
WHAT TO DO ABOUT CHANNEL 0/28
PROJECT TO BUILD
HIFI TUNER WITH AM STEREO
PROJECT TO BUILD
ELECTRIC FENCE CONTROLLER
PROJECT TO BUILD
PHONE HOLD FOR PRIVACY

Registered by Australia Post — publication No. NBP 0240

Australia's Top Selling Electronics Magazine

Electronics Australia

DECEMBER 1985

Aust* $2.75
NZ $3.50

SPECIAL SUPPLEMENT!

ELECTRONICS ON THE WATER

VZ-300 NOW ONLY $99!!

And It Gives You So Much More!

It's unbelievable! The amazing VZ-300 colour computer is at its lowest price ever!! Whether you're a computer expert or a first-timer, the VZ-300 has plenty to offer.

Now, for under $100 there's a computer that will expand to meet your needs. With 18K RAM memory — expandable to an amazing 32K, high resolution graphics, and optional disk drive, printer and a host of extras available: the VZ-300 is unbeatable value!

Because it uses the most popular computer language in the world, 'Microsoft Basic', there's an incredible range of software available; games, business/management, education . . . there's dozens to choose from!

Look at these fantastic specifications!:
CPU. — Z80A running at 3.5MHz
Memory. — 16K Basic ROM
RAM — 18K expandable to 32K
Keyboard — 46 key full stroke with automatic repeat key.

Graphics — 32 columns x 16 lines. 128 x 64 dot (8 colour)/64 x 32 dots (9 colour) selectable colours.

With an unbelievable range of add-ons available your VZ-300 will give you years of service! When good value isn't good enough — DSE makes it even better! Cat X-7300

Dick Smith Electronics Pty Ltd

COMPUTERSTORE™

Volume 47, No 12

Electronics Australia

December 1985

THIS MONTH'S COVER

Water and electronics don't always mix but, for the boating enthusiast, they are all important. Our special supplement this month has the facts on marine electronic equipment (see page 53).

Special Supplement

Features

Hifi, Video and Reviews

Projects and Circuits

Columns

Departments

Electric fence controller

Keep the pigs penned, the cows corralled, the goats grounded and the dogs otherwise preoccupied. Whatever your problem, this new electric fence is just the thing for critter control. Turn to page 34.

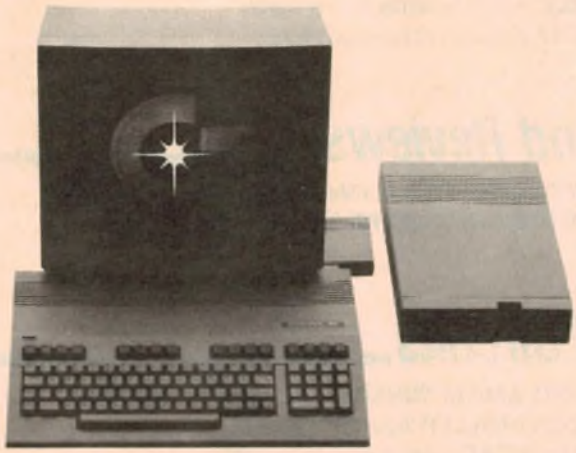
What's coming

Next month we intend to publish a complete compact disc directory and describe a simple video fader. See page 112 for further details.

Playmaster AM/FM tuner

Our new Playmaster AM/FM stereo tuner outperforms anything currently available on the market. It features a wideband AM stereo tuner, 12-station memory, digital readout and synthesised tuning. See page 28.

If you own an Apple IIc, you'd have to add all this



to match the versatility, expandability and higher intelligence of the new Commodore 128

(and it costs less too).

The new Commodore 128™ personal computer is breakthrough technology at a breakthrough price. It outshines the Apple® IIc in performance capability, performance quality and price. It is expandable to 512K RAM while the IIc isn't expandable at all.

And the new Commodore 128 has a numeric keypad built right into its keyboard that makes crunching numbers a lot easier. And the Commodore 128 has graphic and sound capabilities that far exceed those of the Apple IIc. But the most important news is that

the new Commodore 128 jumps you into a whole new world of business, productivity, education and word processing programs while still running over 3,000 programs designed for the Commodore 64.™ That's what we call a higher intelligence.

COMMODORE 128 A Higher Intelligence

C= commodore COMPUTER

Keeping up with you.

BEEMAN MAYRHOFER STOTT/CC422

EDITOR
Leo Simpson
B. Bus. (NSWIT)

ASSISTANT EDITOR
Greg Swain, B.Sc. (Hons. Sydney)

EDITORIAL CONSULTANT
Neville Williams
F.I.R.E.E. (Aust.) (VK2XV)

TECHNICAL STAFF
John Clarke, B. E. (Elect. NSWIT)
Spencer Brown, B.E. (Elect. NSWIT)
(VK2DDH)
Colin Dawson
Robert Flynn
Louise Upton, B.A. (Hons. Sydney)

ADVERTISING PRODUCTION
Danny Hooper

ART DIRECTOR
Brian Jones

SECRETARIAL
Carmel Triulcio

ADVERTISING MANAGER
Selwyn Sayers

PUBLISHER
Michael Hannan

Editorial and Advertising Office: 140 Joynton Avenue (PO Box 227), Waterloo, NSW 2017. Phone: (02) 663 9999.
Telex: AA74488. Facsimile: 662 1007.
Representative: Ruth Stubbs.

Melbourne: 23rd Floor, 150 Lonsdale Street, Melbourne, Vic 3000. Phone (03) 662 1222.
Representative: John Oliver.

Adelaide: Admedia Group, 24 Kensington Road, Rose Park, SA 5067. Phone (08) 332 8144.
Representative: Steve Birbeck.

Brisbane: 25 Balaclava St, Woollangabba, Qld 4102. Phone (07) 391 8922.
Representative: Bernie Summers.

Perth: Tony Allen and Associates, 7 Fore St, Perth, WA 6000. Phone (09) 328 9833.
Representative: Jim Wells.

Distribution: Distributed by Gordon and Gotch Limited, Sydney.

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

Typeset by Magazine Printers Pty Ltd, Regent St, Chippendale and printed by Eastern Suburbs Newspapers, Joynton Ave, Waterloo, NSW for The Federal Publishing Company Pty Ltd.

*Recommended and maximum price only.

Published by the Federal Publishing Company Pty Limited, under licence from Double Bay Newspapers Pty Limited, General Newspapers Pty Limited and Suburban Publications Pty Limited.

FPC

Editorial Viewpoint

by Leo Simpson

SBS should not be swallowed by the ABC!

Right at this moment, there is a move within Canberra to merge the Special Broadcasting Service into the Australian Broadcasting Commission. The seeds of this silly idea were sown awhile ago by the ABC, which has itself been under siege for some time. Indeed, by comparison to the blundering ABC giant, SBS has been a sparkling performer, giving good programming on a low budget.

The reasoning behind the proposed merger is that some factions of the Government are worried that SBS is becoming an elitist service with only a very small portion of the population as its audience.

That reasoning is false. It may be true that SBS TV has only a small viewing audience but that is partly due to its channel allocation. It's an unfortunate fact that a large portion of the viewing populace has not been able to receive the broadcasts on Channel 0 or 28, without taking some positive action such as buying a new antenna.

Given that a large portion of the populace is only interested in Soap and Lotto anyway, they could hardly be expected to expend effort to obtain other programming, especially anything that might vaguely be identified as "ethnic".

It's going to be even harder for SBS to build audience share in future, now that it will be on UHF only, from January 6th, 1986. (See our article on that subject on page 12). That was a sound technical decision as it happens and is a prelude to moving other stations to the UHF bands.

In any case, SBS programming can hardly be regarded as elitist. It has a strong component of sport, and soapies are there too. What is "Rosa de Lejos" after all? No, leave SBS as it. Merging it with the ABC will do no good for anyone.

AM stereo: we show the way

This month we present the first article on our fully synthesised AM/FM stereo tuner. We are very proud of it. It is the first magazine project to use a surface-mounting microprocessor to be published anywhere in the world. As well, it is the first synthesised stereo AM tuner, with the possible exception of professional broadcast monitoring tuners, to feature wide audio bandwidth and low harmonic distortion, and it has the unique feature of an infrared remote control. Naturally, it also has very good FM performance.

At the same time, we are just a little disappointed. We had hoped that more manufacturers would move into the market for AM stereo tuners, whether for hifi or domestic use. Instead, we have had about six manufacturers produce radio/cassette players for cars and three makers produce for the hifi market.

None of these products could be called state-of-the-art. Our new tuner runs rings around them for AM quality. We think the manufacturers could try a lot harder. At the same time, some of the AM stations could do a lot better with their sound quality. They need to use a lot less processing, which in layman's language means less gain-riding and less boosting of bass and treble.

GET READY FOR THE SBS CHANGEOVER ON JANUARY 5!

SBS Ceasing transmission on VHF Channel 0 and transmitting on UHF Band 4 Channel 28 and UHF Band 5 depending on location — just check at your store. Australian made antennas for Australian conditions.

High Gain UHF TV Antenna

Another quality antenna from DSE! Solve those reception problems once and for all. This band 5 UHF is designed for normal reception areas and features variable mounting clamp for easy mounting and aiming! Cat L-4028

$29.50

Combined UHF/VHF Antenna

Why use two antennas when one will handle the job? Our combined UHF/VHF antenna is one of our most popular models. It's ideal for metropolitan reception areas! Great value for a dual purpose antenna! Cat L-4020

$59.95

Economy UHF/VHF

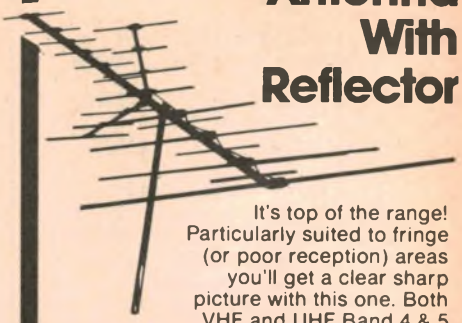
It's made for those good reception areas! If you're close to the transmitter you won't suffer on quality but you **will** save money. Channels 0 to 11 VHF, FM and UHF Band 4 including Channel 28! Cat L-4027

$39.95

UHF 4 Band Antenna

Couple it to your existing VHF antenna and you've got the best of both worlds. Gives excellent reception! Quality Australian made Channel 28 Band 4 antenna at a DSE low price! Cat L-4029

$39.50



UHF/VHF Antenna With Reflector

It's top of the range! Particularly suited to fringe (or poor reception) areas you'll get a clear sharp picture with this one. Both VHF and UHF Band 4 & 5 with inbuilt reflector for maximum gain/minimum ghosting! Cat L-4018

$79.95

Got Two Antennas?

Well, now you only need run one lead! This UHF/VHF Diplexer allows you to connect the two antennas to one TV feed line! Cat L-4470

$8.95

GET THE MESSAGE!

The most efficient and reliable way to stay in touch . . . .

Hurry - limited time only!

BONUS OFFER!! With every D-1022 and D-1012 Pager purchased you get 3 months Answerline Personalised Service . . . FREE when you pay the service contract! You save an incredible $30!!!

Full Alpha Numeric Display

National's top of the line! Get the complete message — without codes! The Alpha Numeric Pager is just packed with features to make communication simple and uncomplicated. Can store 1200 characters over 20 different messages — and you'll get them . . . no matter where you are! Cat D-1022

National Digital Numeric Pager

Now there's a beeper that does much more than 'beep'! The Digital Numeric Pager from National can tell you which number you have to dial or give you a complete coded message . . . instantly! When you need to keep in touch — make it easy, with a digital numeric pager from DSE. It's a lot cheaper than you think! Cat D-1012

$229 **$499**

Beeple: Everyone's Pager!

Everyone can have the convenience of a personal pager with Beeple! The lowest cost pager around. Whether it's for business or around the home Beeple will keep you in touch instantly . . . for under $100! Now communication is within everyones reach at DSE! Cat D-1002

$99

All pagers: connection & service cost extra

Available all capital cities except Darwin & Hobart. Not available in country areas.

DICK SMITH ELECTRONICS PTY LTD

B069

See Address details Page 98

SCAN THROUGH THESE CHRISTMAS CRACKERS!

6 Band MW/FM/SW Radio

Deluxe features at an economy price! 6 bands covering standard AM & FM PLUS 4 shortwave bands! Packed with features you'd expect to pay $$$ more for. Comes complete with protective carry case and quality headphones — at no extra cost! Cat D-2835

$79

6 Bands and . . . Radio Direction Finder

The ultimate in versatility! For the avid radio listener or boat owner this one's a must. Has 6 bands including all 40 CB channels plus shortwave **and** VHF. That's not all — use it as a direction finder against AM radio stations or as a PA amp with optional mic! Cat D-2832

$119

The Shortwave Big-Daddy

Our MW/FM/SW 9 Band Radio is astounding value! Si perb performance over AM, FM and all 7 SW bands. Offers fantastic sensitivity, selectivity, interference rejection and stability as well as a host of inbuilt features. The ideal gift when you're serious about giving!

Cat D-2837

$119

Programmable World Receiver

Direct Key-in World Receiver with Quartz Alarm Clock/Timer — there's hardly a feature it hasn't got! 5 tuning functions including auto scan, direct key in and preset recall. Nine station memory, full AM band (LW, MW and SW), sleep timer in 9 selections (10-90 minutes), LCD display and much, much more! Cat D-2831

$329

BONUS OFFER

With any radio above $50

A copy of the World Radio TV Handbook 1985 edition B-2085. That's right—valued at $32.50 and it's for nothing. Hurry it's for this month only!

FREE!

Air Band VHF Radio with . . . AM & FM

Wow! This budget aircraft band radio will have you listening to the pilots and air traffic controllers! Also covers the normal AM and FM bands so you can use it as normal radio. An exceptionally reliable unit and they're great value as well! Cat D-2836

$29.50

Yaesu FRG 9600 Scanner

Yes, the ultimate communications receiver has arrived! From Yaesu the FRG-9600 is an all mode scanning receiver providing features never offered before at this price! Covers 60-900 MHz continuously with a massive 100 keypad programmable memory!

Cat D-2825

$799

B067

MX-4000 Desk/Car Mount Scanner

The tiny unit that's big on features! Covers 8 bands including 800 Megs and aircraft. Search and scan, priority controls, large LCD display, 20 programmable channels . . . the list goes on! An ideal quality Christmas gift! Cat D-2818

$599

HX2000 Handheld Scanner.

It performs like a fixed model! Up to 525MHz including aircraft band and 20 memory channels all in one tiny unit! Priority scan and search, whip antenna, Nicads . . . you get the lot! Cat D-2815

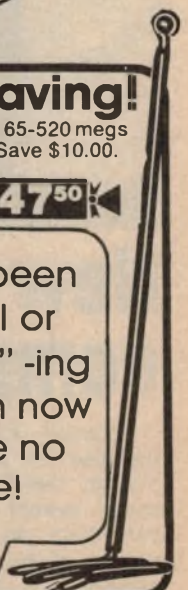
$449

Pick Up A Saving!

Our Scanner Antenna for 65-520 megs is fantastic value. You'll Save $10.00. Cat D-4432

WAS $57.50 $47.50

If you've been "should I or shouldn't I" -ing lately, then now you have no excuse!



BONUS OFFER

Free Australian Radio Frequency Handbook with every Scanner purchase. Valued at $8.95

DICK SMITH ELECTRONICS

PTY LTD

See Address details Page 98

News Highlights

New software makes computers the experts

General Electric scientists have unveiled new software that dramatically reduces the time it takes to build an expert system — the programs enable computers to mimic the reasoning process of human experts on a given subject.

Known as GEN-X and developed at GE's Research and Development Center in Schenectady, NY, the software enables experts in diagnostics, maintenance and other fields to readily store their accumulated knowledge and experience in the computer.

The development of existing first-generation expert systems has required the services of artificial intelligence researchers. They have conducted detailed interviews with experts in a given field in order to extract and input their knowledge and reasoning strategies.

With the new GE system, scientists and engineers possessing a basic familiarity with computers will be able to readily input their own expertise, simply by following instructions in a "fill in the blanks" format.

One such system is already in working order. It is employed in the maintenance and repair of complicated aircraft flight controls. Another will be used to troubleshoot aircraft engines.

Plastic chips challenge silicon

A conducting plastic developed by Japanese chemists could challenge silicon for use in semiconductors.

Scientists working on the project have managed to make a diode (p-n junction) which is stable in air. If the research continues to gain ground it may soon be possible for the plastic, known as polyacetylene, to replace the more expensive, ultra-pure silicon.

The plastic derives its electrical conductivity from a special arrangement of alternating double bonds. The electrons in the double bonds, instead of being localised on specific pairs of carbon atoms, are free to wander over the length of the polymer chain. But this is unstable in air and water, which limits its uses severely.

The Japanese technique overcomes this problem to a certain extent. Ion implantation is being used to alter the polyacetylene's electrical properties. Researchers have doped polyacetylene films with iodine to make it p-type, and then implanted a large dose of sodium ions to give n-type material.

The films then behave like rectifying diodes and are stable in air for a week with virtually no movement of the sodium ions through the polymer matrix — all of which is very promising for future development.

Big new defence contract to Racal Electronics

Racal Electronics Pty Ltd, a Sydney based firm, has been awarded a major contract by the Australian Department of Defence for Project Parakeet, a tactical communications system for the Australian Army. The total value of the Parakeet contract to Racal is around the $A200 million mark.

Parakeet will constitute the heart of a new tactical communications system for the Australian Army. It will provide high-capacity links between major headquarters, a bridge between the combat radio sets and the strategic defence network, and the means of communication for the new AUSTACCS automated command and control system.

All the mainstream design work, testing, manufacture, vehicle/shelter installations and in-service support will be done in Australia. According to Racal, this high level of Australian content will be good for the local electronics industry and will contribute to the growth in Australian expertise.

Welder's helmet uses liquid crystal shutter

A novel approach has been taken, by a company in Hungary, towards eye protection for welders on the job. Using liquid-crystal (LC) and solar cell technology, a protective mask has been developed which automatically darkens when it senses the bright light of a welding arc.

The Wodelic mask has an LC panel through which the welder can see in ordinary light. Within 3ms of detecting the high light levels associated with an arc the LC switches to the mode that shuts the light out. When the arc is removed the panel takes 1.5 to 2s to become clear again.

Powering the LC panel and its electronics is a photosensor and an array of solar cells, making a battery unnecessary. A mirrored layer in front of the LC panel offers some protection if the welder inadvertently puts his hand in front of the photosensor, while a potentiometer is used to adjust the amount of light needed by each welder.

There are a number of benefits with a system where the mask is in place all the time. The convenience of not having to constantly lift and replace it is an obvious time saver as well as being less risky for the welder. It also allows him to see where he is positioning the welding rod at all times, making the work much more accurate.

(Editor's note; A similar development, from an Australian company, was reported in October's feature article on liquid crystal displays.)

Skilled workers lose to computers

According to a recent US report, industry in the US is turning to expert computer systems to preserve the knowledge collected over many years by skilled factory workers. This knowledge used to be passed onto apprentices but, in recent years, these positions in the workforce have begun to disappear.

Frightened of the consequences of losing skilled "blue collar" workers, many industries, especially those in the car industry, are putting their expertise into computer based expert systems.

The trouble with these, according to some, is that they are not yet fully developed. There are a number of bugs that need ironing out before apprentices and skilled workers can be made fully redundant. To rely on an expert system to give an unskilled worker the knowledge he/she once would have gained as an apprentice is seen by some as putting too many eggs in the one basket.

Germany moves into GaAs market

Recently, the German semiconductor industry has decided to launch a $40 million research and development program which will help cope with the two-year headstart that the US and Japan have in the field of gallium arsenide technology.

The final aim of this funding by the Ministry for Research and Technology is to help the semiconductor producers capture a 10% share of the GaAs semiconductor market.

Business Brief

NSD Australia and National Semiconductor have opened a joint Gate Array Design Centre in Melbourne. The Design Centre provides local design of gate arrays for a wide range of applications. They are manufactured by National Semiconductor using the proprietary 2-micron CMOS process.

The facility gives designers the capability to design complex semi-custom digital chips in Australia. The workstation used is a powerful 32-bit computer with high resolution colour graphics. This allows the designer to simulate the gate array's electrical performance before it is manufactured in the US.

Electron beams flatten beetles

Cigarette beetles which plague the multi-million dollar tobacco industry can now be wiped out without the use of pesticides and fumigants. A new technique based on electron beam irradiation has been developed at the University of NSW and is said to be an environmentally safe method of controlling the insect.

Another advantage of the system is that it can be applied after packaging. According to its inventors, it would not be difficult to organise a conveyor belt so that it passed under an electron beam machine. The system would be arranged to give the packages a dose from all sides, thus ensuring few survivors.

DIRECT AUSTRALIAN DISTRIBUTORS FOR HITACHI SEMI-CONDUCTORS

FOR PRICING & AVAILABILITY PHONE:

MELBOURNE
(03) 561 5844
BILL GIBSON
PETER NUTTING
MARSHALL JEFFRESS
FAX: 5616740

TELEX
AA: 37758
LSTRON

SYDNEY
(02) 922 3220
HARRY CROSS
ANNE ALEXANDER
FAX: 927249

News Highlights

Magnavox radios for the RAAF

Magnavox Overseas Ltd and Philips Communications System have been awarded a contract to supply 56 of their new "pacer speak" family of VHF/UHF AM receiver-transmitters to the Royal Australian Air Force.

The radios, intended for ground-to-air communication, will be supplied in Manpack, Base Station, and vehicular configurations and will replace existing An/Pro-41 and A43R radios which are of 1960 vintage and have become difficult to maintain.

Intended mainly for use by the RAAF air transportable telecommunications unit, the radios will be fitted in airstrip operations vehicles. Additionally, they will be utilised for search and rescue operations by some other RAAF units.

The radios provide for compatibility with most approved security devices as well as optional UHF ECCM mode of operation.

Magnetic fields analyse human tissue

A new analysis technique employing powerful magnetic fields, radio waves and computers has been developed by General Electric and used to sample the chemistry of living body tissues.

This new medical technology obtains its results without cutting a patient open or inserting any probes. The relative quantities of certain key chemicals in the body tissues under study are displayed as peaks on a computer printout.

The inventor of the system, Dr Paul A. Bottomley, a physicist at the GE Research and Development Center in Schenectady, NY, stresses that "preliminary results indicate that it could give physicians a valuable new diagnostic tool for evaluating heart disease."

Medical MR (magnetic resonance) spectroscopy follows on the heels of its sister technology — magnetic resonance imaging. The latter also employs magnetic fields and radio waves, but uses them to make pictures of internal body organs and structures.

MR technology is based on the fact that the atomic nuclei of certain chemicals in body tissues can resonate and produce characteristic patterns or spectra from which they may be indentified. The diagnostic potential lies in the expectation that spectra produced by healthy human tissues will differ markedly from those produced by diseased tissues.

VCR war continues

Now that Sony has released its "Hi-Band" Beta VCR in the USA, the Victor Company of Japan are ready to launch a "High Quality" VCR which they claim will outperform Sony's contender in picture sharpness and signal-to-noise ratio.

JVC hope to keep the VHS system alive against what they see as a marketing onslaught by Sony's 8mm and "Hi-Band" Beta units.

JVC's approach to "High Quality" VCRs includes a white-peak-level clipping technique that works within the original frequency scheme. This gives a greater sharpness of picture whilst ensuring good compatibility with existing models.

The pre-emphasised signal is clipped at a white-peak level 20% higher than first generation recordings to provide recorded images with sharper edges. This is by no means a new technique, however the High Quality units take advantage of the clipping by means of recursive comb filters in both the luminance and chroma channels. These reduce both edge and broad-area noise, and enhance the edges between light and dark areas in the image.

Digital oscilloscopes gain ground

Hewlett-Packard have found that analog oscilloscopes are losing so much ground in comparison to digitising scopes that they will phase them out by the end of 1986. The two new HP digital oscilloscopes, the model 54100A/D and the 54200A/D, have sold twice as fast as was expected and have prompted the company to limit their analog models to only two next year.

Although the digital scopes are more expensive, customers will pay the extra because of the added programming and processing ability. It remains to be seen as to whether this will continue to be the trend.

Research and development not up to scratch

According to Mr Jones, "the central problem in Australia's R&D effort is that industry spends too little, not Government too much."

Of at least equal concern is the further reduction in the R&D workforce. In the Business Enterprise Sector, the new figures show a drop of 5% between 1981-82 and 1983-84.

"The importance of research and technical training is not sufficiently recognised" the Minister said. Industry could benefit considerably by having a much greater regard for fundamental research as a training ground for industrial R&D workers.

"CHRISTMAS GIFTS FROM JAYCAR -

AT LAST! A low cost 10 Amp Digital Multimeter with transistor test facility

Digital multimeters are very popular these days but good quality ones with 10 amp scales generally cost well over $100. We think that is too expensive so we've decided to do something about it.
Jaycar is pleased to announce a direct import digital multimeter with sensational specifications at an unheard of price!
Check the specs:

DC VOLT	0.1mV - 1000V
AC VOLT	0.1mV - 700V
DC CURRENT	1uA - 10A
AC CURRENT	1uA - 10A
RESISTANCE	0.1 - 20 Mohm
CONTINUITY	less than 30 ohm @ 1mA
hFE TEST	0-1000 10uA 2.8V NPN/PNP
DIODE TEST	1mA

Basic accuracy of Volts, Current & resistance is between 0.5 - 1.2% depending on range.
DIMENSIONS 170(H) x 90(W) x 35(D)mm

FEATURES

- 0.5" high digits
- High quality probe set supplied!
- Vinyl carry case supplied!
- Built in tilting bail!
- LED & buzzer continuity test!
- Precision thin film resistors used for long term accuracy!
- CMOS logic. 1000-2000 hours battery life!
- Single function range switch
- Complete with battery, spare fuse (2AG) and instruction manual!
- Protected ON/OFF switch!
- Auto polarity
- Protected
- Floating decimal point

Cat. QM-1530

$89.95

AT LAST! A low cost 10 Amp Digital Multimeter/ Transistor Tester & Capacitance Meter!

Jaycar is proud to announce a genuine low cost high performance combination Multimeter/Capacitance meter for the enthusiast! This unit is all the most commonly needed test gear rolled into one!
Similar units are on the market to sell from around $150 to over $200. Why pay more when you can get a Jaycar direct import for less?

DC VOLT	0.1mV - 1000V
AC VOLT	0.1mV - 700V
DC CURRENT	1uA - 10A (20A max 30 secs)
AC CURRENT	1uA - 10A (20A max 30 secs)
RESISTANCE	0.1 - 20M ohms
CAPACITANCE	1pF - 20uF (2%)
CONTINUITY	less than 30 ohms @ 1mA
hFE TEST	0-1000, 10uA 2.8V
DIODE TEST	1mA (Buzzer & LED)

FEATURES:

- 0.5" high digits
- High quality probes supplied!
- LED and Buzzer continuity test
- Precision thin film resistors for long term stability
- CMOS logic. 1000 - 2000 hours battery life!
- Meter protection. Fused
- Complete with battery, quality probes, spare fuse
- Floating decimal point
- Auto polarity
- Impact resistant case

Cat. QM-1540

$129.00

Join the Compact Disc Owners Club - ring (02) 747 1888 or call in to one of our stores for details.

Cat. SL-2700

ONLY $169

DESK MOUNTED LAMP MAGNIFIER

This unit magnifies any object under a clear cool fluorescent light. The magnification is the maximum obtainable (lens 127mm diameter biconvex 4 Dioptres, focal length 254mm) consistent with minimum distortion and eyestrain and good off-angle viewing.
It is NOT cheap, but then again it will definitely last a lifetime. It is built like a Rolls Royce. (We doubt whether 20 years continuous use would wear out the German made flexible arms for example). Spare fluoro tubes are available either from us or electrical outlets. If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.

Technical Information

Illumination: **22W Fluorescent**
Weight: **8.1Kg**
Lateral Extension: **254mm**
Vertical Extension: **254mm**
Fixing: **Heavy table base (grey) with two chrome plated flexible arms.**
Lens: **(see text)**

MAGGY LAMP

NOTE: **This is the GENUINE 'Maggylamp' - don't fall for cheap substitutes.**

FREE DEMONSTRATION!

We now have the Dave Tillbrook designed Vifa 8" 2 way speakers on demonstration at our Sydney city and Gore Hill stores and in our Brisbane store. Call in now!!

Call in to any Jaycar store in December and see our great range of Christmas gifts. We simply do not have time to list them all.
YOU WILL NOT BE SORRY!

Squeaky Clean Mains Filter -

Two fan!astic low cost models. MS-4010 will supply up to 4 appliances. Each 240V socket is isolated from the other, i.e. interference from disc drives is de-coupled from the CPU power supply etc. It will supply up to 4 outlets with a total load of 6 amps (unswitched).
Cat. MS-4010

ONLY $125.00

Single 7.5 amp line socket type filter.
(Unswitched)
Cat. MS-4012

ONLY $34.95

☆ ☆ NEW ☆ ☆ BALANCE (Curve M-N) POTS

For Playmaster Series 200 Amp Kits

Were the balance pots missing from your Playmaster 200 amp kit? It certainly would not have been if you purchased a Jaycar kit.
Jaycar have sufficient stocks of the ORIGINAL balance pots (as used in the EA prototype) for other uses. Please note, however, that these pots are the ¼" shaft pot (with flat) as ORIGINALLY used by EA. They are not "metric" pots.
You can purchase one of these pots and so finish off your valuable project.
Cat. EE-4200

ONLY $3.95

BACK IN STOCK
VOYAGER CAR COMPUTER FUEL FLOW SENSORS

At last after being out of stock for a year we now have stock. If you are a Voyager owner it may be prudent to buy a spare. The Voyager is now out of production in the UK and we do not expect to ever get any more of this item.
Cat. XC-2036

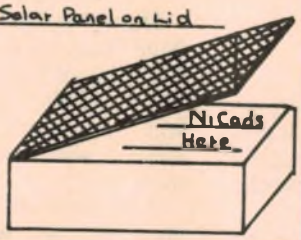
ONLY $45.00

☆ ☆ NEW ☆ ☆ SOLAR BATTERY CHARGER

Cat. MB-3502

ONLY $16.95

This is a genuine new product which we feel will have tons of appeal.
The solar panel in the lid will charge up to 4 x AA NiCads in a fairly short time! It is ideal for yachts, campers or anywhere where 240V is not readily available. It is NO DEARER than an ORDINARY NiCad charger but takes about the same time to charge in reasonable sunlight.



☆ EXCLUSIVE!! ☆ GREAT NEW BOARD GAME FOR XMAS! "TUOHK"

A great treat for Jaycar customers who own a Commodore VIC-64

Jaycar is the exclusive NSW distributor of the great new board game called "University of Hard Knocks". Basically the game works like this:
You load a cassette into your VIC 64 which contains 5000 Trivia type questions
"Community chest" or "Chance"
Type statements
Other instructions
You then lay out the attractive vinyl covered playing board and play the game. The computer provides all questions and answers as well as the odd setback if you land on the wrong square. The game can also be played at different levels so accommodating people playing at the same time with different degrees of general (trivial?) knowledge.
The game progresses until you achieve a "Degree" in the trivia subjects that you have mastered.
No computer skill is required. The computer simply provides information to operate the board game. Around the same price as conventional board games.
Cat. XG-6000

ONLY $49.95

All game pieces etc included

Call in or telephone Jaycar for a FREE copy of our GIANT XMAS MAILER. It's full of incredible bargains!

☆ ☆ NEW ☆ ☆ HEADPHONE WITH INBUILT MICROPHONE

★ Quality dynamic mic insert. Omnidirectional, 600 ohm impedance, -84dB sensitivity, cord length 7 feet.
★ Headphone 40mm Mylar drivers, 400mW rating, 28-32 ohm impedance, stereo, 6 foot cord.
These quality phones feature an excellent gymbal mic boom adjustment. This multi axis adjustment enables you to position the mic comfortably close to your mouth - no matter what shape head you have!
Cat. AA-2020

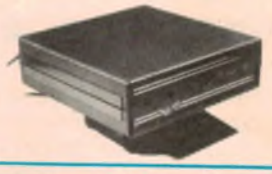
ONLY $29.95

★ Ideal for pop groups
★ CB, amateur radio use etc.
★ Telephone etc.

240V NEGATIVE AIR IONISER

Whilst the scientific proof is thin, many people swear by the efficacy of negative ionisers. This unit is locally made and highly regarded.
Cat. YX-2900

ONLY $69.95



MAIL ORDER HOTLINE (02) 747 1888

ETONE 10" SUBWOOFER

As used in the Electronics Australia subwoofer system.
★ Size 10" (250mm) ★ Cast frame. QT = 0.39, VAS = 631 ★ Power handling 100 watts rms ★ Free air resonance 32Hz ±1Hz ★ Voice coil diameter 2" ★ Magnet assembly 3kg (6.6lbs)
Cat. CW-2119

ONLY $99.95

AA NICADS

RECHARGEABLE BATTERIES
AA size, 1.2V - 450mA. Charges at 45-50mA (14-16 hours). Will outlast well over 1000 recharge cycles with average use.
Cat. SB-2452

1-9 $2.50
10-24 $2.20
25-99 $2.00
100 up $1.80 each

OPEN THURS NIGHT 'TILL 8.30 p.m.

YORK ST. CITY
HURSTVILLE
CARLINGFORD
BRISBANE

QUARTZ CRYSTAL CLOCK MOVEMENT

● Very compact and reliable ● Self starting one second stepping motor has strong torque ● Powered by 1.5V AA battery that lasts for one year ● Supplied with one set of hands ● ±15 second/month accuracy ● 56mm square, 15mm deep ● Complete with data sheet, instructions.
Cat. XC-0100

ONLY $12.95

CORRECTION

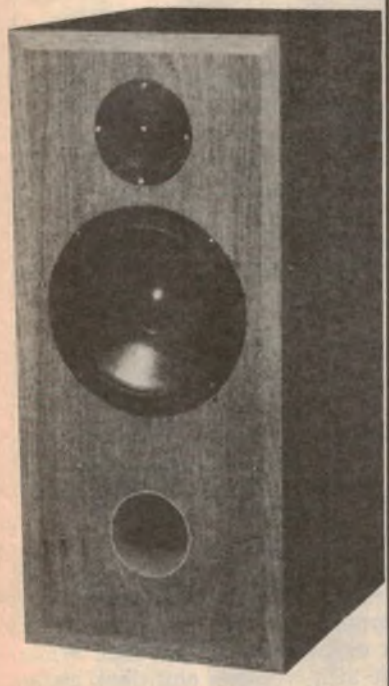
The AVTEK MULTIMODEMS prices advertised on page 13 November 1985 E.A. should have been: Cat XC-4820 at $365; Cat XC-4822 at $399. Jaycar apologises for any inconvenience caused to customers.

HOW APPROPRIATE - FOR YOU"

"VIFA" 8" 2 WAY SPEAKER KITS

See AEM magazine in August

TWEETER D25TG Cat. CT-2020
$59.95 ea $119/pair
WOOFER P21WO Cat. CW-2132
$149 ea $298/pair
CROSSOVER NETWORK
Not a kit, now a factory built precision unit.
Cat. CX-2630
$69.95 ea $139/pair
TOTAL PRICE $557.90
SPECIAL PACKAGE PRICE $499
SAVE $58.90!!



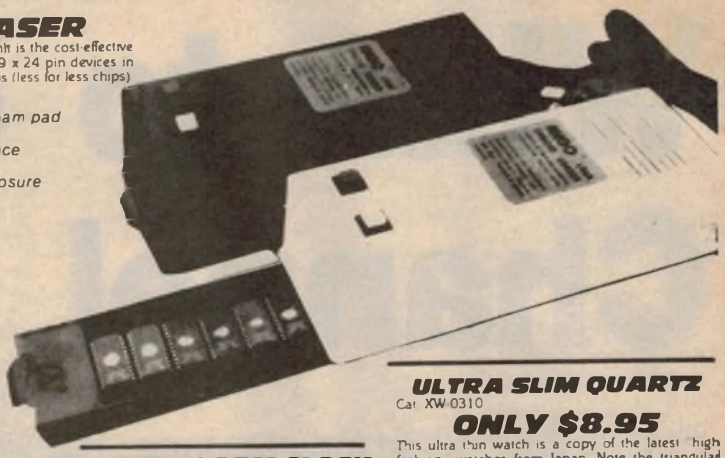
UV EPROM ERASER

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

- Erase up to 9 chips at a time
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures thorough erase
- Engineered to prevent UV exposure
- Long life UV tube
- Dimensions 217 x 80 x 68mm
- Weight 670 grams

Cat. XE-4950

ONLY $99.50



"QUARTZ KIT" set of 6 LCD Watches

Cat. XW-0270

ONLY $14.95

This is once again an ideal childrens gift. 6 separate cases are supplied to maintain the childs interest. The watch module itself snaps into the case. This module is actually Japanese made and is of high quality.

QUARTZ ALARM CLOCK

Cat. XC-0114

ONLY $9.95

This style of clock has been around for some time now but now at a very low price.
Note the special cradle that allows you to wall mount the clock and remove it when necessary.

ULTRA SLIM QUARTZ

Cat. XW-0310

ONLY $8.95

This ultra thin watch is a copy of the latest high fashion watches from Japan. Note the triangular yellow function change button on the face of the watch - not the small difficult to operate button normally found on the side.

Quartz Stop Watch

Cat. XW-0380

ONLY $16.95

Attractive all weather watch with all stopwatch functions as well as 5 function watch! (i.e. day, date etc). Note the generous length knitted lanyard. Very easy to use!

ELECTRONIC TELEPHONE DIRECTORY

Cat. YT-6500

ONLY $59.95

Firstly, it must be emphasised that this is a very high quality product.

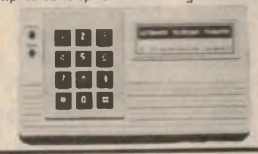
- ★ It can store up to 64 separate telephone numbers or other numbers.
- ★ It is a clock (an excellent travel clock in fact).
- ★ It has an alarm in the clock function.
- ★ It is a full function calculator.
- ★ It is supplied with a quality Dralon pouch.
- ★ It uses readily available AAA batteries.

☆ ☆ NEW ☆ ☆ TELEPHONE CALL DIVERTER

Cat. YT-6505

ONLY $159.00

This piece of equipment enables you to REROUTE that important telephone call to ANOTHER LOCATION unbeknownst to the caller!
A more satisfactory solution in many ways than a complicated telephone answering machine.



OPEN THURS NIGHT 'TILL 8.30 p.m.
YORK ST. CITY
HURSTVILLE
CARLINGFORD
BRISBANE

KID'S LCD NOVELTY GAMES

Cat. XT-1500	"Marshall"
Cat. XT-1501	"Tom's Adventure"
Cat. XT-1502	"Coffee House"
Cat. XT-1503	"Home Sweet Home"
Cat. XT-1504	"Nursery"

ALL PRICED AT $15.95 each

Very popular when they were retailing last Christmas at $34.40. Now they are at a much more realistic price. Ideal Xmas gift for 4-8 year olds - batteries included.

"CALLMASTER" Telephone Answering Machines

Two models available: both Telecom Approved (Telecom Permit # C81-16-18) and Electricity Authority approved (Certificate # CS2029N). ● Dual cassettes. Once only outgoing recorded announcement. You can play back the messages on any cassette player including your car ● Large incoming message capacity - up to 150 messages on a C-60 (12 seconds average call) ● Easy change of outgoing message ● Callmaster stops at end of incoming message. Eliminates blank spots on the tape ● Precision and quality Japanese made. Need we say more? ● 12 months warranty.

Cat. YT-7010
STANDARD TA100
$245.00

Cat. YT-7020
REMOTE CONTROL VERSION
(all the features of the TA100 plus remote control)
ONLY $319.00

OPEN SATURDAY 'TILL 4 p.m. ALL STORES

REVOLVING LIGHT BEACON

Cat. LA-5108

ONLY $38.50

This is the REAL THING. A true motor driven revolving BEACON with automotive-type 12V lamp. Ideal for tow trucks and other emergency vehicles as well as burglar alarms etc.

Hands-Free 10 Memory Desk/Wall Telephone

● Loud and clear fully duplex hands free 2 way speaker ● 10 direct access memories ● Telephone line powered ● Unauthorised call restriction lock (optional) ● Adjustable volume control switch on handset ● Adjustable speaker volume control ● Privacy muting button ● Ringer Hi-Lo control ● Ten 18 digit memories plus one 22 digit last number redial ● Wall mounting or table use ● Programmable PABX pause.

Cat. YT-7092

ONLY $175.00

Jaycar ELECTRONICS

Incorporating ELECTRONIC AGENCIES

NUMBER 1 FOR KITS

N.S.W. SHOWROOMS
SYDNEY: 117 York Street. Tel: (02) 267 1614
CARLINGFORD: Cnr. Carlingford & Pennant Hills Road. Tel: (02) 872 4444
CONCORD: 115/117 Parramatta Road. Tel: (02) 745 3077
HURSTVILLE: 121 Forest Road. Tel: (02) 570 7000
GORE HILL: 188/192 Pacific Highway (Cnr Bellevue Avenue). Tel: (02) 439 4799

QUEENSLAND **BURANDA:** 144 Logan Road. Tel: (07) 393 0777
MAIL ORDERS: P.O. Box 185, CONCORD 2137
HEAD OFFICE: 115-117 Parramatta Road, CONCORD 2137
Tel: (02) 747 2022 Telex: 72293

SHOP HOURS
Carlingford, Hurstville, Gore Hill, Brisbane
Mon-Fri 9am - 5.30pm
Sydney and Concord
8.30am - 5.30pm
See Box for other shop hours

POST & PACKING

$5 - $9.99	$2.00
$10 - $24.99	$3.75
$25 - $49.99	$4.50
$50 - $99.99	$6.50
$100 - $198	$8.00
Over $199	$10.00

COMET ROAD FREIGHT ANYWHERE IN AUSTRALIA ONLY $13.50

MAIL ORDER VIA YOUR PHONE

UHF antennas, cables & splitters

What to do about Channel 0/28

People are getting the message. Television channel 0 will cease transmissions on January 5th, 1986. From then on, as far as Sydney and Melbourne viewers are concerned, SBS will only broadcast on the UHF band. In other localities, SBS is already only available on the UHF bands. What do you need to do to receive the UHF transmissions for SBS? Just read on.

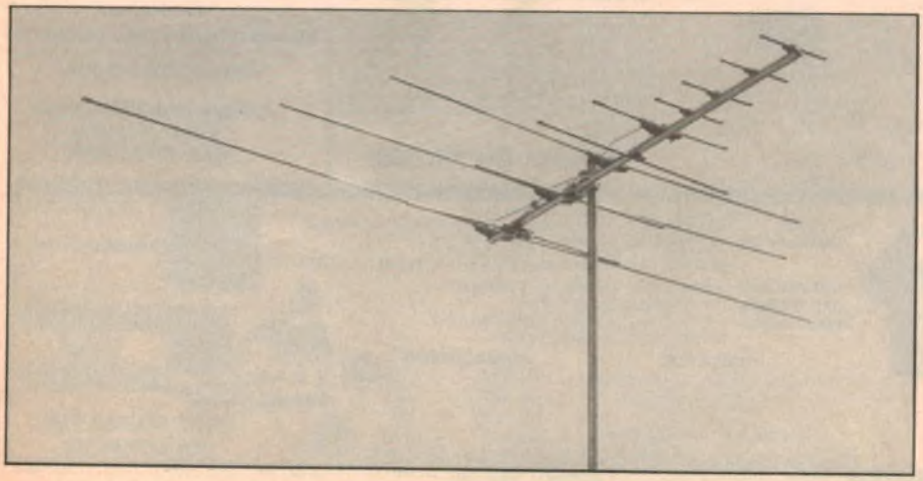
by LEO SIMPSON

Christmas may be the season to be jolly but if you are relying on television for your holiday entertainment, things could be bleak indeed. It is the non-ratings period, when television programs on the commercial stations become even more of an insult to the intelligence than usual. And even though the poor old ABC does its best, albeit with its own commercials, it is not the complete answer.

As a result, intelligent viewers are turning to the Special Broadcasting Service with its excellent news and sports services plus a wide selection of well-produced foreign movies, all presented without commercials. If you are to take advantage of this service, you can no longer rely on VHF to provide it.

In Sydney and Melbourne, SBS transmissions are already available on UHF band IV, channel 28, as indeed they have been from the inception of transmissions. The frequency limits for Channel 28 transmissions are 526 to 533MHz, with the vision carrier on 527.25MHz and the sound carrier on 532.75MHz.

For many people in strong signal areas, the easiest way to gain UHF reception is to update their antenna to this combined VHF/UHF array from Dick Smith Electronics.



In the harbourside and eastern suburbs of Sydney, it is also possible to receive SBS on band V, channel 54, from the Kings Cross translator, on top of the Hyatt Kingsgate hotel. These transmissions are much higher in frequency, with vision carrier on 737.25MHz and sound carrier on 742.75MHz.

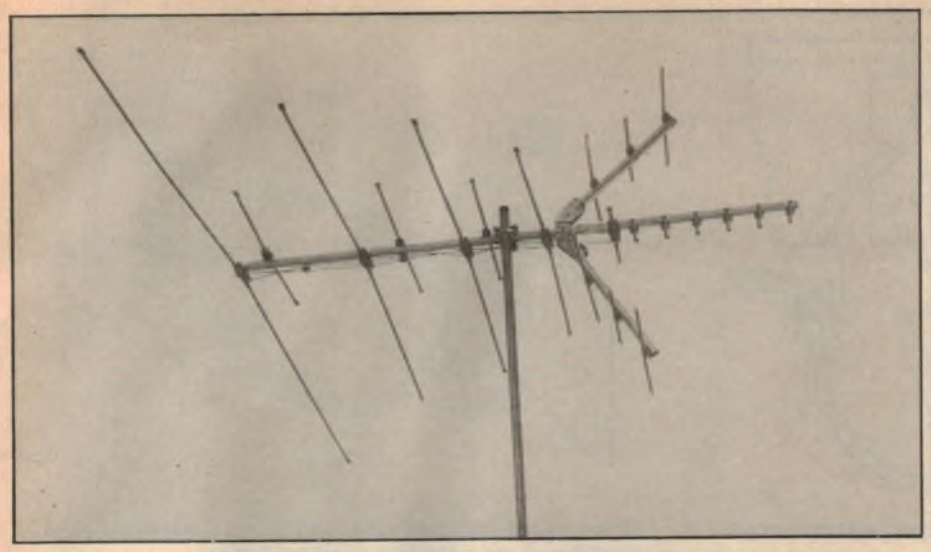
UHF capability

The first thing you need to receive the Special Broadcasting Service transmission on UHF is a TV set with a UHF tuner built in. That seems obvious enough but many of the older sets do not have this facility. There are three solutions to this problem:

(1) Buy a new TV set with a built-in UHF tuner. This is a good idea if your set is around 10 years old and you think that it might be on its last legs. While you are at it, you can also think about buying a set with remote control and incorporating a stereo TV decoder. You may as well. These sets are not going to become any cheaper and a set with remote control is almost an essential these days if you want to be able to "zap" those inane commercials.

(2) Buy a VCR. All current model VCRs are provided with inbuilt UHF tuners and can thus substitute for the tuner in your present TV set. If you already have a VCR, it is probable that it also has the UHF facility. Have a look in your owner's manual and at the VCR tuning panel to confirm this. The only drawback to this approach is that you will not be able to watch and simultaneously record separate TV broadcasts, if both are on UHF.

(3) Buy a UHF adaptor. This is a small unit which sits on top of your present TV set and converts the UHF channels to one of the unused VHF channels which can be received by your set. They can usually be set to put out a signal on channel 0 or 1, but now that SBS channel 0 is to cease operation, it does not matter which. These can be



For people in weaker signal areas, this higher gain combined VHF/UHF array still has the advantage of only one signal cable.

purchased from antenna installation companies and cost around $100 or so.

Another possibility is to consider the stereo TV decoder described in the March 1985 issue of *Electronics Australia* and produced in kit form by Dick Smith Electronics for $249. This incorporates a UHF tuner which would also serve the purpose here.

A final possibility is to install a UHF tuner module in your existing VHF set. Some models were sold as being "UHF ready" with the UHF tuner position on the front panel blanked off. It is possible that some TV distributors may be able to supply a UHF module for your set although installing it will require some television servicing knowledge and access to the relevant service manual. For most of us, the first two approaches are the easiest and most practical.

The antenna

Once your set is able to receive UHF signals, you can consider your antenna and whether it can pick up the UHF signal. The truth is that the UHF signal for the SBS transmissions, on channel 28, is very strong; so strong, in fact, that many people to the west of Gore Hill in Sydney are able to receive the signal whether their antenna is designed for UHF or not. People in other areas of Sydney, particularly those whose rooftop antenna has a line-of-sight to the Gore Hill TV tower, should also be able to get a good signal.

In Melbourne, the situation is similar, with a large proportion of viewers being provided with a strong UHF signal on channel 28.

Whether or not your present VHF antenna will pick up a good UHF signal will depend on your locality and whether the antenna is a Yagi or Log Periodic Array. If it is a Yagi it will most likely pick up a good signal (if you already have good reception on VHF) although its directional characteristics for the UHF bands will not be ideal.

This may mean that its direction of maximum signal pickup may be from one side and its front-to-back characteristic may be poor, giving rise to ghost-ridden reception.

On the other hand, if your present VHF antenna is a log periodic type which has probably been installed since the advent of colour, the likelihood of it picking up good UHF signals is pretty remote. This is because the gain of typical VHF log-periodics rolls off rapidly above channel 11 (ie, above 220MHz) and so the signal pickup at channel 28, 530MHz, is just about non-existent.

Connecting the signal

Let us suppose for the moment that you are going to use your existing antenna and that the antenna lead-in, from the wall socket, is a coaxial cable with conventional Belling Lee plug fitted. If your set is about five years old or younger, it will have one antenna socket on the rear which handles both VHF and UHF signals. The same applies to most VCRs — one coax socket handles all signals.

If you do not have a VCR but have a TV set which is more than about five years old, it will most likely have two sets of antenna connections — a round 75-ohm coax socket for VHF signals and a pair of screw terminals for 300-ohm ribbon, for UHF signals. This is a legacy of older Japanese sets because UHF antenna connections in Japan are usually via 300-ohm ribbon.

Whatever the reason, you now have to make a connection to these screw terminals, in addition to the coax socket, to make sure UHF signals feed into the set. One way to do this would be to use a two-way splitter which gives two 75-ohm coax outputs. The L-4472 from Dick Smith Electronics would be ideal for this.

It could be attached to the back of your set as follows: Make up three short coax cables with coax plugs fitted to the ends of two. One becomes the input cable while the other goes to the existing coax socket on the TV set. The third cable then becomes the UHF output and is fitted with a 75-ohm to 300-ohm balun (for example, DSE Cat No L-4464) for connection to the screw terminals.

Do not use some of the cheaper baluns commonly used for VHF (particularly for connecting video games or computers to TV sets) since their performance with UHF signals is not guaranteed. They're often not all that hot on VHF signals either.

If your TV set has two coax sockets, one for VHF and one for UHF, you may want to use a two-way coax splitter, such as the L-4270 from Dick Smith Electronics. With two coax flyleads

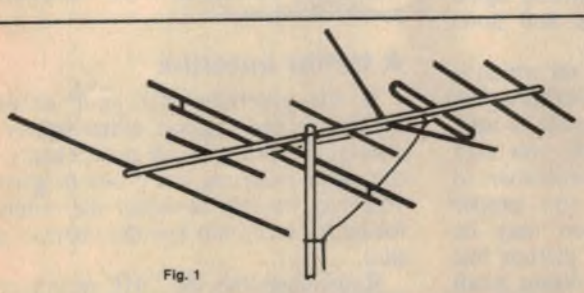


Fig. 1

If you have an existing all-channel VHF yagi array such as this, there is a good chance you can obtain a good UHF signal.

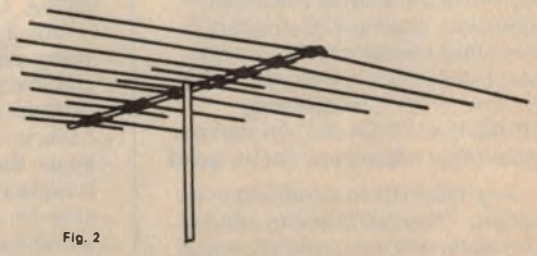


Fig. 2

If you have a log-periodic TV antenna like this, you will most likely have to buy a UHF antenna.

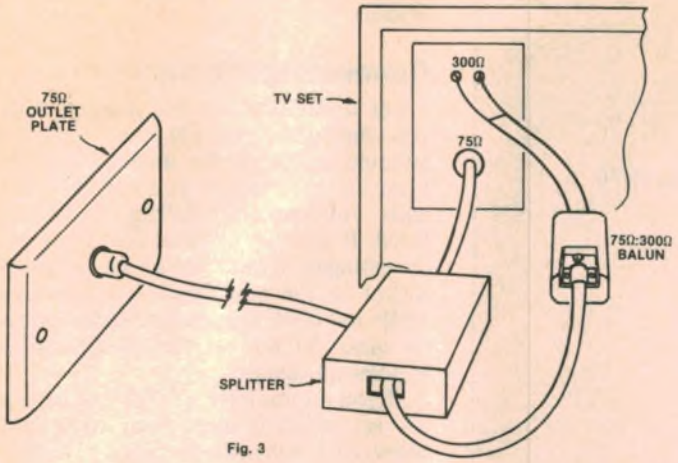


Fig. 3

This is a good way of connecting the signal from your antenna to a set with two coax sockets.

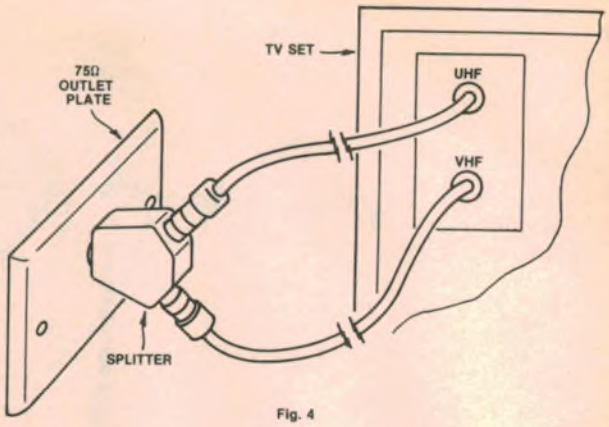


Fig. 4

If your set has 300-ohm UHF terminals, you will need a splitter (or diplexer) and a balun to connect the signals.

What to do about SBS TV

(coax fitted with plugs both ends), you can connect the signal to both sockets with ease. Just plug the splitter directly into the wall socket and then plug the two cables, from the respective UHF and sockets, into the splitter, as if it was a double adaptor. Neat, huh?

If your incoming antenna lead uses ribbon cable and feeds via a balun adaptor to the coax socket, you can take the following temporary approach: Disconnect the ribbon cable from the balun adaptor and connect instead to the UHF screw terminals. This will allow you to at least assess the quality of the available UHF signal before deciding that you need a new antenna. If you find that the antenna is okay, you will have to obtain a two-way 300-ohm splitter to be able to feed the signal to VHF and UHF inputs.

Tuning the set

Strange as it may seem, many people have great difficulty tuning their TV set for the best picture. On the latest TV sets with remote control and on VCRs, the procedure is simply a matter of pressing the right buttons and the process is automatic from there on. Check your owner's manual to be sure you do it the right way.

For simpler sets, whether they have push-button station selection or continuous UHF tuning, the procedure is much the same: set the unit for UHF operation and turn the knob or preset, tuning up the band. As you tune beyond the optimum point for best reception the picture will suddenly become very noisy (read: snowy) and will tend to "tear" as it loses sync. Turn the knob back very slowly again until the noise just disappears.

Having done this for channel 28, you may find that you have a strong signal with no snow or ghosting and good colour. Great. You're lucky.

But if you have an older set which is being used on UHF for the first time, it is possible that you may have poor or non-existent colour. In that case, you may have to call in your local serviceman to align the UHF tuner to give proper reception. Alternatively, you may be able to get a good colour picture but without sound or vice versa. Again, a call to the serviceman is the only solution, unless you are experienced in these matters.

UHF needs good cable

If you are having a new antenna installed, don't skimp on the cable quality. Cheap cables do not give good performance on UHF signals.

Use really good quality cable such as Hills SS3C2, copper screened cable. This has an inner conductor of solid copper wire with polythene applied in the form of a five-cell extrusion, making it air-spaced. The outer conductor is a copper wire braid which is then sheathed in brown PVC. Signal loss at 500MHz is 16.94dB/100 metres. Most other cables are not as good.

Avoid aluminium screened coax cables. They are prone to internal corrosion and are generally not as reliable as copper-sheathed cable. In short, they're junk.

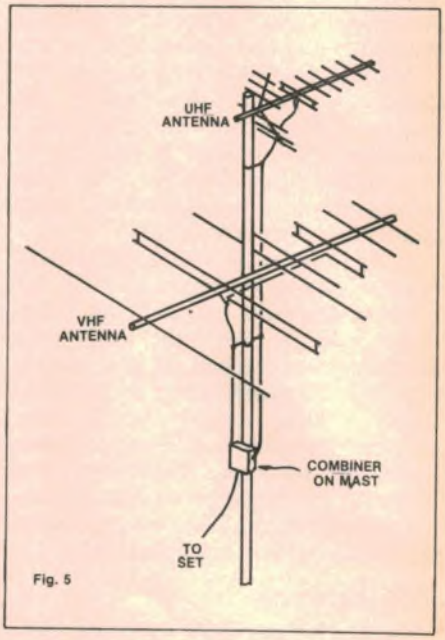


Fig. 5

If you need two antennas, you will need to feed the signals to a combiner on the mast.

In either of these cases, if you have a VCR, check its own UHF reception before concluding that the set is at fault. It is possible that the antenna can be at fault here, because its UHF reception is purely accidental.

A better antenna

If the reception via your existing antenna is not so good, either snowy or ghosty, or both, you are not so lucky. If the signal is strong but prone to ghosts, you may be able to orient the antenna for better reception but the chances are slim.

Remember that the UHF pickup of a VHF Yagi will not necessarily be in the preferred direction and you could have very poor front-to-back and front-to-side

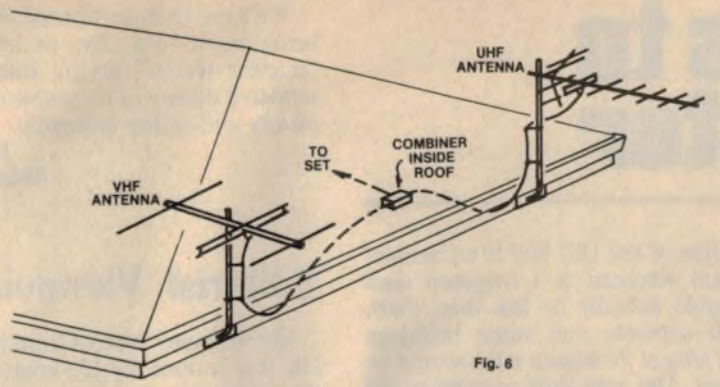


Fig. 6

Where the antennas are separately mounted, feed the signals to a combiner under the roof.

What if you live in a home unit?

Many home units do not have an antenna and cable distribution system which is good enough for UHF signals. Often the complete system will have to be replaced to be able to receive UHF. If you are unable to persuade your body-corporate to spend the money needed, and it could easily run into thousands of dollars for a large installation, or perhaps you live in a rented unit, there is another way.

Provided your unit has a window or balcony with line-of-sight to the channel 28 transmitter, you could consider installing your own UHF antenna. They are so much smaller than VHF antennas that this could be a practical proposition. You could easily clip a small UHF yagi, corner reflector or bow-tie array to your window sill or balcony railing without it becoming noticeable. Then, when you move out, you can easily take it with you.

You will still want the TV signals from the existing VHF antenna, so if your TV has only one antenna socket, you will need a combiner. Most two way splitters can be used backwards as combiners, taking two antennas in, providing isolation between them and providing one mixed signal out. Again, the L-4472 from Dick Smith Electronics is suitable or you could use the L-4270 model.

rejection. The answer is a better antenna, one designed for UHF. That raises quite a few possibilities.

UHF/VHF arrays

How long has your existing antenna been installed? If it has been up for 10 years or more (possibly needing replacement anyway) and you live in an area with good signal strength, such as the western suburbs of Sydney, a combined UHF/VHF array will be a good answer. This has the advantage that it only needs one coax cable from antenna to set and is simpler to install than if two antennas are involved.

If you do decide to replace the existing VHF antenna in this way, it is probably wise to replace the coax cable too. The cable originally installed may not have been suitable for UHF signals and it tends to deteriorate markedly over a period of 10 years, especially if you live in a seaside area or one prone to industrial pollution. See the comments on cable quality in the panel elsewhere in this article.

Combined antennas may have a log-periodic or Yagi section for the VHF signals and a smaller Yagi section for the UHF signals. For both VHF and UHF, the general rule is, the more antenna elements, the higher the gain.

If the antenna you are considering is intended for use with 300-ohm ribbon, don't install it that way. Buy a balun too, one which attaches directly to the antenna terminals. 300-ohm ribbon might be passable in strong signal areas for VHF but it is definitely not the way to go for UHF. Using it is asking for trouble with signal loss and multiple ghost reception due to signals being picked up by the ribbon itself.

What if you live in a weak signal area and already have a large, high-gain VHF antenna? In this case you will want to keep your existing antenna and add a separate high gain UHF antenna. This could be a multi-element Yagi with integral corner reflector such as the Hills TC18/B4 (for UHF band IV) if you live in a fringe area, or it could be a smaller model such as the Hills TC10/B4, a corner reflector or a bow-tie array.

Some Yagi-style UHF antennas do not have a corner array but have a single reflector element behind the folded dipole. These are generally not as expensive but do not have quite as high a gain figure and do not have a narrow vertical acceptance angle which is an advantage in reducing "airplane flutter" caused by aeroplanes passing overhead.

Installation

The additional UHF antenna may be installed on the same mast as the VHF antenna, provided it can be installed as high as possible while still being a metre or so above or below the main array. It is preferable to install the UHF antenna above the VHF array though, to give it the best line-of-sight to the transmitter. It is also possible that a more satisfactory installation may be obtained by having the UHF antenna on its own mast or mounting bracket.

If you are in the transmission area for Sydney's Kings Cross translator, you need a band V UHF antenna. This has elements which are quite a lot smaller than those for band IV.

Whatever UHF antenna you decide upon, make sure that it is made for the appropriate band. A band IV antenna has very little response on band V, and vice versa.

There are two ways of bringing the signals from the UHF and VHF antennas to your set. If both antennas are on the one mast, it may be better to feed both signals to an outdoor combiner mounted on the mast and bring one cable down from it.

On the other hand, if the two antennas are mounted separately, bring the cables into the roof, then into an indoor combiner and then down into the various rooms in your house, via splitters if necessary. Remember that all splitters and combiners in the system must be guaranteed for operation at UHF.

Finally, a word about installation. If you are a keen do-it-yourselfer you may want to make your own installation. Fine. But be aware of the risks. Clambering about on roofs is a very dangerous pastime, particularly if you are preoccupied with mounting and aiming an antenna.

Before you do the job, get a quote for the installation from at least two antenna installers. You may be surprised. You could easily decide that the money you save by doing it yourself is not worth it, especially if you have to go to the trouble of hiring ladders and other tools. By reading this article you will know what is required in your installation and will have the satisfaction of knowing that you have paid for a good professional job, whether you do it yourself or not.

Letters to the editor

Support for Star Wars

I am writing to rebut the arguments put forward in the Editorial of the June issue of *Electronics Australia* against the "Strategic Defence Initiative". I know this is a belated reply, but the topic is still current, and it seems to me that incorrect facts are being propagated.

The Editorial perpetuated the idea that the only possible implementation of SDI is space-based sophisticated laser weapons. However, what is almost never described in the press is the *High Frontier* program. The cost estimate is $15 billion, with five to six years for deployment. The technology is relatively simple — orbiting satellites armed with non-nuclear and non-explosive intercept devices — the ICBM is destroyed by high kinetic energy. The missile would be "torn to pieces".

When it was revealed that Australia was researching the "electromagnetic rail gun", which may have possible use for space defence systems, the immediate Government reaction was to run scared from such possible involvement.

The Editorial argues that if such a system allowed "just a few" missiles through it "will have failed miserably and we will all be up the creek". If we assume that each layer of the proposed three-layer system is 80% effective (resulting in a total effectiveness of 99.2%), then 80 missiles from an assumed total of 10,000 launched would arrive at the US.

But could the arrival of 80 warheads in the US really cause the whole destruction of the US? No! If we assume that each warhead is 1 megaton (and they would actually be less than that), then all concrete and stone buildings over an area of 24 square miles would be destroyed. The area thus covered by 80 explosions would be 1920 square miles.

Let's not say that the destruction of 1920 square miles will be a pleasant thing, but when we consider that the area of the US is over 3,000,000 square miles we discover that less than 0.1% of the US would be destroyed. Certainly a disaster for the particular targets hit, and not something to be wished for, but hardly total destruction of the US, let alone the whole world. This scenario assumes that the Soviet aim is to destroy the US — but their strategy is *defeat*, not destruction.

It is also false to say that it is always possible for the Soviet Union to build one more missile than necessary to overload the defence system. Dr Robert Jastrow says that calculations show that defence stations only need to be increased in proportion to the square root of the number of offensive missiles, not in direct proportion.

Surely there is more merit in a defence system that is incapable of killing anyone, than in an offensive Mutually Assured Destruction concept. Thus it seems that anti-defence defeatists ignore off-the-shelf programs for space-based defence and counter with a "Star Wars" version that will cost "trillions", and "probably won't work". The result is a clouding of the issue and millions spent on study programs, with the predictable outcome that it is "too expensive, won't work".

We have been so worried about either being burnt to a crisp or freezing (the "nuclear winter" myth), that we have rendered ourselves incapable of thinking clearly and acting rationally.

R. J. Long,
Brisbane, Qld.

Editorial Viewpoint

Mr Simpson's type of thinking (ie, it is OK if it is done for the greater good of the country) is socialism — no more no less, and I quote some facts for him to ponder over.

This is an extract from a book written by an avowed socialist and the book is called "The Soviet Blueprints — The new society — The Drama of Socialist Planning".

I quote: "What might be done by purchase, or by a system of extended compensation, was done by forcible seizure in Russia. But it was done. Not that exapropriation, if made in the interests of the community as a whole, need be immoral".

You might say that forcing an ID card on a person is not exapropriation, but it is — it is exapropriation of one more of our freedoms.

Mr Simpson will no doubt say that I am one of those people who does not wish to take responsibility for my actions. Quite the contrary. I ask no favours from anyone and I expect to give none in return except those given of my own volition. I accept no government handouts or freebies and I object strongly to paying taxes so that social welfare recipients can bludge on government handouts.

My company is the only Australian company competing against the largest of the multinationals in the seismic data acquisition field. We expect no handouts and we get none. We compete in a truly free enterprise business and have to date succeeded.

Mr Simpson also states that ID cards would have important ramifications in the fight against crime and my precedent is that Social Security cards in use in North America have done nothing to reduce crime there.

Who do we in Australia continually quote as having the highest crime rate in the western world?

Finally I have been reading your magazine for nearly 30 years and feel that in the last couple of years your editorial style has degenerated to something not worthy of the hard work spent getting to where you were a couple of years ago.

P. A. Grimson,
Bridgeman Downs, Qld.

Improving inverter circuits

Recently you have published projects using small inverters. In the interest of better circuitry I would like to make two comments.

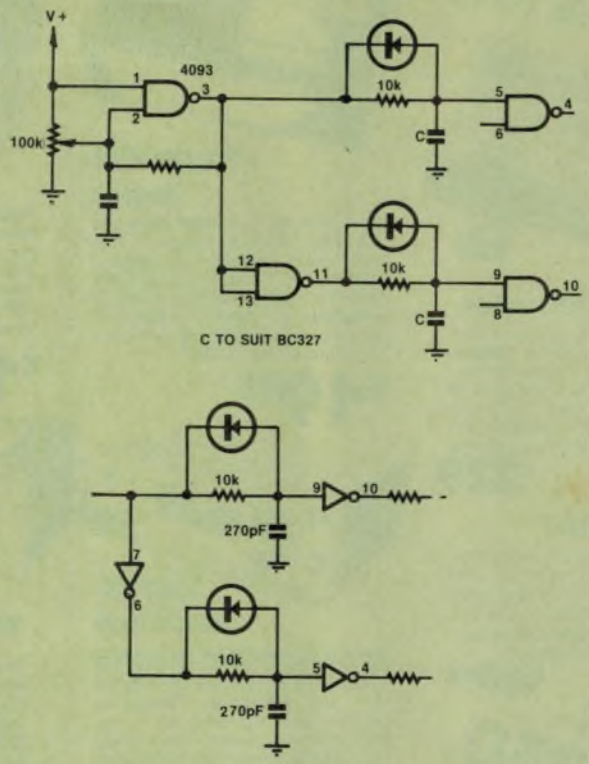
(1). Symmetry: the Megohm Meter in the July 1985 issue uses a 4093. The duty cycle of the clock section is not necessarily 50% but can be made so by suitably biasing the driver input.

(2). Deadband: in neither the above project nor the inverter in the August (1985) issue is any provision made for the turnoff time of the output transistors. (In fact mention is made in the latter of the need to suppress output spikes.) The delay network shown inserted in the drive train will delay the ON edge but not the OFF.

A BD682 has a turnoff time of about 3μs and values of R = 10kΩ and C = 270pF will match this.

If two resistors are inserted in the centretap lead of the transformer, the symmetry can be adjusted for minimum no load current and the ramp form of the current waveform can be examined for switching spikes. With the correct deadband there are none.

W. A. Jolly,
Nambucca Heads, NSW.



Hearing linearity

I read with interest your comments platinum ears and their linearity.

If you wish to pursue this matter further there is a very simple test which you may care to try out. The only equipment needed is two audio oscillators connected to separate small loudspeakers or headphones. I have used two calibrators from sound level meters which produce clean sine waves with a nominal frequency of 1kHz but whose actual frequencies differ by about 2Hz.

If both loudspeakers are placed close to one ear and that ear is non-linear, then a 2Hz beat is heard. I have checked quite a few people in this way and the surprising result is that the large majority show a marked difference in the intensity of the beat perceived by each ear. It is not uncommon to find someone who can detect a strong beat in one ear and nothing at all in the other.

I have not yet found anyone who could not detect a beat in at least one ear.

If the speakers are placed so that their outputs are confined to a single ear, then all the people that I have checked could detect no beat note at all.

A. B. Hollebon,
Cloverdale, WA.

ARE YOU BUILDING AN EA KIT?

If you have purchased an EA kit you may not have all the info you need to build it and get it going properly. Kit suppliers often do not include all the information published on a particular project. If you want to be sure of having all the info on a kit, you need to go to the original source: *Electronics Australia*. We can supply photostat copies of any article we have published for a fee of $3, including postage. If the article was spread over more than one issue, the charge is $6. These photostats include any relevant Notes & Errata.

Write to: **The Assistant Editor, "Electronics Australia" PO Box 227, Waterloo, NSW, 2017**

THE IDEAL XMAS KIT!

