitors.

The combination used here comprised essentially the entire reed-brass-percussion section of the Cleveland Orchestra, supplemented by selected area musicians. The conductor is Frederick Fennell, a native of Cleveland and a specialist in this kind of music. At the time he was Conductor in Residence at the University of Miami and Musical Director of the Symphony Orchestra and Symphonic Wind Ensemble.

Concerning the two suites which comprise the first half of the program, Fennell remarks in his notes that they are foundational to the work of Gustav Holst who, with Vaughn Williams, had a profound influence on the growth of serious band music in the USA.

These are certainly vital performances, with an enormous contribution from the bass drum on this compact disc version.

Bach's Fantasia in G major is a transcription from part of his Fantasia for Organ (No. 572) and its flowing melody provides an appropriate interlude between the Suites and Handel's "Music for the Royal Fireworks".

The last named work was the subject of a review by Julian Russell in the June issue and, while it was an entirely different performance, his remarks on its background are interesting and relevant. Fennell credits the version used here to Anthony Baines and Charles Mackerras.

The instruments, as listed in the notes, comprise a more manageable combination than that originally planned by the composer and the extant "Royal" (George II) while, for their part, Telarc resisted what must have been a temptation to dub in the original "101 brass cannon and 18 pieces of small ordnance".

Even so, in the Overture (6′ 42″) which takes up almost half of the "Fireworks" segment, Fennell and the Orchestra manage to create a firm impression that the Peace Treaty of Aix-la-Chappelle (1748) was something to justify what Julian Russell described as the "joyous din".

In short, if you are partial to a recording of symphonic brass/reeds/percussion, this one should fill the bill but just be cautious, the first time through, to make sure that your system can accommodate that big drum! (W.N.W.)

DEBUSSY

Images for Orchestra. Prelude a l'apresmidi d'un faune. Andre Previn conducting the London Symphony Orchestra. EMI Compact disc CDC-7 47001 2.

Back in 1979, as an LP pressing, this particular recording won the Gramphone Record Award for EMI. It is still regarded by critics as an outstanding example of the art. Of interest is the fact that it was mastered using a digital system which EMI were developing themselves but which was later abandoned, purely for reasons of economy.

It says much that it was in the first batch of recordings to be selected by EMI from their repertoire for re-issue as a compact disc. As such, it has the advantage over the original LP of a complete absence of any sense of the mechanical: no plop as the stylus finds the groove, no hiss, no crackle and the ability to cue and re-cue as desired to any of the six tracks that are pre-encoded.

The performance opens with "Images", composed by Claude Debussy in the period 1906/12. Number 1, "Giques", contains a hint of England in the folk tune "The Keel Row".

Number 2, "Iberia", has a Spanish quality which says much for a composer who had reportedly only ever paid the country a single, brief visit. It is essentially a suite of three pieces which, freely translated into English, are: "The Highways and Byways" (7′21″) "Night Scents" (9′57″) and "Holiday Morning" (4′53″). "Iberia" is often played as a separate item.

Not surprisingly, Image number 3 "Rondes de Printemps" carries overtones of France in two French folk tunes.

Written much earlier than "Images", "Prelude a l'apres-midi d'un faune" was intended to be the first section of a three-part work based on a poem by Mallarme: the remaining parts never eventuated. Nevertheless, "The Faun" (10′18″) is regarded as a miniature masterpiece in its own right and is described in Hugh Ottway's booklet notes as "perhaps as sensuous a score as has ever been penned".

If ever justification is needed of the CD system, it is found in the complete silence from which the solo flute emerges when you choose to preselect this last track. But, even from the very start of the performance, it holds promise of something rather special. Recommended. (W.N.W.)

MOZART

Piano Concertos K.450 and K.467. Alfred Brendel with Academy of St Martin-in-the-Fields conducted by Neville Marriner. Philips compact disc 400 018-2.

Whether or not I was in specially receptive mood, I can't say but I thoroughly enjoyed every minute of this Philips compact disc — the music, the pianist, the orchestra and the technical quality.

In his booklet notes, Arthur Hutchings points out that there was an apparent artistic turning point in Mozart's life in the period 1784/85. Prior to that he had been a favourite of Viennese society in public concerts, but his popularity waned and had subsequently to be regained in the theatre. The two concertos presented here were composed on either side of the "turning point".

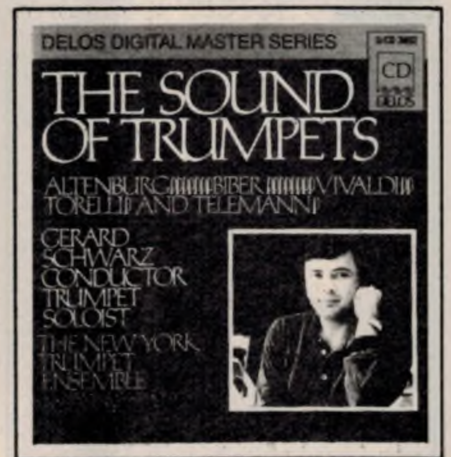
K.450 (No. 15 in B Flat) — allegro, andante, allegro — is one for which Mozart's own cadenzas are available and it is not hard to sense in it the gaiety of the Viennese concert scene. For most, it will have an instant appeal.

