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Australia's Top Selling Electronics Magazine

Electronics Australia

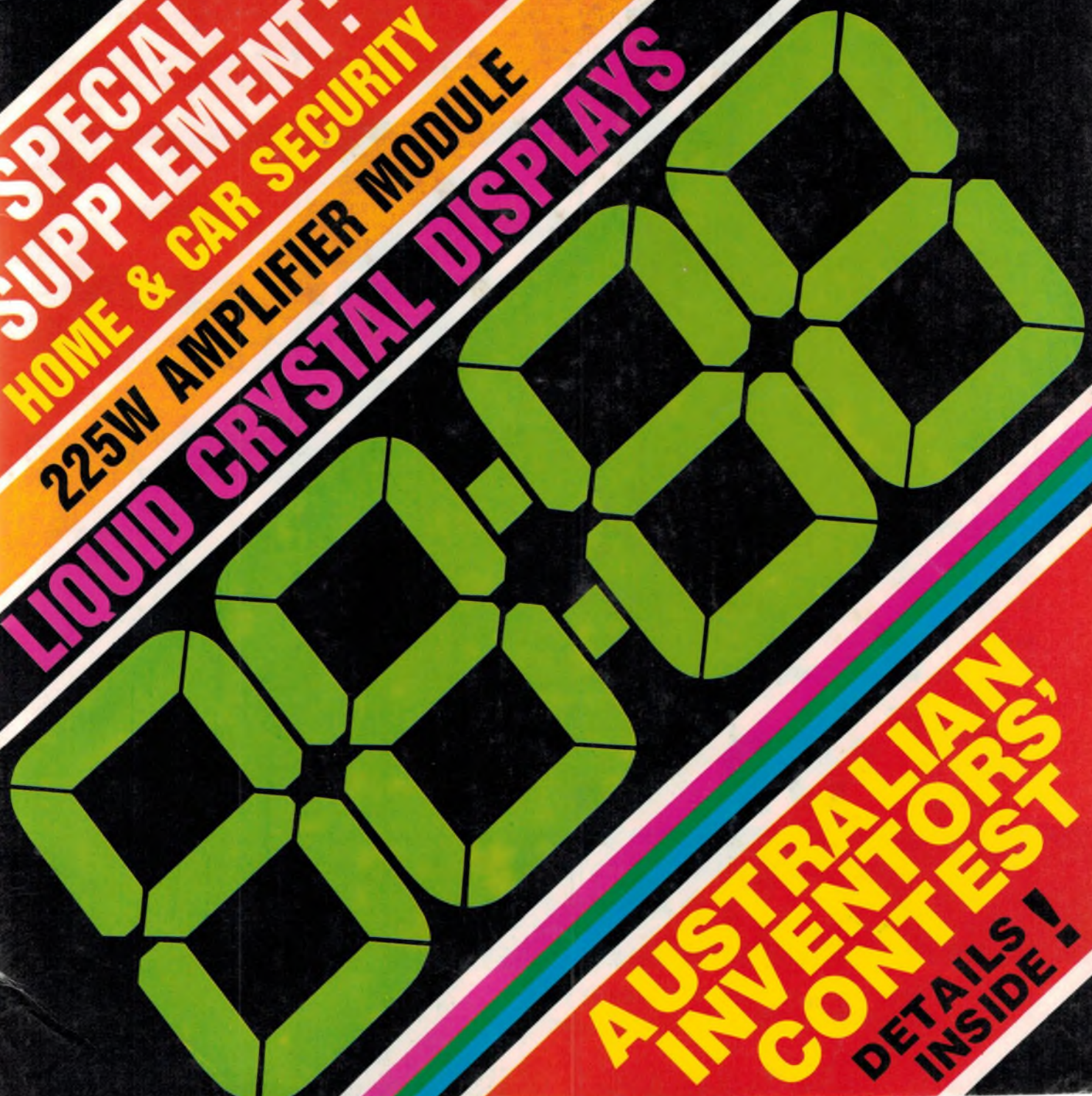
OCTOBER 1985

Aust* $2.60
NZ $3.50

SPECIAL SUPPLEMENT: HOME & CAR SECURITY

225W AMPLIFIER MODULE

LIQUID CRYSTAL DISPLAYS



AUSTRALIAN INVENTORS' CONTEST

DETAILS INSIDE!

NEW LOW PRICE!

A real computer for only $69!

AQUARIUS

The REAL computer that starts from under $100! You'd love to learn about computers? But thought all you could buy for your money were a few boring games. Now, we are the EXCLUSIVE Australian distributors of the new Aquarius. Not the "Claytons" computer but the perfect beginner's computer which gives you the opportunity to see what a real computer does.

Learn how to RUN YOUR OWN PROGRAMS in the Basic language! PLAY GAMES! Organise your HOUSEHOLD FILES! And much much more!

Simply connect the Aquarius to any colour TV and it's ready to teach and entertain the whole family. There's something for everyone. And what's more, you won't outgrow the Aquarius! As you need to learn more, the Aquarius offers a huge range of add-ons that will take you into the world of electronic wizzardry once offered only by the BIG ones.

With a full moving-key keyboard Aquarius is truly EASY to USE. Microsoft BASIC computer language is built right in! The easy-to-read manual and simplified instruction cards make learning a snap.

CREATE your own VISUAL EFFECTS with 16 colours and 256 built-in characters or design your own sound effects! Once you start to expand your Aquarius with the huge software and hardware range you'll find endless uses and possibilities for your system. With it's own mini expander, data recorder, memory expansion cartridges and thermal printer you'll soon wonder what the Great Computer Secret was all about!

FANTASTIC SOFTWARE RANGE

With more than two dozen fantastic games and educational programs available now and many being developed to add to the range shortly, there's just no end to the versatility of Aquarius. Software cartridges just plug into your Aquarius and you're ready for work or play. All software programs are available separately so you can purchase only those which interest you.

AQUARIUS with built in 2K memory (expandable to 34K) and its long list of expansion units and software is the REAL computer for the price of a TOY!

1. MINI EXPANDER

Adds versatility to your AQUARIUS. Game playing is easier and more exciting with 2 detachable hand controllers and additional sound channels. Also has 2 cartridge ports so you can plug in your expanded memory cartridge into one even while you're using software in the other.

Cat X-6005 ..... $69

2. DATA RECORDER

Save your own program or utilise one of the many great software programs available on cassette with this great value unit.

Cat X-6010 ..... $49

3. MEMORY EXPANSION CARTRIDGES

16K or 32K memory cartridges give you far greater flexibity by giving your computer a much larger memory. For more advanced programming.

16K Cartridge Cat X-6015 ..... $69

32K Cartridge Cat X-6020 ..... $129

4. THERMAL PRINTER

Ideal for documenting programs, keeping records or printing charts and records. You'll probably never again see one at this price!

Cat X-6025 ..... $129

Paper roll to suit. Cat X-6026 ..... $3.50

Aquarius Colour Computer

Cat X-6000

WAS $99
NOW ONLY $69

Dick Smith Electronics Pty Ltd

COMPUTERSTOP

Your one stop computer shop at your nearest Dick Smith Electronics centre.

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B036

Volume 47, No. 10

Electronics Australia

October 1985

THIS MONTH'S COVER

Liquid crystal displays (LCDs) have a multitude of uses ranging from digital watches to miniature colour TV sets. Our article on page 62 looks at LCD technology and discusses its applications.

Features

Hifi, Video and Reviews

Projects and Circuits

Personal Computers

Columns

Departments

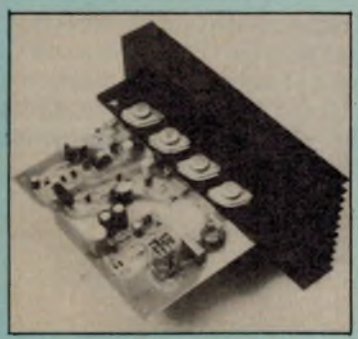
HF amateur transceiver

This exciting new HF amateur band transceiver can cover any single 500kHz band within 2-30MHz and features CW, LSB and USB transmission modes. It's easy to build, a snack to align and will cost you just $349. Pt.1 begins on page 74.

What's coming

Next month we intend to describe a high-quality bookshelf loudspeaker system and a hand-free telephone adapter. See page 117 for further details.

145W mosfet amplifier module



Looking for a rugged amplifier module with bags of power? This design delivers 145W RMS into 8Ω or 225W into 4Ω and features on-board loudspeaker protection. Construction begins on page 34.

SIEMENS

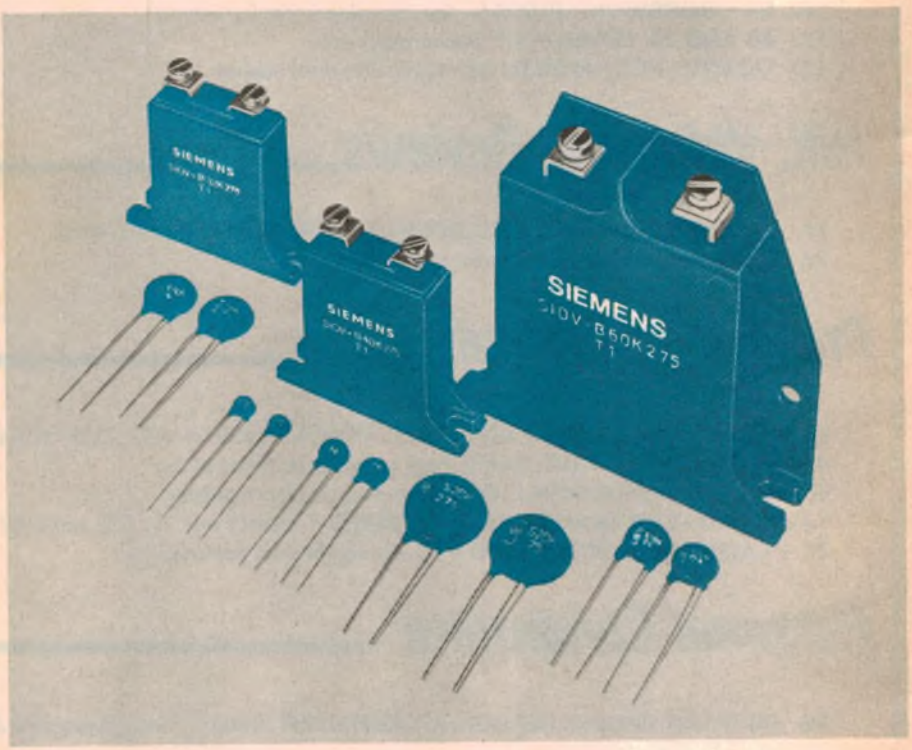
VARISTORS

Australia's widest range. All applications. Biggest stocks. Lowest prices. Quickest delivery. What else?

Siemens is now the biggest and best source of varistors in Australia with a full size range for all applications up to 70 kA. This is of special interest to the telecommunications industry.
Comprehensive stocks, plus Siemens position as one of the world's largest manufacturers of varistors underwrites our promise of quick delivery and suitability.
Siemens innovation aims at achieving substantial cost reductions across a wide spectrum in the following applications:

- ☐ Power engineering
- ☐ Electronic communications
- ☐ Power electronics
- ☐ Measuring technique
- ☐ Processing technique
- ☐ Office electronics
- ☐ RFI suppression
- ☐ Stepped protection

This wide range of varistors is available through Siemens newly strengthened national distributor network. For further information, post the coupon or phone your nearest distributor.



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823/2352CSA

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Distribution: Distributed by Gordon and Gotch Limited, Sydney.

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

Printed by Magazine Printers Pty Ltd, Regent Street, Chippendale and Masterprint Pty Ltd, Dubbo, 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

Let's have a fast rail system!

Around the world, two high speed trains stand out as being the fastest and best. The first was the Japanese Bullet train running between Tokyo and Osaka. It has been going for many years now and is still considered a "must" experience for tourists to Japan. Newer and much faster is the French TGV which presently holds the world train speed record of 380km/h. Its normal operating speed is 270km/h but this is being upgraded to 300km/h.

Both these trains, and fast trains in other European countries, are national showpieces. They are also highly profitable, since they are very efficiently run to an extremely tight timetable.

Now we have a proposal for an Australian high speed train system which is breathtaking in concept and exciting in its originality: a really high speed system, operating at 350km/h, linking Sydney, Canberra and Melbourne, with a travel time between the two state capitals of only three hours. The route is quite different from any that has been considered before and is actually shorter than the present rail connection between Sydney and Melbourne. The full story is presented on page 12 of this issue.

Odd though it may seem, the proposal has come from the CSIRO, and from three people who, although highly qualified, appear to have no present expertise in the field of transport. Be that as it may, the proposal has considerable merit. It certainly does not deserve the short shrift it was given by the Bureau of Transport Economics and by the Federal Government.

One of the main attractions of the proposal is that it would use 25kV AC traction and thus utilise our large coal reserves. The Queensland Railway system has already built up considerable expertise with 25kV AC for electric traction and this would form an excellent base from which to develop a high speed rail system.

The scheme would also undoubtedly take some of the pressure off our major airports. At the same time as it brought about substitution for air travel, it would lessen our imports of oil for aviation fuel. On the face of it, the proposed rail system could be a good deal cheaper to install and maintain than our present two-airline policy.

As with the French and Japanese high speed trains, an Australian version would in itself become a major tourist attraction, as it would pass through some very beautiful scenery.

Look at some of the other major attractions of the scheme. It would be a major infrastructure project which would generate a lot of employment and it could lead to considerable Australian expertise in the field of high speed transport. That could lead to important export income in the future. Even now, most of the technology and all the rolling stock could be built here.

Let us hope the Government gives the proposal more careful consideration. It should establish an enquiry to determine the feasibility of the scheme and if it is viable, the project shoult start as soon as possible.

NEW PRODUCTS:-

ULTRASONIC HOUSE ALARM

This alarm is fully self-contained, even includes the siren. Place it on a shelf, (it looks like a speaker) and the ultrasonic waves detect movement. Great for single room protection, or can be used as a master control for a whole house.

You can connect an external on/off switch, external horn siren. It has provision for N/O instant circuit and N/C instant and delay. A battery compartment is there for C cells, but we recommend a 1.2A 12V Gel battery. Cat SB-2480 $26.50 and 240V power supply Cat. MP-3019 $22.50.

Cat LA-5140

This sold well last month for $69.00.
We need to clear the last few.
This month only
$59.00
SAVE $40.00
That's almost ½ price.
10 Alarm Stickers FREE - worth $8.50

WIRELESS HOME ALARM

This is the fabulous alarm system you've seen us advertising recently, and has been reviewed in Australian Electronics Monthly - July 1985 page 36. Guess what - we're overstocked, and need to clear some. The system incorporates the control panel (pictured), 2 sets of wireless reeds and magnets, 1 passive infra red detector, 1 siren and one remote control.

All this normally costs $599 (pre devaluation). This month you can purchase the set for $499 and we'll give you free another reed and magnet set worth $49.50. This means a lot saving of almost $150. If you need additional components they are all available separately. IR detector $99, Reed/Magnet $49.50, Siren $99, Remote Control $39.50.

Cat LA-5410

ONLY $499.00
PLUS FREE REED/MAGNET SET WORTH $49.50
SAVE ALMOST $150

LA-5400

SAVE $100

MAIL ORDER HOTLINE
(02) 747 1888

MIDI CONTROLLED SAMPLER - Ref: Sonics July 1985
LAST STOCK - Kit $1,500
Built $2,000 - BELOW COST

INFRA RED MOVEMENT DETECTOR

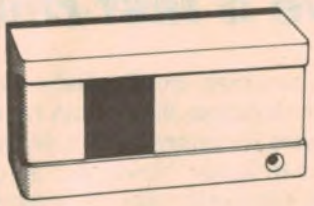
The infra red or IR detector for short, falls into the Black Magic category. It basically is a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna?) which has a "Commutated" field of view. Its reception pattern is comb like, but highly 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 OC 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



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
DIMENSIONS	170(H) x 90(W) x 35(D)mm

Basic accuracy of Volts, Current & resistance is between 0.5 - 1.2% depending on range.

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

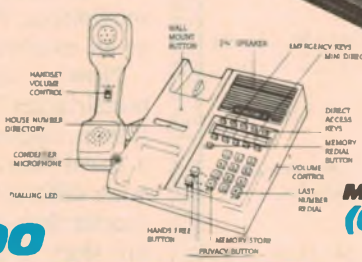
Cat QM-1540

$129.00

Hands-free 10 Memory Desk/Wall Telephone

- Loud and clear fully duplex handsfree 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

NOW OPEN:
Our Gore Hill Store is open till 4 pm Saturdays

MAIL ORDER HOTLINE
(02) 747 1888

ULTRASONIC PEST REPELLER

We were staggered by the price increases on the pest repeller we used to sell, so we found a new one at a more realistic price. Will repel mice, blowflies, birds, spiders, bats, rats, cockroaches, flies, moths and fleas. It's cosmetically appealing and is supplied with a 240 volt power adaptor. We are so sure this product works we will give you a 14 day money back guarantee (less postage costs). Power consumption only 1½ watts.

WHAT HAVE YOU GOT TO LOSE EXCEPT THE BUGS!

ONLY $55.00

Cat YS-5510

AN ECONOMICAL MAINS FILTER

250V AC @ 3A

250V AC @ 3A - insertion loss line to line 20dB 0.8 30MHz. Line to ground 30dB 0.7 - 30MHz. Ideal for computers, amps etc. Quick connect lugs. D.O.T approved.

Cat MS-4002

ONLY $22.50

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: **8.16kg**
Lateral Extension: **254mm**
Vertical Extension: **254mm**
Fixing: **Heavy table base (grey) with two chrome plated flexible arms**
Lens: **(see text)**

ONLY $169

Cat SL-2700

Book/Software Combinations

T199/4A - 51 fun & educational programs - As the title suggests, 51 good examples of TI BASIC in action. Programs can be changed to meet specific needs. The book has 94 pages and contains 4 sections. The cassette has all programs listed in the book, on one side in standard form and on the other in enhanced form. Both book and cassette come in a colourful vinyl case.

Cat BS-0750

ONLY $27.95

T199/4A - 24 BASIC programs

This book/software product runs from child/adult entertainment games to highly applicable household utility and service programs. The cassette supplied has both standard and enhanced program listings.

Cat BS-0754

ONLY $29.95

T199/4A Entertainment games in TI BASIC and extended BASIC

Arcade games at a very cheap price. Add the TI joysticks and extended BASIC module and you can use this product to its fullest extent. 20 programs in 21 chapters. The cassette supplied has both standard and enhanced listings - great fun - great value.

Cat BS-0752

ONLY $29.95

T199/4A BASIC programs

This combination of book cassette goes through each line of a BASIC program to enable you to more fully understand what BASIC is all about. There are many programs for you to work on. Helps you learn while you enter, run and modify the programs.

Cat BS-0755

ONLY $29.95

BASIC tricks for the T199/4A

A valuable programmer's reference that's filled with hard to find ideas, examples, and special BASIC subroutines to help you crank out powerful T199/4A programs.

Cat BS-0756

ONLY $29.95

T199/4A graphics & sounds

Sparkling routines that add showmanship to any program with brilliant graphics and sound. This is a must.

Cat BS-0757

ONLY $29.95

JAYCAR IS No 1. . .

SPECIAL ANNOUNCEMENT

GREAT NEW RANGE OF BEGINNERS BOOKS

Over the past two years we at Jaycar have become very concerned at the upwardly spiralling prices for good technical books. You can imagine our delight when we discovered the range of low cost books from USBORNE UK.

Unfortunately the books are at present confined to the beginners area - but they are EXCELLENT beginners books. Each book is magnificently illustrated in full colour with easy to read text.

Introduction to the New Technology

170(W) x 240(H) 144 pages with illustrations.

This incredible book provides preliminary information on a wealth of subjects related to new technology. The book is in 3 basic sections (each with its own index).

How to Make Computer Controlled Robots

200(W) x 250(H) 48 pages with illustrations.

This incredible book shows you how to actually build a working robot from common materials such as balsa wood etc. Details of electronic control circuits are also provided. (Prior knowledge of electronics is required). Details of interfacing electronics with common computers such as VIC20, C64, Spectrum & BBC also provided. Templates for all wooden components also provided as well as control programs. Great fun just to read!

Cat. BU-1212

ONLY $7.95

INTRODUCTION TO ELECTRONICS

170(W) x 240(H) 48 pages.

An ideal first book for the raw beginner. Subjects covered include: What IS electronics? About electronic current. Building circuits. Looking at resistors. Symbols & diagrams. Storing electric charge. Introducing the transistor. Transistors in circuits. More about voltage/voltage dividers. Digital circuits. Amplifiers. About the microchip. Testing & designing circuits. a colour code computer program. How to solder. Circuit diagrams etc.

Once again the combination of explanatory text and graphic diagrams is fantastic. A full index is provided along with glossary.

Cat. BU-1210

ONLY $5.95

Beginners Computer Handbook

170(W) x 240(H) 144 pages with illustrations.

This magnificently illustrated book is an ideal first book. It assumes that you know virtually nothing! It explains what 'programming' means and describes many popular machines on the market and what they can (and cannot do).

We feel that the authors have done an excellent job combining clear expressive text with excellent illustrations to explain how micros work and how they are programmed. An ideal gift.

Cat. BU-1208

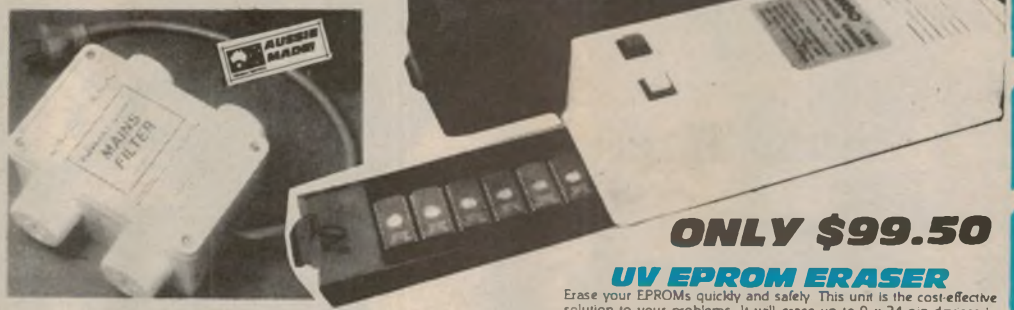
ONLY $10.95

SQUEAKY CLEAN MAINS FILTERS

Two fantastic 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



ONLY $99.50

Single 10 amp line socket type filter (unswitched).

Cat. MS-4012

ONLY $34.95

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

ALARM STICKERS

Put them on your car to confuse would be burglars as to the brand of your car alarm, or just to confuse them if you don't even have an alarm.

Cat. LA-5100

95¢ each or 10 up for 85¢ each

NOW OPEN: Our Gore Hill Store is open till 4 pm Saturdays

HORN MIDRANGE SPEAKERS

These all metal horn midrange speakers will add life to your disco or band system. Rated at 30 watts rms each, in a system they will handle over 100 watts.

4" x 10½"

Dimensions: 102 x 268 x 192mm

Cat. CM-2082

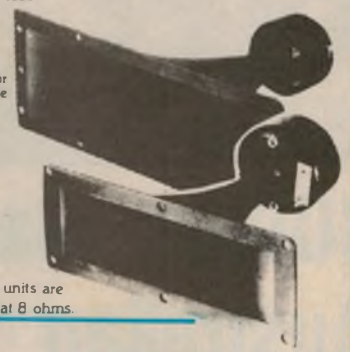
ONLY $34.50

3" x 7"

Dimensions: 183 x 75 x 163mm

Cat. CM-2084

ONLY $28.50



Both units are rated at 8 ohms.

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

TELEPHONE EXTENSION LEAD

15 metres of cable on a wind up reel.

Cat. YT-6013

USUALLY $19.95
SAVE A MASSIVE $10.00
ONLY $9.95

SILICON VALLEY POSTER

This is a full colour caricature poster measuring 760(W) x 575(H)mm and is a full map of the famous Silicon Valley area south of San Francisco. The entire area spans from Mountain View thru Sunnyvale, Cupertino, Los Gatos, Santa Celara, San Hose, Fremont etc !! Famous semiconductor factories such as Fairchild, Hewlett Packard, Intersil, Siliconix, NEC, Signetics, American Micro Systems and dozen you have not even heard of! Each factory is in its correct location. The poster is full of cartoon characters and statements. You could stand in front of it for an hour and not take it all in!

We are convinced that you will be delighted with this poster. It is printed on very heavy art quality paper and is not cheap. Each one is supplied in a cardboard mailing tube. (No room for a picture)

Cat. BP-9220

ONLY $9.95
plus $3 postage (sorry!)

DON'T FORGET

we stock the full range of Bishop Graphics and Scotchcal PCB products.

CAR STEREO WITH AM & FM STEREO

At last, a full-feature AM Stereo (Motorola CQUAM) FM - MPX Stereo and full auto reverse car cassette for only $199!

We have made a scoop purchase of these quality **JAPANESE MADE** units at an unbelievable price! Act quickly! Supply is strictly limited and we will be lucky to get further supplies this side of Christmas!

Cat. AS-1000

ONLY $199.00

MAIL ORDER HOTLINE

(02) 747 1888

MIDI CONTROLLED SAMPLER

Ref: Sonics July 1985

LAST STOCK - Kit $1,500
Built $2,000 - BELOW COST

MEMORY at silly prices

Cat		1-9	10-49	50 up
ZZ8430	6116	$3.99	$3.50	$3.00
ZZ8416	4116	$2.95	$2.45	$2.25
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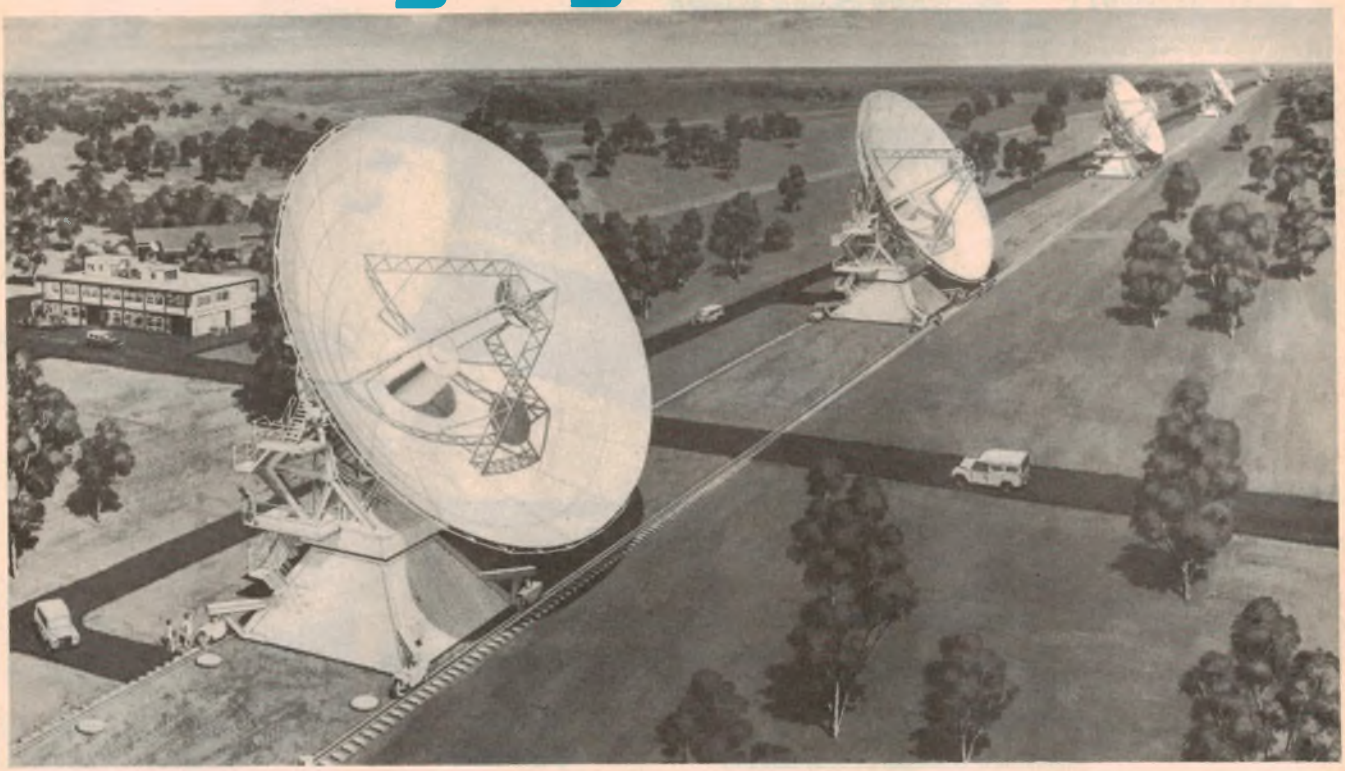
News Highlights



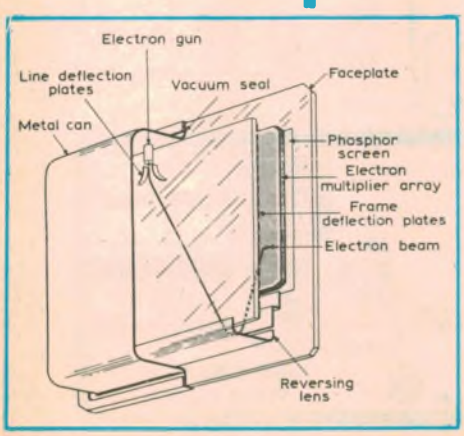
Above: Artist's concept of the proposed telescope array at Culgoora, NSW.

300km diameter Australian telescope

The Australia Telescope is a project which will incorporate the existing Parkes radiotelescope with a new antenna at Siding Spring near Coonabarabran and a 6km array of half a dozen antennas at Culgoora. By linking these antennas electronically, they will be operated as one to simulate a giant telescope 300km in diameter. As an official commemorative activity for Australia's Bicentennary in 1988, the telescope will play its part in moving this country to the forefront of research and development in astronomy.

The CSIRO's radiotelescope at Parkes in central-western NSW.

Flat TV-panel developed by Philips



In England, Philips researchers have developed a flat cathode-ray tube with a picture diagonal of 12 inches and normal TV resolution. The depth of the tube is less than 3 inches, making it the first flat, sealed-off monochrome tube to be made.

The flat cathode-ray tube consists of an electron gun, deflection plates, an electron multiplier array, a phosphor screen and a faceplate that is vacuum sealed in a metal can. Because of the electron multiplier, the electron beam can be of both low current (less than 1μA) and low energy (400 eV). The electron beam travels down the back of the tube to a reversing lens where it is turned through 180° into the front section. A central partition carries a series of frame deflection plates which creates a field to turn the beam forward on to the multiplier.

The current from the gun is amplified several hundred times by the multiplier, before the beam is accelerated to the screen. Because of the low primary beam energy and current the scanning system can be unorthodox. Vertical scan is achieved by progressively ramping the potentials on the frame plates. Electrostatic deflectors near the gun provide the line scan.

This map shows the locations of the antennae for the proposed Australia Telescope.

Searching the universe now requires work in two areas, the fine and the faint. Telescopes must be capable of detecting vanishingly small quantities of radio energy whilst also being able to discern fine detail in those faint objects. The Australia Telescope will meet both of these requirements.

The compact array at Culgoora will see "finely" and the Long Baseline Array linking the Culgoora and Siding Spring antennas with Parkes will be able to see the "faint". In fact it has the capacity to probe the outer limits of the known universe, 100 billion light years away, with high definition.