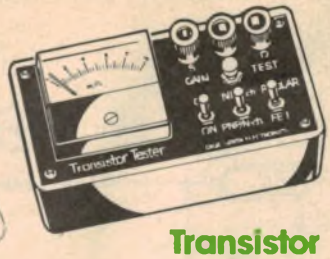
Teletext Decoder

Get the most from your television with this amazing value Teletext Decoder! There's a mine of information just waiting to be plucked out of the air waves. You'd pay around $1000 for a Teletext TV: now you can have the same facility for under $250
Cat K-6315 **$229**

IR Controller

Now, Teletext convenience from your armchair! The Infra-red Teletext Controller is ideal when you just want to sit down and rest. Remote pack has all the same controls as the wired decoder!
Cat K-3425 **$49.95**

Buy both and pay **$250**
SAVE $28.95



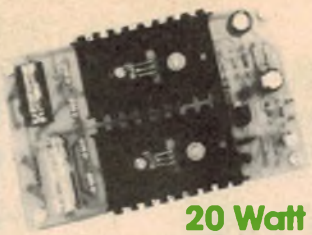
Transistor Tester

Find that fault — fast! With this fabulous Transistor Tester kit. This one tests bipolar transistors, diodes, F.E.T.s and even S.C.R.s and P.U.T.s! Can even be built by a beginner. A useful and practical piece of equipment you just can't do without! Cat K-3052

$19.95

Digital Readout Function Generator

The ideal gift because it's essential for any workshop! Hobbyists, technicians, engineers, etc . . . all need one! Produces sine, triangle and square waves from below 20Hz to 170kHz with a wide range of output levels! Astounding value!
Cat K-3520 **$89**



20 Watt Amp Module

A handy device for any hobbyist to add to his workbench! A general purpose 20W amp module for television, tape recorders, musical instruments, etc. Uses discreet transistors for reliability and it's great value for money! Cat K-3445

$15.95

Playmaster Mosfet Amplifier

The ideal compromise between economy and power! The orginal Playmaster with an incredible 45 watt output and features you'd pay $$$ more for anywhere else! Give one of these kits for Xmas and it'll be remembered for years!
Cat K-3515 **$199**

Bookshelf Speakers

Now you can have both quality and performance from a 2 way speaker system without it being a lifetime investment! These amazing speakers were designed by DSE and Magnavox to bring you the best value bookshelf speakers available — and that's just what we've done! Cat K-4000

$229

Complete Security Home Alarm

A comprehensive Home Alarm at a low, low price! This superb kit gives you features you'd normally pay hundreds for. 8 sectors, security key operation, built-in mains supply and battery backup . . . everything! It's a total alarm system at a bargain price!
Cat K-3424 **$120**

IT'S THE PERFECT GIFT! A CHRISTMAS KIT FOR THE ELECTRONICS TINKER!

SIGHT AND SOUND KITS

K-3035 Mixer preamp SAVE $5	$24.95
K-3143 Musicolour Mk IV	$109.00
K-3153 Beat Triggered Strobe	$59.00
K-3415 AM Stereo Decoder	$39.95
K-3441 60 Watt M/Fet Module (Complete	$49.00
K-3443 120 Watt M/Fet Module with Heatsinks)	$69.00
K-3445 20 Watt Amp Module	$15.95
K-3446 Busker Amp (Shortform Only)	$79.95
K-3500 Graphic Equaliser	$129.00
K-3509 Sound Bender	$32.50
K-3512 Music Generator	$11.95
K-3515 50 Watt M/Fet Amp	$199.00
K-3516 100 Watt M/Fet Amp Series 200	$439.00
K-3060 TV CRO Adaptor	$33.95
K-3232 M/Head Amp Mk 2	$32.95
K-3235 UHF TV Downconverter	$39.95
K-3419 Stereo Enhancer	$79.95
K-3421 Stereo Simulator	$23.95
K-3422 VCR Sound Processor	$52.95

K-6315 Teletext Decoder	$229.00
K-3425 IR Controller (Teletext)	$49.95

BUY BOTH AND PAY ONLY $250 SAVE $28

K-3426 IR Repeater	$34.50
K-3463 Video Enhance	$33.95
K-3472 TV Pattern Generator	$33.95
K-6325 Stereo TV Decoder	$199.00
K-3370 Led Level Meter	$15.95
K-3036 4 Input Mixer preamp	$59.95
K-4000 Book Shelf Speakers	$229.00
K-4001 Low Cost Amp	$99.00
K-3427 General Purpose Preamp	$7.95
K-3505 Super Siren	$14.95
K-3082 Fluoro Starter SAVE $1.00	$3.95
K-3095 Micro Wave Leak Detector	$13.95
K-3333 Negative Ion Generator NEW IMPROVED DESIGN	$34.50

ALARMS AND CAR ACCESSORIES

K-3250 Car Alar	$11.95
K-3251 U/Sonic Movement Detector	$23.95
K-3252 Deluxe Car Alarm	$64.95
K-3253 Car Alarm Mk II	$29.95
K-3254 4 Sector Home Alarm	$23.95
K-3255 Igition Killer	$16.95
K-3424 Home Alarm	$120.00
K-3240 Led Tacho	$23.95
K-3245 Brake Lamp Flasher	$14.95
K-3301 T.A.I	$34.95

AMATEUR RADIO KITS

K-3490 Shortwave Antenna	$16.95
K-6300 UHF Amateur Transceiver	$189.00
K-6302 UHF Trans. Upgrade	$14.50
K-6306 70cm Preamp	$19.95
K-6308 VHF Amateur Transceiver	$189.00
K-6310 VHF/UHF Power Supply	$49.95
K-6312 SWR/PWR Meter	$39.95
K-6318 VZ-200 RTTY Decoder	$69.50
K-6335 Cat FAX/RTTY Decoder	$79.95
K-6330 HF Transceiver	$349.00
K-6345 Radio Direction Finder	$139.00

ASSORTED KITS

K-3052 Transistor Tester	$19.95
K-3084 Speed Controller	$19.95
K-3439 Freq/Period Counter	$119.00
K-3450 LCD Panel Meter	$34.95
K-3451 Counter Module	$23.95
K-3453 Appliance Meter	$39.95
K-3468 RLC Bridge	$44.50
K-3469 Audio Oscillator	$44.50
K-3520 Function Generator	$89.00
K-3432 500 MHz Pre-scaler	$34.50
K-3335 Negative Ion Gen. Kit WAS $39.00	$24.50
K-3438 480 Power Supply	$21.95
K-3448 VK Powermaster	$99.00
K-3449 13-8V 5 Amp Power Supply	$42.50
K-3475 30V Variable Power Supply	$54.95

THERE'S NO BETTER WAY TO GET INTO ELECTRONICS THAN WITH THE FUNWAY SERIES! GIVE ONE THIS CHRISTMAS AND IT'LL BE APPRECIATED FOR YEARS TO COME!

FUNWAY VOLUME 1

Great for the kids!

Projects Kits 1-10

The ideal place to start! Project kits 1-10 assumes you know nothing about electronics and gets you building 10 useful projects . . . . instantly! There's no soldering so you can take your project apart and build the next one. Everything is included! Cat K-2600

Instructions for these kits are in Funway 1

$7.95

Project Kits 11-20

Another ten fantastic kits to build! There's really useful things like the Beer Powered Radio and the World's Simplest Transmitter. You'll have hours of fun and learn heaps to boot! Cat K-2610

(Also requires components from Project kit 1-10 to build these kits).

$8.50

FUNWAY VOLUME 2

Finished Funway 1 — looking for something else to do? Funway 2 gives you 20 new and exciting projects. They're bigger and they're better! Now you can do it the modern way — with printed circuit boards and soldering. The funway to learn!

K-2621 Flashing Brooch	$2.95	K-2631 Wireless Mic	$6.95
K-2622 Canary Door Bell	$4.95	K-2632 Light Activated Switch	$5.95
K-2623 Morse Practice Set	$6.50	K-2633 Metal Pipe Locator	$6.95
K-2624 Univeral Timer	$6.50	K-2634 Sound Activated Switch	$7.50
K-2625 Led Dice	$5.95	K-2635 Home/Car Alarm	$6.95
K-2626 Mono Phonic Organ	$8.50	K-2636 Electronic Siren	$5.50
K-2627 Pkt Transistor Radio	$8.50	K-2637 Led Level Display	$9.50
K-2628 Touch Switch	$5.95	K-2638 Intercom Unit	$9.50
K-2629 Mosquito Repeller	$5.50	K-2639 Led Counter Module	$8.95
K-2630 Basic Amp	$6.95	K-2640 Shortwave Receiver	$7.50

Funway 1 Gift Box

The best Christmas present you could give! Contains Funway Volume 1 and everything you need to build any of the 20 different projects in the Funway 1 series. And it all comes in a re-usable plastic parts tray! Cat K-2605

WAS $24.50

$19.95

Funway Gift Pack Volume 2

The perfect gift and you'll save money! This pack has been specially selected for quality and value! You get Funway Volume 2, a quality DSE soldering iron, a pack of solder, 9 volt battery **and** the 'Wireless Microphone' kit! You're ready to start! Cat K-2620

Funway Value! **$19.95**

FUNWAY VOLUME 3

It's the next step! Now you're becoming a more advanced hobbyist you'll need extra challenge. 10 great projects to build and many of them can be built in different forms — so there's plenty to keep you going! You'll have a great time with this lot and end up with plenty of useful devices to be proud of!

K-2660 Auto Minder	$4.95	K-2665 Light and Sound	$6.95
K-2661 Two Up	$6.95	K-2666 Combined Timer-Lock	$9.50
K-2662 Pokey	$14.95	K-2667 Mini Amp	$14.95
K-2663 Cricket	$9.95	K-2668 Binary Bingo	$12.95
K-2664 Mini Colour Organ	$6.95	K-2669 Mini Synthesizor	$12.95

FUNWAY I, II AND III GIFTBOX NEW

There's 24 fantastic kits to build! The most popular kits from each Funway series. Hours of fun — you'll go from beginner to electronics expert in next to no time! Incredible value Xmas gift — you'll save heaps! Cat K-2680

ONLY **$49.95**

NEW JUMBO FUNWAY BOX

The ideal way to learn all about electronics! Step by step through 30 projects from beginner to expert. Everything you need is right here — all components, PCBs and your very own soldering iron! Make electronics fun with Funway this Christmas! Cat K-2690

ONLY **$89.95**

Fun Way Volume 1

Where it all began! The best selling manual now used as an introductory text book in countless schools, colleges and youth groups. The ideal introduction for beginners from 6 to 66! Cat B-2600

$4.95

Fun Way Volume 2

It takes over where Funway 1 finishes, with 20 exciting new projects to try out. But these projects are different! They're all built the modern way — on printed circuit boards. Cat B-2605

$6.95

Fun Way Volume 3

Another 100 pages of fun. It's the logical progression for those who have worked through Funway Vol. 1 and 2. It's for the more advanced hobbyist, because Funway Volume 3 projects are based on Integrated Circuits. Cat B-2610

$6.95

Funway 3 Bonus Pack

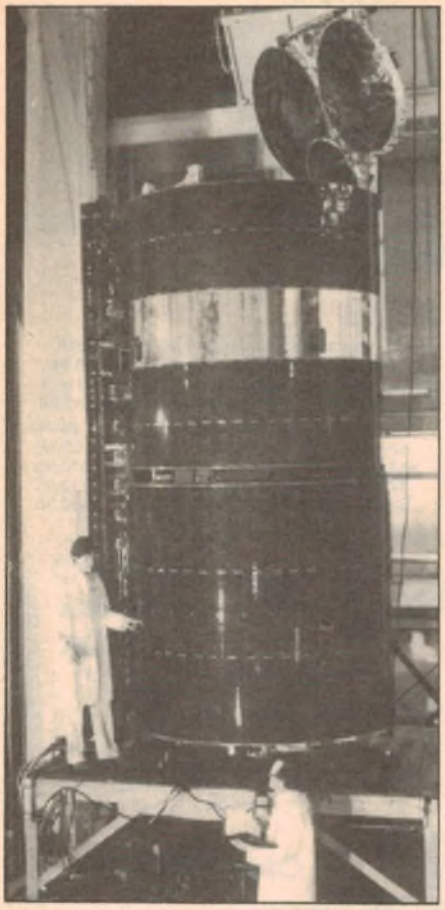
It's extra value! You get the two most popular kits in this series . . . and we throw in the book **FREE!** You get 'Electronic Cricket' and the 'Miniature Amplifier' valued at $24.90 PLUS, Funway 3 book at no extra charge!

Cat K-2670

Ideal for Christmas! **$24.90**

SEE PAGE 98 FOR ADDRESS DETAILS

DICK SMITH ELECTRONICS PTY LTD



Above: Aussat 1 in fully deployed "in-flight" configuration during final checkout prior to launch.

AWA to market

Not content with its control station contract for the AUSSAT satellite system, AWA-Thorn wants a slice of the consumer market as well. The company plans to market its Earth-Link receive-only satellite ground stations for use in outback regions.

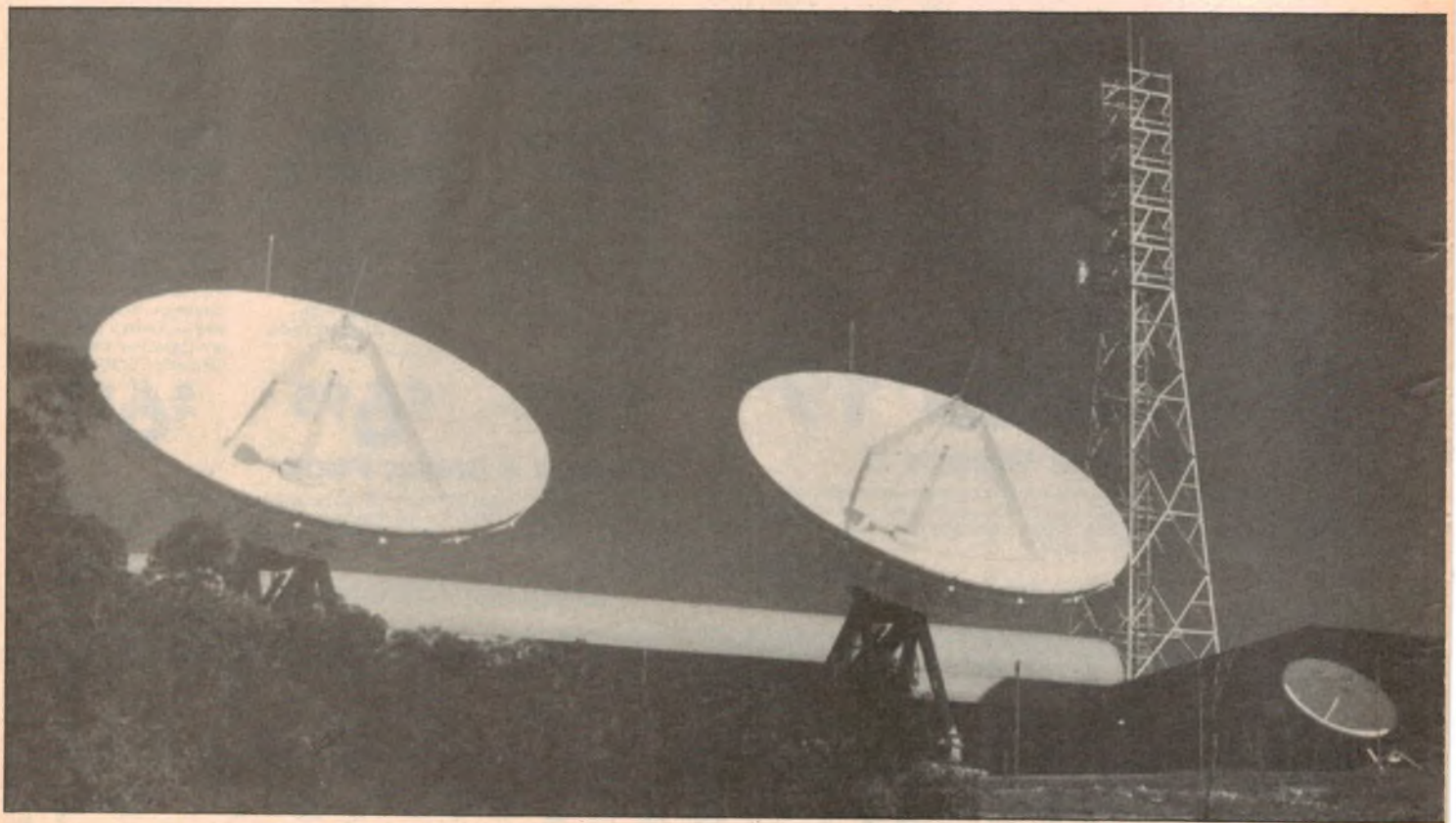
by LOUISE UPTON

Last August, Australia's first domestic communications satellite, AUSSAT 1, was successfully launched by a US space shuttle. All going well, the second satellite should be in orbit by the time this magazine goes to press.

In addition to a range of other services, AUSSAT will broadcast high-quality radio and TV signals to isolated communities and remote homesteads in outback Australia. This service goes under the rather confusing acronym of HACBSS, or Homestead and Community Broadcasting Satellite Service.

AWA-Thorn's announcement of its entry into the consumer end of the market is a significant one. Essentially, Earth-Link is a small receive-only ground station using a small dish antenna and an indoor receiver unit. Its release will ensure that people in outback areas can install earth stations in time to receive the first HACBSS broadcasts.

According to Mr Michael O'Neil, Product-Manager of AWA, the signals received by Earth-Link will be of a very high quality and will include stereo and



The Aussat Satellite Control Centre in Sydney has a 14.2-metre tracking antenna and two 13-metre communications antennas.

Aussat ground station

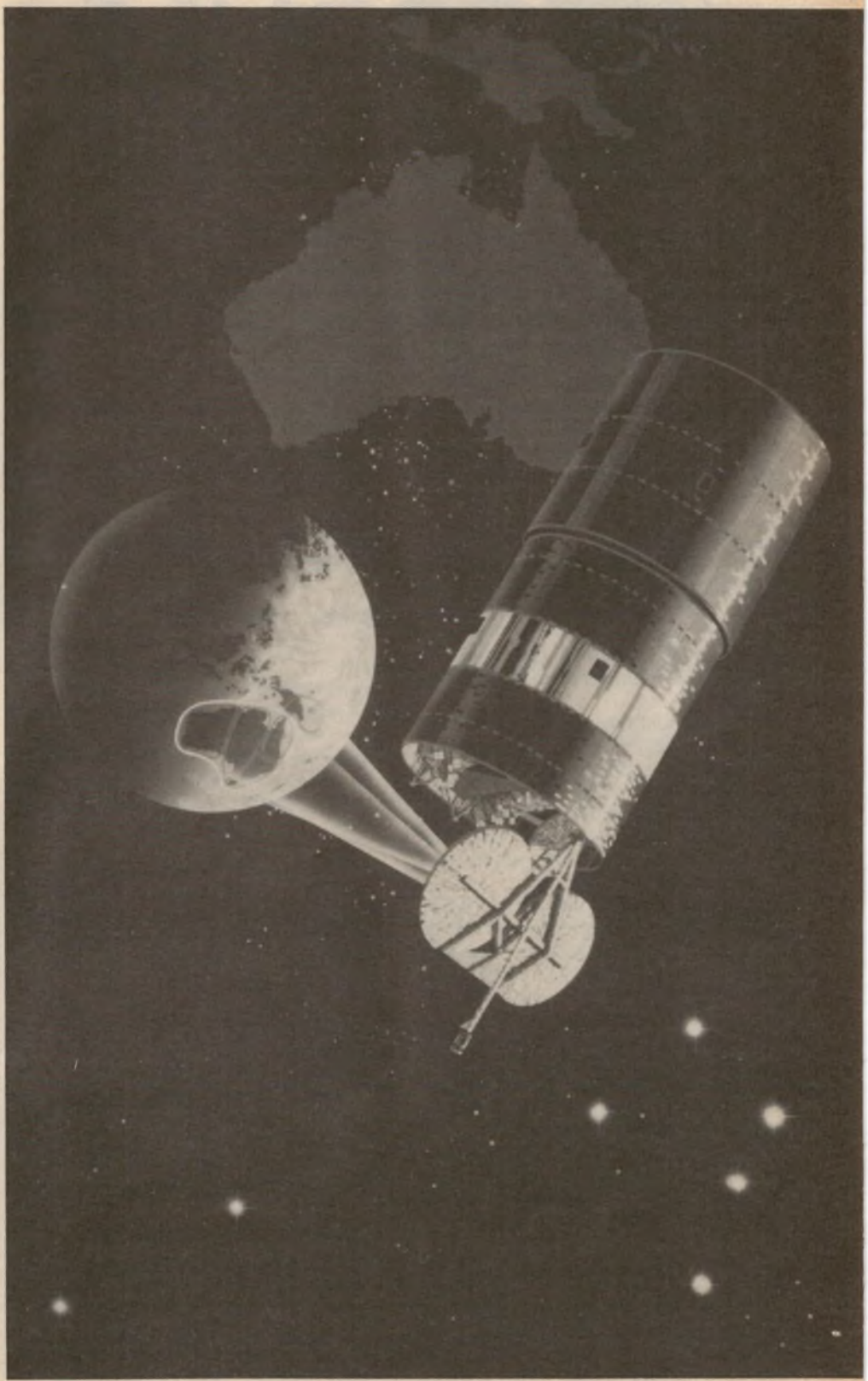
monophonic hifi sound channels, and a data channel.

HACBSS will, in fact, be the world's first operational direct broadcast TV service using the B-MAC system (see EA, September 1985). An advantage of the system is that it allows for data encryption and can address individual receiver units. These features provide Earth-Link with the potential for receiving electronic mail and cyclone warnings.

For many outback Australians, such services will prove invaluable.

The development of Earth-Link is an extension of AWA's interest in the satellite area gained through its Satellite Systems Group. The latest contract completed by this Group was the design and manufacture of the ground-based monitoring and control equipment for the AUSSAT satellite under contract to Hughes Communications International.

The final price of AWA Earth-Link is not accurately known at the time of writing. However it is expected that the cost will be somewhere between $3000 and $4000, plus installation.



Artist's impression showing Aussat 1 and spot beam footprints over the continent.

Confusion over bels

FORUM

Conducted by Neville Williams

On reading the above heading, you may well have jumped to the conclusion that we had either made an inadvertent typesetting error or else adopted American spelling — which is the same thing to some people's way of thinking. In fact, "bel" refers to power ratios and "whistles" to audio tones.

If you're confused, so was I when I received a letter recently from G.K. of Moe, Victoria, commenting on human ears, beat notes between tones, perceived distortion, etc — subjects which have been simmering in these pages since February last.

In his letter, G.K. says that he wrote to "Forum" some years ago, when there was a spate of discussion along similar lines, and was "not too happy" when I suggested in a personal reply that he redirect his submission to a "learned society".

Why I would have done this I'm not sure, at this remote date, but I can only apologise if my response appeared to be discourteous. It could be that G.K.'s proposition was mathematically based and more appropriate to, say, the Proceedings of the IREE than to a general electronics magazine.

Certainly much of his present letter answers to that description, supporting a contention that the addition of two sine waves can still produce sum and difference frequencies, even in the absence of non-linearity.

His starting point (if I can correctly transcribe his freehand) is "my old textbook 'Einfuhrung in die Hoch-frequenztechnik' by Prof Karl Benz", and he carries on from there.

His stated objective: to contribute to the debate, particularly in respect to the "platinum ears" and instrument tuners referred to in the August "Forum", page 30.

I can well imagine that, given countless statements in countless textbooks and magazines, about the fundamental role of non-linearity in the intermodulation process, his contention could promote some very lively argument, supported by lashings of mathematics — fine in its place but, please, not in these columns!

Sorry again, G.K.

If and when it's all resolved, we'll be quite happy to modify our earlier remarks about aural and perceived distortion, as appropriate and if necessary.

Aural "distortion"

Turning to the straight prose, however, G.K. says that, in his earlier correspondence, he had suggested that the logarithmic response of the ear could have something to do with subjective distortion effects — an observation that we presumably failed to publish. Commenting further on that proposition he says:

"One reason for my disappointment was that, if the response of the ear to sound pressures is linear, then we must discard the "bel" system. This system is logarithmic and nobody so far has questioned its validity. So, if the bel is right, simple mathematics can prove that intermodulation frequencies can be presented to the brain."

That statement caused me "furiously to think" and then to question its validity — not on the basis of my very limited knowledge of human ears, but by inference from familiar electronic circuits.

Variable gain amplifiers

These days, with automatic audio gain control, automatic volume expansion and compression, noise limiting systems and voltage controlled amplifiers, there are any number of audio amplifying stages around with a non-linear input/output relationship. dbx processing, for example, involves 2:1 compression on the way in and 2:1 expansion on the way out.

Plot the input/output characteristic of these systems for a range of steady-tone input levels and you'd end up with all sorts of weird curves, leading to a possible assumption that they must produce bags of non-linear distortion. But they don't; not due to the transfer curve, anyway. Indeed, some of the systems (eg, Dolby and dbx) feature in top quality equipment.

The reason is not hard to discover: the input/output gain control characteristic operates dynamically at a deliberately sub-audio rate so that, as far as "individual" audio waveforms are concerned, the system is in a neo steady-state condition. Certainly, no individual waveform ever has to negotiate or suffer the consequences of that weird looking input/output characteristic.

It may well be contended that, if the gain of an amplifier is changing during the passage of an audio signal, no matter how slowly, the end result will be equivalent to some degree of amplitude modulation, resulting in the production of vestigial sidebands. Or, again, that any incremental curvature in the relevant segment of the transfer characteristic must still influence the output waveshape.

Perhaps so, but such effects are sufficiently small to permit the use of dynamically controlled variable gain stages (with "weird" transfer curves) in a variety of top quality, low distortion audio equipment, professional and otherwise.

Aural AVC?

That brings us back to human ears and their widely accepted logarithmic characteristic which, in some respects, must be about as far as one can get from a linear response. The vital question is just how that characteristic is manifest.

If acoustic signals entering the ear are indeed processed through a system having a static logarithmic response, then G.K. can resort forthwith to his "simple mathematics" and "prove that intermodulation frequencies can be presented to the brain".

But what if the logarithmic response is actually a physiological variable gain or sensitivity control function, operating at a sub-audio rate, as in the case of the electronic circuits referred to above?

Few audio/hifi writers venture this far along the road but, in his book "About

and whistles!

Your Hearing", the late G. A. Briggs (of Wharfedale fame) explains the basis of what he describes as nature's "automatic volume control system". It involves a tiny muscle in the middle ear which adjusts the hinge point of the malleus (hammer) and incus (stirrup) in such a way that movement of the stapes is automatically reduced as the incident sound level rises. The muscle, in turn, is activated by the brain.

Unless I am much mistaken, the neuro-muscular reaction time would be well down into in the sub-audio range, so that individual audio waveforms passing through the ear would be handled with the hinge muscle in what I described earlier as a "neo steady state" condition.

On this basis, individual waveforms would not be exposed to a logarithmic transfer characteristic and would exhibit only residual distortion effects equivalent to those suggested earlier for dynamically gain controlled electronic amplifiers.

It becomes a question as to whether this residual distortion — a by-product of the control function — is sufficient to produce the subjective intermodulation effects that we have been talking about, or whether they are due to non-linear effects of a quite different kind? The non-symmetrical or unbalanced nature of the entire middle-ear mechanism for example?

Maybe our correspondent should sort this out before proceeding with his calculations!

CRO patterns

There's something else that I'd invite G.K. to rethink:

Having satisfied himself, mathematically, that non-linearity did not need to be present for intermodulation products to be generated, he rounds off his letter with mention of an experimental set-up which allegedly confirms his findings. I summarise:

To satisfy my curiosity, I built two Wein bridge oscillators generating frequencies 2f and 3f as closely as possible and summed their outputs through 180kΩ resistors into a 10kΩ resistor, a CRO being connected across the latter.

And there it was: all sorts of waves were visible on the screen. When I was able to trigger on the difference frequency, there appeared a chain of balloons with continuously wriggling snakes in them. Unfortunately my oscilloscope did not permit me to measure the actual frequencies involved.

I did not listen to the resultant waveform but, if my analysis is correct, we should hear the fundamental f when the relationship 3f/2f is accurate.

Frankly, I would need to be convinced about G.K.'s expectation and interpretation of his experimental set-up. I'm familiar with it because it's similar to what I sometimes used, in days when electronic organs had to be tuned the hard way.

When two tones are fed simultaneously to the vertical input of a CRO, the beam is deflected in proportion to the sum of their instantaneous amplitudes. In the absence of simultaneous horizontal deflection, it produces an apparently stationary vertical line on the screen.

However, if either tone is moved slowly through a simple or fractional harmonic relationship with the other (2:1, 3:1, 2:3, etc) the instantaneous sum will vary cyclically at a low frequency rate and the trace will be seen to pulsate in length.

I normally used the set-up that way for organ tuning, because use of the timebase tended to disguise the amplitude variation, without offering much help in identifying the tones I was trying to correlate. I found it more meaningful to listen simultaneously to the chord.

An interesting point is that the information available to the ear is also a resultant of the instantaneous amplitudes, in the form of pressure waves acting on the eardrum.

But, whereas the eye is aware of amplitude and unsure of components, the ear is just the reverse: it performs its everyday feat of reconstituting the components from an envelope resultant, while giving only scant attention to the visualised shape of that envelope.

And that brings me back to my earlier reservations about G.K.'s "experiment". While the interaction of two tones and a timebase on a screen can be difficult to interpret anyway, I see a basic philosophical discrepancy in trying to use what the eye sees to validate what the ear is supposed to hear.

It is not for nothing that the accepted two-tone intermodulation test involves the use of elaborate nulling and filtering to isolate, identify and measure the extraneous components.

Moreover, when such tests are applied to modern low distortion amplifiers, the intermodulation products approximate .001% — this using equipment far more sensitive than a general purpose CRO

FORUM — *continued*

and far more perceptive than the human eye. It puts a rather large question mark over G.K.'s strongly held views.

Medium wave DX

If G.K. was unhappy with my original response in the realm of audio, so also was A.A. of Noumea, New Caledonia, in the area of medium wave DX (long distance) reception.

What follows was prepared for an earlier issue but was squeezed out rather unceremoniously when the Editor discovered that he had more copy than would fit into the available number of pages. So here we go again:

Thinking back over a story in Forum for January last, A.A. felt that I did less than justice to an American gentleman, who claimed that he listened frequently to radio station 2CH (Sydney) from his home in New York City.

In fact, he had rung 2CH's afternoon announcer, Barry Spicer, ostensibly from New York and authenticated his claim by holding the phone close to a loudspeaker playing the station's program at that instant.

With apologies to Everybody

I pondered lonely as the clouds,
That float above my island digs
When all at once I heard a crowd . . .
A host of distant wireless sigs!
With just a wire between two trees . . .
Lazily swaying in the breeze!

I agreed with the correspondent who brought it to our attention and, I understand, with the station's own technical staff, that the whole thing was probably a "leg-pull" involving a double phone link, an amateur radio link, or a call from a Sydney address made during one of the American businessman's frequent visits to this country.

But A.A. remembers when, as a boy, he lived at Moss Vale on the NSW southern highlands, 150km or so southwest of Sydney. In those days, there was a radio station in the town (2MV) and it was picked up in New York.

He also remembers a much publicised 1-valve receiver designed by a Mr J. Lake of Queensland. I quote a few snippets:

The particular receiver used an A415 triode detector and I was fortunate to obtain one, new, around 1947, allowing me to construct a copy of this receiver. The results were no less than amazing . . .

. . . it is well to note that some things have not changed to any great extent, such as the natural laws of propagation or the distance between Moss Vale, Sydney and New York.

I can assure you that, from my present location (Noumea), 2CH can be received well on a less than fancy battery operated receiver, when conditions are not affected by local storm activity.

As a point of interest, I am enclosing a photocopy of a QSL card from MW station KOMA, Oklahoma City, USA, received at my present address on a restored but unmodified vintage S-40B Hallicrafters. I also have tape recordings of MW programs from such places as Los Angeles, Salt Lake City, Oregon, Oklahoma and so on.

As you can see, long distance MW reception is far from the realms of impossibility.

Perhaps A.A. should read the article again. As someone who also spent my boyhood on the southern highlands, I referred to DX conditions, as once they were, but went on to list four things that certainly have changed since then, briefly:

- Vastly more stations on air, with virtually all channels now being shared.
- 24-hour operation, with few local broadcasters now shutting down and leaving their channel free.
- The use of vertical antennas with high angle radiation deliberately restricted.
- An enormous increase in the level of man-made electrical interference.

I also pointed out that 2CH's frequency of 1170kHz was a particularly difficult one, in that it occurred in band plans based on both 9kHz and 10kHz separation. Hence my remark:

". . . if you want 1170kHz, you dial up that frequency . . . but whether what you hear is 2CH or babble from a dozen other stations on that frequency would be quite another matter."

I have never been to Noumea but I have visited Norfolk Island on a couple of occasions and, if I wanted to listen for MW stations from half-way round the world, an island in the Pacific would have a great deal to commend it.

On the other hand, it is hard to imagine a less suitable place for such activity than New York City!

To hear New York (or Oklahoma, etc) from Noumea (or Moss Vale, etc) would be one thing; to hear Noumea or Moss Vale or Sydney in New York in present day conditions would be quite another, especially on a regular basis.

Sony ST-S444ES AM/FM stereo tuner

Over the last few years there have been major developments in FM tuner technology leading to great improvements in performance. At the forefront of these developments is Sony, with their ES series tuners. We reviewed the Sony ST-S444ES AM/FM tuner which has a claimed ultimate signal-to-noise ratio of 89dB in mono and 85dB in stereo.

Not only is the specification for signal-to-noise ratio of the ST-S444ES dramatically better than most other tuners, so is the harmonic distortion. In mono, depending on whether the tuner is in Distant or Local mode, the harmonic distortion is claimed to be .006% or .015% respectively. And in stereo, the equivalent figures are .015% and .04%. These figures are now rivalling those for the best amplifiers and compact disc players.

For a product with such an excellent specification, the Sony ST-S444ES has quite low-key styling, which is a pity really, since its appearance is not likely to help push its sales.

That is not to say that it is dowdy; it is merely subdued. The overall finish is charcoal, with black-anodised aluminium fascia. Most of the control lettering is very fine although it is in white which makes it not quite so hard to read.

Control features of the unit are fairly conventional, with 10 pushbuttons for the station presets, five for FM and five for AM. There are also the usual tuning controls plus pushbuttons for Muting and Distant mode.

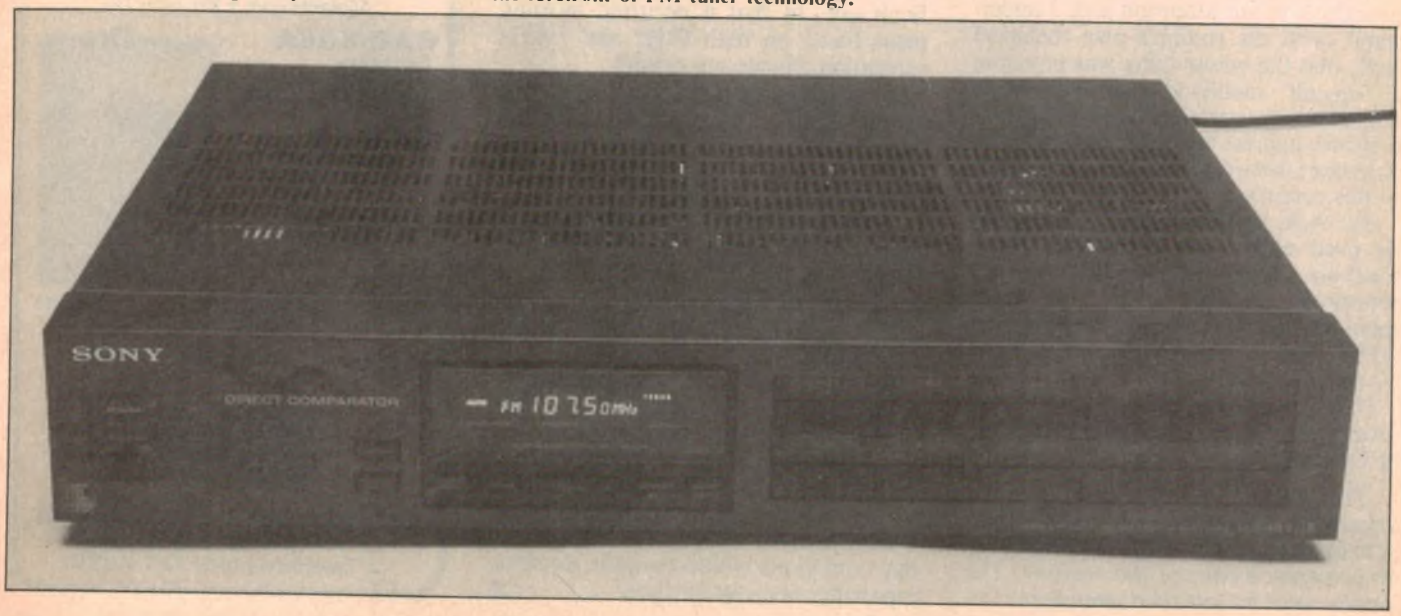
The tuning display is a vacuum fluorescent type, presenting quite a lot of information. As well as the frequency readout, there is an indication of the tuning mode (auto or sweep), FM or AM, Distant or Local mode, signal strength, stereo indication and Memory mode. The display is very good and is easy to read without being too bright or obtrusive.

On the rear panel, these is a screw-in 75-ohm coax socket, for the FM antenna and a pair of screw terminals for the AM antenna. This is supplied as the "Wave Catcher" layout free antenna by Sony and turns out to be a ferrite rod in a plastic housing which can be set up away from the tuner for best signal pickup. It works reasonably well although we suspect that a large loop antenna could work even better, as far as noise rejection is concerned.

Apart from the antenna connections there are also the usual pair of RCA sockets for the audio outputs and an AC voltage selector. The chassis is double-insulated and a two-core power flex, with three pin mains plug, is fitted.

Inside, all the circuitry is accommodated on one large printed circuit board which does not look a great deal different from any other synthesised tuner. A neat feature, as far as reviewers

Despite subdued styling, Sony's ST-S444ES is at the forefront of FM tuner technology.



and servicemen may be concerned, is that each circuit section is clearly labelled on the printed board.

Station settings are held in memory when power is removed by virtue of the lithium cell which keeps the memory powered up.

Dimensions of the ST-S444ES are 430mm wide, 80mm high and 340mm deep. Weight is 4.1kg.

Circuit features

Sony have excelled themselves with the terminology they have applied to this product. They have included new features such as Wave Optimiser Technology and Direct Comparator Technology. The first embraces the WOIS (Wave Optimised IF System) and WODD (Wave Optimised Direct Detector).

The WOIS is a system for changing the IF (intermediate frequency) group delay response and amplitude response, depending on whether the tuner is in stereo or mono mode.

It turns out that they are using two sets of IF transformers, one for the mono mode and one for stereo, with optimised damping for each mode. Not surprisingly, the system of damping is nothing more than an adjustable resistor across one of the transformer coils. In other words, it's a fairly simple idea although as far as we know, it has not been done before.

Similarly, the WODD is a phase locked loop used as an FM detector. The VCO is apparently specially linearised to give low harmonic distortion.

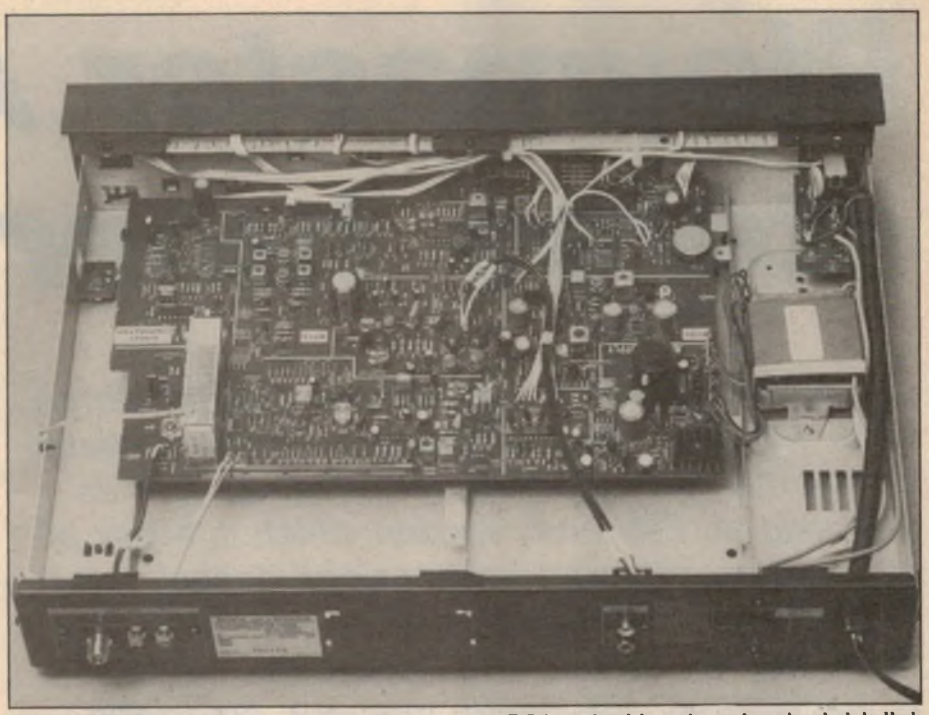
The service manual describes the system as being a phase locked loop with a reference frequency of 100kHz and for this to work a programmable divider with a division ratio of approximately 1000:1 is necessary. This means that there must be a prescaler and indeed there is. It's not a separate IC though.

One advantage of using such a high reference frequency is that it gives lower oscillator jitter and therefore lower audio noise.

Performance

We expected to run into problems with measuring this tuner and indeed we did. Its signal/noise ratio and harmonic distortion specifications are both beyond the threshold of the Sound Technology FM generator set we use. Since this is one of the best FM generator sets around, this is testimony to the peformance levels claimed.

However, we were not able to achieve the excellent S/N ratio claimed for the ST-S444ES. Previously, the best tuner we have measured gave a mono signal to noise ratio of 85dB unweighted and we would regard that as the effective threshold of the Sound Technology FM set.



Most of the circuitry is accommodated on one large PC board, with each section clearly labelled. A lithium cell powers the memory when mains power is removed.

On the Sony tuner, the best result we could achieve in mono mode was an ultimate signal-to-noise ratio of 82dB at an input signal of 2mV at 98MHz. This was measured with an audio bandwidth of 200Hz to 15kHz. When hum was taken into account, the result was 78dB with respect to 75kHz deviation.

In stereo, the equivalent figures were 75dB with a 200Hz to 15kHz bandwidth and −69.5dB when hum was taken into account.

As far as we could determine, there was nothing amiss with our measurement methods (according to IHF specifications) so we are inclined to think that Sony has a different way of achieving the high figures claimed. Make no mistake, those figures for S/N ratio are better than average, apart from the hum which we think could have been better.

We should also point out that the quieting curves are very steep, giving no less than 78dB at only 50μV. This means that it is a very quiet tuner, much better than average, on weak signals.

As far as harmonic distortion was concerned, it was a different story. The modulator in out FM generator appears to have a threshold distortion level of .05% which is better than most tuners have been able to achieve, even in mono.

So when we measured the Sony, we were not surprised to see essentially the same result for distortion at around .05%, for the mono being measured. We would conclude therefore, that the distortion performance is probably close to what Sony claimed. The same goes for stereo distortion measurements. We need a better generator.

Separation between channels also proved to be good, being better than 40dB over most of the frequency range, and bettering 50dB in the midrange.

As far as measurements were concerned, the results point to a phenomonal FM performance which is borne out by listening tests. The ST-S444ES renders very weak stations perfectly listenable when they would be out of contention on ordinary tuners.

It's a pity that the AM performance is but the merest of shadows of the standard for FM. While the signal to noise ratio was quite respectable at 61dB with respect to 100% modulation, the audio bandwidth was particularly narrow, with a −3dB response between 200Hz to 950Hz. That probably explains why Sony have a version of this tuner, the ST-S55ES, which does not have AM.

Even so, we have to conclude that the ST-S444ES is a very good tuner and one that is surprisingly cheap, considering its performance. Recommended retail price is $549 which must be a bargain for a state-of-the-art tuner. (LDS)

AM stereo plus synthesised tuning

Playmaster AM/FM stereo tuner Pt. 1

Our new Playmaster synthesised AM/FM stereo tuner will outperform anything presently available on the market, regardless of price. As well as including an FM tuner section which is every bit as good as any other synthesised design, it is the only unit featuring a genuine wideband, low distortion AM stereo tuner. Naturally, it has a digital readout, 12-station memory, automatic seek and an optional infrared remote control.

by JOHN CLARKE

There's just one way to sum up the performance of our new AM/FM stereo tuner. In a word, it's superlative.

We've been hard at work on this beauty for almost a year now and to say that we're proud of the result would be the understatement of the year. Our new design includes the latest technology and boasts such high falutin' features as stereo AM decoding, synthesised tuning and microprocessor control. But this is one synthesised tuner that doesn't sacrifice performanace at the expense of fancy features.

In designing the new tuner, we kept just one object in mind: we wanted the best possible performance, regardless of the cost. The result is this superb design which puts most commercial units in the shade.

As can be seen from the photograph, most of the circuitry is accommodated on one large printed circuit board (PCB). Three separate, smaller boards are used for power supply components, the front panel LED displays and control pushbuttons, and the FM front end. The main board and the display board are connected by means of several plug and cable assemblies while the FM front end plugs directly onto the main board.

No expensive test gear is needed to build the tuner. A digital multimeter and two plastic alignment tools will suffice.

Stereo AM

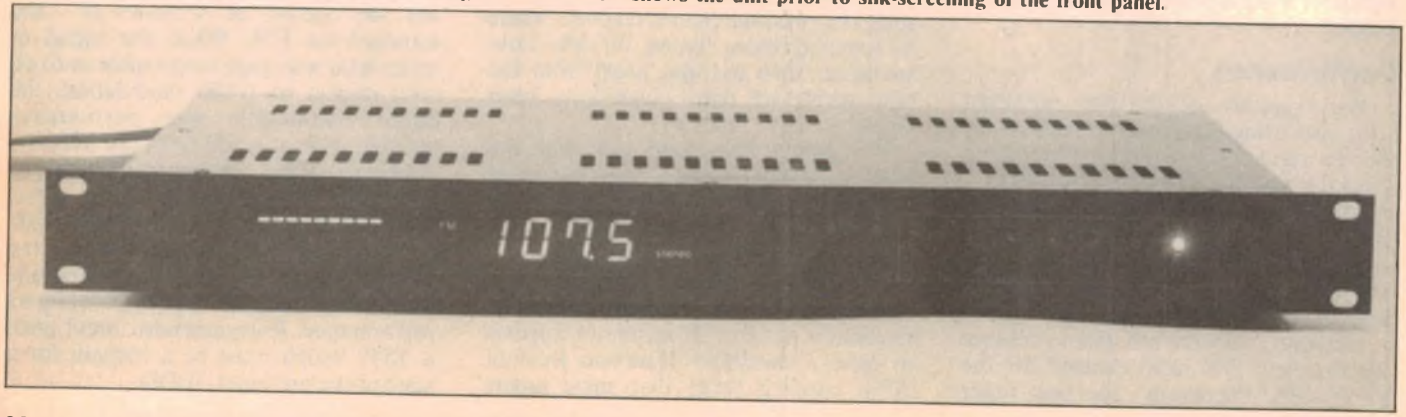
Despite the introduction of AM stereo on February 1st 1985, commercial AM/FM tuner manufacturers have done little to cater for the Australian AM stereo market. Only three brands are currently on the market and the performance of these generally leaves something to be desired, both in terms of audio bandwidth and distortion. We wanted to do much better.

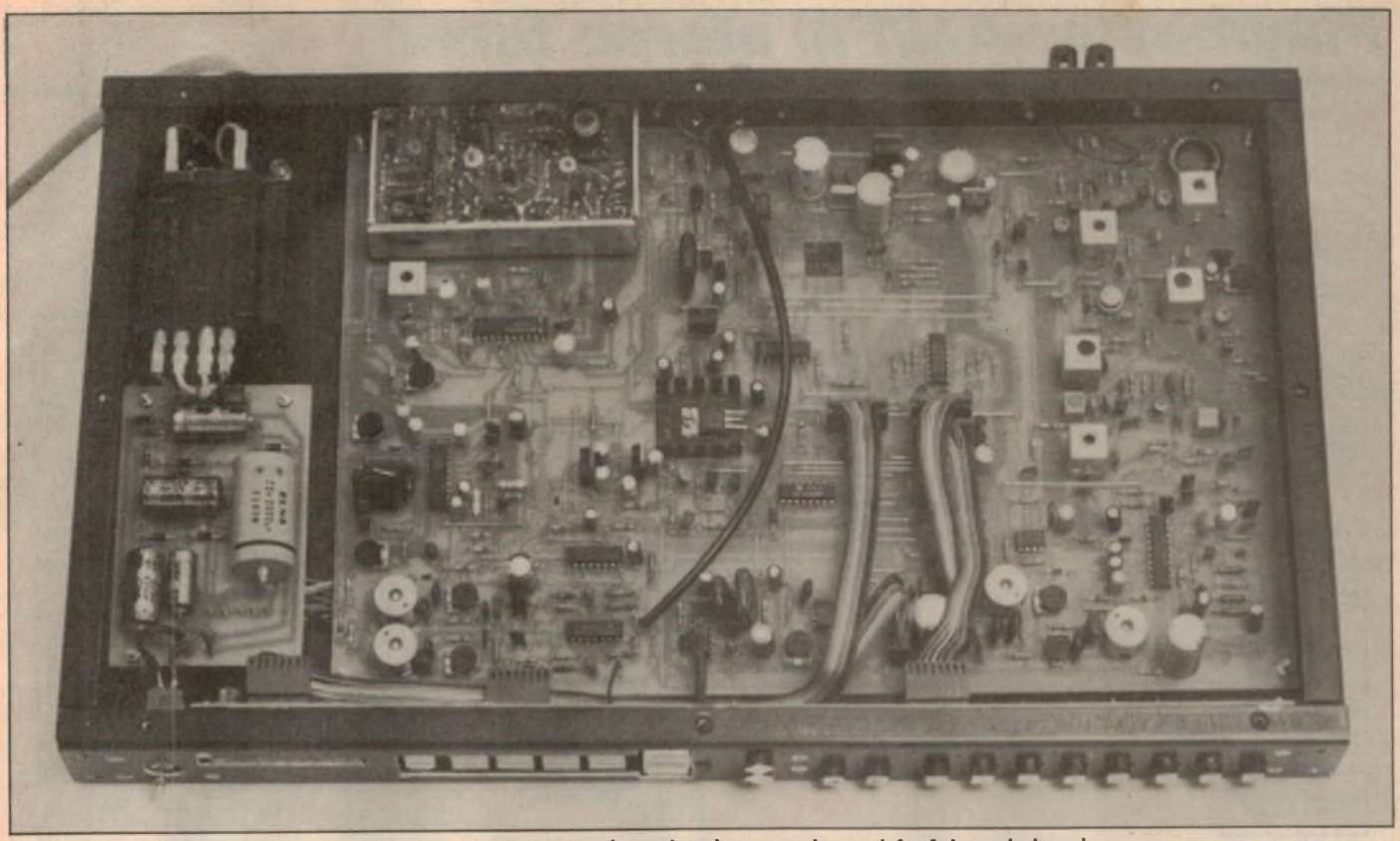
Our new Playmaster stereo tuner has not been compromised with regard to AM bandwidth, distortion or overall performance. It utilises the wide frequency bandwidth available from the AM transmitters to give the best sound possible in AM stereo. Until you've heard it, you won't believe that AM stereo could sound so good. Depending on the program material it can sound every bit as good as FM stereo!

But the new tuner not only produces exceptional sound; it is also a delight to operate. It is all pushbutton controlled and responds instantly to your commands. Press one of the six memory pushbuttons and the tuner locks quickly onto the pre-programmed station. A highly visible 15mm high green readout displays the received frequency.

The 10-level signal strength meter is without doubt the most useful available on any tuner we have seen for a long time. Combined with the quieting curves

The tuner is housed in a slimline rack-mounting case. This view shows the unit prior to silk-screening of the front panel.





View inside the prototype. The FM front end is in the screened metal enclosure at the top left of the main board.

(to be published next month), it gives you all the information you need to allow you to get the best signal quality.

Slimline styling gives the tuner a neat and up-to-the-minute appearance. The black anodised front panel is screen printed and is fitted with black pushbutton switches. The switches and memory indicating LEDs protrude through holes in the front panel while the green LED display is located behind a neutral perspex sheet inserted into the front panel.

This display includes the digital frequency readout, signal strength meter and AM/FM and stereo/mono indicators. The AM, FM, stereo and mono indicators each consist of a LED light bar module which emits a diffused green light. Covering these is a black film negative of the indicator lettering.

When the light bar module is lit, the light only shines through the clear lettering of the covering film. The indicator word is thus displayed with a very professional appearance.

Controls

The front panel controls are quite straightforward. At the extreme left is a pushbutton on/off power switch while immediately to the right of the display window are pushbuttons for forced mono and station seek.

The Seek control does just as its name suggests. When pressed, it sends the tuner scanning up the frequency band and automatically locks it onto the next available station.

Station selection is by means of the up/down Tune pushbuttons or any one of the pre-programmed memory pushbuttons. The two Tune pushbuttons provide manual station selection. Press the up button and the tuner increments in steps of 9kHz for AM or 100kHz for FM. Similarly, pressing the down button causes the tuner to decrement.

If either button is held down, the tuner will scan at a fast rate until the button is released.

To the right of the Tune buttons are the AM/FM switch, the six memory pushbuttons and the Memory Enable switch. Up to 12 stations can be pre-programmed into the memory switches, six for the AM band and six for FM.

It's quite easy to store a station in one of the memory locations. The tuner is simply tuned to the desired frequency, using the Seek or Up/Down buttons. Then the Memory Enable switch and appropriate station pushbutton is pushed to store the setting. If a station button is not pressed within the five seconds, the ME light will extinguish.

Tuner development

As previously stated, work first began on the tuner circuitry about 12 months ago. Many of the components required for the project were specialised and we were fortunate that manufacturers and parts suppliers were keen to assist in meeting our needs.

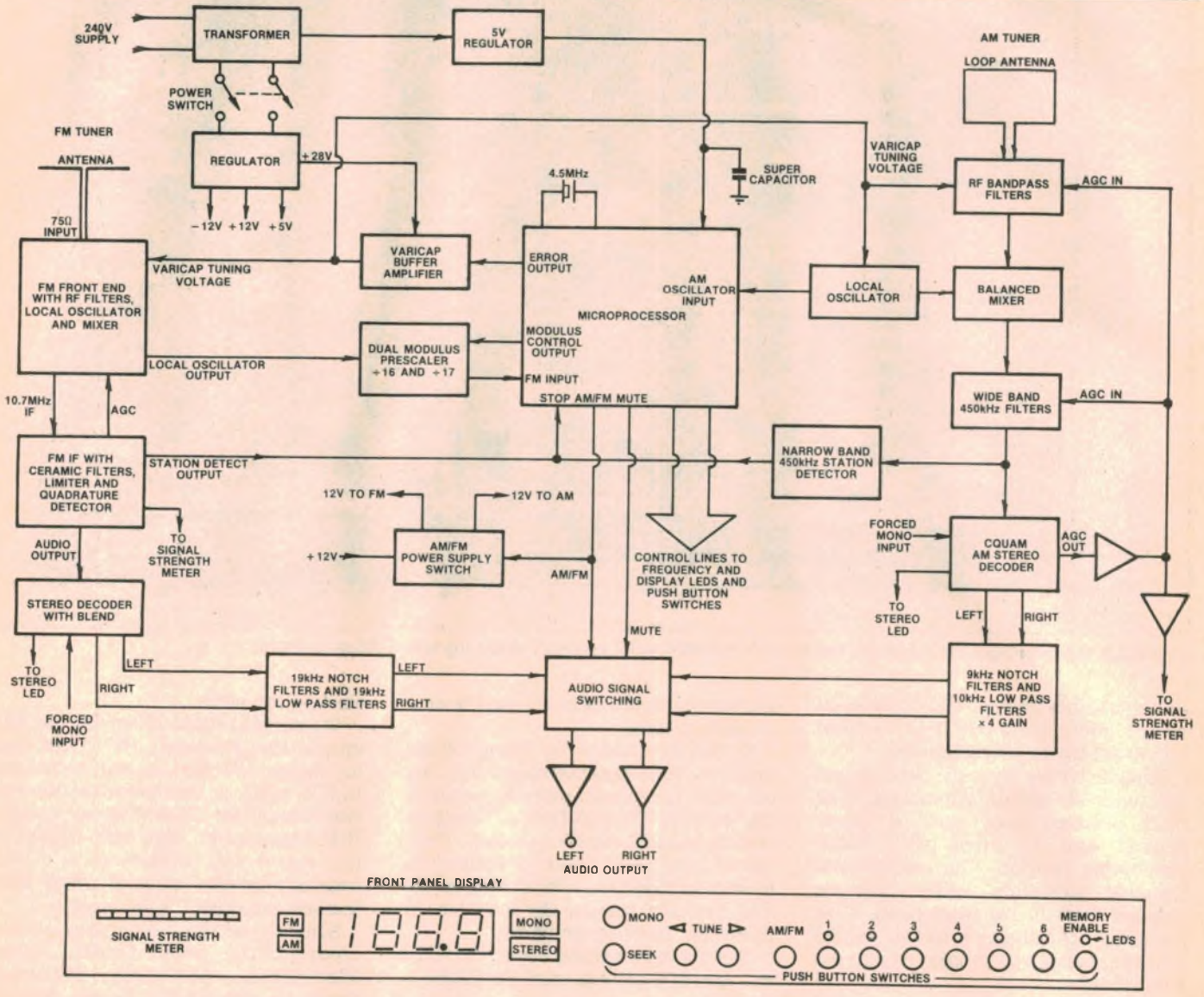
We needed ceramic filters for the AM intermediate frequency (IF) stages and for station detection, as well as for the FM IF stage. A ceramic resonator was also required for the AM stereo decoder. IRH Components were very helpful in this regard and supplied us with the necessary samples, some of which were specially imported for the project.

Similarly, we obtained various ICs and components from Geoff Wood Electronics, Motorola, National Semiconductor, Philips, Plessey, Neosid, Soanar and Watkin Wynne.

Our major problem, however, was to find a suitable microprocessor IC, vital for frequency synthesis and control. Eurovox Australia (Melbourne) was able to help out here. They use a custom NEC microprocessor in their car radios and car cassette players fitted as standard equipment in GMH, BMW, Porsche and Alfa Romeo vehicles. In particular, we acknowledge the help and enthusiasm of Klaus Schuhen at Eurovox who supplied us with sample microprocessors, companion prescaler ICs and crystals, a Eurovox car radio and service information.

Using this information, we have developed a completely original tuner design, based around the NEC custom microprocessor. To our knowledge, its overall performance exceeds that of any commercial AM/FM tuner, produced in Australia or anywhere else.

Playmaster AM/FM stereo tuner



An NEC microprocessor drives the front panel display and provides synthesised tuning of the AM and FM front ends.

Block diagram

The importance of the microprocessor in our new tuner is emphasised by the block diagram. In addition to driving the front panel display, it provides frequency synthesised tuning of the AM and FM tuner front ends and controls power supply and audio output signal switching.

Before discussing the microprocessor control further, let's first take a look at the AM and FM tuner stages.

Both the AM and FM tuners operate on the superheterodyne principle. In each case, a local oscillator tracks the RF filters and is mixed with the incoming RF signal. For AM, the oscillator frequency is always 450kHz above the frequency of the tuned station while for FM it is always 10.7MHz above the tuned frequency.

As a result of this mixing, we obtain a constant intermediate frequency (IF) of 450kHz for the AM tuner and 10.7MHz for the FM tuner, regardless of the tuned frequency. These intermediate frequencies are then filtered and detected.

AM tuner

The AM tuner utilises a large loop antenna which provides a virtually noise free signal to the tuner. Since the loop antenna is a balanced circuit, it acts to reduce common mode interference. In practice, there is almost a complete lack of background noise when tuned to a station.

Following the antenna are the RF bandpass filters. They provide gain at the tuned frequency, with sufficient bandwidth to ensure a wide audio frequency response.

An essential feature of the AM section is the fully balanced mixer. It enables the use of a wideband 450kHz ceramic filter in the IF stage, giving a response only 6dB down at ±12kHz, but sharply rolled off to 35dB down at ±20kHz and 60dB at ±40kHz.

Signal from the IF stage is directed to a narrow band station detector and to a C-QUAM AM stereo decoder stage.

The narrow band station detector block comprises a gain stage, a narrow band ceramic filter and a detector. The ceramic filter has a bandwidth of about 2.5kHz and is 24dB down at 9kHz which is the frequency separation of the AM stations. A station detect signal thus

appears at the output only when the tuner is set to the correct station frequency.

At a setting 9kHz away from the station, the attenuation from the ceramic filter is sufficient to prevent a station detect signal.

The AM stereo decoder is a complete stereo decoding and pilot detection system based on the Motorola MC13020P C-QUAM chip. This provides a high quality detector plus stereo decoding.

Stereo reception is obtained when a 25Hz pilot tone is detected and there is sufficiently low signal noise. As soon as noise appears on the signal, the decoder automatically switches to mono. The decoder can also be manually switched to mono using the forced mono input.

In addition to the left and right audio outputs, the C-QUAM decoder also provides an automatic gain control (AGC) signal. This signal is inverted and controls the gain of the RF bandpass and 450kHz filter stages.

The AGC voltage is also used to drive the signal strength meter via another inverter stage.

The left and right audio outputs from the decoder are filtered using 9kHz notch and 10kHz low pass filter stages. The notch filter removes 9kHz whistles caused by adjacent stations beating with the received station while the low pass filter cum gain stage removes high frequency noise from the audio.

It also boosts the output level from the AM tuner so that it matches the audio output from the FM tuner.

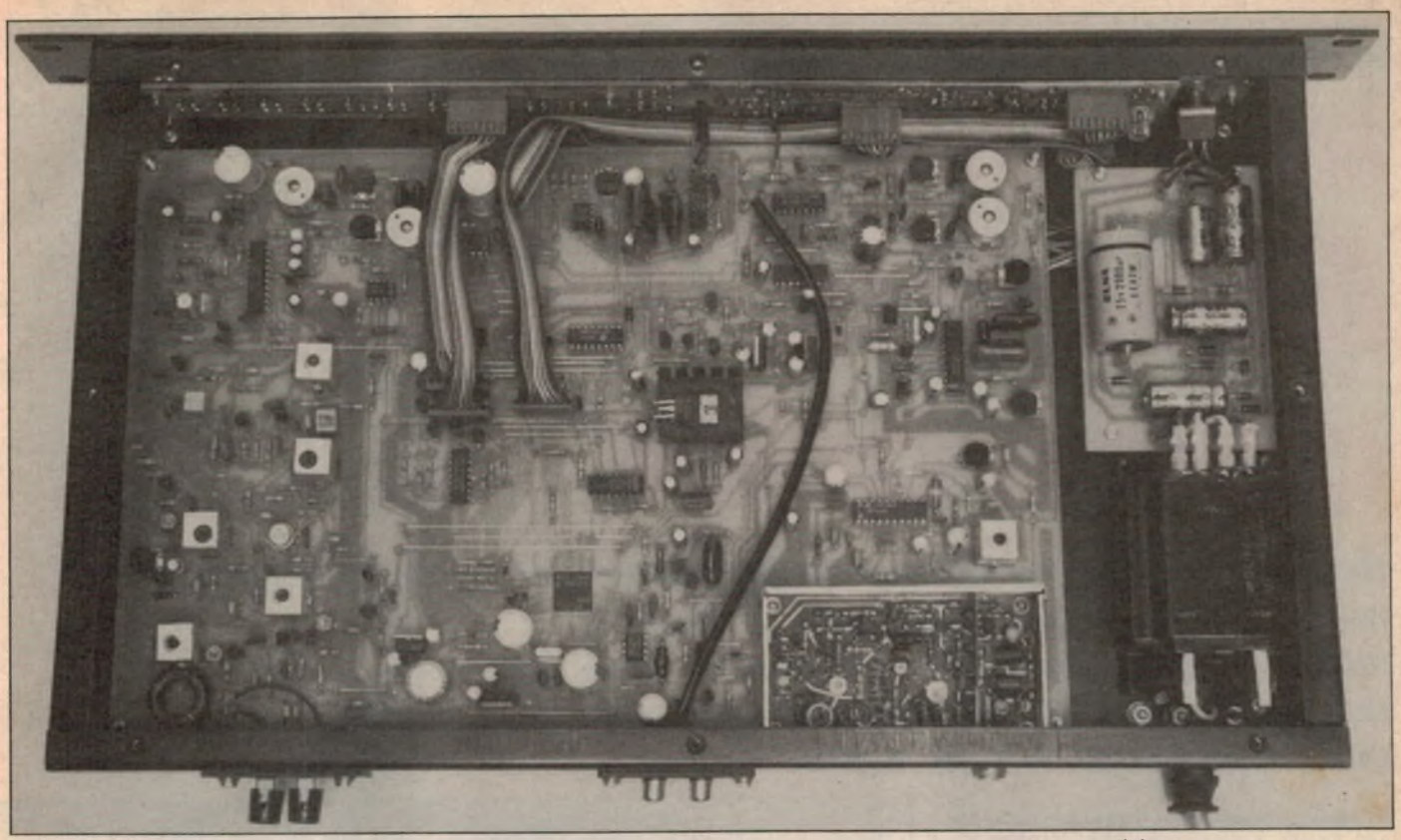
FM tuner

There's nothing radical about the design of the FM tuner. It's a perfectly conventional arrangement with both the IF and stereo decoder stages based on standard National Semiconductor ICs.

The front end includes the RF filters, a local oscillator and the mixer. Double tuning is used on the first stage before amplification using a dual gate MOSFET device. The unbalanced mixer is tuned to the 10.7MHz IF and its output passed to ceramic filters in the IF circuitry.

A National Semiconductor LM1865 advanced FM IF intergrated circuit is used for this section of the tuner. It includes gain, limiting and quadrature detection of the modulated FM signal. A feature of the IC is linearisation of the quadrature detection to considerably reduce distortion.

The IC also provides an AGC signal output which is applied to the front end and eliminates the need for local/distance switching. It also reduces third order intermodulation products due to strong out of band signals overloading the front end.



The microprocessor chip is at bottom centre of the main board, the AM tuner circuit at left, and the FM tuner at right.

Playmaster AM/FM stereo tuner

Also included with the IC is a station detect output and a signal strength output suitable for driving the signal strength meter.

Following the detector is a National Semiconductor LM1870 FM stereo decoder chip. This device incorporates a blend feature which reduces the stereo separation at low signal levels to improve the signal-to-noise ratio.

The left and right audio outputs are filtered with 19kHz notch filters and 38kHz low pass filters. The notch filters filter the 19kHz stereo pilot tone while the low pass filter reduces the 38kHz residual output produced by the stereo decoder.

Phase lock loop control

Varicap diodes are used to tune the local oscillator and RF sections of both tuners. These diodes change capacitance in response to a control voltage and are connected in parallel with inductors to form tuned circuits.

The varicap control voltage is derived from the error output of the microprocessor. This error output drives a varicap buffer amplifier which supplies a control voltage in the range from 0V to 28V DC.

In a superheterodyne tuner, the local oscillator frequency varies according to the tuned station and this frequency is read by the microprocessor controller. In the case of the AM tuner, the local oscillator signal is applied directly to the input of the microprocessor.

A somewhat different arrangement is employed for the FM local oscillator. In this case, the oscillator output is divided with a dual modulus prescaler chip before being applied to the microprocessor. The dual modulus prescaler divides by either 16 or 17, depending on the modulus control output from the microprocessor.

Inside the microprocessor is a phase lock loop (PLL) comprising three separate components: a reference frequency generator, a phase detector and a programmable divider.

The reference frequency generator produces a reference frequency by dividing down the external crystal reference of 4.5MHz. For AM, the reference frequency is 9kHz and for FM, 25kHz.

The programmable divider divides the incoming station frequency and compares it with the reference frequency in the phase detector. This produces the error voltage which is fed to the local oscillator varicaps to "lock" the tuner onto the station.

Since the local oscillator is a precise multiple of the internally generated reference frequency, this phase lock control loop is called a "frequency synthesiser".

Apart from synthesis control, the microprocessor performs several other functions.

To begin with, it has several control lines which drive the frequency display, the mono and AM/FM status indicators, and the memory selection LEDs. With the exception of the mono indicator these are all multiplex driven.

The microprocessor also scans the pushbutton control switches. When one is pressed, the microprocessor responds to the switch function and this response is seen as a change in the display.

Power supply and audio signal switching is controlled by the AM/FM output. The mute output mutes the audio signal whenever the microprocessor is changing stations. The stop input is used during the seek mode, when the tuner is used to automatically scan to the next station. When a station is located, the station detect output from the powered tuner goes high and the microprocessor locks onto that station.

Finally, the microprocessor is permanently powered up via a 5V regulator. However, if the tuner is disconnected from the mains supply, either intentionally or because of a blackout, a super capacitor (47,000μF) maintains power to the memories so that the tuner does not have to be re-programmed.

So much for the block diagram. In Pt. 2 next month, we'll publish the full circuit details.

Keep the cows corralled:

Build this Electric fence controller

Restore discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than our previous design and has been specially designed for use in rural areas.

by COLIN DAWSON

Most readers will probably be aware of the broad concept of an electric fence. Basically, it consists of a control circuit designed to deliver a short high-voltage pulse at regular intervals to one or two strands of bare wire. These strands can either be supported by insulators mounted on existing fence posts or on temporary stakes driven into the ground.

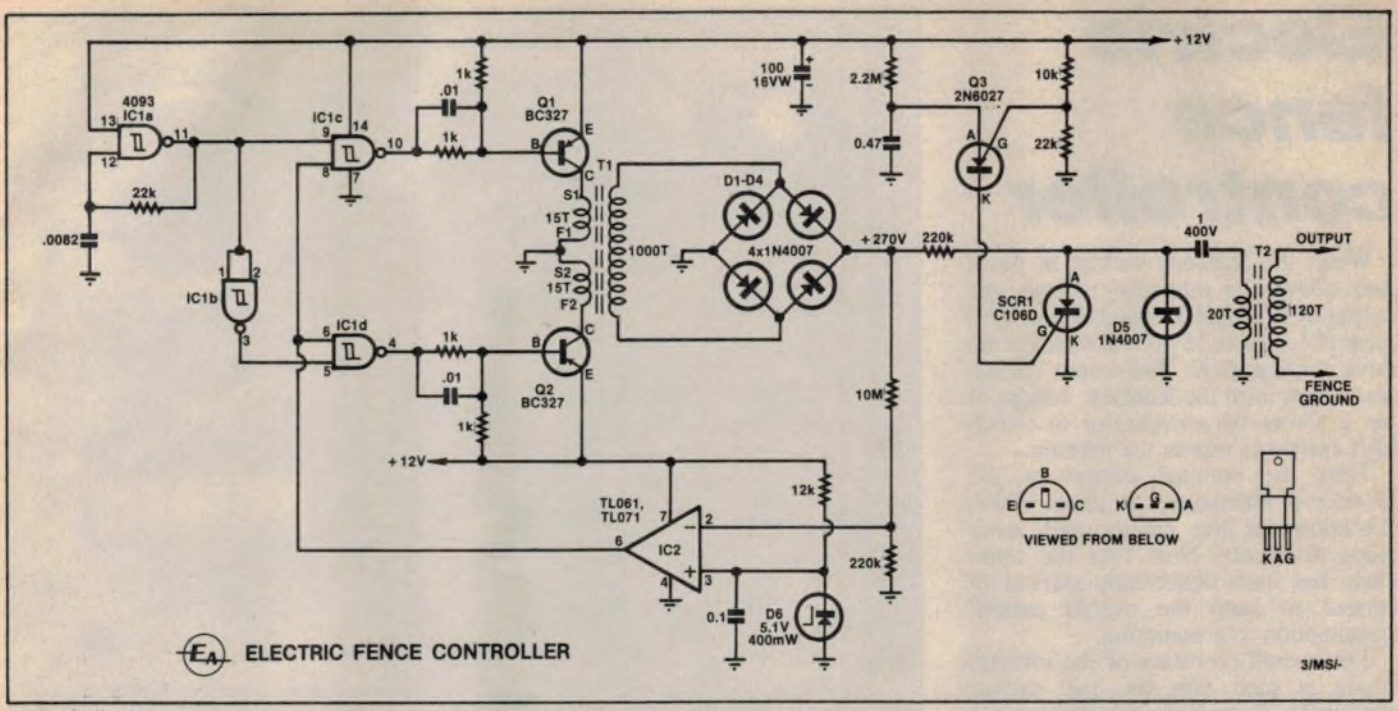
Whatever method is employed, an electric fence is a remarkably effective method of livestock control.

This new electric fence circuit will control all sorts of livestock, from cats to cattle, elands to elephants, dogs to deer, pigs, sheep and turkeys. Not only that, it can be used with either 6V or 12V batteries. Unlike many other designs, the output pulse characteristic is largely independent of the battery voltage, delivering virtually constant output voltage and cycling rates.

In our previous electric fence controller (September 1982), the emphasis was on simplicity and low cost. It used an automotive ignition coil as the output pulse transformer and was intended for small paddocks and vegetable gardens.