K.467 (No. 21 in C) — allegro, andante, allegro vivace assai — has a quite different impact: more structured, emotionally more mature although, in some degree, the quality may be imposed. With Mozart's own cadenzas not available, it has been left to others to suggest them. With his own perception and convictions of what is appropriate, Brendel chooses those by Radu Lupu.

But just when the listener is debating these impressions, the andante introduces an abrupt change of mood: the so-called "dream" andante, with its hauntingly familiar theme. And so to the final movement — one of those which cause mere mortals to marvel at the ability of pianists like Brendel to produce such a brilliant cascade of notes with no hint of falter or fumble.

What impresses in all this is the utter transparency and cleanness of the recording itself. Yes, you can hear the dull thud of the hammers in Brendel's piano — just as you would in the auditorium if you were sitting fairly close up. But more important is the smooth unstressed quality of the orchestral strings.

Whether or not you're a classical music buff, I think you'll enjoy this recent Philips compact disc. (W.N.W.)



VIRTUOSO TRUMPETS

The Sound of Trumpets. Gerard Schwarz, conductor and soloist, with the New York Trumpet Ensemble and the Y Chamber Symphony of New York. Delos compact disc D/CD 3002. [From P.C. Stereo Pty Ltd, PO Box 272, Mt Gravatt 4122. Phone (07) 343 1612].

Released as an LP in 1979, this was one of the foundation recordings for the then new Delos label. But don't pass over this CD version on that account. The performance is brilliant, as also is the sound, mastered as it was on Soundstream digital, using three special B&K microphones with an extra 30dB of headroom to cope with the brass.

It was, in fact, one of the group of three trumpet recordings released by Delos and described in the Chicago Sunday Times as "three of the most important brass recordings ever made, both in terms of playing and presence". The other two were D/CD 3001 "Classic Trumpet Concerti" (reviewed July '84, p118) and D/CD 3003 American Brass Quintet: "Renaissance Elizabethan and Baroque Music."

In her helpful booklet notes for the present disc, Mary Lou Humphrey points out that baroque trumpets were "natural" instruments, with valveless tubes approximately 8 feet long (2.44m) with a single fundamental note. To produce a diatonic scale, they had to be played in the top or "clarino" register, using overtones as high as the eighteenth, and actually producing a soft, flute-like tone. Clarino playing declined in popularity during the mid-18th century, with changing musical styles.

When the trumpet reappeared in 1813 as an essentially different valved instrument, it assumed a new role and the earlier clarino compositions were set aside as technically obsolete and no longer playable. However, modern trumpet virtuosi have developed the techniques and stylistic command to, once again, delight many present-day listeners.

Included in this recital are: Altenburg (1734-1801) "Concerto in D Major"; Vivalid (1675-1741) "Concerto in C Major"; Heinrich von Biber (1644-1704) "Sonata 'Scti Polycarpi' in C Major"; Torelli (1658-1709) "Sonata a cinque No. 1 in G Major"; Telemann (1681-1767) "Concerto in D Major).

The accompanying booklet provides notes on each of the items, most of which contain three or four short movements. They add up to 15 movements in all, averaging about two minutes each but with clear pauses between and indexing which should come up on most CD players as tracks 1 to 15.

As mentioned in an earlier review, there is a school of thought which tends to reject baroque music played on modern instruments with modern techniques and with all the connotations of modern digital recording. So be it.

Let's just say that, if these considerations don't disqualify the record, you'll enjoy what you hear, both musically and technically. (W.N.W.)

DMM RECORDING

Stravinsky; The firebird (1910 version, the complete ballet). Seiji Ozawa conducting the Boston Symphony Orchestra. DMM digitally mastered LP, EMI/HMV ASD-1436341.

Dated 1984, this is probably the most recent of numerous recordings of Stravinsky's "Firebird" — the first of his famous trio: "Firebird" (1910), Petrushka (1911) and "Rite of Spring (1913). All three were staged in the first instance by Sergey Diaghilev — after he had managed to persuade Stravinsky, with some difficulty, that he had the capacity to compose "descriptive" music of this

Records & Tapes

kind. In fact, "Firebird", premiered in 1910, brought Stravinsky international acclaim and the plaudits of notables such as Ravel and Debussy.

In 1919, Stravinsky rearranged the suite taken from the ballet for more modest instrumentation but, for this performance, Ozawa uses the original 1910 version.

The story behind "Firebird" was contrived from several sources and I quote from Noel Goodwin's jacket notes:

"It tells of Ivan Tsarevich, symbolising a Russian folk hero, whom the Firebird helps to rescue a group of enchanted Princesses held captive by Kashchei, an evil sorcerer. Among them Ivan finds his true love and they are married amid general rejoicing."