To observe the sky at radio as well as optical frequencies the antennas are designed to operate at frequencies up to 45GHz (a wavelength of 6.6mm) over the full 22 metre diameter of the dish and up to 115GHz with the central 11 metre diameter area. In the process of achieving this design goal the parabolic surface of the dish must be fitted with sloped surface panels accurate to a fraction of the wavelength of radiation observed.

Eight prototype panels with an accuracy of 0.11mm RMS have been produced by the CSIRO, giving the engineers reason to believe that their design goal of 0.15mm RMS will be reached on a production base.

In an effort to make this an all-Australian venture the majority of the contracts for the development of the sites and the hardware for the telescope have been awarded to Australian companies.

In April the staff and equipment from Robert's Construction Ltd of Queensland moved onto the Culgoora site to begin the civil works. The companies which won the space-technology contracts, worth $20 million, were decided on in late July and are also Australian.

The largest contract has been awarded by the CSIRO to Evans Deakin Industries Ltd from Queensland, for the construction of the 22-metre diameter antennas for the telescope. It is worth $15 million.

The other contracts are for the design and construction of three Overseas Telecommunications Commission (OTC) earth station antennas, and for the development of an Intelstat rooftop earth station prototype.

The OTC station antennas will be designed by MacDonald Wagner Pty Ltd, in consultation with the CSIRO's radiophysics department at a cost of approximately $3 million. The rooftop earth stations are being developed and constructed by a consortium which includes the CSIRO's radiophysics division, the University of Sydney, Codan Pty Ltd of Adelaide and the University of Queensland.

Business brief

● **BWD Industries Limited,** which recently acquired switch manufacturer Swann Electronics, has also acquired the manufacturing assets of part of the Repco Switch company.

The acquisition covers microswitches, rocker switches and door switches supplied to the appliance industry. These products will now be manufactured in Australia by BWD's subsidiary, Swann Electronics Pty Ltd, for the Australian and New Zealand markets.

Bell-IRH announce their appointment as Australian representatives and distributors for the Hitachi range of oscilloscopes and multimeters. The appointment covers all states and Bell-IRH take over all existing service obligations on Hitachi instruments and will continue to offer a two-year warranty and full service support for the product range.

With the release of the VC6041 digital storage scope and the 4-channel, 8-trace V1100A oscilloscopes, Bell-IRH will be walking into a strong market.

News Highlights

Australia should be in space

Professor Keith Cole from La Trobe University in Melbourne is one of the formulators of Australia's first-ever space policy. He believes that although we were once a forerunner in space technology (being one of the first nations to launch a satellite) this is no longer the case. He feels that by implementing a space program and developing the accompanying industries this downward slide could be arrested and the nation's decline as an industrial power may be halted.

The report, entitled "A Space Policy for Australia", is now in the hands of the Minister for Science, Mr Jones, who commissioned it. It specifies three important areas for development. One of particular concern involves the study of Australia's land surface and surrounding oceans from space. Overseas scientists have the ability to do this, whereas we do not.

New interference legislation

Legislation regulating radio frequency interference, which is applicable to a wide range of items including tools and toys as well as entertainment and industrial equipment, will have far reaching effects in Australia, according to the Department of Communications. It requires new standards for all equipment capable of causing radio interference or sensitive to it and has resulted in an increased need for associated testing facilities.

Under the new legislation, any equipment which utilises the radio frequency spectrum but does not comply with an appropriate standard will be considered sub-standard and may be deemed an illegal import.

The required standards will be produced by the Department of Communications in conjunction with the Standards Association of Australia and industry. They will need to describe acceptable limits of radio frequency radiation from all equipment capable of emitting RF energy as well as immunity standards for radiosensitive equipment.

To develop the new electromagnetic interference standards a new group of technicians will be needed.

Japanese consumer market saturated

According to some sources, the domestic market for electronic goods in Japan has been saturated. Matsushita the largest manufacturer of these types of goods have heralded the change by shifting their product emphasis to industrial and computer markets.

The move to establish themselves in these markets has meant that 31% of their product is now industry orientated.

The alternative, expanding to the developing markets of the Soviet Union, India and China, has also been considered in the hope that this might alleviate the problems caused by the saturated home market. The only problem is that the home market was the perfect testing ground for prospective overseas products and this is now a dead-end.

The drop in consumer electronics buying is not restricted to the Japanese. A fall off has occured all over the world (except in the case of video recorders).

Robot gripper is a good handler

A new type of robot gripper can pick up a telephone receiver and present it to a waiting hand. Peter Scott, a roboticist at Imperial College, London University, invented the device and has called it the Omnigripper.

The prototype Omnigripper can handle objects weighing up to about 2kg. It consists of two slightly separated "fingers", each made up of an array of 127 closely-spaced telescopic pins that can ride up and down independently of each other. Lowering the gripper over an object pushes some of the pins out of the way, leaving customised fingers moulded round the item to be lifted. Feedback from each pin can provide tactile information about an object and build up a three-dimensional image of it.

The basic design form of the Omnigripper allows for many variations for different applications, and for the development of bigger and more complicated versions. Industrially, the gripper should prove particularly useful in automatic assembly lines where robots frequently need to handle a wide variety of parts for a given assembly. The Omnigripper principle has been patented internationally by the British Technology Group and the next stage will be to develop versions for licensed users.

Bicentennial communications link

Telecom has awarded three contracts worth nearly $20 million for its first intercapital optical link between Sydney and Melbourne. It is planned to go into action in 1988.

Austral Standard Cables Pty Ltd and Olex Cables Ltd will manufacture the optical fibre cables. NEC Australia Pty Ltd will manufacture the line transmission equipment.

Deliveries of the cable to Telecom will start early in 1986 for the cable laying project which will take about 15 months.

New speeds in transistors

Gallium arsenide, the newest in semiconductor materials, has been used by Honeywell researchers in the USA to produce the fastest computing element ever. It is a transistor in which the electrical signal travels from input to output in approximately 11×10^{-18} of a second at ordinary temperatures.

The company's Minnesota base has already developed a first-phase fabrication technology which it will transfer from the laboratory to its manufacturing division this year.

at the leading edge

IBM® AT COMPATIBLE HARD DISK CONTROLLER OK FOR FLOPPIES
Western Digital's WD1002-WA2 interfaces up to **two** rigid **Winchester** disk drives and up to **two floppy disk drives** to the **IBM Personal Computer**, model **AT**. The same controller can be hooked up to **Interdyne's** ID1010 floppy compatible **10 Mbyte tape backup** drive providing an extremely cost effective data storage combo.
Other features of the WD1002-WA2 include control of floppy drives at **four data rates** 125Kbps, 250Kbps, 300Kbps, 500Kbps, **concurrent transfers** on a floppy and a Winchester drive.

PRIAM 70 MBYTE WINCHESTERS BOOST PC, XT and AT PERFORMANCE
PC VARs are finding that many applications are benefitting from the **30 msec. average access** times offered by Priam's Vertex V170 range of high performance, **high capacity 5.25"** hard disk drives. As well as speeding up disk access by a factor of 3 the seven fold increase in capacity will provide the capacity necessary for **LAN linked systems.** Western Digital's **1002-WX2** and **WA2** controllers are **directly compatible** with the V170.

CML's MONOLITHIC AUDIO FILTERS MAKE THEIR DEBUT.
The FX306, from **Consumer Microcircuits** is the first in a series of **switched capacitor** filter arrays consisting of standard lowpass, highpass and bandpass sections together with amplifier and limiter block. The **CMOS** device operates from a **single 5V** rail and features a **4th order highpass** filter and a **6th order lowpass** filter which, when combined, form a standard **300-3,400 Hz bandpass.** An additional 6th order lowpass filter plus an **uncommitted op-amp** allow for customizing in applications in telephony, cellular/mobile radio, speech scrambling and audio frequency band limiting.

OPTOCOUPLER BELTS ALONG AT BETTER THAN 10 MHz
Dubbed the **PC910, Sharp Corporation's** super high speed optocoupler incorporates an **inbuilt inverting gate**, OPIC, to output a predictable logic swing at the highest data transfer rates.

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Letters to the editor

Toggle switches look daggy

Over the years, the *Electronics Australia* team have been responsible for what is arguably one of the best electronics magazines in the world in terms of content, presentation, technical information and keeping both the tradesman and hobbyist up to date in this rapidly changing world; something which the entire staff should be mighty proud of.

Now everyone knows a lot, indeed quite a lot, of people build the myriad of constructional projects featured in the magazine and that the parts are often easily available in kit form. This saves a lot of problems for both the retailer and customer alike.

These projects have, as time has gone on, taken on a more professional appearance, which is well liked by most people.

The latest Series 200 Playmaster integrated amplifier is proof of the pudding but why, please tell me why, do you people insist on ruining the great appearance of these projects by viciously using those damn, daggy little toggle switches. They look exactly what they are — cheap and nasty. Those horrid little things throw class right out the window.

Now the average miniature toggle switch costs around $1.50. For $3.50, you can buy a neat square pushbutton complete with a colour coded/matched surround bezel and even a hole to mount a status LED. These and many other switches are available as stock items from companies such as C&K Electronics.

As a matter of fact, C&K gave me a recent switch catalog for nix which contains over one million possible switch/actuater combinations, with an enormous range of colours and styles to choose from. These facilities should be used: it's worth it.

Another idea for the Series 200: the (yuk) toggle switches could be replaced with two position rotary switches and be fitted with the same aluminium knobs that are used on the other controls. Construction wouldn't be any harder, the operation wouldn't change nor should the performance, but think of its appearance! Wouldn't it be worth the extra few dollars?

So come on, let's bring the appearance stakes of the projects in line with their performance.

Let's hope the coming fully synthesised tuner project has a decent front panel, and one would expect this same tuner to offer stereo AM reproduction as well as stereo FM, and with a decent bandwidth. I can hardly wait.

S. McBride,
Townsville, Qld.

● The synthesised tuner will offer wideband stereo AM as well as stereo FM.

ID cards not such a good idea

I agree. What a good idea it is for everyone to have identity cards. With such a system, a good government can ensure that criminals and others wishing to cheat on social security and taxation will be identified and subsequently prosecuted. That is, provided it is a good and honest government and they are real criminals.

With such power, how long do you think it will be before someone in authority will take advantage of such a system? Just think how much more efficient Hitler would have been in eliminating the Jews during World War Two.

You may consider it melodramatic on my part to consider it in such a way but I ask what safeguards could ever be placed on it to prevent a similar, subtle "Hitler" from making use of it. The present government is hardly above suspicion considering its power base is the unions and these same unions intimidate and harass individuals who do not have valid union identity cards.

Taxation and social security fraud certainly provides excellent cover to introduce an extension of unionism in its vilest form.

G. Ramsay,
Annerley, Qld.

AM stereo decoder works with valves

Last October, in the EA article on constructing an AM Stereo Decoder, the statement was made that "it was not suitable ... for addition to ... valve radios." I responded, tongue in cheek you may possibly recall, on the affront to the lovely vacuum tube.

Well, now it is with considerable glee and satisfaction that I can assert with certainty that valves are not dead; AM stereo decoders do work with valves! Your statement was really a challenge you see.

To give your article its due, the conventional last generation two-tube tuner would indeed be a no-no. In real terms, what I have done is not to add a decoder to a tuner, but to design and build a valve AM tuner around the decoder board, taking account of the various inhibitions placed on the tuner by the decoder's fussy requirements.

In case there are other nostalgia seekers, perhaps I can briefly outline the design and its philosophy.

(1) Oscillator stability is vital; by selecting a stable later type mixer/oscillator and coupling the oscillator anode to the mixer grid we avoid signal changes "pulling" the oscillator. A fully regulated power supply and a sinusoidal oscillator mode are also important. Add to all this adequate ventilation and the system is ready to go.

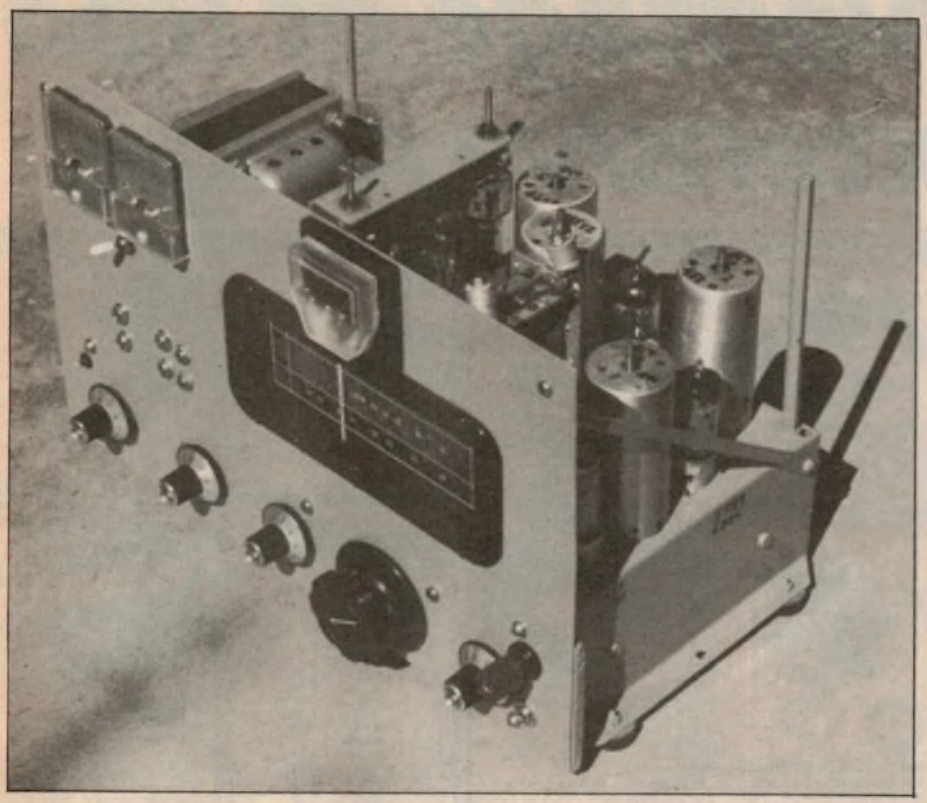
(2) The IF bandwidth is normally too narrow and so the need is for stagger tuned IFs, which in turn require an additional stage for reasonably smooth bandwidth. This also makes up for the inherent gain loss of the mode.

(3) The tuning must be precise. Can't use an "S" meter or magic eye (they can still be purchased incidentally) from the AGC because the flat passband of the stagger tuned IFs makes this impossible. What to do?

Of the several possibilities the method adopted was to construct an extra auxiliary IF stage sharp tuned to 455kHz with its own valve driven parallel off the mixer IF transformer. That makes four IF transformers plus three IF valves. The readout could have been a magic eye (electron ray tube), but a milliameter driven off a triode which was in turn driven by the detected output of the auxiliary IF stage appeared better.

(4) Temperature problems: obviously an open construction would be best. The use of low power dissipation valves and a design which keeps the "wattsy" areas away from the decoder was called for. Good word "wattsy", is it not?

(5) Voltage requirements: tough. There was no realistic way out of using two transformers. One was for the valves and



the other for the decoder and the notch filter. The notch filter could have been another valve and in retrospect this would probably have been better, as it would have simplified the interstage coupling, to say nothing of the removal of a −15V supply needed as well as the +15V required for the semiconductor notch filters. Next time perhaps.

(6) An RF stage recommended? I couldn't see that it would be of any great advantage in a valve line-up where the need was for local reception. There was going to be a lot of gain in the IF area and some high Q, RF coils could even cut the bandpass a little, without being able to be offset by IF stagger tuning without some variation as the band was tuned from HF to LF.

A few extra thoughts caused an IF gain control to be added to accommodate the 30dB signal variation between some stations where I live. The big problem was a suitable dial drive system. Whilst a Jabel 0-100 dial reduction system is available it seemed more nostalgic to rummage around and resurrect an old, small, but effective EFCO dial with real stations marked on it. Some are even in the right place. It needed a complete reconditioning, but then that is part of the challenge.

Well the project took off a few months ago. The final result was an eight valve tuner, with the decoder and notch filters atop the chassis. The enclosed photograph probably tells a better tale than a lot of words.

The valve line-up was 6AJB mixer, three 6DA6 IF stages, two 12AX7s (one an equaliser, one a tuning amplifier), one 12AU7 impedance charger, and a 6EM7 voltage regulator. The power supplies are semiconductors to reduce heat. The whole thing fits sardine fashion on a 300mm × 150mm × 50mm chassis.

In any case, it works. It delivers good clean stereo and is beautifully stable. I wish I could be as enthusiastic about the program material. Maybe like the valves, I am rather dated.

After two hours running, no component, with the exception of the 6EM7 dual triode power regulator, is too hot to hold firmly in the hand. Although not hot thermally one would not try and hold the anode supply input electrolytic in the hand, of course. How it would bite! Well that's about the size of it.

I remain with 40 odd years of R&H, RTV&H and EA a faithful reader.

Brian M. Byrne,
Indooroopilly, Qld.

NDK 5025 Printstar review

Please note that there was an error in your review of the NDK 5025. The review states that the tractor is a standard item. I would like to advise that it is in fact an optional extra, available at $170 ex tax.

H. Haines,
Datascape Int Pty Ltd,
Mosman, NSW.

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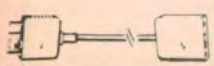

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TECHNICAL INFORMATION
Illumination: 22W Fluorescent
Weight: 81.6Kg
Lateral Extension: 254mm
Vertical Extension: 254mm
Fixing: Heavy table base (grey) with two chrome plated flexible arms.

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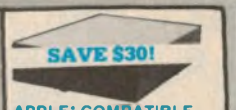

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8226	1.70	1.50
8243	4.50	3.90
8251	3.90	3.50
8253	3.50	3.30
8255	2.90	2.50
8257	3.50	3.10
8259	3.50	3.10
8279	3.50	3.10
2532	7.50	6.90
2764	5.50	5.10
27128	7.50	6.90
1488	55	45
1489	55	45

MSM5832 BACK IN STOCK!

1-9	10+
$12.50	**11.50**

6116P-3 PRICES SLASHED!

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$2.75	**$2.50**

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YFE YF1100 FEATURES

- Large easy to read 3 1/2 digit display
- Facilities for transistor and diode testing
- Clearly laid out front panel
- 10A DC, AC range
- Priced to undersell the others

Cat. Q16025 **$89.95**

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Prime Spec's. 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
14.3181.8MHz	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

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Horizontal Buss	
Cat. H19125	**$39.50**
Vertical Buss	
Cat. H19130	**$39.50**
Pad per Hole	
Cat. H19135	**$39.50**

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

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Cat. C12002 **Per Pair $59.50**

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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	A11328	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

SUPER HORN TWEETER

- Requires no crossover and handles up to 100W!
- Sensitivity: 100dB/0.5m
- Frequency Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size: 96mm diameter

Cat. C12102 **ONLY $14.95**

SUPER HORN

- Wide dispersion tweeter, handles up to 100W
- Sensitivity: 105dB/0.5m
- Frequency Response: 3kHz-30kHz
- Impedance: 8 OHMS
- Size: 145x54mm

Cat. C12103 **$14.95**

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P.A. SPEAKERS

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

Cat. C12000 1-9 **$6.95** 10+ **$5.95**

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Quality 20 minute tapes

Cat. D11141

1-9	10+	100+
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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).

Features include:
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- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
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- Long life UV tube
- Dimensions 217 x 80 x 68mm
- Weight 670 grams

Cat X14950 **$89.50**

36 WAY CENTRONICS CRIMP PLUG

Cat P12200

1-9	10-99	100+
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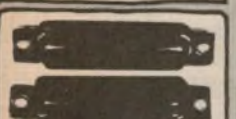


RS232 & 'D' TYPE CONNECTORS

PART	DESCRIPTION	CAT No.	1-9	10+
DE 9P	9 Pin Female	P10880	$1.75	$1.60
DE 9S	9 Pin Male	P10881	$2.25	$2.45
DE 9C	9 Pin Cover	P10992	$2.55	$2.45
DA 15P	15 Pin Male	P10894	$2.10	$1.95
DA 15S	15 Pin Female	P10895	$2.25	$2.10
DA 15C	15 Pin Cover	P10892	$1.15	$1.05
DB 25P	25 Pin Male	P10900	$2.95	$2.80
DB 25S	25 Pin Female	P10901	$3.45	$3.30
DB 25C	25 Pin Cover	P10902	$1.20	$1.10

NEW COMPUTER PRODUCTS!

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**

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables by changing from male to female to male
- All 25 pins wired straight through

Male to Male
Cat X15650 **$19.95**

Female to Female
Cat X15652 **$19.95**

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**

RS232 SURGE PROTECTOR

- Avoids costly damage from large voltage peaks caused by lightening or other power problems
- Uses metal oxide varistors (MOV) to suppress any voltage above 26V on pins 2 3 and 7
- Will handle up to 1 Joule and 250A peak current

Cat X15660 **$34.95**

RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat X15658 **$19.95**

4 WAY DIRECTIONAL JOYSTICK

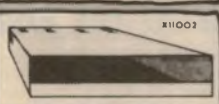
Cat X15635 **$29.95**

AUTOMATIC ANTENNA ROTATOR

- Fully automatic with 50kg vertical load
- Suits most TV - FM - VHF & UHF antennas
- Fully approved by the Energy Authority

SPECIFICATIONS:
Rotation: 360- with mechanical stop
Rotation Time: 360- in 70 seconds
Mast Size: 22 to 40mm 0 diameter
Loading: 50kg vertical
0.25x0.25m wind
Weight: Drive unit 3.1kg
Size: 1520x375(H)mm

Cat A12069 **only $99.50**



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X11011 Case and Pwr Supply $109

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X11012 Case & Pwr Supply $149

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X11013 Case & Pwr Supply $109

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X11004 Bare Case $59
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Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

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115V 3½"	Cat T12467	$12.95

10 Fans (mixed) less 10%

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Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency.

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- Contact terminal Phospor bronze
- Material P B T 94V 0
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Qty	Cat No.	Price
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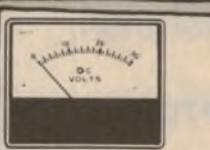

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We have a great range of panel meters at great prices!

Cat No	Description	Price
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Q10504	MU45 0-100uA	12.50
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Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMeitre	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95

RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat S15029	12V 1.2 AH	$12.95
Cat S15031	12V 2.6 AH	$39.50
Cat S15031	12V 4.5 AH	$49.95

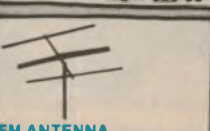
UHF/VHF/FM ANTENNA

Frequency: VHF 48-216Mhz (Ch 1-12) UHF 536-764 Mhz (Ch 25-62)

Up grade your TV system now before Channel 0 disappears! Includes 75ohm and 300ohm balun incredible value!!

Impedance 75 300 (200) Ohm
Element: VHF 4 UHF 9
Gain (dB) VHF 4-6 UHF 4-8

Cat L11014 Normally $39.50 **NOW $29.50**



FM ANTENNA

88-108MHz 75/300 Ohm
Cat L11015 Normally $29.50 **NOW $19.50**

PRECISION INSTRUMENT CASE

Features vent system for cooling, top and bottom snap together (no screws required), removable front and back panels.

Cat	Dimensions	Price
H10114	135x93x47mm	$6.95

ECONOMY 19" RACK CASE

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

Cat	1-9	10+
H10415	$47.50	$44.50

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

HORN CRAZY!!

8W, aluminium or plastic
Normally $9.50
Aluminium Cat C12015
Plastic Cat C12010

1-9	10+
$6.50	$5.95

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**

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The WTCPN Features:
- Power Unit 240 V AC
- Temperature controlled iron 24 V AC
- Flexible silicon lead for ease of use
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EA 1085

The CSIRO's fast train proposal

SYDNEY to MELBOURNE in three hours flat!

How would you like to be able to speed between Sydney and Melbourne in three hours flat, without having to go by air? If a proposal put forward by CSIRO is adopted, we could be able to do just that, on the world's fastest train.

by LEO SIMPSON & LOUISE UPTON

In other parts of the world, high speed trains are a highly successful mode of transport, shifting tens of thousands of people a day. Japan has its bullet train, France has the Train à Grande Vitesse (TGV) and several other European countries have very efficient high speed rail services.

Now there is a proposal for an even faster high speed rail service to connect Sydney, Canberra and Melbourne and, as a bonus pass through the beautiful Snowy Mountains and the Gippsland Coast of Victoria.

Just imagine the journey. Leaving Sydney's Central Station at 9am, the streamlined train wends its way out to the outer suburbs at a rapid clip and then gets on to the new high speed track to the south. In just a few kilometres it has accelerated from around 100km/h or so to the phenomenal speed of 350km/h. At this speed the train passes a trackside observer in a shattering blur. So fast is the train that its 200 metre length has flashed by in only two seconds. Only two seconds!

We blast out through Moss Vale in just a few minutes (the journey in a current train would have already taken an hour or so by now) and then boom on to Goulburn.

Hills, mountains, what are they? With this train they just disappear. While the gradients are quite steep, at up to one in 28, this mighty train goes so fast that hills are just flattened. It trades only a small amount of kinetic energy to top those rises and just as quickly picks it up again on the down grades.

A short while after passing through Goulburn we are passing Lake George and already we are beginning to slow for the stop at Canberra.

Sighing to a stop in the Nation's capital, we have taken just one hour from Sydney. By car, this trip would have taken four hours at legal speeds and by XPT, about the same time.

Leaving Canberra after a stop of only a few minutes we again blast up to full speed and begin the climb through the Snowy Mountains. From there, it's flat chat all the way, until we hit the outskirts of Melbourne, whence we drop back to more normal speeds for the remainder of the trip to Melbourne's Flinders Street station. Journey's end. What a blast. Only three hours to Melbourne. Only three hours back!

Compare that with the present plane trip from Sydney to Melbourne. It takes around half an hour from the city to Mascot airport and check-in time is at least half an hour before departure. If

Above: artist's impression of the CSIRO fast train skirting the Snowy Mountains.

you want a window seat, you need to check in an hour before the plane leaves. The jet takes around 65 minutes or so to make the flight to Melbourne's Tullamarine airport and then its a long road trip by coach or taxi to the city. As a result, it can easily take three hours or more, if you are going by plane. If you were going by the proposed high speed rail system, you would check in a few minutes before departure and alight from the train three hours later, fresh and stimulated by the exhilarating ride, in delightful down-town Melbourne.

Proposed route

As shown in the accompanying map, the proposed route is quite different from that taken by present rail or road traffic. It has been selected to minimise gradients but results in a total length of 868 kilometres, some 92 kilometres shorter than the present rail route to Melbourne.

It has the advantage of passing through Canberra and could provide connections to the Snowy Mountains ski resorts. The route would be dual track all the way to Melbourne but would require the use of existing tracks from Central to Tempe in Sydney. The total length of new track dedicated to the high speed trains would be 796km.

Since the high speed trains would use some of the existing rail route, it will use conventional flanged wheels and rails, albeit with refinements. For the speeds contemplated, rails are the most feasible. Monorails, linear motors and magnetic levitation have yet to be proven for high speeds overseas and so it is not proposed to break new ground in this regard in Australia.

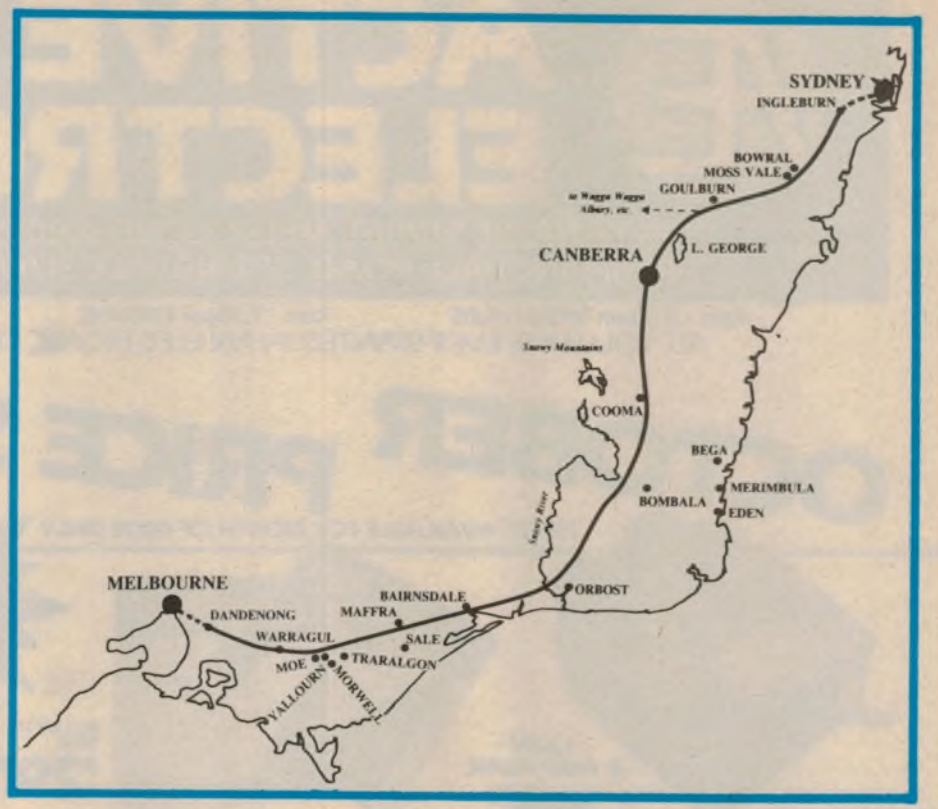
Overseas precedents

The two main precedents for the CSIRO's proposal have been mentioned above: the French TGV from Paris to Lyon and the Japanese Bullet train from Tokyo to Osaka. The TGV line is 425km long and is designed for operating speeds of 270km/h. It presently holds the world rail speed record of 380km/h. Another TGV line is soon to be built which will have operating speeds of 300km/h.

The Bullet train is older than the TGV and operates at 210km/h. British Rail also operates trains at up to 200km/h on non-dedicated tracks.

Significantly, these high speed rail systems overseas are popular and run at a considerable profit while conventional rail systems around the world continue to lose money. Now and in the years to come, the total population represented by Sydney, Melbourne and Canberra will be more than sufficient to patronise the proposed system and thus make considerable profits.

Based on the above overseas precedents, the CSIRO believes that its proposal can be developed around conventional rail principles.



The standard gauge track will be constructed of the heaviest rail currently rolled in Australia (65kg per metre) and laid on prestressed concrete sleepers. Concrete sleepers need less maintenance than hardwood and give better stability of the track holding it firmly in gauge.

The rail will also be continuously welded to minimise wear and tear on both wheels and track. At the same time, the continuously welded track will have to be very heavily ballasted to firmly anchor it against the stresses of expansion and contraction.

A further measure against wear (indicated by BHP research into high axle loads on conventional tracks) is to use hardened rail heads which minimise wear and plastic deformation and the matching of rail cant and profile to wheel profiles.

Design principles

Our present railways largely conform to a nineteenth century pattern designed for steam traction: moderate speeds, fairly sharp curves and modest grades (although some main-line grades in Australia are around 3%, rivalling those anywhere in the world). For mainline tracks though, it has been normal practice to keep grades to 1% (ie, a rise of one metre for every 100 metres of track).

The CSIRO's Fast Rail proposal on the other hand calls for dramatically steeper grades, typically up to 3.5%. Even 5% grades are considered as being feasible.

Such steep grades are feasible because at the high speeds contemplated, most of the energy required is to overcome wind resistance, not the grades themselves. The train needs a great deal of power just to run at the designated speed, since wind resistance is proportional to the cube of the velocity. Therefore it follows that if the train is powerful enough to run at these high speeds it will automatically have enough power to accelerate up the intended grades.