Although secondhand ignition coils are readily available and quite cheap, there are disadvantages to this approach. The most notable is the limitation imposed by the output impedance of the coil. Although this can vary quite markedly from one coil to the next, it is generally quite high. This limits the length of fence which may be energised and provides little immunity to false loads such as grass or dirty insulators.

By contrast, the output transformer in



The circuit consists of a driven inverter, a PUT oscillator (Q3) and an SCR trigger circuit.

the new design is wound on a Siemens ferrite core assembly, as used for the recent high-power car amplifier project. This has a much lower output impedance than an ignition coil and provides a marked improvement in regulation. In simple language, it delivers a lot more punch.

But eliminating the ignition coil was not the only change made for the new controller. In fact, the whole circuit has been completely revised and now owes much of its design to the 500V Insulation Tester project described in June 1985. In particular, the new Electric Fence Controller uses the driven inverter circuit employed in the Insulation Tester.

Although a driven inverter is somewhat more complex than the "ringing" type used in the previous design, it is less affected by component tolerances and is more efficient. Additionally, a significant reduction in current drain was achieved by regulating the inverter. It operates only as necessary to maintain a preset output voltage.

Note that both the inverter transformer and the pulse transformer have to be hand wound. While this may take a little longer than using "off the shelf" components, the winding procedure is straightforward and the improved performance more than justifies the effort.

The accompanying specifications panel sets out the performance of the prototype. Its electrical performance meets the stringent specifications laid down by the Standards Association of Australia as AS3129.

Specifications

Open-circuit Output Voltage	4kV
Output Voltage into 500Ω Load	1.2kV
Pulse Rate	1Hz
Pulse Duration (Open Circuit)	0.6ms
Pulse Duration (500Ω Load)	40μs
Average Current Drain	15mA

Circuit description

In addition to the driven inverter, the circuit consists of PUT oscillator Q3, an SCR trigger circuit (SCR1), and pulse transformer T2. A 1μF capacitor is charged by the inverter to about 270V and then discharged by the SCR into the primary of the pulse transformer which steps it up to 4kV.

The inverter is controlled by IC1, a 4093 CMOS quad NAND Schmitt trigger gate. IC1a is set up as a conventional Schmitt trigger oscillator with a nominal frequency of 5kHz. This drives the other sections of the IC package to give complementary drive signals to the bases of Q1 and Q2.

As previously mentioned, the output of the inverter is regulated. It is for this reason that IC1c and IC1d have been included in the transistor drive circuit. They each have one input (pin 8 and pin 6 respectively) connected to a control line from IC2. This line goes low when the reference voltage at pin 3 of IC2 has been exceeded, disabling both gates and blocking the drive signal to Q1 and Q2.

Q1 and Q2 are driven via 1kΩ current limiting resistors which are shunted with .01μF capacitors to speed up the switching action.

Q1 and Q2 drive the primary of the inverter transformer. When one of the transistors turns on (only one at a time can be on, due to the complementary drive signals), the full supply voltage of 12V is applied to one half of the primary winding. By transformer action, 12V also appears across the other half the primary winding.

The total primary voltage is therefore 24V and the polarity of this voltage alternates from one half cycle to the next.

The inverter transformer has a turns ratio of 30:1000, giving a nominal output voltage of 800V peak-to-peak across the secondary. This secondary voltage is fed to a full wave bridge rectifier.

Assuming that the inverter runs continuously, this would give a nominal DC output voltage of about 800V. But we don't want 800V. We only want 270V and so the inverter is turned off each time the DC output voltage rises above this figure.

This is accomplished by deriving a feedback control voltage from a 10MΩ/220kΩ voltage divider network across the bridge rectifier output. This control voltage is applied to pin 2 of comparator IC2a and compared with a 5.1V zener diode reference voltage applied to pin 3.

Electric fence controller

When the feedback voltage at pin 2 rises above the reference voltage, the output of IC2a (pin 1) switches low. This turns IC1c and IC1d off and removes the drive to Q1 and Q2. The output voltage then drops until the feedback voltage at pin 2 allows the comparator to switch high again and enable the inverter.

Thus the nominal output of the inverter is maintained at about 270V, depending on the resistor and zener diode tolerances. Note that the zener diode has been deliberately starved of current to keep the overall current consumption to a minimum.

The overall operation of the inverter circuit is such that the 1μF output capacitor is charged via the 100kΩ series resistor to the full 270V in less than 0.5s. For the rest of each cycle, the inverter operates only as necessary to maintain this charge.

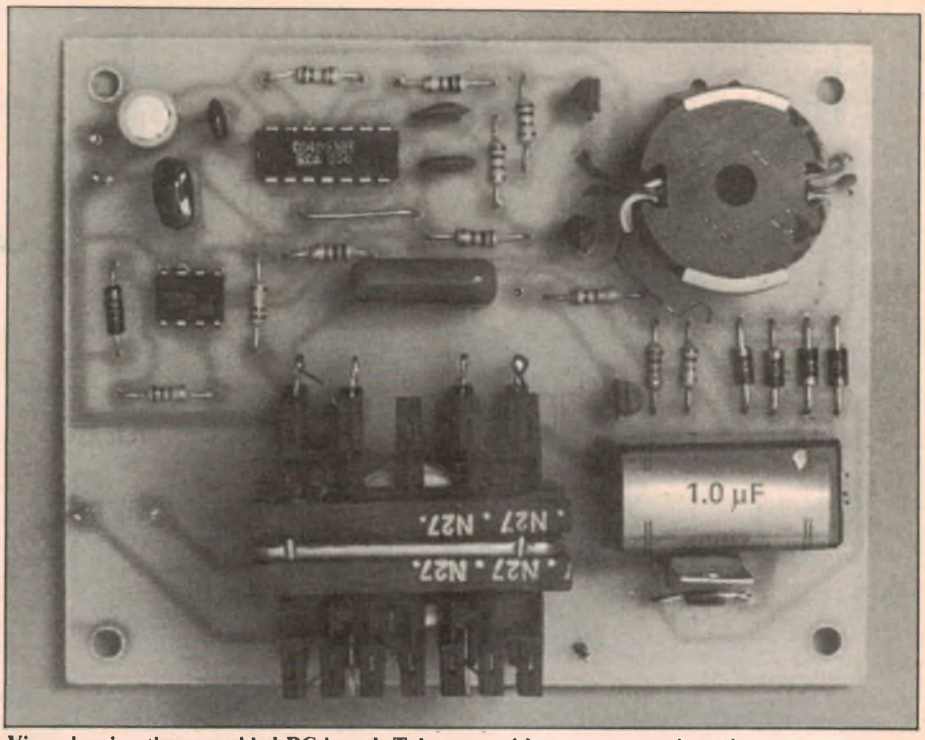
The discharge circuit is controlled by Q3, a 2N6027 PUT (programmable unijunction transistor). This device triggers when the voltage at its anode exceeds the voltage on its gate by 0.6V. The cycle time of the PUT can thus be controlled in two ways: (1) by the RC time constant on its anode; and (2) by the reference voltage applied to its gate.

In this circuit, the reference voltage has been set to two-thirds of the supply voltage (ie, to 8V). With the RC components shown (0.47μF and 2.2MΩ), the cycle time is about one second.

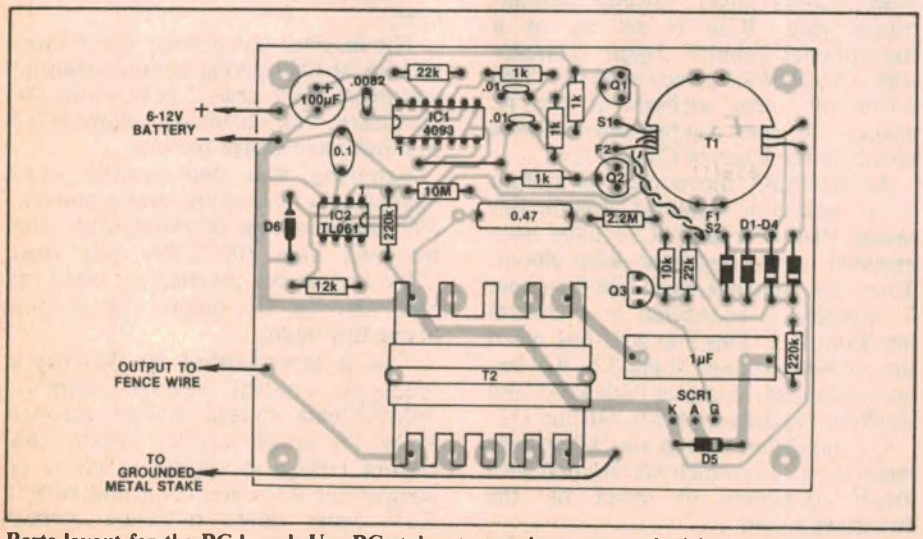
When triggered, the PUT has low resistance between anode and cathode (A and K) and the 0.47μF capacitor on the anode discharges into the gate of the SCR. This, in turn, triggers the SCR which dumps the charge on the 1μF output capacitor into the primary of pulse transformer T2.

Note that, in addition to the inital capacitor discharge cycle, there will be several cycles of ringing before the SCR switches off. The number of additional ringing cycles will decrease as the pulse transformer load increases. With the secondary short circuited, there will be no ringing at all.

The pulse transformer has a turns ratio of 20:1 and delivers an open circuit output voltage of 4kV with a pulse duration of 0.6ms. More realistically, it delivers 1.2kV into a 500Ω load with a pulse duration of 40μs. These figures are well within the standards laid down by AS 3129.



View showing the assembled PC board. Take care with component orientation.



Parts layout for the PC board. Use PC stakes to terminate external wiring connections.

Construction

Winding the two transformers will be the most time consuming aspect of construction. The inverter transformer will take longest so you may as well tackle this first. Apart from the ferrite pot core, and the wire, you will need some adhesive tape and several 50mm pieces of plastic sleeving.

The 1000 turn secondary is wound first using 36 B&S (0.125mm) enamelled copper wire. This can be done by hand if necessary, but a better method is to wind on the turns using a hand drill. If you intend using this method, the first thing to do is to determine the number of turns of the handle necessary to give 1000 turns of the chuck. This done, the former can be mounted by passing a suitable bolt through its core and securing this in the chuck.

It is best to mount the drill in a bench vise to prevent it from moving around too much.

To wind the coil, slip a piece of insulating tubing over one end of the 36 B&S wire. Lay this end in one of the slots in the former and secure it with adhesive tape. Now wind the 1000 turns onto the former, keeping the layers as even as possible.

When the secondary is complete, slip another piece of sleeving over the free end and bind the winding tightly with adhesive tape.

The primary is bifilar wound (ie, two wires are wound on simultaneously) using 26 B&S (0.4mm) wire. Divide the 26 B&S wire into two equal lengths, sleeve both ends of both wires, and label the two starting ends S1 and S2. The

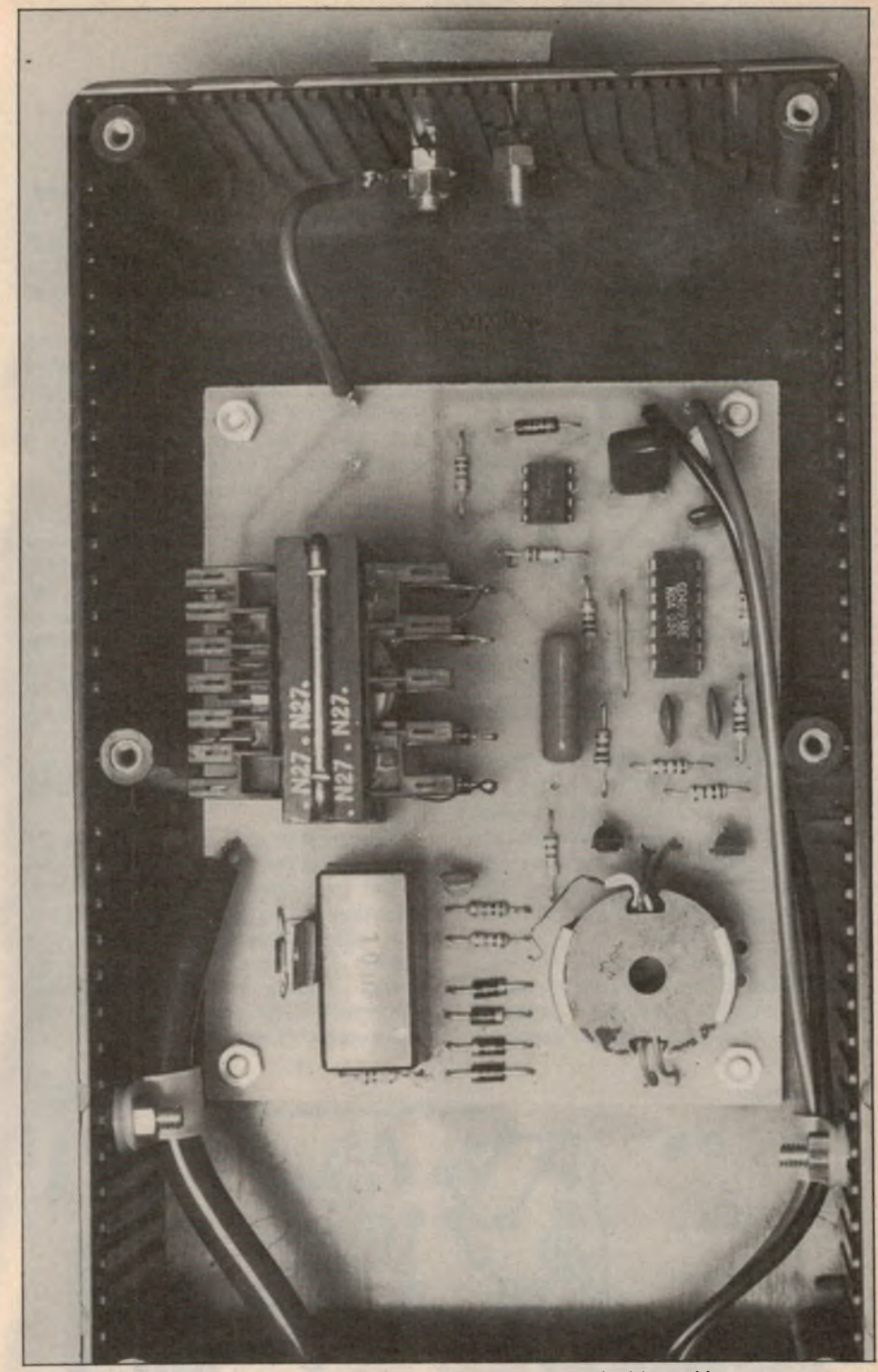
finish ends should be labelled F1 and F2. Lay the two starts in the slot opposite the leads for the secondary windings and secure them with tape.

Wind on 15 turns, finishing off the windings in the same place that they started. Move the sleeving up to the core, and trim off any excess wire. Wind a few more layers of tape over the whole former and trim the wires back to a length of about 25mm long. Strip and tin the last 5mm of all wires.

The pot core assembly can now be completed. This procedure will be self-evident from the construction of the core parts. Make sure that you don't confuse any of the leads. If you do, the inverter will not function.

The pulse transformer is relatively simple to wind. In this case, it is the primary that is wound first. This consists of two layers of 10 turns each of 26 B&S wire wound at one end of the former. Note that the start and finish ends of the primary should be on the same side of the core. Secure the winding with a layer of electrician's insulating tape. Do not use adhesive tape for this job — it is not thick enough.

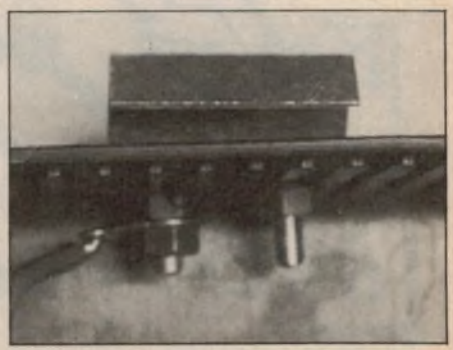
Above: actual size front panel artwork.



The high-tension earth lead is run using copper-core automotive ignition cable.

The secondary winding is also wound using 26 B&S wire. The first layer should fill most of the space left on the former, but leave a gap of 2mm between this winding and the primary. Note that the start should be made on the opposite side to that of the primary. You will probably be able to fit about 50 windings in the first layer.

Each layer of the secondary should be covered by a layer of insulation tape. The tape should overlap each end of the windings. Successive layers or wire should be about 1mm shorter at each end



Close-up view of the output mounting clip.

Build this electric fence controller

than the previous layer — this is to prevent arcing across the ends of the coil.

It will probably take four or five layers to fit the 120 turns of the secondary on the former. This is not a critical aspect of the design, but it is important to leave some space between the ends of adjacent layers. The finish end of the secondary should be terminated well away from the start, at the opposite end of the core.

With the secondary winding securely taped, the pulse transformer assembly can be completed by insertion of the ferrite core. Solder the free ends to the appropriate tags on the plastic core (check the overlay to see which tags match the PCB pattern).

PCB assembly

All the parts are mounted on a PC board coded 85ef11 and measuring 109 × 87mm. This is housed in a low-cost plastic zippy case.

No special procedure need be followed when assembling the PCB although it is a good idea to install the smaller components first. Note carefully the orientation of the diodes, transistors, and ICs when they are being installed. The use of PC stakes for terminating external leads is recommended.

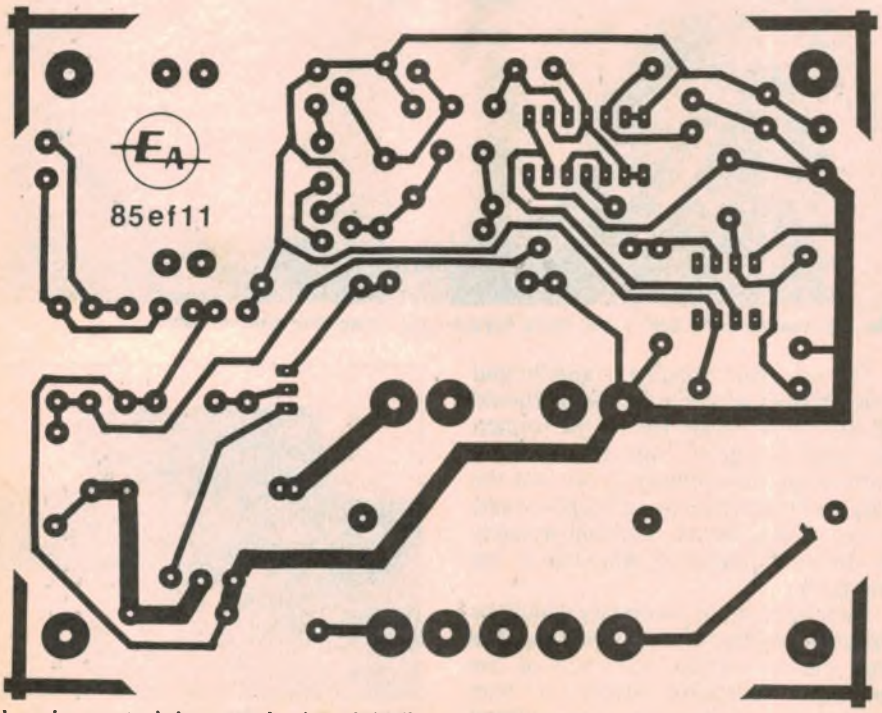
The 1μF capacitor we used is an AEE type, although this range is no longer available. Philips, however, make a 250VAC mains suppression capacitor (MKT-P) which would also be suitable. Should there be any difficulty in obtaining this capacitor, a 0.47μF metallised polyester (greencap) could be used. Note that this should be rated at 630V rather than the usual 100V.

The transformers should be mounted on the board after all the other components are in place. The inverter transformer is held in place with solder lugs while the pulse transformer is secured using its own retaining clamp.

The more mundane aspects of assembly can now be taken care of. This includes preparation of the box and a mounting clip to form the output electrode. On the prototype, this last item is simply a piece of scrap aluminium (about 40 × 25mm) bent into the shape of a shallow hook. This is mounted on the top of the box using two machine screws and simply hangs from the fence wire.

If the installation is to be permanent, then a screw type clamp should be fitted instead.

Construction can now be completed by mounting the PCB on the back panel of the case and installing the wiring. Note that the high-tension earth lead is run using copper-core automotive ignition cable terminated with a large battery clamp. Do not use noise-suppression cable as it will degrade the performance of the unit.



Above is an actual-size reproduction of the PC artwork.

The battery leads can be run using heavy-duty automotive hook-up wire (red for positive, black for negative), as can the lead between the PCB and the output terminal. Note that all external leads should be secured inside the case using suitable clamps. The leads emerge through holes drilled in the bottom of the case.

Finally, the case should be weather-proofed using silicone sealing compound. This should be run around the lid and used to seal the holes around the external leads.

PARTS LIST

1 PCB, code 85ef11, 109 × 89mm
1 plastic project box, 190 × 110 × 60mm
1 Philips FX2240 potcore with mounting assembly
1 Siemens ferrite core, B66339-G-X127 (100121)
1 Siemens former, B66274-B1011-T1 (100260)
1 Siemens mounting kit, B66274-B2002-X (100311)
3 battery clips
15 metres 26 B&S (0.4mm) enammelled copper wire
50 metres 36 B&S (0.125mm) enamelled copper wire
1 0.5m length of copper-cored HT wire
1 1.5m length of heavy-duty hook-up wire (red)
1 1.5m length of heavy-duty hook-up wire (black)
2 machine screws and nuts (4BA)
5 countersunk screws and nuts (4BA)
2 cord clamps to suit

Semiconductors

1 4093 quad NAND Schmitt trigger
1 TL061, TL071 op amp
5 1N4002 diodes
1 5.1V 400mW zener
1 2N6027 PUT
2 BC327 PNP transistors
1 SC106D SCR

Capacitors

1 100μF 16V PC electrolytic
1 1μF 400V metallized polyester
1 0.47μF metallized polyester
2 .01μF ceramic
1 .0082μF metallized polyester

Resistors (1/4W, 5%)

1 × 10MΩ, 1 × 2.2MΩ, 1 × 220kΩ, 1 × 100kΩ, 2 × 22kΩ, 1 × 12kΩ, 1 × 10kΩ, 4 × 1kΩ.

CHRISTMAS EXTRAVAGANZA!!

PROFESSIONAL SERIES RACK MOUNTING CABINETS

These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance:

- All aluminium construction.
- Removeable top and bottom panels.
- All dimensioning conforms to the International Standard.
- Natural or black finish.
- Ventilated lid.
- Deluxe brushed finish anodised front panel.

	1-4	5+
H10401 Natural	$49.50	$44.50
H10402 Natural	$59.50	$53.50
H10403 Natural	$69.50	$62.50
H10411 Black	$55.00	$49.50
H10412 Black	$65.00	$58.50
H10413 Black	$75.00	$67.50

STANDARD DESOLDING PUMP

Light weight, powerful suction. teflon tip. Replacement tips teflon and ceramic. Length 195mm.

Cat. T11241 **$15.95**

MINI DESOLDERING PUMP

Light weight, powerful suction, teflon tip. Replacement tips teflon and ceramic. Length 165mm.

Cat. T11251 **$14.95**

DELUXE DESOLDERING PUMP

Light weight, non conductive, powerful suction, ceramic long life tip. One of the best in the business. Length 210mm, replacement tip HT3C ceramic.

Cat. T11261 **$18.95**

KEYBOARD AND CASE

A stylistic low profile case to give your system the professional look it deserves. Comes with an attached encoded, parallel output keyboard and provisions for 2 x 5¼" slimline disk drives.

Cat. X11080 **$249**

COMPUROBOT

Simply key in a list of commands to the amazing Compurobot and watch him go about performing even your most complex manuevers - up to 48 steps! Forward, backward, left/right turn, left/right curve, robot noises flashing lights and a multi speed gearbox!

Cat. **$49.50**

ARLEC SUPER TOOL

A versatile 12V electric tool for...

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:

Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor. 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee.

Contents:

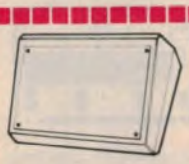
- 12V Super Tool.
- Plugpack AC adaptor.
- 1 spherical milling cutter.
- 1 wire brush.
- 1 grinding wheel.
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm.
- Set of 5 chuck collets.
- 6 eraser sticks.
- Instruction sheets.

Cat. T12300 **$44.95**

FREE STANDING, FOLD UP MAGNIFIER

An ecconomically priced "hands free" magnifier lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.

Cat. T12083 **$11.95**



NEW SLOPING CASES

Plastic with metal front panel available in two sizes:

Cat. H10450 190x120mm **$11.95**

Cat. H10455 256x185mm **$19.95**

(measurements are approx. only)

STROBE LIGHTS 12V

Available in 3 colours, red, blue and yellow. These units have a magnetic base and are fitted with 4 metres of cable terminating in a cigarette lighter plug. Ideal for displays, parties, attention getting, motoring emergencies/breakdowns etc.

Desc.	Cat. No.	Price
Blue	A15046	$32.50
Red	A15047	$32.50
Amber	A15045	$32.50

MODEM PHONE

Check the features and the value for money of this stylish new modem phone...

- Speaker Phone with Built-in Amplifier for Detecting Busy Signal during communication.
- Auto/Manual Answer, Manual Originate, Auto Disconnect.
- Carrier Detect Indication, 20 Memories (each with 18 Digits Capacity) for Auto-dialing.
- BELL 103 CCITT V21 Compatible.
- 300 BPS Full Duplex.
- Last Number Redial.
- Pushbutton Keyboard.
- Volume High or Low Control.
- FCC Approved Direct Connect.
- "In-use" Dialing Indicator.

Cat. X19105 **Normally $199**

Save $25! only $174

(Not Telecom approved)

P.A. SPEAKERS

Low dual cone, wide range, 200mm (8in.). Ideal for public address, background music, etc. Tremendous Value at these prices!

Cat. C12000 **$6.95**

ETI BOOKS

Scanner's World	$5.95
Computer Projects Vol.1	$5.95
Lab Notes and Data	$7.95
Electronics It's Easy Vol 1	$5.95
Electronics It's Easy Vol.2	$5.95
Test Gear Vol.1	$3.00
Test Gear Vol.2	$3.95
Test Gear Vol.3	$4.95
Top Projects Vol.5	$3.00
Top Projects Vol 6	$4.95
Top Projects Vol.7	$3.95
Top Projects Vol 8	$4.95
Top Projects Vol 9	$4.95
Top Projects Vol 10	$5.95
ETI Circuits Vol 1	$2.95
ETI Circuits Vol 2	$2.95
ETI Circuits Vol.3	$2.95
ETI Circuits Vol.4	$2.95
30 Audio Projects	$3.95
Audio Projects from ETI	$5.00
Simple Projects Vol 2	$2.95
Simple projects Vol.3	$5.95
Circuit Techniques Vol 1	$4.75
Circuit Techniques Vol 2	$4.75
Circuit Techniques Vol.3	$4.95
Circuit Techniques Vol.4	$5.95
How to Build Electronic Games	$3.95
Electronic Projects for Cars	$3.95
Project Electronics	$4.75
Radio Experimenters Handbook	$7.95
Electronics Projects for Young Scientists	$3.95
Computers and Computing Year Book	$4.95
Computers and Computing Vol.3	$4.95
Computers and Computing Vol.4	$5.95
How to Build Gold and Treasure Detectors	$3.95
Electronics and Music	$5.95

DESK MOUNTED LAMP MAGNIFIER

This unit magnifies any object under a clear cool fluorescent light. The magnification is the maximum obtainable (lens 127mm diameter biconvex 4 Dioptres, focal length 254mm) consistent with minimum distortion and eyestrain and good off-angle viewing. It is NOT cheap, but then again it will definitely last a lifetime. It is built like a Rolls Royce! Spare fluoro tubes are available from electrical outlets. If you have trouble with fine PCB work or component identification but still want both hands free, this is for you.

TECHNICAL INFORMATION

Illumination: 22W Fluorescent
Weight: 81.6Kg
Lateral Extension: 254mm
Vertical Extension: 254mm
Fixing: Heavy table base (grey) with two chrome plated flexible arms.

Cat C92700 **$179**

WELLER WTCPN SOLDERING STATION

The WTCPN Features:

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

The best is always worth having.

Cat. T12500

R.R.P. $129 **Our price $109**

UTILITY CASE

A must for all technicians, hobbyists and handy-men. Features clear plastic lid so you can tell at a glance the contents, up to 48 compartments adjustable to suit your needs. A place for everything and everything in its place!

Cat. H10449 **$16.95**

PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

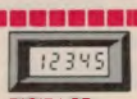
Cat. A12030 **$19.95**

10W RMS SPEAKERS

Including boxes!! At this price you can afford to put a set of speakers in every room!

Dimensions: H 475 x W 245 x D 200mm

Cat. C12002 **Per Pair $59.50**



4½ DIGIT LCD UNIVERSAL COUNTER - C7224

- **Very Low Power**
- **High Count Rate**

A 4½ digit counter offering counting to 20,000 units at rates up to 10MHz. The low current consumption makes it ideal for use in portable instruments. The counter features high contrast 10mm digits. 5V DC or 7.5V to 15V DC supply (typical consumption 1mA), and programmable decimal points. Standard controls are all TTL/CMos compatible and include Reset, Count Inhibit, Store, Leading Zero Blanking, "Carry" Output. The count input is protected against accidental overload. Supplied complete with mounting kit and connectors.

SPECIFICATIONS:

Supply Voltage: (5.5V Abs. Max.) 7.5 - 15V
Typical Current Consumption: 1mA
Maximum Count: 19999
Max. Counting Rate: 10MHz
Typical (Schmitt Trigger):
Count Input Level: VTH 2.5V VTL 2V
Min. DC Input Level: 0V
Max. DC Input Level: 5V
Operating Temp. Range: 0 - 50-C

Cat. Q15530 **$79.50**

S100 PROTOCARDS

Horizontal Buss
Cat. H19125 **$39.50**

Vertical Buss
Cat. H19130 **$39.50**

Pad per Hole
Cat. H19135 **$39.50**

HORWOOD ALUMINIUM CASES

We have a full range of quality Horwood cases.

Cat.No.	Dimensions	Price
H10382	3x4x2"	$5.50
H10383	3x4x3"	$ 6.50
H10384	3x4x4"	$ 7.50
H10385	3x4x5"	$ 7.95
H10386	3x4x6"	$ 8.50
H10387	3x4x7"	$ 9.50
H10388	3x4x8"	$10.50
H10389	3x4x9"	$10.95
H10390	3x4x10"	$11.95

ULTRASONIC PEST REPELLER

The state of the art in pest control! Perfect for keeping the flies away at your summer Bar-B-Ques and the mossies away after sunset!

Further more, no dead pests to dispose of, no toxic chemicals, maintenance free, economical (approx. 2¢ a day) and covers an area up to 2,000 sq ft. Simply plug it in and enjoy a clean pest free enviroment. Perfect for the home, apartment, restaurant, school, office or any indoor area.

Effectively controls...

- Flies
- Mosquitoes
- Mice/Rats
- Fleas
- Silverfish
- Cockroaches
- Ants
- Crickets
- Moths
- Waterbugs
- and many other pests!

Cat. Y95510 **$55.95**

METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field laboratory, workshop, hobby and home applications.

Features...

- Push-button ON/OFF power switch.
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001".
- High Surge Voltage protection 1.5 KV-3 KV.
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS

Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system.
Over-range Indication: "1" Figure only in the display.
Temperature Ranges: Operating 0-C to + 40-C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91530 **$79.95**

TOP QUALITY KITS TO MAKE

THE BRILLIANT SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,000 sold!
For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.

POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS" SERIES 5000 POWER AMPLIFIER....

- 1% Metal Film resistors are used where possible.
- Alumimium case as per the original article.
- All components are top quality.
- Over 1000 of these kits now sold.
- Super Finish front panel supplied at no extra cost.

Please note that the "Superb Quality" Heatsink for the Power Amplifier was designed and developed by ROD IRVING ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms
POWER AMPLIFIER: 100W RMS into 8 ohms (+ -55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0= .0.4 dB 2 8Hz to 65KHz, +0=3 dB. NOTE: These figures are determined solely by passive fillers.
INPUT SENSITIVITY: 1 V RMS for 100W ouput.
HUM: 100 dB below full output (flat).
NOISE: 116 dB below full output (flat, 20KHz bandwidth)
2nd HARMONIC DISTORTION: -0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + = 56V SUPPLY rated at 4A continues -0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above)
INTERMODULATION DISTORTION: 0.003% at 100W. (50Hz and 7KHz mixed 4:1)
STABILITY: Unconditional.

Cat. K44771

Normally $339, now only $319
Assembled and tested $499
packing and post $10

PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" SERIES 5000 PREAMPLIFIER KIT ARE....

- 1% Metal Film Resistors are supplied.
- 14 Metres of Low Capacitance Shielded Cable are supplied (a bit extra in case of mistakes).
- English "Lorlin" switches ae supplied (no substitutes here.)
- Specially imported black anodised aluminium knobs.

Available Assembled and Tested. (We believe that dollar for dollar there is not a commercial unit available that sounds as good!)

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz - 130KHz, + 0 = 1dB Low-Level input-conforms to RIAA equalisation + = 0.2dB
DISTORTION: 1KHz -0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation)
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)-92dB flat -100dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected. -86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal. -71dB flat -75dB A-weighted.

Cat. K44791

Normally $299, now only $279
Assembled and tested $599
packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands from 31.5Hz to 16KHz.
NOISE: -0.008mV, sliders at 0, gain at 0(=103dB0)
20KHz BANDWIDTH DISTORTION: 0.007% at 300mV signal, sliders at 0, gain at 0, maximum 0.01%, sliders at minimum.
FREQUENCY RESPONSE: 12Hz = 105KHz, +0, = 1dB, all controls flat.
BOOST AND CUT: 14dB

Cat. K44590

1 Unit ... **$199**
2 Units ... **$389**
packing and postage $10

LOW-COST BIPOLAR MODEL TRAIN CONTROLLER

Here is a simple model train control for those enthusiasts who desire something better than the usual rheostat control. It provides much improved low speed performance and is fully overload protected, yet contains relatively few componenets. Best of all, you don't need to be an electronic genius to construct it. (80TC12) (EA Dec 80)

Cat. K80120 **$34.50**

ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!
(ETI Aug. 84) ETI 1524

Cat. K55240 **$34.95**

FAIR DINKUM RS232 FOR MICROBEE

The Microbee, among other home computers, has a 'sort of' RS232 port in that it doesn't implement negative-going portion of its ouput signal (TxD). Most peripherals with an RS232 input can cope with that but inevitably, there are those that can't. This project fixes that.
(ETI 676, ETI FEB 84)

Cat. K67680 **$34.95**

ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.
(ETI May 83) ETI 164

Cat. K41640 **$9.95**

VIDEO AMPLIFIER

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead, it's much better! The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugback supply.
(EA Aug. 83) 83VA8

Cat. K83081 **$17.95**

30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec 83) ETI 162

Cat. K41620 **$52.50**

300 BAUD DIRECT CONNECT MODEM

Modem? What do I want with a modem? Think of these advantages:

- Can't afford a floppy disc? Use your telephone to access one for the cost of a call.
- Bored with your old programs? Download hundreds of free programs.
- Want to get in touch with fellow computer enthusiasts? Use 'electronic mail'.
- Ever used a CP/M system? CP-DOS? UNIX? Well a modem will make a your computer a remote terminal on some of the most exciting systems around.

Save on ready built modems.

Cat. K97050 **$99**

PARALLEL PRINTER SWITCH

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently, so that you can select one or the other at the flick of a switch.
(ETI 666, Feb. 85)

Cat. 46660 **$69.95**

LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov. 81) ETI 158

Cat. K41580 **$39.50**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

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

Cat. **$19.95**

1W AUDIO AMPLIFIER

A low-cost general-purpose 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. 84)

Cat. K84111 **$9.95**

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automative ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additonally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept. 82) 82EF9

Cat. K82092 **$19.50**

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.
(EA April 82, 82AO3A/B)

Cat. K82040
Cat. K82041 **$89.50**

ELECTRONIC WATT METER

This unit will measure the power consumption of any mains appliance with a rating up to 3 kilowatts. It makes use of a special op amp called an 'output transconductance amp' or OTA, for short.
(EA Sept. 83) 83WM8

Cat. K83082 **$89.95**

TRANSISTOR TESTER

1000's SOLD

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. 83) 83TT8

Cat. K83080 **$17.95**

LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.
(ETI May 83) ETI 163

Cat. K41630 **$182.50**

40 W INVERTER

This 12-240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May 82) 82IV5

Cat. K82050 **$57.50**

MOTORCYLCE INTERCOM

OVER 300 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!
(EA Feb. 84) 84MC2

Cat. K804020 **$45.00**

MICROBEE SERIAL-TO-PARALLEL INTERFACE

Most microcomputers worth owning have an RS232 connector or port, through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel 'Centronics' interface printers. Save money by building this interface. (ETI Jan. 84) ETI 675

Cat. K46750 **$59.00**

VIDEO ENHANCER

100's SOLD

Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct. 83) 83VE10

Cat. K83100 **$39.50**

LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give your early warning of power failure, and makes a handy beginner's project.
(ETI 280, March '85)

Cat. K42800 **$7.95**

TEMP PROBE

Can measure temperature from -50 to 150-c. It simply plugs into your multimeter - great for digital multimeters. Accuracy of 0.1-c resolution of 0.1-c.
(ETI June 83) ETI 153

Cat. K41530 **$27.50**

DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.
(EA March 82) 82PS2

Cat. K82030 **$87.50**

DURING THE HOLIDAYS !!

15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage. (ETI 581. June '76)

Cat. **$19.50**

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. 84) 84TP2

Cat. K84021 **$27.50**

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER

Here's what you've been asking for a full trasmit-receive system for computer drivan radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Mircorbee tips are avaialble on interfacing the unit to other computers.

(ETI Nov. 84) ETI 755

Cat. K47550 **$139.00**

PH METER KIT

Build this pH meter for the swimming pool season is here again! From swimming pools to fish tanks to gardening,this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units making it suitable for use in the laboratory as well.

(EA Dec. 82) 82PH12

Cat. K82123 **$139**

300W "BRUTE" AMPLIFIER

The "Brute" develops 300W into 4 ohms, 200W into 8 ohms!

For many adudo applications there s no substitue for sheer power - low efficiency speakers, outdoor sound systems, or maybe you like the full flavour of the dynamic range afforded by a high power amp. Whatever your requirement - this 'super power' module should fill the bill. (ETI 466) (ETI Feb. 80)

Cat. K44660 **$89.50**

(Heatsink not included)

PLAYMASTER 300 WATT AMPLIFIER

This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complemetary or quasi-complementary versions, so output transistor shortages should be no problem at all.

(80PA6) (EA July '80)

Cat. K80060 **$79.50**

PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of componenets for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov. 83) 83MA11

Cat. K83110 **$14.95**

VOICE OPPERATED RELAY

EA s great Voice Operated Relay can be used to control a tape recorder, as a VOX circuit for a transmitter or to control a slide projector. (EA Apr '82) 82VX4

Cat. K82043 **$17.95**

EA AM STEREO DECODER

AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system

(EA Oct '84) 84MS10

Cat. K84100 **$27.50**

MOSFET POWER AMPLIFIER

Employing Hitachi Mosfets, this power amplifier features a 'no compromise' design, and is rated to deliver 150 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion.

ETI 477 (ETI Jan. 81)

(Single module only)

Cat. K44770 **$79.50**

Plus power supply (No trans) **$49**

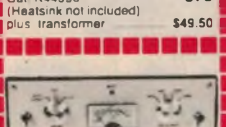
Plus transformer PF4361/1 **$49.50**

150W MOSFET POWER AMPLIFIER

Here's a high power, general purpose 150W Mosfet Power Amp Module! Suitable for guitar and P.A applications and employing rugged reliable Mosfets in the output stage. (ETI 499) (ETI March '82)

Cat. K44990 **$79**

(Heatsink not included) plus transformer **$49.50**



AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder s bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder. (81AO10) (EA Oct. 81)

Cat. K81101 **$47.50**

MICROBEE ENHANCER 1

This totally amazing kit for the Microbee is a must for all Microbee owners/users!

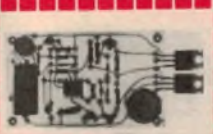
Most expansion units up to this time offered at best only one or other features; and this made it impossible to run, for example, complex sound effects mingled with speech. The Enhancer 1 will do all this and much more as well. It is quite amazing how much has been shoe-horned into this compact unit.

The Enhancer 1's many powerful features include:

- Two ATARI/COMMODORE/ COLECO/SEARS type joystick inputs.
- Two TRS COLOR COMPUTER type joystick inputs.
- Allows the connection of Touch Pads, Paddles, Proportional Joysticks, Trakballs, Mice, temperature senors, lights level sensors, transducers, etc. etc!!
- A 4 voice music/sound effects sythesizer.
- A real time clock.
- Unlimited vocabulary speech synthesizer (option).
- Parallel printer interface (option).
- A built-in speaker with volume control.
- Listings of all necesary routines for use.
- An impressive demonstration program package.
- Compatible to all Microbees.
- Digital recording and playback of speech and sound.
- An 8 channel analog to digital converter with variable voltage or variable resistance type analog inputs and also user selectable resolution from 1 to 9 bits.
- A digital to analog converter with selctable resolution from 1-8 bits.
- Allows automatic data acquisition and logging.
- 5 digital input lines, 4 digital ouput lines.
- A voice input channel.
- A 40 pin experimenter socket with all 8 analog inputs, 5 digital inputs, 4 digital ouputs, 3.58 MHz buffered clock, sound output (so that you can play the sound effects through your HI FI), 3 high resolution voltage comparators, DAC output etc.

The amazing Microbee Enhancer is available exclusively from Rod Irving Electronics.

Cat. **$149**



GENERAL PURPOSE AMPLIFIER CLASS B

One of the handiest 'tools' for the electronics experimenter is a genuine purpose audio amp. This module will work from a wide range of supply voltages, has good sensitivity, is robust and reliable - easy to build too! (ETI 453)

(ETI April '80)

Cat. K44530 **$24.50**

50 W AMPLIFIER MODULE (ETI 480)

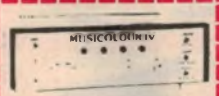
Cat. K44880 **$27.50**

(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)

Cat. K44801 **$29.95**

(Heatsink optional extra)



MUSICOLOR IV

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

(EA Aug. 81) 81MC8

Cat. K81080 **$99.00**

EFFECTS UNIT

An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.

(EA June. 83) 83GA6

Cat. K83060 **$75.00**

HEADPHONE AMPLIFIER

PRACTICE WITHOUT ANNOYING THE FAMILY!

If you play any type of electronic instrument,this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household,or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb. 84) 83MA11

Cat. K83011 **$29.95**

GENERAL PURPOSE PREAMPLIFIER

A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders or microphones by changing a few components. (ETI445) (ETI July '76)

Cat. K44490 **$8.95**

100W SUB-WOOFER AMPLIFIER

Capable of up to 120 watts RMS into 4 ohm loads and up to 80 watts RMS into 8 ohm loads, this power amplifier module has been specifically designed for use as a sub-wooler driver amplifier in a tri-amped hi-fi system. It uses four power Mosfets for rugged, reliable operation. (EA July '82) (82PA7)

Cat. K82075 **$97.50**

SERIES 4000 STEREO PREAMP

This high performance project is designed to complement ETI's 60 watt low distortion amplifier module and forms part of a complete stereo system: the "Series 4000" project. (ETI 471)

(Top Projects Vol. 6)

Cat. K44710 **$54.50**

STEREO ENHANCER

The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an "enhanced stereo effect" with a small unit which attaches to your amp.

(ETI 1405, ETI MAR '85)

Cat. K54050 **$79.50**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time and no more glow plug burnouts on your model engines.

(ETI June 83) ETI 1516

Cat. 55160 **$47.50**

ELECTRIC DUMMY LOAD

With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.

(ETI Oct '80) ETI 147

Cat. K41470 **$119**

MULTI SECTOR ALARM STATION

The Christmas season always brings with it an increase in home burglaries, so nows the time for installing security equipment. Relieve the boredom, save money and at the same time protect your home from intruders with this up-to-the-minute burgular alarm system. Its easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.

Specifications:

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

Complete kit including deluxe prepunched metal work and electronics for only.

Cat. K85900 **$129**

HUMIDITY METER

This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI-256 (Includes humidity sensor $19.50)

Cat. K52460 **$29.50**

CUDLIPP CRICKET

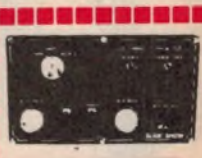
A fascinating Electronic Cricket with just two ICs. The Cudlipp can be used to bug your home, office etc! Great fun! (EA Feb. 82) 82EG2

Cat. K82022 **$12.00**

CYLON VOICE

Have your voice transformed into that of the sinister sounding Cylons. Great fun and scary! (EA Jan. 81)

Cat. K80012 **$19.95**



SLIDE CROSS-FADER

Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built vanalbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. 81) 81SS11

Cat. K81110 **$85.00**

BANKCARD

VISA

MASTERCARD

SIGNATURE EXPIRY DATE

NAME

ADDRESS

P/CODE

EA/12/85 DATE

IC SPECIALS!

	1-9	10+	100+
4116	$1.80	$1.70	$1.60
4164	$1.95	$1.75	$1.70
2716	$5.90	$5.50	$5.50
2732	$6.25	$5.95	$5.50
2764	$8.25	$7.95	$6.00
27128	$7.00	$6.50	$6.25
6116	$2.50	$1.95	$1.75
41256	$9.00	$8.00	$7.50
6264	$8.00	$7.50	$7.00

MSM5832 BACK IN STOCK

1-9	10+
$12.50	11.50

8000 SERIES IC SPECIALS!

	1-9	10+
8085	4.50	3.50
8212	1.50	1.40
8216	1.50	1.40
8226	1.70	1.50
8243	4.50	3.90
8251	3.90	3.50
8253	3.50	3.30
8255	2.90	2.50
8257	3.50	3.10
8259	3.50	3.10
8279	3.50	3.10
2532	7.50	6.90
2764	5.50	5.10
27128	7.50	6.90
1488	.55	.45
1489	.55	.45

IC STORAGE CASE

Electro static charge proof plastic IC case with conductive sponge. Dimensions: 75 x 130 x 19mm.

Cat. H10095 **$5.95**

MINI JUMPERS

- Contact terminal: Phospor bronze
- Material: P.B.T. 94V-0
- Gold plated

Qty	Cat. No	Price
10	P12053	$ 2.95
25	P12055	$ 4.95
100	P12057	$21.95

MIDRANGE HORNS

Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30 watts RMS in a system they will handle over 100 watts RMS.

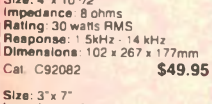
Two sizes to choose from:

Size: 4" x 10 1/2"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 1.5kHz - 14 kHz
Dimensions: 102 x 267 x 177mm

Cat. C92082 **$49.95**

Size: 3"x 7"
Impedance: 8 ohms
Rating: 30 watts RMS
Response: 2kHz - 15 kHz
Dimensions: 76 x 177 x 145mm

Cat. C92084 **$29.95**



SWIVEL BASE

Makes life easy!

Cat. D11100 **$29.50**

UNIVERSAL SOLDERING IRON STAND

Cat. T11302

Normally $5.95 slashed to **$3.95**

LOCAL BURGLAR ALARM CONTROL PANEL

Protect your home over the holidays! The odds against you increase dramatically during the festive season, so now is the time to install a security system, especially while they are this cheap!

- Adjustable exit/entry time delay and alarm time (avoids unnecessary noise pollution)
- 12V D.C. 1.5Amp
- Provision for battery back-up
- Tamper switch
- Optional outputs: Sirens, bells, floodlights, automatic diallers, tape recordings, closed circuit TV, etc.
- Accepts N.C. and N.O. detectors such as infrared, microwave, ultrasonic, wireless, vibration sensor, magnetic switch, door mat, smoke detector, glass breakage sensor, panic button etc.

Cat. S15051 **Normally $99.95**
NOW $79.95

RITRON KEYLESS CAR ALARM

The first shipment sold out immediately to the trade. They didn't reach our own retail stores!

- Activated and disarmed by ignition key, so you never forget to turn it on
- Multi-function, built in siren or external siren, car signal horn output
- Easy to install, no door switch required.
- Automatic reset after 60 seconds (avoids noise pollution)
- Special sensor protects Stereo or CB.
- 12V DC

Cat. S15054 **Normally $39.95**
NOW $29.95

HORN CRAZY!!

8W, 8ohm, aluminium or plastic. Normally $9.50

Aluminium Cat. C12015
Plastic Cat. C12010

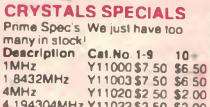
1-9	10+
$6.50	$5.95

HORN SIREN

12V DC, 8W

Cat. C12012

1-9	10+
$14.95	$13.95



CRYSTALS SPECIALS

Prime Specs. We just have too many in stock!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$7.50	$6.50
1.8432MHz	Y11003	$7.50	$6.50
4MHz	Y11020	$2.50	$2.00
4.194304MHz	Y11022	$2.50	$2.00
4.433618MHz	Y11023	$2.50	$2.00
4.75MHz	Y11025	$2.50	$2.00
4.915200MHz	Y11026	$2.50	$2.00
5MHz	Y11030	$2.50	$2.00
6MHz	Y11040	$2.50	$2.00
6.144MHz	Y11042	$2.50	$2.00
6.670MHz	Y11045	$2.50	$2.00
8MHz	Y11050	$2.50	$2.00
8.867238MHz	Y11055	$2.50	$2.00
10MHz	Y11060	$2.50	$2.00
12MHz	Y11070	$2.50	$2.00
14.31818MHz	Y11072	$2.50	$2.00
15MHz	Y11075	$2.50	$2.00
18MHz	Y11082	$2.50	$2.00
18.432MHz	Y11085	$2.50	$2.00
20MHz	Y11090	$2.50	$2.00

WHAT'S NEW AT ROD IRVING ELECTRONICS?

We now have computer chess games! Excellent presents for chess enthusiasts or the whole family!

TRAVEL MATE

- Worlds most compact sensor chess
- Ideal teacher or strong opponent
- Turn on/off anytime. It remembers positions for up to one year.
- Plays for over 6 months on 3AA batteries.
- Knows all the rules and will not accept illegal moves.
- Low cost. 4 powerful skill levels. Estimated 1,400 Elo

Cat. C30000 **$99**

ELECTRONIC CHESS MK10

- Streamline design tabletop chess.
- New 8 level program from beginners to experts.
- Ideal teacher or strong opponent.
- Turn on/off any time. One year memory.
- 1 000 hours play with 3AA batteries.
- Optional mains adaptor available.
- Take back moves, verify, solve problems to mate in 3 and beyond.
- Player vs. player mode, thinks on opponents time, built in opening library.
- Beginner to expert. Estimated 1,500 Elo

MK10 offers so much for so little!

Cat. C30002 **$149**

COMPANION 11

SciSys No.1 selling full size computer!

- Very strong chess program.
- 9 levels with special zero level for beginners.
- Ideal teacher or formidable opponent.
- Turn on/off anytime, one year memory.
- 6 months play on 3AA batteries or optional mains adapter available.
- Take back moves, verify, solve problems to mate in 4 and beyond.
- Player vs. player mode, thinks on opponent time, built in opening library and strong end game.
- Beginner through club player to expert. Estimated 1,650 Elo.

Cat. C30004 **$199**

EXPRESS 16K

Instant response hand held chess computer.

- Instant response - uses opponents thinking time to prepare instant replies to several alternative opponent moves.
- Strong program beats 90% of all chess players (estimated SciSys-Elo 1800)
- Automatic Display Move function
- Extra flat, High-value metallic finish.
- Fast 8 MHz 16K chip.
- 17 playing levels. 1 beginner, 8 casuals, 6 club, 2 special (analysis and problem to Mate in ten moves)
- Very long battery life. 1000 hours playing, one year memory.

Cat. C30006 **$199**

3 IN 1 GAMES

CHESS, TIC TAC TOE, AND CHECKERS!

CHESS: 8 levels, solves up to mate in 4 moves.

TIC TAC TOE: 4 levels of skill, big easy to use pieces, quick response, take back facility.

CHECKERS: 8 levels of skill, take back facility.

Perfect for the whole family!

Cat. C30008 **$149**

NICAD BATTERIES

Save on carbon batteries with these Appolon Nickel cadmiums. Rechargeable up to 1000 times!

1-9	10+
Cat. S15020	AA500 MA
$2.45	$2.25
Cat. S15021	C1.8 AH
$4.95	$3.95
Cat. S15022	D4 AH
$7.95	$6.95

NICAD CHARGERS

Cat. **$24.95**

ECONOMY 19" RACK CASE

Tremendous Value! Dimensions W 480 x H 134 x D 250mm.

Cat. H10415 **$44.95**

RITRON 1

Our most popular model in a steel cabinet to minimise R.F.I. interference.

Green, Cat. X14500 **$199**
Amber Cat. X14500 **$209**

WIND SPEED/DIRECTION INDICATOR

This quality engineered European import enables you to monitor windspeed and its direction from the comfort of inside your boat cabin or home. The system comprises a fully factory made wind direction transducer which is weatherproof and has a drip seal around its moving collar. It is fitted with quality reed switches for trouble free life. An 'N' (indicating North) is shown on the outside of the body for initial compass alignment. The wind speed transducer is built into a similar high quality case but is fitted with three moulded cups on equidistant radial arms. Again high quality reed switches are employed. Both transducers are moulded thermoplastic and are supplied with 25 metres (80 feet) of factory terminated connecting cable. Each transducer is fitted with a stainless steel mounting stud with nuts.

The output of each transducer is displayed on an attractive panel measuring 150(W) x 100(H)mm. A LED shows when the wind direction indicator shows main compass point (i.e. N,S,E,W) when the wind shifts between these points, two adjacent LEDs show, indicating the appropiate wind vector.

Wind speed is indicated on analogue meter with a standard Km/ Hr scale. Scales of 0-30 metres/sec, 0-60 knots, 0-70 mph and 0-7 Beaufort (force) scale, are also provided. It must be emphasised that the meter movement must be carefully dismantled and the scale glued on the face in order to mount the other scales. Warranty is voided doing this, however, damage is unlikely if you are careful. The panel is also provided with a toggle switch to minimise power drain. (powered by 4 penlight batteries)

Dimensions of transducers.
Main body: 40mm dia. 125mm (H)
Diameter of cup rotation is 160mm
Diameter of vane rotation is 240mm

Cat. Q96150 **$199**

TDK AUDIO TAPE BARGAINS

Description	Cat.No.	1-9	10+
DC46 TDK	A11305	2.75	2.10
DC60 TDK	A11307	2.95	2.25
DC90 TDK	A11309	3.50	2.50
DC120 TDK	A11311	5.50	4.25
AD60 TDK	A11315	3.75	2.95
AD90 TDK	A11317	4.75	3.50
AD120 TDK	A11319	6.95	5.50
ADX60 TDK	A11320	4.95	3.50
ADX90 TDK	A11322	5.95	4.50
SA60 TDK	A11325	5.35	3.95
SA90 TDK	A11327	5.95	4.50
SAX60 TDK	A11329	5.25	3.95
SAX90 TDK	A11332	6.95	5.95
MAC60 TDK	A11335	10.95	9.35
MAC90 TDK	A11337	11.50	8.75
MAR60 TDK	A11340	13.50	10.95
MAR90 TDK	A11342	17.20	15.35

P.A. SPEAKERS

Low dual cone, wide range 200mm (8in.). Ideal for public address, background music etc. Tremendous Value at these prices!

Cat. C12000 **$6.95**

TDK VIDEO TAPES AT BARGAIN PRICES!

VHS	E60	$12.50
	E120	$12.50
	E180	$11.80
	E240	$22.40
BETA	L250	$13.50
	L500	$14.40
	L750	$17.50

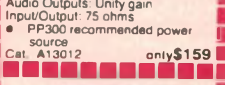
VIDEO PROCESSING CENTRE

Combination stabilizar, enhancer distribution amplifier, RF converter, designed to enchance all recording needs. Will handle 3 VCR's simultaneously with virtually zero signal loss. Built in RF converter permits in-line connection between VCR and TV for improving recording whilst viewing.

Specifications
Power Requirements:
12V DC 300mA
Inputs: Video,Audio
Outputs: 3 video, 3 audio
RF UHF: Channel 36
Output Level: + - 0.3dB
Output Isolation: More than 40dB
Audio Outputs: Unity gain
Input/Output: 75 ohms

- PP300 recommended power source

Cat. A13012 **only$159**



POWERFULL MINI DRILL

Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit. Requires 12V 1 AMP. (use with M19010)

Cat. T12302 **$13.95**

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 **$39.95**

NEW PHONE PLUGS & SOCKETS

We hear on the grapevine that all future installation will use the U.S.A type of plug and sockets for communication lines.

TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres
- Colours: cream, dark brown

Cat. Y16022 **$7.95**

TELEPHONE EXTENSION CABLE

- U.S. plug to U.S. socket
- Length 10 metres
- Cream colour cable

Cat. Y16024 **$8.95**

TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm
- Cream colour cable

Cat. Y16026 **$6.95**

TELEPHONE EXTENSION CABLE

- U.S. plug to 2 U.S. sockets
- Length 10 metres
- Cream colour cable

Cat. Y16028 **$10.95**

RS232 MINI PATCH BOX

- Interface RS232 devices
- With male to female 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

Cat. X15654 **$25.95**

ROD IRVING ELECTRONICS

425 High Street, NORTHCOTE, 3070
VICTORIA, AUSTRALIA
Phone (03) 489 8866

48 A'Beckett St, MELBOURNE, 3000
VICTORIA, AUSTRALIA
Ph. (03) 663 6151

Mail Order and correspondence:
P.O. Box 620, CLAYTON 3168
TELEX: AA 151938

MAIL ORDER HOTLINE (031 543 7877 (2 lines)

POSTAGE RATES

$1-$9.99	$2.00
$10-$24.99	$3.00
$25-$49.99	$4.00
$50-$99.99	$5.00
$100-199	$7.50
$200-$499	$10.00
$500 plus	$12.50

This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included "free"!
Registered Post for orders over $200 included "free"!

MasterCard VISA

Errors and Omissions Excepted.

The Serviceman

The customer is not always right!

How do you cope with the "look-over-your-shoulder-and-tell-you-what-to-do" type customer? Fortunately they are rare but, no matter how well meaning their intentions, they can prove most distracting, particularly when their ideas are way off beam. And what precautions are being taken to protect the public from dangerous imported appliances?

My first story this month is a fairly routine one, but I feel that it is worth telling for a couple of reasons. One is that the fault turned out to be of a type which seems to be on the increase. Another is that the symptoms, history, and owner's diagnosis all pointed in the wrong direction. I wasn't deceived, as it happened, but a less careful approach could have resulted in a time wasting sidetrack.

The set in question was a General model GC145, a 34cm set designed to operate from either 240V AC or 12V DC, and it was this dual facility which is the gist of the story. The owner was a retired chap who, with his wife, was spending his leisure years caravaning around the countryside. Until recently he had managed with a small monochrome set in the van, but finally decided to convert to colour and the General appeared to have all the features he wanted.

He had purchased it from a colleague who runs a retail business and for whom, as in this case, I sometimes undertake warranty coverage. So all the work involved in this story was done under this warranty arrangement.

Dual power supply

This model set might best be described as a standard 240V model which has been upgraded to a dual voltage type by the addition of a DC/DC converter, in the form of a separate package bolted to the left hand side of the chassis. It is a completely professional arrangement and, in fact, is a very convenient one when checking battery operation.

The set is supplied with two interchangeable power cords which plug into a six pin fitting on the chassis and, in so doing, complete the necessary links and connections appropriate to the power cord selected. The 240V cord is terminated at the other end with a standard three-pin plug, and the 12V cord with a cigarette lighter plug.

And this was where the first trouble appeared. The cigarette lighter plug was not really suitable for use in the caravan, which had its own battery 12V lighting system, as well as the customary 240V circuit. The owner preferred to use a pair of heavy duty battery clips which he could connect directly across the battery, but hesitated to modify the 12V cord, reasoning that there might be times when the set could be used in the car.

He solved the problem by obtaining an old cigarette lighter socket — probably from a car junk yard — and connecting the battery clips to it with short lengths of heavy gauge cable. This worked well enough at first but, after a few times, the set refused to work at all on 12V.

This was where I first came into the picture, and the owner explained why he had made up the conversion cable. He was somewhat apprehensive about the arrangement, fearing that it had introduced voltage losses and perhaps damaged the set. And, while he didn't say so, I gained the impression that he had been connected with the automotive industry. At any rate, he seemed to be rather obsessed with voltage drop problems.

I reassured him that I didn't think there was anything seriously wrong with what he had done although, personally, I would prefer to keep plug and socket arrangements to a minimum in low voltage circuits. Thus reassured he left the set with me.

It didn't take long to establish that the fault was in the cigarette lighter plug, as supplied with the set. It was divided into two halves, longitudinally, and held together with a couple of screws. That seemed simple enough and I undid the screws to take a look inside. I suppose I should have known better because the thing exploded under the tension of the spring loaded contacts and I spent several minutes scouring the bench and floor to make sure I had recovered all the bits.

And there were more bits than I expected. The plug was not simply a terminating device attached to the cable; it also incorporated a 10A cartridge type fuse. More to the point, the whole arrangement was pretty grotty, seemingly having been put together on an "out of sight, out of mind" basis. Nothing, including the fuse in its holder, seemed to fit properly and I spent some time cleaning up the moulding and bending and adjusting the various metal pieces to make everything fit.

"It was the kind of job which needed a trained octopus to hold everything together"

Getting it all back together was no snack either. Due to the spring loaded concept it was the kind of job which needed a trained octopus to hold everything together while replacing the screws. Anyway, I eventually managed it, with only two hands, and breathed a sigh of relief when it worked.

So that was that, and the owner went off happily on one of his caravaning jaunts.

Shrunken picture

I heard no more about the set for several months, and had virtually forgotten about it until the owner rang me and reminded me of the original fault. It transpired that he was still in trouble with 12V operation, the problem now being that the picture was noticably smaller in this mode than in the 240V mode.

He went on to explain that he had operated it directly from the cigarette lighter in the car, which didn't seem to make much difference, and had also tried running the engine which, according to him, did make some difference but didn't cure the problem. As before, he was convinced that it was a voltage drop problem and wanted to know where it was likely to be.

Naturally I wasn't prepared to stick my neck out on that basis. Even if the owner's diagnosis was correct there was no way I could nominate the exact cause over the phone. More to the point, I wasn't completely convinced that the explanation was as simple as that. And it

is all too easy to be sidetracked by an — apparently — obvious diagnosis, when the real fault is something quite different.

Instead I suggested he bring the set into the shop, pointing out that it was still under warranty and would therefore not cost him anything. And so it was that he duly turned up at the shop with the set, both power leads, his conversion cable — and a 12V battery! I thought this last item was taking things a bit far but I didn't say anything.

He set it all up, switched on, and proceeded to demonstrate the fault. (It was almost as if he felt I wouldn't believe him otherwise.) In fact, his description had been perfectly accurate; the picture was in a good 25mm on either side, and only slightly less top and bottom. I made a quick check with the set on 240V and confirmed, as the owner had claimed, that it behaved normally in this mode.

My next move was to replace the battery with my own regulated power supply, delivering 13.8V. If it was a simple voltage drop problem I expected the extra 1.8V to make at least some difference. In fact it made not the slightest difference and my few remaining doubts about this theory seemed to be confirmed.

Unfortunately, the significance of this test was lost on the customer. Worse still, he was one of those types who wanted to look over my shoulder and make various suggestions as to what I should try next. The situation was further aggravated by the fact that he was planning to leave on another trip in a few days and, while I had promised him that I would do all I could to have the set ready, he apparently hoped to speed things up by offering his own theories on the problem.

Situations like this can be quite sticky, if one is to preserve good customer relations. Fortunately, I had a perfect solution in this case; a quite genuine call to a customer's home which I had promised at around this time. "Mr Helpful" was obviously disappointed at the turn of events, but could do little other than accept it with a good grace.

When I returned to the shop I addressed myself to the problem in earnest. Taking the back off the set I sough out Test Point 601, shown on the circuit near the 240V converter. This is the main HT rail and is shown as running at 127V. I checked this with the set running from the mains and it came up spot on.

But it was a different story when I swapped the leads over and ran it from the 13.8V supply. The best it could manage now was about 83V and the wonder was not that the picture had shrunk, but that there was any worthwhile picture there at all.

DC/DC converter

The next step was to get at the DC/DC converter. This isn't particularly difficult. As already mentioned this is a separate unit on the left hand side of the chassis (from the rear) and consists of a board about 10cm square, mounted vertically inside a metal screening cover which, however, is open on the left hand side, giving access to the component side of the board. All I had to do was slip the main chassis back until this assembly cleared the side of the cabinet.

This provided access to the voltage adjustment pot, VR680, and I was anxious to see what effect this would have on the problem. In fact, it had no effect at all; no matter which way I adjusted the pot the rail voltage remained stubbornly at 83V. Quite clearly, there was a fault in the converter.

The next thing was to get at the print side of the board. Again, this is fairly easy. By removing two screws the complete unit can be detached from the chassis, and there is enough lead length to enable it to be moved clear of the chassis and on to the bench. Removing four more screws removed the cover over the print side of the board. (It is a pity more sets are not designed with as much thought for the serviceman.)

This circuit employs six transistors, an SCR, a couple of zener diodes, sundry ordinary diodes, plus an assortment of resistors and capacitors. To be honest, I wasn't quite sure where to start. I had a hunch that it would be one of the transistors, but first made a routine voltage check against the figures given on the circuit.

This wasn't very helpful. To be sure, some voltages were incorrect, but it is difficult to know, in circuits of this kind, whether they are cause or effect. I also made an in-situ check of the various diodes, resistors, etc, without finding anything seriously amiss. All of which seemed to point to a transistor as the culprit.

Of the six transistors only three are actually involved in the conversion process, the other three performing protective functions. While not ruling out these latter as possible culprits, I decided to concentrate on the other three first. These were the output transistor (Q682), the driver transistor (Q680), and the error amplifier (Q681).

Since the system was functioning in a fashion, I tended to put the output transistor at the bottom of the list. The error amplifier seemed the best bet, so I pulled it out and checked it. It checked OK and I put it back on the board. I would have preferred to replace it as a matter of course but I had no direct replacement in stock.

Next I checked the driver transistor (2SC2236Y), and this was a different story. It showed significant leakage between base and collector, a condition which could well account for the behaviour. Unfortunately, replacing it presented a problem. I didn't have a direct replacement and obtaining one might take more time than was available.

Eventually, after consulting appropriate data sheets, etc, I settled for a Mullard BD237. This has more than adequate voltage ratings, a similar value hFE, and slightly better current ratings. It was at least worth a try.

I fitted it into the board, reset the voltage adjustment pot as close to its original position as possible, crossed my fingers, and switched on. It worked like a charm. And, what's more, the voltage came up to within a few volts of the required 127. It needed only a touch of VR680 to make it exact.

I let it run for a while and even contrived to get the input voltage down to about 12V, by using some long leads, just to make sure everything would hold up. It did so, perfectly, and I have no

NICHOLSON ELECTRONICS
ELECTRONIC ENGINEERS

TRADE SERVICES

Philips Tuner ECL2060 Exchange or Repair	$10.00
Other Varicap Tuners (Repair Only)	$14.00
Philips Mini Turret Tuner (Repair Only)	$12.00
I.F. Alignment Service Modules or TV	$16.00

MODULES

Philips U Series (K9/K11) Repaired	$16.00
Philips Power Supplies K9/K11 Repaired	$32.00

AWA THORN

4KA Exchange Modules

Power Scan	$30.00
Small Signal	$30.00
Vertical Module	$20.00
Convergence Yoke	$25.00
Convergence Handset	$25.00

THORN 3504 EXCHANGE MODULES

Power Supply	$30.00
Scan Module	$30.00
I.F.	$20.00
R.G.B.	$20.00
Chroma	$18.00
Vertical Sound	$20.00
Convergence	$20.00

HMV 212 MODULES (Repaired only at present)

S/M Power Supply	$30.00
IF/SND	$26.00
Horizontal Timebase	$30.00
Luminance	$20.00
Chroma	$20.00
Vertical	$20.00
Convergence	$25.00

Custom Designed Test Equipment (1 week delay on all items).

Other modules (repaired only at present) Sharp-Sony (KV1830-KU2000), Kriesler-Pye T29-30 modules. Exchanged $50.00.

Other modules repaired Philips, KT3, K12, KEO 2 Sharp, Sony KV2000

National TC 86A, TC 2000 Nordmende, Blaupunkt and others.

TEST TUNER VHF/UHF—Isolated Output. Eliminates Tuner in any TV Internal Power Supply **$68.00**

PICTURE TUBE TESTER REJUVENATOR. Tests-Emission-Heater Cathode Shorts. Rejuvenate and removes cathode grid shorts. Includes 3 sockets and universal lead allowing almost any tube to be tested **$120.00**

SHORTED TURNS TESTER — Fits in toolcase. Includes 9v battery. Test for shorted turns in yokes L.O.P.Tx and other inductors **$40.00**

ZENER DIODE TESTER — Direct readout of Zener voltages from 2v to 100v in two ranges. Internal power supply **$48.00**

SOLID STATE LEAKAGE TESTER. Measures Leakage to 150 megohms. Ideal for Testing Leakage in Transistor diodes, Triacs, Thyristors, etc. **$48.00**

Line Output Switch Mode Power Supply Tester Analyst. Clips in place of Line Output Transistors or chopper. Reads Drive, BT, Shorts, Pulse, Width, without Destroying expensive Transistors. **$140.00**

High Voltage Regulated Supply. Variable to 120 Volts/1 AMP folds down when overloaded **$140.00**

Other Test Equipment still being developed. Colour Bar Generator — Signal Strength meter-Sweep and marker Generator — Enquiries welcome.

3 MONTHS WARRANTY ON ALL WORK AND TEST EQUIPMENT

Prices do not include Freight Charges.

30 BRANDE STREET, BELMORE, SYDNEY, NSW 2192

(02) 759 8359 ***MAIL ORDERS WELCOME***

The Serviceman

doubt that it will hold up below this figure. On the other hand, if a battery is generating substantially less than 12V the user has more to worry about than the size of his TV picture.

And so the set was duly delivered to the customer in time for his departure, and everyone was happy. He wanted to know what had caused the trouble and I gave him the best explanation that I could in lay terms. I don't know whether he understood much of it but at least I think he realised that his original idea about voltage drop in the leads and connectors wasn't really valid.

Transistor faults

At the beginning of this story I suggested that the type of fault involved seemed to be on the increase. I was referring, of course, to the rather vague faults in transistors which can cause all kinds of weird effects. The old idea that a transistor either worked or it didn't, simply going open circuit or short circuit, while never truly valid, was a very popular one.

But not any more. Regular readers of these notes will recall that I have described several cases where troubles were caused by transistors with no discernible fault; they test OK in the tester, but will not perform in the circuit. The only effective way to test them is by replacement. It wasn't quite that bad in this case, since the fault did show on the tester. But what causes these devices to deteriorate in the field?

Perhaps if the makers knew that they would prevent it happening.

A lethal monitor

To change the subject, here is another story from one of my regular contributors, J.L. of Tasmania. Readers may recall that the last we heard of J.L. he had just escaped the lethal fangs of the Hound of the Baskervilles — or one of its progeny — to the amusement of everyone; except J.L.!

Well, that was good for a laugh but his story this time is no laughing matter; it could be quite the reverse in fact. This is how he tells it.

When faced with an outlay of $500 or more for a colour monitor, most computer owners would jump at the opportunity to get a brand new unit for $350-$400. But watch out! One such unit nearly killed its unsuspecting owner and has ruined a perfectly good computer.

The monitor is a "Yangen" model CM1441. The owner doesn't want to talk about it, on the record, but in conversation with the technician who repaired it, the whole sorry story came out. It seemed that the monitor was made in Taiwan for the US market with its 110V mains. We don't know the original design but the power supply was most likely as shown in Fig. 1.

Someone unknown, but probably the manufacturer, decided to rework the monitor for Australian 240V mains. However, to save the cost of building a 240/110 transformer, they elected to use the existing American transformer in an autotransformer configuration. They connected the two 110V windings in series and used the junction for the 110V supply. When we examined the transformer we found it to have two separate windings, but only three accessible terminals.