It's a suitably romantic subject but, after having prepared the recent article on direct metal mastering (DMM) my attention tended to focus initially on the technical quality of the recording, as an example of this new technology.

For those who may have missed the article, the process involves cutting the master recording into a layer of copper on a stainless steel substrate, rather than into a "lacquer" (cellulose nitrate) layer on aluminium. While it requires a somewhat "beefed-up" recording system, it results in a more accurate and quieter cut and reduces the number of steps necessary for the production of consumer copies.

Visually, the depth and amplitude of the cut is lighter than, say, Telarc's "Firebird" (Shaw/Atlanta Orch) but the signal/noise ratio does not suffer as a result. The sombre, mystical tones of the introduction emerge from silence — except for the initial sound of the stylus entering the groove. And the texture of the instrumental sound throughout the side is quite delicious, a tribute not only to the pressing but to the original digital recording.

It would also have something to do with Ozawa's approach to this particular performance, which is light, transparent, precise — to use words which come readily to mind. As such, it stands apart from the usual weightier, more colourful treatment of the work and it may not please those who see the "Firebird" as an orchestral showpiece.

In short, EMI's new "Firebird" is a commendable recording but it may not appeal to those who prefer flamboyance to finesse.

GOSPEL PIANO

Dino — Majesty. Piano, with orchestra and choir. Stereo LP album, Light LS-5828. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135. Phone (03) 729 3777.]

In the unlikely event that you haven't met up with Dino, as yet, he can best be described as a Gospel-orientated counterpart of Liberace. True, he doesn't go in for candles and lace but his keyboard style is very much in the same league, ranging from big sound, through the sentimental to cascading improvisation.

This particular album was recorded live at Bethel Temple, Longworth, CO and, as such, is punctuated by keyboard announcements by Dino and audience applause between numbers.

It opens with the little number "Majesty" followed by "El Shaddai" and "Exodus", all with heavily arranged orchestral backing. On the occasion, it was probably quite spectacular but it doesn't hang together too well as sound only.

By contrast, the piano medley which follows, is much warmer and more spontaneous: In the Garden — For Those Tears I Died — He Touched Me — What A Friend — Amazing Grace — Just A Closer Walk — My Tribute.

This leads into the remainder of the program, which again is quite successful: Easter Song — More Than Wonderful — Liebestraum — Great Is Thy Faithfulness — Chariots of Fire — He Is Lord — We Shall Behold Him.

The sound quality of the recording is very clean, my only criticism being that Dino could have been better served with a close-up mic for his in-between observations.

One thing is in no doubt: Dino's abilities and acceptance as a very gifted Gospel artist. (W.N.W.)

MORE ELVIS

Elvis's 5. Gold Records Album. Stereo LP, RCA Victor APL-14941.

The last Elvis album which I had occasion to mention in these columns was a fairly scrappy collection of recording oddments rounded out with tracks from here and there. By contrast, this one is composed of re-issues of "gold" records and therefore, presumably, of recordings which most Elvis fans will have on hand. But, in case not, here is a list of the titles and the recording dates:

Suspicious Minds (1969) — Kentucky Rain (1970) — In The Ghetto (1969) — Clean Up Your Own Backyard (1969) — If I Can Dream (1968) — Burning Love (1972) — If You Talk In Your Sleep (1973) — For The Heart (1976) — Moody Blue (1976) — Way Down (1977).

Being of relatively recent origin, the recording quality is normal and uniform and you can buy with confidence if your collection lacks a reminder of the legendary pop star. (W.N.W.)

Julian Russell is ill. His record reviews will resume next month.

WATCH OCTOBER ISSUE FOR HUGE CLEARANCE OF VALVES — HUNDREDS OF TYPES

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WATCH OCTOBER ISSUE FOR HUGE CLEARANCE OF VALVES — HUNDREDS OF TYPES

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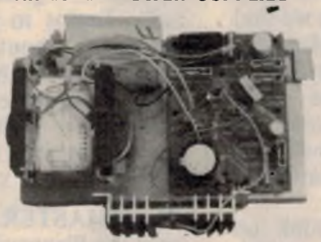

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470 UF 40V	3 for $1
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25 UF 25V	10 for $1
470 UF 16V	5 for $1
220 UF 50V	each 50c
47 UF 200V	each 50c
1000 UF 10V	4 for $1
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22 UF 16V	10 for $1
330 UF 63V	each 50c
1MFD 50V	10 for $1
33 UF 10V	10 for $1
33 UF 10V	10 for $1
1MFD 50V	10 for $1
33 UF 10V	10 for $1
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6N8 1500V	each 50c
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20K wire wound	75c	250K ganged pots	75c
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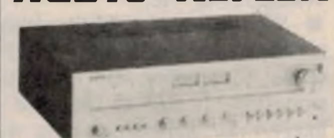

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WATCH OCTOBER ISSUE FOR HUGE CLEARANCE OF VALVES — HUNDREDS OF TYPES

Information centre

OEM MYSTERY: It seems that on every material advertised in our electronics magazines these days we find "ideal for OEMs . . ". The explanation made of these initials must have been some time ago, and I have often exhaustively mused on extraordinary meanings for the acronym. Could you please tell me what does OEM stand for? (P.S., Charmhaven, NSW).