The train's large momentum at high speeds also means that it can climb to considerable heights with small loss in speed. As an example of this, if all friction and wind resistance losses are ignored, a train with a velocity of 350km/h could climb to a height of 480 metres before coming to a stop, after power was removed.

The reason why such steep grades are being considered is that it substantially reduces the cost of construction of the track (while only causing a relatively small increase in running costs). According to the CSIRO's figures, the cost of excavation for the whole route would be around 680 million dollars versus more than 2.8 billion dollars if track gradients were kept to a maximum of 1.5%.

Large radius curves

While it is possible for the track grades to be up to 3.5% or even more, the minimum radius curves specified by the

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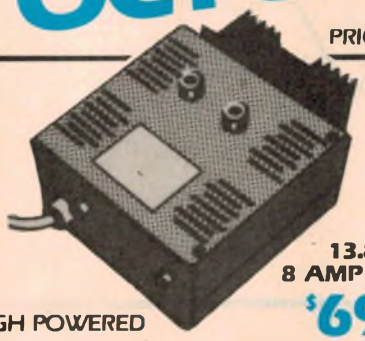

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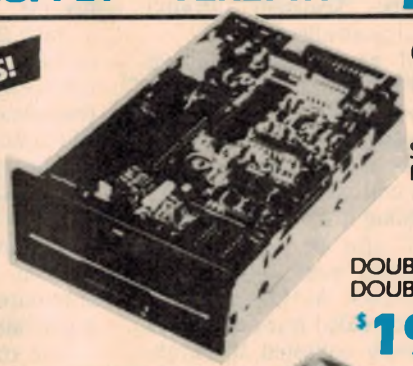

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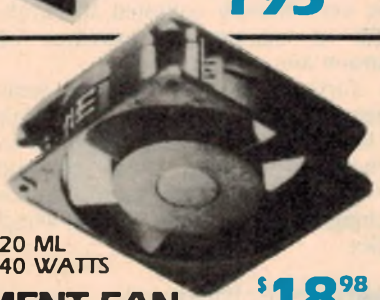

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Sydney to Melbourne in three hours!

CSIRO for the project are much larger than seen anywhere else in the world. The TGV presently uses a minimum track radius of four kilometres but the proposed Fast Rail project would have a minimum radius of seven kilometres.

Even at this large radius, the high speeds involved would cause considerable sidethrust on cars. To overcome this, the track would have to be super-elevated (ie, banked) so that the outer rail is 20cm above the inner rail to cancel out side-thrust and thus minimise track and wheel wear.

In the vertical plane, track radius will be specified at 15 kilometres or more. This is mainly for passenger comfort. If the vertical track radius is much less than this the passengers would have the uncomfortable sensation of lightheadedness every time the train went over a crest.

Method of propulsion

For the speeds involved, a great deal of power is involved. The total traction power for a typical 400 tonne train is 8000kW. That compares with the around 5000kW used to haul the 3000 tonne coal trains in New South Wales. Such large powers mean that electric propulsion is the only practical method.

Using electric propulsion rather than diesel electric means an increase in reliability and the utilisation of existing coal and hydro-electric reserves. If, as envisaged, the Fast Rail scheme leads to a considerable substitution for air travel between Sydney, Melbourne and Canberra, the savings in oil imports could also be very considerable.

As with the French TGV, the electrical energy will be fed to the train via an overhead catenary wire operating at 25,000 volts AC. This has considerable advantages over the 1500 volts DC used for most of Australia's electrified rail systems. The exception to this is the Queensland rail system which has been using 25kV AC for several years now.

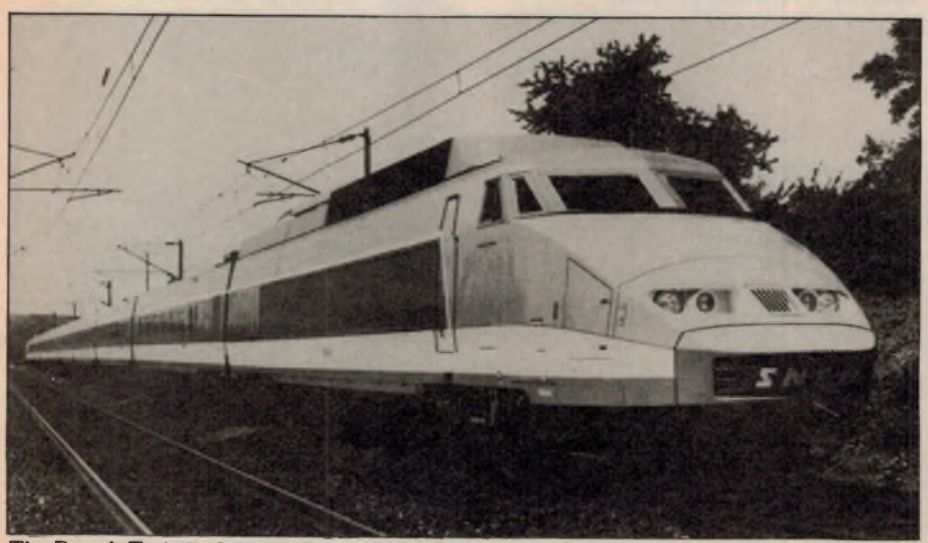
At 8000kW, the current required from a 25kV AC distribution system is a maximum of 320 amps compared with 5333 amps from a 1500V DC distribution system. This advantage translates to much lower transmission losses, a lighter catenary system and support structure, a lighter pantograph operating at much lower forces (resulting in less wear of the catenary and pantograph) and a substantial reduction in the number of electricity substations along the route.

Finally, 25kV AC can be fed from the conventional grid system without the need for special conversion equipment other than transformers and switchgear.

Between Ingleburn and Dandenong, the high speed section of the proposed Fast Rail route, the train will use 25kV single phase AC on the overhead wires for propulsion. The route has been chosen because it passes through the two important areas supplying the electric power, the Snowy Mountains electricity scheme and the Gippsland coal area. At the Sydney and Melbourne ends, the train would have to use the existing 1500V DC system.

The use of AC for rail propulsion only became possible in the last decade with advances in solid state technology. For a dual powered system, the transformers and rectifiers needed to produce 1500V DC from 25kV AC can now be placed on the trains.

The traction motors suggested by the CSIRO would be frame mounted instead of mounted in the bogies. This gives lower unsprung weights and thus lower wear on the track and wheels.



The French Train a Grande Vitesse, which has been clocked at 380km/h.

Braking

Several systems of braking are envisaged. The French have developed linear eddy-current (LEC) braking which is a form of magnetic braking that can be applied at all speeds. This uses large electromagnets close to the rails to provide retardation before the main brakes are applied. Naturally, this heats up the rails, but is practical where traffic frequency is less than one train every 20 minutes.

Another form of braking which could be used is rheostatic or regenerative braking. In this, the traction motors are used as generators which dissipate power in large resistance grids.

Aerodynamic brakes in the form of spoilers might also be highly effective at the high speeds being considered.

The major braking system, however, would probably be a combination of air brakes operating conventional caliper shoes, coupled with regenerative braking to reduce the high speeds before disc brakes could be applied for final stopping. LEC and spoiler brakes would be extras.

Track monitoring

Clearly, at the speeds involved, there will be no level crossings and the track will have to be graded and fenced to prevent animals or people gaining any access. There will also have to be culverts to allow animals and people to move from one side of the tracks to the other, apart from bridges and tunnels for vehicle access.

Some form of microwave or laser scanning system would be necessary to ensure that the track ahead is clear. As well, the CSIRO has considered the possibility of using a scout vehicle which would check the track for obstructions, snow or ice, possibly before the first run of the day.

Conventional trackside signalling would also not be practical and automated control systems such as used on the TGV and other high speed trains would be essential.

Conclusion

The CSIRO have certainly had their work cut out for them in carrying out studies of practicability and in convincing the Government that this is a worthwhile project. At an estimated figure of $2.65 billion with time for construction, at between five and seven years, the project certainly does seem to be feasible and worthwhile. Let us hope that a start can be made in the not too distant future.

Making speakers understood:

A guide to correct microphone use

by NEVILLE WILLIAMS

If you can't understand what's being said in a church service, a public meeting, a conference or a talkfest, don't automatically lay the blame on the amplifier, or the acoustics. Not even a well set-up system can transform all too prevalent mumbling into intelligible speech!

If you sense a certain irritation in the above introduction, it's because a question, frequently addressed to me over the years, consistently reflects a readiness to blame the amplifier system, rather than the people using it, for a difficulty in hearing and understanding what's being said. You've possibly encountered the question and the attitude yourself:

"Tell me: is it possible to buy more sensitive microphones than the ones we're using at present? Some of our people have very soft voices and we need microphones that will sort-of 'reach out' a bit further and pick them up better!"

The questioner then goes on to explain that turning the amplifier up further doesn't help because it only makes it squeal. What they really need is a more sensitive type of microphone . . . "if you know what I mean"!

Admittedly, the question is usually posed by people lacking expertise in the technicalities of sound reinforcement — ministers of religion, church secretaries, group chairpersons, etc — but the wonder is that they are not more alive to the real nature of the problem.

Indeed, they tend to find a frank and truthful answer to their question somewhat off-putting, probably because it's not nearly as easy to implement as the notion of buying more suitable microphones:

"Basically, it isn't an amplifier problem at all. What you really need to do is to insist beforehand that everyone taking part in proceedings speak deliberately, distinctly, and loudly enough to be heard. If they can't, or won't, they are simply not going to be able to communicate. If participants mumble into the microphone, you'll get 'mumble' from the loudspeakers!"

Only rarely is such advice accepted and implemented, with the result that audiences continue to experience the frustration of seeing one of their number address the gathering, without being able to hear what they're saying!

It is probably true that many (especially non-professional) public address amplifier systems could be assembled and installed to better advantage but, even so, technical improvements tend more frequently to moderate rather than to solve what is basically a "people" problem.

Typical situations

For a typical scenario, consider an auditorium seating an audience of a hundred or more — a local church or hall, or restaurant cum convention centre.

For much of the time, in such situations, the amplifier system presents no apparent problem, being used most by the person who needs it least: a minister or lecturer or chairman who is accustomed to addressing an audience and to speaking up, speaking out and speaking clearly! They could probably manage quite well without a microphone but amplification does make things easier both for them and for listeners with impaired hearing.

Even so, an unfortunate minority of ministers, lecturers and chairpersons are afflicted with poor diction, for which the amplifier can still cop the blame. Common speech problems (other than accent) include:

- Speaking too rapidly and, in the process, clipp'n or dropp'n syllbls and/or run'nwordst'gether!
- Lowering the voice for intimate or dramatic effect, forgetting that, for

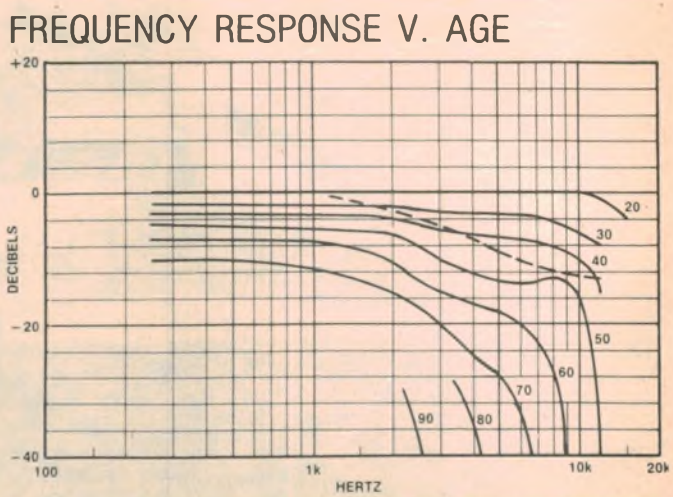


Fig. 1: Referenced to clinically normal hearing of 20-yr-old females (0dB), these curves give some idea of the likely loss of aural acuity with increasing age. Shown dotted is the response of a typical amplifier set for full treble cut.

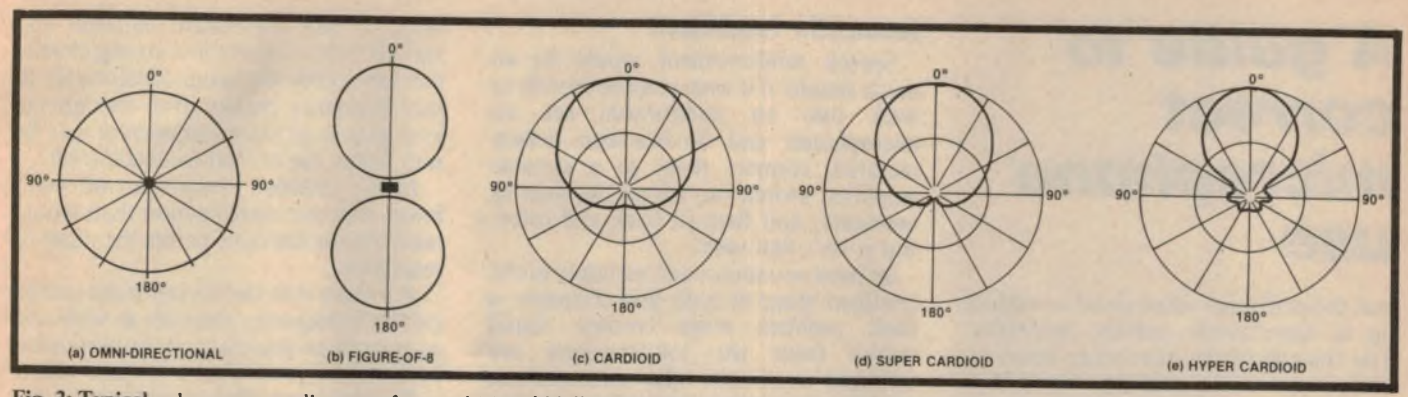


Fig. 3: Typical polar response diagrams for omni (a) and bi-directional microphones (b). The unidirectional "cardioid" patterns c,d,e are typical for 1000Hz and would vary somewhat for other frequencies.

some, the words so "emphasised" may actually become inaudible!

■ Speaking too closely in the microphone, causing it to "pop" on plosive consonants.

■ Letting the voice taper off because the speaker is really thinking about his/her next statement.

Next time you find yourself having to concentrate in order to follow what a public speaker is saying, listen to and analyse what is happening. Not only may you become aware of speech defects, as above, but you may also realise that you are unconsciously having to fill in the gaps by context and by reading lips and facial expressions.

That doesn't have much to do with electronics or acoustics!

By far the worst offenders, however, are people who are not accustomed to public speaking and who, because of inexperience or nervousness, seem totally unaware of the need to project their voice — with or without a microphone. They're on their feet, they have something to say, and the uppermost thought in their minds is to get it over with!

They may do their thing metres away from the microphone or, if guided towards it, react by backing away or speaking more softly than ever.

Children are notoriously unpredictable, sometimes shouting into the microphone to begin with and then, overtaken by timidity, lowering their voice and hurrying through the rest of their assignment at the rate of knots!

Guidance essential

Feed that sort of sound to the microphones and it is essentially what is going to be heard — or not heard — from the loudspeakers. An operator, twiddling knobs, may smooth things out a little but certainly not to the extent of transforming mumble or verbal panic into intelligible speech!

The only really effective way around the problem is to nominate a member, who understands what's required, to help plan or supervise all presentations involving the sound system. He/she may not be welcomed by everyone in a voluntary organisation but, with tact and support, it is usually possible to achieve a considerable all-round improvement.

An officially appointed sound supervisor may also be able to curb the enthusiasm of others — speakers, vocalists and musicians — who seem mistakenly to believe that the effectiveness of communication is measured in disco decibels irrespective of time and place.

One other matter I mention here at the suggestion of Editor Leo Simpson, for whom it seems something of a pet hate. I refer to the improvised presentation of taped material in churches or public meetings. As Leo explained:

Someone needs to present a segment from an audio cassette. But even in a situation served by an effective amplifier system, what do they do? They produce a bargain basement "ghetto blaster", stick it on the table, and turn it full up in the hope that everyone will be able to hear what's on the tape. It sounds awful and spoils the whole presentation!

I agree, and it's yet another acoustically clumsy situation which an appointed sound supervisor could rectify by patching the cassette player directly into the amplifier and fading the excerpt in and out on cue.

The audience

It is also essential for anyone in charge of an amplifier system to be alert to the likely effect of an audience on the building ambience and on the participants (especially if children); as well, to the enormous variation in hearing acuity likely to be evident in an all-age audience.

It's an obvious plus if rehearsals can be organised on site, with the amplifier operative, and providing the opportunity to forestall episodes of mic panic, mic fiddling, mic blasting, etc.

But there's reason for concern if, at such a rehearsal, somebody's voice can only just be heard by a young adult observer at the back of the empty auditorium. With an audience present, the background noise may well be higher

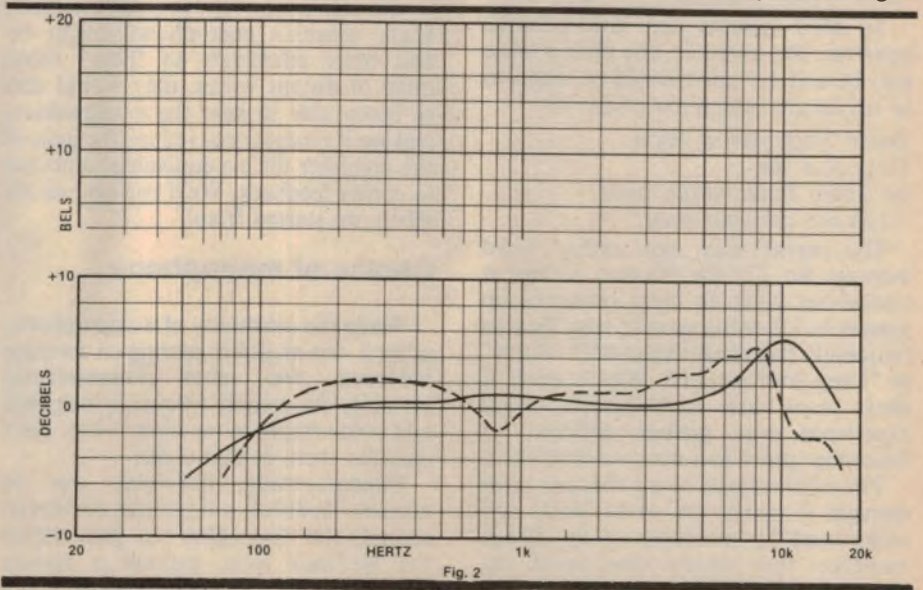


Fig. 2: The claimed frequency response of typical dynamic microphones in the $40 (dotted curve) and $60 price range. They would probably be acceptable for non-critical reinforcement of speech and music in smaller churches, etc.

A guide to correct microphone use

and the performer more timid — adding up to significantly reduced audibility. The chances of the item being heard by older people in the audience would then be slim.

Two years ago, for a "Forum" article, I compiled the curves, reproduced here as Fig. 1, which quantify the progressive loss of aural acuity likely to be experienced with advancing years by adults having clinically normal (not otherwise impaired) hearing, for their age group.

Even at age 60, acuity is down by 7-10dB in the range up to 2kHz, tapering to -18dB at 5kHz and disappearing "down the gurgler" at 8kHz. Above 60, hearing loss accelerates markedly, as shown.

If it was simply a matter of losing 10 or more decibels in overall level, the effect would be less noticeable but there is more to it than that. The steep and progressive roll-off in response above 3kHz cuts deeply into the explosive and sibilant sounds which are critical to understanding speech.

When little Willy stands up to recite a familiar nursery rhyme, the under-40's would hear it this way, even if none too loudly:

Simple Simon met a pieman
Going to a fair.
Said Simple Simon to the pieman:
"Let me taste your ware!"

To their parents and grandparents, however, the over 60s, the child's voice may be scarcley audible and he seems to be saying something more like this:

'Imple 'Imon meh a 'imon
'Oing oo a 'air.
'ed 'imple 'Imon oo the 'imon:
" 'Leh me 'ase your ware!"

The rhyme may look rather weird without the T's, the P's and S's but it emphasises what an older person is up against in following speech; why they so frequently have to interject with "Sorry" or "I beg your pardon". What's more, if their ears are unbalanced, they experience even greater difficulty in following speech in a noisy environment.

The implications of all this are clear enough: If people are to be heard and understood by members of an all-age audience, they simply must speak up, speak out and speak distinctly, to give the amplifier system a reasonable chance to do its job properly.

Acoustic feedback

Speech reinforcement would be so much simpler if it were possible merely to walk into an auditorium, set up microphones and loudspeakers where required, connect them to a suitable amplifier, switch on, adjust the gain as necessary, and then sit back and listen. But it isn't that easy.

In most situations, and certainly in the confined space of halls and churches, a basic problem arises because sound waves from the loudspeakers are reflected back into the microphones, thereby generating secondary signals. These pass through the amplifier again, driving the loudspeakers even harder, which then further agitate the microphones ... and so on "ad cataclysm!"

It is described as a "feedback" effect or, in this case, as "acoustic" feedback, because it involves an acoustic path from the loudspeaker(s) back to the microphone(s) — a path which obviously involves the acoustics of the auditorium itself.

When the gain of the amplifier is turned well down, the feedback effect may not be noticed, but as the gain (or volume) control is gradually advanced, a slight ringing quality becomes evident in the sound being reproduced. That's the danger sign; turn the gain up a whisker more and the whole system becomes unstable, breaking into a sustained squeal.

This is the all too familiar limiting condition which very frequently prevents the gain from being advanced enough to amplify adequately the sound of voices too timid or too remote from the microphone.

It also demolishes the notion of simply substituting more sensitive microphones — the substance of the original question. While sensitive microphones might be able more effectively to "hear" those timid or distant voices, they would also be better able to hear the loudspeakers, making it necessary to reduce the gain of the amplifier (by an equivalent amount) to curtail feedback. We'd end up exactly where we started from!

Choice of microphone

While the sensitivity of a microphone, as such, has no direct bearing on acoustic feedback, two other characteristics certainly do, namely frequency response and polar response (or directivity). Let's consider them in that order:

Fundamentally, instability due to acoustic feedback will become evident as soon as the "loop gain", or gain within the feedback loop, exceeds a certain critical figure — nominally unity.

If the microphone(s) should happen to exhibit a prominence or peak in the mid-range — say somewhere between 400 and 4000Hz — there is a strong chance that instability will occur prematurely in that frequency region, even though the loop gain at all other frequencies may be well below the critical feedback level.

In this situation, the system will offer lower effective amplification than would otherwise be the case, before the onset of instability.

It follows that the microphones should exhibit a frequency response as wide and as smooth as possible and, in particular, be free from prominent mid-range peaks.

By and large, this requirement rules out the use of $10 "cheapie" models, primarily intended for intercoms, cassette recorders, 2-way radio, etc. Even where economy is paramount, one must be prepared to pay around $40, at least, for what are (rather euphemistically) described by parts suppliers as "semi-professional" models, and up to double that for their "entertainer" or "studio" equivalents, with extended bass and treble response.

By way of comparison, sound reinforcement microphones from the big-name specialist manufacturers run from about $200 upwards. They come with guaranteed response curves, and claims of "ruggedised" construction, superior overload performance, lower "handling" and cord noise, etc.

Microphones of this kind are normally selected by professionals in the sound reinforcement business, but they may be beyond the means of small churches and groups trying to meet a need on a limited budget. Either way, it's a matter of shopping around for the best possible microphone(s) consistent with the funds available.

Fig. 2 shows the claimed frequency characteristics of two typical dynamic microphones in the $40-$60 price range, the more expensive model (solid curve) offering a somewhat smoother and wider response. Both purport to be free of mid-range peaks, although both show a rising response around 9kHz. While fairly common in this type of microphone, a rising top end does not pose a major feedback hazard because such frequencies are likely to be considerably attenuated on their way back to the microphones.

Now for the second major characteristic, which must be considered along with the frequency response:

Polar diagrams

Determined by the way that sound waves interact with the diaphragm, microphones can be (and are) designed to exhibit specific directional properties, or polar response curves, as illustrated in Fig. 3 (plan view only).

Fig. 3a depicts an "omnidirectional" microphone, so called because it responds more or less uniformly to sounds arriving from any direction. Fig. 3b, applicable mainly to studio "ribbon" types, is a figure-of-8 pattern, with pickup confined essentially to the front and rear sectors.

Microphones with omnidirectional and figure-of-8 polar responses find application in broadcasting and recording studios but are less suitable for sound reinforcement, by reason of potential problems with acoustic feedback.

For this purpose, "directional" microphones with a restricted pickup area are much to be preferred, because they can usually be orientated to favour the wanted sound and to discriminate against interfering sound from the loudspeakers, thus minimising the tendency to feedback and instability.

Fig. 3c shows a "cardioid" response pattern, so called because of its resemblance to a stylised heart shape. It provides substantially full sensitivity within a 30° sector, concentric with the frontal axis, diminishing to 50% sensitivity at 90°, and to 10-15% along the rear axis.

A so-called "super cardioid" pattern (Fig. 3d) offers increased directivity, with full sensitivity at the front limited to within 15-20° of the axis, reducing to 30-40% at 90°.

"Hyper cardioid" or "super directional" microphones have a polar diagram more reminiscent of the shape of a hot-air balloon, with full frontal sensitivity limited to about 15° from the frontal axis, and cutting away sharply at the sides, as shown.

For use in the average small auditorium, microphones with an ordinary cardioid polar response are a good all-round choice, because they offer a useful back/front ratio, without suffering an undue loss in signal pickup if the speaker stands slightly off-axis — to either side, above or below. (The microphones mentioned in connection with Fig. 2 are of this general type).

As the polar response becomes narrower, rejection of sound from the loudspeakers may be better but there is a greater risk of losing the wanted sound also, if the speaker or performer moves outside the sensitive pickup zone. This is particularly the case with hyper cardioid or super directional microphones, which nevertheless have their own special applications.

Other matters which must be considered in the choice of microphone include their output impedance and output connection arrangements. These will be considered in the following article.

(To be continued)

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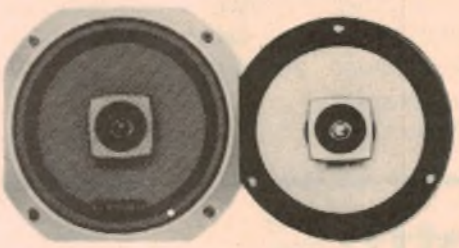

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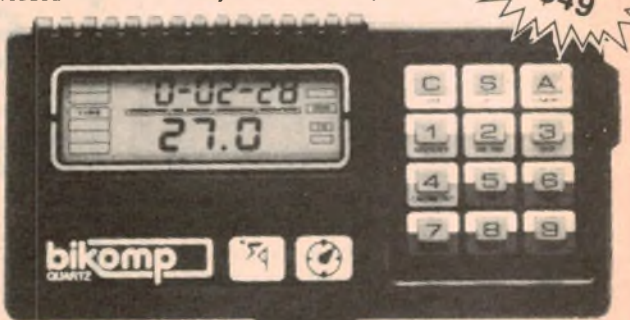

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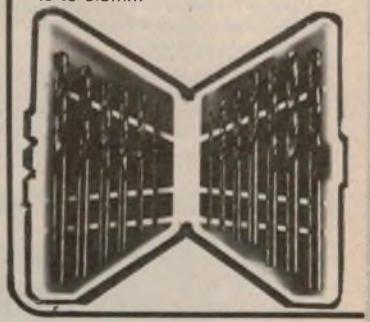

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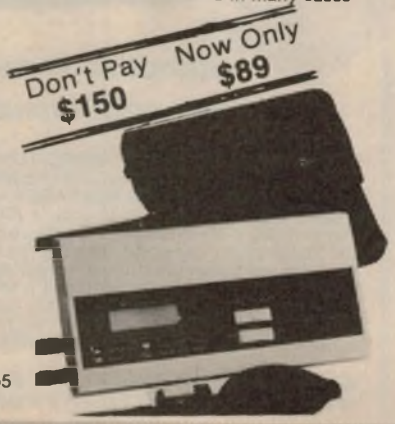

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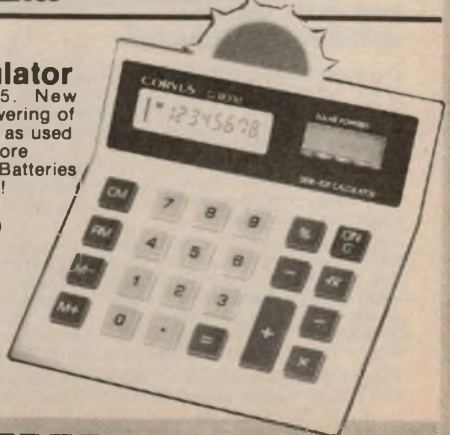
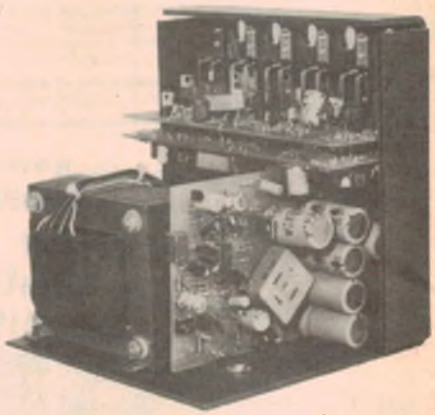


Carver hifi range re-launched

After a long period in the doldrums, the Carver range of high fidelity products has been re-launched in Australia. Carver is known for its innovative approach to hifi design, first embodied in the model M-400 "magnetic field" power amplifier.



The Carver M-400 power amplifier delivers 201 watts per channel from a very small package by using a special switching power supply.

The model 400 is a quite a departure from the format of coventional stereo power amplifiers. Housed in a 17cm cube, the model 400 is rated at no less that 201 watts per channel into 8 ohm loads, with both channels driven, and up to 250 watts into 8 ohms, with one channel.

Carver's approach to obtaining such high power from a small amplifier volume is to use a Triac switched transformer secondary which varies the amplifier's DC supply rails in response to the amplifier of the input signal. This enables the amplifier to deliver very high power for short bursts while not having the penalty of high power dissipation when little or no signal is present.

Since the model 400 was first introduced several years ago, Carver has introduced a number of amplifiers which use the same power supply principle. Latest of these is the M1.5T power amplifier. This has more conventional appearance, being in a rack-mounting case, but still has a very high power rating: 350 watts per channel with both channels driven into 8 ohms, together with very high dynamic power; 750 watts into 8 ohms, for each channel.

Carver also have a professional version of this amplifier which is ruggedised and has additional protection features.

Another Carver product which has interesting innovations is the TX-II stereo FM tuner. As well has having a switchable intermediate frequency (IF) bandwidth which gives improved noise performance on weak signals, the TX-II has a patented stereo multiplex detector which gives a considerable reduction in noise on weak stereo signals.

The method of operation is to synthesize left and right signals from the recovered L + R and L − R signals. This would normally result in poor separation between channels for single channel measurements but the Carver tuner circuitry also recognises when there is strong left or right channel modulation and varies the synthesized signals accordingly.