Wired in this way the monitor was not isolated from the mains, although the chassis could be held at earth through the neutral lead of the original two-core cable. This applied provided the power plug and socket were correctly wired. When it came to using the Australian three-core cable the problem was, "what to do with the earth wire".

The monitor may have been safe had the designer trusted the Australian MEN (Multiple Earth Neutral) system, but he didn't. He decided that the set would be "safer" if the chassis was at the true earth rather than at neutral. So he arranged the circuit as shown in Fig. 2. (No account seems to have been taken of the fact that our 240VAC mains would apply 120VAC or more to the monitor.)

So what happens if the neutral lead breaks? And what if the earth lead does likewise? In the first case the monitor takes the full 240VAC peak (340V) on its B+ rail and probably blows the fuse. In the second case the whole monitor goes up to 120V, with only the inductance of the upper half of the transformer winding to limit the current through the unfortunate computer — or the equally unfortunate user!

It is fairly obvious that the set was never submitted to any electric supply authority for approval. It wouldn't have got through the door! One wonders whether the Customs Department should take more interest in the electrical safety of items imported into this country. More than usual care seems to be called for in respect to items brought in at prices far below those of comparable products.

Another strange situation was revealed when the monitor broke down and was repaired by a qualified technician. It was then found that the Taiwanese auto transformer was the same physical size as a 240V/110V transformer from an old Australian monochrome TV receiver.

As far as can be determined both transformers are of very similar ratings. Only the mounting was different, and that was easy to correct. It seems hardly credible that the tiny difference in cost could persuade a manufacturer to adopt such a dangerous design.

In all probability the monitor could have been given a fully isolated transformer in the first place, at almost no extra cost.

Well, that's J.L.'s story, and more than a little frightening it is too. Quite apart from this particular item, about which some warning can now be given, one is prompted to ask how many other items have come into this country based on the same or similar dangerous designs.

And what regulations are there to protect the average non-technical purchaser? Are they adequate but not being enforced? Or are they simply not good enough? Either way, it seems that someone in authority needs to be de-dingerised.

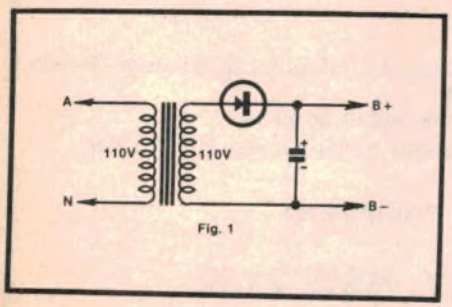


Fig. 1

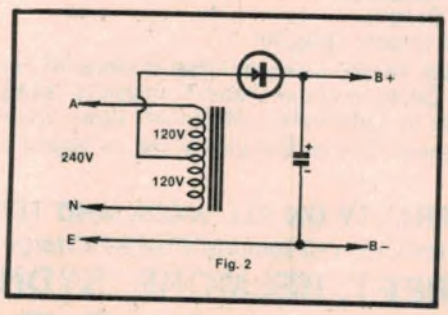


Fig. 2

TETIA Fault of the Month

AWA-Thorn "Q" Chassis
Symptom: Set lost sound briefly on occasions since new. Finally lost sound completely and permanently.
Cure: Clue was zero volts on detector coil pins, instead of 3.6V shown on circuit. Solder dag found on one pin inside coil can was shorting coil to ground.

This information is supplied by courtesy of the Tasmanian branch of The Electronic Technicians' Institute of Australia. Contributions should be sent to J. Lawler, 16 Adina St, Geilston Bay, 7015.

Radio Despatch Service

ESTABLISHED 1934

CLOSING DOWN SALE

YES AFTER 51 YEARS
WE ARE CLOSING
AND MUST SELL
ALL OUR STOCK

PRICES ARE SLASHED!
SO BE EARLY,
EVERYTHING MUST GO
BEFORE DECEMBER 24TH

ALL STOCK REDUCED TO CLEAR

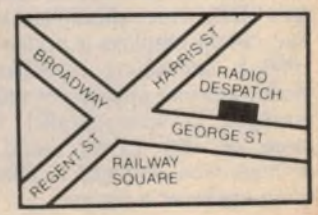
* SEMICONDUCTORS
* RESISTORS
* CAPACITORS
* SWITCHES
* EA & ETI PC BOARDS
* TI SOFTWARE
* BOXES
* SOLDERING IRONS
* COMPUTER CONNECTORS
* TRANSFORMERS
* PLUGS & SOCKETS
* PATCH CORDS
* POTENTIOMETERS
* LIGHT EMITTING DIODES
* 7 SEGMENT DISPLAYS
* DATA BOOKS
* WIRE — COMPUTER / GENERAL PURPOSE
* CALCULATORS
* GOODWILL POWER SUPPLIES
* CK TOOLS
* RELAYS
* IC SOCKETS
* BATTERIES
* MULTIMETERS
* GRAB BAGS

AND MUCH MORE!!

WE WOULD LIKE TO THANK
ALL OF OUR CUSTOMERS
OVER THE PAST 51 YEARS
AND WE WISH YOU ALL
A MERRY CHRISTMAS
AND HAPPY NEW YEAR

Radio Despatch Service

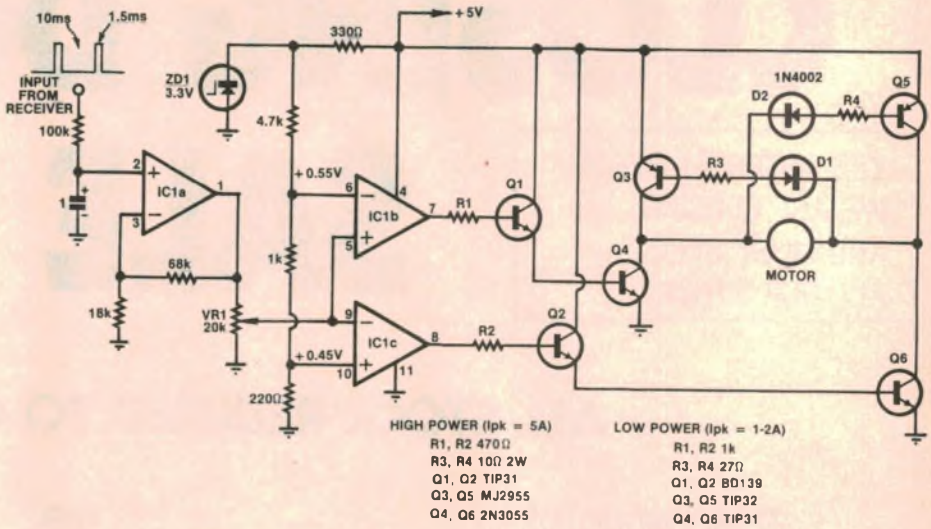
869 GEORGE STREET SYDNEY 2000
TELEPHONES 211 0744 • 211 0816



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.

Speed control for motors



This circuit was designed for use in a radio-controlled car to provide speed and direction (forward/reverse) functions. It uses pulse width modulation for high-torque, low-speed running and efficient use of the limited battery capacity available in model cars.

With the joystick in "neutral", the incoming pulses from the receiver are generally about 1ms long, recurring every 10ms. This signal is integrated and amplified by IC1a to give a triangular waveform with a mean DC level of about 0.5V on pin 1. From there, the signal is fed via VR1 to comparators IC1b and IC1c which have their other inputs held at 0.55V and 0.45V respectively.

Under these conditions, the output of each comparator is low and no power is applied to the motor.

If the joystick is moved in one direction, the sawtooth waveform mean level will rise or fall (depending on the direction) and one comparator will begin producing pulses at its output. The mark-space ratio of the pulses will depend on the degree of movement of the joystick.

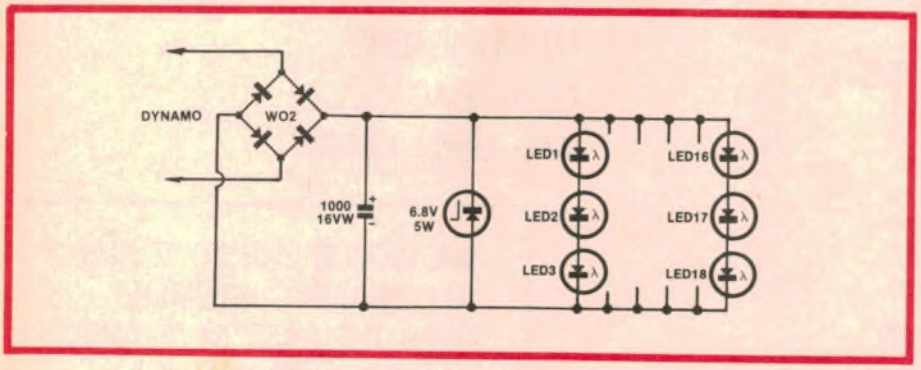
Assuming IC1b is active, the output pulses drive transistors Q1 and Q4. Q4, in turn, drives Q5 via D2 and R4 and the motor now rotates in a given direction, its speed dependent on the mark-space ratio.

Similarly, if IC1c is active, Q2, Q6 and Q3 conduct and the motor rotates in the opposite direction. D1 and D2 are necessary to prevent Q3 and Q5 from conducting simultaneously.

VR1 is adjusted for nil output when the joystick is centred. It works over a wide range so that the unit is compatible with other types of transmitter encoding.

R. Richardson,
RNZAF Base Wigram,
Christchurch, NZ.

$25



Solid state bicycle tail light

The advantage of this design over a conventional incandescent lamp is that it uses LEDs which should last indefinitely. The circuit employs a bridge rectifier, a 1000μF smoothing capacitor, a zener diode transient suppressor and 18 LEDs arranged in series/parallel. Of course, more or less LEDs could be used, perhaps even arranged to take the shape of an arrow or a circle.

All parts can be mounted on tagboards within the light housing itself. It was found that, with 18 LEDs, the intensity easily surpassed that of the incandescent globe they replaced.

The dynamo used was a typical 6V bicycle dynamo. For dedicated cyclists, a variation would be to build two LED assemblies, mount one on each side at the rear of the bicycle, and alternately drive them with a bistable oscillator.

G. Schmuckley,
Richmond, Vic.

$20

Knight Rider scanner light

Here's a circuit that simulates the scanning lights on the car Kitt in the Knight Rider TV show.

IC1a is a D-type flipflop connected as an oscillator with frequency dependent on the setting of VR1. This drives the clock input of IC2, a 4516 binary up/down counter. The 100k resistor and 0.1μF capacitor on pin 2 of IC1a set the mark-space ratio.

The other half of the D-type flipflop, IC1b, drives the up/down input (pin 10). This ensures that the 10 lamps light with a back and forth scanning effect. The 22μF capacitor and 10kΩ resistor on pin 9 of IC2 provide power on reset.

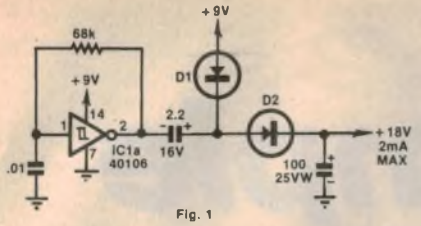


Fig. 1

A clutch of charge pumps

In CDI for August 1985, C. C. Wright of New Zealand devised a small charge pump to drive a 12V relay from a 10V line. These circuits follow on from his idea.

All four circuits should be capable of delivering up to 18V from a 9V supply, provided the intended load is not too ambitious.

Fig. 1 uses a 40106 Schmitt trigger oscillator which drives the pump. When IC1a's output is low, the 2.2μF capacitor is charged via D1 to +9V. When IC1a's output subsequently switches high, the positive side of the capacitor goes to +18V and this charges the 100μF capacitor via D2.

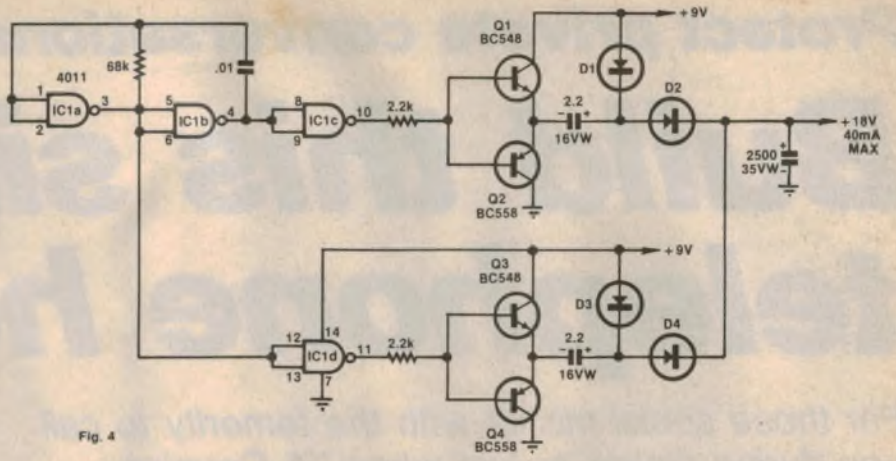


Fig. 4

As can be imagined, this circuit is incapable of delivering anything like 18V to all but the smallest loads — and then with a hefty ripple.

Fig. 2 improves this situation by virtue of its two-phase action. While one 2.2μF capacitor is being charged, the other is supplying the load. Note that IC1b is slaved off IC1a so that the two Schmitt outputs operate in anti-phase.

Fig. 3 is yet another improvement. In this case, a two-gate oscillator formed by IC1a and IC1b drives the system, while IC1c and IC1d act as buffers.

The final version, Fig. 4, interposes a pair of complementary bipolar transistors (Q1-Q4) between the buffers and the 22μF charge pump capacitors. These greatly increase the drive capability to around 40mA (up from about 6mA in the case of Fig. 3).

R. Mellor,
Peakhurst, NSW. **$40**

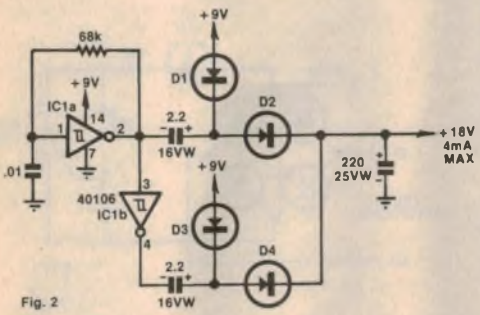


Fig. 2

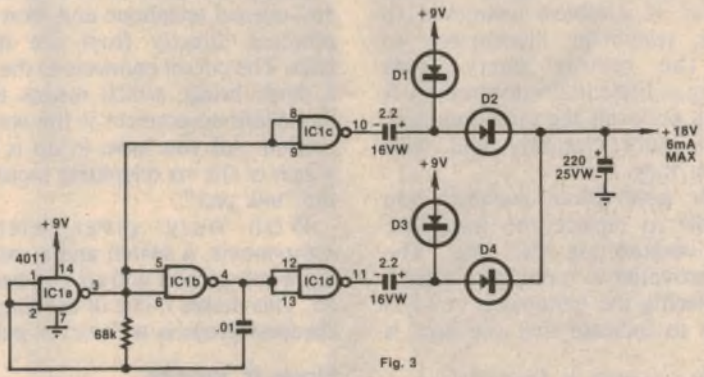
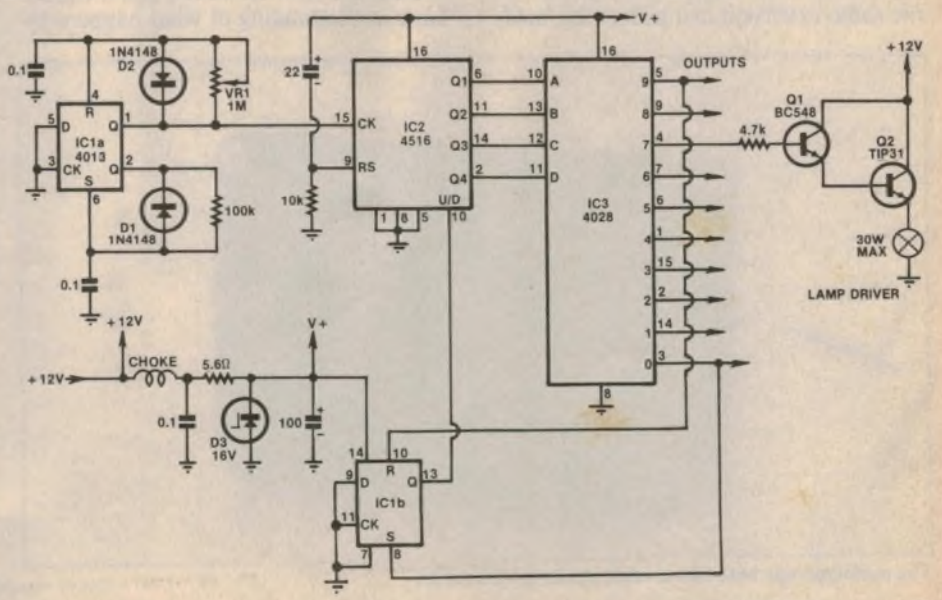


Fig. 3

The Q1-Q4 outputs of IC2 drive IC3, a 4028 BCD-to-decimal decoder. When the "0" output (pin 3) of IC3 is high, the Q output of IC1b is also high and this causes the counter to count up to 10 (ie, to output "9"). When output "9" switches high, the Q output of IC1b is set low and the counter counts down to zero. The Q output of IC1b now switches high again and thus the cycle is repeated for as long as power is applied.

The outputs of IC3 are used to drive the lamp drivers (10 in all). These consist of NPN Darlington transistor pairs capable of driving 12V 30W lamps. Note that the TIP31 transistors will require heatsinking.

P. Howarth,
Gunnedah, NSW. **$20**



Protect private conversations

Build this simple telephone hold

For those social misfits with the temerity to call you during dinner or just when "A Country Practice" is coming on, this Telephone Hold project is the perfect solution. By pressing a button, you can zap the offender into limbo with all the professionalism of a government department.

by COLIN DAWSON

In addition to disciplining unwanted callers, a telephone hold can actually be quite useful. It is almost instinctive to cover the telephone mouthpiece to prevent the remote party from overhearing confidential information. A hold switch performs the same function, but much more elegantly and with complete privacy.

With the hold circuit installed, you will be able to replace the handpiece without disconnecting the line. The device is activated by pressing a switch before replacing the handpiece. A LED illuminates to indicate that the hold is operating.

The hold function is discontinued as soon as the handpiece is lifted "off the hook" again. In fact, any telephone on the same extension can cancel the hold.

The hold circuit is both simple and virtually universal. It can be used with any normal telephone and, best of all, is powered directly from the telephone lines. The circuit connects to the lines via a diode bridge which means that it is impossible to connect it the wrong way around. All you have to do is find out which of the six telephone input wires is the "talk pair".

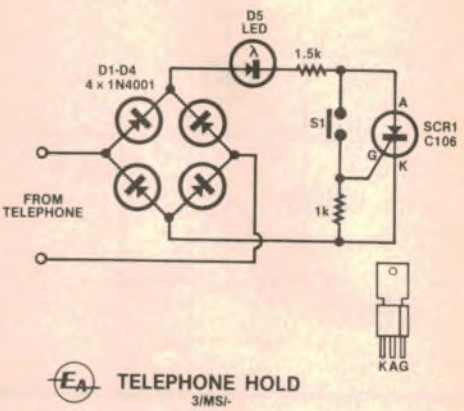
With only seven electronic components, a switch and a small PCB, the whole project will set you back about $5. This makes it one of the simplest and cheapest projects we've ever published.

How it works

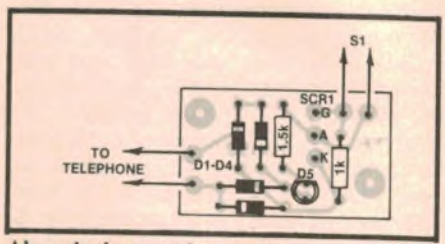
The circuit is simple indeed, but to understand how it works, you'll need a basic understanding of what happens inside the telephone.

The exchange supplies power to your telephone at 48V DC. This voltage (or very close to it) can be measured across the talk pair of wires when the handpiece is in the cradle. Any voltage substantially below this figure is seen as an "off hook" situation and prevents the line from being disconnected.

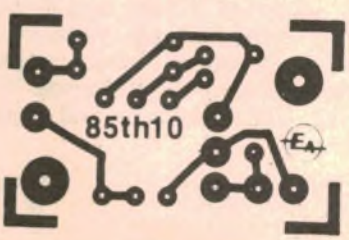
The hold circuit simulates the low impedance load of the telephone. By imposing this load across the line when the handpiece is actually on the hook, the voltage across the talk pair is made to look like an off-hook voltage. This prevents the line from being disconnected. Since the handpiece is in the



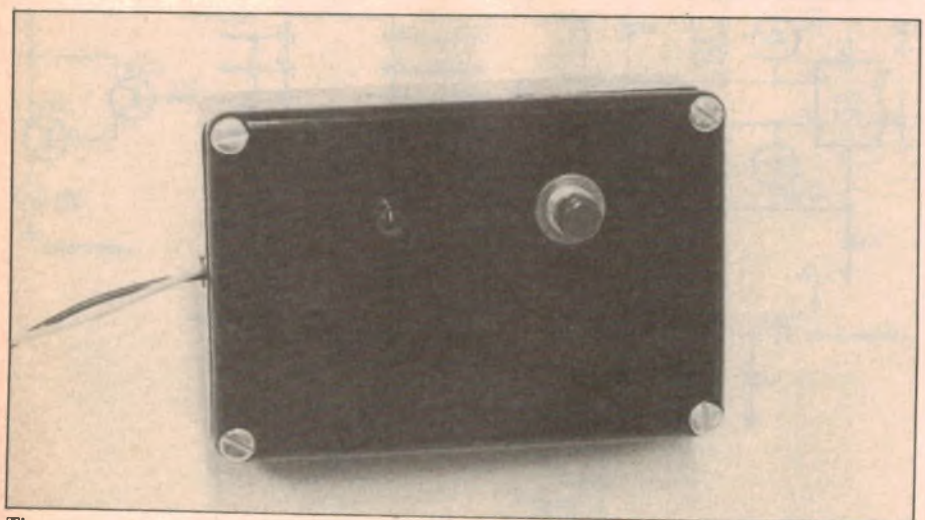
The circuit uses an SCR to simulate the telephone off-hook impedance.



Above is the parts layout diagram.



Here is the actual-size PC artwork.



The prototype was built into a small plastic project box.

cradle, the internal microswitch will disconnect the mouthpiece and thus effectively mute the circuit.

Now that we know what the hold circuit does, let's take a look at how it's done.

At the heart of the circuit is an SCR (silicon controlled rectifier). These devices, also known as thyristors, normally have a very high resistance between their anode and cathode terminals. When the gate terminal is taken a few volts higher than the cathode, the SCR is triggered. The resistance between anode and cathode then becomes very low, and stays low even if the gate voltage is removed.

Once triggered, the only way the SCR can be turned off is by reducing the anode to cathode current to zero. It then reverts to the high resistance state, awaiting another trigger signal.

In this circuit, the SCR is used to simulate the telephone off-hook impedance. Note that because the triggered resistance of the SCR is very much lower than the telephone off-hook impedance, it is necessary to use a 1.5kΩ series resistor in the anode circuit. This limits the voltage drop to about 25V which is sufficient to simulate an off-hook condition.

The 1.5kΩ resistor also limits the current through LED D5 to a safe value.

Normally, the gate is kept at ground potential by the 1kΩ pull down resistor. As soon as the hold switch is operated, the gate is taken to the anode potential. If the telephone is off-hook, the voltage reaching the SCR is only about 1.6V (5V minus the forward voltage of two diodes in the bridge at 0.7V each, minus the LED voltage of 2V). This voltage will not be sufficient to trigger the SCR.

If, however, S1 is held down while the handpiece is replaced, the input voltage will jump to the full 48V. This is more than enough to trigger the SCR which responds almost instantly. Because the delay between the input voltage increasing and the SCR turning on is so short (typically 1μs), the telephone does not have time to respond to the on-hook condition. Instead, the voltage falls to the 25V level and the telephone continues to operate in the off-hook mode.

The only way for the SCR to be turned off is for the input voltage to be brought down to the 5V level again. This will happen if the handpiece is removed from the cradle, thereby cancelling the hold. The telephone can be used for normal conversation when the hold is cancelled.

The LED will be illuminated while the hold mode is engaged. It extinguishes when the handpiece is lifted.

Construction

The circuit is built on a PCB coded 85th10 and measuring 28mm x 44mm. It is small enough to fit inside a standard telephone case but this is illegal unless you actually own the telephone. If the telephone is rented, as in the majority of cases, the project will have to be housed in a separate box.

Begin construction by soldering the parts to the board. Be sure to install the components exactly as shown on the overlay diagram. The only components which are not polarised are the two resistors and S1. All the others must be installed the right way around.

The SCR, a C106, will probably come in a package with a large heatsink tag. This can be trimmed off, allowing the SCR to fit into a smaller space.

Irrespective of whether the project is mounted inside the telephone case or not, the telephone will have to be opened to gain access to its terminals. There will be a circuit diagram inside the case, indicating which terminals are used for the talking pair. Once this is known, it is a simple matter to make the necessary connections.

A multimeter is a virtual necessity at this stage — it will allow you to verify that you have chosen the correct terminals. Make sure that the voltage swings between the 48V and 5V when the cradle mechanism is operated.

On the telephone we used to test the project, the appropriate terminals were labelled "B" and "P1" and the leads were blue and red. It will be obvious from the circuit diagram which terminal is the ground, but the positive terminal may not be so obvious. Don't confuse it with the earpiece line which is shown connecting to an inductor.

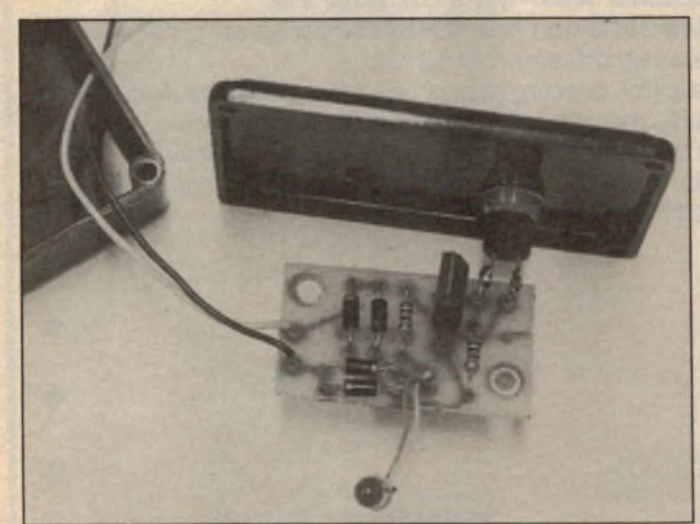
Having made the appropriate connections, the project is ready for testing. Make a call in the normal manner, press and hold the switch and replace the handpiece. Now release the switch and check that the hold is activated (the LED should be on). Finally, lift the handpiece and check that the conversation can be continued (the LED should extinguish).

So that's the telephone hold project. Now for the next idea: how about something that prevents other people from putting you on hold?

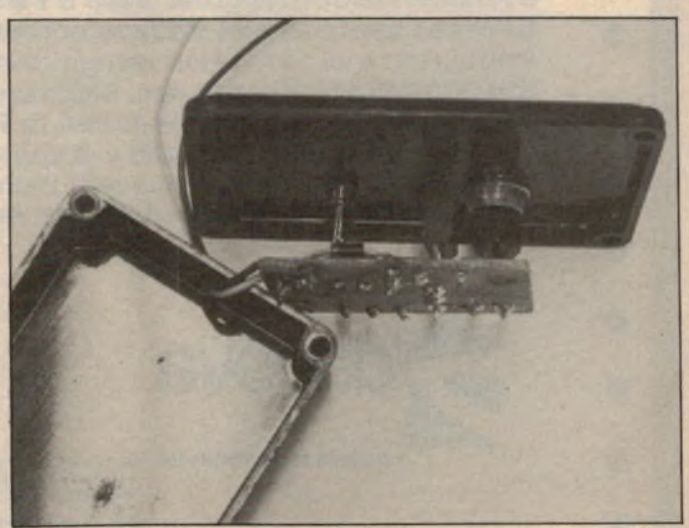
Note: This project was adapted from a similar circuit published in the Summer 1985 issue of *Hands on Electronics*, New York, USA.

PARTS LIST

1 PCB, code 85th10, 28 x 44mm
1 SCR, C106 or equivalent
1 red LED
4 1N4001 diodes
1 1kΩ resistor, 5%, ¼W
1 1.5kΩ resistor, 5%, ¼W
1 SPST momentary contact pushbutton switch
1 plastic project box, 83 x 54 x 24mm
2 metres insulated hook up wire



View showing the assembled PC board.



The PC board is soldered to the back of the switch terminals.

at the leading edge

NEW "SHORT SLOT" HARD DISK CONTROLLER.
Western Digital's **WD1002S-WX2** supports ST506/412 interface drives of any configuration up to **1,024 cylinders** and **16 read/write heads.** This **8" x 3.85"** form factor board is **IBM PC®, XT® plug compatible** and can control up to two drives which need not be of the same capacity or configuration. **70 and 85 MByte** high performance drives from **Vertex** can now be easily accommodated to boost overall system performance. Data transfer can be either **programmed I/O or DMA.**

INTERDYNE'S 20 MBYTE TAPE BACKUP LINKS TO FLOPPY PORT.
Designed to provide cost effective and rapid archiving for **IBM's AT** range of PCs, **Interdyne's ID1020** joins their popular **ID1010**, which is becoming the de facto standard in 10 MByte streamers. storage for both drives may be either **mirror** or on a **file by file** basis. In the case of a total hard disk failure both the ID1020 and the ID1010 can be used in a **random access read/write mode** just like a **super capacity floppy drive.**

NEW SOFTWARE ALLOWS PCs TO ACCESS X.25 NETWORKS.
Western Digital and **TITN, Inc.** have developed, **FLEX.25**, a software package to link IBM PCs and compatibles using the X.25 network protocol. FLEX.25, together with the **WD4025** controller board, manages the complete communication functions of a packet data network at the PC level. The network software has already been certified for direct connection to major U.S. and European networks.

SPEECH RECOGNITION AND SYNTHESIS ADD-ON FOR IBM PC.
General Instrument Microelectronics designed the **VRSM1000** as an evaluation tool for speech recognition and synthesis using the **SP1000/VRS1000 chip set.** Software which accompanies the board allows for synthesis of several words stored in RAM, recognition of digits and phrases with voice confirmation and a graphics demonstration of the uses and parts of the VRSM1000. Applications will include voice dialling of telephones, robotics, assistance for the handicapped and security control.

daneva

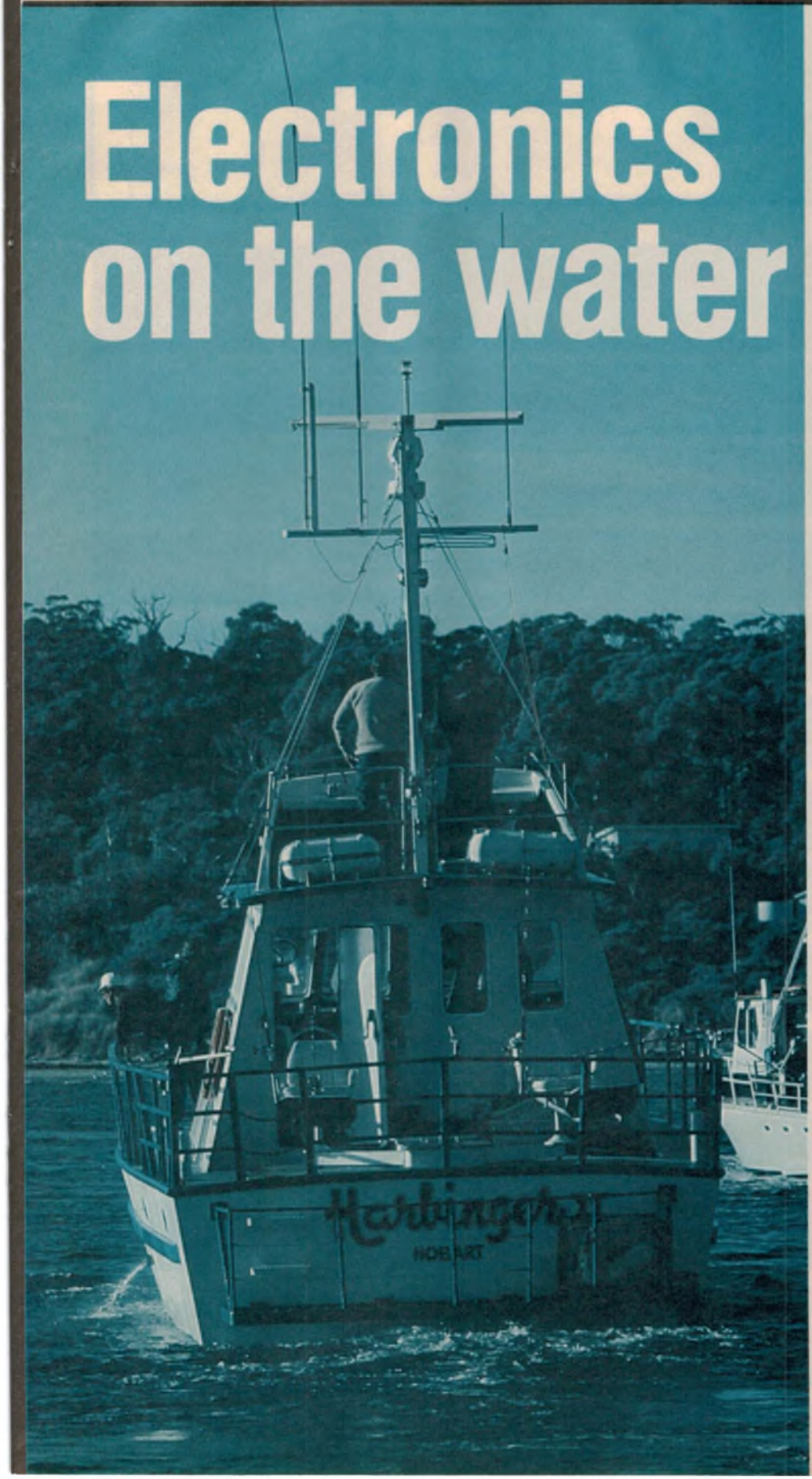
daneva australia pty ltd
66 Bay Rd. Sandringham Vic. 3191
P.O. Box 114 Sandringham Vic. 3191
Telephone 598-5622 Telex AA34439
Suite 28 47 Falcon Street
Crows Nest NSW 2065
Telephone 957-2464 Telex AA20801

Distributors
Adelaide: DC Electronics (08) 223-6946
Brisbane: Baltec (07) 369-5900

DAN003

SPECIAL SUMMER FEATURE

Electronics on the water



*by Terry Ayscough **

Maritime activities sometimes have an image of tradition and conservatism but, for many periods during their long history, ships and sailors have been at the forefront of technological innovation.

When Captain Cook discovered our shores, he was using experimental navigation methods which were the culmination of huge advances in astronomy, mathematics and precision engineering. The little ship *Endeavour*, filled with scientists and their equipment and sent out to explore an unknown ocean, was the space shuttle of its day.

Last century, the great clipper ships were the jumbo jets of their age, offering unrivalled speed and capacity for inter continental trade.

Even today, the prestige of American technology is on the line, as leading aerospace companies help to research and design a yacht, in an effort to win back the America's Cup.

Leisure boating is one of Australia's fastest growing activities and a sizeable industry is developing to cater for its needs. We hope this supplement will show how modern electronic technology is helping to make boating safer and more pleasurable than ever before.

**Gemini Electronic Services,*
11 Kokoda Crescent,
Beacon Hill, NSW 2100.

Contents

Marine transceivers for power boats and yachts

Three basic types of Marine transceivers are available for use in power boats and yachts. These commonly go under the names 27MHz, VHF and HF/SSB.

The cheapest and most popular units operate on 10 channels in the 27.68 to 27.98MHz range. Old fashioned AM double sideband modulation is normally used, although single sideband (SSB) sets are available. Maximum transmitter output power is limited to 4 watts and with a correctly tuned whip anntenna, this gives a usable range of 10 to 20 nautical miles (20 to 40 kilometres).

All shipboard transmitter installations must be licensed. For 27MHz equipment, this is done by joining an organisation which operates a base station, such as a yacht or fishing club or the coastguard. The boat equipment is then granted a licence as part of that organisation's communications network. No operator's licence is required for 27 MHz channels.

Because 27MHz marine transceivers are based on CB equipment produced in large quantities overseas, they provide a very economical form of marine communication. AM sets designed for 12 volt operation normally retail in the range $140 to $180 with SSB models costing up to $300. Battery powered hand-held sets, ideal for smaller craft such as runabouts and sailing dinghies, sell for between $70 to $150, depending on the number of channels and power output provided.

One of the most popular 27MHz sets currently available is the GME GX281, which normally retails for around $150. Although originally based on a CB design, the 281 has been specially adapted for marine use. The front panel layout was made as simple as possible, the receiver local oscillator circuit redesigned to avoid "image" interference problems and the chassis and case are given extra treatment during manufacture to minimise corrosion in damp salty air.

On 27MHz it is usual practice to identify a channel by the last two digits of its frequency. The emergency channel of 27.88MHz thus becomes channel 88. Most modern sets, including the GX281, indicate the two digit channel number on a bright LED or fluorescent display, which makes operation simple for non technical users. Power consumption is 1.2 amps receive and 1.7 amps transmit.

For an all-up cost of $250 to $300, 27MHz equipment can provide adequate communications for vessels operating inshore during daylight hours. There are currently about eight well known brands of 27MHz marine radio available and any one of these will give good results when properly installed.

VHF transceivers

The next level of marine communications is provided by the VHF service operating in the 156-162MHz range. A maximum transmitter power of 25 watts is used and with a short but efficient ground plane antenna, mounted as high as possible, this will give reliable ranges of 25 to 50 nautical miles (50-100 kilometres). The use of FM (frequency modulation) ensures almost noise free reception and good speech quality.

The Overseas Telecommunications Commission (OTC) operates eight major marine radio stations around the Australian coastline. These provide regular weather reports and other information on VHF plus 24 hour a day monitoring of emergency channels. In addition, the OTC Seaphone service enables calls from ships to be linked in to the national telephone network, giving access to anywhere in Australia or overseas. Repeater stations are being installed to extend the effective range of VHF and it is planned to eventually cover the entire eastern and southern Australian coastline from Cairns to Adelaide.

VHF marine radio is used world wide and although our own Department of Communication specifications are fairly tough, a wide selection of imported units, suitable for small boats is available. Retail prices start at about $390 for a 55-channel unit.

A good example of current technology in this area is provided by the Uniden range of VHF sets, imported by Santronic Agencies. The various models offer 60 to 90 frequency synthesised channels.

Top-of-the-range sets have two illuminated key pads, one to call up the function required and one for numerical

The GME GX281 is a popular 27MHz marine transceiver. It sells for about $150.

Transceivers

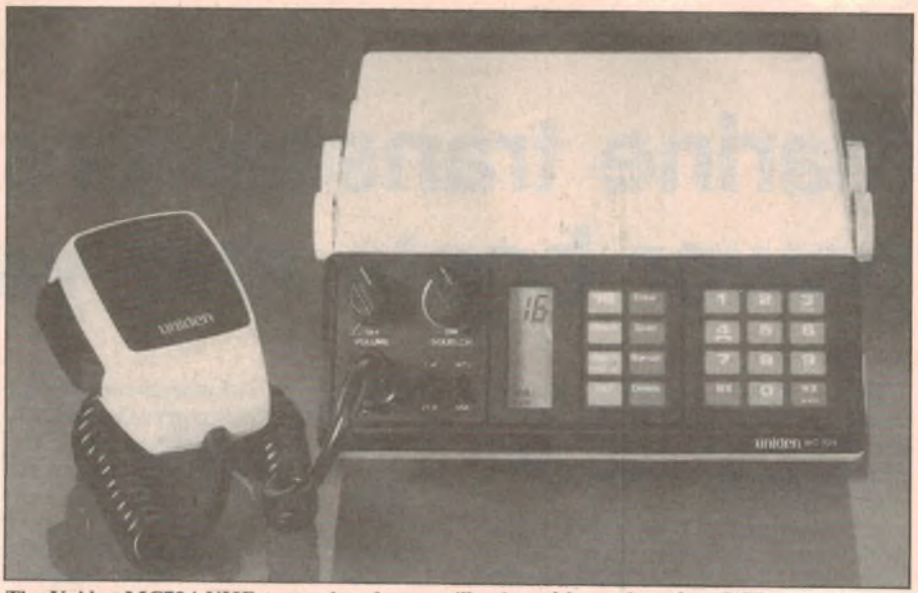
channel selection. A back-lit liquid crystal display shows the channel, functions and power level selected, plus transmit and receive signal indicators. There is also a bright/dim illumination adjustment for night time use.

Emergency monitoring

Many VHF sets have a built-in dual "watch" facility. When selected, this automatically cycles the set from whichever channel it is on back to emergency channel 16 every few seconds. If a signal is detected, channel 16 will be held, so the message can be heard. Some Uniden models can be programmed for the dual watch facility to operate on any channel selected by the user. Power consumption with a 12V supply is 0.6A on receive and 4.5A on full power transmit.

At the moment there are over a dozen different brands of VHF sets with Department of Communications (DOC) approval available in Australia. An annual station licence fee is payable and operators must have a Certificate of Proficiency obtainable by passing a simple DOC examination.

A complete VHF installation will cost the boat owner about twice as much as a similar 27MHz installation. It will however give better range, freedom from interference, full 24-hour emergency coverage and easy access to the telephone system. Because of these factors, VHF is set to become the principle small boat communications system for Australian coastal waters.



The Uniden MC724 VHF transceiver features illuminated keypads and an LCD.

For those intrepid sailors who venture across the oceans or explore remote coastlines beyond VHF coverage, there is still a need for HF radio with all its variability. The change over from double side band AM to single side band (SSB) modulation a few years back gave a greatly improved service with better ranges and reduced interference.

Unfortunately however, it also increased the price of equipment and a small boat owner would now expect to pay between $2500 and $5000 for a full HF installation.

Antenna tuning

It is seldom possible to erect an antenna which is a quarter wave long on the lowest HF frequencies, and most transceivers need to use a separate antenna tuning unit (ATU) to compensate for this.

The ATU provides inductive loading for the antenna on low frequencies and capacitive loading on high frequencies as required. The ATU may be manually readjusted each time the frequency is changed or may be preset for each channel at the time of installation. On power boats a long helically wound fibre glass whip antenna is normally used for HF but on many sailing boats it is possible to insulate and tune part of the wire rigging which supports the mast.

This HF SSB transceiver is manufactured locally by Wagner Industries.

HF transceivers

Most marine HF transceivers cover the 2, 4 and 6MHz bands and frequencies are selected according to the distance to be covered, whether it is day or night and the level of static being experienced. Typically, 2MHz channels give 100 nautical mile range during daylight extending to over 500 miles at night and 4MHz channels give 300 miles by day, extending to over 1000 miles at night. All current equipment uses solid-state power amplifiers, giving outputs from about 90 watts peak for the smallest sets up to 400 watts peak for the biggest.

Because Australian HF transceiver requirements have been rather specialised, there has not been much importing of equipment and local manufacturers have supplied most of the market's needs. Marine HF equipment is basically similar to that used for inland fixed and mobile applications such as the Flying Doctor service and this has helped spread costs over a large number of users.

Wagner Industries of Sydney started operations in 1951 and currently manufacture two different 12V HF transceivers. Model 829MR has capacity for 10 crystal controlled channels in the range 1.7 to 7MHz and provides 90W peak output. Model 1829MR can be fitted with up to 24 channels and gives a power output of 160 watts. Both sets come complete with a separate manual ATU. Typical retail prices would be $1700 for the 829MR and $2400 for the 1829MR. Wagner also have a third model giving 280W output on a 24V supply.

Codan are another well known Australian manufacturer located in Adelaide. They recently announced their HF 4000 model which departs from the traditional deep box approach by splitting the control circuits and power amplifier into two separate units. The control unit would normally be mounted on the vessel's bridge or navigation area convenient for use, whilst the power amplifier could be placed close to the ships batteries for maximum efficiency. Two alternative ATU's, one manual and one automatic, are available and these would normally be mounted close to the antenna lead in point.

The HF4000 uses a frequency synthesiser controlled by a plug-in ROM to generate 256 channels in the range 2-23MHz. Power output is 150 watts peak on a 12V supply or up to 400 watts on a 24V supply. Most functions are selected by push buttons and there is a six-digit fluorescent display to indicate frequency or channel number, as appropriate. Typical retail price for a 12V HF4000 with manual ATU would be just under $4000.

In addition to the equipment described, there are also transceivers from other local manufacturers and a small range of imported units. HF transceivers are likely to need service or modification at some time during their useful life and it is important to find out about spare parts and service back up before making a substantial investment.

For HF/SSB, as with VHF, a station licence and operator's certificate is required.

Emergency radio beacons

One of the lowest cost items of marine electronic equipment, but potentially the most valuable, is the "emergency position-indicating radio beacon" or EPIRB. There is a lot in common between a sailor buying an EPIRB, a pilot ordering a parachute or a racing driver taking out life insurance. They all hope deep down that their investment will never have to be used.

EPIRBs are small battery powered transmitters with very distinctive swept-tone modulation. They put out signals on the civil aircraft emergency frequency of 121.5MHz and the military frequency of 243MHz. These channels are continuously monitored by planes on trans-oceanic flights and at normal cruising altitudes an EPIRB can be heard from over 200 kilometres away.

An EPIRB should only be activated when urgent assistance or rescue is needed and normal radio communication is not possible. Examples might be when a vessel is disabled with no power supply or if the crew has abandoned ship and taken to a life raft.

The Department of Communications (DOC) lays down strict guidelines covering the construction and performance of EPIRBs and also tests units to ensure compliance. Only a few units are currently approved, so care is necessary when making a purchase and any older, non approved models should be regarded with the greatest suspicion.

Most EPIRB's have tough moulded plastic cases with a lanyard for securing to a life raft. The antenna is usually about 500mm long and of the pull out telescopic or self erecting spring type. The cases must be completely watertight and float with the antenna upright and clear of the water.

Two of the most popular units with DOC approval differ quite markedly in their design. They are the AWA B990 and the GME MT248.

The AWA B990 is imported from New Zealand and can be bought for around $160 including tax. It has a box shaped case 170mm x 185mm, which makes it convenient to stow in a ship's locker. Withdrawing a pin on top releases the spring-loaded unbreakable antenna and enables a toggle switch to be flipped, activating the transmitter.

A sealed alkaline battery pack forms the lower part of the unit and provides 200 milliwatts output on both of the emergency frequencies, for up to five days. The pack is easily detachable and replacements could be carried to prolong the operating period, if desired. Because of their limited shelf life, battery packs need to be replaced every two years.

Greenwich Marine Electronics (GME) manufacture their MT248 EPIRB at Gladesville in Sydney. The case is cylindrical, with a height of 260mm and a maximum diameter of 80mm. It comes complete with a mounting bracket and sells for around $170, including tax.

The on-off switch also incorporates a test position. This activates the transmitter, causing a LED to flash but, at the same time, disconnects the antenna, so no signal is radiated.

Perhaps the most interesting innovation with the MT248B is the use of polycarbon monofluoride lithium batteries. These are claimed to retain 90% of their capacity after 10 years shelf life. In use, they provide 200 milliwatts transmitter output on both emergency frequencies, for a minimum of five days.

To help recover their hefty investment in development and tooling costs, GME are planning to export EPIRBs, incorporating their new lithium battery technology, to Western Pacific countries and the USA. With this in mind, American FCC approval for a special export model has already been obtained.

Quality control is a prime concern at GME and every EPIRB has its electrical performance tested in a screened room and its case pressure tested for leaks under water, before being released for sale.

Emergency radio beacons save lives. GME's MT248 sells for around $170 and comes with lithium batteries.

The AWA B990 emergency radio beacon is imported from New Zealand.

Depth sounders & fish finders

A glance through most marine equipment catalogs will reveal an array of depth sounders with a bewildering variety of shapes, sizes, specifications and price tags. This is because sounders may be designed for slightly different purposes and because there are a number of ways of displaying the information they provide.

Generally speaking, the small boat skipper may want to use a depth sounder in up to four different ways.

The most obvious use for a sounder is to avoid running into underwater objects such as rocks, reefs, sandbars and mud banks. At best this could mean an embarrassing wait for the next high tide and at worst, could result in severe damage to the vessel.

Marine charts give accurate information on water depths and sounder readings can be compared with chart figures to confirm a vessel's position. This technique is especially useful in coastal navigation, where depths generally increase more or less in proportion to the distance offshore.

It is sometimes difficult to get an anchor to dig into the bottom properly, and a change of wind or tide may cause the boat to start drifting. If the crew are unaware that this is happening, a dangerous situation can easily develop. When a boat is drifting, the depth of water under it will probably change and many sounders are designed to detect this and trigger an audible alarm.

The more sophisticated types of sounder provide a graphical display of conditions underneath the boat and enable shoals of small fish, or individual large fish, to be located. Sounders specifically designed for this purpose are usually called fish finders and are widely used by both sporting and commercial fishermen.

Depth sounders all work on the same principle. A burst of high frequency signal, somewhere between 25kHz and 200kHz, is fed to a transducer under the boat. This produces a pulse of ultrasonic energy which travels downwards through the water until it encounters an object of different density, such as a fish or a muddy, sandy or rocky bottom. Some of the ultrasonic energy is reflected and travels back to the transducer, which feeds it back into the receiver section. By measuring the time which elapses between the pulse being transmitted and the echo being received the depth is calculated and displayed.

Ideal for use in small boats, the Seafarer 700 is imported from the UK by AWA Marine.

The choice of ultrasonic frequency depends on the application. Lower frequencies of 25 to 50kHz suffer less attenuation as they travel through water and are used in sounders required to measure ocean depths in excess of 1000 metres. Higher frequencies of 150 to 200kHz produce a narrower beam of energy for a given size of transducer and are used when the best resolution of depth changes, or reflections, is required.

Transducers are generally of the ceramic type and the peak transmitter power varies from about 20 to several hundred watts. For best results, the transducer face should be in direct contact with the water. This is done by mounting it through a hole in the hull, or on a bracket over the stern.

For obvious reasons many boat owners are reluctant to have holes drilled through the bottoms of their boats and in this case, the transducer can be mounted internally. When this is done, the transmitted pulse and return echo both have to pass through the hull material and attenuation occurs, appreciably reducing the sounder's operating range.

Four types of display are commonly used for depth sounders.

One of the oldest, but still very popular methods, uses a neon lamp or LED mounted on a rapidly rotating arm. The transmitter pulse occurs as the arm is passing through the 12 o'clock position and lights the neon. When an echo is received, the neon again lights and the distance travelled by the arm gives a measure of water depth, which is read off an adjoining circular scale. With practice, it is possible to judge whether the bottom is hard or muddy and to spot certain fish with this type of display.

Digital displays, usually of the liquid crystal type, are also very popular, particularly where the sounder's main use is for avoiding shallow areas, such as mud banks or sand bars.

For serious fish finding, a chart recording or television screen display will normally be used. Chart recorders use a moving paper roll to give a permanent graphical record of the ocean floor, plus any large fish or shoals passed over, as the vessel moves along.

The most visually interesting displays are provided by colour picture tubes. Television-type scanning is used to represent the section of water just passed over by the boat, from surface to bottom. Strong echoes show up as reddish colours, with weaker signals producing yellows and greens against a pale blue background. New information is added at the right hand edge as the boat moves along and the displayed image moves slowly across the screen, from right to left.

Depth sounders

Many units in the upper price bracket incorporate microprocessors. These enable simple touch-pad operation to be provided, by automatically setting the various parameters to give optimum results.

A quick look at two very different units will illustrate the present state of small craft depth sounder technology.

Seafarer 700

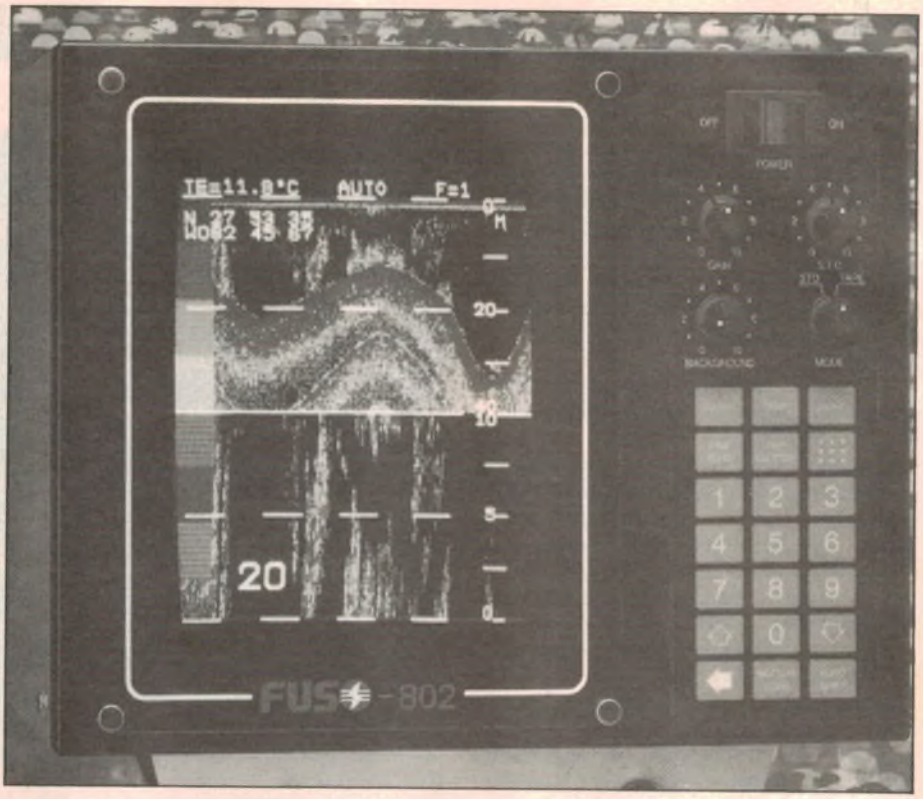
The Seafarer 700 sounder is imported from the UK by AWA Marine and has most of the features necessary for pleasure boat use, excluding fish finding. It retails for about $240 including sales tax.

The main display uses a rotating yellow LED and ranges reading 0-20, 0-60 and 0-200 metres can be selected. In addition, there is also a liquid crystal digital readout in metres, giving the user the best of both worlds.

Separate audible shallow and deep water alarms are provided. The shallow alarm is normally used whilst underway, to warn the helmsman that a critical depth has been reached. Both alarms can be used together, as an anchor watch system, to alert the crew if the vessel drifts into either shallow or deeper water.

The Seafarer 700 can be operated from an internal 9V battery or a 10.8-32V external supply. Current consumption is a maximum of 120 milliamps which drops to 12 milliamps in the anchor watch mode. Peak transmitter power output is about 100 watts, with a nominal frequency of 150kHz.

The sounder itself is intended for mounting inside the boat, where it will be protected from sun and spray. A weatherproof 4-digit liquid crystal repeater, driven from the main unit, is available for use on a cruiser flybridge or in a yacht's cockpit. This retails for about $120, including tax.



The Fuso 802 Colour CRT Fish Finder is imported from Japan by GME.

Fuso 802

The Fuso 802 Colour CRT Fish Finder is at the top end of the depth sounder range, imported from Japan by Greenwich Marine Electronics.

A rectangular colour CRT with 200mm diagnonal screen is used, mounted vertically to give the most effective display of depth information. At the very top of the screen, alphanumeric characters indicate water surface temperature and operating mode. Below this is a multi-colour graphics display, covering the whole area from the water surface to the ocean floor.

In the graphics display, strong echoes from the bottom produce red and orange colours. Echoes in the medium to weak range produce yellow, green, purple and blue respectively. An anti-clutter control can be used to progressively remove colours representing the four weakest levels to give a clean display, without reducing the sounder's sensitivity. Both graphic displays have an electronically superimposed graticule showing depths in metres, feet or fathoms. In the bottom lefthand corner of the screen, large digital characters show present depth of water under the boat.

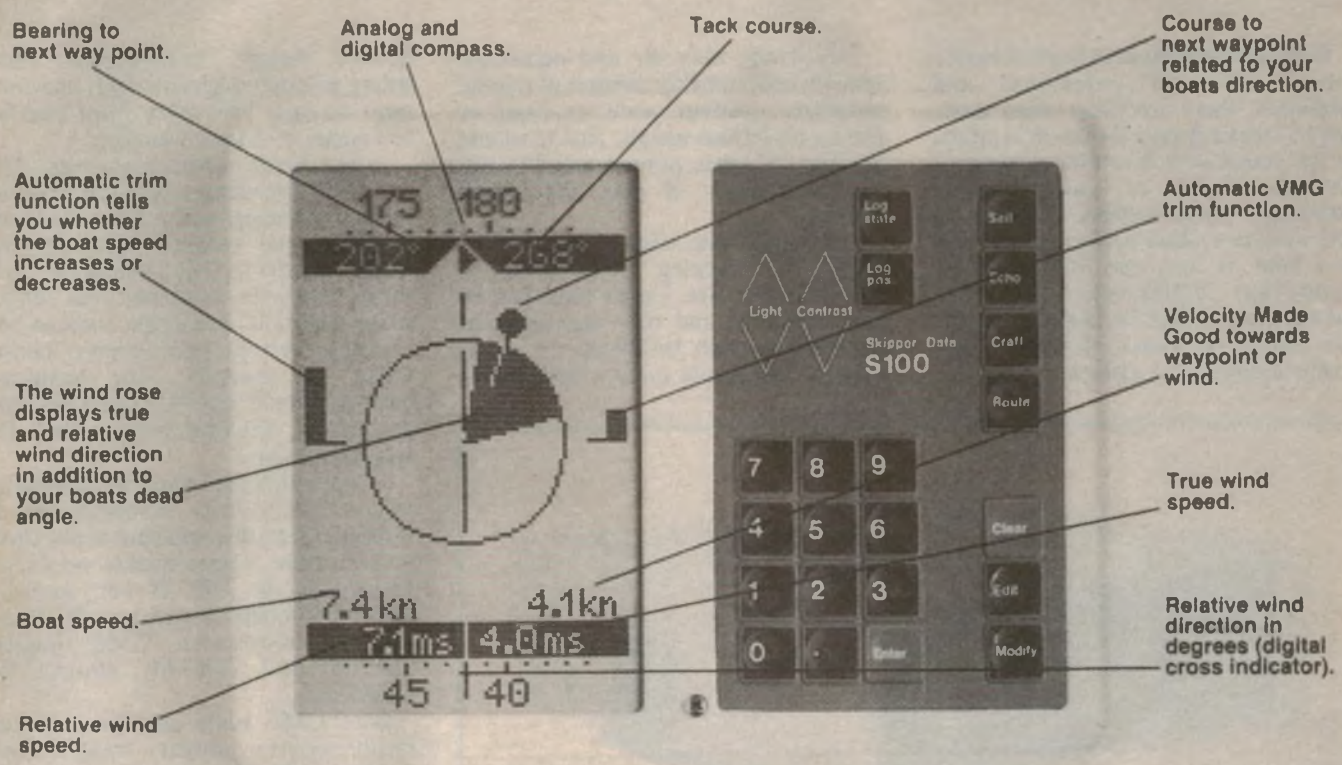
An auto shift facility ensures that the sea bed remains on screen, even if a sudden increase in depth occurs as the boat moves along.

The Fuso 802 measures 267mm wide, 270mm high and is 385mm deep. Its price in Australia is about $3400 including tax.

The standard model uses a 200kHz operating frequency and with the maximum peak transmitter power output of 500 watts, can read depths down to 800 metres. An optional 50kHz model is available if greater range is required.

Skipper Data S·100

The sailboat computer making you sail faster and safer.



The picture visualizes a sailing display with all interesting data for efficient "waypoint" -sailing. If less data is wanted the modify-button may be used to program out certain functions.

Advanced sailboat instrumentation need no longer cost you a fortune.

Skipper Data S100 costs considerably less than other advanced systems and generates more information than any other comparable instrument on the market. The information is presented both graphically and digitally on a large, easy-to-read, LCD display.

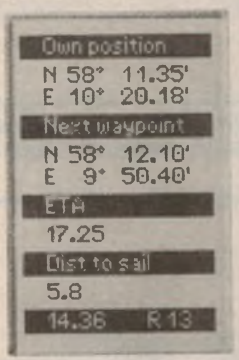
Log, compass, wind data, engine data, watch, echo sounder and nav.-computer – all in one instrument !

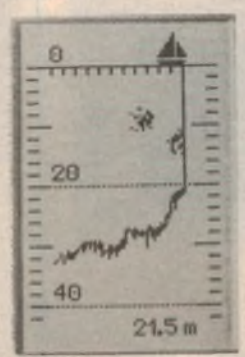
Whether you are cruising or sailing regattas you will appreciate how Skipper Data S100 gives you a faster and safer voyage.

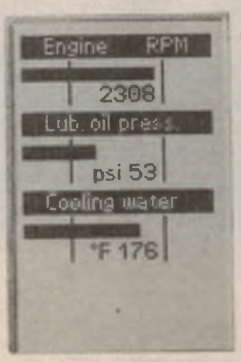
Skipper Data S100 answers all your questions.

How far upwind can I go to sail most efficiantly ? What is my position ? What course should I take – and how far is it to the destination ? How strong is true wind ? How deep is it here ? What is fuel and water supply ?

Continue asking, and Skipper Data gives your the answers. Engine data, fuel supply, sea- and air temperature... and 16 different alarm functions.







Easy to use.

Normally you only push one out of four buttons to get the information/ display picture you want. However, you also have the possibility to plan the whole voyage by programming all the waypoints in latitudes and longitudes.

Power efficient.

The power consumption of Skipper Data S100 is only 200 mA., or less than a flashlight bulb. Consequently, there is no danger of draining the battery. If the power supply should break down, an internal battery insures all stored information for 4 years.

Prepared for the future.

Skipper Data S100 is manufactured to comply with the NMEA standards, and interface units for LORAN C, Decca, GPS and autopilots are being developed.

Measures: H=210 mm, W=280 mm, D=34mm. Power consumption: 2.4W/12V (10–15V).

AVAILABLE FROM

RACAL MARINE

AND 50 DEALERS THROUGHOUT AUSTRALIA

SYD (02) 888-6444
MELB (03) 699-2133
BRIS (07) 393-0699
PERTH (09) 331-1199

Sound systems

While messing about in boats is itself a great source of enjoyment and relaxation, there are times when news, sport or music from a local radio station, or the sound of a favourite cassette, is wanted. Plenty of good quality, automotive sound systems are available and, when new, these perform just as well in a boat as in a car. But there are important differences between automotive and marine sound gear and you should be aware of these before finally deciding on a system.

The damp, salty air and occasional spray in boats quickly disposes of normal protective coatings, such as paint or plating on ferrous metals. And it attacks loudspeaker cones, printed circuit boards and most kinds of plug and switch contacts.

On the plus side, there is usually more scope for mounting loudspeakers on boats than in cars. Larger units can be accommodated and they can often be mounted through bulkheads or in the sides of cupboards to give better bass. Beware though. Loudspeakers have strong external magnetic fields and they must be kept well away from steering compasses or fluxgate sensors.

A satisfactory antenna for local AM and FM broadcast reception can be made by running two to three metres of insulated wire vertically up from the equipment and then horizontally, in an L shape above the headliner. For longer range reception, an outside antenna will be needed and specially designed marine whips are available. The broadcast receiver should not be connected into any of the antenna systems used for communications.

If the small boat owner is prepared to take a chance with corrosion and is willing to replace equipment every three or four years, a good quality car sound system will be OK. If not, specially marinised sound systems, such as the recently announced GME models GR926 and GR934, should be considered.

Both GME units are based on car radio/cassette player designs but significant changes have been made to adapt them for marine use: plastic outer cases, with no unnecessary gaps or holes protect the equipment from spray and salty air, circuit boards have an all over moisture-resistant coating and heavy duty plating is used on all metalwork.

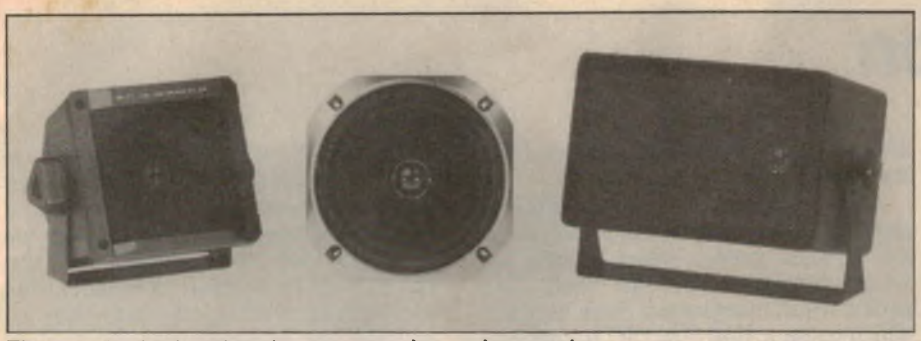
Model GR926 has a manually tuned AM/FM radio and stereo cassette player giving 8 watts output per channel. In addition to normal AM coverage from 525-1605kHz, it also has a weather band range of 200 to 405kHz. This gives reception of aeronautical radio beacons which, when located near major airports, transmit a continuous voice recording, giving wind strength and direction, barometric pressure and thunder storm warnings. Retail price of the GR926 is about $250, including tax.

Model GR934 has AM stereo as well as an FM stereo decoder, but does not include the weather band facility. Tuning is frequency synthesised with 12 preset stations and a digital readout, which also doubles as a clock. Retail price is round about $400, including tax.

Loudspeakers with paper cones are not really suitable in damp environments and two different gimbal-mounted boxes incorporating speakers with poly-propylene cones are available as optional extras for the GR926 and GR934.

AWA have also recently announced a full specification marinised component

Marine entertainment equipment must be specially designed to prevent corrosion. Both the GME GR926 (above) and GR934 radio-cassette players feature plastic cases, heavy-duty plating and moisture resistant coatings on circuit boards.



These marine loudspeakers incorporate polypropylene speaker cones.

stereo system model MS5000. This has a transparent plastic door to protect the two control panels from spray or rain.

When ocean cruising, or even coastal cruising in some of the more remote areas, a vessel will often be out of range of FM and medium frequency AM stations. When this is the case, short wave broadcasts can provide news and entertainment. In addition, the navigator will probably want to pick up time signals from Lyndhurst or WWV and the skipper will feel happier if he has a back-up for the HF/SSB communications receiver. All of these requirements can be covered by having aboard one of the sophisticated all-band, portable receivers which have recently become available.

Sony ICF2002

The Sony ICF2002 is a good example of these and has a frequency coverage of 150kHz to 30MHz AM, 87.5MHz to 108MHz FM and 116MHz to 136MHz air band. On the main AM range, the receiver operates as a double conversion superhet, with first IF of 55.845MHz, which ensures freedom from image interference problems.

A phase locked loop (PLL) frequency synthesised tuning system is used. This enables wanted frequencies to be entered via a numerical key pad selected by a rotary tuning knob, called up from one of the 32 memories, or located by a built in scanning system. Selectable bandwidth and USB/LSB carrier insertion facilities, make the receiver suitable for SSB reception.

An LCD clock display is provided and a four event timer can be programmed to select any frequency at any time, so important weather broadcasts, or news bulletins, will not be accidently missed.

The ICF2002, runs for 30 hours on its internal batteries but for regular use on board a boat the optional 12 volt adaptor would be useful.

A wide selection of 12 volt, portable, monochrome or colour TV receivers is available and most will operate quite happily aboard a small boat. Reception of VHF TV signals down at sea level can pose problems though, especially if the vessel is tucked away in a snug anchorage, with high ground around.

An external antenna will normally be required and this should be raised as high as possible. A directional antenna will help to reduce ghosting, but may need frequent re-adjustment if the boat is swinging on a mooring or anchor.

Specially designed omni-directional and compact directional TV antenna systems for marine use are available. These often incorporate built-in preamplifiers, powered via the co-axial cable, to improve picture quality.

Instrumentation

In the past, boat instruments gave only very basic data about speed, direction and wind conditions. The accuracy of some of this information was also poor, due to limitations in the designs used. It was up to the crew to correct and interpret the data, based on experience and intuition.

With the advent of microcomputers, it is now possible to automatically compensate for errors in data collected, to generate new and sometimes more relevant information and to make accurate predictions concerning boat performance. The presentation of information has also improved and analog or digital readouts are being replaced by graphic displays.

For even the most basic types of navigation the mariner needs to know his speed and direction through the water. In both these areas, electronic sensors and indicators are rapidly taking over from earlier mechanical systems.

VDO Sumlog

The German VDO company produces a wide and very popular range of marine instruments, which are marketed in Australia. VDO's Sumlog SL is a good example of a basic electronic speed and distance measuring system, designed for the average sail or power boat.

A transmitter or sensor unit is installed through the vessel's hull and it has a small paddle wheel rotated by water flowing under the boat. The paddle wheel incorporates three magnets which cause a Hall effect IC to produce three pulses of electrical current for each rotation, of the paddle wheel.

Simple electronic measurement of the pulse rate gives boat speed through the water and adding up the pulses gives the distance covered. An IC in the indicating unit performs these tasks, driving a 240-degree analog meter to show speed, and a stepping motor, linked to a pair of odometer type number drums, gives the total distance and trip distance covered. Additional speed or distance indicators can be added, as required.

Compasses

Marine compasses have been progressively improved and refined over a period of at least 1000 years. The latest development is the "fluxgate magnetometer" compass which measures the earth's magnetic field, without needing any moveable parts.

The VDO ADIS 360 fluxgate sensor unit incorporates analog computing circuitry to process the compass outputs and this also checks and compensates for deviation due to distortion of the earth's field by magnets, ferrous objects or electrical systems on board ship. In addition, the navigator can also feed in information about variation, which is the local difference between true North and magnetic North, and this will result in a true bearing being indicated. A third advantage of electronic processing is that controlled damping can be used to minimise swinging of the compass reading, as the vessel yaws in rough seas.

The VDO compass display unit has a 360° movement and a pre-settable steering grid, to remind the helmsman of the correct course. A separate indicator provides for input of local variation and shows the amount of deviation being corrected.

A simple fluxgate sensor will drive up to 10 indicators and, unlike normal compasses, these may be installed wherever required, regardless of proximity to other indicators or equipment containing magnets.

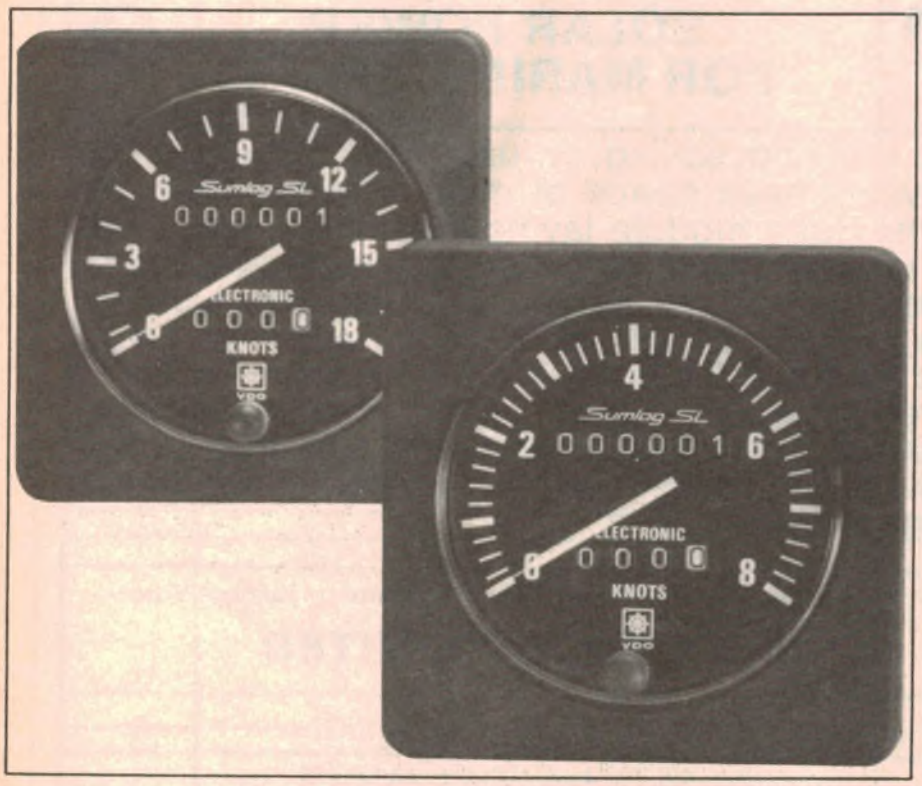
In addition to the boat's heading and speed, a sailor needs to know the direction and strength of the wind. These measurements are usually made by a wind vane and spinning cup type anemometer on the yacht's mast. In some of the latest units, LEDs and phototransistors are used to provide frictionless conversion of mechanical to electrical signals. (See EA, Aug. 1981). This technique greatly enhances wind instrument sensitivity and accuracy.