● We have often tried to think up suitable explanations for this cryptic three letter grouping but have usually ended up with something stodgy. the letters mean "original equipment manufacturer".

TRANSISTOR ASSISTED IGNITION: I purchased from Dick Smith a Transistor Assisted Ignition kit. Now fitted to my Volvo 144 Gl the engine runs OK but after about 20km the tachometer swings from low to high readings. I would appreciate your advice. What could be the fault! (R.T., Wangaratta, Vic.)

● We assume that although the tachometer starts to play up after a short while, the motor still continues to run smoothly. If this is the case then it is likely that there is nothing wrong with the transistor-assisted ignition itself but there may be a poor solder joint in the connection to the tachometer.

On the other hand, if the motor seems to be running less smoothly when the tacho begins to play up we would be suspicious about the ignition circuit itself. It may be that the spark intensity is varying because of an intermittent malfunction. If this is the case, the prime suspects are the resistors in the emitter circuit of Q3 (3 x 2.7Ω).

PLAYMASTER 50/50: I have recently built the Playmaster 50/50 Mosfet Stereo Amplifier. I am satisfied in the way it works and looks but while testing the unit I discovered that some resistors were heating up. The ones I coloured in red were getting hot (circuit attached to this letter) and the ones in blue were getting warm. I want to know if this is normal or is there something causing it to heat up.

Another thing: while setting the quiescent current I got the following voltage readings as marked on photo copy. Is this all right? Would it effect the amplifier in any way? The amplifier seems to work perfectly except for the few problems I discovered.

Another thing how do you measure −50 volts or any negative voltages? Do you just swap the multitester probes or is there a special way to measure it? (S.A., Ferndale, WA.)

● All of the resistors you have marked in red will become quite hot. This applies particularly to those rates at 5 watts. In fact, a 5 watt wirewound resistor dissipating at its full rating will have a body temperature of some 200 degrees Celsius above the surrounding ambient temperature. All the resistors you have market would appear to behaving normally.

The voltages you obtained across the 100Ω 5W current limiting resistors during the quiescent current setting procedure are in the right ball-park. And yes, when measuring negative voltages you must reverse the meter probes unless you have a digital multimeter which has automatic polarity indication.

BREAKERLESS IGNITION: I have for some time been successfully building electronic projects from kits. I now want to advance a step further by building projects from published circuits, such as the breakerless ignition circuit featured in December 1983.

Whilst making up a component list from the circuit which calls for 3 IN4761 I cannot relate this part number to any zener diode in either Dick Smith or Tandy catalogue. Was this a misprint in the original circuit diagram? As no voltages are given, I would appreciate your advice.

Also one other matter confuses me. The circuit p43 uses transistor BC557 (Q1). Yet the photo on p42 shows a BC559 transistor. Please confirm correct transistor. (J.G., Golden Beach, Qld.)

● We are sorry about your confusion. As noted in the article in December 1983, the full details of the transistor-assisted ignition were published in the February 1983 issue. We did not wish to devote the space to republish the complete article.

If you refer back to the February 1983 article you will find that the 1N4761 zeners are described as 75V units.

The zeners are included to provide protection against excessive voltage which might be developed across the main switching transistor if a spark plug lead became disconnected.

And that BC559 slipped by us. The creator of the project, John Clarke, fitted a BC559 initially just to get it going. It should have been replaced with a BC557 for the photo. We specify the higher-rated BC557 to ensure reliability.

Breakerless ignition problems

BREAKERLESS IGNITION: I have constructed your Transistor Assisted Ignition from a Dick Smith kit. I built it back in 1981 and it has given stout service since then. The problem is that now the TAI is in my latest car, a Mazda 626. The unit works faultlessly except it causes the electronic tacho to surge every minute or so. The engine gains approx 500rpm in a split second. So I decided to upgrade the unit to "breakerless" with the Hall Effect unit marketed by Jaycar.

This unit also worked very well once the car was started; it would work first time every time until bedded down for the night. First thing next morning the motor would refuse to fire. Then, after a frustrated half hour of cranking it would fire and run on one or two cylinders and would not increase speed as the throttle was opened.

If I was lucky enough to keep the motor running long enough to get mobile it would misfire badly then suddenly it would run perfectly, stop and start all day. The fault lay somewhere in the system because when the conventional ignition was re-set it worked perfectly everytime. I have spent a small fortune on new plugs, leads and dynotuning but the fault still persists. (B.S., Kalangadoo, SA.)

● As much as we hate to say it, the fault probably lies in the Hall Effect device. It is not entirely clear from your letter whether you have tried restoring the circuit to normal transistor-assisted operation. If the engine works properly under these conditions then the fault is likely to be in the Hall Effect device and is probably a faulty internal connection.