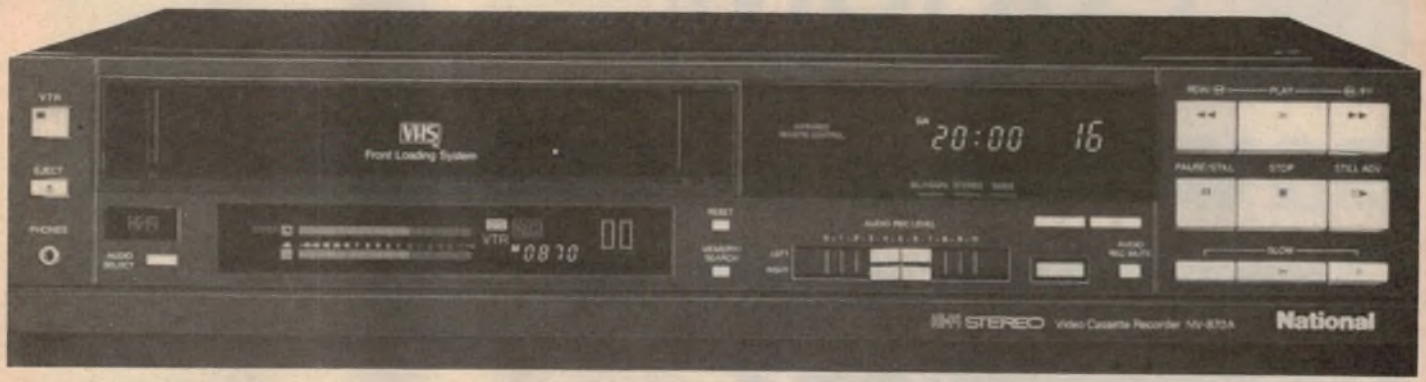
The same tuner circuit features are incorporated into the Carver receiver which also has the "magnetic field" power amplifiers.

Also included in the range is an up-market compact disc player which, typical of the Carver approach, features a unique facility, the Digital Time Lens. This is claimed to improve the sound quality from some CD recordings by slightly modifying their channel separation and frequency response and by adding dither (noise).

We plan to review the Carver CD player in a future issue.

Carver products are distributed in Australia by Odyl Communications Pty Ltd, 112 James St, Templestowe 3106 and 3 Smail St, Broadway 2007.

The Carver receiver embodies the circuit features of the TX-11 tuner and the magnetic field power amplifiers.



The new National NV-870A hifi video recorder has enhanced features in comparison to the still current model NV-850A. The additional features include variable, slow-motion replay, FM multiplex filter, front panel headphone with volume control and generally improved control layout.

Pioneer releases AM stereo tuners

Pioneer has introduced two AM stereo tuners onto the Australian market. One is a fully synthesised design while the other is a manually tuned unit. Both tuners, which are available as individual hifi components or as part of Pioneer music systems, employ the Motorola AM stereo decoder IC.

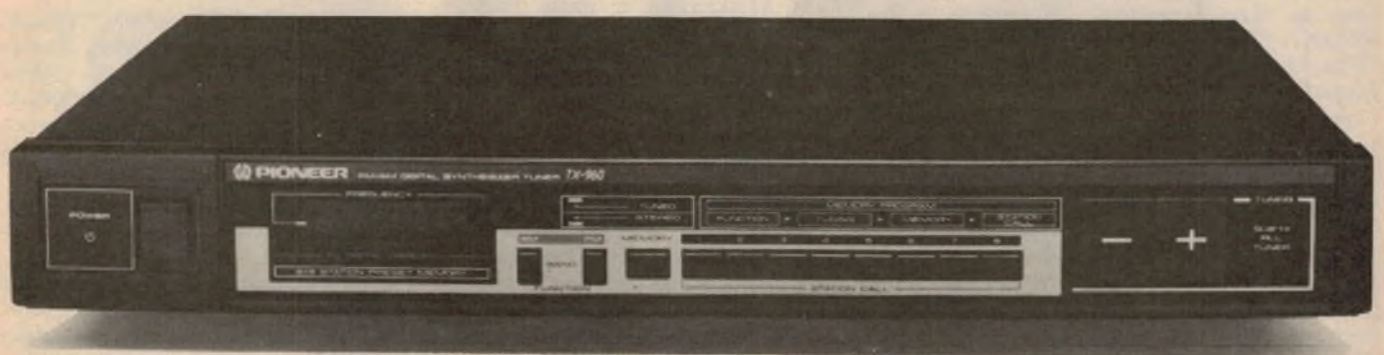
The TX-960A synthesised tuner has 16 station presets; eight for AM and eight for FM. The tuner is essentially a regular Pioneer production model which has been specially modified for the Australian market with the internal addition of a PC board carrying the Motorola C-QUAM AM stereo decoder circuitry. The other addition is a small wire loop antenna which gives quieter AM reception than the conventional ferrite rod.

FM specifications are typical of a medium price range tuner, with 50dB quieting obtained at 1.8μV in mono and 17.8μV in stereo. Ultimate quieting is quoted at 77dB in mono and 73dB in stereo, while stereo separation is a claimed 40dB at 1kHz. Harmonic distortion is 0.4% in stereo mode.

For the AM side, Pioneer have not published specifications for AM bandwidth or distortion but quote 50dB for signal-to-noise ratio and 30dB stereo separation at 400Hz. Recommended retail price of the TX-960A is $299.

The lower-priced TX-560A from Pioneer is a manually tuned unit with lower sensitivity but otherwise similar specifications to the TX-960A. As is common with manual AM tuners, the sensitivity is slightly higher than for the synthesised unit. Again, Pioneer have not quoted AM bandwidth or distortion but claim the same figures for signal-to-noise ratio and AM stereo separation. Recommended retail price of the TX-560A is $239.

The two AM stereo music systems released by Pioneer are the X-400AM and X-100AM. The X-400AM features 40 watt per channel amplifier, belt-drive turntable, five-band graphic equaliser, double cassette deck, TX-960A tuner and a pair of S-300X square woofer loudspeakers. Recommended retail price is $899. The X-100AM has a 25 watt per channel amplifier, belt-drive turntable, cassette deck, TX-560A tuner and S-300X loudspeakers. Price is $759.



Pioneer's TX-960A synthesised AM/FM tuner is one of first hifi tuners on the market to feature the Motorola C-QUAM decoder. RRP is $299.

FORUM

Conducted by Neville Williams

B&W Films in Colour: Breakthrough or Desecration?

A recent segment in the TV program "Sixty Minutes" featured scenes from old black and white movies which had been "colorised" by computer controlled video processing. For some, it represented a major technical breakthrough but others see the process as nothing less than "aggressive, infuriating desecration of an historic art form!"

I, personally, watched the presentation with considerable interest and, to the extent that one could judge from a TV screen, the results were impressive. There was nothing about the pictures to suggest that they were other than normal colour images and it would presumably have been a breeze to have simulated, instead, the muted colour or "tinted sepia" effect used for some recently made period productions.

It so happens that we published an article on colouring B&W films in the Feb/Mar '83 issue of our then associate publication "VideoMag" without knowing, at the time, whether the process would be taken up commercially. It now appears to be on its way, with "colorised" video versions of such diverse films as "San Francisco", "Broadway Melody", "Mutiny on the Bounty", "Way Out West" and "The Life and Legend of Wyatt Earp".

The VideoMag story credited the basic idea to Ralph Weigner, an electronics buff from Philadelphia, partnered by Donald Havens. We checked it out with them, before publication. Weigner had produced the "Chromaton 14" in the early '70s, a colour system for video graphics, and the two had then turned their attention to colour processing B&W films in 1976.

According to the article, their "BJA Vivicolor" system was working well enough by the following year for the ABC TV network (USA) to intercut colour processed B&W footage into a mini-series on the life of Dwight Eisenhower — unnoticed by millions of viewers, but nevertheless establishing a world first for the process.

For the VideoMag article, we were unable to obtain any off-screen shot from a Vivicolor tape but, to illustrate the visual effect, we had a professional colourist process a B&W print from Laurel and Hardy's 1932 classic "Way Out West". By sheer coincidence, it was from the very scene that was featured in the "Sixty Minutes" segment.

In the TV presentation, however, the originator of the process was introduced as Wilson Markell (or a name that sounded like that) from ColorizationInc. Whether or not the two companies are associated is unclear but the methodology is certainly similar.

How it's done

The first frame, or a key frame in each scene is set up on a video screen and, using an electronic "paintbrush" (see EA, Sept '81), an artist colours the entire picture, inserting the appropriate hues and densities within the various outlines constituting the original B&W image — buildings, objects, faces, etc.

Details of the superimposed colour image are memorised by a computer as it is built up: areas, hues, outlines and whether the colour edges are to be "hard" (for buildings, furniture, etc) or "soft" as for facial features and rural scenes.

By suitably programming the computer, and giving it a little assistance where necessary, it can automatically readjust the colour areas to match progressive small shifts in the B&W outlines as successive frames are brought up on the screen. The procedure not only automates the colouring process but ensures a high degree of consistency from frame to frame.

By keeping track of the B&W frame number (luminance) and the equivalent colour image (chrominance) the two can be brought together into a convincing composite colour video signal. Even so, says Wilson Markell, colorising a feature film is no small task. There are approximately 600 separate scenes, for example, in "Way Out West" and colorising it involves months of work.

But, he said, the cost of colour processing a film is still only about 10% of what it would cost to remake it in colour — even supposing that were possible.

A bitter critic

In the VideoMag article, Donald Havens is quoted as envisaging Woody Allen's modern black and white "Manhattan" as a good candidate for colour processing, along with other such films as "Raging Bull", made by Martin Scorcese.

"Perhaps, in the future," he said, "those film makers will ask us to colourise their films."

In fact, Woody Allen emerged in the Sixty Minutes segment as a bitter critic of the whole idea and his are the adjectives which are used in the introduction — the first of quite a few! He worked in

black and white, he explained, from choice, not necessity:

"It's a very beautiful form of photography . . . an art form . . . offering emotional nuances you can't get in colour.

"It's horrible . . . an insult . . . it shows the general contempt the business aspect of film making has for the artistic side of it!"

Anne Baxter, co-star of another international B&W film "Yellow Sky", felt that it, along with other successful B&W films, should be left as they are, describing colorisation as a "hype". As for old and indifferent films, it would need more than just colour to "jazz them up!"

On the other hand, Fred Astaire, who featured in a colorised version of "Broadway Melody" liked the idea, as also did Cary Grant. They saw it as giving a new lease of life to some of their early work.

An art form?

It is undoubtedly true that any number of photographers and cinematographers regard — or have regarded — black and white photography as an art form in its own right, and their artistic efforts have been appreciated as such by at least a proportion of those viewing their work.

It is fair enough for Woody Allen to maintain that such work should not be colour processed without at least having respect to the wishes of the director.

However, Woody Allen and others who chose deliberately to make certain films in black and white, are scarcely representative of the directors who made the other 40,000 features and 1500 TV series that, according to Wilson Markell, are currently gathering dust in distributors' vaults.

They were made in black and white because that was the only medium available at the time. Or because early colour film was not up to standard, or too costly or, yet again, because colour cameras of the day were too cumbersome for highly mobile filming. The directors had little choice but to do the best they could with what they had, like it or not.

If their output now spends all or most of its time in the vaults, unseen by other than buffs and the odd late-night TV audience, it makes sense that the best of those films, at least, should be brought out of obscurity and given a fresh appeal to a present-day TV audience.

If an enthusiast prefers to watch them in their original form, says Wilson Markell, he/she has only to turn down the colour knob on the TV set. Colorisation adds a chrominance signal; it does not fundamentally alter the original monochrome image.

Woody Allen argues that an audience is "infantile" if acceptance of a film is influenced by the addition of colour and the industry should not pander to that level of reaction. Audiences should be prepared to judge and accept films on their intrinsic merit, not on the basis of whether they were shot in black and white or colour!

Ideal or not, the simple fact is that, in the real world, there is an overwhelming preference for colour presentation, whether for cinemas, television, magazines, or personal photographs. If the public expects and demands colour, the practical alternatives for thousands of ageing B&W films seem all too obvious: colour or condemn; tint or tip!

Not new, anyway!

Before getting too up-tight about tradition, it may be as well to recall that colour(ed) movie prints are just about as old as the industry itself.

As we pointed out in the VideoMag article, Pathe pioneered the idea in France as far back as 1905, with artists laboriously hand tinting films, a frame at a time, working with water soluble aniline dyes and tiny brushes under a magnifying glass.

In 1906, Pathe devised stencils or masks, made by cutting segments of the image from duplicate prints, which were maintained in accurate register with the film being tinted by means of precision sprockets.

Various other aids were developed during the following years and the process remained in use until about 1929. The advent of of talkies, about that time,

What about the old silents?

Technology now exists to re-process the old silent classics so that they can be shown on modern projectors or on TV, without flicker and at the correct rate of image movement.

A high quality stereo sound track can be provided carrying sound effects and a full orchestral accompaniment to match what was commonly specified and provided in first-release silent picture palaces.

And now, the prints can be video processed into "living" colour.

Would there be an audience for such films and, if so, for which of those memorable silent epics?

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not only shifted the emphasis in film production but saw an increase in frame rate from 18 to 24 per second, making it just that much more difficult to cope with manual tinting.

It might well be argued that the industry forfeited colour in the rush to incorporate sound!

... 75 years of work worth billions of dollars! ...

With something like 40,000 B&W feature films in the vaults, and 1500 TV series, Wilson Markell says (perhaps wryly) that ColorizationInc is looking at about 75 years of work worth billions of dollars!

Because it is a video process, he is concerned only with the television and home video market. Indeed, he appears to agree with Woody Allen to the extent that colouring B&W films for theatrical presentation could be undesirable.

Why the distinction, I'm not so sure. High resolution video equipment is already in existence, capable of producing images appropriate for film projection. I see no basic reason why the colorisation process should not be adapted forthwith for high resolution equipment and used for the production of regular cinema release prints of successful B&W classics.

Technical breakthrough or desecration? I guess it's a matter of opinion!

"Distorted" strings

It was in February last that I first speculated in print about the frequent "edginess" of massed orchestral strings, and/or massed voices. I suggested that what was often taken to be distortion in the record/replay system might, in fact, have its origin in the multitude of potential beats between the multiple sound sources, each slightly out of tune with the rest.

In the presence of non-linear distortion, whether in our ears or in a record/replay system or both, the potential beats become real and are discerned as spurious non-musical frequencies, or "noise" or "distortion".

Various observations since then have tended to confirm the idea of a link between conductors' not infrequent concern about out of tune playing, and hifi buffs' not infrequent puzzlement over what was assumed to be inherent system distortion.

Two more observations came to my attention recently, the first in Julian Russell's record reviews on page 107 of the August issue. Referring to conductor Leonard Bernstein he remarked:

"On his only visit to Australia, he mentioned to me how difficult it was to find an orchestra where the strings could play without vibrato."

As far as multiple beats are concerned, resulting in non-musical sum and difference products, random individual vibrato would produce essentially the same end effect as off-tune playing by any other name, or for any other reason.

The second observation came in a letter from R.M. of Dickson, ACT. He says:

I was interested in the references to orchestral distortion in "Forum" (Feb/June/Aug '85).

Although I have been a concert goer for 30 years, it was only recently that I became conscious of this phenomenon. My awareness may have been highlighted by the "wiriness" of the upper strings on my CD's and, indeed, I felt consoled to realise that such "distortion" could actually happen in a live performance.

Where excessive distortion existed on conventional discs, I simply attributed it to having got one from the end of the stamper run!

As I said, it is a consolation to know that live performances are, themselves, not perfect, as evidenced by a report I read recently of Stravinsky (circa 1960) complimenting the Cleveland Orchestra on its ability "to play the centre of a note."

I suppose that the inability of players to always do this would increase perceived distortion?
R.M. (Dickson, ACT)

Thank you for your letter, R.M., and for the spontaneous expose of a hifi buff's innate concern:

I'm consoled by the thought that the "wiriness" of orchestral strings is mainly to do with my ears and the orchestra. I was worried, for a while, that there was something wrong with my new compact disc system!

Baffles, boffles, etc

From A.B. of Parkdale, Victoria, comes a letter of thanks for the article in the June issue along lines which he specifically requested: A plain language discussion of loudspeakers and enclosures, old and new. We titled it "Baffles, boffles, boxes and vents".

He apparently thought enough of the article to read it through three times and, in so doing, realised why he had previously been so confused:

My "knowledge" of the subject was based on misinformation sincerely given in the mid '50s, when I was an eager student. It permitted translation into workable arrangements for public address but I could never equate it to hifi applications.

For example, I was told that, when building a cabinet for a column of loudspeakers (for indoor public address) always to omit one loudspeaker to allow free movement of air. The cabinets I made up worked quite well but obviously more from good luck than properly engineered technology.

The article elsewhere in this issue on speech reinforcement in local churches, etc, is a further "plain language" discussion, this time on a topic with which A.B. should be more familiar. It will be interesting to see whether it reflects his own experience.

145W into 8 ohms or 225W into 4 ohms

High-power mosfet amplifier module

If you are interested in building an amplifier with bags of power, it is hard to go past the module presented here. Based on the Playmaster Series 200 amplifier, it delivers 145 watts into 8 ohms and a whopping 225 watts into 4 ohms.

by LEO SIMPSON & ROBERT FLYNN

While the Playmaster Series 200 amplifier has not been around for long, it is quickly developing a reputation as a rugged and reliable brute, with lots of grunt. Not everybody needs the whole circuit though, which is why we decided to present this module based on the power amplifier design.

As a single channel amplifier teamed with a well regulated power supply, it can deliver substantially more than one channel of the Playmaster Series 200 and that on a continuous basis.

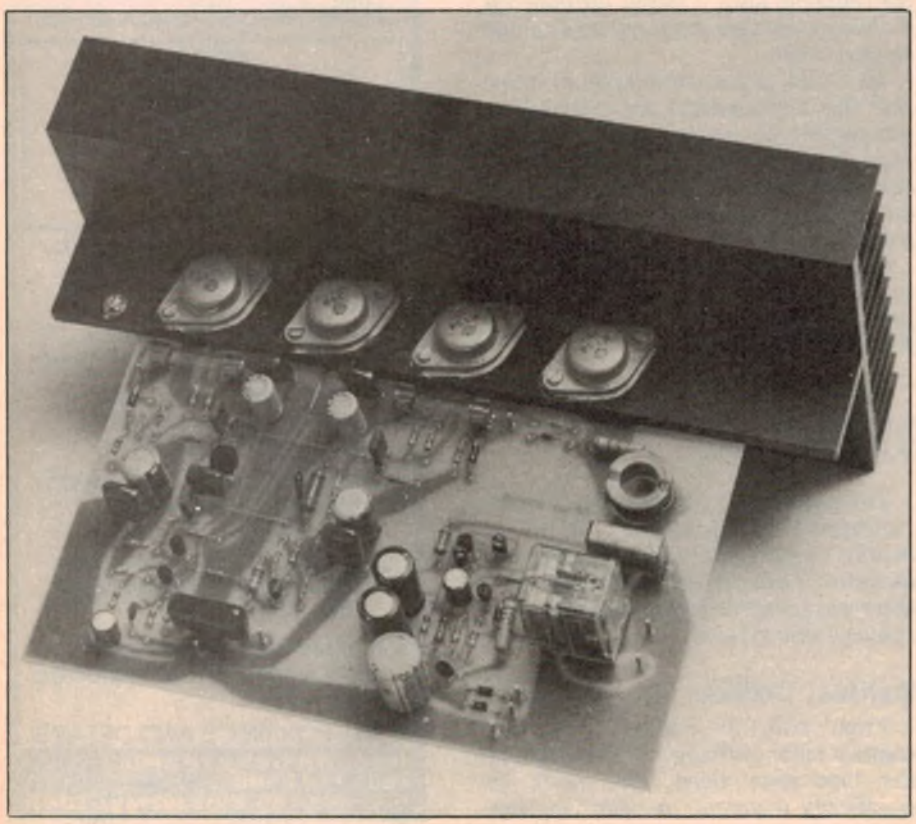
As well as incorporating the power amplifier circuit together with the integral heatsink, the module also includes loudspeaker protection and turn-on delay. Loudspeaker protection is absolutely essential for a high power amplifier such as this, because if a fault ever develops, the loudspeaker is liable to be burnt out in short order.

Consider what would happen if the amplifier developed a fault which caused the output to go to one of the supply rails. In the circuit under discussion, this would apply plus or minus 70V to the speaker.

For an 8Ω speaker having a DC resistance of about 6Ω, this would result in a current of 9A or more, depending on the regulation of the power supply. Under these conditions the speaker voice coil would be dissipating more than 450 watts but the supply fuse could not be relied upon to blow before the speaker voice coil was burnt out or worse, before the whole speaker system catches fire!

In view of the above, it is foolish not to have loudspeaker protection in a high power module such as this. The cost of reconing or replacing your loudspeaker(s) is bound to be more than the cost of repairing the amplifier.

Below: on-board loudspeaker protection is a feature of this rugged amplifier module.



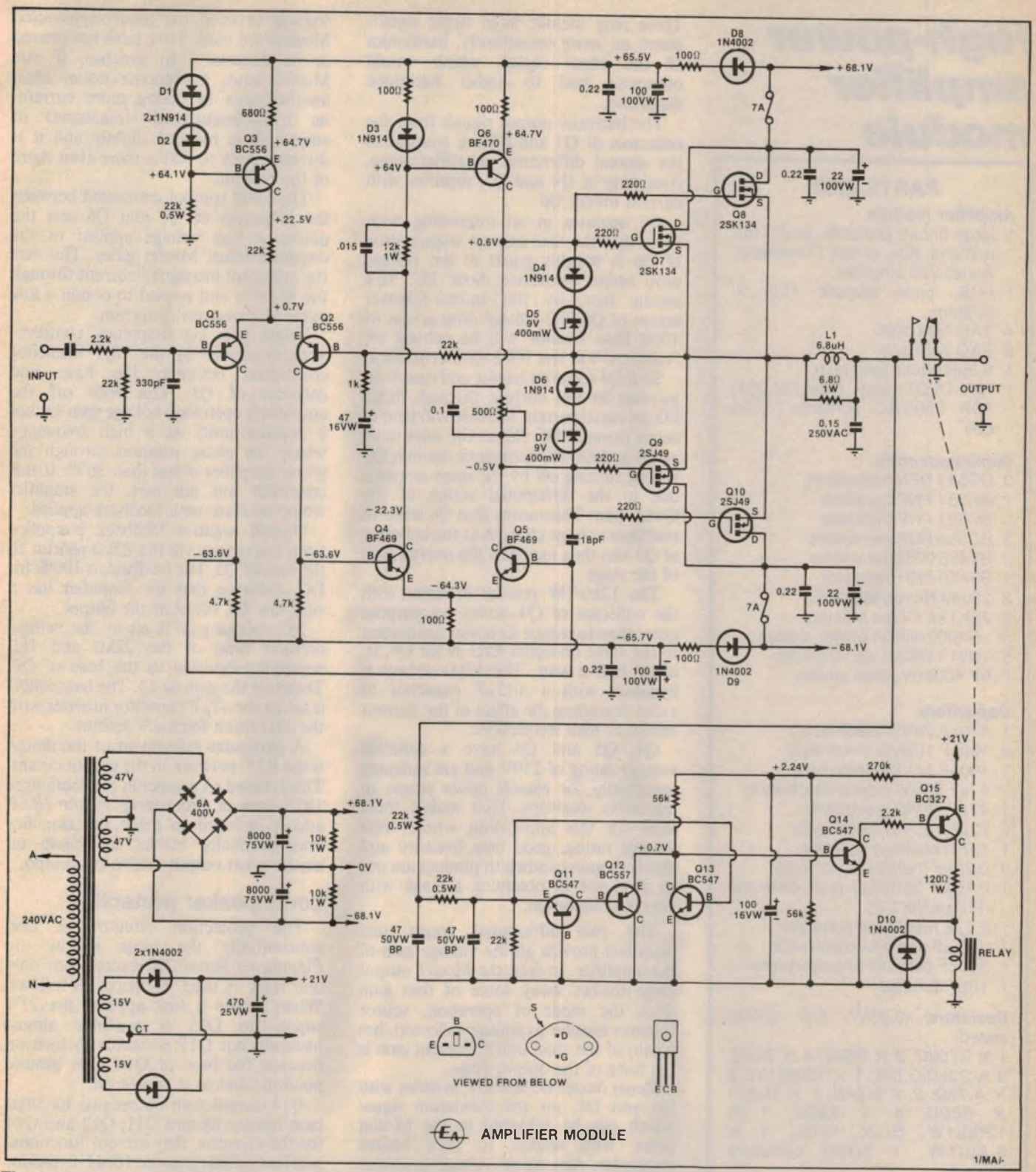
Circuit description

The power amplifier stages of the Playmaster Series 200 were described in the January 1985 issue. For those who have not seen that article, we will run through the description again, though with a different emphasis, so the rest of you will not be bored silly.

The circuit is in fact identical to the power stages of the Playmaster Series 200, except for the provision of higher rated fuses.

The input signal to the amplifier is fed via a 1μF metallised polyester capacitor and a 2.2kΩ resistor which, in conjunction with the 330pF shunt capacitor, acts as a low pass filter, to attenuate signals in the RF region. The 2.2kΩ resistor also tends to act as a "stopper", to reduce the possibility of the amplifier going into supersonic oscillation.

Q1 and Q2 form a differential pair with Q3 acting as a constant-current



The rated power of 225W into 4 ohms or 145W into 8 ohms is obtained with the Ferguson PF4363 transformer.

"tail". By virtue of the diodes, D1 and D2, and the emitter-follower action of Q3, about 0.6 volts is applied to the associated 680Ω emitter resistor. This sets the current through Q3 at around one milliamp and this is shared equally through Q1 and Q2.

The 22kΩ resistor in series with the collector of Q3 serves no purpose in the normal course of events. It is a fail-safe component. If Q3 happened to fail and go short-circuit, the 22kΩ resistor would limit the current to three milliamps and allow the amplifier to operate almost normally. Without the 22kΩ resistor, a failure in Q3 would possibly cause almost all the semiconductors in the amplifier to be blown.

The reason why Q3 is there, instead of a simple resistor, is to act as a constant current source. By maintaining the total current through Q1 and Q2 very constant, it improves the power supply rejection ratio (PSRR) of the entire amplifier. The better the PSRR, the less likely is the amplifier to respond to variations in the power supply rails.

High-power amplifier module

PARTS LIST

Amplifier module

1 large finned heatsink, as for the lefthand side of the Playmaster Series 200 amplifier
1 PCB, code 85ma9, 153 × 202mm
4 3AG fuse clips
2 3AG 7A fuses
1 6.8μH choke (see text)
1 12V DPDT relay, type FRL264, 10A 250VAC contacts, 160Ω coil

Semiconductors

3 BC547 NPN transisitors
1 BC557 PNP transistor
1 BC327 PNP transistor
3 BC556 PNP transistors
2 BF469 NPN transistors
1 BF470 PNP transistor
2 2SJ49 N-type Mosfets
2 2SK134 P-type Mosfets
5 1N4002 silicon power diodes
5 1N914 silicon signal diodes
2 9V 400mW zener diodes

Capacitors

1 470μF 25VW electrolytic
2 100μF 100VW electrolytic
1 100μF 16VW electrolytic
2 47μF 50VW bipolar electrolytic
1 47μF 16VW electrolytic
2 22μF 100VW electrolytic
1 1μF metallised polyester
4 0.22μF metallised polyester
1 0.15μF 250VAC dual dielectric (Philips MKT-P)
1 0.1μF metallised polyester
1 .015μF metallised polyester
1 330pF ceramic or polystyrene
1 18pF ceramic

Resistors (0.25W, 5% unless stated)

1 × 270kΩ, 2 × 56kΩ, 4 × 22kΩ, 3 × 22kΩ/0.5W, 1 × 12kΩ/1W, 2 × 4.7kΩ, 2 × 2.2kΩ, 1 × 1kΩ, 1 × 680Ω, 4 × 220Ω, 1 × 120Ω/1W, 5 × 100Ω, 1 × 6.8Ω/1W, 1 500Ω miniature trimpot

Power supply

1 300VA transformer, Ferguson PF4363, 94V centre-tapped at 3A, 30V centre-tapped at 500mA
1 6A 400V bridge rectifier
2 8000μF 75VW electrolytic capacitors
2 10kΩ/1W resistors

These may include large ripple signals (hum) or, more importantly, harmonics of the input signal, which would otherwise lead to higher harmonic distortion.

The balanced output signals from the collectors of Q1 and Q2 are coupled to the second differential amplifier stage, consisting of Q4 and Q5, together with current mirror Q6.

Q6 operates in an interesting way. Note that the base-emitter voltage drop of Q6 is roughly equal to the voltage drop across associated diode D3. This means that, by the emitter-follower action of Q6, the voltage drop across its 100Ω base resistor will be echoed (or "mirrored") in the 100Ω emitter resistor.

So if Q4 turns on harder and causes an increase in the current through diode D3, an equal current increase will tend to occur through Q6. But at the same time as Q4 and Q6 are turning on harder, Q5 will be turning off by the same amount, due to the differential action of the Q4/Q5 pair. This means that Q6 tends to reinforce voltage changes at the collector of Q5 and thus increases the overall gain of the stage.

The 12kΩ/1W resistor in series with the collector of Q4 serves no purpose other than to reduce its power dissipation to the same no-signal level as for Q5, ie, about half a watt. The 12kΩ resistor is bypassed with a .015μF capacitor to avoid degrading the effect of the current mirror at high frequencies.

Q4, Q5 and Q6 have a collector voltage rating of 250V and are intended specifically for class-B driver stages in television receivers. That makes them ideal for this application where their voltage rating, good beta linearity and excellent gain-bandwidth product are put to good use in obtaining a stage with very low distortion.

The two differential stages just described provide all the voltage gain of the amplifier. In fact, the Mosfet output stage throws away some of that gain since the mode of operation, source follower (similar to emitter follower), has a gain of less than unity. Current gain is the forte of the output stage.

Zener diodes D5 and D7, in series with D4 and D6, set the maximum signal which can be delivered to the Mosfet gates, with respect to their source electrodes. Any signal voltage in excess of ±10V will be clipped. Thus the diodes form an effective overdrive circuit, preventing excessive power dissipation in the event of a short-circuit across the output.

220Ω resistors are connected in series with each Mosfet gate. These function as "stoppers", helping prevent spurious RF oscillation.

No source degeneration resistors or any other measures to ensure current-sharing between the parallel-connected Mosfets are used. They have not proved to be necessary. In practice, if one Mosfet tends to become hotter than another, due to taking more current, its transconductance (measured in amps/volt) is reduced slightly and it is throttled back to take a more even share of the current.

The 500Ω trimpot connected between the collectors of Q5 and Q6 sets the quiescent bias voltage applied to the complementary Mosfet gates. This sets the quiescent (no-signal) current through the Mosfets and is used to obtain a low value of cross-over distortion.

Single pole lag frequency compensation is applied by the 18pF capacitor connected between the base and collector of Q5. This rolls off the amplifier's open loop voltage gain so that it reaches unity at a high frequency where the phase rotation through the whole amplifier is less than 360°. If this condition was not met, the amplifier would oscillate with feedback applied.

Overall negative feedback is applied from the output via the 22kΩ resistor to the base of Q2. The feedback is 100% for DC, ensuring that the amplifier has a very low DC offset at the output.

AC voltage gain is set by the voltage division ratio of the 22kΩ and 1kΩ resistors connected to the base of Q2. These set the gain to 23. The bass rolloff is set by the 47μF capacitor in series with the 1kΩ shunt feedback resistor.