Many sailors still prefer a large analog meter rather than a digital readout for compass and wind direction and also for fluctuating information, such as wind speed.

A power boat skipper will probably be using electronic tachometers for accurate measurement of motor speed, but most other engine instrumentation, such as temperature and pressure gauges, remains electric rather than electronic.

The equipment described so far utilises electronics to give the skipper or navigator better quality data, but has not provided assistance with its analysis or evaluation. The next stage of instrumentation deals with this requirement.

The UK firm of Brookes and Gatehouse (B and G) have developed a world-wide reputation for innovation in the marine instrumentation field and



VDO's Sumlog SL provides basic speed and distance measurement for small boats.

B&G's versatile Hercules 2 system drives a mixture of digital and analog indicators.

their equipment is used on a high percentage of world class racing yachts. It is imported into Australia by Peter Green Ship Chandlers. The B and G Hercules 2 microprocessor-based system combines performance monitoring and navigation functions and delivers up to 32 separate pieces of information to a mixture of analog and digital indicators.

Speed measurement

Work by B and G on instrumentation for 12-metre yachts, leading up to the 1983 America's Cup Challenge, showed that big improvements were needed in the accuracy of information from sensors. Design improvements to fluxgate compasses and wind instruments left them with predictable errors and these could be compensated for during data processing. In the case of speed through the water however, a simple propellor or paddle wheel would not give the very high accuracy and linearity required so a new system using ultrasonics was developed.

The B and G Sonic Speed System uses two small transducers facing together underneath the boat, with one about a metre in front of the other. Each transducer can operate as either a sender or receiver.

When the boat is in motion and a pulse of ultrasound leaves the front transducer, it travels through water which is itself moving towards the rear transducer. Because of this it takes less time for the signal to complete its journey. The rear sensor is next used as the transmitter and sends a pulse of ultra sound against the direction of water flow to the front transducer. This time the signal takes longer to complete its journey.

As the time delays are directly and constantly proportional to the rate of water flow, the speed of the boat can be calculated with great accuracy, even at high and low ends of the range.

A typical Hercules 2 system comprises the sensors previously mentioned, plus others, to give rudder position, angle of heel, water temperature and so on, and a depth sounder. In addition, there is the computer and a master display unit or MDU, which is the heart of the whole system.

The computer drives a range of large diameter analog meters and the MDU drives multifunction digital displays, so that information can be presented at various locations on the boat and in the form required.

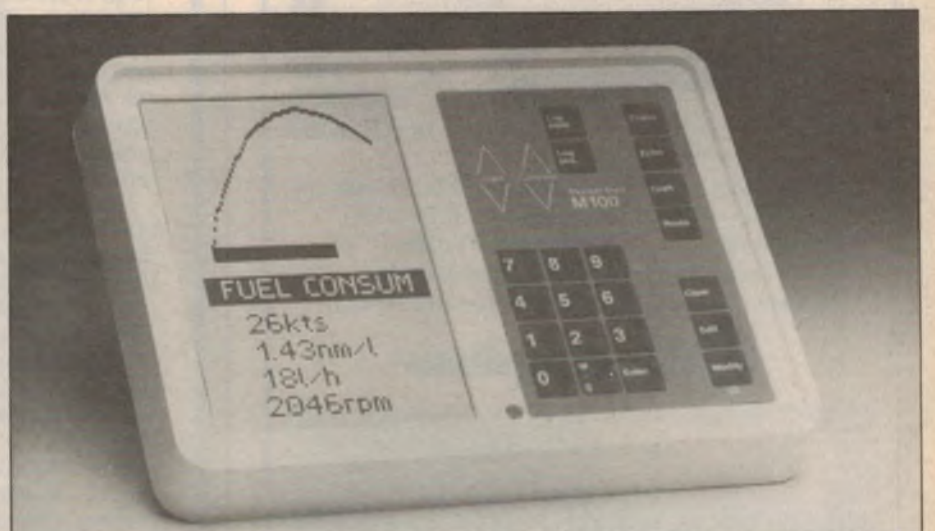
Hercules 2 is supplied with three programs in memory, giving theoretical performance figures for various types of yachts. The program can be scaled up or down to suit the particular yacht's size and refined as actual sailing data is accumulated. For the racing skipper, this is equivalent to having a well sailed yacht of similar type close by, with which to compare his boat and crew's performance.

The MDU has an RS232C interface, allowing the ready exchange of data with other equipment, such as a satnav system or automatic pilot. In fact, with a full system, the only thing remaining for the skipper to work out is how to pay the bills.

Skipper Data

For those requiring centralised data processing and display, but without the very high levels of accuracy and flexibility provided by Hercules 2, the recently announced Skipper Data System could be of interest. This equipment originates from Norway and is handled in Australia by Racal Marine. Two models are available, the M100 for petrol-engined power boats and the S100 for sail boats. A third version, for diesel-engined power boats, should be available in a few months.

Perhaps the most striking thing about the Skipper Data units is their use of a 100 x 160mm (approx 13000 pixel) liquid crystal panel, which provides alphanumeric, graphical and pictorial data displays. The sailing model produces



Imported by Racal Marine, the Skipper Data M100 calculates and graphically displays fuel consumption against speed to allow optimum throttle openings to be used.

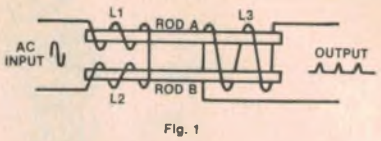


Fig. 1

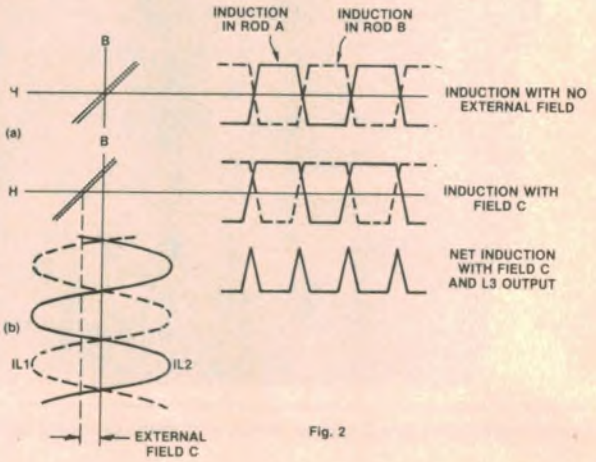


Fig. 2

The Fluxgate Principle

Two strips of high permeability metal are placed side by side as shown in Fig. 1. Each strip has its own primary coil, L1 and L2. The coils are connected in series, but are wound to magnetise the strips in opposite directions. A single secondary coil L3 is wound around both strips.

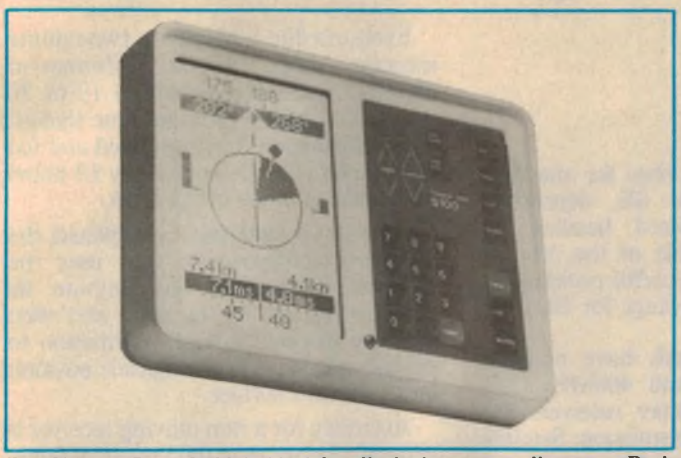
A strong AC current flowing through the primary coils drives the strips into saturation as shown in Fig. 2a. Flux in the two strips is equal and opposite throughout the cycle, so it cancels out and no current flows in the secondary coil.

If an external field with lines of force parallel to the strips is present, it will magnetise them during the non saturated periods. This magnetism will have the same direction in both strips, partially cancelling the primary coil flux in one strip and adding to it in the other. As the flux in the strips is no longer exactly equal and opposite there cannot be perfect cancellation and current pulses will be induced in the secondary coil, as shown in Fig. 2b.

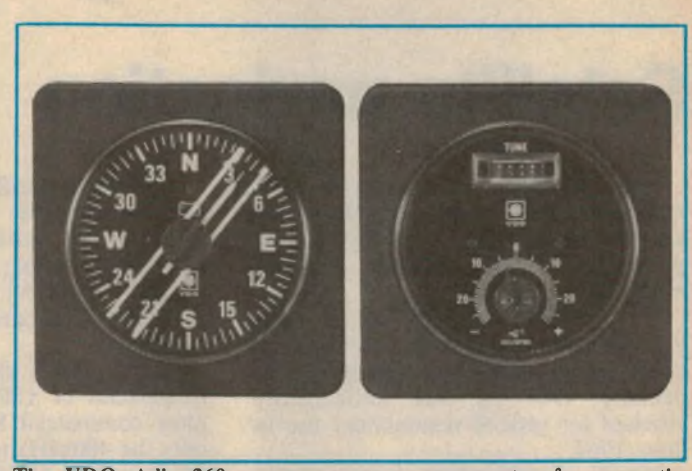
The external field only affects the strips during the brief periods between saturation and at these times, the flux gate is said to open. Such openings occur at twice the primary current frequency.

If the external field's lines of force occur at right angles to the strips, they do not affect the magnetic balance and no output is obtained from the secondary coil. Fields at intermediate angles will produce outputs from the secondary coil in proportion to the cosine of the angle.

Two sets of strips and coils, mounted at right angles, can thus be used to make an electronic compass which measures the direction of the earth's magnetic field through 360 degrees.



The Skipper Data S100 is ideal for displaying vector diagrams. Both models incorporate a depth sounder.



The VDO Adis 360 compass system compensates for magnetic deviation and variation, and features controlled damping.

a vector type diagram showing course made good, course to next waypoint plus true and apparent wind direction. At the same time, the compass reading and apparent wind angle are given at the top and bottom of the panel, in strip analog form.

Other sections of the display show bearing to waypoint, tacking angle, boat speed, relative and true wind speed, in digital form. If this is all too much, specific items can be programmed out by the user.

Instead of wind data, the M100 power boat model calculates and displays fuel consumption against speed which enables optimum throttle settings to be used.

Both units incorporate a depth sounder with pictorial views of the bottom contours and deep or shallow water alarms.

The navigational computer function accepts programming of up to 100 waypoints, along a chosen route. Signals from the compass and log sensors are used to calculate course distance and time to run. A log display includes total and resettable trip distance, average speed, date, time and stop watch.

A house keeping function displays engine RPM, oil pressure, water temperature and running time. Pressing a key changes this to indicate the levels of up to five onboard tanks for water and fuel. Another selection gives the electrical system voltage, current load and consumption in watts, plus air and sea temperatures.

The S100 of M100 units consume only 0.2 amps. They retail for about $4200 including sales tax.

Satellite navigation

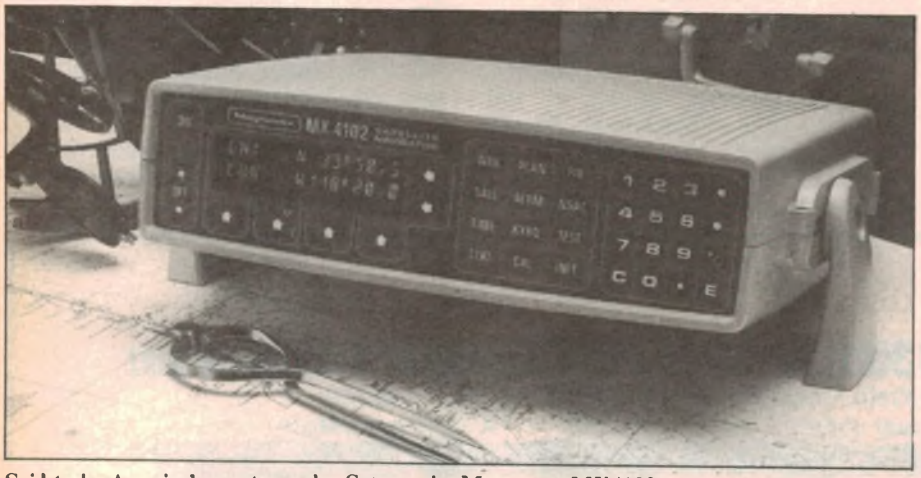
One of the most impressive combinations of space technology and microelectronics for everyday use is provided by the Transit satellite navigation system.

The original Transit system was developed for use by US Navy Polaris submarines and became operational in January 1964. It was subsequently released for general non-military use in July, 1967.

At the moment there are six active satellites, all in orbits which pass over the north and south poles. Each satellite has an altitude of about 1075 kilometres and takes about 107 minutes to circle the earth. The six orbits thus make up a "birdcage" in space with the earth slowly turning at its centre.

A satellite usually rises for the first time in the NE or SE, depending whether the northward heading or southward heading side of the orbit is being used, and for a useful position fix must remain in radio range for 10 to 18 minutes.

The satellite's signals have nominal frequencies of 150 and 400MHz, but most commercial Satnav receivers use only the 400MHz transmission. Satellite speed is over 11 kilometres per second and this causes a Doppler shift of several kilohertz in the signal frequency, as the transmitter first approaches and then recedes relative to the receiver on earth. A microprocessor in the receiver analyses the Doppler shift and stores the information in memory.



Said to be America's most popular Satnav, the Magnavox MX4102 costs about $4400.

The A300SS also provides position readout between satellite fixes.

Each satellite transmits a two-minute message giving detailed information about its own orbit to within 10 or 20 metres and highly accurate time signals. This information is re-computed and fed into the satellite memory every 12 hours by ground stations in the USA.

When a satellite pass is completed, the receiver microprocessor first uses the Doppler information to compute its position relative to the orbit and then uses the received orbital information to provide a latitude and longitude position on the earth's surface.

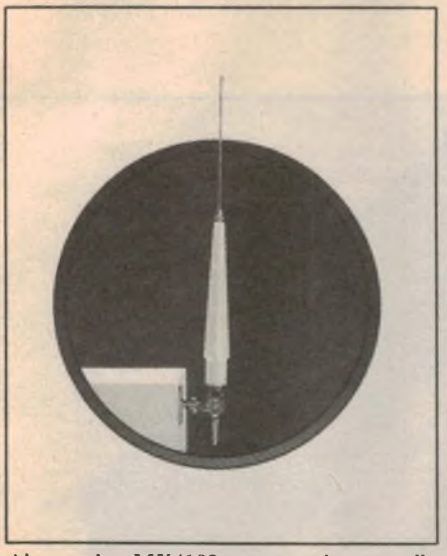
Accuracy for a non-moving receiver is generally better than 0.05 nautical miles, or about 100 metres. Usually however, the receiver will have been moving during the satellite pass and the microcomputer must be fed details of heading and speed so compensations can be made. An error in speed information of 1 knot can cause a corresponding position error of 0.25 to 0.5 nautical miles.

As the Transit satellites all pass over the North and South poles, the time between position fixes in polar regions is typically less than 20 minutes. Because the orbits fan out towards the equator however, the average waiting time between fixes in Australia and New Zealand latitudes is a little over 60 minutes and can, on occasions, extend to several hours.

The US Department of Defence is currently deploying a new satellite navigation system known as Global Positioning System or GPS. This uses 18 satellites in 17,500 kilometre high orbits, which will provide continuous coverage over the whole earth's surface. Because of its military value however, it is doubtful if this system will be available for commercial use before the end of the decade.

Although the Transit system has now been operational for well over 20 years, it has been progressively improved and updated. Spare satellites and launching rockets have been retained to replace any failures and users of the system can be confident that it will continue to be available up to at least 1995.

The first commercial Satnav receivers built in 1967 were costly and bulky, consisting of separate receivers, computers, magnetic tape storage and teletype terminals. In 1977 Magnavox announced the world's first Satnav equipment using microprocessor technology and progressive development has seen the computer program stored in ROM, the teletype terminal replaced by a small VDU and the receiver and computer combined into one case.



Above: the MX4102 antenna is ruggedly constructed and easy to mount.

The introduction of relatively cheap, compact, low consumption units in 1980 opened up the small boat market and there are now tens of thousands of Satnav receivers installed on yachts and power boats throughout the world.

It was mentioned earlier that information on the boat's speed and heading are required to enable the microcomputer to accurately interpret the received signal and calculate the satellite's apparent position. This information can either be entered manually using a key pad on the Satnav or provided automatically by a speed transducer and flux-gate compass.

Many top of the range Satnavs even make automatic corrections for the various errors which can occur with magnetic compasses and also calculate and then allow for ocean currents and sideways drift of the vessel.

Antennas for receiving the 400MHz satellite signals are usually of the quarter wave monopole or ground plane type. Lower priced Satnavs generally come complete with a passive antenna fitted with about six metres of coaxial cable. Top of the range units often have a low noise preamplifier built in to the antenna and this is powered by DC supplied via the coaxial cable.

Satnav antennas need to be mounted clear of metal objects which could screen the UHF signals. As the satellites must have an altitude of more than 10° above the horizon to provide a satisfactory fix however, there is not much to be gained by installing them at the tops of masts or on very long poles.

Cable losses can degrade the performance of systems with passive antennas and this is another reason for choosing a mounting position close to the equipment.

State-of-the-art in small boat Satnav is exemplified by two popular units currently available in Australia.

Navstar A300S

The Navstar A300S is imported from the UK by Peter Green Ship Chandlers and retails for about $2900. As well as providing accurate latitude and longitude after each suitable satellite pass, it will also give positions between fixes, based on course and speed information supplied manually or from external sensors if fitted. The bearing and distance to nine pre-programmed waypoints along the route are also provided. Alarms can be sounded to let the navigator know that a new satellite fix has been computed or that the vessel is off course, etc. Twelve previous satellite fixes are held in memory and pre-calculated details of up to 100 future passes can be called up.

The basis of the system is the well-tried and tested Z80 microprocessor, supported by 4K of ROM and 28K of EPROM. Battery back-up is provided to maintain the clock and memory for up to three months with no external power applied.

Small sailing boats need to economise on electrical power usage, so the A300S has a high efficiency switched-mode supply consuming only six watts at 9-30 volts DC. Many Satnavs use fluorescent character displays, but the A300S has a two line 16 character liquid crystal display, which helps keep power consumption down. In addition, it gives good readability in bright sunlight and is back-lit for night viewing.

The A300S comes complete with a 220mm high passive antenna weighing only 0.25kg. A larger line-powered active antenna is available as an optional extra.

Magnavox MX4102

The Magnavox MX4102 is claimed to be America's most popular Satnav and is the latest in a long line of equipment developed over 20 years for the Transit system. It retails in Australia for around $4400 in its basic form.

As well as many of the features found on the Navstar unit just described, the MX4102 incorporates an elaborate navigational and route planning package, accessed via a menu which appears on the two-line fluorescent display. Errors which would affect heading information, such as compass misalignment, magnetic deviation and variation are automatically calculated and compensated for. Full self-test facilities are also built in. Power consumption is 12 watts at 10-40 volts and a five year memory back up is provided.

Several other excellent Satnav receivers from the UK, Japan and the USA are available in Australia. A prospective purchaser needs to decide whether automatic inputting of course and speed information is required and should also check out the availability of service back up before making a final choice.

Autopilots

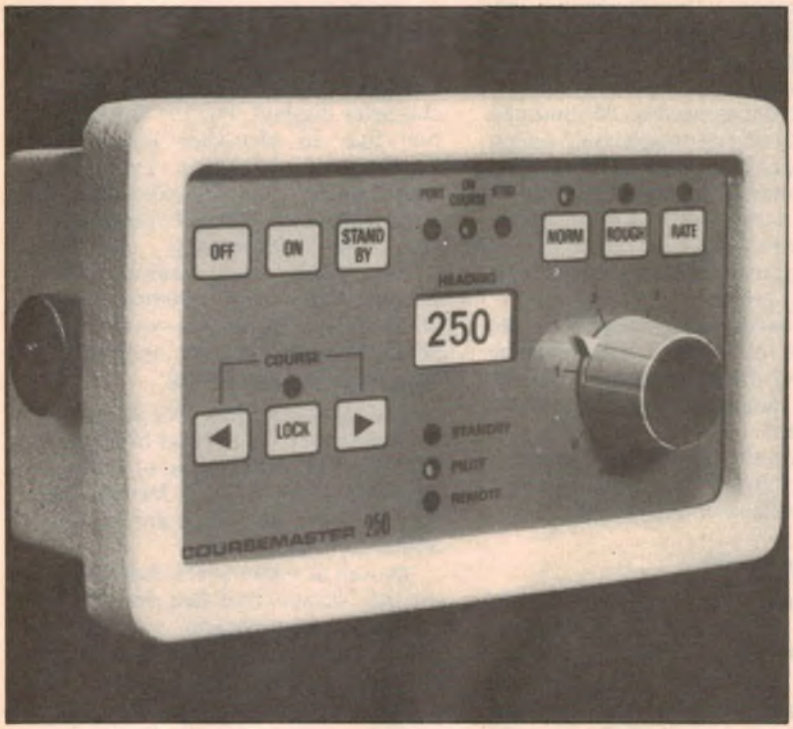
Many cruising yachts and power boats have limited crews, and the last thing most skippers want to do is spend eight or 10 hours each day steering the vessel. A solution to this problem was provided in the early 1970s, when low cost, electronically controlled, autopilots became available. In the decade or so following their introduction, the performance, reliability and power consumption of marine autopilots has been dramatically improved.

A basic autopilot system comprises three major sections: Firstly, an electronic compass giving outputs to indicate that the boat is on or off course. Secondly, a motor system to operate the vessel's rudder and feed back information on its position.

Thirdly, an electronic control unit to store the selected heading and compare this with the actual heading and supply drive to the steering motor, so the boat is quickly brought back onto course without overshooting.

Autopilots for boats below about 10 metres in length are usually off the shelf, detachable units, designed for installation by the purchaser. They push or pull the tiller on small yachts, or drive the existing steering wheel via a flexible belt on power boats or larger yachts. On craft over about 10 metres in length, autopilots are often customised to suit the vessel's characteristics and are usually built-in.

Autopilots



Manufactured in Sydney, the Coursemaster 250 is a customised built-in autopilot for larger vessels.

The Autohelm 1000 model is a detachable unit designed for medium-sized tiller-steered yachts.

Autohelm

The well known Autohelm range of autopilots is imported from the UK by Solo Marine. Models from small detachable tiller units for day-sailer yachts up to fully built-in systems for large power or sailing craft are available.

An Autohelm 1000 model has been on the market for some years, but has recently been completely updated to incorporate microprocessor control circuitry and push-button operation. It is a self-contained detachable unit, designed for medium sized, tiller-steered yachts.

The unit is set up by manually steering the vessel onto a required course. An "auto" button is then pressed, which results in the outputs from a fluxgate compass being memorised. Any variation in heading causes a servo motor to operate, pushing or pulling the tiller to bring the vessel back on to course. It is sometimes desirable for a yacht to follow a course determined by the wind direction rather than a compass bearing and an optional wind vane attachment is available for this purpose.

Four control buttons give ±10° or ±1° changes in heading. The 10° buttons also provide a "dodge" facility, to take the boat around obstructions or other craft, but with easy return to the memorised course. A piezo buzzer beeps to confirm valid commands from the buttons and also provides an audible alarm if the vessel remains off course for more than 20 seconds.

Four Darlington power transistors control reversible current drive of up to 7 amps to the motor. Drive is removed for a brief period during every cycle and back EMF is measured. This will be proportional to motor speed and thus indicates load and rudder position. A normal control thrust of 40kg and a stall thrust of over 70kg is provided at the tiller.

The microprocessor is a 40-pin device with an 11MHz crystal controlled clock frequency. Precautions are taken to minimise radiation which could interfere with radio reception. Analog to digital converters are used to interface signals from the fluxgate compass, wind vane and motor back-EMF circuits. Power consumption averages 4 watts or 0.3 amps. The Autohelm 1000 Micro retails for approx $680 including sales tax.

Coursemaster

A good example of a customised, built-in autopilot for larger vessels is provided by the Coursemaster 250 System. Coursemaster is a Sydney company, which started business in 1974 and now successfully exports their products to New Zealand, Europe and the USA.

Heading information is provided by a fluxgate compass, which can be remotely mounted from the control unit, to avoid any local magnetic influences.

The control unit itself is in a weatherproof aluminium case and uses membrane touch pads for most user inputs. A three-digit liquid crystal display gives the boat's heading in degrees. All signal processing circuitry is digital for maximum reliability and a course resolution of better than 1° is claimed.

Mechanical or hydraulic rudder drive options are available. The mechanical system uses a printed circuit servo motor with 85% efficiency. This takes up to eight amps but with an average 15% on duty cycle, the average power consumed comes down to about 1.5 amps or 18 watts.

Prices for the Coursemaster 250 vary according to the options required but a basic system, as described, is about $2250, including sales tax.

Other up-market autopilots, including another model from Coursemaster, can be interfaced with Satnav receivers. This allows automatic heading information to be supplied to the Satnav and "bearing to next waypoint" information to be fed back to the auto pilot.

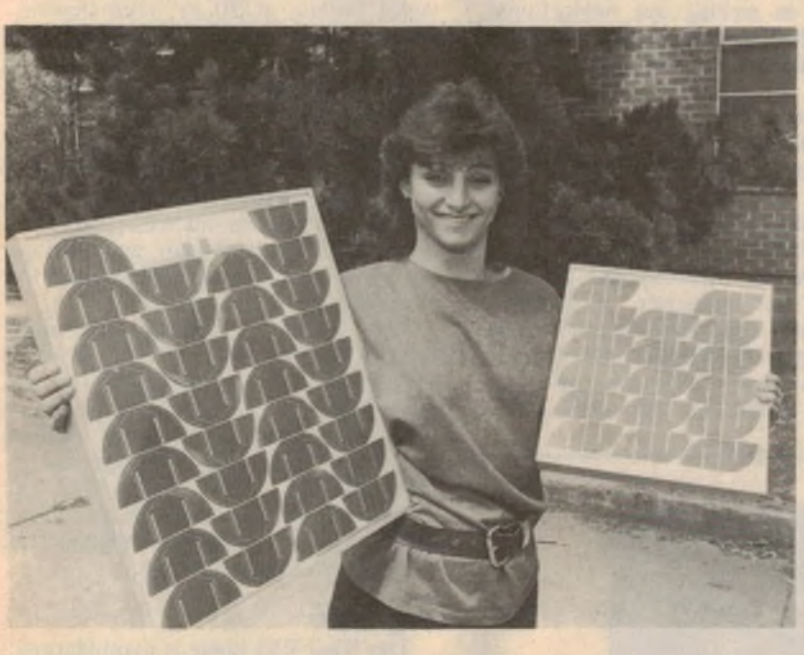
Perhaps it is time for helmsmen to be placed on the endangered species list.

DO FLAT BATTERIES BOTHER YOU?

TIRED OF CARRYING HEAVY BATTERIES TO RECHARGE? TIRED OF HAVING ACID SPILLS ON YOUR CLOTHES? JUST PLAIN TIRED OF HASSLES WITH BATTERIES?

IF SO, HERE ARE TWO **SPECIAL OFFERS*** TO SOLVE YOUR PROBLEM:

SOLAR MODULES WILL TRICKLE CHARGE YOUR BATTERY ALL WEEK LONG — READY FOR YOUR USE AT WEEKENDS. IT ALSO PROLONGS BATTERY LIFE. AND THE SUN IS FREE!



COMMON FEATURES:

- TEMPERED SOLAR GLASS
- ANODISED ALUMINIUM FRAME
- SEALED JUNCTION BOX WITH FLYING LEADS
- BLOCKING DIODE SUPPLIED

GR 434

- 15.6V 0.48A 7.5 WATT
- SIZE: 321 × 346 × 37mm
- IDEAL FOR 12V BATTERIES UP TO 100 A/hrs
- **SPECIAL OFFER PRICE $159**

GR 234

- 15.6V 0.96A 15 WATT
- SIZE: 414 × 479 × 37mm
- IDEAL FOR 12V BATTERIES UP TO 200 A/hrs
- **SPECIAL OFFER PRICE $249**

**Valid only for the month of December 1985 unless sold out earlier.*

AMTEX ELECTRONICS

A DIVISION OF **TLE ELECTRICAL PTY LIMITED**
(Incorporated in New South Wales)

36 LISBON STREET
FAIRFIELD, NSW 2165
AUSTRALIA
TELEPHONE (02) 728 2121, 727 5444
TELEX AA27922 ATTN AMTEX

ORDER FORM

To: AMTEX ELECTRONICS
36 LISBON STREET,
FAIRFIELD 2165

Please send me
. . . . (qty) GR 434 @ $159 = $ . . . . . .
. . . . (qty) GR 234 @ $249 = $ . . . . . .
Certified post $5.00 per unit = $ . . . . . .
Total $
Cheque/Money order enclosed
Please charge my Bankcard:
No . . . . . Expiry . . . . . .
Signature . . . . . .
Name: . . . . . .
Address: . . . . . .
. . . . . .
. . . . . .

Radar

Radar has been an essential part of large ship navigation for longer than most of us care to remember but only in recent years has it started to become really popular for small pleasure craft in Australia.

This may be due in part to our relative freedom from fogs and poor visibility, which can be very common in some places overseas. On the other hand small boat navigators in Australia do not enjoy the benefits of a low cost position fixing system such as Loran C in the USA or the RDF network in Europe and this makes radar especially valuable for use around our coasts.

Brochures describing marine radar systems generally include strings of technical specifications and some of these are more important than others.

Two of the most quoted characteristics are peak power output and maximum range. Small marine radars operate in the X band (roughly 9300 to 9500MHz) and radio waves of this frequency will only travel a very short distance beyond the visible horizon. A small cruiser with its antenna say five metres above the water would thus have a radar horizon for small objects close to sea level of about five nautical miles. In this case, there would be little point in using a 10kW peak output set with a theoretical range of 72 nautical miles. On the other hand, a large yacht with the antenna 15 metres up the mast would have almost twice the range and might be able to put the extra power to good use.

Minimum range and range resolution are especially important; imagine an unlit vessel in your path at night which disappears from the radar screen whilst still half a mile away. High resolution, short range operation is also essential for uses such as picking out navigational marks and buoys or passing through narrow harbour or river entrances at night.

Most radars have five or six switchable ranges, allowing the operator to concentrate his attention and obtain maximum detail from the area of interest. Each range will provide three or four electronically generated rings, which can be superimposed on the display to aid estimation of distance. Many radars also have variable range and bearing markers, which the operator can move until they coincide with particular objects on the screen. The precise range in miles and bearing in degrees is then shown in digital form on a separate display or sometimes in a corner of the main display.

Bearing resolution is also very important. This is the radar's ability to separate objects which are close together at similar range, or to give details enabling coastlines to be easily identified on charts. Bearing resolution depends on the horizontal beam width or aperture of the antenna used. Generally, the bigger the antenna, the better the bearing resolution.

Antenna vertical beam width should also be considered, especially for yachts where the radar might be used with the vessel heeling at 20 or more degrees. Under these conditions, a narrow vertical beam would send most of its energy skywards on one side of the vessel and seawards on the other.

Because a rotating radar antenna is likely to become entangled in ropes and wires on a small boat, many are now housed in fibreglass radomes. The effect of a radar antenna's weight and windage on the boats stability should always be considered before installation.

The general trend in electronics towards smaller, more power efficient circuits has helped radar designers get away from the power hungry monsters of a few years ago. A typical modern small boat radar can be expected to consume from 3 to 6 amps on a 12 volt supply and this should not be a problem on craft with a properly designed and maintained electrical system.

Marketed by AWA Marine, the Vigil RM is an easy-to-use remote-controlled radar.

Vigil RM

The Vigil RM radar is manufactured by Mars Electronics in the UK and handled in Australia by AWA Marine. It retails for about $4800 including Sales Tax.

The display unit looks very like a small TV monitor and uses a 254mm (10 inch) diagonal green P39 phosphor tube. A conventional circular radar display appears on the screen, but this is produced by 625 line television style scanning, rather than the more usual rotating time base system. In addition to the circular radar plot, the screen also provides alphanumeric information on control settings.

Perhaps the most innovative feature of the Vigil is that all functions are controlled from a separate weatherproof keypad with infrared signalling to the monitor. This is rather like a TV remote control system and would enable a crew member in wet oilskins to use the radar, without dripping all over the chart table.

The Vigil radome contains the antenna, transmitter and receiver. It is 623mm in diameter and weighs 11kg.

Antenna rotational speed is 40 RPM. Horizontal beam width is 4° and vertical beam width is 28°. Magnetron peak power output is 3kW.

Seven ranges covering 0.25 to 16 nautical miles are provided. Selectable anti-clutter circuits reduce spurious echoes from rain, snow or wave crests. Variable range and bearing markers are provided. Power requirements are 12V at 3A.

Racal Decca 170

The Racal Decca 170, which also originates from the UK, is a more conventionally styled small boat radar system. It retails for around $4200 including sales tax.

A 180mm P7 phosphor CRT with magnifier gives a 243mm (9.6 inch) circular display. The P7 phosphor has a short persistence blue glow, followed by a long persistence yellow glow. An orange filter over the screen is used to improve contrast.

Eight ranges covering 0.25 to 48 nautical miles are provided, with the number of range rings changing to best suit each display. Minimum range is better than 25 metres. A variable range marker is available as an optional extra. Sea and rain clutter supression circuits are incorporated.

The 170 radome has a diameter of 880mm and weighs 18kg. Antenna horizontal beam width is less than 2.7° and vertical beam width is approximately 25°. The antenna rotates at 25 RPM and magnetron peak output power is 5kW. Current consumption is 6.6 amps at 12V.

There are many other excellent marine radars available, including a variety of units from Japanese manufacturers. The prospective purchaser is advised to carefully consider his requirements and check out the market place, before making a final choice.

Weather facsimile

Of all the hazards which lie in wait for the unsuspecting mariner, a storm at sea must rate as one of the most fearsome. Few places in the world experience weather changes with such speed and ferocity as when a southerly buster sweeps along the Australian east coast during the summer months.

Regular marine weather forecasts are available from many sources, but these often cover only short periods ahead, are already several hours old or have not been prepared for the particular section of coastline or ocean of interest.

An answer to this problem is provided by tuning in to a world wide network of radio facsimile transmitters, which regularly broadcast weather maps and other information.

Most skippers and navigators have a working knowledge of meteorology and a surface pressure analysis chart showing the position of highs, lows and fronts, plus a prognosis chart for up to four days ahead will enable them to make a fair guess about the weather coming their way. In addition, some stations also transmit weather satellite cloud cover pictures and charts showing ocean temperatures, currents and wave heights, which can all be very useful.

Australia has two stations transmitting weather charts. These are AXM in Canberra and AXI in Darwin. Frequencies used range from approximately 5 to 20 MHz.

There are about 40 stations around the world providing a weather facsimile service. Some nearer ones include Dakar and Pretoria covering the Indian Ocean and Guam, Tokyo, Honolulu and San Francisco covering the North and South Pacific.

The Model FX-240 facsimile recorder is marketed in Australia by AWA Marine.

Alden's Marinefax 3 weather facsimile is available from Mee-Too Industries.

Facsimile systems transmit pictures in a similar way to slow scan television. Various horizontal scanning rates can be used but the most common is 120 lines per minute. Electro sensitive paper is fed slowly past the horizontal scanning system to give the same effect as vertical scanning in television. A long chart can thus take many minutes to receive and will contain thousands of scanning lines. Frequency shift keying (FSK) is used with 1500Hz representing black and 2300Hz representing white.

Weather facsimile recorders are available as either stand alone units or with a built in radio receiver. If a separate receiver is to be used to feed the recorder, it must have good frequency stability to keep the FSK signals correctly tuned.

One of the best known manufacturers of radio facsimile equipment is Alden Electronics of the USA and several of their marine models are available from Me-Too Industries in Australia. Their smallest unit is a briefcase-sized recorder known as the Marinefax 3, which retails at about $4200. Further up-market, they have the Marinefax 6 model, with a built in frequency synthesised receiver covering 80kHz to 29.9MHz. This has all the world's weather facsimile frequencies stored in memory.

A microprocessor-controlled system allows starts, stops and frequency changes to be programmed in by the user for unattended operation. A 16-character liquid crystal display shows receiver frequency, time, date, and so on, plus prompt and confirm information during programing. The Marinefax 6 operates from 12 — 32V DC plus normal mains supplies and consumes 38 to 55 watts. Retail price is about $7800.

AWA Marine also offer an integrated receiver/recorder model FX240, produced by JMC in Japan. Metallized paper is used in the recorder and this does not produce fumes or carbon dust and is easy to store. Receive frequency is selected by digital switches on the front panel which control a phase locked loop synthesiser. The FX240 retails in Australia for around $4900.

The receivers in both the Alden and AWA units can be used for ordinary communication purposes, with the recorder switched off.

Solar panels

Solar panels are a boon on a boat. The usual small boat electrical system consists of one or more lead-acid batteries, charged from an alternator/rectifier system driven by an inboard or outboard motor. There is always a need to conserve electrical power, especially on yachts, where the motor might not be run very often.

Even when no current is being taken from a lead-acid battery, its charge will run down and this can be a real problem if the boat is not used for a few weeks.

Assistance for the overworked alternator and a solution to the battery run down problem can be provided by using solar panels.

Silicon solar cells were originally developed to power space craft. Each cell gives 0.4 volts on load and by combining 36 into a solar panel, a nominal output of 14 volts is obtained. This is ideal for keeping a 12 volt lead-acid battery in a healthy condition.

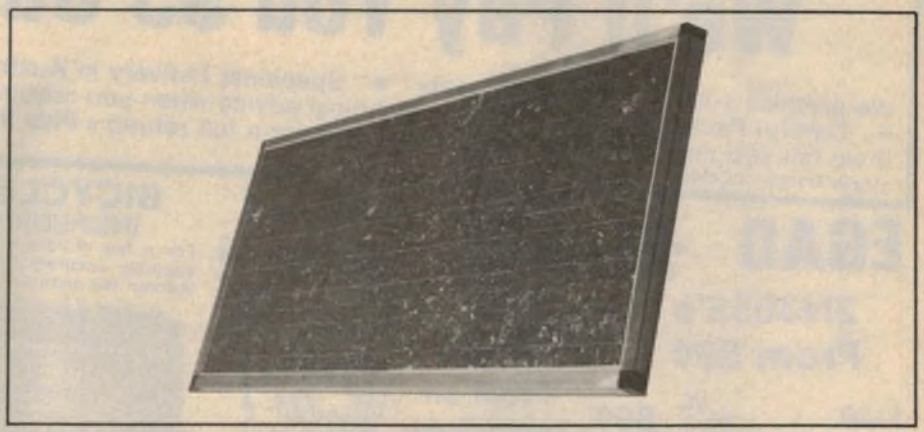
The amount of solar energy available on a clear day varies from place to place and from season to season. A good average figure for most Australian cities is about one kilowatt per square metre. The conversion efficiency of solar panels is not high and the electrical output obtained would generally be less than 100 watts per square metre.

In practical terms, this means that on a bright sunny day, a small 14 volt panel about the size of this magazine would deliver 0.1 amps, a medium sized panel about the size of a tabloid newspaper would deliver 0.6 amps, and a large panel somewhat bigger than a broadsheet newspaper would provide 2.75 amps.

These figures assume the panels are tilted to receive maximum radiation from the sun. In practice, this is difficult to achieve on a vessel underway or swinging in different directions around a mooring, so the usual compromise is to use horizontal mounting. This can result in output being 30 to 40% below manufacturers' specified levels, which naturally assume optimum orientation.

Most small solar panels have a built-in blocking diode, to prevent battery current flowing back through the cells at night time, when their output falls to zero.

A wide range of both locally made and imported solar panels is available. Solarex manufacture cells and panels in Sydney and offer various systems tailored to small boat requirements.



Solarex solar panels come in various sizes and start from about $130.

The simplest Solarex system uses a small solar panel measuring approximately 120 × 250mm and costing about $130. This provides an average charge of about 4 amp-hours per week, which would keep an already charged battery on an unused, moored or trailer boat in reasonable condition.

If charging of a rundown battery is required, but space is limited, a medium sized panel of about 300 × 460mm is recommended. These retail for around $200 each and provide about 25 amp hours of charge per week. Over a long period, battery overcharging may occur and a regulator could be needed.

Sailing vessels on long voyages might not want to run the motor at all and solar power would then have to supply the total need. In this case, at least one and possibly several large panels would be required. A panel of about 460 × 970mm would generate about 40 watts of power or over 100 amp hours of battery charging from an average week's sunshine.

Amtex Electronics is another well known name in the solar panel business and they import a range of panels from various manufacturers in the U.S.A. and Japan. Most local and imported panels come with 5-year guarantees and if not damaged should have an indefinite life span.

Accessories

Most of the major applications of electronics in the marine area have now been covered, but there are some other accessories which also deserve a mention.

Radio direction finders tuning the 200-420kHz band can be a handy aid to navigation, particularly if there is a beacon close to your intended destination. This system is well developed in Europe, but in Australia marine beacons are few and far between and the sailor has to fall back on aeronautical beacons which, not surprisingly, are located for the convenience of aircraft rather than ships.

Alarm systems

A boat sitting unattended on a mooring may appear to present easy pickings for thieves and many owners have installed electronic alarm systems. These generally use microswitch or reed relay sensors on all entrance points with normal exit and entry time delays being provided. The alarm itself is often a klaxon horn and some systems also turn on external lights, enabling police on security patrols to quickly identify the vessel.

Gas alarms are an important item on boats with petrol engines or where LP gas is used for cooking. Both fuels have vapour which is heavier than air and, if leaks occur, this can build up in the lower parts of a boat's hull, creating a potentially explosive situation. Gas alarms detect the presence of these gases and sound an audible warning.

Perhaps the cheapest and simplest electronic device used on board boats is the strobe light. These use an oscillator to store voltage in a capacitor to be discharged into an Xenon tube which then emits a short but very intense flash of white light. Strobes are used on boats as collision warning lights and also in conjunction with life rings, to aid recovery of any unfortunate person who falls overboard at night.

We'll Pay You $5 Cash!

BLUE RIBBON SERVICE

We promise you ★ Product Quality ★ Speediest Delivery in Australia ★ Careful Packaging ★ Friendly, technical advice when you require it. If we fail you may return your purchase to us for a full refund ★ **Plus $5 for your trouble.** ★ Less Transport Costs.

EGAD

2N3055's From 59¢

1—9	89¢
10—24	79¢
25—99	69¢
100 Up	59¢

Premium Quality Famous PECOR Brand

Look At This

Superb Quality Nicad's

From an Incredible

$1.50

1—9	$2.20
10—99	$1.80
100 plus	$1.50ea

Save Up to 50%

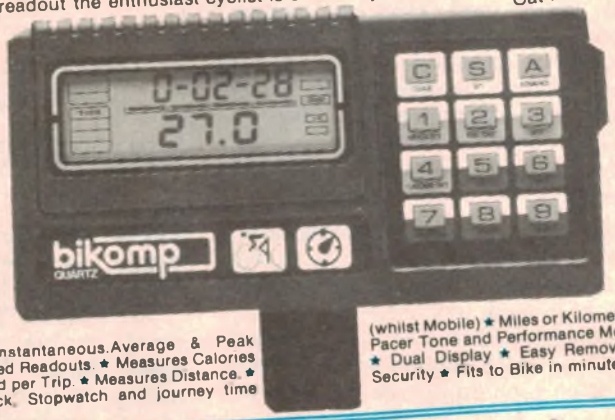
Cat S 5020

BICYCLE COMPUTER

INCREDIBLE 12 FUNCTION

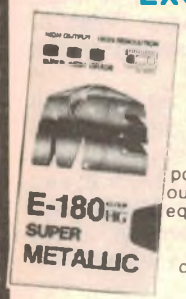
For a few dollars more than a digital speedo this superbly accurate computer provides every activity readout the enthusiast cyclist is ever likely to require.

$49 Cat No. D 2050



★ Instantaneous.Average & Peak Speed Readouts. ★ Measures Calories Used per Trip. ★ Measures Distance. ★ Clock, Stopwatch and journey time (whilst Mobile) ★ Miles or Kilometres ★ Pacer Tone and Performance Monitor ★ Dual Display ★ Easy Removal for Security ★ Fits to Bike in minutes.

VHS VIDEO TAPE EXCELLENCE



We've tested the lot - **Well how does ME stack up?** — in a word **superb** - Forget all about paying a premium for BASF or TDK — Altronics possitively guarantee our new **ME Metallic** is equal to the very best- and that goes for mechanical construction as well as picture quality!

Were **$12.00** Limited Stocks

NOW $9.90 Cat A 9330

10Up **$8.90**

Solar Energy Kit

Natty Solar Kit—Solar cell converts sunlight to electrical energy which in turn drives motor/propeller. Includes fantastic little booklet on Solar experimentation. **Just the shot for school projects. Free energy from the sun. Educational — Great Fun.**

A 0960

Only **$12.50**

A Great Xmas Gift Ideal for the Kids

Famous PRO 2 Mylar Stereo Phones with Dynamic Mic.

Simply Brilliant Mylar Stereo headset and Dynamic Mic conbination **Phones** 30-18KHz 28 Ohms, 6.5mm Stereo Jack Max input 400mm **Mic.** -84db, 600 ohms, 6.5mm Mono Jack.

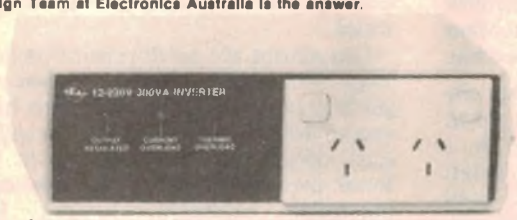
Cat C 9050 $29.50

240V Mains Power From Your 12V Battery

300 Watt Inverter with Auto Start

(See EA Sept.'85)

Just think how handy it would be to have 240 Volt AC Mains Power when camping, or for your Boat or Caravan—Well this brilliant new design from Leo Simpson and the design Team at Electronics Australia is the answer.

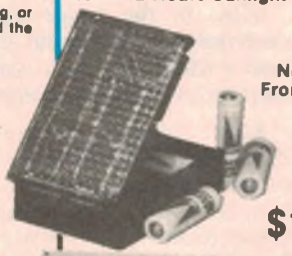


• **Auto Start** draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if desired • **Thermal Over Load** • **Current Regulated** • **Current Overload**

Complete Kit	K 6752	$199.00
Fully Built and Tested	K 6754	$249.00

Solar Battery Charger

Charges up to 4 AA Nicads in approx. 10 — 12 Hours Sunlight



Great New Product From Altronics A 0230

$12.50

Solar Module .4V 450MA

Series or parallel to obtain desired power configuration. (Includes joiner strap for this purpose) Cat A 0210

$4.50

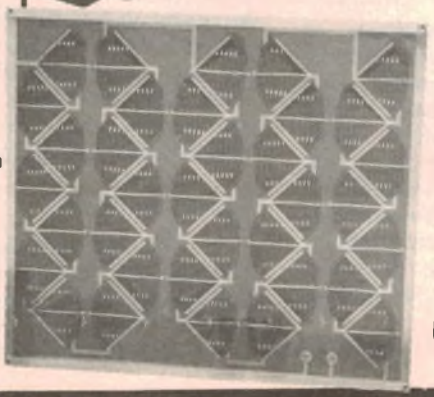
Treat yourself to the Greatest thing to happen to AM in 60 years

AM Stereo Sensation

★ Am Stereo ★ FM Stereo ★ Auto Reverse Tape Deck

Delightful AM Stereo is now yours for an unbelievable price. This Top Quality **Roadsound RCR 760** Stereo AM and FM Receiver boasts 8 watts per channel and high grade Auto reverse tape deck (Metal Compatibility) C 9122

Amazing Price $189.00



Price Break through Solar Cell Array 18V @ 7 Watt

Brilliant New Solar Array at an amazing price. Yes, for less than $90 we now have just the handiest Solar Modules available. Superb for Powering or Charging 12-15 Volt circuits — Now there's no excuse for that flat Car, Boat or Caravan Battery. Solar Cells are fixed to a fibre board, front covered with tough EPS and rivetted into stainless steel frame. Cat A 0220

Amazing Price Break Through $89.95

A practical approach to Electronics

PART 3

How to solder plugs & switches

Most off-board components, such as plugs, sockets and switches, have a metal plating applied to their contacts. These off-board components require special soldering techniques.

by KINGSLEY HOWE

The main point to note with off-board components is that you are soldering onto the plating on the surface of the contacts. Just how well the solder "takes" (or sticks) depends on the type of plating and the finishing process.

In electronics there are three main reasons for applying a coat of metal by electroplating: (1) to provide a protective coating to prevent corrosion; (2) to provide a hardwearing surface; and (3) to improve the appearance of the part.

The majority of plating is carried out at room temperature. Up to 12 different tanks may be used on one line, a line being a set of tanks containing chemicals and water rinses. A part starts at tank 1 as a "raw" part and finishes at the last tank as a plated part.

The plating process

The metal is first cleaned by a hot solvent. This removes any oil or grease from the surface. The next tank usually contains a mixture of caustic soda and sodium cyanide, to strip off any oxides, stains or scale. The third tank may consist of diluted acid or water, to remove any caustic from the parts. In fact a further tank may be required as a second rinse, just to be on the safe side.

After leaving the rinse, the part will have a clean, etched surface. This is to enable the plated metal to "bite" onto it. Plated metal does not alloy with the metal beneath; it only sits on the surface. How well this grip is maintained depends to a large degree on the roughness of the etch.

The next step is to plate the metal. Just how well this is done depends greatly on the skill of the plater and the purity of the plating tank. The minimum purity of the metal used as a plating material must exceed 99.9%.

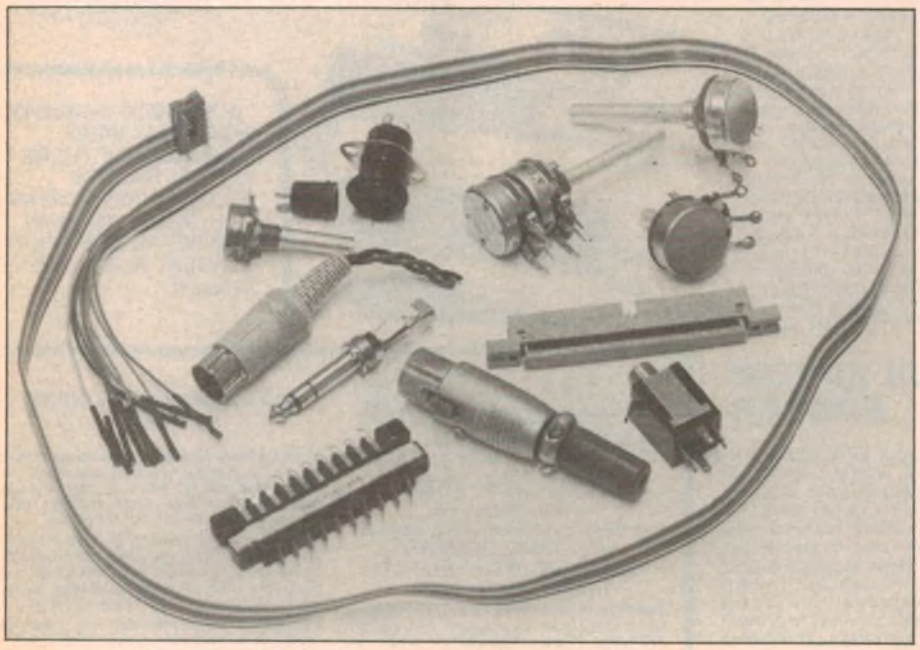
The plater is now faced with overcoming problems of contamination by impurities. This he solves by "dosing the tank" with a range of chemical additives. These are especially formulated to combine with the unwanted material and settle it to the bottom, where it does not interfere with the plating.

Failure to keep additives and pH in the plating tank within rigid limits will result in poor plating. This is where a high degree of skill is required to obtain a high standard. The Japanese overcome this obstacle by installing automatic plating plants worth millions of dollars, with computer-controlled equipment dispensing the correct amounts of additives when needed.

Those companies not able to afford the high cost of an automatic plant must resort to manual methods. The results from some are quite startling. If parts are not rinsed correctly, and cleaning chemicals still adhere (ie, they are trapped in the etched surface), plating will still occur, as there are usually enough additives in the plating tank to ensure this. However, no adhesion will take place, with the consequence that the plating will strip easily.

This can happen, say in the case of an audio plug and socket, where insertion and withdrawal of the plug causes the nickel plating to peel. Some last for years, others strip after only a few weeks of use. As most of these sockets are mounted in a cabinet (amplifiers, etc), and hidden

Below is a collection of plugs, switches and cables which require special soldering techniques.



from view, you may well spend some time wondering why your unit is acting up.

Once the surface coating is gone at the contact point, corrosion takes place, as the base metal is now unprotected. If this happens with output sockets — be careful. With only a faint sound coming from the speakers, there is a temptation to wind up the volume. When the sound level is still found to be much lower than normal, the next thing to do is check the connections. Wiggling the output plugs can cause sudden and full contact and, with the amplifier going full bore, this can prove too much for the speakers, which promptly commit hari-kari.

If you wish to test the plating for proper adhesion at home, a wire can be soldered to the plated surface and a sawcut made next to the solder, just deep enough to reveal the base metal. Now grip the wire with a pair of pliers and pull. The plating should not lift easily, or at all. Another test is to bend a plated strip (say from an old part in your junk box) which is nickel plated, at right angles with a pair of pliers. Often, under this sort of treatment, the coating will flake off quite readily.

Nickel plating

A large number of parts are nickel coated, such as switches, plugs, sockets, etc. Some take solder readily, others do not. There are several reasons for this.

First, the solderability of the nickel depends on the composition and ratio of the plating tank chemicals. The plater is often forced to adjust the chemical makeup of the tank to suit the job at hand. This is normal practice, whatever type of metal is being used.

This is where the plater's skill (or lack of it) shows up. Most of the nickel plating applied (from whatever formulation is employed) will adhere. It will vary in colour and hardness, but it will do the job intended and protect the plated part from corrosion. However, this does not imply that the particular nickel will solder readily.

On some items, the solder flows quickly as the heat spreads over the surface. In other cases, regardless of the amount of heat applied, the solder merely forms a blob and won't spread. In this case, either the nickel is unsuitable for soldering or the manufacturer has applied a protective chemical to the surface to prevent corrosion. This is known as an inhibitor.

When such a piece of hardware is encountered, and a lot of heat is employed in attempting to solder it, you may well end up melting the plastic insulation. The item is then rendered useless. The only way to overcome this is to file the area to be soldered right through to the base metal.

If the base metal is of brass, this will show as a yellow colour when exposed, and will take solder well, without using too much heat. If a yellow colour is not evident, the part may be steel which is normally difficult to solder. This being the case, tin the area immediately, whilst you have a clean surface. It will need a little more time and heat than brass, but should not cause damage to the plastic insulation.

Insulation

Two types of insulation are employed: thermoplastic, which is relatively easy to melt (and scratch), and thermoset plastic, a type which retains its shape at high temperatures. You may solder hardware fitted with thermoset plastic insulation with impunity. It will take temperatures well above those used in soldering.

To identify each type, remember thermoset is virtually the same in appearance as ordinary circuit board, and is quite hard. Thermoplastic materials are relatively soft and are found in a wide range of colours. Once they are overheated, the original shape is lost and there is no chance of salvaging them. The only course open is replacement.

Pots and cables

Potentiometers should be tinned before soldering on any wires. You may prefer to fill the holes with solder, until a mound forms. When attaching leads to pot terminals, just lay the wire on top of the solder mound, and melt. Over the years, the terminals on pots have become thinner and thinner, and any method of attaching a lead without having to wrestle it out is preferable to twisting the wire inside the hole and then finding that the whole terminal pulls away when you attempt to remove the wire at a later date. Don't worry, the joint will hold. You are more likey to break the cable first.

On some hardware, where the terminals are short, and close to the plastic body, you may not have much choice on where to solder. You are restricted to only a small area. In this case an easy method of avoiding a "meltdown" is to keep a small lid partly full of water close at hand, along with some cotton buds. As soon as you have made a joint, hold the wet cotton bud at a point between the solder and the plastic body. This will cool the metal and prevent the heat from entering the item.

Some points to remember

If your iron is used at the correct temperature, a ring of flux will remain around the joint when it has cooled. The flux should be the same colour (or only slightly darker) than that which can be seen on the end of the solder roll. Some dark particles may also be found mixed in with the flux. This is a case of the flux doing its job properly.

With multistrand cables, twist the wires together and tin them straight away. Turn them over and examine the bottom — you may have only used enough solder to cover the top of the joint.

Finally, if you do make a mess of the whole board, don't throw it out. Buy some solderwick, soak off the solder and recover all the usable components you can. Try to repair the board — well, at least have a go at it.

If some tracks have lifted, replace them with wire links, then try soldering in some of the components that you removed. With care, you should be able to salvage the board and get the project to work.

Build this HF amateur transceiver

Part 2

In October, we introduced the Dick Smith HF amateur transceiver and described the circuit operation. This month we describe the counter circuit and detail construction and alignment.

by GREG SWAIN

Frequency counter

Two different versions of the frequency counter can be built, one to cover the lower (0-0.5MHz) band segment and the other to cover the upper (0.5-0.999MHz) segment. The latter is used exclusively with the 3.5MHz (80-metre) version of the transceiver while the lower band counter must be used with all other versions.

Both versions use a 4-digit LED readout and employ virtually identical circuitry. All that is required to change from one version to the other is to alter two wire links and two diodes.

Fig. 3 shows the circuit details. Let's take a look at how it works.

The output from the VTO (emitter of Q11) is coupled via a .01μF capacitor to the base of Q901, an MPF102 N-channel FET wired as a source follower. Q901 provides the necessary high input impedance to avoid loading the VTO circuit. The output is taken from the source of Q901 and fed via C902 to common emitter amplifier Q902.

Q902 functions as a clipping amplifier. The output of this stage appears at the collector and is a square wave at the same frequency as the VTO. This signal is fed to pin 1 of IC901, a 74LS90 counter which divides by 10. The output of IC901 is taken from pin 12 and applied directly to the count input (pin 8) of IC903.

IC903 is an Intersil ICM7217A 4-bit counter IC. This device has a 4-bit parallel I/O (input/output) port which allows a preset count to be loaded. For the lower band counter, a count of 0000 is loaded while for the upper band counter, a preset count of 5000 is loaded.

IC903 also contains internal latches, BCD to 7-segment decoder drivers and internal multiplexing circuitry. It direct drives a 4-digit common-cathode LED display (3881). Pins 15-18 switch the display digits while pins 21-28 drive the display segments.

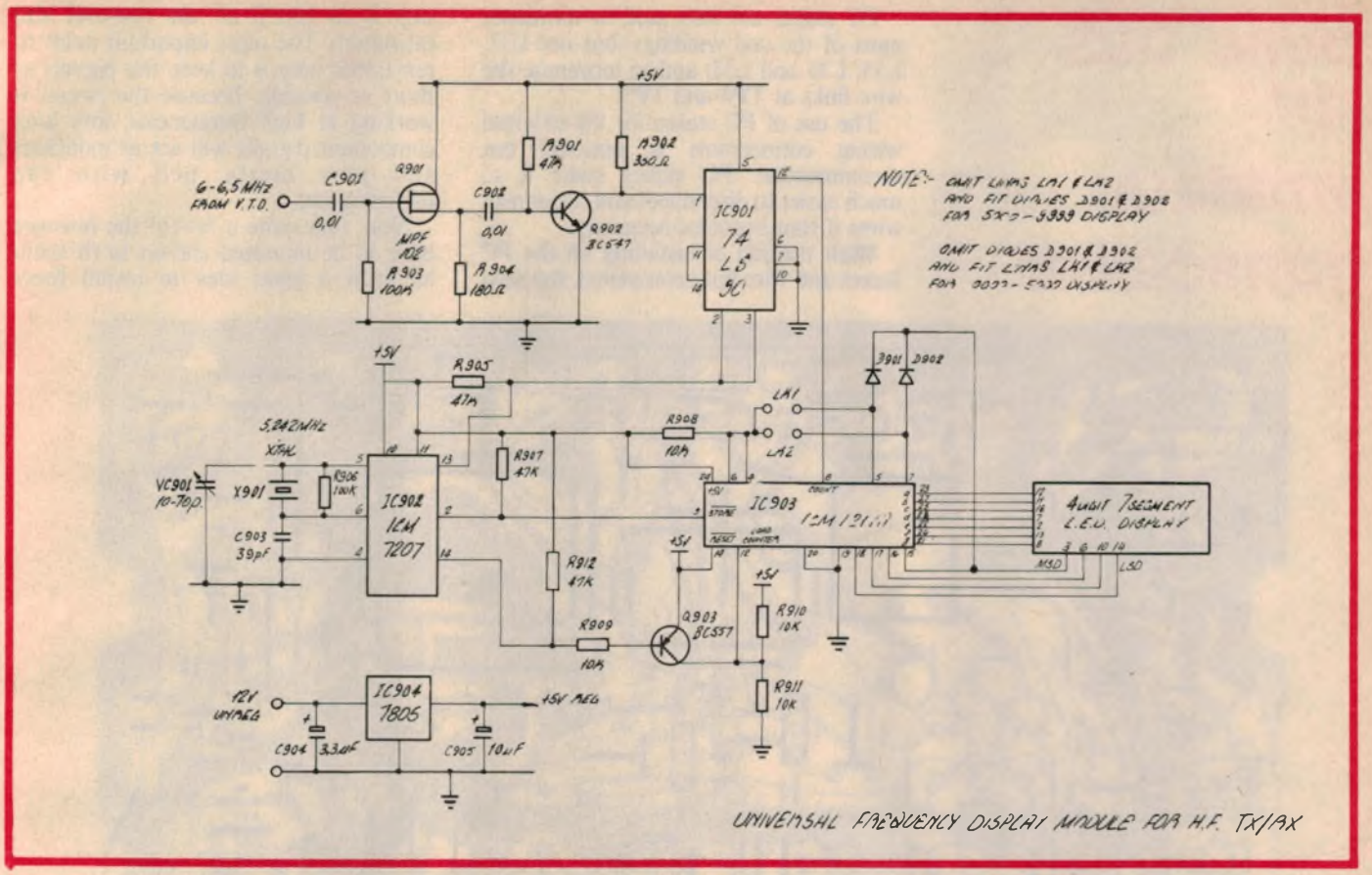
IC902, an Intersil ICM7207 oscillator/frequency divider chip, provides the timebase signals for the counter. Crystal X4 sets the oscillator frequency to 5.24288MHz and this is divided by the chip to produce the STORE and LOAD COUNTER signals on pins 2 and 14 respectively.

Additionally, a 5Hz square wave gating signal appears at pin 13 and this is applied to pins 2 and 3 of IC901. This signal is used to control IC901 which only counts when pins 2 and 3 are pulled low.

The sequence of events is quite straightforward. First, the gating signal (pin 13, IC902) goes low for 0.1s and the divided VTO frequency from IC901 clocks the 7217A counter. Subsequently, at the end of the gating signal, pin 2 of IC902 goes low and the contents of the counter are stored and displayed. Finally, pin 14 of IC902 goes low, Q903 turns on, and the counter is preloaded so that it is ready for the next cycle.

Note that pin 12 of IC903 (LOAD COUNTER) is a Tri-state input. R910 and R911 bias this input to 1/2 Vcc (2.5V) when Q903 is off.

The transceiver is built into an ABS plastic case with two interlocking halves.



D901, D902 and the two wire links set the preload count. For a 0000-5000 display, D901 and D902 are omitted and the links installed so that pins 5 and 7 are pulled high via R908. For a 5000-9999 display, the links are omitted and D901 and D902 installed.

Because the gating period is 0.1s, and because IC901 divides by 10, the VTO frequency is effectively divided by 100. Thus, IC903 counts between 60,000 and 65,000 pulses, depending upon the setting of the VTO. This means that the counter will overflow several times during the count period so that only the last four digits (ie, the remainder) will be displayed.

For example let's say that the VTO is tuned to 6.3895MHz. This means that the 7217A will count 63,895 pulses (ie, 6.3895MHz divided by 100). Thus, the display will read "3895".

Construction

While the circuit of the new HF transceiver is relatively complex, its construction is reasonably simple and does not require any special assembly techniques. A soldering iron and a screwdriver are virtually all you need. Make sure that the iron has a small chisel-shaped bit, for quick and effective soldering.

Most of the parts are accommodated on a single-sided printed circuit board (PCB) measuring 162 × 199mm and coded with the Dick Smith Electronics type number K6330 11. The front and rear panels are also made from PCB copper laminate and are soldered at right angles to the main PCB.

The frequency counter circuit is accommodated on a separate double-sided PCB with plated through holes (both versions use the same board). This is mounted on the main board using machine screws and spacers.

The whole PCB assembly fits into a specially designed ABS plastic case which has two interlocking halves secured by four screws. As can be seen from the photos, the front panel has white silk-screened labelling on a black background. This is combined with an attractive set of knobs, a backlit signal/power meter and the digital readout to produce a professional looking transceiver which is every bit as good as expensive commercial units.

Construction aids

All purchasers of this transceiver kit will receive a detailed assembly manual which describes construction on a step-by-step basis. The parts layout diagram comes complete with a grid pattern and you simply insert each part in turn at the grid location and cross it off the parts list.

In addition, the main PCB will be supplied with a screen-printed overlay to aid the job of parts placement. The copper side of the board will also have a solder mask to reduce the possibility of solder bridges. Provided you take things slowly, it should be almost impossible to make a mistake!

Board preparation

Before actually mounting any of the parts, a certain amount of work on the PCB is necessary. The first job is to remove a 3mm strip of solder mask from the earth pattern at either end of the PCB. This can be done by masking off each 3mm strip with masking tape and then removing the solder mask using a cotton bud dipped in nail polish remover.

Alternatively, the solder mask can be scraped off using a sharp utility knife.

Constructors should also inspect the board very closely to see if the solder mask has encroached on to any of the mounting holes for the components. Check also that all component holes have in fact been drilled and that there is no evidence of bridging in the copper pattern. It's far better to spot and correct any faults at this stage than to try finding them when soldering is complete.

PCB assembly

Now for the PCB assembly. Begin by installing the PC stakes and wire links. Essentially, PC stakes are used at each of the test points (TP1-TP7), as locating points for the front and rear panels, and to support the VTO shield (more on this later).

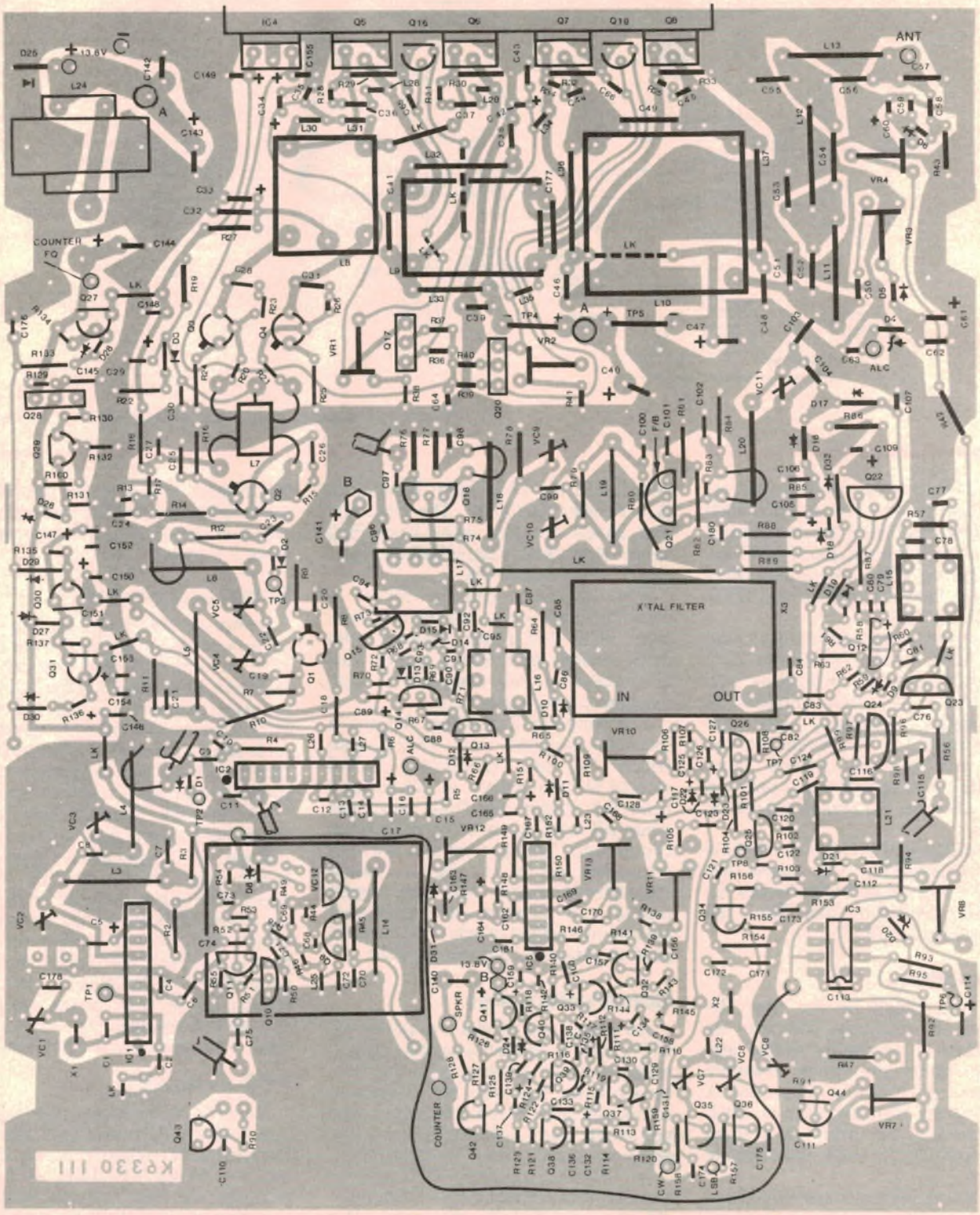
Build this HF amateur transceiver

PC stakes are also used to terminate most of the coil windings (but not L32, L33, L36 and L37) and to terminate the wire links at TP4 and TP5.

The use of PC stakes for the external wiring connections is optional but recommended. PC stakes make it so much easier to disconnect and re-connect wires if that becomes necessary.

With the job of installing all the PC stakes and wire links completed, the next step is to install all the resistors and capacitors. The most important point to remember here is to keep the pigtails as short as possible. Because the circuit is working at high frequencies, any long component pigtails will act as inductors and play merry hell with the performance.

Note that quite a few of the resistors have to be mounted end-on to fit them in. It is a good idea to install these



Parts layout for the main PCB. Tables showing the component values required for each particular frequency band will be supplied with the kit.

vertical resistors with the colour code running down the body. It is then easier to check the resistor values this way.

Little comment is called for with regard to mounting the capacitors except that you must use the capacitor type designated. There are no exceptions here. Do not interchange greencaps (ie, metallised polyester) for ceramics or tantalums for normal electrolytics, or vice versa.

Semiconductors

The next step is to mount the semiconductors. Do not install the 7805/LM340T regulator or transistors Q5-Q8 at this stage. These components are bolted to the rear heatsink and are installed later.

Mount the diodes first and again make sure that the pigtails are kept as short as possible. Check the polarity of each diode carefully as it is inserted into the PCB. Note that many of the diodes are also mounted end on.

Care is also required when mounting the transistors to ensure correct lead orientation. Double check each transistor against its pinout diagram before soldering it into circuit. The small signal plastic pack transistors (but not Q16 and Q19), plus the metal encapsulated MFE131 (Q1), should be mounted so that the transistor bodies are about 3mm above the surface of the board.