LCD COUNTER: I am really in need of help. I cannot get the main parts for the 2MHz LCD counter published in August and September 1983. In particular I cannot obtain the 74C946 or the 32.768KHz watch crystal. Can you point me in the right direction? (C.N., Salisbury Downs, SA.)

You search is over. Dick Smith Electronics has both these parts in stock. The 74C946 is a standard catalogue item (Z-6301) at $19.95 while the watch crystal (K-6030) is available only from the DSE mail order department, PO Box 321, North Ryde, NSW 2113. The price of the crystal is $3.60.

SPEAKER BOXES: I'm a 15-year-old and have little experience in electronics. I have decided to make a set of speaker boxes for school this term and I was wondering if you could help me out.

I am thinking of using an 8-18kHz tweeter a 1.5-10kHz midrange and a 50-5000Hz woofer, with a four combination 3-way crossover changing over at 800/5000Hz, 800/7000Hz, 1600/5000Hz, 1600/7000Hz.

I was told that this was OK (I am not sure what this means. Could you please explain). Is this a good combination? If it is what crossover point should I use? Any explanations or diagrams would be extremely helpful as I am not too sure what needs to be done. I also have a 3kHz-30kHz tweeter. Would this be any better than the 8-18kHz tweeter (or would it be a useless range for tape and records)? (G.O., Chifley, NSW.)

● You certainly have asked quite a few questions there and we really can't treat the subject in any depth in these columns. However, let's attempt to answer your questions in brief.

First, even though you may have a few speakers which will cover the whole audio spectrum with suitable overlaps at the crossover points they will not necessarily work satisfactorily with each other.

Each driver should be a good match to the others in terms of efficiency. It is no good, for example, using a tweeter which is much more efficent than the woofer and midrange units.

The drivers should also have a nominal impedance which suits that of the crossover network otherwise the attenuation slopes will hit or miss — probably miss.

Another point which must be watched is the resonant frequency of the tweeter and midrange units.

The resonance of these units must either be very well damped or the crossover network should be designed so as to eliminate the possibility of exciting the resonance with normal program signals.

The above info should be enough to set you on the right path as you refer to books on the subject in your local library. It is not a simple subject with simple answers. But you will have a lot of fun finding out what those answers are.

DIRECT VIDEO: Recently I decided to modify a colour TV to operate in both modes ie. as a colour TV and direct video monitor for my TI-99/4A home computer. Since beginning this project I have struck a few problems as follows: (a) The video output of the TI is R-B-Y; (b) most TV sets nowadays have hot chassis; and (c) how to convert the R-B-Y video output to composite video.

Whilst pondering these problems I decided to flick through a few back issues and with great surprise came across the December 1982 review of the TI home computer. This used a Thorn UHF/VHF television set, converted by TI to allow for direct video entry whilst doubling as a standard television. If possible, may I have the information regarding the technical aspects of the review. I can assure you it would be greatly appreciated. If not could you suggest an appropriate avenue of obtaining this data. (G.J., Bandiana 3690).

● We do not have any information on modifying the Thorn TV set for direct video and colour input. We assume that the set would have had a power transformer so that these connections could be easily made. We suggest you consult with a competent TV technician or contact your local computer club.

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

Forum . . .

. . . *continued from p89*

to approximate a good ground plane? Intergrated circuit manufacturers give very detailed information on how to lay out this grid, but how often is it used? How much rubbish has been printed on the advantages of "active" terminations for computer busses, as opposed to a simple resistive termination? Who knows the proper way to terminate a bus, and why?

COMMENT: Perhaps I did appear, in the May issue, to concede too readily the expertise of all "computer and long-distance communications engineers" in the area of signal cables. However, what I had in mind is apparent from what followed, namely the huge amount of information which is available to them in textbooks, manuals and learned papers and the fact that, to my knowledge, none of it supports the way-out claims of the golden-ear buffs.

As I said: "The purveyors of deluxe and directional cable would have it made if they could only find someone from that area able to produce a rigorous engineering paper validating their claims. It would be a sensation.

As for A.F.'s caustic remarks on digital equipment designers, he may well have bought a new argument of his own from readers involved in that area. I guess he can take care of himself.

He concludes his letter with this remark:

"I'll admit that a lot the above was written with my tongue firmly in my cheek, but even so . . . have a long and active retirement and keep arguing.

Thanks again A.F. and I'll try to do that. In the meantime, by way of good measure, we've dropped in a couple of other expressions of hifi opinion.

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

September, 1934

From a superhet construction project: The main bias resistor is a wirewound resistor of 250 ohms and actually carries about 50 milliamps. We specify a 100-milliamp rating to be on the safe side. When the set is running, this resistor may warm up a trifle but should never really get hot enough to scorch the paper label on it.

What symbols mean: An aerial is usually a piece of copper wire mounted up in the air so that it does not make metallic contact to the earth of anything making contact to earth. The aerial therefore cannot be mounted on a tin roof or tied to a spouting. For preference, porcelain insulators should not be fitted but these are not essential. The lead-in is the wire which runs from the aerial to the set and is often actually a portion of the aerial wire.