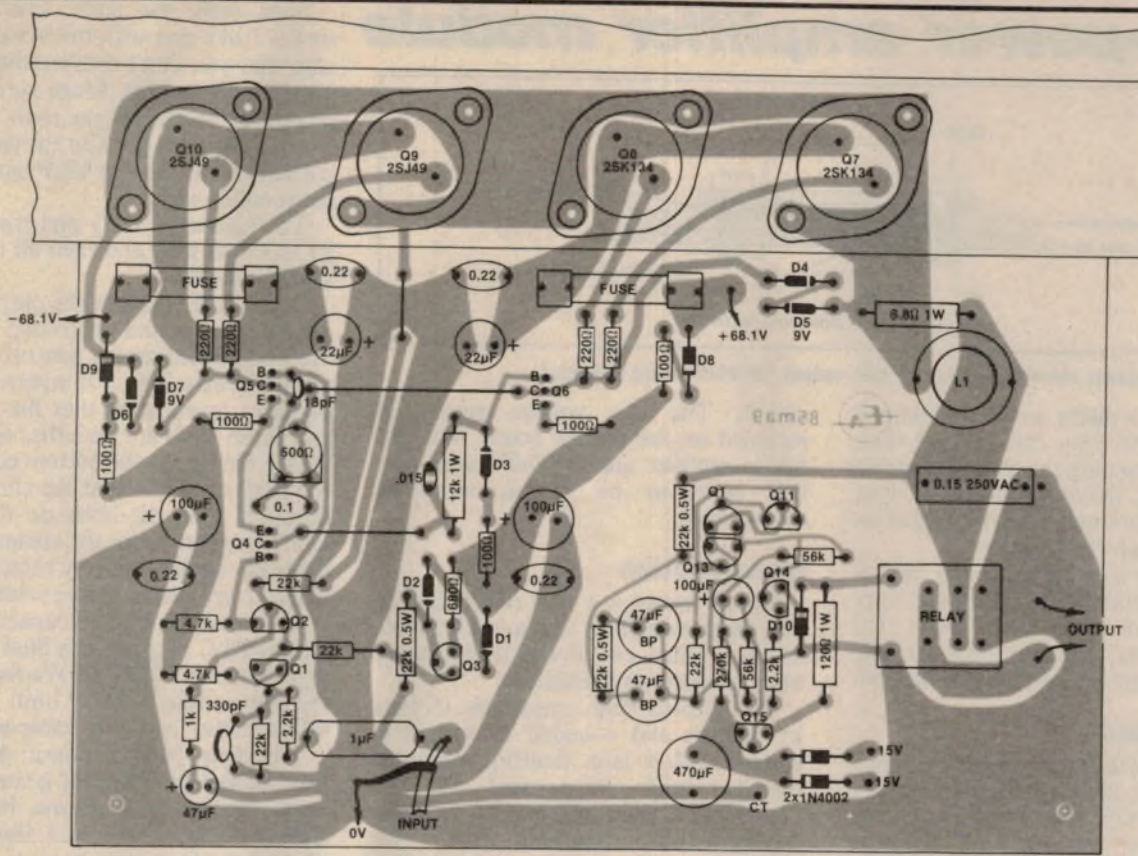
A particular refinement of the design is the RLC network in the output circuit. This is based on a paper in the September 1975 issue of *Proceedings of the IREE* and is included to make the amplifier unconditionally stable; ie, stable no matter what output load is connected.

Loudspeaker protection

The protection circuitry is also substantially the same as in the Playmaster Series 200 except that only one relay is used. It works as follows: When power is first applied, the 21V supply to Q15 is available almost instantly but Q15 is unable to turn on because the base of Q14 is at ground potential and so it, too, is off.

Q14 cannot turn on because its 56kΩ base resistor (ignore Q11, Q12 and Q14 for the moment, they are not functional yet) is supplied from the 100μF capacitor which is initially discharged. After switch-on, this capacitor is slowly charged up which allows Q14 to turn on. This then turns on Q15 and energises the relay. Thus the turn-on delay is a few seconds. This is useful in preventing any turn-on thumps being fed to the loudspeaker.

When the amplifier is switched off, the 21V rail drops to zero almost immediately, de-energising the relay and



Parts layout diagram for the Mosfet amplifier module. The wiring layout is critical, so use of the PCB is mandatory.

disconnecting the loudspeaker once more.

The more important function of the circuit is the protection feature and this is where Q11, Q12 and Q13 come into play. Note that the amplifier output is monitored via a low-pass network consisting of two 22kΩ resistors and two 47µF/50VW bipolar electrolytic capacitors. This renders the protection circuit insensitive to normal AC output signals. However, if the output of the amplifier develops a negative DC potential of more than 2 volts, Q11 will be forward biased (because its emitter will be pulled negative with respect to its base). Q11 then turns on Q12 and shorts the base of Q14 to ground. This turns Q14 and Q15 off, which turns off the relay and disconnects the speaker, protecting it from damage.

Similarly, if the amplifier output develops a positive potential of 2 volts or more, Q13 will be forward biased, which will again short the base of Q14 to ground, with the same result as before.

Arc protection

An interesting point about the arrangement of the relay is that when the loudspeaker is disconnected, it is shorted to the 0V rail. The reason for this is that if a large DC fault occurs in the amplifier, the moving contact of the relay will more than likely produce an

Performance of prototype

Power output

4 ohms	225 watts
8 ohms	145 watts

(measured with a 240VAC regulated power supply)

Harmonic distortion

less than .02% up to full power output into 4 and 8 ohm loads

Sensitivity

1.5V RMS for 145 watts into 8 ohms; input impedance 22kΩ

Frequency response

−3dB down at 3Hz and 140kHz; at 1W

Hum and Noise

−116dB unweighted with respect to 145 watts into 8 ohms with input unloaded

Damping factor

at 1kHz	>50
at 30Hz	>50

Stability

Unconditional

High-power amplifier module

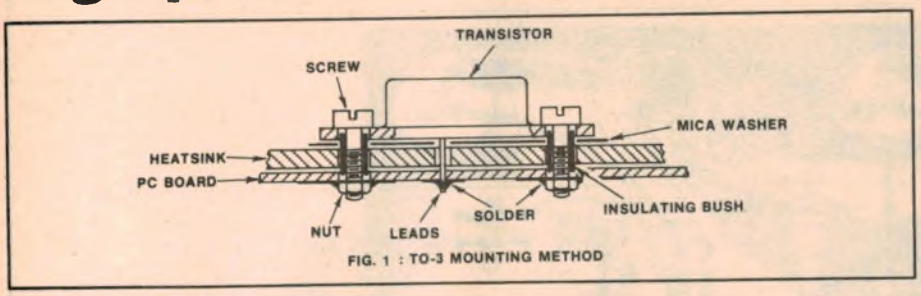


Fig. 1: this diagram shows how the Mosfet output transistors are mounted.

arc and this is likely to be maintained even when the relay contacts are fully open. By connecting the moving contact to the 0V rail, the arc is shorted to deck so that it cannot maintain the damaging current through the speaker.

Under this condition, if the arc is shorted to ground, the resulting very heavy current will soon blow the amplifier's fuses. Thus the amplifier may be damaged but the speaker is protected.

Power supply

The suggested power supply is shown on the circuit diagram. It consists of a Ferguson PF4363 transformer, wired for a centre-tapped secondary, 47V a side. This feeds a 6A bridge rectifier and two 8000μF/75VW electrolytic capacitors to produce balanced supply rails of $\pm$68.1V, at no signal (with the mains supply at 240VAC).

The transformer also has two 15V windings which are connected to feed a full-wave rectifier (consisting of two diodes) and a 470μF capacitor. This supplies 21V DC to feed the protection circuit. The low voltage supply is included on the printed board. The 6A bridge rectifier and 8000μF capacitors will have to be chassis mounted components.

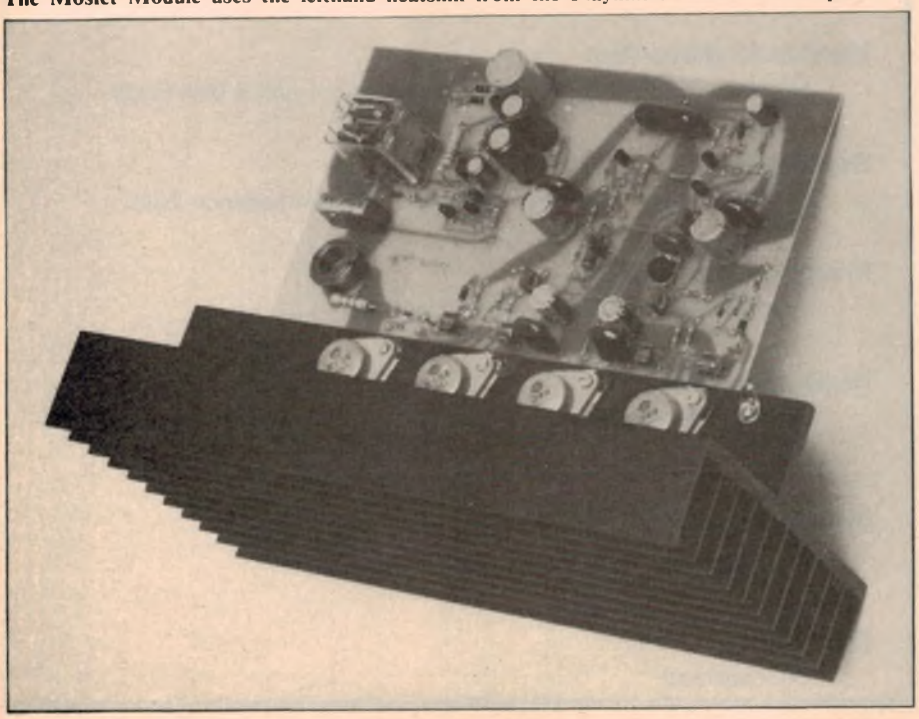
Construction

Wiring layout is a very critical aspect of a Mosfet amplifier design such as this so the printed circuit board design we have produced is mandatory.

The printed board measures 153mm by 202mm and is coded 85ma9. It is teamed with a large heatsink which is identical with those used for the Playmaster Series 200. In fact, it is the lefthand side heatsink from the aforementioned amplifier. A smaller heatsink should not be used unless the amplifier is to be used at lower supply voltages.

Assembly of the board is a relatively straightforward process but it should not be hurried. First, make a visual check of the PCB to see if there are any shorted tracks or open circuits in the copper pattern.

The Mosfet Module uses the lefthand heatsink from the Playmaster Series 200 amplifier.



Start with the links, resistors and diodes. Take care with the latter, making sure that you don't confuse the 1N914s with the 9V zeners. Make sure that all diodes are connected the right way into circuit. The same goes for the electrolytic capacitors but the two 47μF bipolars can go in either way.

The fuse clips, relay and trimpot can be mounted next and then all the small-signal transistors.

The 6.8μH choke at the output of the amplifier is wound with 24.5 turns of 1mm enamelled copper wire on an 11mm plastic former. This will involve winding on three layers such that the coil start and finish leads are on either side of the plastic former, at the bottom edge. Bend the leads at 90° so that the choke mates naturally with the holes on the board. Don't forget to clean the enamel coating from the choke leads (by scraping them with a razor blade) before soldering.

Note that the 0.15μF capacitor in the output RLC network is a dual dielectric type, rated at 250VAC. We recommend the Philips type MKT-P unit: 2222 330 40154. Other types are liable to fail.

The four Mosfet power transistors must be isolated from the heatsink using mica washers and plastic bushes, as shown in Fig. 1. We used 5mm lengths of 3mm fibreglass tubing for the insulating bushes. Smear the mating surfaces of the Mosfets and the heatsink with heatsink compound before assembly. The transistors are secured to the heatsink using 12mm 6BA screws and nuts. The nuts (brass) should be soldered to the PCB to ensure reliable long-term contact between the cases of the transistors and the copper tracks.

As each transistor is mounted, use your multimeter (set to a low "ohms" range) to check that its case is insulated from the heatsink. If the case is shorted, check the insulation around each screw by removing them one at a time. When everything is OK, the gate and source leads can be soldered to the PCB.

Setting up

Assuming that you have completed the amplifier and its power supply, check the voltage on the two supply rails before making final connection to the amplifier board. Wait for the 8000μF capacitors to discharge below 5V before making connections. Remove the negative supply fuse clip and connect a multimeter set to measure up to 1A across it. **It is most important not to connect a load to the amplifier at this stage.**

The output stage quiescent current can now be set. Rotate the 500Ω trimpot fully anticlockwise and apply power. The trimpot should then be adjusted for a 100mA reading on the meter.

Switch off the power and wait for the

Above is an actual size reproduction of the PC artwork.

voltage across the supply capacitors to drop. The meter can now be removed and a fuse installed in the negative supply line.

Re-apply power and check that the DC voltage at the amplifier output is close to zero; ie, no more than ± 100mV. Typically, the voltage will be around ± 10mV or even lower.

The action of the protection circuitry should also be checked.

The relay should pull in a few seconds after power is applied and drop out again when power is removed.

Now connect a 1.5V battery across the first 47μF bipolar capacitor, ie at the junction of the two 22kΩ resistors. This should cause the relay to drop out. Reverse the battery connection and check that the relay again drops out.

Finally, connect a loudspeaker and check for the presence of hum or any other signal. With no signal applied the amplifier should be absolutely quiet. Touching your finger to the input should then cause the speaker to emit a small "blurt". If so, all is well.

RANGE OF KITS:-

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AM CQAM STEREO DECODER KIT

Because this kit has been so popular, we thought we'd give you a chance to buy it at a special price.
Cat. KA-1555

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now only $17.50
SAVE $7.45
WE WANT EVERYONE TO HAVE AM STEREO

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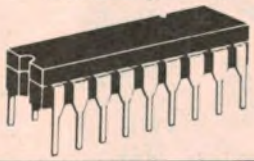
Usually $11.95
NOW ONLY $6.95
SAVE $5.00



8 CHANNEL MIXER Model 8002

Balanced input 8 channel stereo mixer with features only found in units costing $1,500 or more!

MAIN FEATURES:
- Balanced (600 ohm) mic. inputs/line inputs
- Input attenuators
- Cannon connectors included in the price
- Bass, mid and treble equalisation on each input
- Effects (i.e. echo etc) capability
- Foldback on all 8 inputs
- Stereo pan on all 8 inputs
- 60mm slide faders used throughout
- 19" rack mount capability (or console mount)
- Professional black front panel with format borders and multicoloured knobs to assist function indentification
- Designed for quick and easy service
- VU metering
- Only high quality components used
- 5534A OP amps used for low noise and very low distortion

TECHNICAL:
- Signal to noise microphone input -75dB with ref to +4dBM
- Signal to noise line input -90dB with ref to +4dBM
- Line level +4dBM (0VU)
- Distortion less than 0.005%
- Power requirements 240V AC 50Hz 25 watts

8002 MIXER

Ref: EA April/May 1983

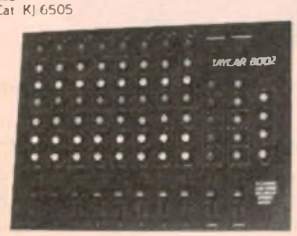
8002 RACK KIT This is the basic mixer. This kit gives you virtually all the electronics. Provided front panel VU meters, 11 PCB's, all pots (rotary and slide), knobs, components for PCB's, hook-up wire etc. All Cannon XC chassis connectors are included as well. It is ideal for rack mount and all that is necessary is a ±15V 1A power supply.
Cat. KJ-6504

$535.00

FREE DESK CONSOLE THIS MONTH

For October only, if you purchase the above kit, we will give you the desk console FREE - worth $98

8002 DESK CONSOLE This kit consists of console chassis, power supply including fuses, power lead etc. and wooden end pieces. It enables you to mount the rack kit for conventional desk top use.
Cat. KJ-6505



NOW OPEN:
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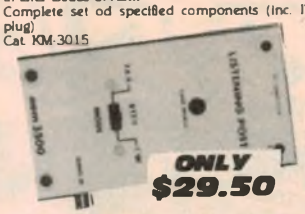
The Listening Post

Ref: AEM July 1985

This device attaches between audio output of a short wave receiver and the input port of a computer. It allows decoding and printing of Morse Code, Radio-teletype (RTTY), AND radio facsimile (FAX) pictures! You can, for example, watch weather maps from the Met and dump them on to your printer!
Specific software for the Microbee is in the first article. Programs for other popular computers will be printed in later issues of AEM.
Complete set od specified components (inc. IDC plug).
Cat. KM-3015



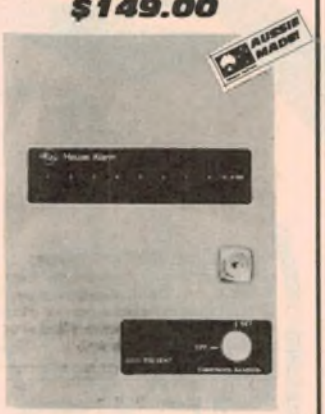
ONLY $29.50

8 SECTOR BURGLAR ALARM - Ref: EA Jan/Feb 1985

Why buy a commercially made up unit for more when you can buy this kit and SAVE money! A unique feature of this kit is the fact that you can wire N/O and N/C alarm sensors ON THE SAME LINE.
- ★ 8 SECTORS
- ★ 2 delayed entry sectors
- ★ Steel box
- ★ Includes battery and siren driver in the price
- ★ Variable exit and entry delays

Cat. KA-1580

$149.00



ETI 699 Modem Kit

Ref: ETI May 1985

This brilliant new design is a price breakthrough. Never has a modem with such SOPHISTICATED FEATURES been offered at such an incredibly low price. Now you can have no excuse to gain the tremendous benefits that a modem will offer viz:
- ★ Access to huge data banks
- ★ Networking
- ★ Telecommunications
- ★ Electronic shopping
- ★ Software exchange
- ★ And much more.

This ETI kit is a full modem with facilities similar to units costing hundreds of dollars more. It even includes a Telecom approved push button telephone! Now is your chance to use your electronic skills in your new hobby and save a fortune over ready builts. You can obtain this modem kit (which includes a telephone for us humans) for the incredibly low introductory price of only $139. That's right! $139, inc. case, down to the last nut and bolt. But hurry! Stocks of the critical modem chip are very low and will severely limit kit supply.
Cat. KE-4695

ONLY $139.00

240V NEGATIVE ION GENERATOR Ref: AEM Sept 1985

The Jaycar kit includes ABS plastic case, special PCB etc. Please note that this kit is the ORIGINAL KJ-6511 around which the AEM project was based.
Cat. KJ-6511

ONLY $45.00

AEM 9500 Beat Triggered Strobe

Ref: AEM July 1985

This project provides a very bright stroboscopic effect for parties, discos, etc., but with an ADDITIONAL FEATURE! This strobe will actually flash in synchronisation with the music!
The Jaycar kit includes case, photographic reflector, flash tube etc.
Cat. KM-3018

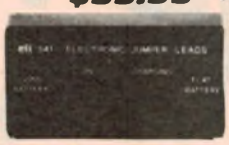
ONLY $59.00

ONLY $49.00
SAVE $10.00

Electronic Jumper Leads - ETI 341

Ref: ETI August 1985. This project enables you to charge up a car battery via the cigarette lighter plugs in each car. A small inverter boosts the battery voltage from car No 1 to charge the flat battery in car No 2 via its cigarette lighter socket.
It's amazing how quickly you can put enough charge in a flat battery to start the car!
Complete set of parts including 2 x cigarette lighter plugs.
Cat. KE-4703

$39.95 NEW!



Digital Bench Type Capacitance Meter

Ref: EA August 1985
- ★ Easy to assemble
- ★ 4 digit LED readout
- ★ Measures from 1pF to 99.9uF
- ★ 3 ranges
- ★ Bench type mains powered

Cat. KA-1595

NEW!

ONLY $79.95

PLAYMASTER SERIES II MOSFET AMP KIT

Ref: EA Jan/Feb/March 1985

"... s stereo amplifier that will equal or better just about any integrated commercial amplifier, regardless of price". Leo Simpson, Editor of EA, February 1985.

MAIN FEATURES
- Switchable phono input for MM and MC cartridges
- Electronic signal switching
- Full facilities for dubbing between two cassette decks
- Monitor loop for either of two cassette decks or a signal processor
- Click action pushbutton switches for selection of sources, dubbing and tape monitor with LED status indicators
- Centre detents on bass, treble and balance controls, multiple detents on volume control
- Heavy duty heatsinks
- Power transformer for low hum and noise
- Easy to build - all parts except power supply mount directly on the two printed circuit boards; wiring has been kept to an absolute minimum.
- 100 watts RMS per channel into 8 ohm load
- Less than 0.01% total harmonic distortion

Cat. KA-1500

ONLY $429.00

AEM 6500 - 60/120 WATT UTILITY MOSFET AMP MODULES

Ref: AEM July 1985

This is a low cost high performance design using proven MOSFET technology. A single pair of (2SJ49/2SK134) Mosfets will deliver up to 60 watts output. Another pair may be added for 120 watt performance. The module has been designed to fit into a large variety of commonly stocked instrument cases and rack boxes. It features VERY LOW distortion and impeccable transient performance. It is unconditionally stable and virtually blow-up proof. It can be powered from common transformer/rectifier/capacitor combinations. A Winner!
As usual, the Jaycar kit reflects a quality approach. All specified components for each version are included.

60 WATT MODULE Cat. KM-3010
$49.50
120 WATT MODULE Cat. KM-3012
$65.00

ETI 698 Microbee Dialler - ETI July 1985

Complete set of parts.
Cat. KE-4696

ONLY $19.95

DWELL/TACHOMETER

Ref: EA Sept. 1985

Tune up your car quickly and easily with this handy piece of gear. The Jaycar kit includes case, large meter and Scotchcal meterscale.
Cat. KA-1612

ONLY $34.95
Suits 4-6 or 8 cylinder cars

NEW!

ETI 1401 DIRECT INJECT BOX

Ref: ETI Sept. 1985

This unit accepts unbalanced audio inputs (line or mic. level) and produces a line level balanced signal to drive mixers or balanced input equipment. The Jaycar kit includes die-cast box, specified push button switch bank and all other parts.
Cat. KE-4708

ONLY $34.95

NEW!

MAIL ORDER HOTLINE
(02) 747 1888

JAYCAR IS No1. . .

40 WATT DC INVERTER

Ref: EA August 1985
An upgrade of a previous design featuring a smart new ABS case.
Cat. KA-1598

NEW!

$79.95

300 WATT INVERTER

Ref: EA Sept. 1985

This totally new design is a vast improvement over the EA June 1982 project. It features a modern all-plastic case, easier assembly, toroidal type inverter transformer, auto start up and double switched power outlets.
And it's cheaper than the old model!!!
The Jaycar kit contains all specified parts to enable you to complete the project in one go.
Cat. KA-1610

ONLY $199.00

NEW

Car Booster Amp

Ref: EA August 1985.
This project enables you to have 2 x 50 watts ***RMS*** of power for your car sound system. In order to do this, a special high voltage power supply forms part of the system. Absolutely stunning value for money. Around half the price of inferior commercial units.
The Jaycar kit is, as usual, absolutely complete.
Cat. KA-1600

ONLY $179

NEW

BRAKE LAMP FLASHER

Ref: EA November 1984

What is the best way to avoid rear end collisions when you hit the brakes? According to tests conducted among Sydney Taxi Drivers, the best way is to have additional FLASHING stop lamp installed on the parcel shelf. This project provides this facility. The Jaycar kit includes all specified parts but NOT the automotive stop lamps which are available from motor accessory or hardware stores for about $20.
Cat. KA-1564

WAS $16.50
NOW ONLY $12.50

MAIL ORDER HOTLINE
(02) 747 1888

TOUCH LAMP DIMMER

Ref: EA April 1983

You can turn lights on and off (AND dim them) with one touch! Uses high-tech Siemens IC. Features attractive HPM wall plate (supplied). The Jaycar kit contains ALL the necessary components including the small contact spring. Watch out for similar products that don't!
Cat. KA-1508

ONLY $24.95
REMOTE OPTION Cat. KA-1509
ONLY $14.50

INFRA RED DIMMER

INCLUDES HAND CONTROLLER WITH I.R. DIODES

Ref: EA January 1984

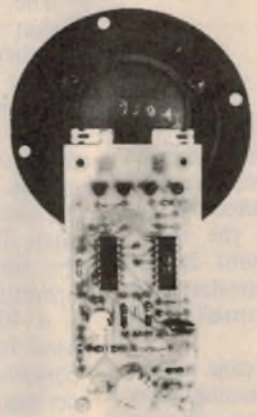
Now you can dim or turn off the lights from the comfort of your own armchair. This shortform kit contains all parts for the I.R. kit.
NOTE: Kit must be used in conjunction with the Jaycar KA-1508 Touch Lamp Dimmer.
Cat. KA-1529

SUPER SIREN

Ref: EA November 1982

Earsplitting sound from a CMOS that only draws 5mA on average! Includes a powerful imported piezo siren.
Cat. KA-1055

ONLY $17.95
SHORT FORM (Electronics Only)
Cat. KA-1484
ONLY $8.50



SUBWOOFER AMP

Ref: EA July 1982

State-of-the-art Mosfet technology combined with a low-pass filter. Around 100 watts RMS drive capability. Ideal for use with the Jaycar subwoofer speaker (Cat. CW-2119). Amp will take line level (1V) input or connect direct to speakers. The Jaycar kit includes all PCB parts, heatsink and power supply filter capacitors.
Cat. KA-1452

ONLY $89.95

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

'BEACHCOMBER' DELUXE METAL DETECTOR

Ref: EA December 1984

This unit is sensitive, accurate, has discriminate control and has automatic zeroing, as well as cancelling facility. It comes in a specially imported plastic case facility and pre-wound, sealed search head. The final project looks great and competes favourably with units costing up to $700.
Cat. KA-1554

THIS MONTH - $169
SAVE $70 - usually $239

300W PLAYMASTER AMPLIFIER

Ref: EA June 1980

This rugged design provides 200W rms into 8 ohms and 300W rms into 4 ohm loads. All parts fit onto a single PCB. It also features comprehensive protection circuitry, and will even withstand short circuits for short durations without adverse affect. Unlike other high powered amps, it is unconditionally stable. It will not therefore break into supersonic oscillations, overheat and fail.
The Jaycar kit of this project provides a quality roller-tinned fibreglass PCB and other quality components down to the heatsink compound.
Cat. KA-1115

ONLY $99.95

300W AMP POWER SUPPLY KIT

This basically consists of a 300VA power transformer (PF4363), rectifier and filter capacitors. It also has 15VAC power for the speaker protector.
Cat. KA-1116

ONLY $79.95

Speaker Protector for Playmaster 300W amp

Ref: EA July 1980

This device is designed to mate with the Jaycar KA-1115 Playmaster 300W amp module. It also provides the handy facility of switch on mute. This disconnects the speakers for the first few seconds when the amp is switched on, avoiding the horrifying 'thump' in the speakers. If you have expensive speakers (whether you have the EA 300W amp or not) this speaker protector is cheap insurance. The Jaycar kit provides all PCB parts including the relay.
Cat. KA-1117

ONLY $14.95

Deluxe Red Light Flasher

• This kit is simply the easily identifiable pushbutton square dash mounted switch with a flasher circuit on the back! Very sneaky! You get the deterrence of a flashing red light (the original light switch as used on the real alarms) but without the cost or installation hassle of a full alarm. Kit includes 2 BONUS car alarm window stickers.
Cat. KJ-7000

ONLY $24.50

EL-CHEAPO RED LIGHT FLASHER

(ETI 260 12V FLASHER)

A 12 volt chrome bezel fits to the dashboard and flashes continuously. Cheap but effective.
Cat. KE-4012

ONLY $7.95

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MIDI CONTROLLED SAMPLER

• Ref: Sonics July 1985
LAST STOCK - Kit $1,500
Built $2,000 - BELOW COST

Electronic Crossover

Ref: EA November 1984
NEW SHORT FORM KIT!

You can NOW build this desirbale project for a lot less! There have been requests for a version of this kit that can be built into other equipment. This is it!
The kit contains PCB and all board components etc. The box (including front panel) and selector switches are not supplied but everything else!
Cat. KA-1571

ONLY $79.00

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Jaycar ELECTRONICS

Incorporating ELECTRONIC AGENCIES

NUMBER 1 FOR KITS

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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
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MAIL ORDER VIA YOUR PHONE

And now ladies and gentlemen, we present:

EA's exciting Quiz Game

For one million dollars, plus a Ferrari, plus a block of flats, plus Tasmania, what is this circuit? Answer: the Electronics Australia trivial transistors Quiz Game. It has flashing LEDs, a chime and a buzzer, and can be used by up to three contestants at once.

by COLIN DAWSON

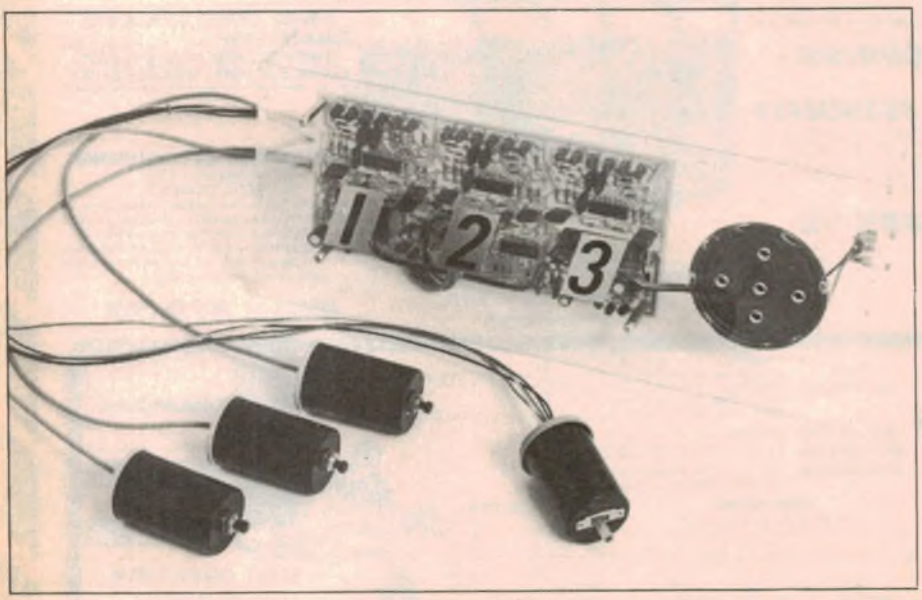
Incorporating all the features of popular TV quiz shows (except a hyperactive compere, a beautiful assistant and fabulous prizes), this new electronic game should stimulate endless hours of inconsequential quizzing.

It works just like the popular "Sale of the Century" quiz game. As in the TV version, the game is controlled by a quiz master and each contestant is provided with an answer button. When an answer button is pressed, one of three rows of LEDs illuminates to indicate the successful contestant and a chime sounds. At the same time, the other two contestants are locked out.

An in-built timer circuit gives the contestants just seven seconds to answer each question, although this period can easily be extended if required. If no answer is offered within the seven second period, an unpleasant buzzer sounds to ensure that the contestants are made aware of their intellectual inadequacy.

The circuit is reset by the quiz master after each question. This extinguishes the LEDs and resets the answer circuits, or cancels the buzzer. The quiz master then sets the circuit to "wait" to start the next timing period.

To give the answer chime the "proper" sound, it has been designed to decay with a quite pleasant tremolo effect. This is very much in the style of the TV quiz shows. Similarly, the answer LEDs (there are six in each row) illuminate in a chaser style — just like the real thing.



Our version of the Quiz Game was housed in an attractive perspex frame.