In practice, this simply involves pushing the transistors down onto the board as far as they will go without placing undue strain on the leads. Note that a ferrite bead must be fitted to the base lead of Q21 (C1674).

Transistors Q16 and Q19 at the rear of the PCB should be installed about 6mm proud of the board.

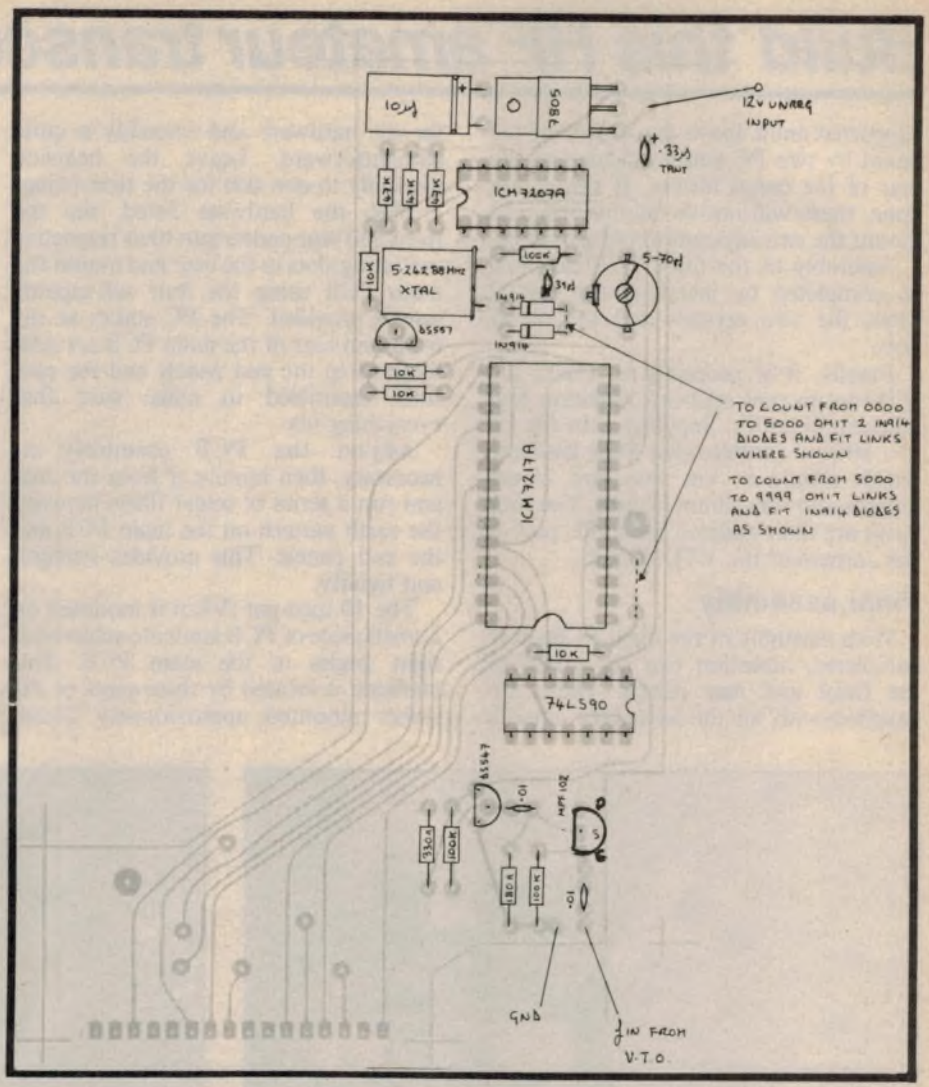
The TO-39 metal package transistors — Q2, Q3 and Q4 — are mounted flat against the PCB. Take care with the orientation of the two BD139 bias regulator transistors (Q17 and Q20) — the metal tabs face towards the two adjacent 1000μF capacitors (C40 and C47). The metal tab of the BD140 faces towards the rear of the PCB.

The integrated circuits should be pushed down onto the PCB as far as they can go before soldering.

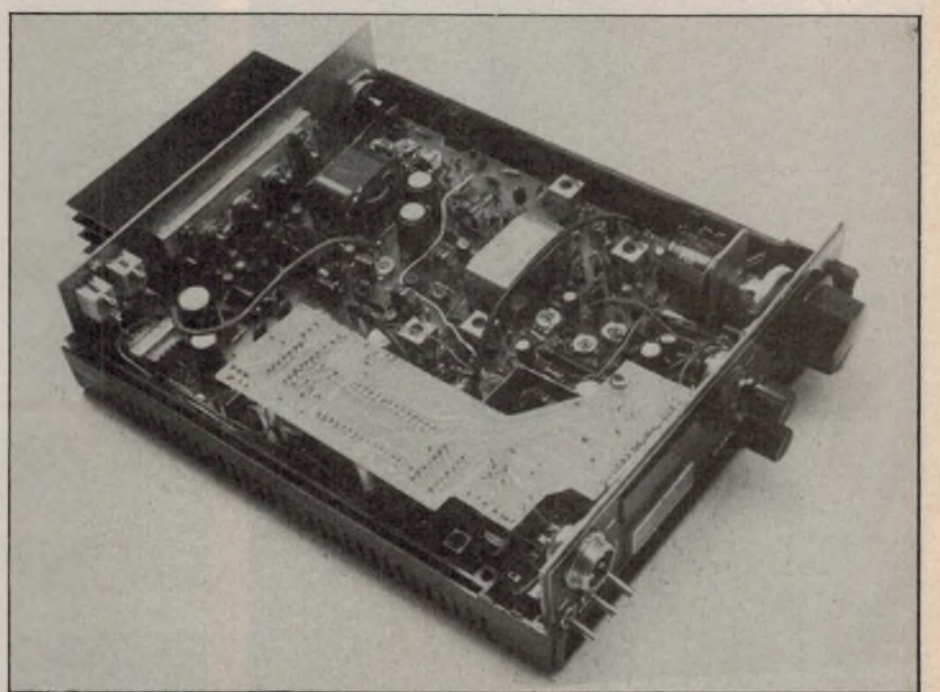
Inductors

At this point, you are ready to begin installing the various RF transformers and coils. Twenty of these have to be wound by you, the constructor. The necessary winding details for the 3.5MHz band are shown in Table 1. Be sure to use the correct gauge of wire for each coil and wind the coils exactly to specification.

Install each coil as it is wound and use PC stakes to terminate the windings where appropriate. Note that L11 is



Above: parts layout for frequency counter PCB (underside of PC pattern shown only).



View inside the completed transceiver. Note that the frequency counter circuit was revised following publication of Pt.1 in the October issue.

supported 6mm above the surface of the board by two PC stakes soldered to the rear of the balun former. If this is not done, there will not be enough room to mount the two adjacent toroid inductors.

Assembly of the main PCB can now be completed by installing the crystal filter, the two crystals and the preset pots.

Finally, it is necessary to shield the VTO to prevent spurious radiation into adjacent circuitry. Supplied with the kit is a strip of double-sided PCB laminate which should be cut into two 28mm lengths and two 38mm lengths. The four strips are then soldered to the PC pins at the corners of the VTO circuit.

Final assembly

With assembly of the main PCBs now completed, attention can be turned to the front and rear panels. These are supplied with all the necessary cutouts for the hardware and assembly is quite straightforward. Leave the heatsink assembly to one side for the time being.

With the hardware fitted, slip the front and rear panels into their respective mounting slots in the case and mount the main PCB using the four self-tapping screws provided. The PC stakes at the front and rear of the main PCB are now soldered to the end panels and the case fully assembled to make sure that everything fits.

Adjust the PCB assembly as necessary, then remove it from the case and run a series of solder fillets between the earth pattern on the main PCB and the end panels. This provides strength and rigidity.

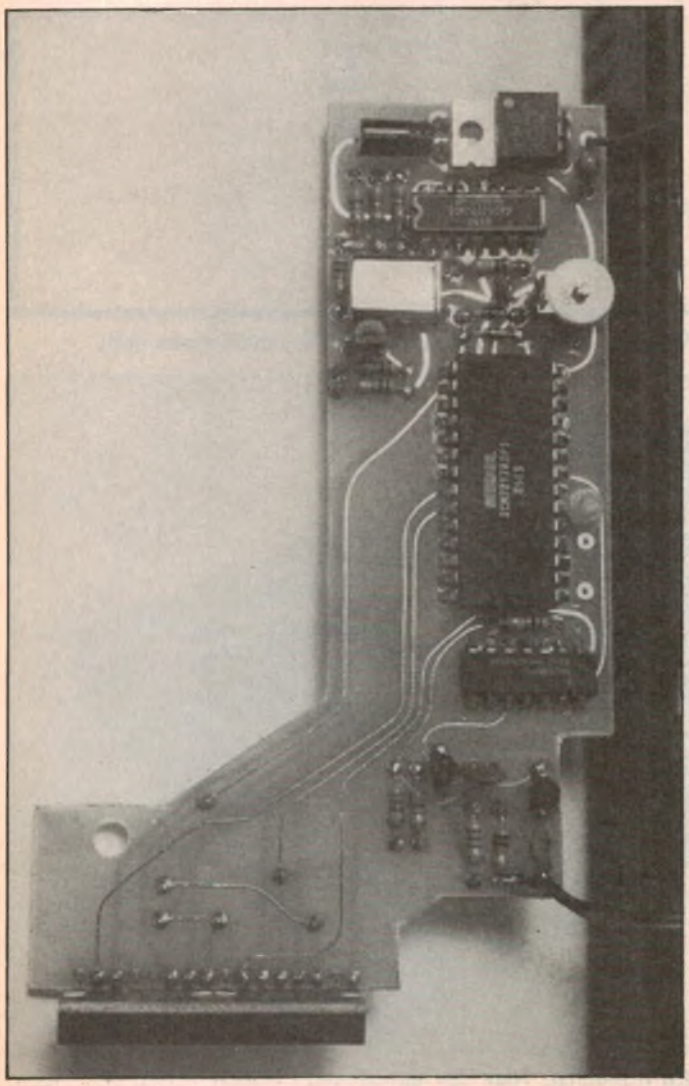
The 10-turn pot (VR5) is mounted on a small piece of PCB laminate soldered at right angles to the main PCB. This laminate is located by three pairs of PC stakes mounted approximately 25mm behind the front panel. The shaft of the pot mates with a 6:1 reduction drive for precise control (see photograph for details).

Now for the heatsink assembly. The first step is to bolt the 3-terminal regulator and the four RF power transistors, Q5, Q6, Q7 and Q8, to the 80 × 25mm aluminium sub-heatsink.

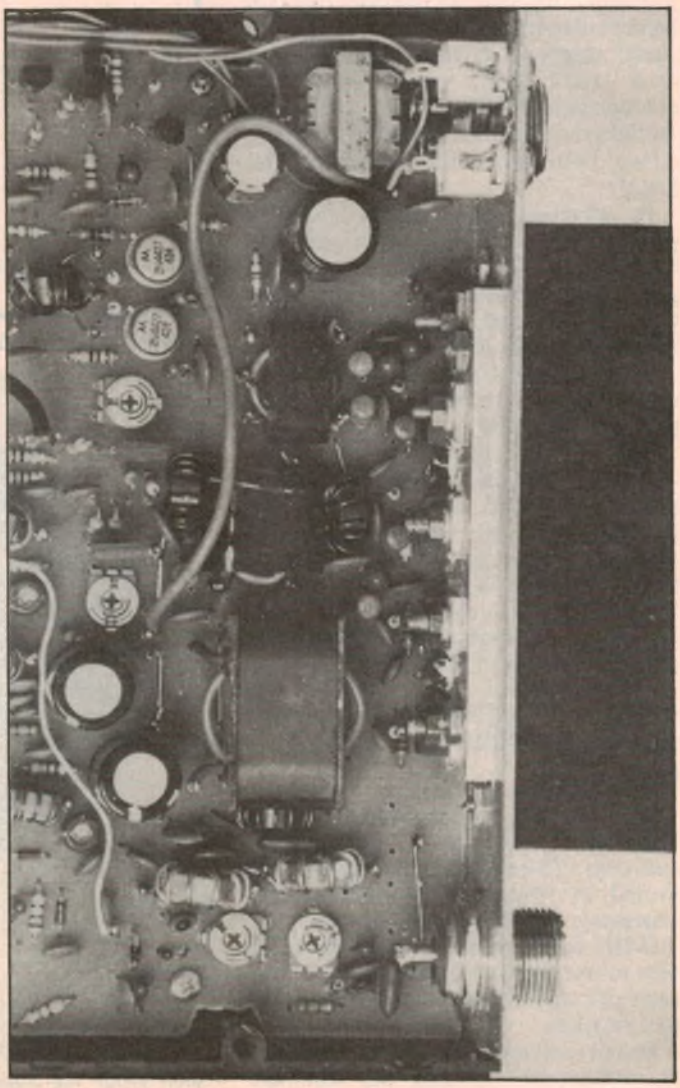
To do this, install the regulator and transistors on the PCB, then introduce the sub-heatsink through the rear-panel cutout. The regulator and transistors can now be bolted to the sub-heatsink using the countersunk screws supplied.

Note that the transistors must be isolated from the heatsink assembly by means of mica washers and insulating bushes. The 3-terminal regulator is bolted directly to the heatsink. Smear all surfaces with heatsink compound before assembly.

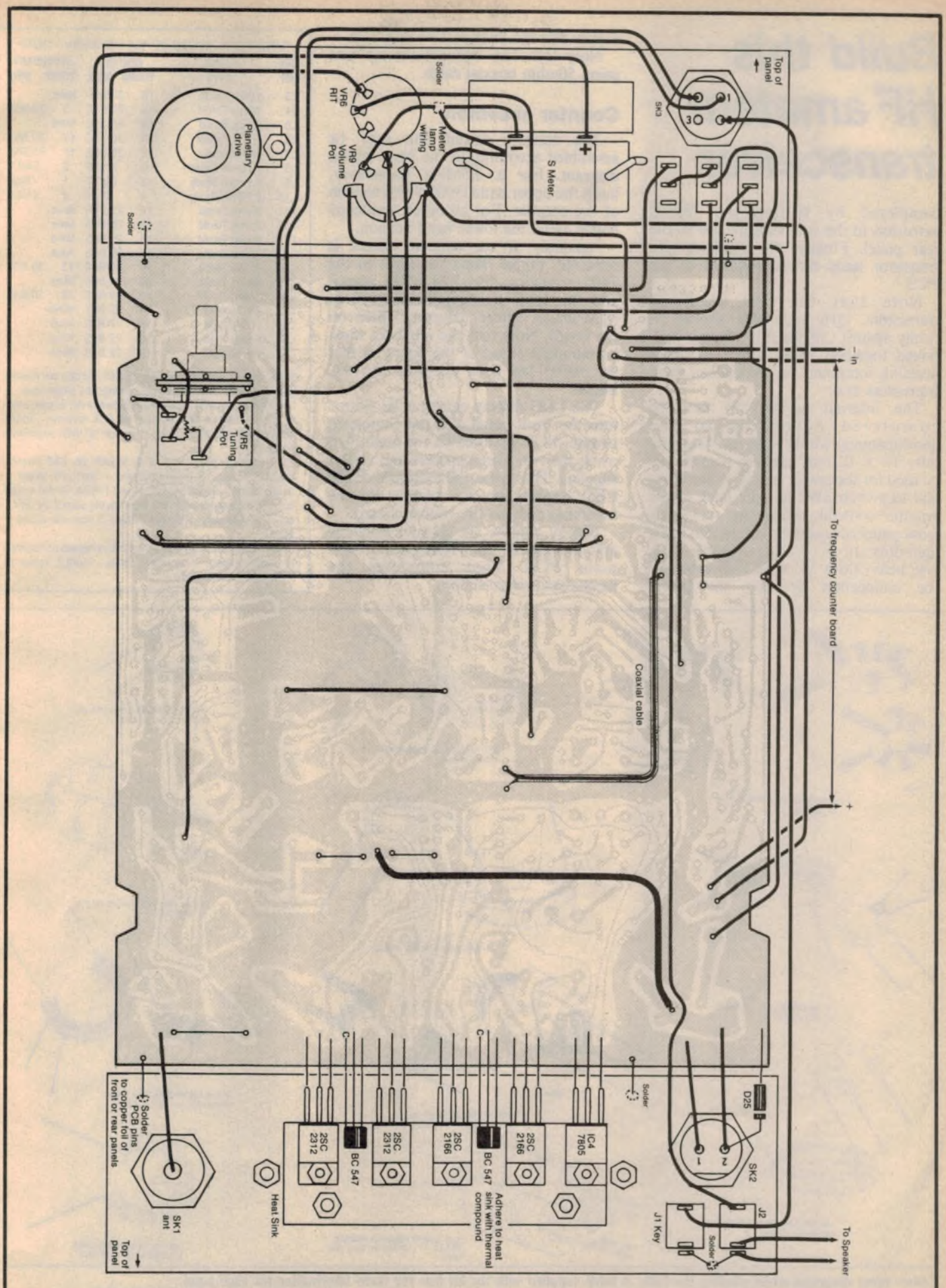
The heatsink assembly can now be



View showing the assembled frequency counter board.



This photo shows the RF output and low pass filter stages.



Note that the 2SC2166 and 2SC2312 transistors must be insulated fron the heatsink using mica washers and bushes.

Build this HF amateur transceiver

completed by bolting the finned extrusion to the sub-heatsink and to the rear panel. Finally, the regulator and transistor leads can be soldered to the PCB.

Note that the bias regulator transistors, Q16 and Q19, should sit firmly against the heatsink when it is all bolted together. Don't forget to smear heatsink compound on the faces of these transistors also.

The internal wiring can now be completed according to the accompanying wiring diagram. Medium-duty 10 × 0.2mm hook-up wire should be used for the power supply connections and to switch SW1 (on the back of the volume control), while the remaining front panel connections can be run using light-duty 10 × 0.12mm flexible wire. Use heavy-duty 24 × 0.2mm cable for the connection between the power supply and the links at TP4 and TP5.

Note that two connections are run using 50-ohm coaxial cable.

Counter assembly

The counter circuit can now be assembled according to the parts layout diagram. For a 3.5MHz transceiver, build the upper band (5000-9999) version of the counter. For all other frequency bands, build the lower band version.

Assembly of the counter circuit is relatively simple. Bend the leads to the 7805 regulator, the 5.242MHz crystal and the 10μF electrolytic capacitor at right angles before mounting them on the board. Note that the regulator must be mounted proud of the board so that the metal tab does not foul the PC tracks.

The LED display can now be slotted into the front panel and the completed counter PCB mounted on the main PCB using the two 35mm spacers and screws supplied. That done, the terminals on the LED display can be soldered to the matching pads on the counter board.

Finally, remove the counter assembly and connect the three flying leads to the main PCB. That completes the mechanical construction.

TABLE 1: COIL WINDING DETAILS FOR 3.5MHz VERSION

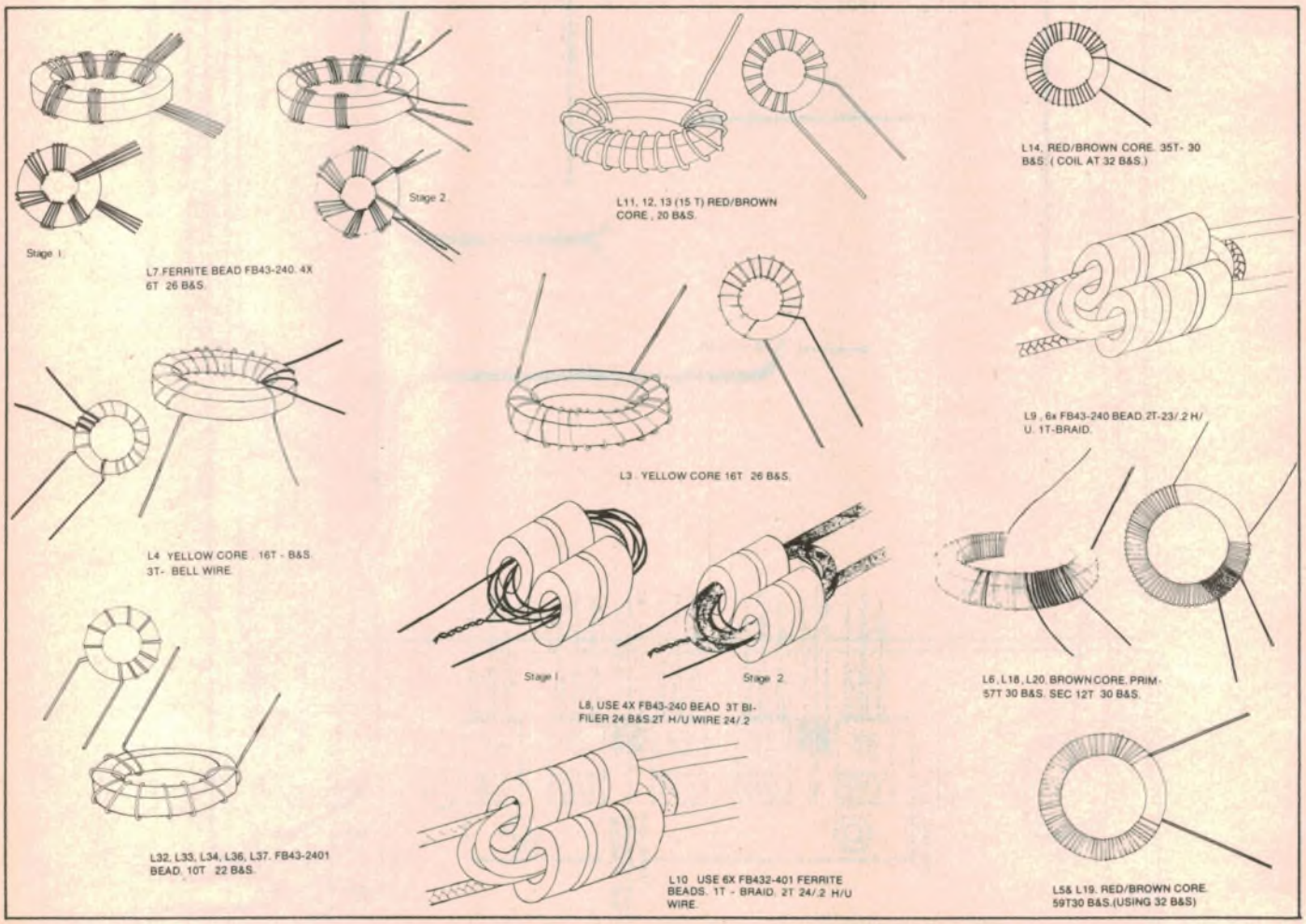
COIL REF.	CORE TYPE	PRIMARY TURNS	PRIMARY WIRE	SECONDARY TURNS	SECONDARY WIRE
L3	Yellow Toroid	16	25 B&S	None	
L4	Yellow Toroid	16	25 B&S	3	25 B&S
L5	Brown Toroid	59	30 B&S	None	
L6	Brown Toroid	59	30 B&S	12	30 B&S
L7	Ferrite Bead	12	25 B&S	12	25 B&S
L8	4 Ferrite Beads	6	24/0.2	2	24/0.2
L9	6 Ferrite Beads	2	24/0.2	1	Braid
L10	6 Ferrite Beads	1	Braid	2	24/0.2
L11	Brown Toroid	15	20 B&S	None	
L12	Brown Toroid	15	20 B&S	None	
L13	Brown Toroid	15	20 B&S	None	
L14	Brown Toroid	35	30 B&S	None	
L18	Brown Toroid	59	30 B&S	12	30 B&S
L19	Brown Toroid	59	30 B&S	None	
L20	Brown Toroid	59	30 B&S	12	30 B&S
L32	Ferrite Bead	10	22 B&S	None	
L33	Ferrite Bead	10	22 B&S	None	
L36	Ferrite Bead	10	22 B&S	None	
L37	Ferrite Bead	10	22 B&S	None	

Notes: Ferrite beads are type FB 43-240. Toroids are Amidon HF iron powder cores. All toroid windings are single layer.

☐ All toroid primaries have a space between the winding ends to provide correct lead spacing for PCB mounting. Toroid secondaries are wound over one end of their respective primaries.

☐ L7 consists of 6 turns of 4 strands 25 B&S twisted together. Primary is between strand 1 start and strand 2 finish. Strand 2 start is joined to strand 1 finish. Strand 4 start is joined to strand 3 finish and becomes the secondary centre tap. The secondary is between strand 3 start and strand 4 finish.

☐ The turns on L14 should be bunched or spread as required to obtain correct VTO tuning range. 240/0.2 refers to 24/0.2mm insulated wire.



Follow these diagrams when winding the coils. A table supplied with the kit lists the turns information for each band.

MERRY CHRISTMAS FROM ROD IRVING ELECTRONICS!

MODEMS

RITRON MULTI PURPOSE MODEM
Our New RITRON Multi Purpose Modem has arrived and has all the standards you require. Just check the Ritron's features:
- CCITT V21 300 Baud Full duplex
- CCITT V23 1200/75
- Bell 103 300 Full duplex
- Bell 202 1200 Half duplex
- Auto answer, auto disconnect.

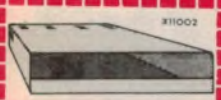
Telecom Approval No. C84/37/1134
$379

1200/75 BAUD RATE/BIT CONVERTER
For computers not capable of split baud rates. Buffers characters at 1200 and converts to 75 baud.
Cat. X1910-5 **$99**

MODEM PHONE
Check the features and the value for money of this stylish new modem phone.
- Auto/Manual Answer, Manual Originate, Auto Disconnect.
- Speaker Phone with Built-in Amplifier for Detecting Busy Signal during communication.
- Carrier Detect Indication.
- 20 Memories (each with 18 Digits Capacity) for Auto-dialing.
- BELL 103 CCITT V21 Compatible.
- 300 BPS Full Duplex.
- Last Number Redial.
- Pushbutton Keyboard.
- Volume High or Low Control.
- "In-use" Dialing Indicator.

Cat. X19105 **only $174**
(Not Telecom approved)

HARDWARE



COMPUTER AND DISK DRIVE CASES AND POWER SUPPLIES

5¼" DRIVES

1 x 5¼" Slimline Drive Case
X11001 Bare Case **$49**
X11011 Case and Pwr Supply **$109**

2 x 5¼" Slimline Drive Case
X11002 Bare Case **$69**
X11012 Case & Pwr Supply **$149**

1 x 5¼" Standard Drive Case
X11003 Bare Case **$45**
X11013 Case & Pwr Supply **$109**

2 x 5¼" Standard Drive Case
X11004 Bare Case **$59**
X11014 Case & Pwr Supply **$149**

8" DRIVES

1x 8" Standard or 2 x 8" Slimline and computer Case (BB1)
X11006 Bare Case **$99**
X11016 Case & Pwr Supply **$399**

2 x 8" Slimline Drives and Computer Case
(BB1 and BB2 etc)
X11007 Bare Case **$145**
X11017 Case & Pwr Supply **$399**

1 x 8" Slimline Drive Case
X11020 Bare Case **$95**
X11022 Case & Pwr Supply **$159**

Dual 8" Slimline Drive Case
X11025 Bare Case **$99**
X11026 Case & Pwr Supply **$275**

130W IBM COMPATIBLE SWITCH MODE POWER SUPPLY
DC output: +5/13A, -5V/0.5A
+12V/4.5A -12V/0.5A
AC Input: 240V AC +—15% 1.5A
47Hz - 63Hz
Cat. X11096 **$239**

UV EPROM ERASER
Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety in about 40 minutes (less for less chips). High UV intensity at chip surface ensures EPROMS are thoroughly erased.
Cat. X14950 **$89.50**
(Dimensions 217 x 80 x 68mm)

DRIVES

APPLE* COMPATIBLE SLIMLINE DISK DRIVE
Japanese Chinon mechanism.
Normally $225 **This month $185**
(*Apple is a registered trade mark.)

MITSUBISHI DISK DRIVES

MF353 (3½" DRIVE)
Double sided, double density, 1 M/Byte unformatted, 80 track per side.
Cat. C11953 **$280**

M2896-63
Slimline 8" Disk Drive. Double sided Density No AC power required. 3ms track to track. 1.6 Mbytes unformatted. 77 track side 10s/su10 bit soft error rate.
Cat. C11916 **$550**

M2894
Standard size 8" drive. Double
Cat. C11914 **$630**

M4854
Slimline 5¼" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1.6Mbyte unformatted 3ms track to track access, 77 track/side.
Cat. C11904 **$350**

M4853
Slimline 5¼" disk drive. Double sided, double density, 1 Mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.
Cat. C11903 **$260**

M4851
Slimline 5¼" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system.
Cat. C11901 **$199**

M4855
Slimline 5¼" disk drive, double sided, double density, 96 track/inch, 2.0 Mbytes unformatted.
Cat. C11905 **$385**

MF351
3½" Standard size disk drive. Single sided, double density.
Cat. C11921 **$225**

CARDS

APPLE* COMPATIBLE CARDS

Printer Card Cat. X17029	$89
Drive Card Cat. X17019	$95
80 Column Card Cat. X17025	$109
Speech Card Cat. X17009	$69
Music Card Cat. X17011	$99
Super Serial Cat. X17035	$129
RGB Card Cat. X17039	$79

IBM COMPATIBLE CARDS

MULTIFUNCTION CARD
(384K RAM) Parallel, serial and game port. Plus battery backup clock.
Cat. X18013 **$429**

DISK CONTROLLER CARD
Controls 2 slimline drives
Cat. X18005 **$149**

HIGH RESOLUTION MONOCHROME GRAPHICS CARD
Give your IBM real graphics capability.
Cat. X18007 **$249**

512K RAM CARD
(Includes RAM)
Cat. X18015 **$399**

MONITORS

PHOENIX 4
- R.G.B. TTL.
- High Resolution.
- 13" CRT Dot Pitch 0.31mm.
- Horiz. Resolution 720 dots.
- Vert. Resolution 240 T.V. Lines.
- Display Characters 2000 Ch. (80 x 25).
- 8 Display colours and intensity.
- Green text display.

Cat. X14520 **$799**

PHOENIX 5
Suits Apple, Commodore, even your VCR!
- Pal and R.G.B.
- Normal Resolution.
- 13" CRT Dot Pitch 0.65mm.
- Horiz. Resol. 320 TV lines.
- Vert. Resol. 560 TV lines.
- Display Characters 1.000 Ch.(40x25).
- 16 Colours (Pal).
- Green text display.

Cat. X14522 **$499**

RITRON 2
Stylish swivel base monitor, available in amber or green.
Green Cat. X14500 **$215**
Amber Cat. X14500 **$219**

SOFTWARE

GRAPHIC MOUSE SYSTEM
Now everybody can create superb computer graphics in minutes. Think of how much more professional your work could look with the 'Graphic Mouse'! An absolute must for Apple IIe users. Includes software and mouse.
Cat. X17037 **only $99**

JOYSTICKS

APPLE JOYSTICKS
Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 **$29.95**

DISKETTES

5¼" FLOPPY DISK SPECIALS!

XIDEX

	1-9	10+
S/S D/D Cat C12401	$31.00	$29.00
D/S D/D Cat C12410	$38.95	$36.50

VERBATIM DATALIFE

S/D D/D Cat. C12501	$27.95	$26.95
D/D D/D Cat C12504	$39.95	$37.95

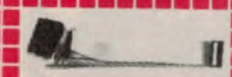
VERBATIM VALULIFE

S/D D/D Cat C12421	$24.95	$22.95
D/D D/D Cat C12425	$31.95	$29.95

3½" XIDEX DISKETTES!
Yes, that's right, we now have "hard to get" 3½" diskettes!
Cat. C12600 S/S box of 10 **$65**

MINI DISK STORAGE BOX
Holds up to 30 x 5¼" diskettes.
Cat. C16020 **$16.95**

CABLES AND CONNECTORS



COMPUTER LEADS
We have a wide range of computer leads available, all at very reasonable prices!

APPLE:
- Apple II, IIe, II+, with parallel interface card
- Dual 10 pin (20 contacts) connector to Centronics 36 pin plug
- Length 2.4 metres

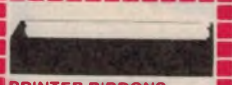
Cat. P19025 **$24.95**

IBM
- IBM PC, XT, and look alikes with 25 pin "D" plug on computer end to Centronics 36 pin plug on printer end.
- Length 2.1 metres

Cat. P19029 **$34.95**

PRINTERS

NEW 180 CPS PRINTER! KAITEC KAI 180 EX
Standard 80 column Dot Matrix Printer. High quality printing by NLQ mode. 3K Buffer. High-speed, low-energy consumption 9 wire dot head gives: Printing speed 180 C.P.S.
Logic seeking printing or incremental printing with high response, stepping motor. Use of fan-fold, roll or cut-sheet paper is possible with adjustable sprocket pin feed and friction feed. Both fixed and proportional character pitches are available. Emphasized and double print modes are possible. 9 graphic modes are available. 8 language international character font internalized.
SPECIFICATIONS:
Printing Type: Impact Dot Matrix
Maximum Printing Range: 203mm
Print Types: ASCII 96 Others 7 language
Character Format: Character Mode Standard 9 x 9 dots
NLQ 18 x 20 dots Graphic Mode
Printer Modes: (a) Fixed pitch mode (b) Proportional pitch mode
Character Size: 2.42(H)x 1.99(W)
Printing Speed: 180 Character per sec. (pica)
Paper Feed Method: (a) Adjustable sprocket pin feed paper width 4-10 inch (pull through) (b) Friction feed paper width 4-8.5 inch
Interface: Parallel interface 8-bit parallel (Conforms to Centronics)
Cat. C20020 **Only $499**



PRINTER RIBBONS
CP80, BX80, DP80, BX100, MB100
$9.90

IBM* COMPATIBLES from $1,495!

Incredible deals to suit everyone including our special package deals!

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. **only $1,495**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty **only $2,100**

256K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, A 120 C.P.S. printer and a monochrome monitor and 3 months warranty! **only $2,400**

640K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, A 120 C.P.S. printer, a monochrome monitor and 3 months warranty! **only $2,500**

*IBM is a registered trademark

ROD IRVING ELECTRONICS
425 High Street, NORTHCOTE, 3070
VICTORIA, AUSTRALIA
Phone (03) 489 8866

48 A'Beckett St, MELBOURNE, 3000
VICTORIA, AUSTRALIA
Ph. (03) 663 6151

Mail Order and correspondance
P.O. Box 620, CLAYTON 3168
TELEX: AA 151938

MAIL ORDER HOTLINE (03) 543 7877 (2 lines)

POSTAGE RATES

$1-$9.99	$2.00
$10-$24.99	$3.00
$25-$49.99	$4.00
$50-$99.99	$5.00
$100-199	$7.50
$200-$499	$10.00
$500 plus	$12.50

This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.
Certified Post for orders over $100 included "free"!
Registered Post for orders over $200 included "free"!

MasterCard VISA

Errors and Omissions Excepted.

BANKCARD
VISA
MASTERCARD

SIGNATURE EXPIRY DATE / /

NAME

ADDRESS

P/CODE

EA/12/85 DATE / /

Build this HF amateur transceiver

Alignment

Most constructors will build the 3.5MHz (80-metre) version of the HF transceiver, so the following alignment notes are for this band only. Alignment details for other versions are similar and are given in the assembly manual.

The alignment procedure is quite straightforward although you do need access to some test equipment: (1) a digital multimeter; (2) a general coverage shortwave receiver; and (3) a dummy load (eg, Electronics Australia, November 1975, File No. 7/SW/8; or Dick Smith Cat No. D-7010).

A digital frequency meter (DFM) would be useful but is by no means essential since the transceiver's internal frequency counter can be used for alignment. A 15MHz CRO, an RF signal generator and a power meter would also be handy but again are not essential.

Initial checks

(a) Connect the transceiver to a 13.8V supply. The meter lamp should light and the LED readout should display the VTO frequency. This can be checked by adjusting the tuning control — the readout should change.

(b) Turn volume control fully clockwise. Hiss should be heard from the loudspeaker.

(c) If difficulty is experienced, refer to the fault-finding section in the manual.

Frequency counter alignment

(a) Adjust the crystal oscillator in the counter for correct frequency by using an external DFM or calibrated HF receiver.

(b) Disconnect the lead between the VTO and the frequency counter input at the VTO end (ie, leave the other end of the lead connected to the counter input). This lead now becomes a wandering test point to help in alignment.

(c) Connect the test lead to test point TP1 and adjust VC1 for correct crystal frequency. For example, in an 80-metre transceiver the correct adjustment will give a reading of "1920", or 8.1920MHz on an external DFM.

Offset oscillator

(a) Connect the counter to TP8, select USB and adjust VC6 for a reading of "6950" (10.6950MHz on an external DFM).

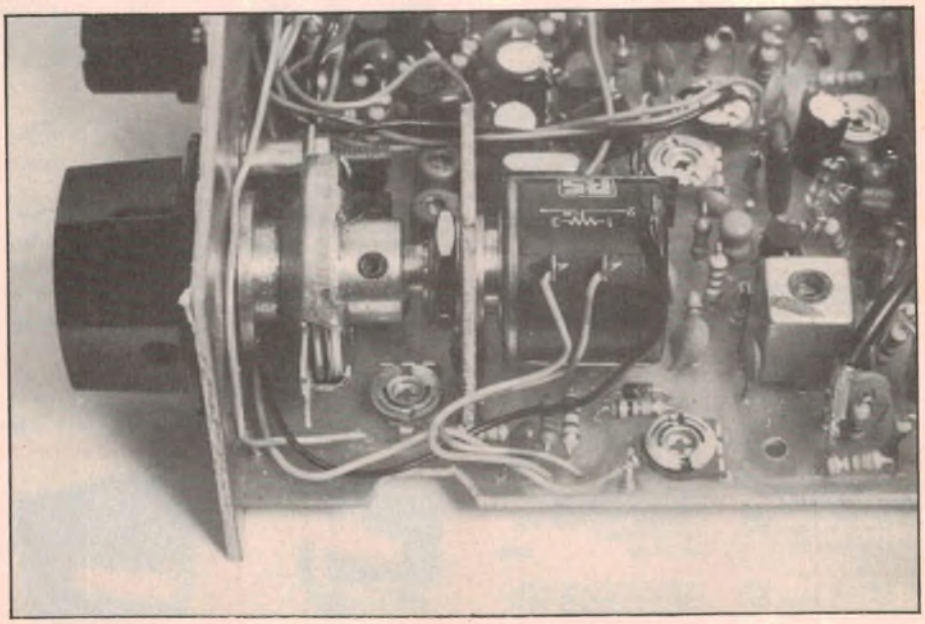
(b) Select LSB and adjust VC7 for a reading of "6920" (10.6920MHz).

(c) Select CW and adjust VC8 for a reading of "6935" (10.6935MHz).

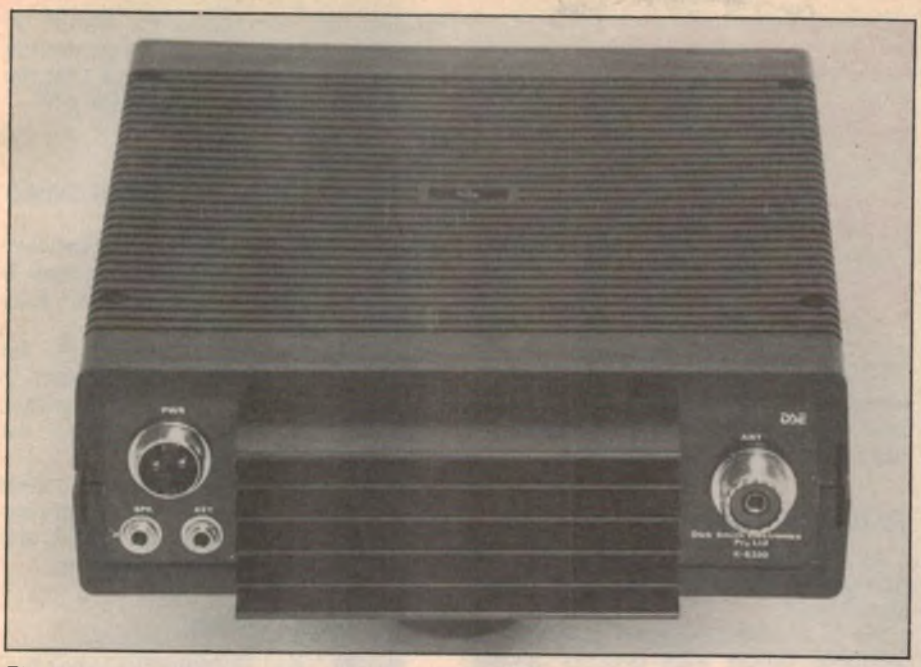
(d) Reconnect test lead to VTO output. Display should now read VTO frequency.

VTO alignment

The VTO should theoretically cover 6-6.5MHz when the main tuning control is rotated from one extreme to the other. In practice, the VTO should be adjusted for a 100kHz overrange at either end (ie, the VTO should cover 5.9MHz to 6.6MHz).



This close-up view shows how the 10-turn tuning pot is mounted.



The rear pannel carries various sockets for power, speaker, key and antenna connections.

(a) Set the RIT (clarifier) switch to the centre-off position.

(b) Set the tuning control fully anti-clockwise and note the reading on the display. This should be around 4000 (ie, 100kHz below 500kHz).

(c) Adjust the tuning control fully clockwise. The display should now read around 1000 (ie, 100kHz above 999.9kHz).

(d) If this tuning range cannot be achieved, adjustment of the turns on L14 will be required.

L14 is adjusted by spreading out or bunching the turns over approximately one-third of the winding. Several adjustments may be required to give a VTO range of 6-6.5MHz with equal 100kHz overrange at either end. An overlap of around 100kHz is desirable, but 50kHz is acceptable.

When the tuning range is correct, L14 should be glued in position using epoxy adhesive. Exercise care with this adjustment, as the performance of the transceiver is dependent on the VTO.

Note: if the lower band version of the counter is used, L14 should be adjusted so that the display reads between 9000 and 6000 (ie, 100kHz below 0kHz and 100kHz above 500kHz).

Heterodyne mixer

(a) Connect a 100μA DC meter (use your multimeter) to TP2 and set VTO to centre range (ie, for a display reading of 2500 or 7500).

(b) Adjust VC2 and VC3 for maximum reading (about 30μA).

(c) If an external DFM is available, check the frequency at the output of L4. This should be the crystal oscillator frequency plus the VTO frequency. For example, if the crystal oscillator frequency is 8.192MHz and the VTO is set to 6.25MHz, the DFM should read 14.442MHz.

This can also be checked by placing the antenna to a shortwave receiver close to L4.

Receiver alignment

(a) Advance volume control fully and adjust L21, L15, L16 and L17 in order for maximum noise from the loudspeaker.

(b) If a calibrated signal generator is available, adjust the output of the generator to 10.6935MHz and select CW mode on the transceiver.

(c) Peak L21, L15, L16 and L17 for maximum reading with considerable input into the emitter of mixer transistor Q18 via a 100pF coupling capacitor. Approximately 10μV from the signal generator will produce a meter deflection. Note that VR8 (meter adjust) should be set approximately three-quarters clockwise.

(d) Connect a 3.5MHz 50-ohm antenna to the transceiver and check for receiver noise. Tune to the centre of the band.

(e) With no received signal, peak VC9, VC10 and VC11 in order for maximum receiver noise. This can also be observed as a small deflection on the S-meter.

(f) If a calibrated signal generator is available, connect it to the antenna input and adjust it for a half-scale reading on the S-meter. Reduce the signal generator level as VC9, VC10 and VC11 are tuned for maximum reading.

Note: most operators will use only a small portion of the tuning range, eg 3.5MHz to 3.7MHz. In this case, VC9,

Build this HF amateur transceiver

VC10 and VC11 should be adjusted to obtain equal sensitivity at the top and bottom of the range after first aligning at the centre frequency (3.6MHz).

AGC and S-meter

(a) Connect a DC voltmeter to TP7 and adjust VR10 for 2V DC with no signal input.

(b) If a calibrated signal generator is available, adjust VR8 (S-meter adjust) for an S9 reading with 100μV input.

Transmitter alignment

(a) Set VR1, VR2, VR4, VR12 and VR13 to mid-position.

(b) Set VR3 and VR11 fully anti-clockwise.

(c) Note reading on counter and tune for convenient readout; eg, 2000.

(d) Connect the microphone, operate the PTT switch and set VR7 for the same reading. Release the PTT switch and check that the reading stays the same.

(e) Connect a 50-ohm dummy load to the transceiver output and select either USB or LSB.

(f) Remove link from TP4 and insert a 100mA meter with polarity as shown on PC overlay.

(g) Press PTT switch and adjust VR1 for 50mA idling current with no microphone input. Note: this reading will take time to stabilise as the driver transistor bias circuit equalises in temperature.

(h) Re-install the link at TP4 and install the meter at TP5. Adjust VR2 for a reading of 100mA. As before, allow time for the reading to stabilise.

Second mixer

(a) Set VC4 and VC5 to mid-position, select CW mode and connect a DC amp meter (0-5A) in the power lead.

(b) Connect a 100mA meter to TP3.

(c) Set the transceiver to the centre of the band, operate the PTT button or key, and adjust VC4 and VC5 for maximum reading at TP3. Note: operate the PTT or key for short periods only. Use your hand to check for excessive heatsink temperature.

At this stage, RF output should be evident and the transceiver should be drawing in excess of 3A. If an external power meter is available, check that the transmitter delivers around 15W CW.

Balanced modulator

(a) Select the USB mode and connect a dummy load to the output.

(b) Couple the load to a shortwave receiver or CRO via a coupling loop (a few turns will do) and set VR11 fully anticlockwise.

(c) Adjust VR12 and VR13 for minimum RF output with no input to the microphone. If using a shortwave receiver, set VR12 and VR13 for minimum S-meter reading.

(d) Switch to LSB mode and repeat step (c). If using a CRO, switch between USB and LSB and adjust VR12 and VR13 for equal minimum readings.

ALC adjustment

(a) Set VR11 three-quarters clockwise and select either USB or LSB mode. Set VR3 (ALC adjustment) fully anti-clockwise.

(b) Operate PTT while whistling into the microphone. The current drawn by the transceiver should increase towards 5A peak during short whistle bursts.

(c) Rotate VR3 clockwise until RF output just decreases as short whistles are fed to the microphone. This can be monitored using a CRO or shortwave receiver as above and can also be seen on the RF output meter on the front panel.

(d) If the transceiver is to be used to drive a linear amplifier, and the full 30W PEP is not required, the ALC control can be used to reduce the RF output to the required level.

Final adjustments

(a) Connect a calibrated RF power meter and adjust VR4 to obtain a similar reading on the front panel meter. If no external power meter is available, operate PTT switch, whistle into microphone and set VR4 so that the front panel meter reads in red on signal peaks.

(b) Connect a CRO to the output via a coupling loop (use dummy load) and set VR3 for minimum envelope clipping when speaking into the microphone.

(c) With the output heatsink warm (from use), a final check of transmitter bias at test points TP4 and TP5 should be made. Insert a current meter at each test point in turn as described previously. Adjust VR1 for 50mA at TP4 and VR2 for 100mA at TP5 with no signal input. Allow time for the readings to stabilise.

Construction of the HF transceiver is now completed. Note that the unit can draw up to 5A on transmit and requires a good regulated power supply for correct operation.

Books & Literature

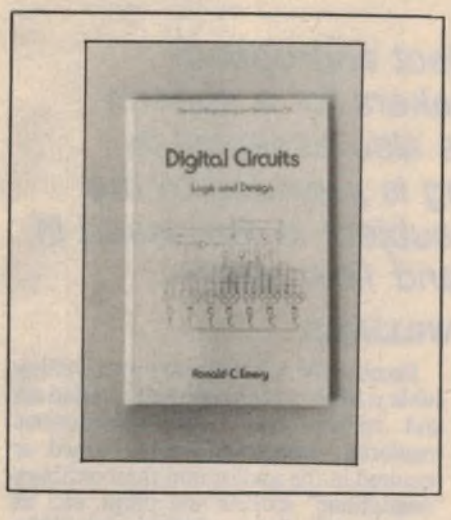
Electrical engineering and electronics

DIGITAL CIRCUITS, Logic and Design (Electrical Engineering and Electronics Series, Vol 25): by Ronald C. Emery. Published 1985 by Marcel Dekker, Inc New York and Basel. Hard covers, 157mm x 236mm, 232 pages, illustrated. ISBN 0-8247-7397-7. Recommended retail price $47.50.

Digital circuits are an essential part of any electronics course. In this text the author introduces the student to the basics of digital circuits — both combinational and sequential — in a systematic and logical order of self contained chapters. These consist of an introduction, text material, examples, a summary, and problems.

As with many other texts, this book teaches both theory and practice.

The book discusses Boolean algebra concepts and their application to electronic circuitry; minimisation techniques of combinational digital circuits; the application of combinational circuit concepts to practical problems; sequential circuits, their characteristics and limitations; and methods of developing general sequential circuitry.



Numerous diagrams with explanations are used to describe many IC logic chips now available commercially. In short, a book that should prove invaluable to the student and for the practising engineer.

Our review copy came from the publishers, Marcel Dekker, Inc, 270 Madison Avenue, New York NY 10016, USA. (L.U.)

IBM personal computer manual

USING YOUR IBM PERSONAL COMPUTER: by Lon Poole. Published 1983 by Howard W. Sams & Co, Inc. Soft cover 202mm x 235mm, 314 pages, illustrated with diagrams, tables and photographs. ISBN 0-672-22000-8. Recommended retail price $29.95.

Learning the ins and outs of a personal computer (PC) can take time. This soft cover book on the IBM PC can make this process a little less fraught with difficulty and is certainly informative reading for anyone who wants to know more about PCs and what makes them tick.

The book has been divided into two sections. The first deals with the basics of packaged programs while the second section gives a comprehensive guide to writing your own BASIC programs.

Each section is further broken down into chapters of manageable size, five in the first part and 10 in the second. Accompanied by well captioned photographs and illustrations, the first chapters go a long way towards giving the reader a good overall view of the IBM PC.

In chapter two, the author explains the start-up procedure and gives directions for using the printer. By the time the reader has reached chapter four, he or she should have no difficulty in using packaged programs with the computer.

In the second section, the user is introduced to the rudiments of BASIC programming. The straightforward text used by the author makes the concepts easy to follow and quickly dispels the mysteries of the technology.,

Our review copy came from Dick Smith Electronics Pty Ltd and would make a useful manual for any IBM PC or Challenger owner. (L.U.)

Digital instrumentation

DIGITAL INSTRUMENTATION: by A. J. Bouwens. Published 1984 by McGraw-Hill Book Company, New York. Hard covers 157mm x 236mm, 330 pages, illustrated with diagrams. ISBN 0-07-006712-0. Recommended retail price $72.95.

Digital Instrumentation is distributed in Australia by McGraw Hill and is part of a series of test and measurement books written at Philips Industries in the Netherlands.

The author of this title, A. J. Bouwens, is well versed in the development of test and measurement equipment, having worked in this area for over 30 years.

Bouwens has split his discussion into three very distinct parts. The first covers "Basic Binary Theory and Logic Circuits", the second covers "Digital Counters and Timers" and the third, "Digital Voltmeters and Multimeters".

Within these sections are building block chapters which take the reader carefully through the concepts of digital instrumentation. These chapters deal with such things as the various logic elements (AND, NAND, NOR, etc), the modes of operation of digital counters, and timers, and operational amplifiers.

The many tables and diagrams are clear and easy to follow and amply illustrate the author's points in a concrete fashion. For the student, specifically, there are a number of questions at the end of each chapter. Working through these would be a must for anyone wishing to familiarise themselves with the concepts covered in each chapter.

An answer section for these questions is stowed neatly away at the back of the book, along with a comprehensive Glossary of Terms. For the engineer or student, this book (which is based on a Philip's training course) would make extremely useful reference material. (L.U.)

Making speakers understood: Pt.3

The PA system must be correctly installed

While it is important to select appropriate microphones and loudspeakers for a speech reinforcement system, it is also essential to ensure that suitable cabling is provided to the associated amplifier. The subject is discussed in some detail in this third and final article.

by NEVILLE WILLIAMS

In a domestic installation, interconnection of the various units is a fairly routine procedure, if only because most of the cables are only about a metre long, while those to the loudspeakers are unlikely to exceed about 10 metres. If a microphone is required at all, it is usually of a type fitted with three metres or so of shielded cable and 6mm connector(s) which plug directly into the amplifier or cassette deck.

In a typical local church or auditorium, however, the cable links are usually much longer and need to be planned with care, if the performance of the system is not to be prejudiced.

This follows from the fact that it is normal practice to install the amplifier behind the audience — therefore remote from the microphones and loudspeakers — so that the system can be controlled as necessary, without causing a distraction.

The ultimate provision is undoubtedly a small theatre-style booth to accommodate the amplifier, along with other possible recording, projection and lighting equipment — a facility that is a lot easier to plan into a new building than to provide as an afterthought!

Alternatively, a small partial enclosure can sometimes be created above an entrance lobby or, failing that, at floor level. As a last resort, even a built-in cupboard can be adapted to accommodate and protect an amplifier and its somewhat vulnerable accessories.

Whatever the set-up, each microphone-to-amplifier circuit will ultimately involve an appropriate mic socket at the front of the auditorium, 20 metres or more of shielded twin-lead cable, installed permanently under-floor or above-ceiling, and provision at the other end for connection to the amplifier.

Because the microphone's own trailing cable is likely to be tugged at, trodden on and tripped over with monotonous regularity, something more rugged is required in the auditorium than ordinary "headphone" sockets and plugs, etc, as used in the home. Cannon or other studio type multi-pin wall sockets are virtually essential, with matching cord-grip plugs.

Microphone impedance

Ordinary, general purpose "high impedance" microphones (typically 10kΩ ohms or more) are likewise unsuitable for direct use in this sort of installation, if only because the shunt capacitance of the long cable is almost certain to cause severe treble attenuation.

While this problem can be alleviated by the use of impedance step-down transformers, much the better course is to select microphones having a low output impedance to begin with, typically 600 ohms or less, with provision at the amplifier end to accept a signal feed of this nature. (More about this later).

The EMI problem

But there is more to it than just impedance. Even though shielded, a long microphone cable handling low-level signals is vulnerable to EMI (or electromagnetic interference) from mains wiring within the building and even from power mains in the street outside. 50Hz EMI can cause an annoying hum when the amplifier gain is advanced, particularly at night, with lighting circuits active and heavier currents flowing in the street mains.

But even if the hum level as such is not all that serious, control tones on the mains may break through loud and clear, due to EMI, being noticeable by reason of their high audibility — and their unfortunate habit of occurring at the least opportune times!

Re-locating microphone cables further from mains wiring seldom helps much and the only really effective precaution — and standard procedure in professional systems — is to use microphones, connectors and cables which are not only fully shielded but also electrically balanced, as illustrated.

Balanced system

Fig. 1 depicts a dynamic (moving coil) microphone with the signal circuit brought out via a twin-lead shielded cable. Internally, the signal leads may connect directly — and only — to the voice coil, as shown, to give a nominal impedance of (typically) 50 ohms, or via a small in-built step-up transformer to provide a somewhat higher impedance (eg, 200-600 ohms).

(Other types of microphone can also be arranged internally to provide a low-impedance, balanced output but dynamic microphones are probably the most natural choice for a small scale non-professional system).

The important requirement is that the signal circuit be totally isolated from the external shielding — the body of the microphone, the cable braid, and the shell of the wall socket and plug.

(In bygone years, when "affordable", balanced, low impedance dynamic microphones were a rarity, we sometimes had to dismantle high impedance types to break the usual internal "earth" connections, remove unwanted step-up transformers and fit twin — rather than single-shielded cable — a tedious and somewhat hazardous operation!)

To preserve the isolation, the mic plug and matching wall receptacle must obviously have at least two pins available for the signal circuit, independent of the shell and cable braid.

For the same reason, the fixed cable running back to the amplifier must be of a PVC covered and shielded type, with twin inner conductors, insulated and preferably twisted together. If the inner conductors are simply positioned side by side, it is advisable to twist the cable

every 20-odd cm, during installation, at the same time keeping it reasonably clear of mains wiring.

At the amplifier end, the cable (or cables) can be terminated by further sockets or a tagstrip or, in the simplest case, connected directly to the amplifier.

Whatever the method adopted, the signal circuit should remain completely isolated from the "earthy" shielding system until the two are deliberately bridged adjacent to the amplifier. Prior to that, a check with an ohmmeter, looking down the line from the amplifier end, should indicate an open circuit.

The idea behind all this is that, when the microphone wiring is exposed to alternating magnetic fields, current and voltage induced in each of the twin signal leads will be identical and in phase.

Potentials may appear on the leads relative to the shell/shield system but there will be no circulating current around the signal loop or through the input system to the amplifier; hence no hum and, hopefully, no control tones either.

By way of a bonus, a balanced input system also tends to minimise random pickup from nearby broadcast or TV transmitters or from mobile transmitters in passing vehicles.

Amplifier input

In the days of valve (or other) amplifiers with high-impedance, unbalanced mic inputs (ie, one side "earthy"), it was necessary to use impedance matching transformers between low impedance mic lines and the mic input(s) to the amplifier, as shown in Fig. 2a.

Professional "line to grid" transformers, fully shielded against hum pickup, could be quite expensive in their day, although miniature versions could be extracted "free" (but unshielded) from general purpose high impedance microphones, in the process of converting them to low impedance — as mentioned earlier.

Currently, suppliers like Jaycar and Altronics offer Mumetal shielded mic transformers, 200/10kΩ ohms reversible, for about $18.

If not adequately shielded, impedance matching transformers are likely to pick up 50Hz hum, if brought within a metre or so of the amplifier power transformer. Some may therefore need to be mounted well away from the amplifier and orientated for minimum hum pickup, calling for a metre or more of shielded lead, wired as indicated in Fig. 2a.

Ideally, the low impedance winding should match the rated microphone impedance (50, 200, 500 ohms, etc) but, in practice, a considerable mismatch can usually be tolerated. If the primary is centred-tapped, it can be earthed, as shown. If no centre tap is available, one side can (and should) be earthed instead.

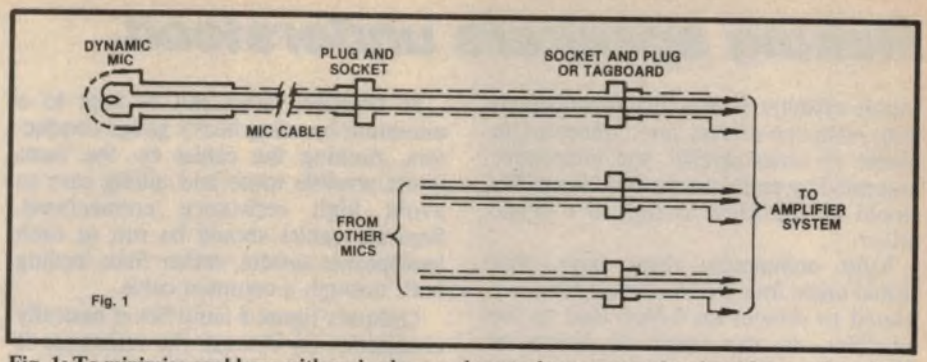


Fig. 1: To minimise problems with mains hum and control tones, use a low impedance microphone with a balanced and shielded lead, connecting to the amplifier through a similarly balanced fixed cable. Loss of treble due to cable capacitance is also minimised.

With a solid state amplifier having unbalanced, low impedance inputs (Fig. 2b), one side of the line can be commoned with the shield braid adjacent to the amplifier and the other side of the line connecting to the active input.

The ideal arrangement, however, is for the amplifier system to be equipped with low impedance, balanced microphone inputs (Fig. 2c) normally involving low noise differential preamplifiers, (eg the Balanced Eight-Channel Mixer in our April 1983 issue). In such a case, the twin mic lines can be fed straight in, while the shield is earthed to the amplifier chassis.

Amplifier system

In a typical small church or auditorium, up to three separate microphones may be required on occasions and, where possible, the amplifier should provide separate inputs and faders for that number of mic channels.

Where this is not practicable, one possibility is to provide twin mic sockets at the auditorium end of one or more of the lines so that, in special circumstances, microphones can be operated in parallel. It is not by any means an ideal arrangement but is manageable, provided that the microphones involved are identical and are being used for similar purposes.

Ideally, the amplifier should also provide one channel to suit a magnetic phono cartridge, plus a couple of other "Line" or "Auxiliary" inputs to cope with possible signals from a tape or cassette player, compact disc player, film projector, an FM "wireless" microphone, or even from somebody's multi-channel mixer. That adds up to about six channels in all.

Why not plan for a multi-channel mixer as a standard fitment?

A simple one, maybe, in conjunction with a basic amplifier but nothing too pretentious. In the writer's experience, an elaborate mixer can be justified only where there is an on-going need for it and where someone who understands it will always be on hand. Over-ambitious equipment can all too easily become a liability, with non-technical people never quite sure as to which of the 60 knobs to twiddle!

As for power output, something around 30-40W RMS will normally suffice for a modest auditorium, assuming reasonably efficient line source loudspeakers. A 20+20W stereo amplifier could alternatively be used to drive twin line source systems, being fed with stereo signals from records and tapes but mono signals for ordinary speech reinforcement.

Loudspeaker wiring

Loudspeakers were discussed at some length in the previous article with attention concentrating, for typical small installations, on four-loudspeaker line

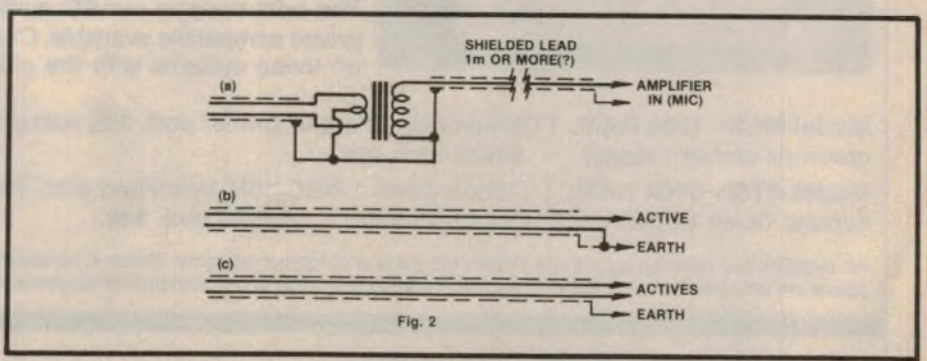


Fig. 2: A Lo/Hi impedance or "line to grid" transformer is normally necessary with amplifiers having high impedance mic input channels (a). With low impedance inputs, it is usually possible to make a direct connection (b) or (c).

Making speakers understood

source systems. It was further suggested that, with the drivers interconnected in phase, in series-parallel, the impedance presented by each system to the amplifier would be the same as that of a single driver.

Most commonly, these days, that would mean four 8-ohm drivers interconnected to present an 8-ohm load to the amplifier. In the event of 4-ohm or 15-ohm drivers being used, the net impedance would assume those respective values but 8 ohms is the most likely and convenient all-round figure.

If the amplifier happens to be a stereo unit, 8-ohm line source systems at the front left and front right of the auditorium would logically be connected to the respective channels.

With a mono PA amplifier, the two loudspeaker systems would be fed in parallel (and in phase) from the "low impedance" output terminals, presenting a net load of 4 ohms. Fortunately, most popular PA amplifiers in the marketplace are rated to work into such a load.

A question which arises in this context is the possible loss in signal level occasioned by feeding loudspeakers at voice coil impedance through unusually long leads — typically 20 metres or more, and up to 40 or 50 metres there and back.

In practice, losses can be kept to a minimum by using heavy gauge conductors, running the cables by the most direct possible route and taking care to avoid high resistance connections. Separate cables should be run to each loudspeaker system, rather than feeding both through a common cable.

Ordinary figure-8 lamp flex is basically unsuitable: (a) because the resistance is needlessly high and (b) because the individual conductors are not clearly identified, making it difficult to keep track of polarity and phase.

Electronic, electrical and/or automotive supply stores carry other types of figure-8 cable intended for domestic loudspeaker systems, automotive circuits, etc, using heavier conductors, colour coded for easy identification.

The most pretentious of such cables boast an overall DC resistance down to around 10 milliohms per metre, or about 0.2 ohm for a 20-metre length. But two such lengths serving two enclosures would be likely to cost over $100!

Fortunately, it is still possible to keep the series resistance well under 0.5 ohm with much less expensive cable and, relative to 8-ohm loads, the subjective difference in sound level or quality would be negligible.

In selecting cable, incidentally, don't overlook what your friendly electrician may be able to come up with in the way of electrical cable, as used for mains wiring. Some of it has very stout conductors indeed; and don't forget that the earth wire can be paralleled with one of the other conductors, further to reduce resistance.

(Knowing the gauge and number of conductors, the DC resistance of any given cable can be calculated readily enough with the aid of a set of wire tables.)

Fortunately, the loudspeaker cables do not need to be shielded but, purely as a precaution, it is a good idea to put a twist in them as they are installed. In some amplifiers, RF signals which may be picked up by long loudspeaker leads can find their way back into voltage amplifier stages via the negative feedback loop, becoming audible as low-level background sound. A twist in the leads may just help to inhibit such random pickup.

In discussing loudspeaker cables, we have deliberately avoided involvement in medium impedance or so-called 70-volt or 100-volt feedlines, requiring step-down transformers in each loudspeaker unit. These techniques have their place in commercial installations but are not warranted in a small scale system. Do the right thing with 8 ohms and you will be just as well off.

Electronics Australia Binder &

WIRELESS WEEKLY. Our own time machine! It may look like a book, but don't let it's appearance fool you. There are no whirling dials and control levers; but once you open the cover, it'll take you on an incredible journey backwards in time. You'll find yourself back in the 1920's, when Australia's first few radio stations were just getting established and a typical radio set cost ten weeks' wages. We've chosen a collection of highlights from the 1927 issues of 'Wireless Weekly': You'll find some front covers, a few editorials, the best new items, a collection of typical do-it-yourself radio set designs, and some selected pages from the programme listing. Plus a sprinkling of the original advertisements, of course. These are particularly fascinating because they show prices and put everything into proper context. Send today for ***The Best of Australia's Wireless Weekly in 1927*** . . . A fascinating and nostalgic trip into our radio past. **N0049A** **$3.95**

ELECTRONIC PROJECTS FOR YOUR CAR. How can you extend the performance of your car without it costing an arm and a leg? With these selected projects from *Electronics Australia* you can add all of the gadgets you've dreamed of: Cruise Control, Courtesy Light Delay, Deluxe Burglar Alarm, Headlight Reminder, Audible Reversing Alarm, Transistor-assisted Ignition with Optoelectronic Trigger, Driveway Sentry, Speed Sentry, Tacho/Dwell Meter, Breakerless Ignition, Audible Turn Signal and more easy-to-build projects to add value, interest and safety to your pride and joy! PLUS Feedback from those who have built the projects themselves and Bright Ideas for you to develop yourself: Automatic Antennae Retraction, 6V Car Adaptor, Fuse-Failure Indicator and more . . . **C0064A** **$3.95**

ELECTRONIC TEST GEAR TO BUILD. Why buy it? These valuable projects from *Electronics Australia* will add a new dimension to your workshop! Detailed, step-by-step instructions guide you through the construction of the most useful of electronic workshop test gear: 500 MHz 7-digit Frequency Meter, Wheatstone Bridge and Resistance Box, AC Millivoltmeter, DC Voltmeter, LCR Bridge, Modulated Signal Injector, Audio Prescaler. PLUS Feedback from those who have built the projects themselves and Bright Ideas for you to develop yourself: Linear Frequency Controller, Dummy Loads, General Purpose Counter Timer and more . . . **Never built a project before?** What better way to get started than by building the test instruments needed to begin a workshop? **Build it yourself to save and learn at the same time!** **F0067A** **$3.95**

EASY-TO-UNDERSTAND GUIDE TO HOME COMPUTERS. Confused by all these computer terms? This clearly written book from the editors of *Consumer Guide* tells exactly what computers are, how they work and why they are so amazingly useful, all in plain English. Here is all of the information needed to understand and use computers, and even to start programming. A special buying section compares the most popular home computers. This book is your ticket to the computer age! Spiral bound, 96pp. **H0066G** **$12.00**

THE USER'S GUIDE TO APPLE. The editors of *Consumer Guide* have compiled a thorough introduction to the Apple IIe and II Plus computers, software and peripherals. With colour illustrations and a clearly written text, this reference will guide the newcomer through all phases of learning how to use the computer: From setting the system up, learning what each key does, expanding the system with peripherals, to buying new software. Specific exercises are included for each of the keys. Spiral bound, 80pp. **H0061G** **$12.00**

THE USER'S GUIDE TO COMMODORE 64 & VIC 20. The editors of *Consumer Guide* have compiled a thorough introduction to the Commodore 64 and Vic 20 computers, software and peripherals. With colour illustrations and a clearly written text, this reference will guide the newcomer through all phases of learning how to use the computer: From setting the system up, expanding the system with peripherals, to buying new software. Specific exercises are included for each of the keys. Spiral bound, 80pp. **H0065G** **$12.00**

EA1285 BOOK TITLE/PRODUCT NAME	CODE NUMBER	QTY	PRICE TOTAL

Cheque*/Money Order ☐ *Please make payable to the Federal Publishing Company Pty. Ltd.

Put your cheque or money order in an envelope. Mail to Freepost 4, PO Box 227, Waterloo, NSW 2017. No postage stamp required in Australia.

Mastercard ☐ American Express ☐ Bankcard ☐ ☑ Tick

☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐☐☐☐ Credit Card No.

(Unsigned orders cannot be accepted)

Card Expiry Date..... Signature.....

Allow up to 6 weeks for delivery.

Total order value $.....

Add postage and handling $.....

TOTAL $.....

NAME:.....

ADDRESS:.....

.....

.....POSTCODE:.....

POSTAGE AND HANDLING CHARGES

ORDER VALUE	ADD
1 Book	$1.50
Up to $9.99	$2.25
$10 to $19.99	$4.25
$20 to $39.99	$5.25
$40 to $99.99	$6.25
$100 and over	$7.25

For airmail to New Zealand, Papua New Guinea, Oceania and Southeast Asia, add $6.00 to these charges.

Book Sales

MAIL COUPON TO:
FREEPOST 4 *(No stamp needed)*
The Federal Publishing Company,
PO Box 227, Waterloo, NSW 2017
Tel: (02) 663-9999. Tlx: AA74488

DIGITAL ELECTRONICS. Electronic equipment plays an important role in almost every field of human endeavour and every day, more and more electronic equipment is 'going digital'. Even professional engineers and technicians find it hard to keep pace. In order to understand new developments, you need a good grounding in basic digital concepts and *Introduction to Digital Electronics* can give you that grounding. Tens of thousands of engineers, technicians, students and hobbyists have used this book to find out what the digital revolution is all about. This new fourth edition has been updated and expanded to make it of even greater value. No previous knowledge of digital electronics is necessary — The book includes an excellent coverage of basic concepts. **A0079A** **$4.50**

BASIC ELECTRONICS. This popular text has now been re-issued. *Basic Electronics* is almost certainly the mosty widely used reference manual on electronics fundamentals in Australia. Written as a basic text for the electronics enthusiast, it is also being used by radio clubs, secondary schools and colleges, and in WIA youth radio clubs. It begins with the electron, introduces and explains components and circuit concepts and progresses through radio, audio techniques, servicing test instruments, television, etc. If you've always wanted to know more about electronics, but have been scared off by the mysteries involved, let *Basic Electronics* explain them to you. Easily understood diagrams and text make this the perfect introduction to the growing and exciting world of electronics. We've even included five electronic projects for the beginner. **A0074A** **$4.50**

PROJECTS & CIRCUITS. If you like building electronic projects in your spare time, you can't afford to miss out on this exciting book of popular projects from *Electronics Australia*. Just look what's inside! **Audio and Video Projects:** Video Amplifier for Computers and VCRs, Video Enhancer, Vocal Canceller, Stereo Simulator for Tuners and VCRs, Guitar Booster for Stereo Amplifiers. **Automotive Projects:** Transistor-assisted Ingition System, Breath Tester, Low Fuel Indicator, Speed Sentry, Audible Turn Indicator. **Mains Power Control Projects:** Musicolor, Photographic Timer, Driveway Sentry, Touch-lamp Dimmer. **Power Supplies and Test Equipment:** Battery Saver for Personal Portables, Dual Tracking ±22V Power Supply, 3 1/2-Digit LCD Capacitance Meter, In-Circuit Transistor Tester. **Plus EA's 10-year project index.** **C0069A** **$4.50**

THE BEST VIC/COMMODORE SOFTWARE. Trying to find the most suitable software for personal computers can be frustrating. The editors of *Consumer Guide* have compiled comprehensive reviews of VIC 20 and Commodore 64 programs based on ratings by user groups; further evaluation is given by the editors and Commodore software experts Jim and Ellen Strasma. Each review describes the program's purpose and features, detailing both the good points and bad. Each program has been rated for ease of use, clarity of written and on-screen instructions, and overall performance. The program's price, publisher, format and hardware requirements are also included. The reviews are presented in sets by topic: Word Processing, Business, Home, Education, Networking, Strategy Games, Arcade Games and Programming Aids. Spiral bound, 192pp. **K0052G** **$12.00**

THE BEST APPLE SOFTWARE. The editors of *Consumer Guide* have compiled comprehensive reviews of Apple II, II Plus and IIe programs based on ratings by user groups; further evaluation is given by the editors and Apple software expert Roe Adams. Each program has been rated for ease of use, clarity of written and on-screen instructions, and overall performance. The program's price, publisher, format and hardware requirements are also included. The reviews are presented in sets by topic: Word Processing, Business, Home, Education, Networking, Strategy Games, Arcade Games and Programming Aids. Spiral bound, 160pp. **K0060G** **$12.00**

MAGAZINE BINDERS **B901EA**

Ready to use binders with easy, clip-in fastener, covered in soft, decorator brown vinyl. Holds 12 issues of electronics Australia.