24-hour time: This is what the BBC said about its experiments with the 24-hour clock: The public experiment with the 24-hour system of timing, which began in April, will end on August 13. The system has been effectively introduced to the public. There has been, however, no evidence of either widespread support or opposition. Moreover, in view of the Government's decision that it will take no action to secure the extension of the use of the 24-hour clock, the BBC will revert on August 19 to the old system for all its public operations.

Powerful public address amplifier: To help things along at election meetings the AWA has produced "the largest amplifier yet seen in an election campaign in any part of the world"; it is mounted on a car like a sedan car, and at times the loudspeaker can be heard three miles away. The speaker requires 200 watts for field-excitation, and has a power in the moving coil up to 125 watts, compared with about two watts in the same part of an ordinary receiver. The amplifier and power supply are installed in the car.

Wireless lodestones: "I guarantee you luck or refund your money" states an advertisement of Wireless Weekly, September 14, 1934. "If you have bad luck in the lottery games, gambling, love, business, you should carry a pair of Mystic Brahma Highly Dynamic Lodestones. These lodestones are carried by occult Oriental people as a powerful charm — one to prevent bad luck, evil and misfortune, and the other to attract much good luck.

RADIO TELEVISION AND HOBBIES 2/6

September, 1959

Transistorised TV: Recently announced in America is a completely transistorised TV receiver which is now available on the market.

The receiver is made by the Philco Corporation, and weighs 15lb including the weight of the rechargeable battery. Its retail price in America is $250, or about £120 Australian.

The set uses a total of 21 transistors for both audio and video circuits combined. A 2in cathode ray tube is used to provide the picture which is optically magnified.

Aircraft panel displays; Glowing electroluminescent panels may replace the maze of dials in aircraft cockpits and simplify auto dashboards, according to Westinghouse who have developed a new electronic device for displaying numbers or other kinds of information on a thin, flat, radiant screen.

The new device is called an "electroluminescent digital indicator." Bright enough for use in broad daylight, it is the first instrument of its kind to be built entirely of "solid-state" elements — those which, like transistors, take the place of electronic tubes but are smaller and have no moving parts.

The panels are flat screens with a series of phosphor-coated electroluminescent strips which glow when they are energised electrically. Seven of the strips will form any number from zero through nine. Using a different design, a screen with 14 segments can display any letter from A to Z, and in addition show the numbers zero through nine. Transistors have been used as switching elements.

150kW transmitter: The new BBC National transmitter at Droitwich has a power of 150 kilowatts, and was reported to be testing during July; the quality "impressively good". The BBC has published drawings of it; the two-steel lattice masts are each 700 feet high and the base of each 150 ton mast is supported by porcelain insulators on a concrete base. The station is driven by four 750hp diesel engines.

British hi-speed computer: The British Air Ministry has ordered a £190,000 electronic computer to handle the payroll calculations of the 80,000 civilians working for the Ministry throughout the United Kingdom.

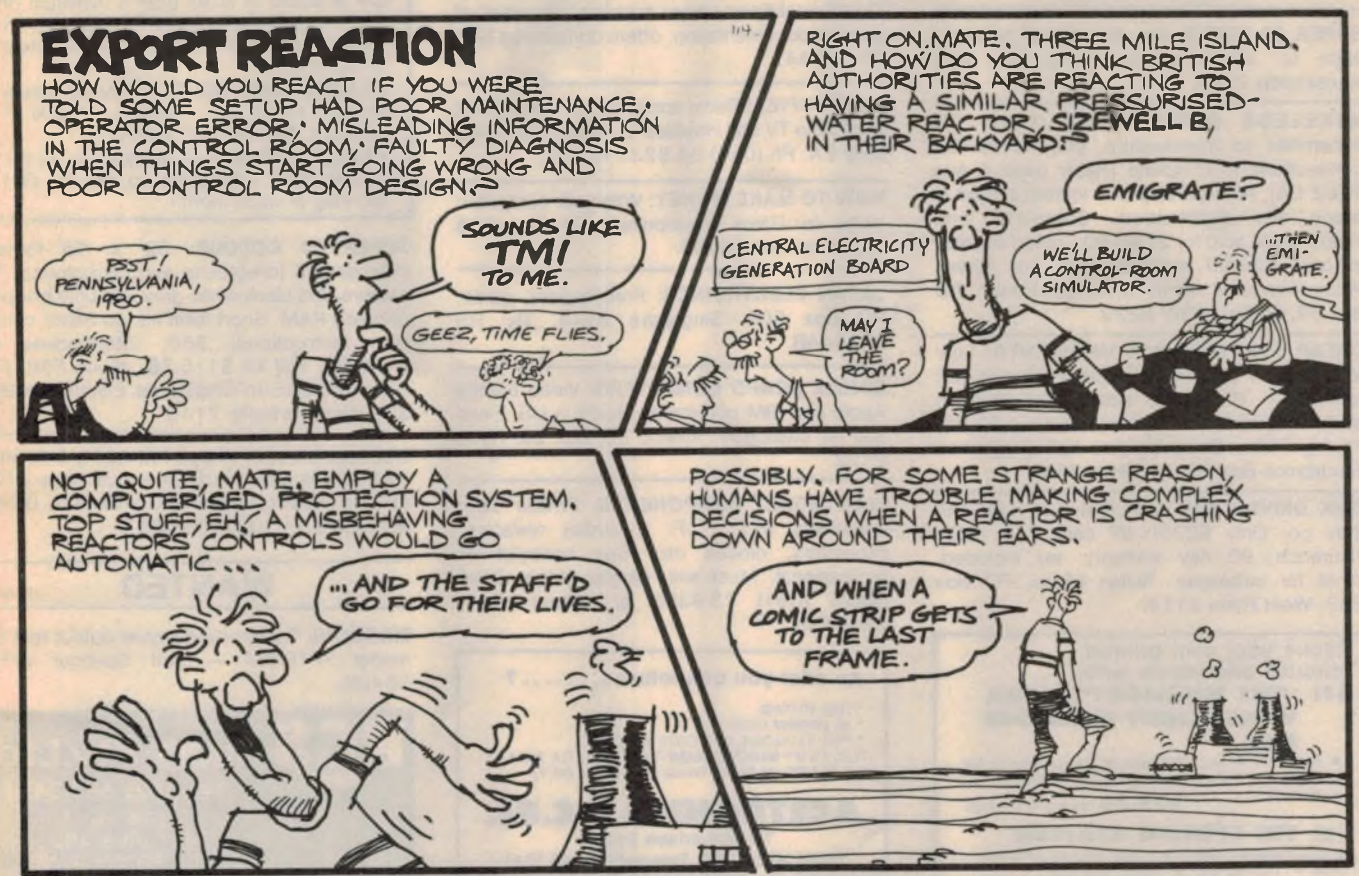
The computer — an EMIDEC 1100 being manufactured by EMI — is expected to be able to complete the calculations involved in the pay statistics in little more than half the working week.