Circuit description

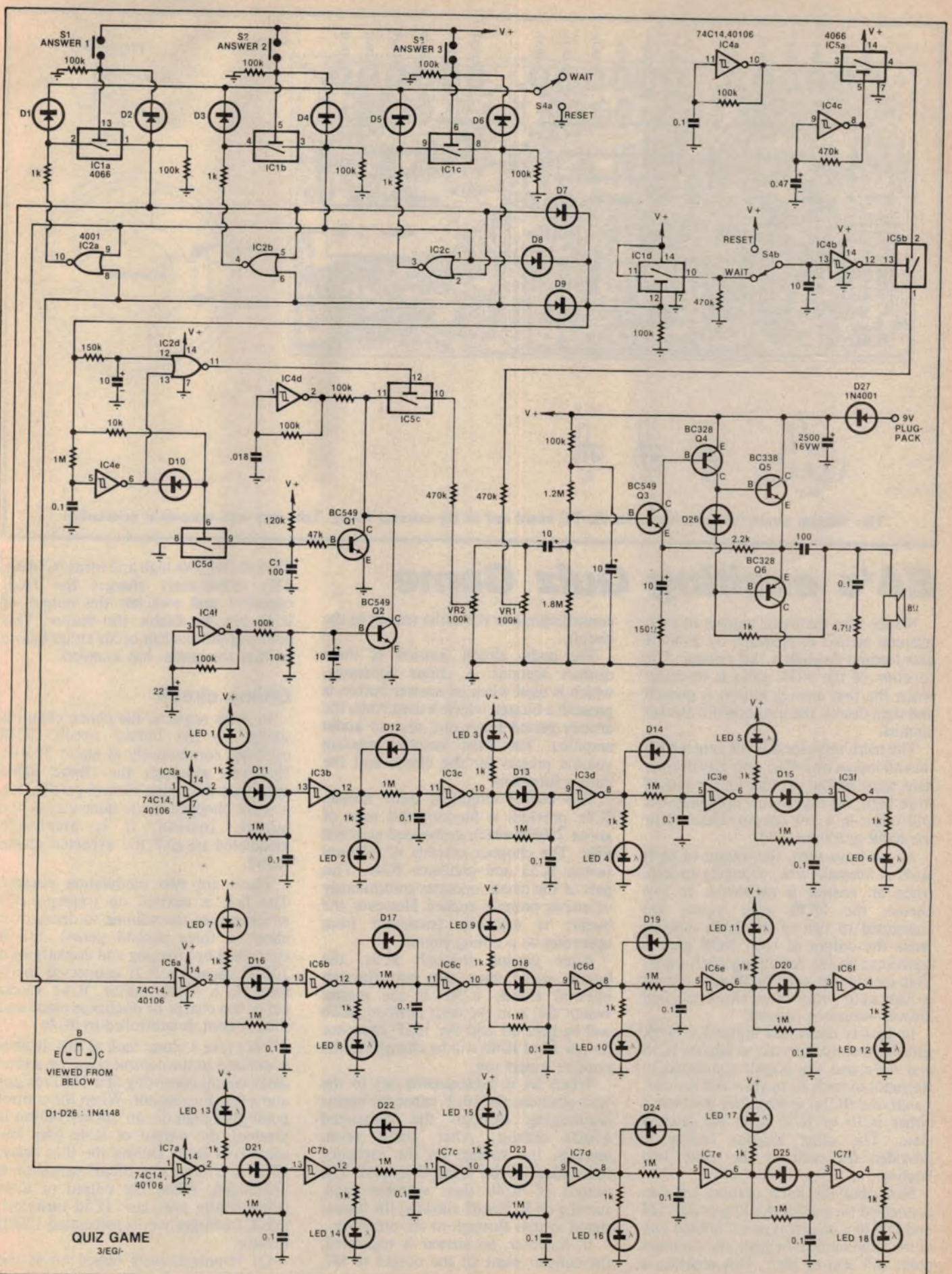
The most important aspect of the circuit is the detection and lockout circuitry. In addition to disallowing any answer after the first, it controls the audio and LED sections of the circuit.

For each of the three contestants, there is a latch and an associated lockout circuit. As soon as a contestant presses the answer switch, his answer circuit will latch. This automatically disables both of the other answer circuits as well as operating the chime and LEDs.

A 4016 CMOS bilateral switch IC is used for the latching circuit. This IC contains four bilateral switches and these devices simulate a single pole, single throw switch. A control voltage determines whether the switch is in the on or off state. In this circuit, the control voltage is supplied by the contestant's answer switch. IC1a, for example, is the latch for contestant one and the control voltage is fed to its pin 13.

The latching action for the CMOS switches is provided by diodes D2, D4 and D6 which are connected between the output pins and the control pins. In the case of IC1a, D2 is connected between pin 1 (output) and pin 13 (control). When S1 is pressed, pin 13 is connected to the positive supply and IC1a switches to the on state. Assuming that the input (pin 2) is initially high, D2 will now be forward biased and thus holds pin 13 high, even if the answer switch is released. Hence IC1a will be latched.

If the input to IC1a had been low, the output would have stayed low, irrespective of the voltage on the control pin. This situation arises if another answer button is pressed first. In order to explain this aspect of the circuit, it is necessary to consider the detection and lockout circuitry.


S1 ANSWER 1
S2 ANSWER 2
S3 ANSWER 3
V+
WAIT
S4a
RESET
D1
D2
D3
D4
D5
D6
D7
D8
D9
IC1a 4066
IC1b
IC1c
4001 IC2a
IC2b
IC2c
74C14,40106 IC4a
4066 IC5a
IC4c
IC1d
S4b
IC4b
IC5b
IC2d
IC4d
IC5c
IC4e
D10
IC5d
BC549 Q1
BC549 Q2
IC4f
D27 1N4001
9V PLUG-PACK
BC328 Q4
BC338 Q5
BC549 Q3
D26
BC328 Q6
VR2 100k
VR1 100k
LED 1
LED 2
LED 3
LED 4
LED 5
LED 6
LED 7
LED 8
LED 9
LED 10
LED 11
LED 12
LED 13
LED 14
LED 15
LED 16
LED 17
LED 18
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D12
D13
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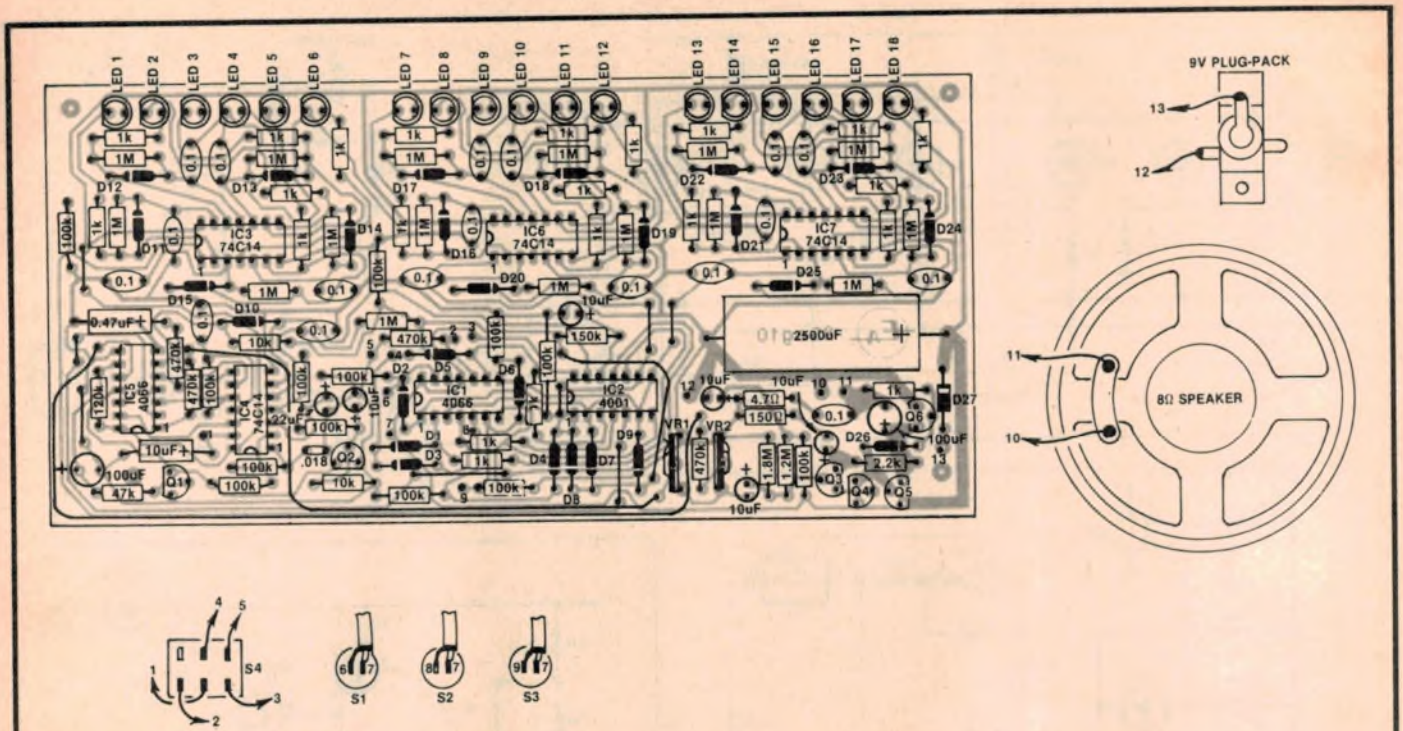
D15
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
IC3a
IC3b
IC3c
IC3d
IC3e
IC3f
IC6a
IC6b
IC6c
IC6d
IC6e
IC6f
IC7a
IC7b
IC7c
IC7d
IC7e
IC7f
74C14, 40106
VIEWED FROM BELOW
D1-D26 : 1N4148
QUIZ GAME
3/EG/-



This diagram shows the parts layout for the PC board and all the external wiring. Take care with component orientation.

EA's exciting Quiz Game

Notice that the input voltage to each bilateral switch is provided by a NOR gate feeding through a 1kΩ resistor. The function of the NOR gates is to detect when the first answer button is pressed and then disable the unsuccessful answer circuits.

The truth table for a NOR gate is such that all inputs (the 4001 only has two per gate) must be low in order for the output to be high. All other input combinations will result in a low output. Here's how the NOR gates are used.

As we have seen, the output of each latch is normally low, changing to high when an answer is registered. In this circuit, the NOR gate inputs are connected to two of the latch outputs while the output of each NOR gate is connected to the remaining latch input. This means that each NOR gate output is high until either of its two associated answer buttons is pressed.

In greater detail, the inputs for NOR gate IC2a are connected to latches IC1b and IC1c and the output connected to the input of latch IC1a via a 1kΩ resistor. Latch one (IC1a) is therefore disabled if either IC1b or IC1c is in the latched state. The same lockout facility is provided for each of the other two latches.

Note that the latch outputs are also connected via a diode AND gate (D7, D8 and D9) to a common point. Should any of the latch outputs be high, the common point will also be high. This provides a control signal for the audio section of the circuit.

The audio circuit consists of three distinct sections: a chime generator, which is used when an answer button is pressed; a buzzer, which is used when the answer period times out; and an audio amplifier. The latter includes separate volume presets for the chime and the buzzer functions.

The buzzer circuit is quite simple. IC4a provides a fundamental tone of about 250Hz which is chopped at about 6Hz. The chopper consists of bilateral switch IC5a and oscillator IC4c. This part of the circuit operates continuously whenever power is applied. However, the buzzer is normally prevented from operating by a timing circuit.

After passing through IC5a, the buzzer signal must also pass through bilateral switch IC5b. If the master switch (S4) is in the reset position, IC5b will be held off and the 10μF capacitor on pin 13 of IC4b will be charged to the positive supply rail.

When S4 is subsequently set to the wait position, the 10μF capacitor begins discharging through the associated 470kΩ resistor. After about seven seconds, the voltage on the capacitor falls below IC4b's lower threshold. The output of IC4b then switches high, turning on IC5b and allowing the buzzer signal to pass through to the amplifier.

If, however, an answer is registered, the control point (at the output of D7, D8 and D9) goes high and turns IC1d on. This immediately charges the 10μF capacitor and switches the output of IC4b low to disable the buzzer. This disabling process can occur either before or after the buzzer has sounded.

Chime circuit

In some respects, the chime circuit is similar to the buzzer circuit. IC4d oscillates continuously at about 833Hz. However, although the chime signal must past through a control gate (IC5c), it is not chopped in the same way as the buzzer. Instead, it is amplitude modulated to give the expected chime sound.

There are two modulation circuits. The first is centred on transistor Q1 which causes the volume to decay over about a three second period. Q1 is controlled by charging and discharging a 100μF capacitor (C1) connected to its base via a 47kΩ resistor. IC5d selects either the charge or discharge mode and this, in turn, is controlled by IC4e

Let's take a closer look at this. IC4e is connected to the control point via a time delay circuit consisting of a 1MΩ resistor and a 0.1μF capacitor. When the control point goes high (ie, an answer button is pressed), the output of IC4e goes low some 0.1s later. During the 0.1s delay, IC5d is on and the 100μF capacitor is discharged. When the output of IC4e subsequently goes low, IC5d turns off, and C1 charges via its associated 120kΩ resistor.

Q1 is progressively biased on as the

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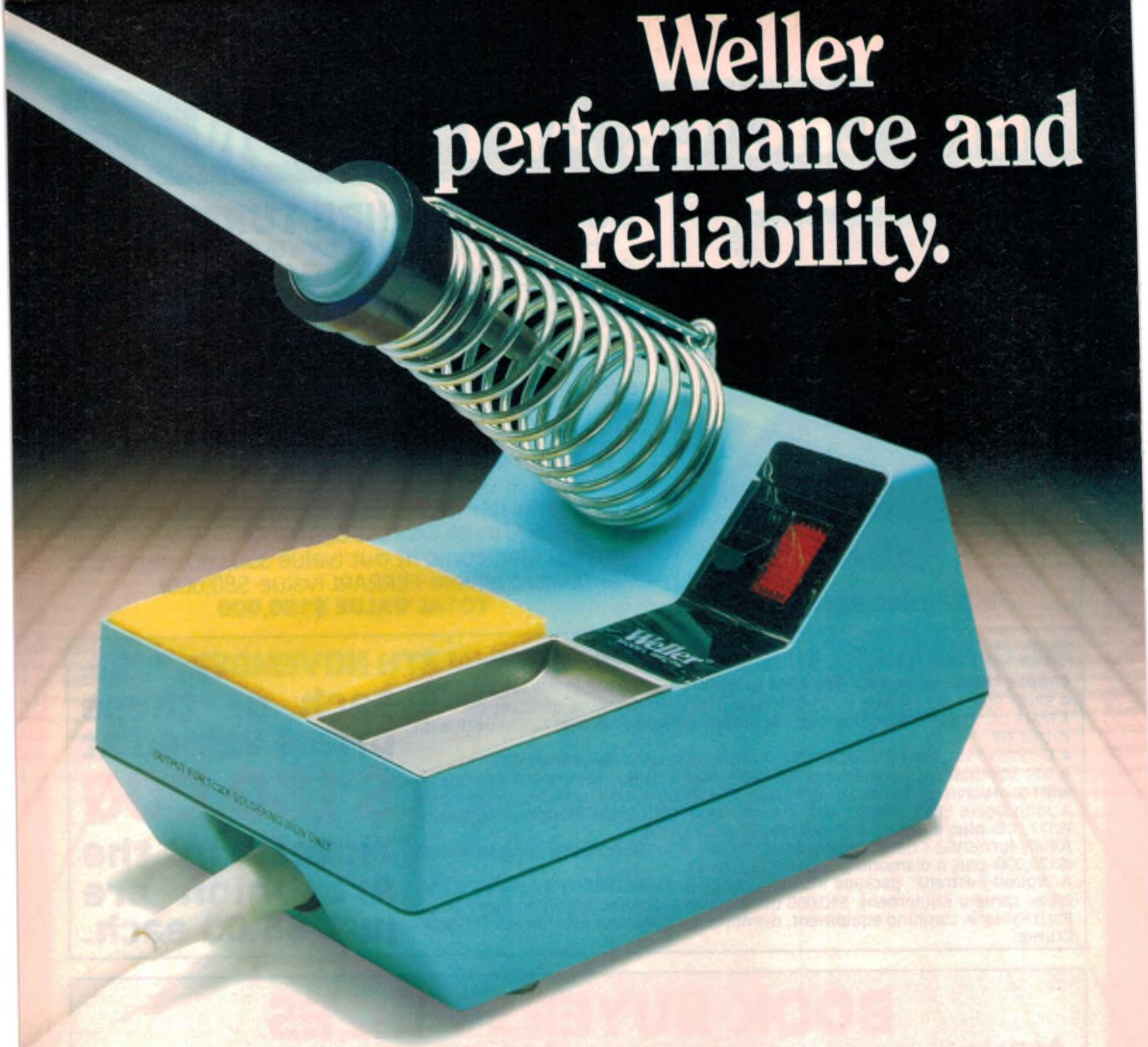

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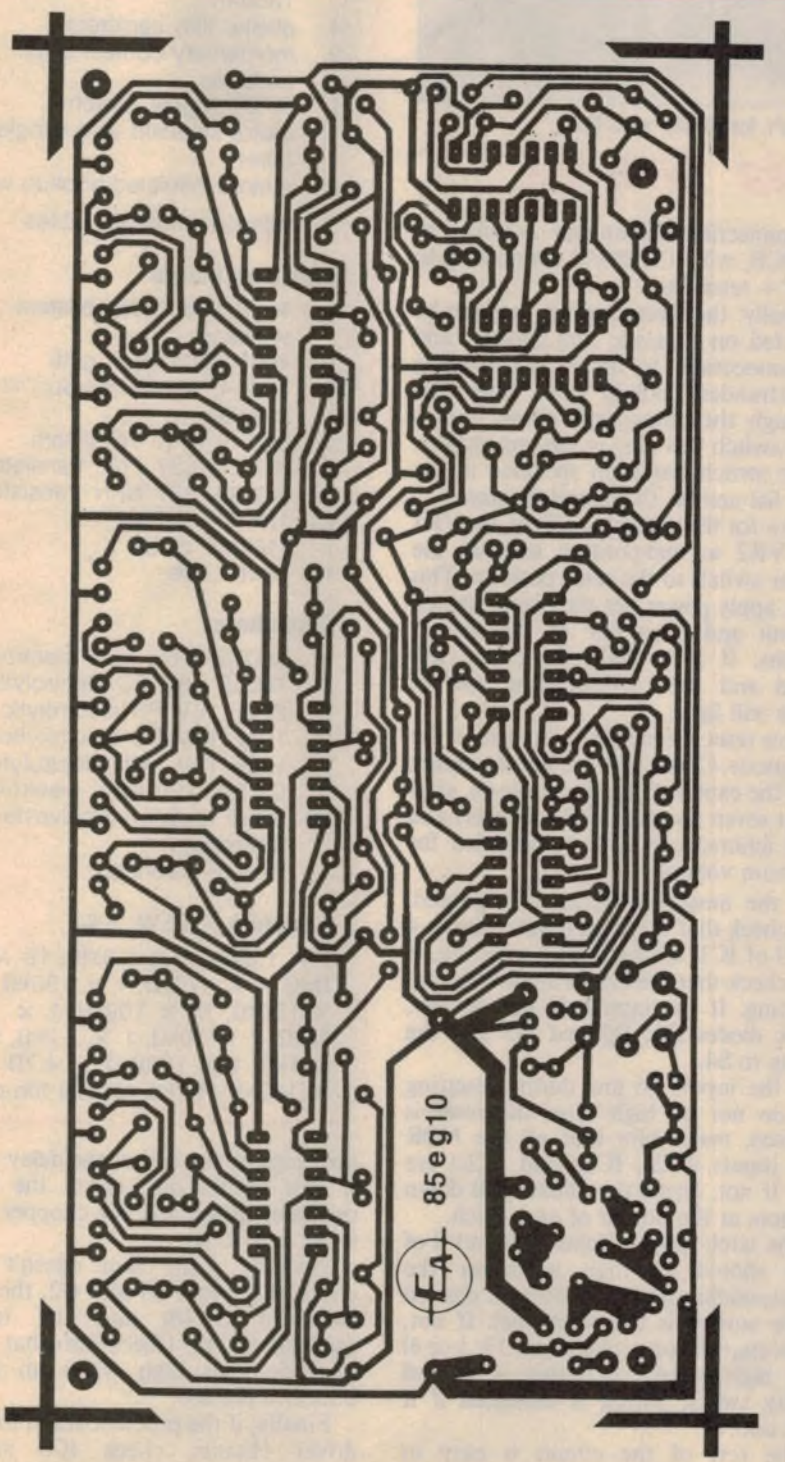
100μF capacitor charges. This shunts the chime signal to ground, thus causing the decay effect.

The second modulation circuit is based on Q2. This operates in parallel with Q1 and provides a second shunt path for the chime signal. Schmitt trigger oscillator IC4f controls Q2 so that the chime is amplitude modulated at about 1Hz. As a result of the Q1 and Q2 circuits, the chime signal decays with a tremolo effect.

The chime control gate (IC5c) is controlled by NOR gate IC2d. This is configured so that IC5c disconnects the chime circuit from the amplifier except for a 5s period after an answer button is pressed. This prevents the chime signal from leaking through when the circuit is reset.

IC2d disconnects the chime circuit during the delay period of IC4e. This prevents switch click (from the master switch, S5) from feeding through to the amplifier.

The volume presets for the buzzer and chime circuits are VR1 and VR2 respectively. These feed into a fairly conventional four-stage audio amplifier similar to that used in previous EA projects.



Here is an actual size artwork for the PC pattern.

LED driver circuitry

The LED driver circuitry consists of three identical sections, one for each contestant. Each of these sections is controlled by its corresponding latch output. Schmitt trigger inverter IC3 controls the LEDs for S1, IC6 the LEDs for S2 and IC7 the LEDs for S3.

When IC1a registers an answer (ie, pin 1 goes high), pin 2 of IC3a goes low and turns on LED 1 via its series 1kΩ resistor. At the same time, the 0.1μF capacitor on the cathode of D11 discharges via the associated 1MΩ resistor and, after a short delay, switches the output of IC3b high.

IC3b now drives LED 2 via another 1kΩ limiting resistor and IC3c via another RC delay circuit. After a short delay, pin 10 of IC3c goes low and turns on LED 3. This sequence of events is repeated for the remaining inverters in the 74C14 package, IC3d, IC3e and IC3f, which control LEDs 4, 5 and 6 respectively.

The result of all this electronic skulduggery is that the LEDs turn on in chaser fashion. LED 1 turns on first, followed by LED 2, then LED 3, and so on down to LED 6. Diodes D11 to D15 ensure that the LEDs all turn off at the same instant when the circuit is reset.

LED driver circuits IC6 and IC7 work in exactly the same manner.

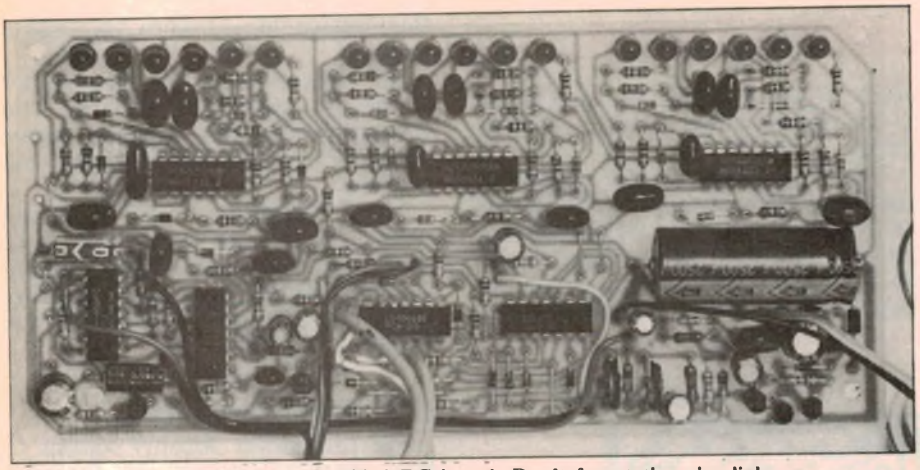
Power for the circuit is derived from a 9V DC plugpack supply. Diode D27 provides protection against reverse polarity connection while the 2500μF electrolytic capacitor provides supply decoupling.

Construction

As shown in the photograph, the Quiz Game is housed in an attractive perspex frame. The big advantage of this scheme is that there is no need to make special cutouts in the front panel for the LED displays. Adhesive labels obtained from a hardware store are used to indicate the contestant number.

All of the circuitry, with the exception of the switches, speaker and power socket, is accommodated on a printed circuit board (PCB) coded 85eg10 and measuring 181 x 87mm.

No special procedure need be followed



Above: close-up view of the assembled PC board. Don't forget the wire links.

EA's exciting Quiz Game

when assembling the board although we suggest that the smaller components be installed first. Leave the larger components such as the capacitors, LEDs and trimpots till last.

Note carefully the orientation of the diodes, transistors, electrolytic capacitors and ICs when they are being installed. A PCB pin should be used for the common (V+) connection to the answer switches.

Pay particular attention when installing the LEDs. The cathode lead is indicated by a flat area on the LED body and is the shorter of the two leads. Make sure that the LEDs are all mounted at the same height — about 3mm proud of the board is ideal.

The PCB can now be completed by installing the three insulated wiring links.

Final assembly

The front panel of our perspex frame measures 350 x 128mm. Once cut to size, the edges can be smoothed by laying some fine sand paper on a table top and rubbing the perspex edges back and forth across it.

As shown in the photograph, the PCB is mounted on 25mm standoffs towards one end of the panel while the speaker is mounted at the other end. Mark out and drill the mounting holes for the PCB, followed by several larger holes for the speaker. The speaker can then be glued in position using epoxy resin.

Side pieces were affixed to either end of the front panel to make it stand upright. These side pieces measured 85mm deep × 128mm high at the front × 105mm at the rear to angle the front panel backwards. A DC power socket to suit the plugpack transformer was mounted on the righthand side piece, adjacent to the loudspeaker.

We mounted the pushbutton answer switches in discarded plastic film canisters (try your local chemist shop for these). Single core shielded wire is ideal for connecting the answer switches to the PCB, with the shield connecting to the V+ terminal.

Finally, the master switch can also be mounted on a plastic film canister and the connections to the PCB run using multistranded hookup wire. Note that although the photograph shows that a slider switch was used in the prototype, a toggle switch has been specified in the parts list and on the circuit diagram.

Now for the smoke test. First, set VR1 and VR2 to mid-position and set the master switch to the reset position. This done, apply power, set the master switch to wait and press one of the answer buttons. If all is well, the chime will sound and the corresponding row of LEDs will light.

Now reset the circuit and return to the wait mode. Check that the buzzer sounds after the expiry of the wait time (ie, after about seven seconds). VR1 (buzzer) and VR2 (chime) can now be adjusted for optimum volume.

If the answer switches are ignored, first check that the latch inputs (pins 2, 4 and 9 of IC1) are high after resetting. If not, check that the inputs are low during resetting. If the inputs do not go low, check diodes D1, D3 and D5 and the wiring to S4.

If the inputs go low during resetting but do not go high after the reset is released, make sure that all the NOR gate inputs (IC2a, IC2b and IC2c) are low. If not, check the 100kΩ pull down resistors at the output of each latch.

The latch outputs (pins 1, 3 and 8 of IC1) should go high whenever the corresponding answer button is pressed (make sure it is the right one). If not, check that the control pin (pin 13, 5 or 6) goes high when the button is pressed (faulty switch wiring is indicated if it does not).

The rest of the circuit is easy to troubleshoot. If the buzzer doesn't sound, check first that pin 13 of IC5b goes high at the end of the delay period. If this checks out, check the buzzer oscillator (IC4a) and the chopper circuit (IC4c and IC5a).

Similarly, if the chime doesn't sound, check transistors Q1 and Q2, the chime oscillator (IC4d) and the tremolo oscillator (IC4f). Check also that pin 12 of IC5c goes high when an answer button is pressed.

Finally, if the problem lies in the LED driver circuits, check IC3 and its associated parts for answer button S1, IC6 for S2 and IC7 for S3.

PARTS LIST

1 PCB, code 85eg10, 181 × 87mm
1 miniature 8Ω loudspeaker
1 panel mounting DC power socket (to suit plugpack transformer)
4 25mm tapped standoffs
8 screws to suit standoffs
1 9V DC plugpack transformer
1 sheet of perspex, 500 × 130mm
4 plastic film canisters
3 momentary contact SPST switches
1 DPDT toggle switch
1 metre shielded wire (single core)
2 metres insulated hookup wire
3 adhesive number lables

Semiconductors

2 4016, 4066 quad bilateral switches
1 4001 quad NOR gate
4 74C14, 40106 hex Schmitt inverters
3 BC549 NPN transistors
2 BC328, 327 PNP transistors
1 BC338, 337 NPN transistor
23 1N4148 diodes
1 1N4001 diode
18 5mm LEDs

Capacitors

1 2500μF 16V axial electrolytic
2 100μF 16V PC electrolytics
1 22μF 16V PC electrolytic
5 10μF 16V PC electrolytics
1 10μF 16V axial electrolytic
1 0.47μF 16V axial electrolytic
18 0.1μF metallised polyester (greencap)
1 .018μF greencap

Resistors (0.25W, 5%)

1 × 1.8MΩ, 1 × 1.2MΩ, 16 × 1MΩ, 4 × 470kΩ, 1 × 150kΩ, 1 × 120kΩ, 13 × 100kΩ, 1 × 47kΩ, 2 × 10kΩ, 1 × 2.2kΩ, 22 × 1kΩ, 1 × 150Ω, 1 × 4.7Ω, 2 × 100kΩ 10mm vertical trimpots.

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- **Noise: - 100dB below full output**
- **Intermodulation Distortion: 0.003% at 100W (50Hz & 7kHz mixed 4:1)**
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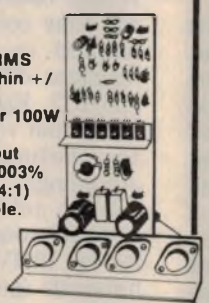

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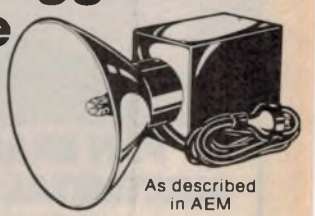

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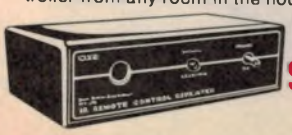

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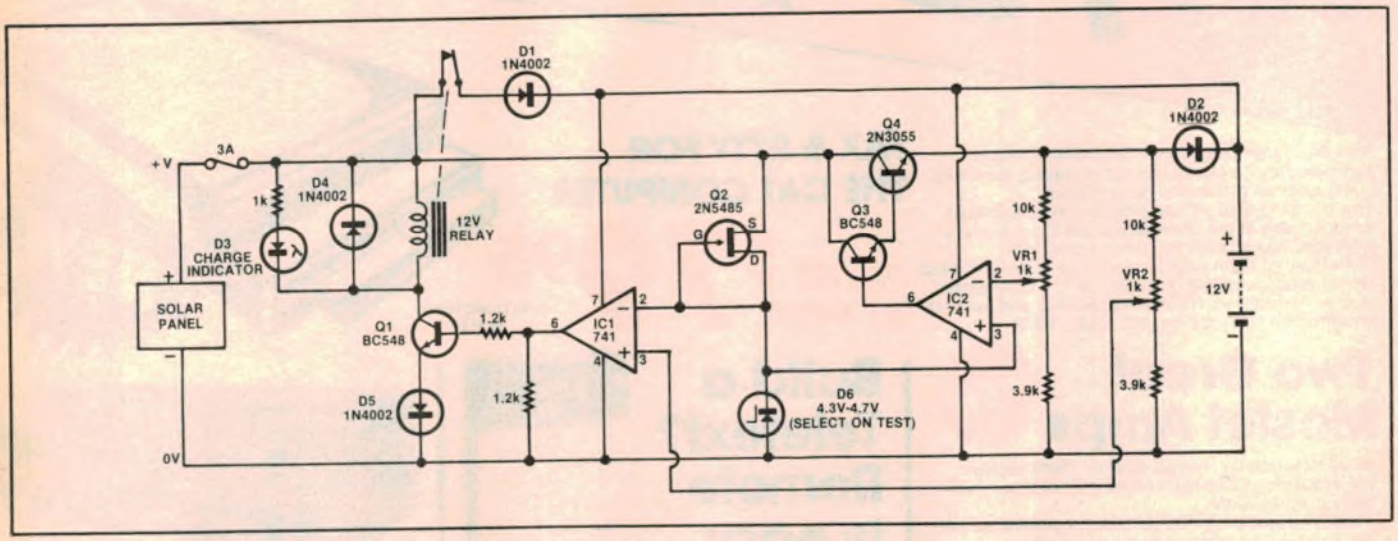
Circuit & Design Ideas

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.