$7.50

MAGAZINE HOLDERS **H951EA**

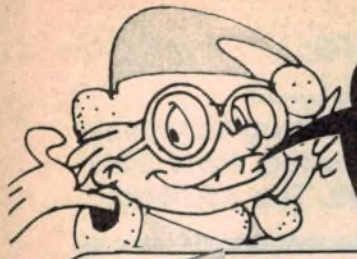
Big, easy to assemble holders, covered in soft, decorator brown vinyl. Holds 12 issues (at least) of Electronics Australia.

Postage and packing additional.

$7.00

SAVE WITH SIX

6 Holders — only **$37.50**
6 Binders — only **$39.95**



THE PERFECT GIFT FOR THE ELECTRONICS TINKERER! PUT A SMILE ON SOMEONE'S FACE THIS XMAS. YOU CAN'T DO BETTER!

SAVE!

Multimeter Capacitor Checker

WAS $119

$99

It's four tools in one and a must for any hobbyist, technician, etc! Not only do you get the normal ranges found on a digital multimeter but it also has five ranges of capacitance checking, two ranges of conductance **PLUS** diode check position! For Xmas you'll save an amazing $20!!! Cat Q-1460

SAVE!

Mini Multimeter With Bonus Carry Case!

$13.50

A fantastic little multimeter for the beginner or for anyone who gives their multimeters a hard time! It's an 11 range, 2000 ohm/volt pocket sized meter that's ideal for general work! It's rugged and reliable and right now comes with a bonus carry case **FREE!** Cat Q-1010

Battery Lamp and Fuse Tester.

Free pack of 2 Alkaline Batteries S-3281

VALUE!

$13.75

Don't throw those old batteries away — you could be throwing good money out! This battery, lamp and fuse tester checks a huge range of cells from 1.5V-9V actually under load! Checks Nicads, calculator and watch batteries **and** miniature lamps and cartridge fuses! Cat Q-1525

STORE LOCATIONS

NSW			Treloar's Bldg, Brisbane St	**Tamworth**	**66 1961**	Gold Coast Hwy & Welch St	**Southport**	**32 9863**
Swift & Young Sts	**Albury**	**21 8399**	263 Keira St	**Wollongong**	**28 3800**	Bowen & Ruthven Sts	**Toowoomba**	**38 4300**
T55 Terrace Level	**Bankstown Sq**	**707 4888**	**ACT**			Ingham Rd & Cowley St West End	**Townsville**	**72 5722**
Shop 1, 65-75 Main St	**Blacktown**	**671 7722**	96 Gladstone St	**Fyshwick**	**80 4944**	Cnr Pacific Hwy & Kingston		
613 Princess Hwy	**Blackehurst**	**546 7744**	**VIC**			Woodridge Rd	**Underwood**	**341 0844**
Oxford & Adelaide Sts	**Bondi Junction**	**387 1444**	Creswick Rd & Webster St	**Ballarat**	**31 5433**	**SA**		
531 Pittwater Rd	**Brookvale**	**93 0441**	145 McCrae St	**Bendigo**	**43 0388**	Wright & Market Sts	**Adelaide**	**212 1962**
Campbelltown Mall Queen St	**Campbelltown**	**27 2199**	Shop 46 Box Hill Central Main St	**Box Hill**	**890 0699**	Main South & Flagstaff Rds	**Darlington**	**298 8977**
Shop 235, Archer St Entrance	**Chatswood Chase**	**411 1955**	Hawthorn Rd & Nepean Hwy	**East Brighton**	**592 2366**	Main North Rd & Darlington St	**Enfield**	**260 6088**
147 Hume Hwy	**Chullora**	**642 8922**	260 Sydney Rd	**Coburg**	**383 4455**	24 Park Terrace	**Salisbury**	**281 1593**
162 Pacific Hwy	**Gore Hill**	**439 5311**	1150 Mt Alexander Rd	**Essendon**	**379 7444**	**WA**		
315 Mann St	**Gosford**	**25 0235**	Nepean Hwy & Ross Smith Ave	**Frankston**	**783 9144**	Wharf St & Albany Hwy	**Cannington**	**451 8666**
4 Florence St	**Hornsby**	**477 6633**	Shop 9 110 High St	**Geelong**	**43 8522**	66 Adelaide St	**Fremantle**	**335 9733**
Elizabeth Dr & Bathurst St	**Liverpool**	**600 9888**	291-293 Elizabeth St	**Melbourne**	**67 9834**	William St & Robinson Ave	**North Perth**	**328 6944**
450 High St	**Maitland**	**33 7866**	Bridge Rd & The Boulevarde	**Richmond**	**428 1614**	Centreway Acde, Hay St	**Perth City**	**321 4357**
173 Maitland Rd, Tighes Hill	**Newcastle**	**61 1896**	Springvale & Dandenong Rds	**Springvale**	**547 0522**	**TAS**		
Lane Cove & Waterloo Rds	**North Ryde**	**88 3855**	**QLD**			25 Barrack St	**Hobart**	**31 0800**
George & Smith Sts	**Parramatta**	**689 2188**	157-159 Elizabeth St	**Brisbane**	**229 9377**	**NT**		
The Gateway High & Henry Sts	**Penrith**	**32 3400**	166 Logan Rd	**Buranda**	**391 6233**	17 Stuart Hwy	**Stuart Park**	**81 1977**
818 George St	**Railway Square**	**211 3777**	Gympie & Hamilton Rds	**Chermside**	**359 6255**			
125 York St	**Sydney**	**267 9111**	Queen Elizabeth Dr & Bernard St	**Rockhampton**	**27 9644**			

Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days, unforeseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionaly, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first ... just in case! Thanks. Dick Smith Electronics

MAJOR DICK SMITH ELECTRONICS AUTHORISED RESELLERS

NSW: • **Ballina:** A. Cummings & Co, 91-93 River St 86 2284 • **Bathurst:** Electronic Shop, 74 Bentick Street, 31 4421 • **Bowral:** Barry Gash Electronics, 370 Bong Bong St 61 2577 • **Broken Hill:** Hobbies & Electronics, 31 Oxide St 88 4098 • **Charlestown:** Newtronics 131 Pacific Hwy 43 9600 • **Coffs Harbour:** Coffs Harbour Electronics, 3 Coffs Mall, Park Ave, 52 5684 • **Deniliquin:** Deni Electronics, 220 Cressy St, 81 3672 • **East Maitland:** East Maitland Electronics, 99 High St 33 7327 • **Gosford:** Tomorrows Electronics & HiFi, 68 William St, 24 7246 • **Lismore:** Decro 3A/6-18 Carrington St, 21 4137 • **Port Macquarie:** Hall of Electronics, Horton Centre, Horton St, 83 7440 • **Orange:** Fyle Electronics 173 Summer St, 62 6491 • **Tumut:** Tumut Electronics Wynyard St, 47 1631 • **Tweed Heads:** Stuart Street Wholesale, Sh 3, 4 Stuart St. • **Swansea:** Swansea Electronics, 184 High St, 71 1674 • **Wagga:** Phillips Electronics 82 Forsyth St, 21 6558 • **Windsor:** M & E Electronics, Sh 7, Mc Ewans Arcade, 206 George St, 77 5935 • **Young:** Keith Donges Electronics 186 Boorowa St 82 1 279 **VIC:** • **Hamilton:** John Thompson & Co, 138-148 Gray St, 72 2000 • **Echuca:** Webster Electronics, 220 Packeham St 82 2956 • **Mildura:** McWilliams Electronics 110A Langtree Ave, 23 6410 • **Morwell:** Morwell Electronics, 95 George St, 34 6133 • **Shepparton:** GV Electronics Centre 100 High St, 21 8866 **QLD:** • **Atherton:** Maartens Music Centre 55 Main St, 91 1208 • **Bundaberg:** Bob Elkin Electronics, 87 Bourbong St, 72 1785 • **Cairns:** Electronic World Shop 27 K-mart Westcourt Plaza, 51 8 555 • **Gladstone:** Supertronics Cnr Hebert & Auckland Sts 72 4321 • **Mackay:** Stevens Electronics, 42 Victoria St, 51 1723 • **Maryborough:** Keller Electronics, 218 Adelaide St, 21 4559 • **Mt Isa:** Outback Electronics 71 Barkley Hwy 43 3 331 • **Rockhampton:** Purely Electronics, 15 East St, 21 058 **SA:** • **Mt Gambier:** Hutchessons Communications, 5 Elizabeth St, 25 6404 • **Whyalla:** Eyre Electronics Shop 15 Forsythe St, 45 4764 **WA:** • **Albany:** Micro Electronics 133 Lockyer Ave 41 2077 **TAS:** • **Launceston:** Advanced Electronics 5A The Quadrant, 34 1399 **NT:** • **Darwin:** Ventronics 24-26 Kavanagh St, 81 3491

DSX PRESS ORDER SERVICE

Use your Bankcard, Mastercard or Visacard. Just phone **008 226610** (toll free) for fast 24 hour despatch of your order.
Enquiries, By mail, or phone (02) 888 2105.

ORDERS OVER $75 **FREE DELIVERY**

POST & PACKING CHARGES	Order Value	Charge	Order Value	Charge
	$5.00 - $9.99	$2.00	$50.00 - $74.99	$6.00
	$10.00 - $24.99	$3.50	$75.00 or more	~~$9.00~~
	$25.00 - $49.99	$4.50		

Terms available to approved applicants
SA Customers: Credit facilities available through
AGC Adelaide, 10 Pulteney St, Adelaide

bankcard welcome here

MasterCard

VISA

AGC Credit Line

DICK SMITH ELECTRONICS PTY LTD

P.O. Box 321, North Ryde N.S.W. 2113. Tel: 888 3200

EVERY HOBBYIST WANTS A WELL EQUIPPED WORKSHOP! MAKE ONE HAPPY WITH THESE SUPER VALUE TOOLS AND COMPONENT PACKS!

BONUS!

Scope Cordless Soldering Gun!

Now you can work anywhere! The scope rechargeable soldering iron lets you work in the field . . . anywhere without a power point! A huge 60 watt capacity it will get the heat where you want it in just six seconds. Now you can have portable power and **SAVE!** Get a **FREE** Bonus Charger, spare Tips and Element with cordless iron! Cat T-1600

Don't pay $99 elsewhere

NOW $85

BONUS!

Soldering Iron!

Buy one of our fantastic value 20 watt, 240 volt soldering irons and you'll get Bonus Solder and 4 piece Solder Aid Set **FREE!** You'll save $5!! The ideal Xmas gift for any workshop!
Cat T-1330

STOCK LIMITED

Valued at $15.90

$10.95

BONUS!

VALUE $16.95

DSE Soldering Iron!

No workshop should be without a quality DSE soldering iron! With every DSE 15 watt 240 volt soldering iron we're giving away a Bonus roll of Desolder Braid . . . and it's FREE! You'll save $3 with our DSE Xmas Bonus Offer!
Cat T-1310

LIMITED STOCK

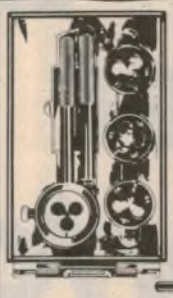
NOW $13.50

Quality 38 Piece Tool Set!

Give a gift that means something! This quality 38 piece tool kit would be at home in any workshop. Comes with multimeter, wire cutters/strippers, pliers, screwdrivers, tape, and assorted connectors. All in a sturdy plastic carry case! Cat T-4832
Over $35 Value!!!

WORTH OVER $35!

$29.95



Die Set

Wow! It's a six piece die set! Comes complete with instructions & hinged plastic carry case! Cat T-4905

WAS $29.50

NOW $26.50

Tap Set!

If you've got a die set you'll need a tap set so you can do a professional job! Here's fantastic value! A five piece tap set with 2mm to 5mm taps and 4 jaw tap holder. You'll save over 25%! Cat T-4910

WAS $13.50

NOW $9.95

68 Piece Deluxe Repair Kit

Ideal for auto electricians, technicians, handyperson, etc! You get wire cutter/strippers, long nose pliers, 12V circuit tester, screwdrivers, insulating tape, spare wire plus an assortment of the most used connectors. All in a sturdy plastic carry case! Cat T-4834

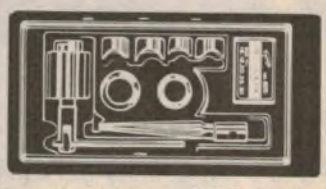
WORTH OVER $25!

$14.95

SUPER VALUE!

Hole Punch Set

You'll save with this handy hole punch set! Ideal for chassis work. You get 12mm tapered reamer, tommy bar and 5 punches from 16mm to 30mm. It'll handle steel up to 22 gauge and aluminium up to 16 gauge. You won't need any more! Cat T-4900



WAS $29.95

NOW $27.50

Cable Snippers

Wow, the highest quality Boker 5056 cable snippers! They're a must for any workshop. A quality German made tool that will give you years of reliable service! It's like owning the Rolls Royce of wire snippers!
Cat T-3202

$14.95

COMPONENTS — BUY IN BULK & SAVE

SPECIAL!

Resistor Pack

Over 300 computer selected 1/4W types for this ridiculous Xmas Special low price! Ideal for any workshop — professional or hobbyist! You'll save on our regular price and get the lot for over 66% less than the individual price!
Cat R-7010

WAS $6.95

NOW $5.00

Ceramic Capacitors

Quality ceramic capacitors in a specially selected pack! Over 60 in all. Voltages from 50V to as high as 630V. Save a fortune on one-off prices and save again with our Xmas Special!
Cat R-7050

WAS $4.95

NOW $3.95

Metal Film Resistors

Save heaps! Over 300 precision 1% 1/4W E-12 metal film resistors for this all time low price. Now there's no excuse for not using metal film resistors in your projects! Cat R-7015

WAS $13.95

NOW $12.00

Signal Transistors

100 of the most used transistors the hobbyist, technician etc can have! You get DS547, 548 and 549s NPNs, DS557 & 558s and BC 159 PNPs — all in one extremely useful pack! Cat Z-3000

WAS $11.95

NOW $10.95

E-24 Metal Film 1% Resistors

The savings are even bigger! Over 300 E-24 metal film 1% resistors for those who really need precision resistors. Covers over 60 values from 11 ohm to 910k ohms: computer chosen for maximum usefulness! Cat R-7020

WAS $17.95

NOW $15.00

Signal Diodes

100 quality diodes that can be used in anything from crystal sets to computers! With 0A90, OA91/DSOA91, OA95, OA47 and 1N914 silicon diodes all in one pack! Put one in the junk box now and save!

WAS $11.95 Cat Z-3005

NOW $9.95

Electrolytic Pack

Enormous savings on Electrolytics! 55 top quality single ended electrolytics. There's bound to be the one you need! From 2.2uF to 470uF and voltages from 10 to 25! You won't forgive yourself if you miss it!
Cat R-7030

WAS $6.95

NOW $5.95

Power Diode Pack

Now, 57 diodes and SCR's for half of what you'd pay to buy them separately! And there's no useless rubbish values either. They're the most used values — so you'll always have just what you need.
Cat Z-3010

WAS $14.95 NOW $9.95

Greencap Pack

60 quality greencaps. And there's no weird, rubbish values in this pack. They're all popular greencaps and they're rated at 100 volts too! Values from .001uF to 0.22uF!
Cat R-7040

WAS $9.95

NOW $8.95

Premium LED Pack

100 premium quality 5mm LEDs to get your projects looking great! You get red, green, yellow and orange — enough for anything! That's $33 worth for under $20. You save $4 off our regular price! Cat Z-3015

WAS $23.95

NOW $19.95

250 Mixed Capacitors

Unbelievable value! No workshop should be without. You get 250 mixed capacitors of varying value.
Cat R-7110

WAS $9.95

NOW $8.95

Microswitch Pack.

Throw one of these into the junk box — you can't go wrong. 10 quality microswitches in one pack! Cat J-1036

WAS $7.50 $6.00

Signal Mixed Transistors

100 commonly used signal transistors in one pack. Incredibly handy to have around.
Cat J-1037

WAS $9.90 $8.50

B070

Basic facts on passive components

Selecting the best resistor/capacitor

Part 2

There are a lot of factors to consider when selecting the proper capacitor for your design or project. In this article we'll look at those factors, and which of the many, many types of capacitors is right for your application.

by VICTOR MEEDIJK

As we saw last time, there are a lot of factors you should consider in selecting resistors for your projects and designs. As you might expect, the same holds true for capacitors. In capacitor selection, you should consider such things as operating temperature, humidity, AC ripple, and operating frequency. In addition, capacitance, as well as other capacitor specifications such as current rating, leakage current, voltage rating, and life expectancy, should be considered so that the device chosen will be appropriate for the application at hand.

Materials used in manufacturing a capacitor, as well as how those materials have been assembled, will affect capacitor specifications. As an example, capacitance is based upon electrode area and the type and thickness of the dielectric used. Varying any or all of those things will, of course, change the capacitance of the device. But that is not the only parameter that will change.

For instance, if the electrode surface area of an aluminium electrolytic capacitor is increased (to increase the unit's capacitance) through the use of finely etched electrode foils, the device will have a larger ESR (Equivalent Series Resistance) than similar smooth-metal foil units. That is because the ESR depends upon the volume of the foil used.

You can also increase capacitance by using dielectrics with high dielectric (high-K) constants. But capacitors that use high-K dielectrics are not as stable (they are more sensitive to temperature and voltage variations) and generally have a higher dissipation factor than capacitors that use dielectrics with lower dielectric constants.

Capacitor package styles also should be considered. High lead inductances, common to tubular units, restrict high-frequency performance. Tubular ceramic capacitors however, are the most stable form of capacitor and, since there is no opposing electrode to provide stray capacitance pickup, almost the total capacitance is provided by the ceramic.

Dipped or moulded radial-lead packages reduce interconnection impedances by allowing the capacitor to be mounted close to a PC board surface.

Chip capacitors have contacts, rather than leads, to even further reduce interconnection impedances. In addition, those devices are thin enough to mount beneath unsocketed ICs, thus reducing the length of a trace for a bypass capacitor. That is important in high-frequency circuitry since a PC trace can have an inductance of 10 nanohenries/inch.

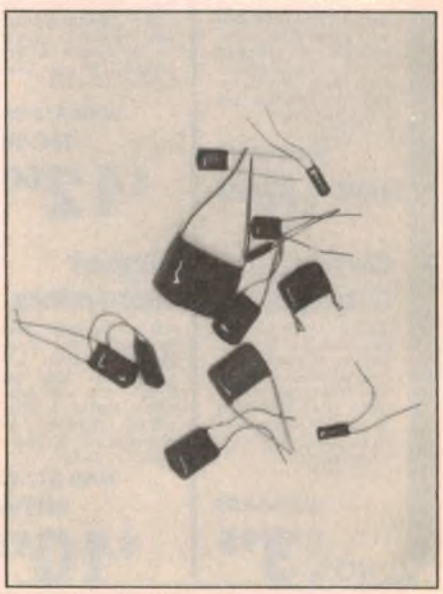
Capacitors come in a variety of styles including ceramic, mica, paper, plastic, aluminium, and tantalum types.

Each type was designed for best performance in a specific application or environment. Each type of capacitor is discussed below, and the important specifications and considerations that pertain to the type of capacitor are summarised in Table 2. Table 3 is a glossary of capacitor terms and specifications.

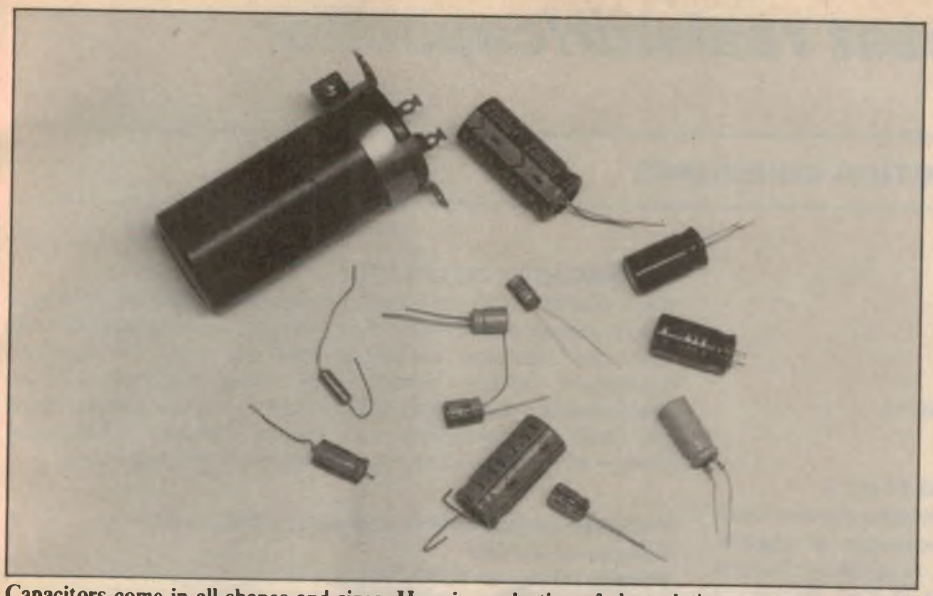
One note about Table 2 — the specifications shown there are only provided as guidelines. It is certainly possible to find units with slightly, or even greatly different specifications.

Ceramic capacitors

Ceramic capacitors are used in many applications. For instance, they are used as bypass capacitors. They are also used to compensate for temperature-caused changes in resonant frequency in tuned circuits. When used in that second application, the ceramic capacitors should be mounted close to the tuned circuit, but be shielded from any heat generating components.



Above: metalised polyester capacitors.



Capacitors come in all shapes and sizes. Here is a selection of electrolytics.

The EIA has broken ceramic capacitors into categories. Class one capacitors are those that have very predictable temperature vs. capacitance characteristics. One type of Class one ceramic capacitor is the NPO (Negative-Positive-Zero) capacitor. That designation means that the negative and positive temperature coefficients of the device are zero and that they suffer almost (nothing is ever absolute) no change in capacitance vs. temperature. Other Class 1 capacitors have very predictable changes in capacitance with temperature. For instance, a ceramic capacitor that is specified as N750 has a negative temperature coefficient of 750 parts-per-million, per-degree-centigrade. That is, for each degree centigrade the temperature rises, the capacitance of the unit will drop 750 parts-per-million.

Class two capacitors are those that are non-linear. Their temperature coefficients are specified by a three letter code that specifies the low and high temperature ranges and the maximum change in capacitance from that at 25°C. Table 4 shows the EIA Class two code, and what the various designations mean. As an example, an X7R capacitor will vary in capacitance by no more than a factor of ±15% over the temperature range of −55°C to +125°C.

Mica capacitors

There are two types of mica capacitors. One type is a stacked foil unit consisting of alternate layers of metal foil (or deposited metal film) and sheet mica insulators. The metal foil layers are connected together with tin-lead foil strips with terminals attached by using solder coated pressure clips.

The second type of mica capacitor is the silver-mica capacitor. Those have a silver electrode material screened on the mica stampings, which are then assembled as described above. The silver-mica capacitors are very susceptible to silver-ion migration, which can occur within a few hours, when exposed to high DC-voltage stress, high humidity, and high temperature. The ion migration results in the capacitor short circuiting.

To keep internal inductance small for high-frequency use, button-style silver-mica capacitors have the anode connected through the centre of the stack of mica sheets. The other terminal is formed by the case, which is connected to all points around the outer edge of the electrode. That design permits the current to fan out in a 360° pattern from the centre terminal thus providing the shortest RF current path from the centre terminal to the chassis.

One of the more common micas used for capacitors is Muscovite mica, which comes from India. That substance has a dielectric constant between 6.5 and 8.5, can be split into thin sheets, is non-porous, and does not readily absorb moisture.

Mica capacitors are temperature and frequency stable, have a low dissipation factor, and perform well at frequencies up to 500MHz. Those high precision units are used in a variety of applications, including tuning circuits, oscillators, filters, and RF power circuits.

Glass capacitors

Glass capacitors are used in applications that require high stability in a hostile environment. Those devices can withstand vibration, acceleration, extreme moisture, vacuum, and high operating temperatures; they are, however, susceptible to damage from mild mechanical shocks. They have a life expectancy of 30,000 hours or greater.

Glass capacitors perform very well at high frequencies up to 500MHz, and have a frequency range of 100kHz to 1GHz. Because of their characteristics, those devices are commonly used in missile and spacecraft electronics.

Paper/plastic capacitors

Paper and plastic capacitors are used in applications that require high and stable insulation resistance at high temperatures, and good capacitance over a wide temperature range. (However, an exception to that are the metalised — we'll talk about metalisation in a moment — paper units, which have low insultation resistance and are prone to dielectric breakdown.) Plastic types are less affected by humid conditions than paper units since they are non absorbent. Plastic capacitors, such as polycarbonate and polyester (Mylar) types, are generally intended for applications where minimum capacitance change with temperature is required. They are especially suited for tuned and precision-timing circuits.

In metalised capacitors, a thin film of metal is deposited directly on the paper or plastic dielectric. Doing that gives the capacitor a "self-healing" characteristic called "clearing". If there is a hole or contaminant in the dielectric of the capacitor, a short may occur, resulting from the heavy current flow in the fault area. In a metalised capacitor, that heavy current flow will melt away a very small part of the thin metal film, thus disconnecting the fault from the capacitor. These capacitors are best for analog circuits because the momentary current flow during the clearing action may result in a spurious signal and cause false triggering in digital logic circuits.

Metalised plastic devices work well in switching power-supply output filters because they have a comparatively low ESR, as well as stable temperature characteristics. When using those capacitors in such an application, however, be sure that the unit selected is rated to handle the voltage surges produced by the circuit.

Tantalum electrolytics

Tantalum capacitors offer high capacitance in a small package size and have an excellent shelf life. Various types of tantalum electrolytic capacitors are available including solid, sintered slug, plain foil, etched foil, wet slug, and chip. Applications include low-frequency filtering, bypassing, coupling, and blocking. The solid types are not temperature sensitive and have a lower capacitance-temperature characteristic than any other electrolytic capacitor.

Applications that tantalums are not suitable for are in RC timing circuits, triggering systems, or phase-shift networks. That's because they have high "dielectric absorption" characteristics. That is, when a capacitor is discharged,

Selecting the best resistor/capacitor

TABLE 2 — CAPACITOR SELECTION GUIDELINES

CERAMIC
Values: 1pF to 2.2μF
Tolerance: 10% or 20%
Voltage rating: 3.3 volts to 6 kilovolts DC
Dissipation factor: to 5%
Temperature coefficient: to 200,000 PPM/°C
For NPO's —
Tolerance: 0.25% to 10%
Temperature coefficient: 0±30 and 0±60 PPM/°C
Notes: General purpose high insulation-resistance devices used for transient decoupling of ICs and compensation of reactive changes caused by temperature variations. Applications include filtering, bypass, and non-critical coupling in high frequency circuits. Frequency sensitive (capacitance will vary with frequency) so characteristics should be measured at intended operating frequency. Should be mounted next to components being compensated, and shielded from sources of heat. Due to low voltage failure problems, should not be operated significantly under rated voltage under humid conditions. In circuit design, consideration should be given to changes in the dielectric constant caused by temperature, electric field intensity, and shelf aging.

CERAMIC CHIPS
Values: 10pF to 0.18μF
Tolerance: 5 to 20%
Temperatue range: −55 to +125°C
Insulation resistance: greater than 100,000 megohms

MICA
Values: 1pF to 0.1μF
Voltage ratings: 100 to 2500 volts DC
Temperature range: −55 to +150°C
Temperature coefficient: −20 to +100 and 0 to +70 PPM/°C
Derating factor: 60% voltage (dipped case) and 40% voltage (moulded case)
Mica chips —
Values: 1 to 10,000 pF
Voltage rating: to 500 volts
Notes: Used in timing, oscillator, tuned circuits, and where precise high frequency filtering is required. Capacitance and impedence limits are very stable and capacitors perform very well at frequencies of 10kHz to 500MHz. Devices using silver in their construction are very susceptible to silver ion migration resulting in short circuits. Failures can occur in a few hours if capacitors are exposed to DC voltage stresses, humidity, and high temperature.

GLASS
Values: 0.5 to 10,000 pF
Tolerance: to 5%
Voltage rating: 100 to 500 volts DC
Temperature range: −55°C to +125°C
Temperature coefficient: 0 to 140 PPM/°C
Notes: High insulation resistance, low dielectric absorption and fixed temperature coefficient. Has much higher Q than mica devices. Performs very well at high frequencies up to 500MHz and can operate in range of 100kHz to 1GHz. Capable of withstanding severe environmental conditions but are susceptible to mild mechanical shocks and should be mounted accordingly.

PAPER/PLASTIC DIELECTRICS
Many dielectric and case configurations are available. Each type has its own characteristics. For example, metalised paper units have low insulation resistance and are prone to dielectric breakdown failures. Plastic types have superior moisture characteristics than paper units. Polycarbonate and Mylar types are used in applications that require minimum capacitance change with temperature, such as tuned or timing circuits.

Metalised polycarbonate and polycarbonate film —
Values: up to 50μF
Voltage rating: to 1000 WVDC
Dissipation factor: .5% (at 25°C and 120Hz)
Temperature range: −55 to +125°C
Derating factors: 50% voltage; 80% of rated temperature
Notes: DC blocking, filter, bypass, coupling, and transient supression applications. Close tolerance, high frequency capability (40-400kHz) and high insulation resistance. Not suitable for sample/hold circuits, fast settling amplifiers, or filters due to dielectric absorption characteristics. Small size, medium stability and long life expectancy under load.

Metalised polyester/polyester foil —
Values: 0.001 to 100μF
Voltage rating: up to 1500 WVDC
Dissipation factor: 1% (at 25°C and 120Hz)
Temperature range: −55 to +125°C (with 50% derating above 85°C)
Notes: See polycarbonate for typical applications. Moisture resistant and high insulation resistance. Small size, medium stability and very good load life. Capacitance will however vary widely with temperature. Foil units are generally lower cost than metalised types. Polyester film is commonly known as Mylar, which is a DuPont trademark.

Polystyrene foil —
Values: to 10μF
Voltage rating: up to 1000 WVDC
Dissipation factor: 0.03% (at 25°C and 120Hz)
Temperature range: −40 to +85°C without derating
Notes: Used in timing, integrating, and tuned circuits. High insulation resistance, and small capacitance change with temperature. Has excellent dielectric absorption characteristics. Large size with excellent stability and very good load life.

Paper/metalised paper/paper foil —
Values: to 100μF
Voltage rating: to 5000 WVDC
Temperature range: −30°C to +100°C (derated by 30% over 75°C)
Temperature coefficient: greater than 4500 PPM/°C
Notes: General purpose. Medium stability and very good load life. Large size; low cost. Metalised paper has paper coated with thin layer of zinc or aluminium and are smaller than metal foil units. They are, however, prone to dielectric breakdown of insulation resistance and have poor surge handling capability. Paper foil units used in high voltage/high current applications. Their dissipation factor varies with temperature. Maximum temperature is +125°C.

Selecting the best resistor/capacitor

Polypropylene foil/metalised polypropylene —
Values: to 10μF
Voltage rating: to 400 volts DC and 270 volts AC (foil units: 200 to 1600 volts DC and 300 to 440 volts AC)
Temperature range: −55°C to +105°C
Notes: Foil units are used in tuned circuits, integrating circuits, timing circuits and CRT deflection circuits. Metalised units are used in DC blocking circuits. Good high frequency capability, high insulation resistance, close tolerance, high stability and excellent dielectric absorption characteristics.

Less common types —
Polysulfone: Similar to polycarbonate and polyproplyene capacitors. Small size, high temperature range (to 150°C), suitable for high-frequency applications, and high insulation resistance. Excellent in high current and military applications. Not for sample/hold, fast settling amplifiers, or filters due to dielectric absorption characteristics. Poor history of availability.
Polyvinylidene fluoride: Considered experimental. Has high dielectric constant (about four to 12 times that of polyester devices), which results in a very small sized capacitor. Those units suffer from significant capacitance change with temperature, particulary at low temperatures.
Polyethylene terphthalate: For applications that require high reliability; high insulation resistance at high temperatures.
Metalised paper polyester/paper polyester foil: The foil unit has a slightly better dissipation factor than the metalised type. Operating temperature of −55°C to +125°C with voltage ratings of 240 to 600 (DC) available.
Paper polypropylene: Available in voltage ratings of 400 to 800 (AC). Operating temperature from −40° to +80°C.
Teflon/Kapton: Has a temperature range of −55°C to +250°C with a temperature coefficient of .009°C. Teflon's extremely low dielectric absorption makes it good for critical sample and hold circuitry. Those capacitors used in specialised applications such as oil well drilling equipment. Those capacitors are large in size since the dielectric is not available in thin gauges.
Parylene: Manufactured by Union Carbide, those capacitors are equivalent to polystyrene types in performance but are rated to +125°C, versus +85°C for polystyrene.

TANTALUM ELECTROLYTIC

Solid type —
Values: 0.001 to 1000μF
Temperature range: −55°C to +85°C (if derated, to +125°C)
Voltage rating: 6 to 120 volts DC
Tolerance: 5% to 20%
Leakage current: varies with temperature
Derating factor: 50% voltage
Notes: Used in low-voltage DC applications such as bypass, coupling and blocking. Not for use in RC timing circuits, triggering systems, or phase shift networks due to dielectric absorption characteristics. Also not recommended for applications subject to voltage spikes or surges. High capacitance in a small volume with excellent shelf life. Solid types not temperature sensitive and have lowest capacitance-temperature characteristic of any electrolytic unit. Dielectric absorption and high leakage currents make them unsuitable for timing circuits. Except for non-polarized units, these devices should never be exposed to DC or peak AC voltages in excess of 2% of their rated DC voltage. To prevent failures due to leakage or shorting when series connecting for higher voltages, parallel each unit with a shunt resistor.
Chip types —
Values: 0.068 to 100μF
Tolerance: 5% to 20%
Voltage rating: 3 to 50 volts DC
Temperature range: −55°C to +125°C
Leakage current: varies with temperature
Non-solid types —
Values: 0.5 to 1200μF
Tolerance: −15 to +30, and 20%
Voltage rating: to 350 WVDC
Temperature range: −55°C to +85°C (if derated, to +125°C)
Leakage current: varies with temperature
Notes: Polarised foil units are used for bypassing or filtering out low-frequency pulsating DC. Allowance must be made for leakage current. Not suitable for timing or precision circuits due to wide tolerances. Large values available. Etched foil has 10 times the capacitance per unit volume as plain foil types. Peak AC and applied DC voltages should not exceed rated maximums. Usable to 200kHz. Non-polarised foil are used in tuned low-frequency circuits, phasing low-voltage AC motors, and in servo systems. Sintered slug units are used in low-voltage power supply filtering and in DC applications. Can not withstand any reverse voltage. Leakage current lowest of all tantalum types; no appreciable leakage below 85°C. Usable to frequencies of 1MHz.

ALUMINIUM ELECTROLYTIC

Values: 0.68 to 220,000μF
Tolerance: −10 to +75%
Voltage rating: up to 350 volts
Temperature range: −55°C to +85°C (if derated, to +125°C)
Dissipation factor: varies with temperature
Temperature coefficient: varies with temperature
Notes: Used in filter, coupling and bypass applications where large capacitance values are required and capacitances above nominal can be tolerated. Sum of the applied AC peak and DC voltage should never exceed the rated DC voltage. Aluminium electrolytics are larger than tantalum electrolytics but less expensive. Loss of capacitance, to as little as 10% of rated value, will occur as the aluminium oxide electrode electrochemically combines with the electrolyte. Oxide film deterioration also requires capacitors to be "re-formed" after storage to prevent dielectric failure. That involves application of rated voltage for a period of 30 minutes, or more, to restore initial leakage current value. Over time, dissipation factor can rise by as much as 50%. Four terminal devices are available (two leads for each connection) that offer low ESR and inductance at high frequencies. Those units were designed for use in switching power supplies.

TRIMMER CAPACITORS

Values: range from 0.25 to 1pF and 1 to 120pF
Glass/Quartz: Low loss, high Q, and high stability for high tuning sensitivity applications. Frequency range up to 300MHz.
Sapphire: High level of performance between 1 and 5GHz.
Plastic: High grade units can be operated up to 2GHz.
Ceramic: Smallest sized single turn units with maximum capacitance under 100pF. Capacitance changes with temperature.
Air: High level of performance through UHF Band, from 300MHz to 1GHz.
Mica: Has wide capacitance range and relatively high current handling capability.
Vacuum/Gas: Used for high voltage applications. Values from 5 to 3000pF, with voltage ratings from 2 to 30 kilovolts (DC).

Selecting the best resistor/capacitor

the dielectric retains a residual charge. Thus, even if a capacitor that has a high dielectric absorption characteristic has been discharged to "zero", it may still be holding a considerable charge. That, as you might imagine, can cause considerable problems in timing circuits and the like.

Tantalum capacitors also are not recommended for circuits that produce spikes, surges, or pulses. If their voltage rating is exceeded by even a few volts, the device is likely to fail.

Tantalums may be polarised or non-polarised. Polarised capacitors should never be exposed to a reverse DC or peak AC voltage greater than 2% of its rated DC voltage. Non-polarised units, as their name would imply, do not suffer from that limitation. Non-polarised units are made up of two polarised units in series with their cathodes connected together.

Aluminium electrolytics

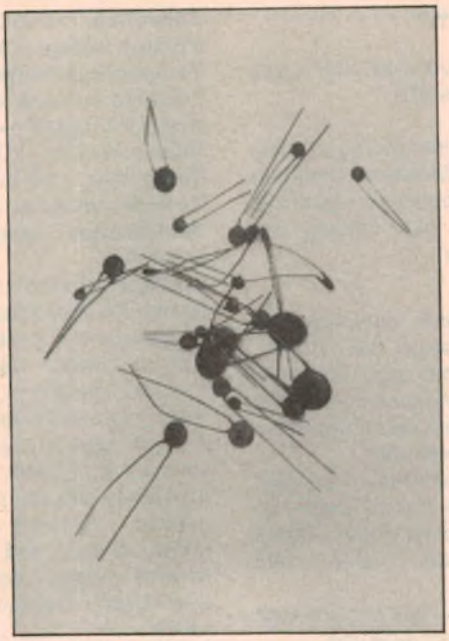
Aluminium electrolytic capacitors are generally larger than tantalums, and are less expensive. One problem with aluminiums is that they will change capacitance (drift) over time. That is caused by the aluminium oxide electrodes chemically combining with the electrolyte. Because of that, capacitance can drop substantially to 10% of rated values. Those units also have a limited shelf life due to oxide film deterioration and must be "re-formed" after long periods of storage. Re-forming consists of applying the capacitor's rated voltage to the unit for a period of 30 minutes. Re-forming also prevents dielectric breakdown or shorting. In addition, the dissipation factor of these devices can rise as much as 50%.

To prevent electrolyte evaporation and component cleaning problems, aluminium electrolytics sometimes have an epoxy end seal. However, without a vent, such capacitors may explode if exposed to reverse or overvoltage conditions.

Aluminium electrolytics are used in filtering, coupling, and bypass applications where large capacitances, and capacitances that are higher than the nominal value, can be tolerated.

Trimmer capacitors

Trimmer capacitors fall into three categories: multi-turn, single turn, and compression types. Multi-turn capacitors have either glass, quartz, sapphire, plastic, or air dielectrics, while single-turn devices use ceramic, plastic, or air dielectrics. Compression types use a mica dielectric.



Above is a selection of ceramic capacitors.

Glass, quartz, or air dielectric devices are selected for applications requiring low loss, high Q, stability, and tuning sensitivity. Glass and quartz devices are used at frequencies up to 300MHz. Air dielectrics are usable to about 1GHz. For frequencies of 1GHz, sapphire dielectrics offer the best performance.

Ceramic and plastic styles are less expensive, with high grade plastic dielectric devices being usable at frequencies up to 2GHz.

TABLE 3 — GLOSSARY

DC leakage — Small current that flows through or across the surface of the dielectric or insulation of the capacitor.
Dielectric — Insulating material between the plates of a capacitor.
Dielectric absorption — A property of a capacitor's dielectric such that even when the capacitor is discharged to zero, a residual charge remains stored in the dielectric.
Dissipation Factor — Important in AC applications, it is the ratio of effective series resistance (ESR) to capacitive reactance X_C and is usually expressed as a percentage. The dissipation factor varies with temperature, humidity and frequency.
Electrolyte — Current conducting solution (liquid or solid) between two electrodes or plates of a capacitor.
Equivalent series resistance (ESR) — Energy losses in the capacitor due to lead resistance, termination losses, and dissipation in the dielectric.
Insulation resistance (IR) — Measure of a capacitor's insulation quality expressed either in megohms or as a time constant, RC in seconds. That value determines a capacitor's leakage current for a continuously applied DC voltage when a capacitor is fully charged.
Temperature coefficient — A capacitor's change in capacitance per °C. May be positive, negative, or zero and is usually expressed in parts per million per °C (PPM/°C).
Working voltage (WVDC) — The recommended maximum voltage at which a capacitor should be operated.
Quality factor (Q) — A figure of merit used mostly in tuned circuit applications. It is defined as a 1/DF or X_C/ESR.

TABLE 4

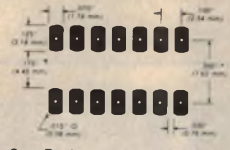
Letter Symbol	Low Temp	Number Symbol	High temp	Letter Symbol	Maximum Capacitance Change
Z	+10°C	2	+45°C	A	±1.0%
				B	±1.5%
				C	±2.2%
		4	+65°C	D	±3.3%
Y	−30°C			E	±4.7%
		5	+85°C	P	±10.0%
				R	±15.0%
		6	+105°C	S	±22.0%
X	−55°C			T	±22%-33%
		7	+125°C	U	±22%-56%
				V	±22%-82%

EVERYTHING YOU NEED TO MAKE PRINTED CIRCUITS

NOW STOCKING COMPLETE RANGE OF E-Z CIRCUIT DRAFTING AIDS

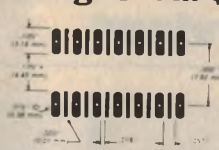
FULL RANGE OF RISTON MATERIALS, CHEMICALS CALL FOR PRICES

Dual in Line Packages All $4.37/pack



Cut Pad

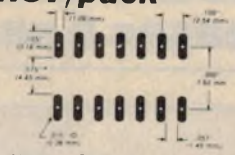
No. of Leads	Qty/ Pkg	Scale	Catalog Number
14	32 28	1X 2X	EZ6014 EZ6038
16	32 28	1X 2X	EZ6004 EZ6109
18	28 26	1X 2X	EZ6900 EZ6901
24	12 12	1X 2X	EZ6535 EZ6536
28	12 12	1X 2X	EZ6903 EZ6904
40	8 8	1X 2X	EZ6906 EZ6907



Cut Pad With Conductors

• Use where conductor traces must be routed between pads

No. of Leads	Qty/ Pkg	Scale	Catalog Number
14	32 28	1X 2X	EZ6760 EZ6761
16	32 28	1X 2X	EZ6762 EZ6764
40	8 8	1X 2X	EZ6984 EZ6985



Narrow Cut Pad

• Use where a longer terminal area is desired. Can be used with conductors between terminals.

No. of Leads	Qty/ Pkg	Scale	Catalog Number
14	32 28	1X 2X	EZ6013 EZ6071
16	32 28	1X 2X	EZ6453 EZ6244
40	8 8	1X 2X	EZ6987 EZ6988

Pre-Spaced Pads $4.37/pack

Center to Center Spacing	Pad Type	Scale	Pads Per Strip	Strips Per Pack	Catalog Number
.100"		1X	40	6	EZ5000
		2X	20	7	EZ5001
		1X	40	6	EZ5003
		2X	20	7	EZ5004
		1X	40	6	EZ5017
		2X	20	7	EZ5018
		1X	40	6	EZ5020
		2X	20	7	EZ5021
.156"		1X	25	6	EZ5014
		2X	13	7	EZ5015

Edge Connectors $4.37/pack

Center to Center Spacing	Patterns shown 1X (1:1) scale. Dimensions shown 1X (1:1) scale; for 2X scale, multiply values shown by 2.	Scale	Contacts/ Strip	Catalog Number	Strips/ Pack
.100"		1X	44	EZ6805	2
		2X	22	EZ6809	5
.125"		1X	35	EZ6704	2
		2X	17	EZ6716	4
.156"		1X	28	EZ6708	3
		2X	14	EZ6720	5

P.C. Drills

Take your pick of tungsten carbide or high speed steel. Available in 0.8, 0.9, 1.0 and 1.2mm T.C. drills $5.85 each. H.S. Steel $1.75 each.

Donut Pads

The basic all-purpose PC terminal area for termination of wire or component leads extending through the PC board. ID aids in accurate pad location to grid centers.

E-Z CIRCUIT Tape Donut Pads are unsurpassed for uniformity and accuracy. These photographically opaque terminal areas are accurate to ± .002" (0.05mm). E-Z Circuit opaque black pads are only .005" (0.13mm) thick.

$3.35/pack

1. Select the largest possible pad. Allow enough room for conductor traces and the physical conditions of artwork preparation and manufacturing of the actual board (MIL-STD-275).
2. A small ID makes registration easy, but may make it difficult to locate pad center after photo reduction.
3. Choose an ID smaller than hole to be drilled. (Drill size for plated-through holes must be larger than final hole.)
4. Use Multi-Pad configurations for multi-pad terminal patterns. It is much easier, much faster, and much more accurate to lay down a whole pattern printed to specific tolerances than to tediously position individual pads.

STANDARD INCH

OD in	OD mm	ID in	ID mm	Cat. No.	Qty/ Pkg
.080	2.00	.031	0.79	EZD216	96
.100	2.54	.031	0.79	EZD101	96
.120	3.05	.031	0.79	EZD239	96
.125	3.18	.031	0.79	EZD102	96
.150	3.81	.031	0.79	EZD144	96
.156	3.96	.031	0.79	EZD103	96
.160	4.06	.040	1.02	EZD247	108
.187	4.75	.031	0.79	EZD138	108
.200	5.08	.031	0.79	EZD139	108
.250	6.35	.062	1.57	EZD105	128
.300	7.62	.062	1.57	EZD111	112

Precision Slit Tapes

"Super" 201 is a flexible extra-strong photographically opaque, pressure-sensitive precision slit tape with exceptional adhesive characteristics. It will not creep or lift if stretching is avoided during application. "Super" 201 is extremely flexible and has a non-reflective matte finish. Only .005" (0.13 mm) thick.

- Precision slit to exacting tolerances to assure highest quality PC artwork and photography
- Manufactured from the same high quality materials as E-Z CIRCUIT PREKUT TAPE SHAPES to insure compatible PC artwork and photography

STANDARD INCH
20 Yds./Roll

Tape Size in.	Tape Size mm	Cat. No.	
.020	0.51	EZC3000	$3.05
.026	0.66	EZC3002	$3.05
.031	0.79	EZC3004	$3.25
.040	1.02	EZC3006	$3.25
.050	1.27	EZC3008	$3.25
.062	1.57	EZC3010	$3.35
.080	2.03	EZC3012	$3.35
.093	2.36	EZC3014	$3.35
.100	2.54	EZC3016	$3.35
.125	3.18	EZC3018	$3.35
.200	5.08	EZC3020	$3.46
.250	6.35	EZC3022	$4.57
.500	12.70	EZC3024	$5.70

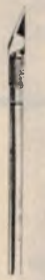
Accurate Grids

10 X 10

Grids are produced on accurate stable film with 0.1" pattern for maximum accuracy. Matte one sided. .003" thick.

Sheet Size	Catalog Number	
8½" X 11" (215.9 x 279.4mm)	EZ1463	$2.63
11" X 17" (279.4 x 431.8mm)	EZ1466	$4.87

Knife & Blades

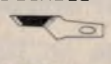


X-Acto Knife Holder $3.56

- Use to apply E-Z CIRCUIT pressure-sensitive printed circuit drafting aids
- Use to cut and trim E-Z CIRCUIT pressure-sensitive printed circuit artwork tape
- Ideal for trimming E-Z CIRCUIT pressure-sensitive Copper Tape and Component Mounting Configurations
- Includes X-Acto blade (Order No. EZ3108, shown below)

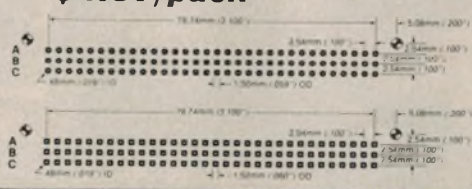
X-ACTO REFILL BLADES

No 16 Blades $3.05
5 blade pack



No 11 Blades $3.05
5 blade pack

DIN41612 Connectors All $4.37/pack



DIN41612 connectors patterns have three row designations A, B and C. Three pattern combinations are available AB, AC and ABC. They are also available with round or square pads.

ROUND PAD

64 Pin Pattern (A-B) Scale	Symbols Per Pkg	Catalog Number	64 Pin Pattern (A-C) Scale	Symbols Per Pkg	Catalog Number	96 Pin Pattern (A-B-C) Scale	Symbols Per Pkg	Catalog Number
1X	2	EZ6869	1X	2	EZ6875	1X	2	EZ6871
2X	2	EZ6870	2X	2	EZ6876	2X	2	EZ6872

SQUARE PAD

64 Pin Pattern (A-B) Scale	Symbols Per Pkg	Catalog Number	64 Pin Pattern (A-C) Scale	Symbols Per Pkg	Catalog Number	96 Pin Pattern (A-B-C) Scale	Symbols Per Pkg	Catalog Number
1X	2	EZ6878	1X	2	EZ6881	1X	2	EZ6884
2X	2	EZ6879	2X	2	EZ6882	2X	2	EZ6885

8.30 to 5 Monday to Friday. 8.30 to 12 Sat
Mail Orders add $3.00 to cover postal charges.
Next day delivery in Sydney add $5.00
All prices INCLUDE sales tax
Tax exemption certificates accepted if line value exceeds $10.00

GEOFF WOOD ELECTRONICS

GEOFF WOOD ELECTRONICS PTY LTD
Incorporated in N.S.W.
656A Darling St, Rozelle 2039
(One door from National Street)
Tel: **810 6845**

bankcard
$10.00 minimum

specialising in electronic components for the professional and hobbyist.

New Products...

Product reviews, releases & services

RF power meter with frequency counter

Vicom Australia Pty Ltd has released the new Fujisoku range of termination power meters which include a built-in frequency counter.

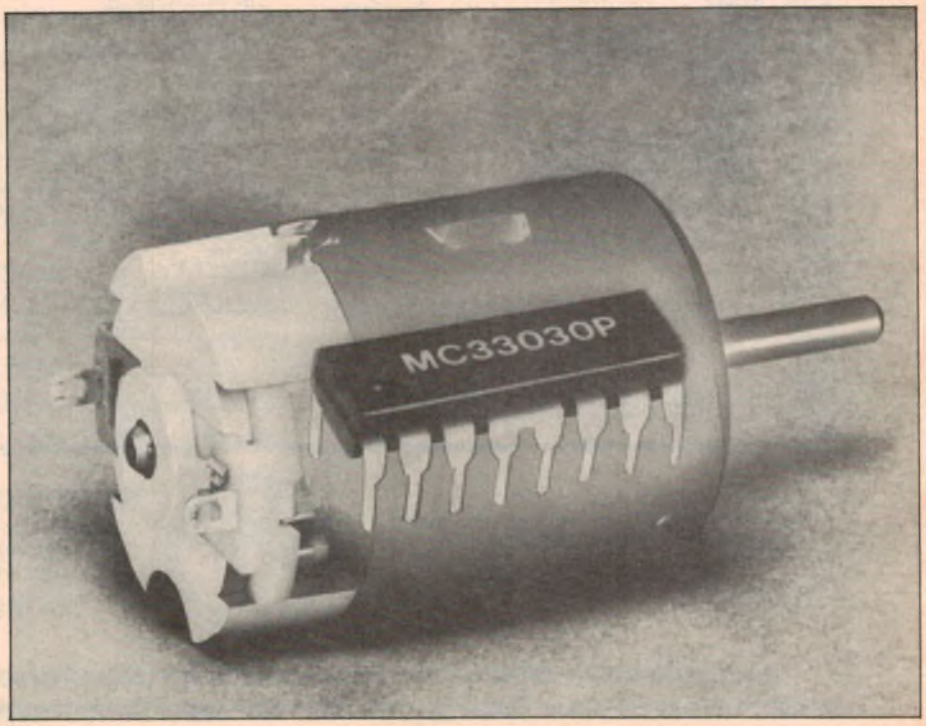
The frequency counter has been designed for low power consumption and operates from internal batteries. The counter uses a 7-digit LCD.

The instruments feature wide frequency range, compact rugged construction and light weight, making them ideal for servicing applications.

Three models are available to cover the frequency ranges 0-150MHz, 30-500MHz and 330-960MHz. Other models for higher RF power are available.

For further information contact Vicom Australia Pty Ltd, PO Box 366, South Melbourne, Vic 3205. Telephone (03) 62 6931.

DC servo motor controller/driver



The Motorola MC33030P is a new monolithic DC servo motor controller/driver that contains all the active functions necessary for a complete closed loop system. It is ideally suited for bidirectional drive of fractional horsepower motors in applications where precise position sensing is required.

The IC features an error amplifier and window detector, drive and brake logic with direction memory, over voltage shut-down and an adjustable dead band to prevent excessive hunting.

Although the device is mainly intended for DC servo applications, it can also be used as a pulse width modulator motor speed controller. The MC33030P is packaged in a 16-pin plastic DIP.

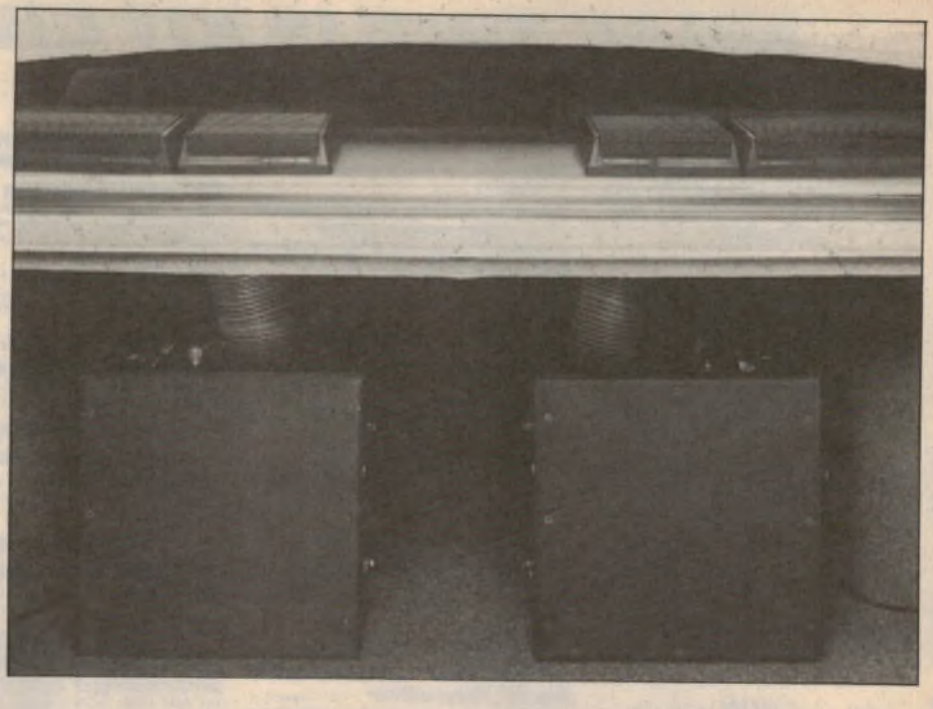
For further information contact Motorola Semi Conductor Products, 250 Pacific Highway, Crows Nest, NSW 2065. Telephone (02) 438 1955.

Car speakers from KEF

New from KEF are two high-quality speaker systems designed for automotive use — the GT100 and GT200.

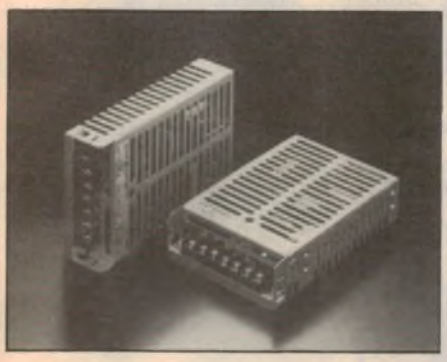
The GT100 system is rated at 50W and each speaker contains a pair of drive units and a crossover network. It uses a 2.54cm soft-dome tweeter with a high temperature voice coil and ferrofluid cooling. The woofer is an 11cm long-throw unit with a paper cone treated to prevent ingress of moisture.

The GT200 is for the power hungry. It has two, 8-litre cavity enclosures, each containing a 200mm driver and crossover circuitry. These enclosures are designed for mounting in the car's boot or hatch area and couple their sound output to the car's interior via flexible pipes.



The midrange and high-frequency content is handled by a pair of satellite units based on the design of the GT100.

For further information on these KEF products contact The Falk Electrosound Group, 28 King St, Rockdale, NSW 2216. Telephone (02) 597 1111.



DC input power supplies

Amtex Electronics has released a range of 29 DC input power supplies. These switch mode power supplies are efficient, radiate less heat and are lighter and more compact than linear power supplies.

The models stocked by Amtex are rated from 12.5-50W and are available for 12, 24 or 48V DC input. There is a choice of single, dual or triple outputs.

Both input and output voltages are floating, allowing either positive or negative polarity. Other features include short circuit protection and over-voltage protection.

For more information contact Amtex Electronics, 36 Lisbon Street, Fairfield, NSW 2165. Telephone (02) 727 5444.

XMAS TIME IS KIT GIVING TIME

(to yourself that is. . .)

Join the Compact Disc Owners Club - ring (02) 747 1888 or call in to one of our stores for details.

NEW KITS FROM JAYCAR

The big news this month is from Electronics Australia. They announce 2 major projects in their December issue.

The first project is the world beating AM stereo/FM stereo fully synthesised Hi Fi tuner. The staff of EA have designed a tuner which they believe has no peer. Nothing from Japan, Europe or the USA can beat it. Because of the complexity, this project will run over several months.

Jaycar as usual will be providing a full kit of this project. It will include a fully punched chassis with all original components. We have not finalised costing yet BUT save your pennies! You won't believe the sound once you have built it.

Project No 2 is a fully functioning 5 axis robot arm with substantial and payload capability. This robot features a unique construction material - blank printed circuit board!! All axes are precision servo-controlled and a considerable amount of software is provided. Truly an exciting and world class project!

Also of note is the Dave Tillbrook designed ultra-fidelity preamp. Jaycar will have a full kit of this one too!

☆ ☆ NEW ☆ ☆

Motor/Gearbox Kit

This fantastic new kit enables you to produce a shaft speed between 3 and 2,000 RPM!

It uses a small DC motor with a 'modular' gearbox attached. You are supplied with gear wheels, spacers etc to configure your gearbox to almost any speed within the 3-2,000 RPM range. Measures only 48(H) x 25(W) x 37(D)mm (not including output shaft)

Cat. YX-2600

ONLY $14.95

OTHER POPULAR KITS

Please excuse the lack of photographs - not enough space.

Electronics Australia Popular Kits

☆ Playmaster Series II 200W MOSFET Amp

Cat. KA-1500

Fully integrated amp kit. No compromise type design. A classic.

ONLY $439.00

Car Booster Amp - EA August 1985

This brute gives you 2 x 50W RMS in your car!

Cat. KA-1600

ONLY $179.00

300 WATT Inverter (New Design) Ref: EA September 1985

New rugged project featuring high impact plastic case, double power outlets, auto start up, easy construction and lower cost than old model.

Cat. KA-1610

ONLY $199.00

8 Sector Burglar Alarm

Ref: EA January/February 1985 - the TOTALLY PROFESSIONAL alarm for the concerned householder. Very comprehensive.

Cat. KA-1580

ONLY $149.00

"PEST OFF" Ultrasonic Pest Repeller - EA November 1985

A mozzie season special. See last months EA for more information.

Cat. KA-1620

ONLY $39.95

Bench Type Digital Capacitance Meter - Ref: EA August 1985

measure from 1pF to 99.9uF with this handy piece of equipment.

Cat. KA-1595

ONLY $79.95

ELECTRONICS TODAY INTERNATIONAL

ETI 5000 Series Amps

Still without doubt our most popular Hi Fi amp kits ever! You KNOW that you always wanted the best. Now that it's Xmas time why not shout yourself a system on your Bankcard?

ETI 699 Modem - Ref: May 1985

One of the most popular ETI kits for years. 300 Baud, built to Telecom specs, and very low cost!

Cat. KE-4695

ONLY $149.00

ETI 1404 4 Input Mixer

Ref: July 1985 - Jaycar's SHORT FORM kit now includes the Cannon connectors at no extra cost.

Cat. KE-4700

$99.00 - A Bargain!!

ETI 341 Electronic Jumper Leads - A nifty and easy way to recharge a flat battery in a car without lifting the bonnet!

Cat. KE-4703

ONLY $39.95

ETI 698 Microbee Dialler - Ref: July 1985 - A handy addition to the Bee if you are into communication.

Cat. KE-4696

ONLY $23.95

ETI 342 Pulse Shaped Discharge Ignition

Ref: April 1984 - Brilliant design. A must for high performance ignition enthusiasts. Can be Hall Triggered. Complete kit.

Cat. KE-4690

ONLY $79.50

ETI 675 RS-232 to Centronics Interface

One of our most consistently popular kits.

Cat. KE-4666

ONLY $29.95

AUSTRALIAN ELECTRONICS MONTHLY KITS

AEM 3500 'The Listening Post'

Ref: July 1985 - Decode all that info on your short wave radio to show Morse code, RTTY, Weather maps etc. Wonderful! (A personal computer is required).

Cat. KM-3015

$29.50 Very Popular

AEM 6500 60/120W Utility Mosfet Amp

Modules designed by David Tillbrook. Brilliant performance 60W or 120W versions.

Cat. KM-3010 (60W)

ONLY $49.50

Cat. KM-3012 (120W)

ONLY $65.00

AEM 8500 Courtesy Light Extender

Ref: November 1985 - Fit this to your car and your cabin light will stay on for a specified period - just like the very expensive cars!

Cat. KM-3025

ONLY $8.95

AEM 9500 Beat Triggered Strobe

Dance to the inbeat flash or the strobe or operate it in conventional fashion!

Complete kit.

Cat. KM-3018

ONLY $59.00

Jaycar also carries dozens of other EA kits - just ask!!

MAIL ORDER HOTLINE

(02) 747 1888

☆ ☆ NEW ☆ ☆

300 WATT INVERTER WITH AUTO START

NOT A KIT - BUILT, TESTED & GUARANTEED

This is the built version of the "Electronics Australia" September 1985 project!

Just think how handy it would be to have 240 volts AC mains power when camping, or for your boat or caravan - well this brilliant new design is the answer.

● Super compact - tough ABS case ● Uses high efficiency toroid transformer which keeps the weight down, battery drain and heat dissipation ● Auto start draws power from your battery on when appliance is plugged in and turned on i.e. battery can be left permanently connected ● Thermal overload automatically shuts down if/when output stage is overheated (through high ambient temperature and high load or combination thereof - automatic reset ● Current regulated inverter ensures the unit is being used within designed overload limits ● Current overload unit self limits - LED indicates overload condition.

COMPLETE KIT VERSION

Cat. KA-1610

ONLY $199.00

FULLY BUILT & TESTED

Cat. MI-5000

ONLY $249.00

INFRA RED MOVEMENT DETECTOR

The infra red or IR detector for short, falls into the Black Magic category. It basically is a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna?) which has a "Commutated" field of view. Its reception pattern is comb like, but highly tuned to the IR wavelength of human bodies. When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit.

IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects. Curtains, for example, can wave about without tripping the alarm. Even the cat is unlikely to trip the unit.

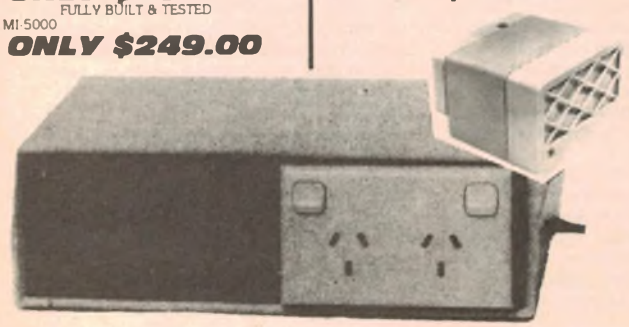
FEATURES:

- 12V DC powered
- Small 77mm x 62mm x 51mm
- Double sensor
- Computerised QC to lower failure rate
- Built-in test lamp
- Alarm output SPST 30V DC @ 1A
- NO or NC terminations

Cat. LA-5017

SAVE $20.00

ONLY $89.00 ea



☆ ☆ NEW ☆ ☆

HANDS-FREE TELEPHONE ADAPTOR

Ref: EA November 1985

Jaycar now has stocks of this superbly designed project. Call in and check it out now! Note: this unit is ORIGINAL to the design.

Cat. KA-1640

ONLY $79.00

OPEN THURS NIGHT 'TILL 8.30 p.m.

YORK ST. CITY
HURSTVILLE
CARLINGFORD
BRISBANE

AEM 6010 ULTRA FIDELITY PREAMP

Ref: Australian Electronics Monthly

As we write this kit is nearing completion. By the time that you read this we will have the full kit price. Call in or ring us for further details.

Steam Sound Simulator

Ref: EA December 1984

Build this realistic steam sound simulator for your model train layout. It features an infra-red optical switch to synchronise the "chuffs" to the wheel rotation. Like the KA-1561, it picks up the power from the railway tracks. All specified components supplied including 32 ohm headphone type transducer.

Cat. KA-1562

$17.95

"RAILMASTER" Pulse-Power Train Controller

Ref: EA September 1984

This is a state-of-the-art train controller offering tremendous features.

- ★ Variable simulated inertia
- ★ Full short circuit protection including both audible and visual indicators
- ★ Power and track monitoring indicators
- ★ Adequate power for double and triple heading locos
- ★ Fixed 12V DC and 15V AC power for lighting and accessories
- ★ Optional walk around throttle

The Jaycar kit includes realistic Scotchcal front panel and the special console case only available from us. The large paddle switches have been specially imported just for this kit. We believe that you will be delighted with this unit.

Cat. KA-1560

$89.95

Optional Walk Around Controller Cat. KA-1559

ONLY $9.95

Diesel Sound Simulator

Ref: Ea November 1984

This project mounts inside a model train (i.e. goods wagon) and produces a noise similar to a diesel locomotive. The 'speed' varies according to the throttle action for added realism. All listed parts provided.

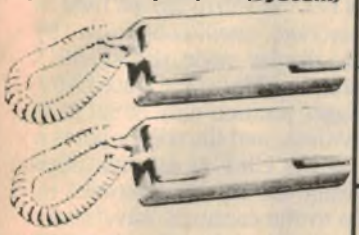
Cat. KA-1561

$19.95

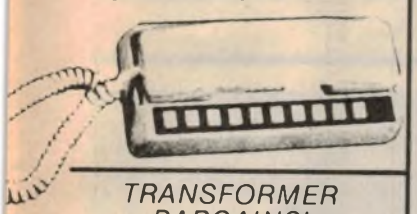
DO iT YOURSELF IN DECEMBER & SAVE!

INTERCOM BARGAINS
HUGE SCOOP PURCHASE!!

DEAL 1
2 station telephone system with call button. Units can be up to 2km apart. Quality units. Size 76 x 224 x 80mm
Cat. AJ-5506
$69.95 per pair (system)



DEAL 2 10 station all master common talk telephone system. Allows one conversation at any one time between two and/or all stations - suitable for installations requiring between 3 to maximum 10 stations - call selector button to each station - each unit with readily identifying junction box (previous wiring experience not required) - adjustable volume control - wiring 13 strands (for 10 installation) - distance to 1000 metres - power source (each unit) 12V DC - idling current 1.9mA - Dimensions 225 x 100 x 80mm
Cat. AJ-5508
$69.95 per station



TRANSFORMER BARGAINS!
Two small power transformers at never-to-be-repeated prices. Stocks strictly limited.

ALT-2 240V to 6, 9 & 12V AC at 300mA
Conventional chassis mount.
Cat. MM-1994
ONLY $3.95

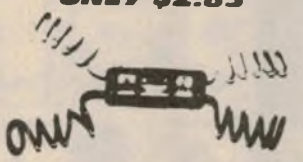
ALT-3 240V to 6, 9 & 12V AC at 500mA
Chassis mount
Cat. MM-1996 **$4.95**

SCOOP PURCHASE
600 Ohm line transformers SLASHED!!!
Another amazing below cost buy! Australian made chassis mount 600:600 ohm line isolating (or matching) transformer at a bargain price. Both primary & secondary windings are an identical 600 ohms. The transformer measures 27(W) x 20(D) x 21(H)mm and features a grain oriented silicon steel for hi fi. There is no doubt that the unit would pass line level, even +4dB/m without trouble, probably more.
Cat. MT-4725
1-9 $2.95; 10-24 $2.50
25+ $2.25 each

☆ ☆ NEW ☆ ☆
CENTRONICS 57 Series Micro Ribbon IDC Line/Chassis Socket
Quality moulded unit with strong plug retaining clips. Can be chassis mounted or use as a line socket.
Cat. PS-0896
$17.50 each
10 up $16.50 each
IDC plug to suit & solder type are available.

OPEN SATURDAY 'TILL 4 p.m. ALL STORES

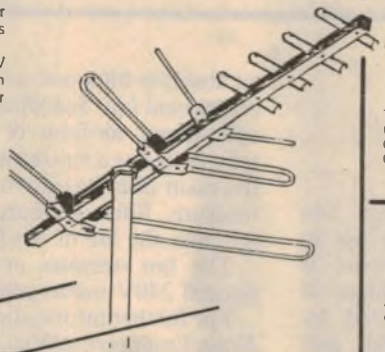
☆ ☆ NEW ☆ ☆
AUTOMOTIVE TYPE 2 PIN PLUG/SOCKET CONNECTOR
Bullet type moulded plug and socket fits into a matching moulded receptacle. Generous quantity of lead supplied each way. Ideal polarised automotive/marine connector.
Cat. PP-2016
ONLY $2.85



Channel 0-28 to go UHF only in JANUARY!
The multicultural channel (0-28) will cease VHF transmissions at the end of December 1985. In order to receive this network properly (which has some GREAT programs on it), you will need a TV antenna with elements cut for the shorter wavelength bands. All commercial channels have UHF channels as well.
Why not use this opportunity to update that old antenna so that your reception continues? Remember you will probably have time over the holiday break and you won't miss a great deal of worthwhile TV as it is a non-ratings period. You may also find you get a better picture on the UHF commercial channels than VHF.
We at Jaycar have updated our range of TV antennas/accessories to provide you with the most cost effective solutions to your antenna problems.
Call into Jaycar for expert advice!