EMIDEC 1100 is one of the most advanced computers in the world and uses cores and transistors throughout which ensure a degree of reliability never before possible. The use of transistors means that size can be kept at a minimum and costly cooling systems necessary in thermionic valve machines eliminated.

Mass spectrometer: General Electric scientists at the Hanford atomic plant laboratories soon will place in operation one of the most advanced machines for "finger-printing" atoms.

Called a mass spectrometer, the machine can be used to identify the isotopes in any element. In addition, it can provide an exact answer to the question of how much of which isotope is present.

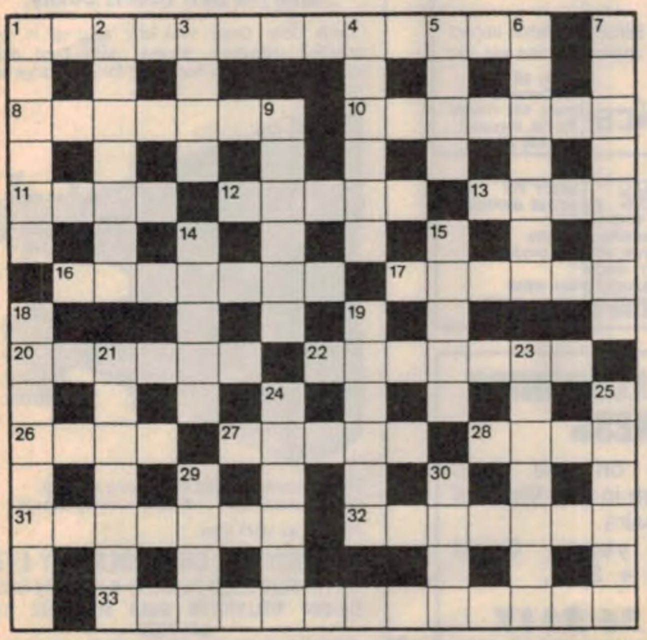
emerson's out of this world



SEPTEMBER CROSSWORD

ACROSS

1. Variable resistor. (13)
8. Computer operands. (7)
10. Variety of 1 across. (7)
11. A way to deactivate a circuit. (4)
12. Computer character. (5)
13. Name an effect. (4)
16. Type of multivibrator. (7)
17. Name of an inventive genius. (6)
20. TV control. (6)
22. Part of a sound reproduction system. (7)
26. Time tones. (6)
27. Colour used in coding resistors, etc. (5)
28. Source of television ghost. (4)
31. Radioactive element. (7)
32. Components of a CRO. (1-6)
33. Device activated by a current. (13)



DOWN

1. Early type of cell. (6)
2. Morsels from your Apple? (7)
3. A gate. (4)
4. An array. (6)
5. Type of speaker cone. (4)
6. Amplifies a telephone circuit. (7)
7. Communication equipment. (4,4)
9. Protect a circuit or component. (6)
14. The turning point for a workshop enthusiast? (5)
15. Wheel often found in a tape player. (5)
18. Process in which a signal is utilised in discrete pieces. (8)
19. Type of communication system. (3-3)
21. Collapse a TV tube. (7)
23. Bound electron-hole pair. (7)
24. First name of Lord Rutherford, electronics pioneer. (6)
25. Communication satellite (6)
29. Part of a radiation pattern. (4)
30. A given name of 17 across. (4)

SOLUTION FOR SEPTEMBER

S	I	G	N	A	L	G	E	N	E	R	A	T	O	R
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E	L	E	C	T	R	O	P	H	O	R	E	S	I	S

FOR SALE

SUPER 80 USERS: For free list of products write to: Matrix software, PO Box 291 Kensington 2033.