Solar panel regulator

Most solar cell panels are designed to deliver a no-load output of around 19V. This means that a 12V lead-acid battery can quickly overcharge to 16 or 17V if the output of the solar panel is not regulated, even allowing for a 0.6V drop across a blocking diode.

However, voltage regulator circuits can also cause problems. In particular, the voltage drop across the regulating transistor, usually around 1.2V, is too high to allow most solar panels to work efficiently. This circuit overcomes that problem by initially applying the full solar panel voltage to the battery via a relay and a blocking diode (D1).

IC1 is wired as a comparator. D6 sets the reference voltage on the non-inverting input while the inverting input monitors the output voltage via VR2 and its associated 10kΩ and 3.9kΩ resistors. FET Q2 is a constant current source.

In practice, VR2 is set so that, when the battery voltage is below 13.8V, pin 6 of IC1 is low, Q1 is off and the relay contacts are closed. When the battery voltage rises above 13.8V, Q1 turns on, the relay contacts open and current is supplied to the battery via a series regulator circuit consisting of Q4, Q3 and IC2. Error amplifier IC2 monitors the output voltage and adjusts the drive to Darlington pair Q3 and Q4 accordingly.

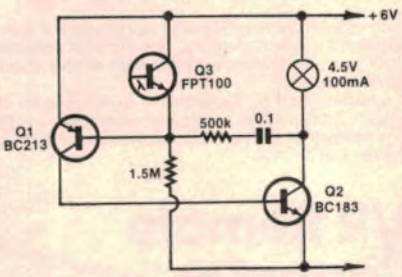
The setting up procedure is straightforward. First VR1 is adjusted for a 13.8V output at the battery terminals (no battery connected, relay contacts open). VR2 is then set to the relay operating point and, finally, VR1 is reset for 14V.

"Wireless World"
August, 1985.

Night-time lamp flasher

This simple lamp flasher is designed to turn on automatically at night. Transistors Q1 and Q2 form a regenerative oscillator. At switch on, Q1 is biased on and supplies base current to Q2 which turns on and lights the lamp.

The 0.1μF capacitor now charges via the base-emitter junction of Q1, the 500kΩ resistor and Q2. After a short time, Q1 turns off, thereby turning off Q2 and the lamp. The 0.1μF capacitor then discharges via the 1.5MΩ resistor and the cycle repeats.



During daylight hours, phototransistor Q3 clamps the base of Q1 to the positive supply rail to stop the oscillator. The flash rate can be changed by altering the RC network.

"Wireless World"
August, 1985.

Projection lamp warm-up unit

This circuit is based on one published in the July 1968 issue of *Electronics Australia*. It has proved to be a very useful circuit for protecting projector lamps and other high output lamps from blowout due to the switch-on surge.

Later model projectors which have 24V lamps do not need this protection as their inbuilt transformers current limit at switch-on.

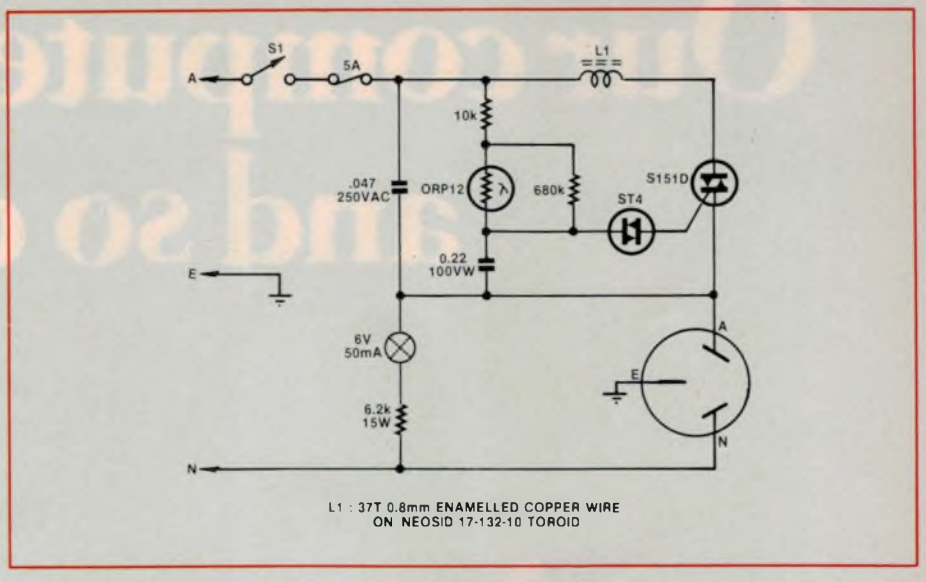
The method of protection is to limit the AC voltage fed to the lamp at switch-on by a phase controlled Triac. It works as follows: the ST4 and the Triac constitute a standard phase control circuit with the 680kΩ resistor setting the minimum brilliance of the lamp. When power is applied, the current through the 6.2kΩ resistor brings the 6V 50mA lamp up to brilliance relatively slowly, in about a second or so. The lamp is arranged to illuminate the ORP12 light dependent resistor and in doing so, reduces its resistance to a low value.

The ORP12 shunts the 680kΩ resistor with its low resistance value and thus causes the ST4 trigger device to fire very early in each mains half cycle. Thus full power is applied to the output after a delay of about a second. This is sufficient to give the lamp load a controlled warm-up and thus protect it from a damaging inrush current.

The 6.2kΩ resistor needs to be a 15W unit as it dissipates about 9 watts. The 680kΩ resistor may need to be adjusted to give the desired level of initial brilliance.

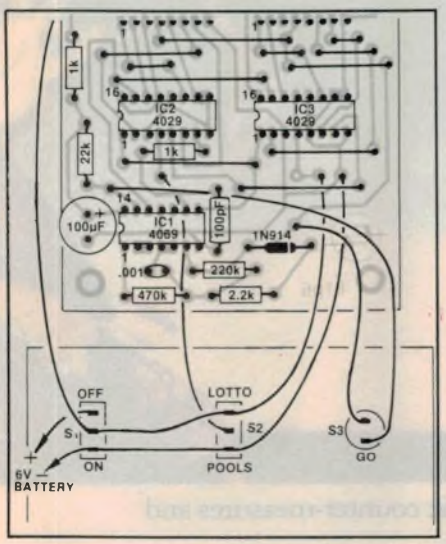
An interesting point about the circuit is that since the voltage applied to the 6.2kΩ resistor is controlled by the Triac, the initial current through the 50mA lamp will be very low. This will then progressively rise as the ORP12 light dependent resistor advances the Triac firing point.

Because high power lamps can damage the Triac if their filament blows and arcs over, the Triac should be rated at 15A and the circuit should be fused to suit the lamp rating.



L1 : 37T 0.8mm ENAMELLED COPPER WIRE ON NEOSID 17-132-10 TOROID

Modification to Pools/Lotto Selector



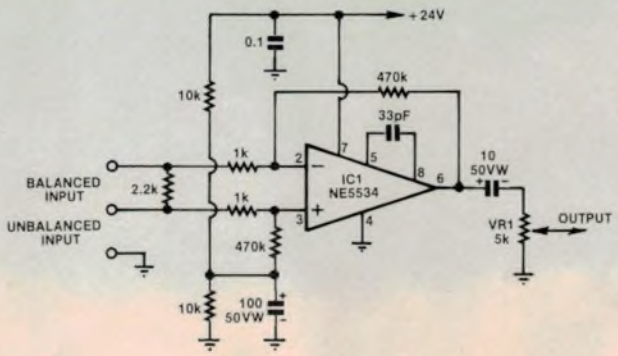
The Pools/Lotto Selector (EA, July 1981) generated a random number between 1 and 40 or between 1 and 55, depending upon the mode selected. Recently, Lotto in Western Australia was changed to 45 numbers. The following modifications allow the Pools/Lotto Selector to be used with the new system:

1. On the parts layout diagram, remove the link that connects pin 4 of IC2 to pins 4 and 13 of IC3.
2. Remove the lead to the wiper (centre terminal) of S2 and connect it to the lotto side of the switch, as shown on the wiring diagram (ie, to the +6V side of the switch).
3. Connect a new lead from the wiper of S2 to pin 4 of IC2.

The accompanying wiring diagram shows all the modifications.

A. E. White,
Collie, WA.

$15



Balanced microphone input stage

Based on an NE5534 low noise op amp, this microphone preamplifier provides a gain of 470 and can handle both balanced and unbalanced low-impedance microphones. The two 1kΩ resistors set the input impedance while the output is at low impedance to drive a 5kΩ level control.

Frequency compensation for the op amp is by means of the 33pF capacitor connected between pins 5 and 8. Power for the circuit should be provided by a well filtered 24V rail. The two 10kΩ resistors across the supply bias the non-inverting input to half supply.

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The Serviceman

Picking up someone else's pieces

One of the least enviable jobs any serviceman can tackle is trying to sort out the mess left behind by a previous service effort. Not only is the trail completely cold as regards any original symptoms, but there is the additional complication of more faults introduced in the process. On the other hand there is the challenge to succeed where someone else has failed.

Such is the background to my main story this month. It all started when the company panel van was hit by a marauding lamp post — the van was stationary at the time, of course — and had to be taken to a local panel-beating shop for some bashing and painting.

Realising the nature of my business, one of the young panel beaters asked me if I would look at his TV set and advise him if it was worth repairing. I said I would be happy to do so and began questioning him as to the symptoms, history, etc of the fault. The result was a somewhat surprising story.

It seemed that the set had simply failed — completely — and he had taken it to a serviceman in a nearby suburb, whom he named, and who I happen to know. He is a nice enough bloke and we have exchanged experiences and compared notes on a few occasions. And while I don't know him all that well, I had formed the impression that he still had a good deal to learn about modern sets.

Anyway, this chap had had a go at the set, apparently spent some time on it, then finally returned it to the owner with the pronouncement that it was not capable of being repaired. That was a challenge in itself; there is nothing makes my hackles rise quicker than sweeping statements of this kind. I would take a lot of convincing that any reasonably modern TV set was incapable of being repaired; uneconomic perhaps but seldom impossible.

The owner wasn't completely convinced either, so he took it to a second service organisation. They took one look inside the cabinet and, apparently shocked by the mess left by the first serviceman, simply refused to touch it. So the owner found himself left with a set which was supposedly incapable of being repaired and faced with the prospect of having to buy a new set.

Small wonder that he grasped at the straw when he encountered my van.

Nothing promised

The upshot of all this was that I suggested that he bring the set into the shop and let me have a look at it. While promising nothing I told him I thought there was a good chance it could be fixed but that, in any case, I would give him a fair appraisal of the situation.

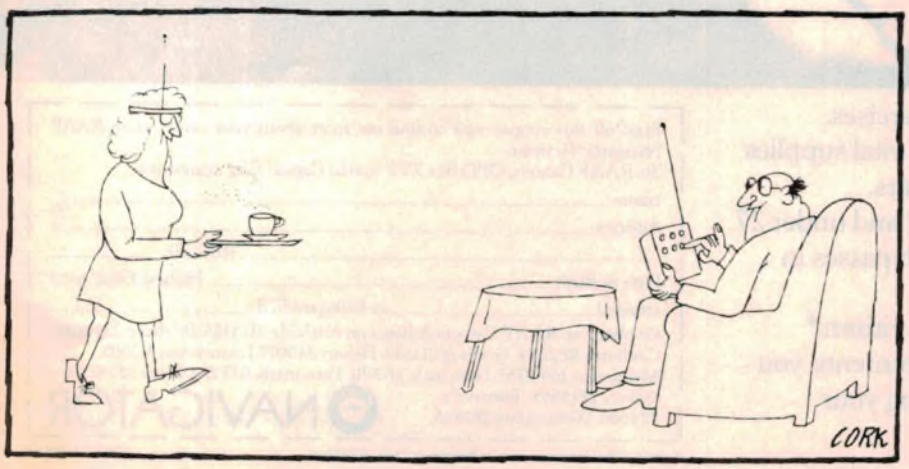
He was on my doorstep first thing the following morning with the set. It was an Hitachi model CWP-139; a smallish set with a tube size around 33cm. It is not a set that I have had a great deal of experience with, although some of the larger Hitachi models from the same period use very similar circuitry. In addition, Hitachi also market sets under the General Electric and GEC label. Again, large sections of the circuit are similar.

When I ultimately found time to pull the back off the cabinet and look inside I was more than a little dismayed at what I saw. The set is made up of two boards: the "signal chassis board" which, as its name implies, handles all the signal processing, and the "power deflection board" consisting of the power supply and horizontal and vertical deflection circuitry.

This latter board sits in the bottom of the cabinet and was obviously the one that had been worked on. And I say "obviously" because it was a pretty grotty sight. Quite a number of components had been removed and replaced, none too tidily, including the line output transformer. It was easy to understand why the second organisation had knocked the set back.

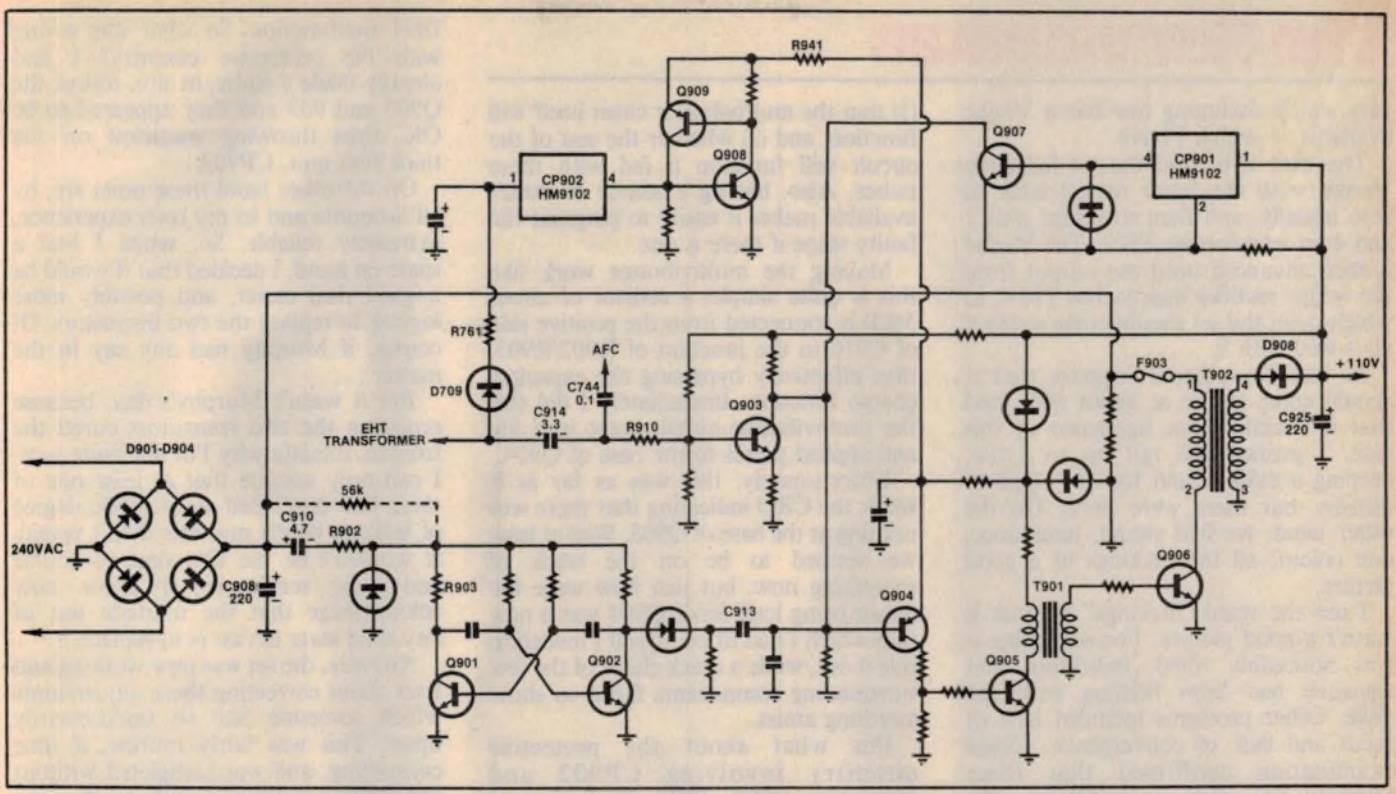
But the sight of the line output transformer started the bells ringing. I recalled that the first serviceman I mentioned had rung me a couple of months previously seeking advice on just such a model set in which the power supply refused to function. It was obviously this set because he had been convinced that the line output transformer was at fault, had replaced it without result, then re-fitted the original transformer.

I had made some suggestions at the time as to other tests that he could make, but it seemed that he had either made them or didn't consider they were appropriate. So we left it at that and I thought no more about it. But now the set was on my bench and I looked like being the bunny.



Basic circuit

At this stage it may help the reader to follow the story if I give a brief run-down on the power supply circuit, even though the broad philosophy is fairly common these days. The accompanying skeleton



Above: power supply circuit to the Hitachi CWP-139. The mains is applied to a bridge rectifier and regulated by a switching circuit.

circuit should help the description.

Mains power comes into a bridge rectifier (D901 to D904), the output of which is filtered by a 220μF capacitor (C908) and sits at about 340V. This is fed to the primary of transformer T902, the other end of this winding going to chassis via a chopper transistor (Q906). The base of this transistor is driven by line pulses via transistors Q903, 904, 905, and transformer T901. Pulses to drive Q903 are derived from a winding on the line output transformer via C914 and R910.

Output from the secondary of transformer T902 is rectified by D908, filtered by C925, and delivers 110V DC which becomes the HT rail for the set. And this 110V rail drives, among other things, the line output circuitry. So we have a curly-cum-back situation whereby the line circuit cannot function until it is supplied with 110V, and the 110V cannot be generated until the line circuit delivers pulses.

Stalemate!

To overcome this a starting circuit is provided, consisting of Q901 and Q902 in a multivibrator circuit. This is intended to function only briefly, at switch-on, and delivers pulses via D905 and C913 to the base of Q904. These drive the chopper transistor, allowing the 110V rail to be energised, the line circuit to be activated, and pulses fed to Q903. And so the setup becomes self-sustaining.

Energising the multivibrator for the brief period required is achieved by energising it from the 340V rail via C910 and R902. The act of charging C910 is sufficient to activate the multivibrator for a second or so; long enough to get the system started.

There are two other functions to understand in this circuit, both involving a thick film device type HM9102 (CP901, CP902). These are voltage divider/reference voltage devices, used to compare a running voltage with the reference voltage and to generate a suitable correction voltage.

In the case of CP901 the 110V rail is under scrutiny, being fed into pin 1. An error voltage appears at pin 3 and is fed to error amplifier Q907 which, in turn, controls Q904. The other unit, CP902, functions as an overvoltage protector. It senses the line output pulses, via D709, R761, and generates an error voltage at pin 4 which drives Q908, Q909. This combination is connected to the emitter of Q904 and, when turned on by excessive pulse amplitude, can shut the system down.

Well, that's the theory of the system. Although reasonably familiar with it I could only guess at what might be wrong. However, the makers do suggest a couple of simple checks to narrow down the possibilities. But first I simply switched on to see what would happen. In fact, nothing did; the set was as dead as the dodo.

A quick check with the multimeter showed that the bridge rectifier was working and that voltage was being applied to one side of the fuse F903 (800mA), but that there was nothing on the other side. The fuse was blown. On the strength of that I checked Q906, in situ, using a multimeter. Not surprisingly, I found that it had broken down, and between all three elements to boot.

Fitting a replacement wasn't nearly as easy as testing it, involving removing several pieces of metalwork and a heatsink. But it was done eventually and I tried again. There was still no joy so I decided to go over the rest of the transistors and make similar in situ checks.

All seemed well until I came to Q904, which I was unable to test for the simple reason that it wasn't there. Apparently my predecessor had removed it for some reason and forgotten to replace it. I found and fitted a suitable replacement and gave the set another try.

Still no joy. At this stage I had to make a decision as to my next most logical move. Superficially, at least on a static test basis, the power supply appeared to be intact, raising the possibility that the fault could be in the set itself; that there was no 110V rail because something was holding it down.

Granted, it didn't seem very likely but, on the other hand, there was a very easy way to check it and, once having cleared the set of suspicion, I would feel more justified in delving into the power supply in greater detail. The test I had in mind is suggested in one of the manuals and is

very simple assuming one has a Variac available — which I have.

The trick is to feed the set from the Variac, with the latter turned back to zero initially, and then to bridge pins 1 and 4 on transformer T902. The Variac is then advanced until the output from the bridge rectifier approaches 110V, at which point the set should come to life if all is well with it.

In fact the manual suggests that it should come to life at about 80V, and that is exactly what happened in this case. I pushed the rail up to 110V, keeping a close watch for any signs of distress, but there were none. On the other hand, we had sound, luminance, and colour; all the makings of a good picture.

I use the word "makings" because it wasn't a good picture. For one thing it was noticeably tilted, indicating that someone had been fiddling with the yoke. Other problems included lack of focus and lack of convergence. Closer examination confirmed that these controls had also been fiddled, the maker's paint seals having been broken. Why anyone would attack these adjustments on the basis of the set's symptoms I simply cannot imagine. Talk about clutching at straws.

(There is another test suggested in some manuals to determine whether it is the set or the power supply which is at fault. This is simply to disconnect the 110V rail from the signal board and run the power supply unloaded. From bitter experience I must warn that this is the surest way I know to destroy Q906. Apparently removal of the load from the transformer allows it to generate substantial peak voltages. If such a test is contemplated an appropriate load should be connected in place of the set.)

Anyway, my check had cleared the set and thrown suspicion firmly back on the power supply. I had in mind another test suggested in the manual, but first I made another check. When I replaced Q906 I had simply rewired the base and emitter leads exactly as I found them, without bothering to check the connections. But the more I thought about it the more doubts I had that the wiring as I found it was correct.

Sure enough, a check with the appropriate diagram confirmed my suspicion; the leads were reversed. That corrected, I tried again, but again no joy; the system simply would not start which brings me to the test I just mentioned.

Starting circuit

This involves the multivibrator starting circuit. The idea is to make it run continuously, thus clarifying two points; (1) that the multivibrator ciruit itself will function, and (2) whether the rest of the circuit will function if fed with these pulses. Also, having a source of pulses available makes it easier to pinpoint the faulty stage if there is one.

Making the multivibrator work like this is quite simple; a resistor of about 56kΩ is connected from the positive side of C910 to the junction of R902/R903, thus effectively bypassing the capacitor charge function. Immediately I did this the multivibrator circuit leapt into life and applied pulses to the base of Q904.

Unfortunately, this was as far as it went, the CRO indicating that there was nothing at the base of Q905. Well at least we seemed to be on the track of something now, but just how were the pulses being lost? Since Q904 was a new unit which I had fitted myself I tended to rule it out, while a quick check of the few surrounding components failed to show anything amiss.

But what about the protective circuitry involving CP902 and transistors Q908, 909? If there was something wrong here it might well be simulating an over voltage condition — which didn't actually exist — and shutting the systems down. Fortunately such a theory seemed easy enough to check. By simply lifting resistor R941 the protective function could be disabled.

This was done but, before switching on, I took the precaution of turning the Variac back to zero. By bringing the voltage up slowly I could monitor the HT rail and also keep a look out for any signs of distress in other parts of the circuit. In fact the power supply commenced functioning immediately and as the HT rail came up to around 80V the set burst into life again.

Finally, with the mains input at around 240V the HT line pegged at 110V exactly as it was supposed to. The only thing wrong was the absence of any protective function in the event of an EHT malfunction. So what was wrong with the protective circuitry? I had already made a static, in situ, test of the Q908 and 909 and they appeared to be OK, thus throwing suspicion on the thick film unit, CP902.

On the other hand these units are, by all accounts and in my own experience, extremely reliable. So, while I had a spare on hand, I decided that it would be a good deal easier, and possibly more logical, to replace the two transistors. Of course, if Murphy had any say in the matter . . .

But it wasn't Murphy's day, because replacing the two transistors cured the trouble. Exactly why I'm not quite sure. I can only assume that at least one of them had developed some subtle degree of leakage which my tests didn't reveal. It wouldn't be the first time of course and most servicemen I know now acknowledge that the ultimate test of any solid state device is to replace it.

Anyway, the set was now working and I set about correcting those adjustments which someone had so unnecessarily upset. This was fairly routine, if time consuming, and was completed without any further problems appearing. And the end result was a very nice picture, and a slap in the face for the "couldn't be fixed" theory.

Horizontal hold

I fitted the set back in the cabinet, pushed it into a corner of the bench, and let it run while I went on to the next job. Some time later I happened to glance at the set and realised that it had lost horizontal hold. I reset the control and the picture came good, but I realised that the locking range was quite small; much more critical than it should have been.

This was a bit of a blow but there was nothing for it but to pull it out of the cabinet again and start looking. Checking on the circuit around the horizontal oscillator (Q702) and the AFC circuit (Q701) I was reminded of a similar fault, described to me by a colleague, which involved a fault in one of two diodes, D701 and D702.

Deciding that, once again, replacement might be the quickest and surest check, I fished out a new pair and started looking for the suspected culprits on the board. In fact, I didn't really get that far because, in the process, I suddenly came across what appeared to be a component position, but with the component missing.

Further checking on the circuit established that it was a 0.1μF capacitor, C744. Since it wouldn't be the first time a component had been deliberately omitted during manufacture, due to design modification the first thing I did was to examine the copper side of the board for signs of tampering. And this

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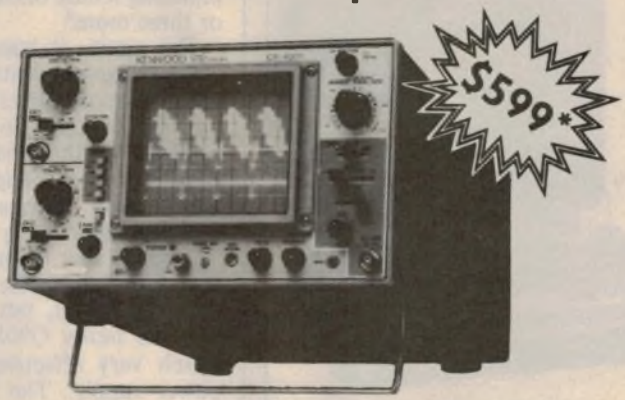

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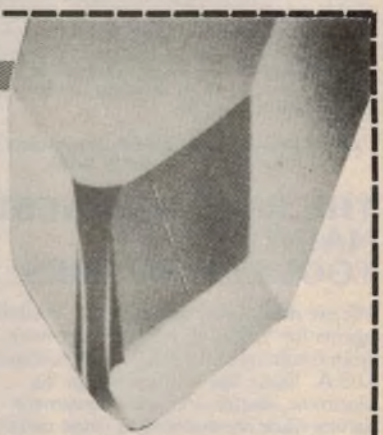

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left no doubt in my mind that someone had removed the capacitor.

More detailed checking of the circuit showed that it formed part of a circuit from the same pulse line which activates the power supply and obviously feeds pulses to the AFC circuit. Not much wonder that we had a locking problem. But why had it been removed? Would replacing it cure one fault and create two or three more?

But again, it wasn't Murphy's day. Fitting a new capacitor cured the locking problem most effectively, and without any side effects. So why had it been removed in the first place? Frankly I haven't a clue; it appears to be just one more quite illogical "suck-it-and-see" approach adopted by my predecessor.

And on that theme, just what was it that first disabled the set? It's hard to be sure, of course, but my bet is that it was the faulty Q908, 909 combination which very effectively shut down the power supply. The remaining defects, including the destroyed Q906, were the result of my predecessor's efforts to find it. And it seems highly likely that Q906 was destroyed because he followed the suggestion about disconnecting the power supply from the set proper.

And that, from a strictly electronic point of view, more or less winds up the story. But I was far from happy about the grotty appearance of the board. I had been over it with the soldering iron and remade any joints I felt might be suspect, but large lumps of surplus flux around the remade joints made it a sorry sight. Beauty may be only skin deep, but I imagine the appearance of the board may have been one reason for the refusal by the second service organisation to have anything to do with the set.

I have tried several ways of cleaning boards, including the use of methylated spirit, but eventually discarded them in favour of my present technique. This uses lacquer thinners and, while it calls for a certain amount of skill, is very effective. (I need hardly add that thinner is extremely volatile and should not be used in the vicinity of any open flame, lighted cigarettes, etc.)

The skill required involved applying no more thinner than is absolutely necessary in order to dissolve the flux, otherwise there is a risk of removing the original green paint from the board, which could make it look worse than ever. I apply it with a small artist's brush with the bristles trimmed short to give them added stiffness.

I know it sounds drastic and risky but I have found it to be completely successful. Be sparing with the thinner; too little is far better than too much. If you want to try it I suggest you practise on a few discarded boards first. You'll soon get the feel of it.

In this case the end result was most gratifying, with the board looking almost new. At least if anyone asks who last worked on the board my ears will not be burning.

And so the set was eventually returned to a very happy customer, even though I had to hand him a substantial account. After all, I had had to do a lot of cleaning up and sorting out.

Exorcising ghosts

To change the subject, here is something more about ghosts — the electronic variety — and the exorcising thereof. I first mentioned this subject back in January and December 1977, describing a system being developed by Toshiba, using a CCD video delay line.

More recently, in January this year, I mentioned that the first commercial version of such a system had been incorporated in a set released by, rather surprisingly, Hitachi. So what had happened to Toshiba?

I have just learned that Toshiba has now released its version. It has been released in the USA and is designated model CZ2094. I understand it was described in some detail in the magazine "Audio Video International", by David A. Paterson. For the moment all I have been able to learn is that it uses a 51cm flat face, square corner tube, and offers several features apart from the ghost suppression.

It makes extensive use of VLSI circuits and digital technology, features 32 key-operated functions, with a screen display of all functions, freeze frame facility, multi-channel sound, and a second picture facility in any corner and variable in size from one sixteenth to one quarter of the tube area. All of which will undoubtedly add to a very substantial price tag.

Fair go mate! All we wanted was ghost suppression.

TETIA Fault of the Month

HMV (Healing) C211, C212.

Symptom: Still some flagwaving on VCR playback, even after fitting manufacturers recommended modifications to flyback comparator circuit.

Cure: reduce value of C214 from 0.47μf to 0.1μf. C214 is part of a second phase comparator (synch pulse/osc output) contained in TBA920 and in some cases both comparators need to be modified.

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.