TV GUTTER MOUNT BRACKET
This is basically a short section of galvanised mast with a clamp at one end. It fixes to a rain gutter or other suitable fixing place. You than have a light duty mast to mount an antenna! 10 metres of 300 ohm terminated lead is included. Ideal for the Quick Rig (Cat. LT-3175).
Cat. LT-3914
ONLY $9.50

ECONOMY RECEPTION
"Quick Rig" VHF/UHF Primary Reception Antenna
This is our lowest cost VHF/UHF antenna. It is supplied with U-bolt for most mounting. Because it does not present a large wind load it can be gutter mounted via the gutter mount mast bracket. (See Cat. LT-3914).
The Quick Rig is all you need if you live in the majority of the metropolitan areas of the major coastal cities.
Cat. LT-3175
ONLY $44.95
MAST EXTRA



☆ ☆ NEW ☆ ☆
"GHOST BUSTER" All new VHF/UHF Anti-Ghosting TV Antenna
- ★ Superb front-to-back ratio
- ★ High gain on UHF & VHF
- ★ 75 ohm output
- ★ Very strong but light
- ★ Registered unique design

We expect this to be our hottest seller!
Cat. LT-3150
ONLY $99.50
75 ohm 'F59' type male connector
Cat. PP-0640 **ONLY $1.20**

Call in to Jaycar for a great range of TV accessories including cable, splitters, diplexers, amplifiers etc.

MULTI FEATURE RECHARGEABLE TORCH
Cat. YS-5035
ONLY $29.99
Firstly other brand name versions of this product sell for around $45. This unit is better and has more features.
- ★ Automatically comes on as an emergency light
- ★ Exclusive in built magnet for attachment to steel surfaces - e.g. car
- ★ Cost INCLUDES charger & NiCads
- ★ Swivel head for vertical operation
- ★ Red filter supplied for flashing emergency light use
- ★ Wall fixing screws supplied
- ★ Wall cradle supplied **NOT $45**

ONLY $29.99

TRANSISTOR ASSISTED IGNITION
Ref: EA January 1983
Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and DIE CAST BOX - as used in the original EA unit.
Beware of kits that use flimsy sheet metal. This kit is designed to be used with contact breaker points. If you want Hall-Effect breakerless option we suggest the KA-1505.
Cat. KA-1506
ONLY $37.95

TAI HALL-EFFECT "BREAKERLESS"
Ref: EA December 1983
This kit is virtually identical to the KA-1506 except that it contains the interface electronics for the KJ 6655 Hall-Effect Triggerhead.
Cat. KA-1505
ONLY $39.95

CONTACTLESS HALL-EFFECT "BREAKER POINTS"
See EA December 1983
A professionally engineered electronic ("breakerless") contact breaker system. Each kit contains the following:
- ★ **Hall Effect Triggerhead**
- ★ **Magnetic rotors for both 4 & 6 cylinder cars**
- ★ **Over 6 cam lobe adaptors**
- ★ **Over 12 different adaptor plates for your particular distributor**
- ★ **Other hardware (i.e. screws)**
- ★ **Removes from car when you sell it.**
- ★ **As easy to install as a set of points**
- ★ **Simple instructions included**

Cat. KJ-6655
ONLY $32.50

OPEN THURS NIGHT 'TILL 8.30 p.m.
YORK ST. CITY
HURSTVILLE
CARLINGFORD
BRISBANE

Jaycar ELECTRONICS
Incorporating ELECTRONIC AGENCIES
NUMBER 1 FOR KITS

N.S.W. SHOWROOMS
SYDNEY: 117 York Street. Tel: (02) 267 1614
CARLINGFORD: Cnr. Carlingford & Pennant Hills Road. Tel: (02) 872 4444
CONCORD: 115/117 Parramatta Road. Tel: (02) 745 3077
HURSTVILLE: 121 Forest Road. Tel: (02) 570 7000
GORE HILL: 188/192 Pacific Highway (Cnr. Bellevue Avenue) Tel: (02) 439 4799

QUEENSLAND **BURANDA:** 144 Logan Road. Tel: (07) 393 0777
MAIL ORDERS: P.O. Box 185, CONCORD 2137
HEAD OFFICE: 115-117 Parramatta Road, CONCORD 2137
Tel: (02) 747 2022 Telex: 72293

SHOP HOURS
Carlingford, Hurstville, Gore Hill, Brisbane
Mon-Fri 9am - 5.30pm
Sydney and Concord
8.30am - 5.30pm
See Box for other shop hours

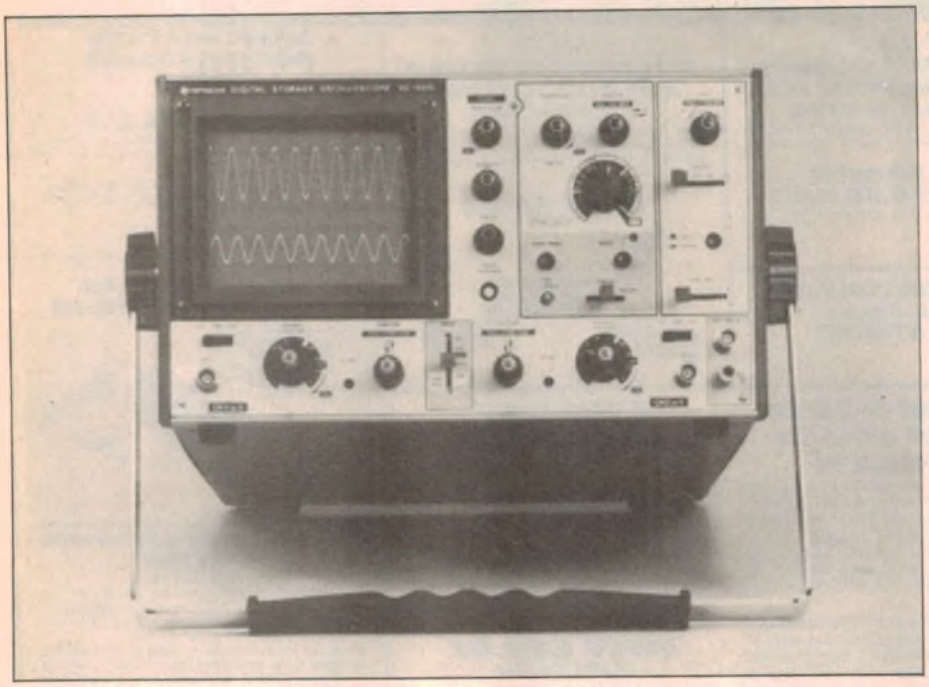
POST & PACKING

$5 - $9.99	$2.00
$10 - $24.99	$3.75
$25 - $49.99	$4.50
$50 - $99.99	$6.50
$100 - $198	$8.00
Over $199	$10.00

COMET ROAD FREIGHT ANYWHERE IN AUSTRALIA ONLY $13.50

MAIL ORDER VIA YOUR PHONE

New Products...



Digital storage oscilloscope

Hitachi's new VC-6015 can be used as a digital storage oscilloscope or, by changing the display mode, the VC-6015 can be used as a 10MHz dual trace CRO.

A pre-trigger position may be set at 0, 2, 5 or 8 divisions, and the trigger point is displayed on the CRT as an intensified point, allowing the user to determine its relationship to the captured waveform.

A hold function maintains one stored waveform while another is captured. The recording function enables a pen recorder to be linked to the CRO for hard copy of stored waveforms.

For further information contact IRH Components, 32 Parramatta Road, Lidcombe, NSW 2141. Telephone (02) 648 5455.

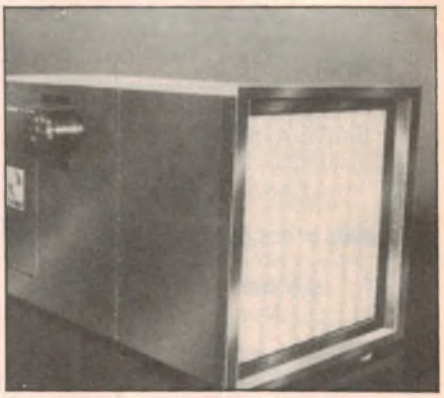
Portable asbestos fan filter unit

Air & Noise Engineering has introduced a fan filter unit for use in situations where asbestos material is being removed from the buildings. It ensures that any dust generated by asbestos removal is localised and collected through the filter.

The unit consists of a roughing filter, an absolute filter and a backward curved centrifugal fan. Specifications include an operational air-flow of 366 litres per second. It has a throwaway pre-filter and the main filter has a manometer fitted to measure filter pressure drop and to optimise the life of the filter.

The fan operates at 2500rpm on a normal 240V mains supply.

For further information contact Air & Noise Engineering (Vic) Pty Ltd, PO Box 135, Box Hill, Vic 3128. Telephone (03) 890 0316.

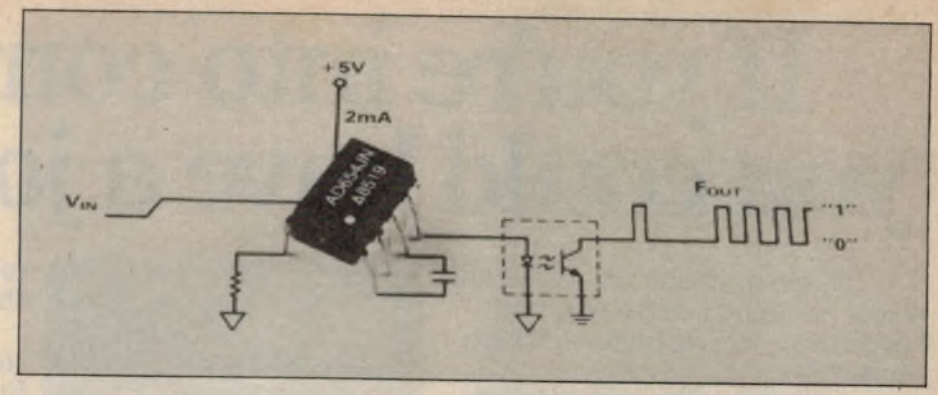


Low-cost voltage-to-frequency converter

A low-cost 500kHz full-scale voltage-to-frequency (V/F) converter, featuring low quiescent power drain from a single 5V power supply, has been introduced by Analog Devices, Inc.

The AD654 monolithic V/F converter draws 2.5mA maximum. It operates from single or dual supplies, from +5V to +36V or from ±5V to ±18V, and guarantees maximum non-linearity of ±0.1% and ±0.4% with 250kHz and 500kHz full-scale operation, respectively.

The AD654 can be used in power monitoring and motor control, temperature measurement, energy management, phase-locked loops, and isolated signal transmission.



Unlike most low cost monolithic V/F converters, only one resistor and capacitor are required to set the full scale frequency; a pull-up resistor is used for setting the voltage level of the open-collector output stage. The AD654 accepts positive, negative or bipolar input signals and produces a square-wave output capable of driving opto-couplers, long cables or up to 12 TTL loads.

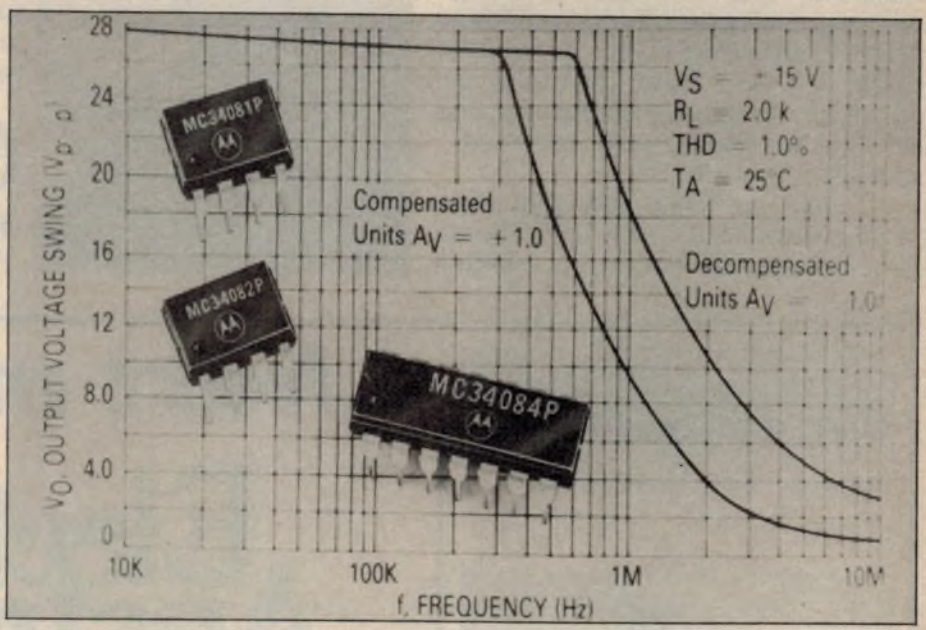
For further information contact Parameters Pty Ltd, 41 Herbert Street, Artarmon, NSW 2064. Telephone (02) 439 3288.

New JFET op amp family

A new generation of JFET input operational amplifiers — the MC34080/35080 series — has been introduced by Motorola. The devices are available in single, dual and quad versions, compensated and decompensated. According to Motorola, they offer bandwidth and slew rates that are up to four times greater than previously available industry standard amplifiers.

A combination of JFET and bipolar technologies, along with an all-NPN output stage, has yielded a fully compensated op amp family with a gain bandwidth product of 8.0MHz and slew rates in excess of 30V/fls. The decompensated versions are available with a gain bandwidth of 16MHz and slew rates of 60V/fls.

The single and dual op amp versions utilise an internal trimming network which greatly reduces input offset errors. Input offset voltage is specified to within



0.5mV maximum for the prime grade single op amp, and 1.0mV maximum for the dual devices.

Other features include: high input impedance, low distortion and low equivalent input noise voltage.

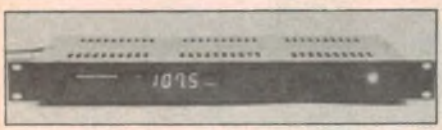
For further information contact Motorola Semi Conductor Products, 250 Pacific Highway, Crows Nest, NSW 2065. Telephone (02) 438 1955.

Protective packaging for vital components

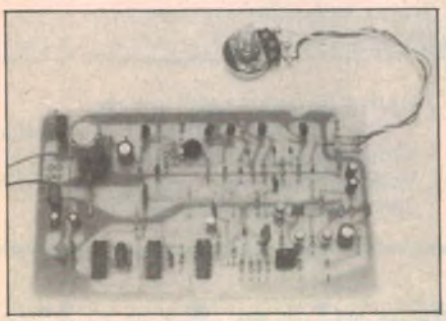
Rheem's Sealed Air Products Group has released protective packaging material designed specifically for the electronics industry.

Anti-Static Air Cap, a bubble cushioning material, is claimed to provide protection against potentially damaging static build-up, in addition to physical protection during warehousing, handling and shipping operations. It can also be used for packing volatile or potentially explosive products, or in atmospheres where the generation of a static spark could have catastrophic consequences.

For further information contact Rheem Sealed Air Products, 3 Burrows Road, Alexandria, NSW 2015. Telephone: (02) 519 4211.



Playmaster stereo AM/FM tuner.



Video fader control circuit.

Carver's new compact disc player.

Next month in Electronics Australia

Sony's 8mm Video

Sony's new CCD-V8 8mm video camera/recorder is very impressive. We tested it and bring you our report in January *Electronics Australia.*

Video Fader Control

Add a touch of professionalism to your home movies with our new video fader. It allows a scene to be faded to black (and back again) without loss of colour or picture lock (sync). Note: held over from last month due to lack of space.

Stereo AM/FM Tuner

Next month, we will present the full circuit diagrams for our new synthesised stereo AM/FM tuner and describe its operation. Don't miss out on your copy.

Compact Disc Special

January *Electronics Australia* will present a full directory of all issued compact discs currently available in Australia. We also review Carver's impressive new CD player.

*Although these articles have been prepared for publication circumstances may change the final content.

New Products...

Computer designs PC artwork masters

A new computer aided designed (CAD) service for PCB artworks and overlays has been announced by RCS Design Pty Ltd, Alphington, Victoria. The artworks are produced on a Gerber Photoplotter which produces accurate masters ready for the PCB manufacturer.

The CAD system itself is based on the P-CAD Electronic Design Automation System from Quest International Computers and uses 5.25-inch floppy disks. Typical sets of artwork masters include negatives for component and solder side trackwork, component layout, solder resist and the drilling pattern.

The procedure is suitable for both single sided and multilayer boards. In addition, RCS can supply tapes for numerically controlled drilling machines.

For further information contact RCS Design Pty Ltd, 728 Heidelberg Road, Alphington, Vic 3078. Telephone (03) 49 6404.

RF test gear from Vicom

Vicom has released a new range of RF test instruments from Fujisoku of Japan.

The range includes termination power meters, wideband and narrow-band power meters, through-line power meters and RF power peripherals, including coaxial switches and dummy loads.

Further details can be obtained from Vicom Australia Pty Ltd, PO Box 336, South Melbourne, Vic 3205. Telephone (03) 62 6931.

Guide for RF transistors

Designer's Guide — Small Signal, Low Noise Transistors is a 126-page data and applications manual covering the TRW line of transistors for receiver and RF circuitry.

The manual includes a cross reference listing nearly 100 competitive transistors and 22 TRW substitutes or equivalents. Also included in the manual are packaged outline drawings with dimensions and application notes, including schematics and PCB patterns.

For further information contact Total Electronics, 9 Harker Street, Burwood, Vic 3125. Telephone (03) 288 4044.

REVIEWS OF RECENT
Records & Tapes
CLASSICAL • POPULAR • SPECIAL INTEREST

ELGAR

Concerto for Cello and Orchestra Op.85. Yo Yo Ma (cello) and the London Symphony Orchestra conducted by Andre Previn. CBS Digital Disc IM 39541.

I still have faint memories of hearing the first performance of this concerto a year or so after World War One, when I was a young boy at the old Queen's Hall in London. Philip Ramey's sleeve notes remind me that the soloist was Felix Salmond and the date October 19, 1919. I remember the work was an immediate success welcomed by rousing applause.

The concerto is autumnal in character like so much of Elgar's late music. Gone was the heroism of earlier days "replaced by sadness and melancholy," to again quote the Ramey notes. In comparatively recent years it has been often played by notable soloists, perhaps the most popular of whom was the lovely Jacqueline du Pre, so brutally cut down since her recording of it by incurable multiple sclerosis.

Yo Yo Ma plays it with effortless fluency and eloquent tone. He has a sensitive feeling for the cusp of a phrase. His lyrical reading of the first movement puts him among the greats. Not so long ago he astonished with a dazzling technique. Nowadays he shows he is capable of deeper things.

The music covers the whole compass of the instrument, the balance between soloist and orchestra is fine, the recording transparent with Previn encouraging the young cellist in every bar. I'd like to direct particular attention to Yo's immaculately intoned double stopping. An exciting performance and recording.

After the vigourous melodiousness of the Elgar the polytonality of the Walton sounds a bit effete nowadays. The music — and Yo — exploit the full range of the instruments possibilities yet with not quite the same conviction as in the Elgar. Much energy is emitted by both soloist and orchestra. And there are some technical wonders in the scherzo — perhaps the best movement. Its pace is exhilarating and the trio has real melodies.

Later grave-voiced musings go on to ramble a bit. Still later, a vigourous low solo passage, quite shapeless, sounds just silly as a cadenza followed by a cacophonous tutti just as silly. Then comes the real cadenza, wonderfully played as an introduction to some real melodies. The fine reading of the Elgar more than compensates for some of the not too important shortcomings of the Walton. It is a disc I can unreservedly recommend. (J.R.)

BRAHMS

A German Requiem. The Vienna Singverein Choir, vocal soloists and the Vienna Philharmonic Orchestra conducted by Herbert von Karajan. Two digital boxed discs 410 521/1.

If you like your music serious here are two pieces that should please you. But the composers had nothing in common. Indeed Brahms scorned Bruckner and described his works as "symphonic boa constrictors — the work of a crafty village schoolmaster."

The digital recording is outstanding. The choir is widely inflected, the balance between it and the orchestra perfect. So too is the co-ordination between the two groups. Behind it all the organ is there but never obtrusive. The choir's intonation is faultless and the singing attractive. Not unexpectedly the Requiem is solemn — no difficult task for Brahms.

Brahms had no time for the contemplation of an after life, Bruckner was a devout practising catholic. Death meant nothing more to Brahms than the loss of a few friends. Bruckner sought the consolation of his faith.

The sound is great, wide dynamically but never insufferable despite its digital processing. Among the soloists Jose van Dam is an attractive baritone without mannerisms. His production is rock steady yet expressive. The soprano, Barbara Hendricks, a small black woman in her accompanying photograph, has a surprisingly big voice for her size, a wide tessitura but in this work no very great emotional involvement.

However her voice is always pleasing and the sense of pitch is unshakeable even in the most difficult parts of her contributions. Different soloists are used in the Bruckner Te Deum. He contrasts a solo vocal quartet to the choir. This is composed of Janet Perry (soprano), Helga Mkker Molinari (mezzo), Gista Winbergh (tenor) and Alexander Malta (bass). Bruckner's use of heavy brass is solid rather than brilliant in the manner of Elgar. However its use is specially worthy of mention.

The Te Deum contains much jubilation but no merriment. The vocal quartet enters sparingly but efectively, all the solists are good with a special word of praise for the young sounding soprano. Those to whom this sort of thing appeals should find considerable enjoyment. (J.R.)

SHOSTAKOVITCH

Symphonies Nos. 6 and 11. Concertgebouw Orchestra conducted by Bernard Haitink. Two boxed Decca Digital Discs 411 939-1.

Both these symphonies reveal Shostakovitch's deep obsessive pessimism. The Sixth was composed in 1939 with the threat of war hanging over the composer's country, the Eleventh the memory of the martyrdom of Russian workers in the October Revolution 40 years earlier, when troops fired on them unarmed as they gathered to petition an absent Tsar outside the Winter Palace in Leningrad in 1906.

The first movement of the Sixth is slow and in a mood of brooding

melancholy. Long curling themes seem to express distrust of all that is human. It is a long largo in two parts which meld together. You can recognise the beginning of the second part by an expressive cor anglais solo in a theme which comes close to despair.

The whole movement reveals this very real despair. Even the second movement, an allegro, is alive and vigourous but without any real sense of jollity. Absent in such a movement are his characteristic cheeky little tunes.

In the Finale, a presto, quietly busy strings hurry about their business. They express uneasy relief but nothing deeper. Nowhere is there any spirit of jubilation. Everything is very regimented. And everyone is as busy as a one-armed paper hanger with the itch. A powerful but depressed statement.

The first movement of the Eleventh graphically depicts the snow-covered square outside the Winter Palace where the workers are gathered to petition the absent Tsar. The atmosphere is bleak and hopeless with the waiting expressed by ultra long piano to pianissimo sequences. The music seldom rises above mezzo-forte.

The second movement shows the crowd moving peacefully towards the Palace but the troops misinterpret the workers' intention and fire on them, killing many.

The third movement is a dirge "In Memoriam" of the fallen workers. It contains a long elegiac melody played on the violas with an accompaniment of pizzicato cells and double basses. This leads to the finale described as a promise of ultimate victory of the people and an assurance that the guilty will be punished. There was a wait of many years before this was realised but the symphony was composed in 1957 — 40 years after the event. It is a profound statement of despair and hope.

The orchestra is fine and the recording excellent.

By the way a visiting Russian informed me that Shostakovitch's name is pronounced with the accent on the second syllable. (J.R.)

MAHLER

Symphony No. 5. Chicago Symphony Orchestra conducted by Sir George Solti. Decca Analog Disc 414 321/1.

There are some discomforting features about this performance despite the fine playing of the Chicago Orchestra. These are mostly a matter of tempos. The fast bits go so fast that they scurry past and the analog recording — pretty long in the tooth — is so opaque that much, indeed most of, the detail is lost.

This is all the more irritating when one considers Mahler's fine ear for scoring, however large his orchestra. Indeed this is sometimes one of the best features of his work. There are however some great moments. The first movement, a funeral march makes stately progress, the slower parts sounding much the best. Some clumsiness in the recording however makes the high trumpets inaudible or, if audible, too faint to establish the right balance.

The second movement opens at such a pace that detail is totally obscured. This in some way deprives the re-introduction of the first part of the funeral march of some of its effect. After this it's back to the hurricane. And here again one listens in vain for true trumpet balance.

The third movement has true Viennese lilt especially with the anticipation and extension of the second beat in the bar. The movement is broken in two by the turnover with some of the pizzicato plucking inaudibly at the beginning of the second side.

Solti adjusts admirably to the many changes of moods and tempos. This movment has a strange structure especially in the slow part which might loosely be described as a trio. It runs over 16 minutes — very long for, a scherzo. But then the symphony is, all the way, on the large size.

The ever popular adagietto movement makes a noble contribution deeply felt but never sentimentalised. The concluding rondo starts with some cheeky little tunes and goes on to present travesties of sounds from previous movements. Alas, again it here and there goes too fast for absorption. Even differences in tempos don't entirely rule out this fault. Altogether, in spite of the superb playing, you'll do better with a more recent performance. (J.R.)

ABORIGINAL ROCK

Big Name, No Blankets. The Warumpi Band. Stereo LP, Powderworks/Yinura POW-6098. Distributed by RCA.

In the context of considerable debate about the impact of allegedly anti-social rock scene lyrics, it is refreshing to note the philosophy of the Warumpi Band, as expressed in this debut album.

As listed, the band comprises: George Rurrambu (vocals, didgeridoo, boomerangs), Neil Murray (vocals, guitars, bass), Sammy Butcher (guitar, bass), Gordon Butcher (drums).

Interviewed recently on television, they voiced strongly the conviction that they should use their recently won popularity to advance rather than erode the culture and welfare of their own aboriginal people.

Their songs, all original, are presented,

Records & Tapes

some in their own language, some in English:

Waru (Fire) — Blackfella, Whitefella ("It doesn't matter what your colour") — Breadline — Nyuntu Nyaaltjirriku ("Don't be like this, man") — Animal Song (instrumental) - Warumpinya — All the Kids ("Should eat good food") — Fitzroy Crossing — Mulga & Spinifex Plain ("That's where a man feels at home") — Gotta Be Strong ("For our children's future").

Nor does the message end with the titles: the diction is good and, for extra measure, the lyrics are given in full on an inner jacket.

Set to an uncomplicated but well played driving rock rhythm, the whole performance has about it the authentic, compelling quality of a group which really does have something to say. In fact, the recording prompted some discussion about its potential value as background tuitional material for school use.

The recording quality is about average. (W.N.W.)

BOYS' CHOIR

Heinrich Schutz: Deutsches (the German) Magnificat SWV 494. The Psalms of David SMV 24; 24, 25, 29, 35, 36 and 39. Sung by the Windsbach Boys' Choir, conducted by Karl-Friedrich Beringer. Bellaphon compact disc 690-01-020. From P.C. Stereo Pty Ltd, PO Box 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612.

This is a companion disc to "Motetten: J.S. Bach", by the same choir and conductor, reviewed in the April issue. This one however, features compositions by Heinrich Schutz, often compared with his Italian contemporary Claudio Monteverdi and hailed as "the best German conductor of all" of the 17th century.

Born in 1585, he spent the years 1609-1613 in Venice as a pupil of Gabrielli, and associated with the historic St Mark's church, where he became deeply involved in then emerging forms of sacred music.

Schutz' organ and orchestral compositions have largely disappeared, as also has the score of his — the first ever — German opera. But over 500 vocal works remain, mainly sacred and varying from motets to large scale oratorios; these written over a period of about 60 years.

The German Magnificat is the first item on the disc but was actually his last composition, written in his 86th year. For 8 parts in 2 choruses, it is a song of praise of the Blessed Virgin.

Fifty years earlier, as Court Conductor for the Prince-Elector of Saxony, Schutz had published 26 Psalm settings, of which the six comprising the remainder of the program are representative examples.

Each is the subject of brief comment in the accompanying booklet, the most intriguing being Psalm 100. It also uses two choruses but the second, smaller chorus sings what is virtually an echo of the main chorus. And very effective it is, especially as presented by the superb Windsbach Boys' Choir — one that was founded in 1946 and that has gone on since to win international acclaim.

Sung in German, the Psalms would have their greatest appeal to those fluent in the language.

All told, I would rate the recording ahead of the Bach Motets, with its potentially wider appeal and relative freedom from the "edginess" that can so easily compromise choral music. (W.N.W.)

THE NEW WORLD

Dvorak: Symphony No.9 in E minor, Op.95, the "New World". The Sydney Symphony Orchestra conducted by Jose Serebrier. Digitally mastered stereo LP, RCA VRL1-0485.

This is a companion disc to "Serebrier Conducting Wagner" (RCA VRL1-0485) reviewed in the September '85 issue: the same conductor and orchestra, the same recording set-up and the same venue — the Sydney Town Hall.

The vital difference, perhaps, is that this one faces stiffer competition, with Dvorak's "New World" vying with Beethoven's Fifth and Tchaikovsky's "Pathetique" as the symphonies most often performed (and recorded) in the modern repertoire. Perhaps I can adapt a summary of its background from what I wrote in another review in July last:

Born in Bohemia in 1841, Dvorak received his early musical training at the Prague organ school but, at age 20, became violinist for the National Theatre. In his '30s, he turned to composing and attracted attention with such scores as Slavonic Dances, Slavonic Rhapsodies and Czech Suite.

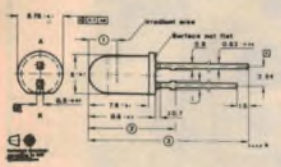
The period 1892-5 was spent in the USA as Director of the newly formed National Conservatory of Music in America, based in New York. Founded by Mrs Jeanette Thurber, its objective was to encourage the composition of characteristically American music, primarily of the classical genre.

It was an objective with which Dvorak developed considerable empathy, as he became conscious of the very different culture of the "new world", involving Indians and the West, Negroes, and the writings of authors like Henry Wadsworth Longfellow.

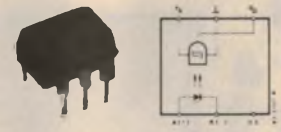
TELEFUNKEN TOPICS

NEW PRODUCTS FROM TELEFUNKEN

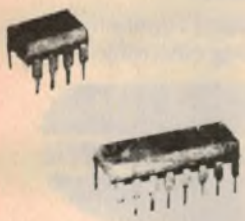
HI POWER IRLEDS
The TSHA series from TFK offer radiant intensities to 900mW/SR, suitable for pulse applications in communications, light barriers etc. We also have a full range of PIN diodes, phototransistors and photo-IC's for detectors. EX-STOCK.



DATA COUPLERS
The K8000 series couplers are used where high voltage isolation is needed in high speed (500Kbit/Sec) data links. CMOS/TTL compatible. EX STOCK.



MULTI-CHANNEL COUPLERS
These are in addition to our very wide range of standard (4N..) series devices, triac couplers, A/C input types and EXTRA HIGH VOLTAGE 10kV-15kV models.



30 LED DRIVER
The 1096B can drive 30 LEDS in moving spot mode by a clever current steering technique. Input sensitivity is wide range adjustable and 5 can be cascaded for 150 leds. EX-STOCK.

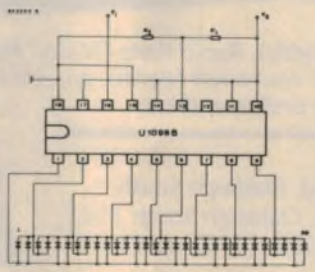
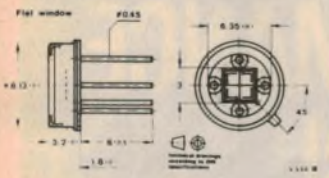
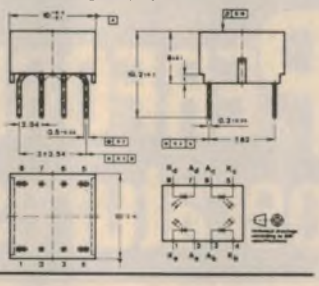


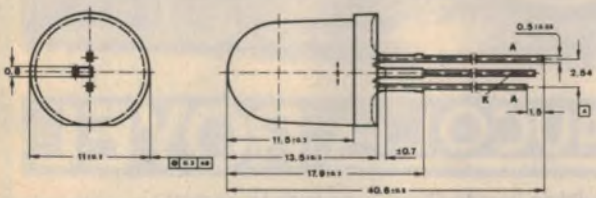
PHOTO-QUADRANT DETECTOR
The S239 is used for laser alignment, optical surveying, robotics and guidance systems. High output, high speed, linearity and broad response are the main features. EX-STOCK.



LIGHT BAR DISPLAYS
The TDA4100/8100 use 4 or 8 hi-efficency LEDS in red, yellow and green to form large light emitting surfaces for backlighting and making up large displays. EX-STOCK.



JUMBO LEDS
The 10mm diameter TLH040 series are available in red, yellow and green high output selection for use as large indicators for display panels etc. EX-STOCK.



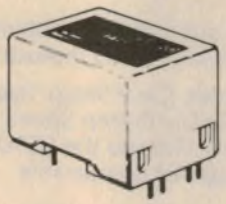
Promark Electronics PTY. LTD.

SYDNEY	MELBOURNE	TOLL FREE
02-439 6477	03-878 1255	008-22 6226

WORKS 739

PCB TRANSFORMERS

2.5/3VA

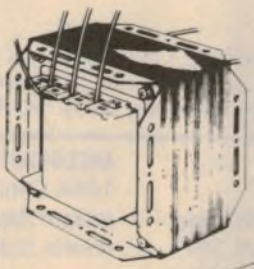


12/15VA

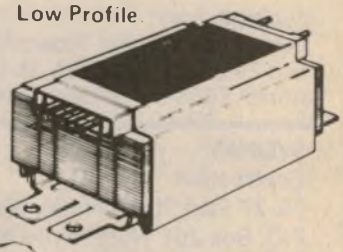
5/7 & 7.5/10VA

- Manufactured to AS3126 and Telecom approved
- Suit standard PCB grids and simplify construction

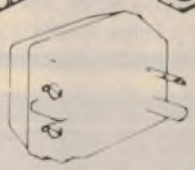
POWER TRANSFORMERS



Low Profile



Conventional



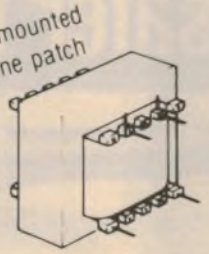
Plug Pack Adaptor

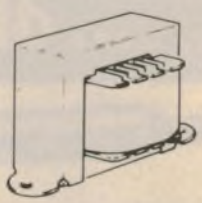
AUSTRALIAN MADE

- Wide range of secondary voltages from 1.5V to 115V
- Stock range has ratings up to 1000VA
- Special types for microprocessors, 115V etc

AUDIO TRANSFORMERS

PCB mounted phone patch





75 ohm to 300 or 600ohm matching transformer

- Line and Matching transformers up to 150W
- Power transformers for high power amplifiers
- Transistor drivers
- Special 'C' core transformers

Ask for MAL VK2BMS or DOUG VK2BPX

TALK TO FERGUSON - THE AUSTRALIAN COMPANY WITH NEARLY 50 YEARS EXPERIENCE OF MANUFACTURING IN AUSTRALIA FOR AUSTRALIAN CONDITIONS

FERGUSON TRANSFORMERS PTY. LTD.
7 Moorebank Avenue, Moorebank 2170
Tel: (02) 602 1222 Telex: AA25728
Melbourne: (03) 561 6699

FERGUSON

Records & Tapes

It was in this context that Dvorak wrote his ninth (and last) symphony which he inscribed on the first page in Czech: "From the New World". He was quick to contest the notion that he had translated a negro spiritual into symphonic form insisting, rather, that he had composed "only in the spirit of American national melodies".

A fine point, perhaps, but the inspiration will be plainly evident as you listen.

As for the companion Wagner recording, the SSO is in fine form although, in the Dvorak, the ponderous acoustics of the Sydney Town Hall have tended to overweight the bass somewhat and round off the treble. It doesn't have quite the sonic bloom of Telarc's Slatkin/St Louis S.O. LP version reviewed in July '81.

But I quibble. This is an excellent recroding in its own right. (W.N.W.)

JAZZ IN STEREO

Benny Goodman and His Orchestra. The Great Bands in Digital Stereo — Vol. 4. Simulated stereo LP, RCA VPL1-0471.

This has to be a good one both for jazz afficionados and for those who want merely to enjoy the sound without having to concern themselves with the musical logistics: who played what and where!

For afficionados, a double-sided sheet of notes by Ron Wills tells of Benny Goodman's efforts to set up a band — disastrous at first but culminating in an orchestra which became the envy of his peers. It's quite a story in its own right.

Fourteen tracks are detailed on the rear of the jacket, complete with time and place and list of the players for each occasion — all of them notable, some of them famous in the world of jazz.

All tracks come from 78rpm RCA/Victor recordings made in the period 1936-38. From a note on the jacket, I gather that modern pressings from the original masters were made available to recording engineer Robert Parker for re-recording and re-processing in his own unique way.

The sound is clean and free from surface noise and embellished with a prudent amount of synthetic reverberation and stereo speed. Those who merely want to turn back the clock and listen can do so without any harsh reminder that it all happened fifty years ago!

Included are "swing" numbers by the full band and examples of Goodman's "chamber" jazz, using just three or four musicians. I list only some of the titles but they will give you an idea of the contents:

China Boy — Changes — Get Happy — My Melancholy Baby — Warppin' It Up — Bach Goes to Town — Sing For Your Supper — One O'Clock Jump.

This should prove a very popular release. (W.N.W.)

ROCK GOSPEL

Randy Stonehill: Celebrate This Heartbeat. Stereo LP, Powderworks POW-4039. Distributed by RCA.

Some may disagree with my classification of this album as "gospel" on the grounds that the lyrics are less explicitly so than traditional hymns, while the music also belongs to quite another age. However the lyrics, set out in full on an inner sleeve, certainly reflect Christian values as applied to social problems, seen through the eyes of youth.

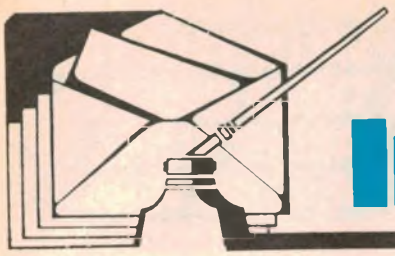
As well, Randy Stonehill expresses his thanks to "everyone at World Records", a company which specialises in Christian music.

Despite the totally bland cover portrait, Randy Stonehill comes through as a very capable songwriter, musician and singer, backed here by an equally capable team. The music ranges from soft, sentimental rock to the hard variety, loaded up with electronic echo and other gimmickry.

But it's very capably done and very clean in terms of sound quality, strongly suggesting digital mastering mixing, and possibly direct signal feed from the keyboards, guitars and other whatnots.

The track titles: Overture (Celebrate This Heartbeat) — Still Small Voice — Celebrate This Heartbeat — Modern Myth — Who Will Save the Children — When I Look to the Mountains — Allison — Whatcha Gonna Do About That — Stop the World — I'll Remember You.

In summary, an album that will probably go over well with the younger set, especially in cassette form on a personal tape player. (W.N.W.)



Information centre

Playmaster Series 200 Amplifier

I have just received the May issue of *Electronics Australia* and have read through the article on the Playmaster Series 200 with great interest. I intend to build this amplifier as soon as time permits.

After looking at the photo for the power supply components, I realised that there is space for additional components. I would like to know your comments on the following:

(1) How about a stabilised power supply? I think it would improve your hum and noise figures and channel separation.

(2) How about using a separate rectifier bridge for each channel, using two filter capacitors for one channel and the remaining two for the other?

(3) I have seen the enclosed power supply circuit used in some amplifier designs. Apparently, it increases channel separation.

I would be very grateful for your comments. I don't think cost is a factor. (K.V., Selangor, Malaysia.)

● A stabilised power supply would do little to reduce hum and noise in the Playmaster Series 200 amplifier. The small amount of hum present is due to direct radiation from the transformer into the low signal circuitry.

In fact, a stabilised supply would have a number of significant drawbacks. It would add to the overall cost, significantly increase the heat dissipation, and reduce the dynamic headroom of the amplifier; the amplifier would have no more power under transient conditions than on steady state signals.

A separate rectifier bridge won't help matters much either. Most of the crosstalk in the amplifier is caused by stray capacitance in the low level circuitry. It's not a power supply problem.

Shortwave receivers

I am interested in purchasing a good shortwave receiver for the purpose of listening to worldwide transmissions as a hobby. Would you be able to recommend some brand names and where can I obtain some information on the receivers?

Recently, I received some brochures on the Yaesu FRG 8800 and the Bearcat DX 1000. Would you care to comment on these receivers as regards the best capabilities of the two.

Also I would like to know why I can receive Perth and the Eastern States' AM stations from Telfer near Marble Bar, at least 1600km from Perth, on a cheap Bellteck car radio but am unable to receive anything on AM and rather poor shortwave reception with an outdoor antenna from a Sony FH7 cassette receiver. Are there any powerful AM and or shortwave car radios on the market that are suitable for reception from outback areas?

As a point of interest, I have been obtaining your magazine since I was about 13, back in 1959/60 when I used to build transistor sets. From my limited knowledge of electronics I believe that EA is the most comprehensive electronics magazine available and often purchase it to keep up with the latest technology. (A.K., Telfer, WA.)

● Unfortunately, we are not in a position to recommend specific brand names. However, we suggest you have a look at receivers from Tandy, Sony, Yaesu and Trio.

Regarding your reception of Perth and eastern states AM stations, it is usually the case that car radios are far more sensitive than cassette radio receivers. If you want better long distance AM reception you should consider installing a car radio. One of the most sensitive car radios presently available is a manually tuned model from the Eurovox range.

Infrared TV Sound Controller

I have constructed your Infrared TV Sound Control (EA, January 1983) and installed it in an AWA Thorn Model 9405 colour TV. This set has a DC volume control, so the remote control has been wired between the audio detector and the audio amplifier. These circuits are on separate boards, so it was an easy job to intercept the adjoining shielded cable.

The problem is that the sound control receiver is sensitive to mains spikes. These spikes appear on pin 1 of IC4 as down pulses so that, when other appliances switch off (eg, the refrigerator), the volume goes down.

I have a CRO but I have been unable to discover where the spikes enter the circuit. They can, however, be traced right through the amplifier board. Any suggestions as to how to rectify this most annoying problem would be greatly appreciated.

Also, have you ever designed a project to display instantaneous fuel consumption (other than the Car Computer) using a fuel flow sensor and a propeller shaft speed sensor. If not, could you design such a project as I think it would be preferable to buying a car computer.

Finally, would it be possible to design a project that could be wired between a tape deck and an amplifier and which would duplicate the Dolby noise reduction facility found on more expensive tape decks. (E.McD., Rochester, Vic.)

● Mains interference can find its way into your TV Sound Control either via the power supply or through direct radiation into the amplifier front end.

Assuming the latter, make sure that you position the amplifier board well away from the power supply in the TV set and from mains cables. The leads between the amplifier and demodulator boards should also be kept well clear of mains sources and should be twisted together.

If it is a power supply problem, try installing a DC choke (eg, Dick Smith Cat. No. L-1900) in series with the lead to the 12-30V power supply. A line filter in series with the lead to the refrigerator may also help. This filter should be rated at about 5A. Alternatively, try getting rid of the refrigerator.

An instantaneous Fuel Consumption Meter was described in the March 1983 edition of *Electronics Australia* (File No. 3/AU/34). It featured a 20-LED bar graph display and could be switched to display instantaneous fuel consumption in either litres/100km or litres/hr. A copy of this article is available from our Information Service for $3 post paid.

We have no plans to describe an add-on Dolby noise reduction circuit. Such a device would have limited application, particularly as Dolby cassette decks can be purchased for less than $100.

Low Distortion Audio Oscillator

Some years ago I built your low distortion Audio Oscillator (EA June '81) and am very pleased with it. The only (not complaint) small thing I would like to improve upon is the 10kΩ linear-pot. I would like to replace it with a larger diameter unit to enable easier and more accurate setting of frequencies when used in conjunction with a DFM.

Also I am not sure, but seem to remember an article or earlier oscillator where you stated the use of an inverse log pot was preferable but expensive. Could you please advise me of your preference and if possible, the name and address of a possible source of purchase? (B.G., Tamworth, NSW.)

● Unfortunately, good quality dual gang pots are becoming expensive and very hard to obtain. We cannot nominate any source which could help. If any reader or advertiser has knowledge to the contrary, we would be delighted to know about it.

TAI and photo distributor

At long last I have found reference to a photo distributor, together with the circuit for the Transistor Assisted Ignition (TAI), in the one book, "Electronic Projects For Your Car".

Years ago I made a photo distributor but could never find a circuit for TAI. Now I have the circuit for TAI and have lost both the distributor and the circuit. I notice on page 41 you say ". . . elsewhere in this article we give details on an opto-electronic distributor head." Evidently that is an extract from another article (magazine).

Mechanically I am OK but electronically I need help, so any tips or hints you could pass on would be greatly appreciated. Incidentally, I am the proud owner of a 2.08-litre Beetle sparked up with an 8V battery (do I have a problem?). What circuit changes should I make for compatibility through a 6V coil? (B.G., Bribie Island, Qld.)

● Several photo or opto distributors have been published by EA over the years. The one you are referring to was probably that published in the February 1983 issue.

Unfortunately, the TAI circuit is not suitable for 8V operation as it stands but it should be workable provided some of the resistor values in it are changed. We suggest that the three 150Ω1W resistors be reduced to 100Ω each, the three 2.7Ω 1W resistors be reduced to 1.8Ω each and the 1kΩ resistor from the base of Q2 to the 0V line increased to 1.5kΩ.

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

BACK ISSUES: Available until stocks are depleted. Price $4 including postage and handling. When back copies are exhausted, reprints of articles may be obtained for the same cost. If the issue you require is not shown on the list below, please nominate the article you would like photo-copied and the issue in which it appeared. Send cheque, money order or credit card number (American Express, Bankcard, Master Card), name and address to: Elizabeth Barnett, Direct Marketing Division, Federal Publishing Company, PO Box 227, Waterloo 2017.

AVAILABLE BACK ISSUES:
1981: Jun, Jul.
1982: May, Oct.
1983: Jan, Mar, Apr, May, Jul, Aug, Nov, Dec.
1984: Jan, Feb, Apr, May, Oct, Nov, Dec.
1985: Jan, Feb, Mar, Apr, May, Jun, Jul, Sep, Oct, Nov.

PC BOARD PATTERNS: High contrast, actual size transparencies: $3, including postage. Please specify positive or negative.

PROJECT QUERIES: Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the last three years. Charge $3. We cannot provide lengthy answers, undertake special research, or discuss design changes. Nor can we provide any information on commercial equipment.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" or submitted without fee may be answered in the "Information Centre" pages, at the discretion of the Editor.

COMPONENTS: We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 227, Waterloo, 2017.

Notes & Errata

12/230V 300VA INVERTER (September 1985, File 3/TI/14): To provide reverse polarity protection for the low current portion of the circuit, we recommend connecting a 1N4002 diode in series with the supply. It should connect between the positive battery side of fuse F1 and the emitter of transistor Q12. On the wiring diagram, the anode of the diode connects to the battery side of the fuse holder (the wire indicated by a "1") and the cathode end via a length of hookup wire to the terminal marked with a 1.

Reverse polarity protection for the output transistors and driver transistors is already provided by diodes D1 and D2 and ultimately the fuse.

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.

December 1935

Brain study: the latest addition to the field of medical electronics is a brain excitation device. Electric impulses applied to certain areas of the brain allow researchers to trace the relationship between the brain and the muscular and nervous reactions associated with it.

As wires attached to the skull of an animal greatly impede its mobility, it has been suggested that magnetic coupling between a current source and the brain probe might be much more effective.

HF heating: one of the most important uses of high frequency energy is the melting of metal and ore charges in induction furnaces. This type of furnace offers several advantages, namely: freedom from contamination of the melt, high temperatures obtainable, circulation of the molten charge by the electromagnetic forces within it, the possibility of use within a vacuum or controlled atmosphere, and ease of repetition in the duplication of alloys.

Such furnaces have been used in the laboratory on a small scale, but it is only recently that large furnaces have been used in production work.

Magic eye: the new magic eye tuning indicator valve is now available to the public. The advantage of the 6E5 tuning valve over a tuning meter is that it has no moving parts and, consequently, there is nothing to wear.

When in operation, the inside of the valve lights up with a blue semi-circular glow, the circle opening up as the set is tuned to a station.

Coastal patrol: the patrol vessel now being prepared by the Commonwealth Government to operate in the Timor Sea will be a versatile little craft. The radio equipment being installed will be adapted to enable communication with the aeroplanes of Imperial Airways. In the event of a plane being forced down, a special direction finder will enable the patrol boat to locate it.

Noise pollution: in setting up a schedule for abating annoying noises, technicians in the city of New York have not omitted radio receivers. The report mentioned that radio sets that could be heard by neighbours will not be permitted between 11 o'clock at night and 7am.

Salvage Our Ship?: it seems that the London steamship, Tower Bridge, got lost in a North Atlantic icefield, with the ice drifting past in huge chunks. The skipper sent out an SOS.

The call was picked up by the Liverpool steamship, Newfoundland, which gave such directions as put the Tower Bridge back in its place in London. Then the company which owned the Newfoundland proceeded with a legal action, claiming that its radio instructions constituted a salvage. The owners got 1500 pounds, the master 200 and the crew 300.

December 1960

World's most powerful: long range radar for missile detection and intercontinental television are some of the applications foreseen for this new UHF ceramic metal valve, which has a maximum usable frequency above 600Mc.

With a peak rating of 5,000,000 watts, RCA's latest super power tube will be used to explore some of the newest areas in communications. Only a little larger than an office typewriter, the tube will deliver 300kW of continuous power at frequencies up to 450Mc.

Safer luminous dials: use of tritium, the radioactive isotope of hydrogen, has been approved for use on clocks and watches instead of radium to make the figures shine at night.

Tritium has none of the gamma rays which make the radium salts for dials a potential hazard. It is normally a gas but can be incorporated in several organic substances.

Electrical glass: a new process for making electrically conductive glass has been developed in Russia.

In the process, the glass is heated almost to its melting point and then treated with tin chloride. This process causes the glass to become a permanent conductor of electricity.

The process is said to be cheaper than that used for the production of electrically conductive films on the surface of glass.

Head up display: work now in progress is aimed at presenting vital flight data as a pattern of light on the pilot's windshield. Designed to take the blindness out of flying, the display projector simulates images of the horizon, the outline of obstacles, or the earth below and projects them into the pilot's forward view in proper perspective, as if painted on clouds.

One of the most challenging problems was to make the display visible even in the brightest sunlight. Engineers designed what is called a trichroic combiner — glass coated with multiple layers of dielectric. This filters out all ambient green light, thereby increasing the pilot's sensitivity to this part of the spectrum. The flight information is then projected from a green CRT and is reflected completely in the chamber.

Transmission line faults: when a fault occurs somewhere in the many thousands of miles of power transmission line now spanning the countryside, the first clue of its whereabouts is likely to be given by an instrument looking very much like an ordinary oscilloscope. The instrument may save hours of precious time.

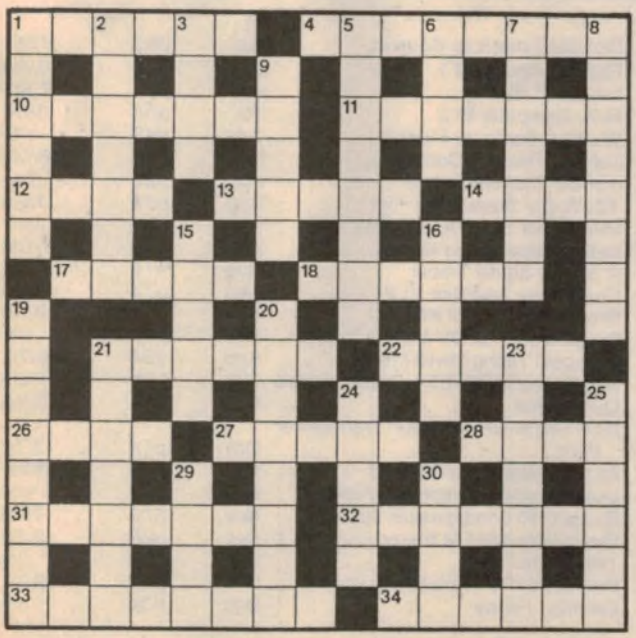
A high frequency pulse is sent down the line and the reflected signal displayed on the oscilloscope. A normal line will cause evenly spaced, constant amplitude reflections. A fault in the line will be clearly indicated by an irregular pulse. The distance to the fault can be determined by counting the number of normal pulses (which are five miles apart) in the trace.

Solar radio: the first Australian solar powered radio receiver is about to be released by Stromberg-Carlson. Designated the "Wayfarer", the set is a 7-transistor portable, also suitable for use as a car radio. As a portable, it can be either operated from the solar cell battery, or from four torch cells.

DECEMBER CROSSWORD

DOWN

1. An aspect of tone. (6)
2. Useless computer data. (7)
3. Fix a setting, etc. (4)
5. Said of a winding using a single strand of wire. (8)
6. What a common cable is colloquially called. (4)
7. Metal somewhat like platinum. (7)
8. The polarity of the base of a dry cell. (8)
9. Outback radio was once called — wireless. (5)
15. Physicist after whom a diode was named. (5)
16. Hypothetical charged particle. (5)
19. Improved the quality of a signal. (8)
20. Mathematical treatment of complex signals is known as Fourier —. (8)
21. Audio device. (7)
23. Discoverer of the electron. (7)
24. Transfer computer data. (5)
25. Atomic particle. (6)
29. Control component. (4)
30. Satellite launching body. (4)



ACROSS

1. Type of switch. (6)
4. Contact area in semiconductor device. (8)
10. Possible result of excessive use of 21 down. (7)
11. Forming a picture. (7)
12. Power absorber. (4)
13. Computer language. (5)
14. TV set control. (4)
17. Clear a counter reading. (5)
18. Early kind of tube. (6)
21. Inventor of the planar process at Fairchild. (6)
22. Type of logic table. (5)
26. Apple's first customer? (4)
27. Prefix meaning "beyond". (5)
28. Surname of father and son who separately won a Nobel Prize for physics. (4)
31. Mathematical ratios. (7)
32. The drift mobility of charge carriers partly determines the — time. (7)
33. Computer file. (4,4)
34. Type of connector. (6)

SOLUTION FOR NOVEMBER

B		T	R	A	N	S	P	O	N	D	E	R		A
A		H		X		I		H		E		H		R
F	L	E	M	I	N	G		M	I	C	R	O	H	M
F		R		S		N		M		K		D		A
L	A	M	P		G	A	M	E	S		D	I	R	T
E		A		P		L		T		T		U		U
	F	L	A	R	E			R	E	A	U	M	U	R
A				O		P	Y	E		B				E
D	E	C	I	B	E	L				G	L	O	B	E
A		U		E		O		P		E		O		P
P	I	T	S		S	T	R	U	M		F	U	E	L
T		S		P		T		L		E		N		A
I	S	O	L	A	T	E		S	I	L	I	C	O	N
N		U		P		R		E		M		E		A
G		T	R	A	N	S	I	S	T	O	R	S		R

INDEX TO VOLUME 47

General Features

Personal Computers

Notes and Errata

Constructional

JANUARY-DECEMBER, 1985

Forum

Circuit and Design Ideas

Audio/Video Electronics

Serviceman

Design and Theory

Test equipment Reviews

Hifi Reviews

WISHING YOU A MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR

WISHING YOU A MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR

WISHING YOU A MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR

A.C.E. RADIO ELECTRONICS CENTRE

136 VICTORIA RD, MARRICKVILLE, NSW 2204.
PHONE 51 3845.

PROUD TO BE AUSTRALIAN

50 WATT RMS SPEAKERS

NEW MODEL

NEW MODEL

ETONE FACTORY SCOOP
EVEN LOWER THAN FACTORY PRICE

A PAIR FOR $49.95 OR $28.95 EACH

RUGGED TOP QUALITY HI-FI WOOFER. 30cm 8 ohms ● 90 DAYS FACTORY WARRANTY ● FOAM POLY SURROUND ● STURDY SUSPENSION FOR RICH REPRODUCTION ● 3.5cm VOICE COIL ● FERRITE MAGNET ● FREQ. RESPONSE 35- 0Hz. RESONANCE 35Hz.

P-P NSW FOR ONE $4.50. INTERSTATE $6.90. P-P NSW FOR TWO $6.50 INTERSTATE $8.50.

HALF PRICE MAGNAVOX 6W MK6 HI-FI WOOFER ● 20 WATTS ●

6" 8 ohm ● Freq respon 50-6500Hz. Reson 45Hz. Rolled foam surround ● High compliance suspension ● Barium ferrite magnet ● Excellent linearity at high power.

$15.95
EACH OR $30 PAIR

P-P NSW for 1. $2.50. FOR 2 $4.50.
INTERSTATE. For 1. $3.50. For $2. $7.

ETONE SPEAKER SPECIALS

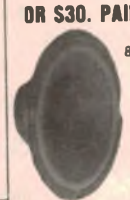
GENUINE FACTORY PRICES

Rugged top quality Aust made brand new bargains — all with factory warranty

Model	Size	Cone Type	V/Coil	Reson. Hz	Freq Hz	Watts Rms	Price Ea or	2 for
4310	38cm	Straight surround	8 or 15 Ohms	45	40-6000	60	$88.00 or	$170.00
4510	38cm	Straight surround	8 or 15 Ohms	45	40-6000	100	$110.00 or	$214.00
4350	38cm	Hi-Fi	8 or 15 Ohms	30	30-4000	120	$88.00 or	$170.00

Pack and Post for 1 speaker NSW $7.50 Vic $8.50 SA Q T $10. NT WA $12.50
Pack & Post for 2 speakers NSW $9.50 Vic $11. SA Q T $20. NT WA $22.50

ONLY $16.95 EACH OR $30. PAIR FOR ETONE 8" 8 OHM TWIN CONE



Speaker with rolled foam surround freq 40-15000 Hz. Reson. 40Hz.

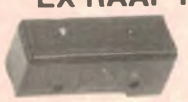
20 WATTS
Limited Stock

P-P NSW FOR ONE $2.50 FOR TWO $4.50
INTERSTATE FOR ONE $3.50 FOR TWO $6.

* MAKE US AN OFFER WE CAN'T REFUSE*

Even the ridiculous wont offend. All ex-disposals and surplus electronics **must go.** We're desperate for the space. Heaps of goodies. Bargains galore.

EX-RAAF HI-POWER MICRO SWITCH.



N/O. N/C Contacts. 2A 600VAC. 5A 240VAC. Size 50 × 20 × 18mm. **95c** *each P-P 75c.*

10 FOR $8. P-P NSW $3. INTERSTATE $4

HEAD PHONES

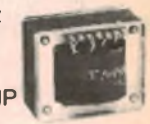
PADDED
HI-QUALITY
USA

$4.50 P-P $1.50 LO IMP

240-110V Stepdown TRANSFORMER

Double wound 240V AC 50Hz input
110V AC output. 1.5 AMP

1.5A



165VA

$25.00

P-P NSW $5.50 INTERSTATE $7.50

*Also 240/110. 5A. 550VA. WT. 14Kg.

$69.95 P-P NSW $7.50. V, Q $12. SA, T $15. NT, WA $20.

STEREO RECORD PLAYER

EX-AWA

240 VAC

$12.50

P-P NSW $3,
INTERSTATE $4.50

3 Speeds 33, 45, 78 RPM ● Plays 12", 10" or 7" records ● Gimbal mounted chrome plated tubular metal tone-arm with counterweight ● Ceramic cartridge with flip over stylus. (base not included)

RELAY

National 6VDC

$2.65
P-P $1.35

SPDT 1A contacts. High speed. 200 ohms DC Res. Magnetically Shielded. 20 × 10 × 10mm.

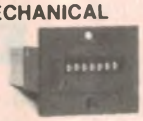
12VDC FUJITSU.

SPDT 1A Contacts. 20 × 10 × 10mm.

$2.95 P-P $1.35

7 DIGIT COUNTER

ELECTRO — MECHANICAL



60 × 50 × 65mm
Mounting hole size.
50 × 25mm

$5.95

Mini 240/24V Transformer to suit $1.75.

P-P NSW $1.35 INTERSTATE $2.

HI-POWER BRIDGE RECTIFIER

400 PIV 25 AMP

$4.95 P-P 75c

5 WATT ZENNER DIODES

3.5 Volt, 4.25, 4.7, 5.7, 6.2, 7, 8, 9, 10, 11, 12, 15, 16, 18, 20, 22, 24, 27, 30V

10 MIXED **$10.95**
P-P $1.35 Interstate $2.50

12VDC RELAY

$2.25
24 × 19 × 30mm
2 N/O 3A.
P-P $1.35 PLATED CONTACTS

HIGH GRADE OMRON RELAY

12VDC

$5.95
P-P $1.50

3 sets of 240V 10 amp change over contacts ● perspex cover and 11 pin base included ● size 50mm × 37mm × 35mm ● ex computer ● somebody made a boo-boo. The coil is marked 50 VAC ● hence the ½ price bargain

INTEGRATED CIRCUITS

TYPE 2708
$4.95

TYPE 6802P
$3.50

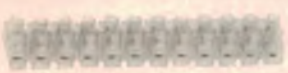
TYPE 6821 **$1.95** P-P $1.50

TRANSISTOR

TIP 31 NPN
with Heat Sink
60V 3A

10 FOR $7.50 P-P $1.50

SCREW TERMINAL



12 WAY 10 FOR $7.50
240V RATED. NYLON.

P-P NSW $2.50. Interstate $3.50.

A AND R POWER TRANSFORMER

Primary Tapped from 200V to 250V 50Hz.
Secondary 0—20. 30.48V 2.5 Amps.
Size 95×80×85mm

$9.95

ALSO
V48, 30, 20, — CT — 20, 30, 48V 2A

P-P NSW $5.50
INTERSTATE $7.50

$14.95

RED NEON

240V AC

INDICATOR LAMP

10mm SQ REFLECTOR. 40mm LONG
PUSH FITS 9mm HOLE

10 FOR $6.95 P-P $1.50

EGG INSULATORS

85c EACH

HIGHLY GLAZED CERAMIC

IDEAL FOR AERIAL. ELECT FENCE ETC.

10 FOR $7.50 P-P NSW $2.50 INTERSTATE $3.50

HIGH GRADE POTTER AND BRUMFIELD RELAY

P-P $1.50 **$3.50**

KU series ● 240 VAC 50Hz operation ● 3 sets of 240V 10 amp change over contacts ● perspex cover and mounting base included ● size 50mm x 37mm x 35mm ● ex-computer ● as new condition. At less than ⅓ of the normal price.

TRIAC

TYPE 225D
SENSITIVE GATE
400V. 10AMP

10 FOR $17.50
OR $1.95 EA. P-P $1.50

FOR REGISTERED POST, ADD AN EXTRA $3.65 TO PACK & POST CHARGE.

WE BUY

WISHING YOU A MERRY CHRISTMAS AND A HAPPY AND PROSPEROUS NEW YEAR

EA marketplace EA marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $40. Other sizes up to a maximum of 10 centimetres are rated at $20 a centimetre. CLASSIFIEDS: $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 18th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisement. Address your letter to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, PO BOX 227, WATERLOO, NSW 2017.

FOR SALE

SPDCAL: A fast M/L spread-sheet for Microbees. 16k, 1000 cells; 32k, 2000 cells. Tape and instructions $20. Electron Electronics, RMB 462, Talbot 3371.

AMIDON FERROMAGNETIC CORES: Large range for all receiver and transmitter applications. For data and price list send 105X220 SASE to: R.J. & U.S. Imports, PO Box 157, Mortdale, NSW 2223. NSW: Geoff Wood Electronics, Rozelle. ACT: Electronic Components, Fyshwick Plaza. VIC: Truscott Electronics, Croydon. WA: Willis Trading Co, Perth.

TRANSISTORS: BC548, 549 10 for $1.00. SGS 2N3055 10 for $6.00. Free P&P to L.M.F. Products, PO Box 384, Cootamundra, 2590.

DO YOU WANT TO BE A RADIO AMATEUR?

The Wireless Institute of Australia, established in 1910 to further the interests of Amateur Radio, conducts a Correspondence Course for the A.O.C.P. and L.A.O.C.P. Examinations conducted by the Department of Communications. Throughout the Course, your papers are checked and commented upon to lead you to a successful conclusion.
For further information, write to:

THE COURSE SUPERVISOR
W.I.A. (N.S.W. DIVISION)
P.O. Box 1066
PARRAMATTA, N.S.W. 2150.

Make your own printed circuits and labels with:

(1) "THE MAXILIGHT" ULTRA VIOLET LIGHT EXPOSURE BOX
*Easily assembled kit

$159.00

(2) THE ETCHING STATION
*Etches printed circuits, hands-free, in 10 minutes.

$54.00

(3) THE SQUARECUTTER
*Cuts PC boards into rectangles without squaring, scribing, filing.

$39.00

Write or phone for brochure

SESAME ELECTRONICS
PO Box 452, Prahran 3181
(03) 527 8807

BLACKTOWN NEXT TO TELECOM OFFICE
Electronic Components
PC Boards, Computer Repairs
OPEN MONDAY TO SATURDAY
(02) 621 5809
30 Campbell St BLACKTOWN NSW
CQ ELECTRONICS

BUILD AN 8K TO 256K: Centronics parallel printer buffer. Has Single/multiply copy, Hex output mode, and ROM diagnostics to aid kit builders. Uses only Z80A, 8255, 2716, 74LS00, 74LS04, and dynamic RAMS. Instructions Board & EPROM $39. For more info send SASE to Don McKenzie, 29 Ellesmere Cres, Tullamarine 3043.

SUPER 80 COLOUR: Short form kit now $40 including pack/post. For info send SAE to Chipspeed Electronics, PO Box 337 Wentworthville 2145.

EX-ABC AUDIO TAPES: ¼" wide on 10½" metal spool, $6.85; plastic spool, $5.85; 7" spool, $2.25; 5" spool, $1.25. Post extra. Also in stock: ½", 1" and 2" tapes. Waltham Dan, 96 Oxford St, Darlinghurst, Sydney. Phone (02) 331 3360.

NEW RADIO VALVES: For entertainment or industrial use. Waltham Dan, 96 Oxford St, Darlinghurst, Sydney. Phone (02) 331 3360.

With these selected projects from *Electronics Australia* you can add all of the gadgets and gizmos you've dreamed of —
Cruise Control
Deluxe Burglar Alarm — Courtesy Light Delay
Audible Reversing Alarm — Headlight Reminder
Transistor-assisted Ignition with Optoelectronic Trigger and many more easy-to-build projects to add value, interest and safety to your pride and joy!
Available from your Newsagent Now! Or send $3.95 plus $1.00 post and packing for each title to Electronics Australia, PO Box 227, Waterloo 2017, NSW.

HI FI SPEAKER KITS: Raw drivers, X-overs, plans, replacement speakers and accessories from the world's finest manufacturers. For audiophiles and beginners. Dynaudio, Focal, Foster, Kef, Magnavox, Peerless, Scanspeak, Vifa etc. "Siderealkaps", premium audio grade capacitors just arrived from USA. We ship anywhere within Aust and export to NZ and Pacific. Send $2 for latest catalogue. Audiocraft, PO Box 725, Toowong, Brisbane, Australia 4066.

BUSINESS FOR SALE

ELECTRONICS: A profitable business for a technician on the beautiful mid-north coast NSW. Service to modern computerised equipment. Own hours. Established and growing fast. Vendor will train. $22,000 + SAV. Reluctant, genuine sale. D. Wilcox R. E. (065) 66 0306. All hours.

GENERATE ELECTRICITY FROM THE SUN

ARCO PV PANELS

M73B 40 WATTS 12V

Provide power for pumping, lighting and refrigeration. Now only $295 each.

ELANTE PTY LTD
5 CREMORNE ST, RICHMOND, VIC.
Phone (03) 429 9733

PRINTED CIRCUIT BOARDS
Minimum postage & packaging on all EA & ETI Project PCBs
Catalogue 1976-85 (inc components) $1.00
PCBs made to order — 48 hr prototype service
Bankcard/Mastercard
Acetronics PCBs
112 Robertson Rd, Bass Hill 2197
(02) 645 1241

A NEW CONCEPT FOR LOW VOLTAGE PROJECTS
COPPER FOIL TAPE: thin pure copper tape backed by special hi-tack adhesive. Current carrying capacity, 5 amps, FULLY TESTED at 24V 5A. Not recommended for mains voltage.
4mm RRP $8.03 6mm RRP $9.84 33 metre rolls
GIFFORD PRODUCTIONS
PO BOX 62 St Kilda, Vic 3182 (03) 534 3482

R.C.S. RADIO PTY. LTD.
Established 1933
IS THE ONLY COMPANY
WHICH MANUFACTURES AND
SELLS EVERY PCB & FRONT PANEL
published in EA and ETI
651 Forest Road Bexley 2207
AUSTRALIA
RING (02) 587 3491 FOR INSTANT PRICES
24-HOUR TURNAROUND SERVICE

ADVERTISING INDEX

YOU CAN RECEIVE TELEVISION WHEREVER YOU ARE, WITH AWA EARTH LINK.

Australia's first communications satellite, AUSSAT 1, has now been placed in orbit. For the first time television and radio reception will be available to isolated communities or homesteads anywhere in Australia via the Homestead and Community Broadcasting Satellite Service (HACBSS).

The satellite system

Known as AUSSAT, the Australian national satellite communications system will initially have two operating satellites.

The satellites will be in orbit 36,000 km above the equator at a longitude a little east of Australia.

Satellite services

A wide range of services will be provided to the entire continent and offshore islands.

Services will include HACBSS direct television and radio broadcasts to homesteads and remote communities, high quality television relays between major cities, digital data transmission for both telecommunications and business use, voice applications for urban and remote areas and centralised air traffic control services.

Earth stations

To use the satellite system you need ground equipment, known as communications earth stations, appropriate for the service required.

Earth stations use dish-type antennas of varying diameters and costs, depending on the services used.

AWA Earth Link

AWA Earth Link is a receive-only earth station for reception of HACBSS television and radio.

HACBSS signals will cover all of Australia and will, for the first time, bring programs to remote homesteads and areas where present broadcasting reception is poor.

AWA Earth Link earth stations will be distributed and guaranteed throughout Australia by AWA-Thorn.

For the location of your nearest AWA dealer, please telephone:
Sydney, 638 8444; Newcastle, 52 7088; Melbourne, 459 1688; Brisbane, 44 7211; Townsville, 72 2255; Canberra, 80 5314; Adelaide, 269 1966; Perth, 277 7788; Hobart, 72 4366; Darwin, 84 3243.

AWA EARTH LINK

IF YOU'RE LISTENING TO VIDEO MOVIES IN STEREO YOU'RE MISSING HALF OF THE ACTION!!

Most stereo movie soundtracks aren't simply stereo. They are, in fact, *four* channel soundtracks which have been encoded onto two channels by a special process developed by Dolby Laboratories. The four channel soundtrack, when correctly decoded, provides not only left/right information, but also front/back information placing the listener in a three dimensional sound environment. This is not another pseudo-quadraphonic gimic — it's real 3D sound and *has to be heard* to be believed.

Try the best "Dolby Stereo" cinema in town, and then ask for a demonstration of the Raidek SD100 video movie soundtrack decoder at your favourite Hi-Fi/Video retailer. You'll find the impact of "Surround Decoded" Stereo movies is even more stunning in your own home. For just $599.00 and the cost of a modest pair of rear speakers, you can go to the movies every night of the year — you don't need a big screen, it's the big sound that puts you in the picture.

SD100 FEATURES

★ Proprietry decoder circuit provides excellent separation between output channels ★ Built–in delay line for optimum front to back separation ★ Built–in power amplifiers deliver 2 x 25 watts RMS to drive surround speakers (no additional amplifiers needed) ★ Separation enhancement circuit for improved front to back separation with poor quality soundtracks ★ Treble and bass controls for surround channel ★ Connects directly between a stereo video recorder, stereo television or video–disc player and a normal hi-fi amplifier.

RAIDEK SURROUND STEREO

For further information contact:

RAIDEK SOUND INDUSTRIES PTY. LTD.
30 Williams Road, North Rocks
N.S.W. 2151 Australia.
Ph: (02) 871 7873

The Raidek SD100 video movie soundtrack decoder is designed and manufactured in Australia and is covered by an Australian patent pending. Beware of inferior so-called "Surround" systems from overseas manufacturers which do not contain the necessary decoding circuitry to produce the results described above.