WIRELESS GUITAR: Instrument FM transmitter ex manufacture, only needs few connections to complete (Refer page 4 Aug 1982 EA), main pc board is tested, potted in place and guaranteed. Complete with instructions, sold for $149.50 Limited quantity at only $39.50 including p&p, for further information send sae to Oatley Electronics, PO Box 89, Oatley, NSW 2223.

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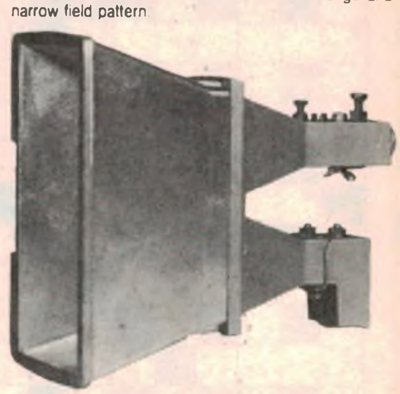

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121 Forest Road,
Hurstville 2220.
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347 9251.

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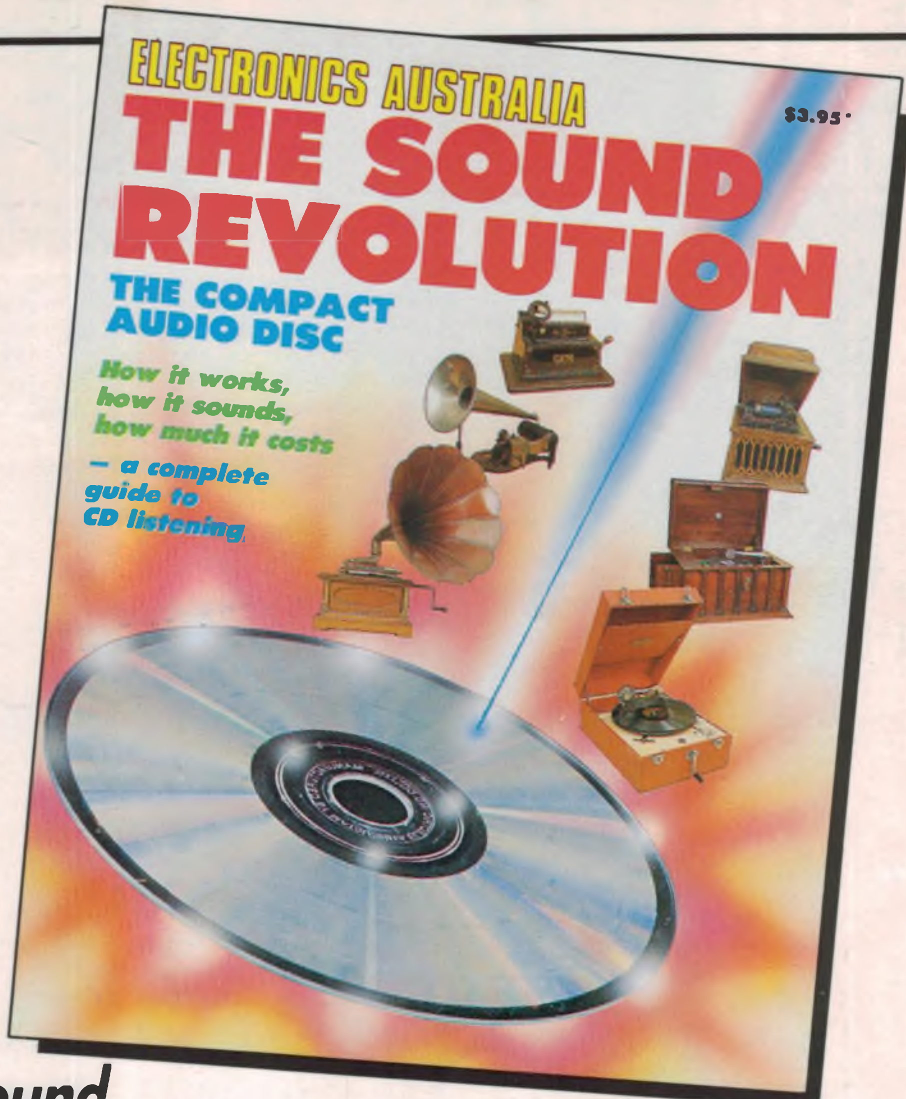

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