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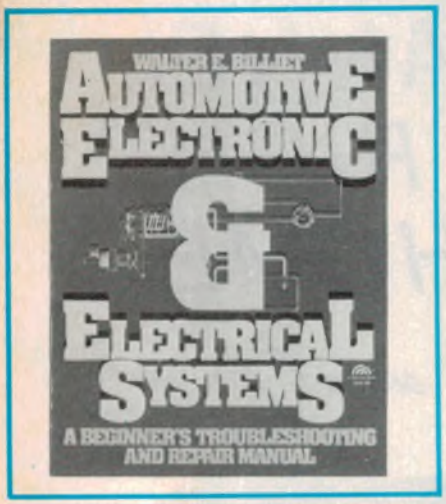
Books & Literature

Automotive Electronics



AUTOMOTIVE ELECTRONIC & ELECTRICAL SYSTEMS: A beginner's troubleshooting and repair manual. By Walter E. Billiett. Published by Prentice-Hall of Australia Pty Ltd, 1985. Soft covers, 280 × 215mm, 276 pages, illustrated with photos and many diagrams. ISBN 0 13 054248 2. Recommended retail price $35.95.

One of the great difficulties presented by the electronic systems on modern cars is the lack of information on servicing. While manufacturers' original information can be very comprehensive, it can be difficult and expensive to obtain.

This book goes some way to redress this problem although it only covers the American automobile manufacturers, viz, GM, Ford, Chrysler and AMI. Even so it does provide a useful insight into the major electronic systems on most cars.

There are 13 chapters: (1) Introduction, (2) Fundamentals of Automotive Electricity, (3) Electrical, Electronic and Ignition Components in General, (4) Battery Service, (5) Starting System, (6) Charging System, (7) Ignition System, (8) Emission Control Systems, (9) Computer Control Systems, (10) Troubleshooting Computer Control Systems, (11) Electronic Fuel Injection Systems, (12) Troubleshooting Electrical-Electronic Problems and Engine Performance and (13) Lighting Systems and Electrical-Electronic Accessories.

Each topic is treated in quite a lot of detail and specific American models are discussed. A particular attraction of the book is that it is so well written and easy to follow.

A few aspects of automotive electronics which are not covered are dashboard car computers which calculate petrol consumption and so on, the new electronic dashboard displays and car sound systems, a subject in itself.

Even so, for anyone involved in automotive electronics, it would be a most useful reference. Our review copy came from the publishers. (L.D.S.)

Security Electronics

SECURITY ELECTRONICS: by John E. Cunningham. Third edition published 1983 by Howard W. Sams & Co, Inc. Soft covers, 210 × 128mm, 255 pages, illustrated with many diagrams. ISBN 0 672 21953 0. Recommended retail price $22.95.

While people tend to think of "security electronics" as embracing burglar alarms of one type or another, this book covers a wider field, taking in not only burglar alarms sytems for business, home and car, but also the areas of bank holdup alarms, computer crime, electronic eavesdropping, personnel identification, personnel screening for weapons (as at airports), communications security (scrambling), and lie detection.

The bulk of the book, however, is devoted to burglar alarms which are covered in great detail. Every type of detection system is discussed and there are many diagrams devoted to characteristics and circuit applications. Some of the more unusual detectors which are discussed include beat frequency and bridge-type proximity detectors, vibration detectors and infrared body-heat detectors.

In summary, a well-written and very topical book which we can recommend. Our review copy came from Jaycar Electronics, PO Box 185, Concord, NSW 2137. (L.D.S.)

Electronics Australia

Home and Car Security 1985

Alarms are only alarms. They may be one of the best deterrents to burglary, but they offer no protection themselves. Protection comes from a well-planned security system covering your house, yard, car and garage, and even specific items. No matter how well-planned, no system will be reliably effective if it is not properly designed, installed and maintained.

As a start, ask yourself: What am I trying to protect against? How can I get this protection? What do I want a detector to find? How will the alarm be sounded and who will respond?

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Uses the ultrasonic "Doppler" technique to detect movement within 6 metres. Powered via a 9 volt battery and optional AC adaptor providing total flexibility and mains failure back-up. It can be easily expanded into a highly sophisticated security system with additional Arlec accessories.

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3 **Home burglar alarm.**
Using the ultrasonic "Doppler" technique, the unit detects any movement within 8 metres. Simply plugs into the mains supply and when triggered emits an ear splitting siren. Features include automatic battery back-up in case of power failure plus additional high powered siren loudspeaker and magnetic switch to protect doors or windows. Includes facility to add optional external detectors.

4 **Electronic car alarm.**
Immobilises the car ignition circuit. When a thief attempts to enter your car an ear splitting siren blasts for 3 minutes. The alarm incorporates an automatic delay which allows you 30 seconds to leave the vehicle and 10 seconds to re-enter and cancel the alarm. Easy to install. Switches to protect boot and bonnet supplied. Features 2 optional circuits to protect car parts and accessories.

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Home Security

Home security is not something you can buy. Security will only come after forethought, thorough planning, informed choices, skilled installation and proper maintenance.

by John Farrell*
and Jake Kennedy**

THE SECURITY INDUSTRY today is the growth industry that everybody seems to want a slice of. There are a host of new retailers, installers and products blaring at us from the radio, TV, billboards and movie screens. This host has brought problems, notably the poor quality of some products, and the sheer number of new alarms, detectors, combinations and complex systems that face the worried home owner.

The security industry itself has to cope with outdated regulations. While the Standards Association of Australia has published *Intruder Alarm Systems Parts 1 and 2*, which set standards for Installed Systems, Central Stations and Signalling Links, these were published in 1978. The revision of these parts and *Part 3* covering Detection Devices should be available late this year. (These and other useful publications are available from the Standards Association offices in all capital cities.)

The following survey covers the type of detectors and systems that are currently available. The information here should better arm you for discovering what's best for your own particular needs. Some of the features you'll be offered sound great, but *Do you really need them?* Some systems are cheap, but *Will they do what you want?*

First, we will look briefly at the various types of 'space' or 'movement' detectors, so-called because they are designed to detect movement in a certain volume of space. With a working knowledge of each type, it's possible to start narrowing the field of choice without leaving home. There are many brands of space detector available, but they are all one of four main types: *ultrasonic, microwave, passive infrared* or *UHF radio.*

Although ultrasonic (US) detectors use sound energy and microwave (MW) detectors use electromagnetic energy, they are very similar in operation. Both use the Doppler effect, but in quite different frequency ranges, as their names indicate. (Refer to the accompanying box for an explanation of the Doppler effect as applied here.) Ultrasonic detectors operate between 20 and 40 kHz; the standard, when published, will probably be 22 kHz. Microwave detectors for Australia currently use a frequency between 10.500 and 10.655 GHz, although the Department of Communications has indicated that all new equipment should operate in the 24.00 to 24.25 GHz range. Passive infrared (PIR) detectors use a completely different approach: They emit no signal whatsoever (hence *passive*), but rely on changes in the energy received from the surveillance area.

*Alarm Systems Convener for ASAIL and Executive Member of the Australian Standards Association's Committee Electronic Alarm Systems; and Business Development Manager, Chubb Security Australia Pty Ltd.

**Special Projects Editor, Electronics Group, Federal Publishing Company.

Ultrasonic Movement Detectors

Our ears can hear sounds with frequencies up to about 20 kHz, above that is 'ultra-sound'. The ultrasonic signal used by this type of detector is generated by an electronic oscillator feeding an ultrasonic transducer. The amplified signal from the transducer is then transmitted using air as the medium. The transmitted signal is reflected by objects within the area under surveillance. The reflected signal is received by a second transducer which converts the acoustic energy back to electric energy. After this electrical signal is amplified, it is compared with the original amplified signal from the oscillator.

If there is no movement in the area, there will be no frequency difference between the two. When a moving object is present, however, the receiving transducer returns a signal differing from the reference frequency by the Doppler shift. A signal processing circuit picks up the difference and actuates the alarm.

Many ultrasonic motion detectors house the transmitter and receiver together in the same case. These are normally mounted on a wall or in a ceiling corner and are used to protect an area up to 6m x 9m with a 3.5m ceiling. The area actually protected will vary from brand to brand, so check the specifications. (All of the specifications quoted in this article are intended as a guide only: Make your choice based on specific data for specific units.)

Another type of US detector uses separately housed transmitting and receiving units. A system with this type can be designed to use multiple receivers with a single transmitter. A typical installation would have the single transmitter mounted in the ceiling near the centre of the room and receivers mounted on opposite walls.

Ultrasound will be completely contained within a room, generally, since it does not penetrate most structural materials. Like any sound, it is absorbed by carpets and other soft furnishings. However, 'hard' furnishings will reflect — and may distort — the US signal; this distortion can cause false alarms. Keep in mind that *any* furniture may block the US signal and create a shadowed area that the detector cannot see. Before deciding on this type of detector, have a demonstration in your home. Ideally, you should try any detector where you want to use it before buying it.

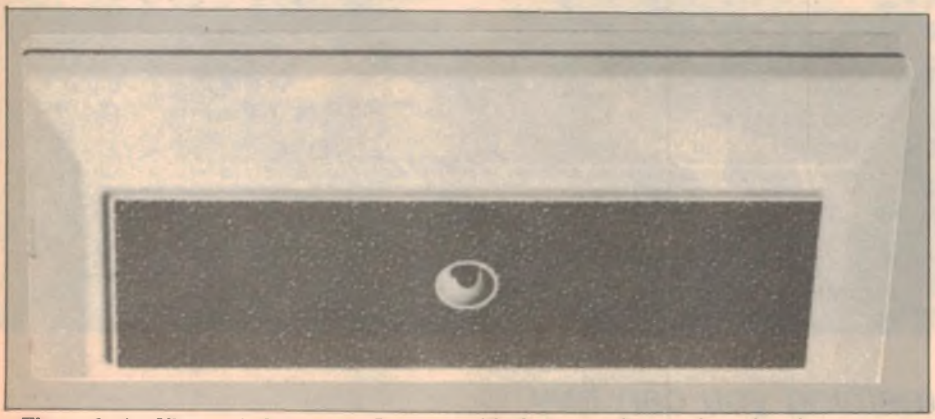

Figure 1. An Ultrasonic Movement Detector with the transmitter and receiver housed together. Its operating frequency is about 33 kHz.

Doppler Effect

To understand what US and MW motion detectors are looking for, let's look briefly at the Doppler effect. Think of the familiar change in pitch of a passing locomotive's whistle — that's a Doppler effect. The change in pitch (frequency of the sound waves) is directly related to the difference in velocity between the observer and the source. Think of the sound waves from the locomotive's whistle as a ball thrown from the train to an observer: When the train is approaching, its velocity is added to whatever force the ball is thrown with; after the train has passed, it's subtracted. Now consider the detector as the observer and the intruder as the source (whistle). We can calculate the shift in frequency caused by a moving intruder by restating the Doppler shift equation as:

$$fD = \frac{2Vf+}{C}$$

where: fD = the Doppler shift as perceived by the detector

V = the source's (intruder's) velocity in relation to the detector

f+ = the frequency of the signal transmitted by the detector

C = 3×10^8 m/s for MW *or* 344m/s for US.

Now, assume an intruder moves towards the detector at 0.5m/s, and the detectors use the lower ends of the ranges given in the article. Then, we can determine the relevant frequency shift:

$$\frac{(2)\ (0.5)\ (10.5 \times 10^9)}{3 \times 10^8}$$

= 35 Hz for a MW detector

or

$$\frac{(2)\ (0.5)\ (22 \times 10^3)}{344}$$

= 64 Hz for an US detector

Those frequency shifts are what the detector circuit is supposed to be detecting. When the circuit 'sees' a shift corresponding to movement, it sounds an alarm.

As an aside, the intruder's velocity of 0.5m/s is a standard movement: the proposed standard states, in effect, that at 80% of the manufacturer's claimed distance range for a detector and with the sensitivity set to minimum, the detector "will enter the alarm condition" before the target can move 2.0m. As a guard against false alarms, the standard also stipulates that at 80% of the claimed range and with the sensitivity set on maximum, the "detector shall not enter an alarm condition" before the target moving at 0.5m/s has movd 100mm.

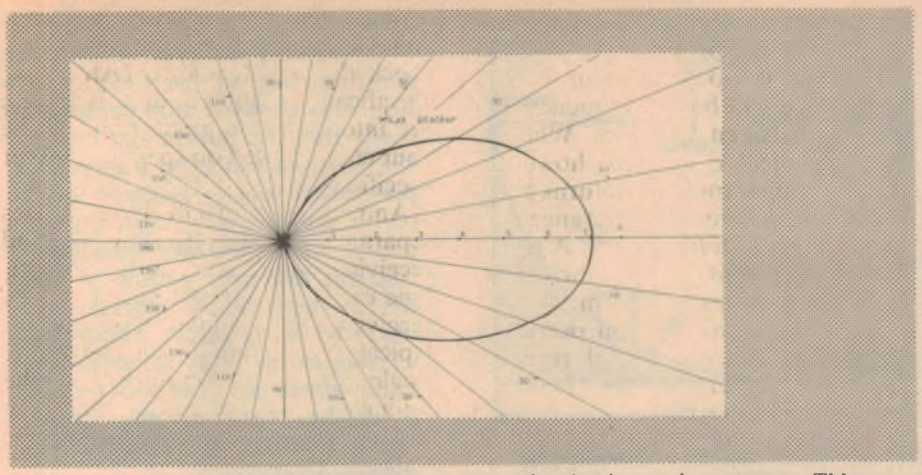

Figure 2. A polar diagram for the unit in Figure 1 showing its maximum range. This same unit can be adjusted from the 7m range shown, down to 1m.

Note that ultrasonic Doppler shifts (and false alarms) can be caused by air turbulence, eg, convection currents from a heater or a draught. Also note that part of the US signal may penetrate exterior walls; when this part is reflected, it may be seen by the detector as movement in the room. The ring of a doorbell or telephone is another common cause of false alarms, so any system you buy should have filters for these sounds.

A curtain blowing in the wind is certainly moving and it will set off an alarm without "balanced signal processing", which simply means the reflected signal is compared to the transmitted signal over a period of time. The forward and backward movement of the curtain will be cancelled out during this period by balanced signal processing, so no alarm will result.

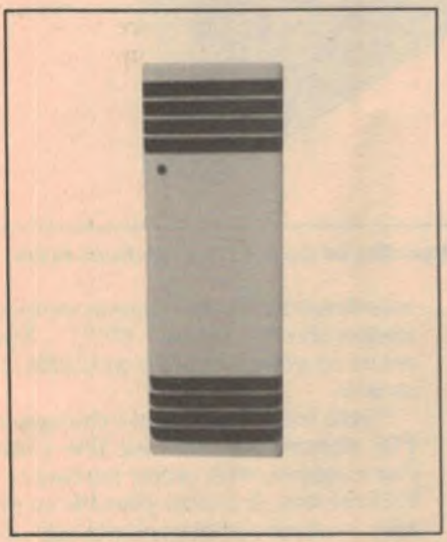

Figure 3. This Ultrasonic Movement Detector has two separate transmitters and receivers housed together that "see" at 90 degrees to each other. This gives a much greater coverage than units with one of each.

Air itself will absorb sound, with the extent of the absorption related to relative humidity. Maximum absorption occurs when the relative humidity ranges between 30% and 50%. This absorbed sound is one of the commonest causes of false alarms with US detectors, because the system will respond with an alarm if the total received signal drops below a pre-set fraction of the transmitted signal. Sensitivity settings should be made, then, when the relative humidity is in the 'maximum absorption' range. Each brand of US detector has its own peculiarities in this area, so ask what effect changing humidity will have on it.

Microwave Motion Detectors

A microwave motion detector works on the same broad principle as an US detector, but uses an ultra-high-frequency electromagnetic field generated by a Gunn diode. The field can be transmitted "unfocussed" or in one of many controlled patterns using a particular transmitting antenna. The system may use a single housing for both the transmitting and receiving antenna, in a "siamese twin" configuration. Alternatively, the two antennae may be housed separately and mounted at opposite ends of the room.

Because of their high frequency, microwaves will pass through most building materials with little loss of energy. Even double brick and concrete exteriors are penetrated, but the MW energy is so weakened by two passes through the wall, that the reflection is useless for motion detection. In practice this means that a lounge room mounted MW detector with its receiver gain set to see an intruder 3 feet inside the room, can send waves through an exterior wall. The weakened energy of the reflection from a passing car could then be "seen" by the detector as movement within the lounge room.

On the other hand, microwaves are reflected by metal which is, in fact, used as shielding in MW detectors. Without adequate shielding, microwaves can exit through the back of the detector and bounce back with an unwanted signal.

It follows then, that MW detectors also need to be sited with caution. An "in house" demonstration before buying is again emphasised. Microwave detectors can have a range exceeding 100m for outdoor use with a typical range of 15 to 30 metres for indoors.

There are various types of signal processors used with MW detectors, too. A recent development is the use of a *stereo* Doppler effect: Two Gunn diodes, two transmitters and two receivers provide the detector with a more precise "view" of the room. The processor is then better able to discriminate between movement and false signals. If MW detectors are the most suitable for a particular application, the added expense of a "stereo" system can be balanced by a marked reduction in false alarms.

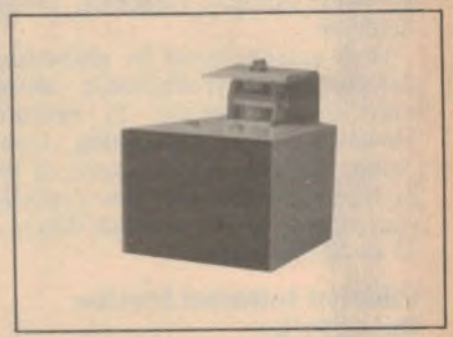

Figure 4. A Microwave Motion Detector suitable for large warehouses or a single room. This unit has a built in control unit.

Never locate a MW detector near a moving object, eg, electric fans or curtains. Microwave ovens do not effect the system unless the oven is faulty and most of the microwave energy is escaping from it. MW detectors pointed at fluorescent lights are a common cause of false alarms, so ensure that the lights are not "seen" by the detector.

It is extremely important to locate the MW transmitter and receiver(s) so that an intruder must move towards one or the other. (Movements at right angles to the transmitter-receiver axis will give lower Doppler shifts, so the probability of setting off

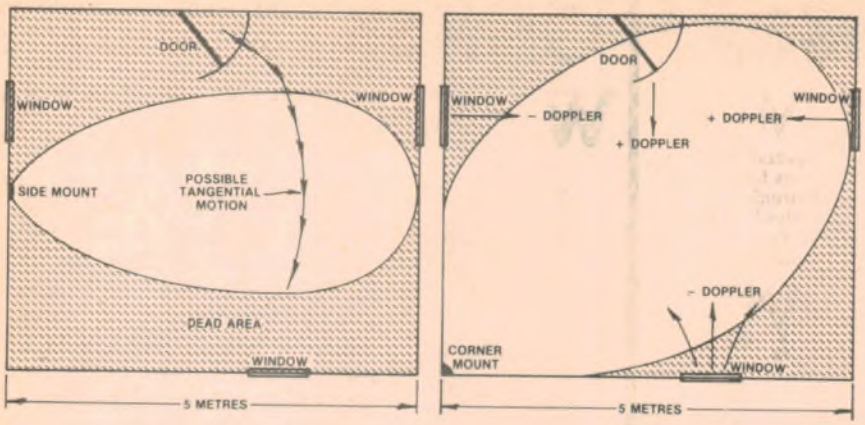

Figure 5. The area typically covered by a Microwave Motion detector is shown for the same unit mounted on a side wall and a ceiling corner. A ceiling corner mounted unit allows much greater coverage from the same unit. The diagram on the left shows the tangential motion referred to in the text. Regardless of the point of entry, the coverage on the right will give a Doppler shift.

the alarm is reduced.) Movement tangential to the detector is possible. Theoretically, this shouldn't activate the alarm; in practice, it will, since it is impossible for the intruder to keep all body surfaces tangential to the detector.

High current drain by microwave detectors has traditionally meant they were expensive to operate. However, the transmitting Gunn diodes were the main source of the problem and they are now available with relatively low current drains— 25 to 40 milliamps.

Passive Infrared Motion Detectors

Systems using passive infrared (PIR) detectors have a pyroelectric sensor which receives heat energy and converts it to electrical. Since all objects, including furniture, continuously emit infrared radiation, the sensor will produce a background voltage in response to the background radiation, even under quiescent conditions. When an intruder moves across a zone seen by the detector, there will be a change in the infrared energy reaching the sensor, a corresponding change in the voltage output and a corresponding change in environmental noise level as the alarm is activated.

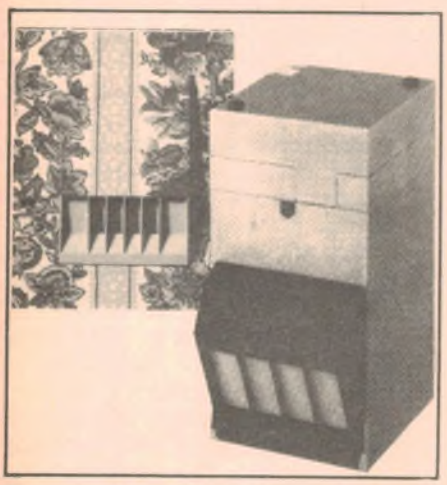

Figure 6. A wide choice of Passive Infrared Motion detectors are available. This unit can be mounted so that its front is almost flush with the wall; trim plates are used to match the wall colouring, as seen on the left.

The pyroelectric sensor may be located either at the focus of a series of mirrors, with each mirror reflecting the infrared energy it 'sees' from its zone on to the sensor; or it may be located behind a Fresnel lens with each facet focusing the energy it sees on to the sensor.

Infrared emission (heat radiation) from a piece of furniture, wall, whatever, depends not only on their temperature, but on the rules of emission. One of these rules paraphrased, states that the darker the body, the less infrared radiation it emits, eg, a matt black toaster radiates less heat (cools more slowly) than a chrome-plated one. Misunderstanding this rule has led some people to believe that a "matt black" intruder is less likely to be detected. Theoretically, as long as his body temperature remains above absolute zero *(−273°C)*, it will be "seen" by the sensor. In short, there is no practical way to escape detection.

However, as the ambient temperature approaches normal body temperature — about 35°C — there is a severe reduction in the efficiency of PIR detectors. The proposed standard warns that detection may not reliably occur when the "average temperature of the environment" is 36 to 38°C. It further states that "unreliable detection could occur at ambient temperatures below 0°C". That refers to units currently available, of course.

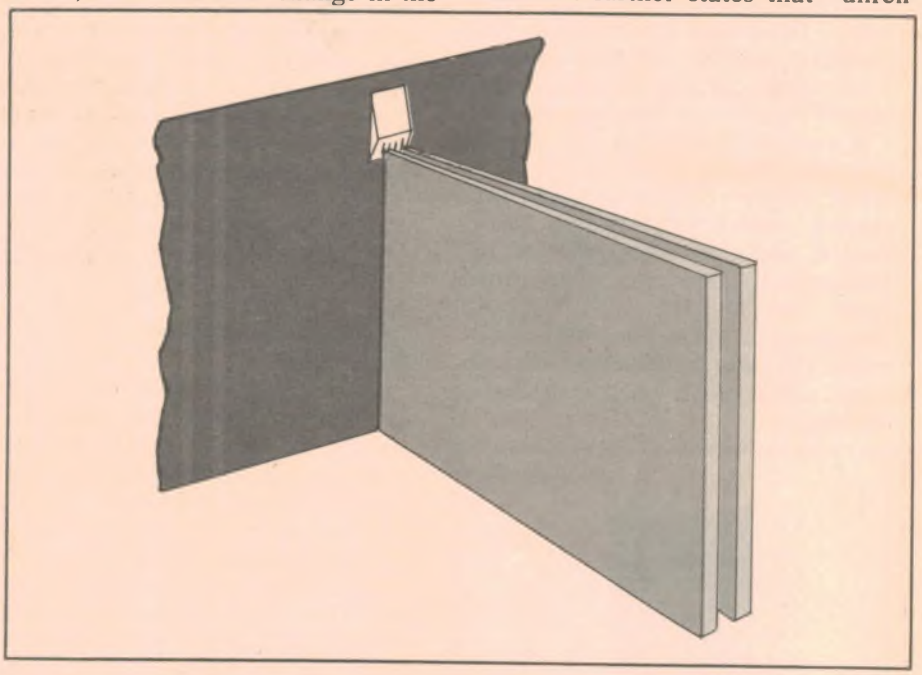

Figure 7. The "fingers" of a PIR detector. Depending on the unit, they can be up to 6m high and 10m long.

There have been many changes to PIR detectors in the last few years. For example, with either mirrors or a Fresnel lens, it is now possible to obtain various arrangements of the zones ("fingers") seen by the sensor. These vary from one solid curtain along an entire wall with the rest of the room free, to systems with 20 or more fingers spanning 115 degrees.

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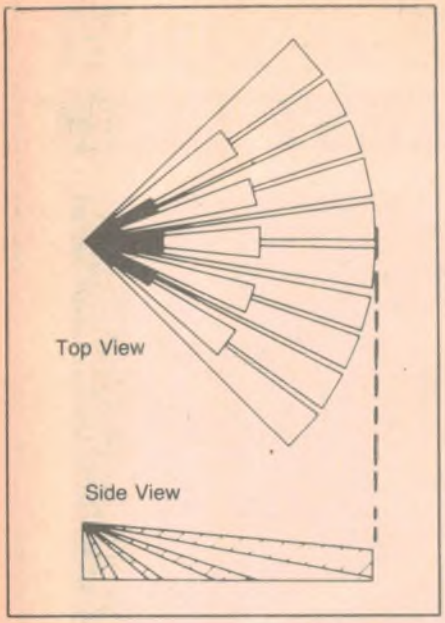

Figure 8. Multiple finger coverage. Note the shorter fingers between the long ones. This unit also has "creep detectoion".

Multiple finger systems often feature short fingers of detection between long ones. Another feature is "creep detection" which means that one or more fingers cover the space immediately in front of and below the unit.

This last mentioned feature is an example of what you may not need and shouldn't be frightened into paying for. If the PIR detector is properly placed in a room, it may not be possible for an intruder to get close enough to the unit without sounding the alarm anyway. And, any unit you are going to rely on should have some form of tamper-proofing that will sound the alarm as soon as the detector itself is interfered with. However, if you have your prize trophies on a table in front of the detector, the triple protection that the feature offers may be comforting. Note that many brands offer "creep detection" as a standard feature; that's fine, but as stated earlier, don't be frightened into paying extra for it if you don't need it.

Another recent refinement to PIR detectors is "multiple zone coverage". Before this, the sensing system reacted to anything it saw as a moving source of radiation, eg, convection currents caused by a heater or variations in background radiation. This was because only a single detector covered all zones. Multiple zone coverage uses a somewhat more complex system: Each mirror or lens facet directs the PIR energy it sees onto a two-element pyroelectric sensor. The optical system is arranged so that each sensor element sees separate but adjacent zones. When an intruder enters a zone, he is seen by one element before the other. The imbalance between elements activates the alarm. While more expensive, this system is able to compensate for many of causes of false alarms from PIR detectors.

Because they are passive, infrared detectors need the most consideration when siting. The following hints should eliminate the most common causes of false alarms.

Do not locate the unit where direct sunlight will fall on it, or in a room with west-facing windows unless the detector is looking at a cold surface, eg, a brick wall. Make sure the device is located away from any source of infrared radiation, eg, heaters and fireplaces. Try not to site the unit so it is "looking" across a draught, which can alter the background radiation.

PIR detectors can cover a room 9m square, and give the best coverage when mounted in a ceiling corner. If the unit must be wall-mounted, look for one with a wide field of view to give the most complete coverage.

UHF Radio Motion Detectors

These are probably the least understood (and least common) of all the motion detctors. At this time, they are also categorically the most expensive. However, ultra-high-frequency (UHF) radio motion detectors are the easiest to instal and are the hardest to defeat, so they certainly are worth considering.

When shopping for a security system, you may come across "wireless systems". Do not confuse these with systems using UHF radio motion detectors. Wireless systems use UHF signals to replace wire connections in the system, eg, between the detector and alarm. These systems do not *necessarily* use UHF detectors, although it makes manufacturing sense to combine the two uses of UHF signals in one system. Even within the industry, especially amongst the newcomers, there is a great deal of confusion between these very different applications.

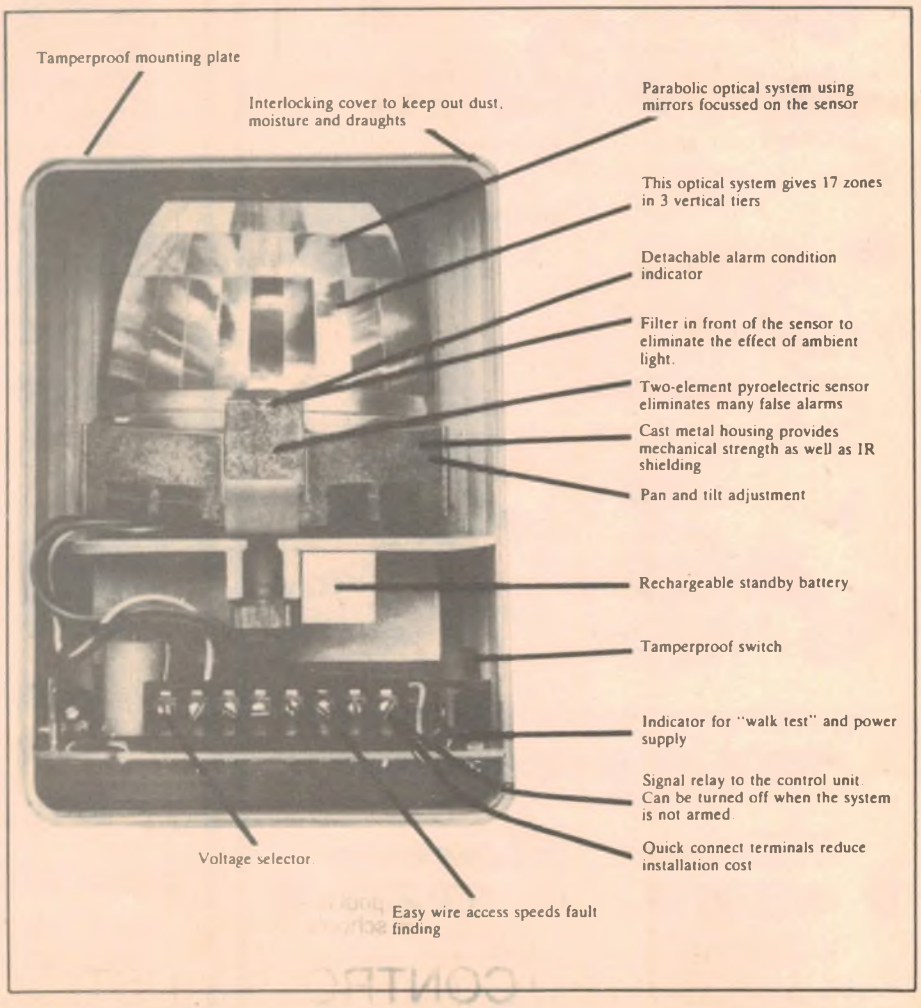

Figure 9. A Passive Infrared Motion Detector with its cover removed to show various features. This unit uses mirrors with the sensor mounted in front.

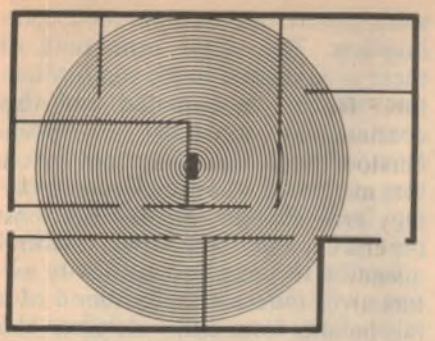

Figure 10. The field generated by a UHF Radio Motion Detector mounted in the normal position. Because of their High penetrating ability, these detectors must be sited carefully.

Although there are excellent wireless systems available, they have not yet been addressed by the Standards Association nor, formally, by the Department of Communications. Imported units may illegally use frequencies in our military and police bands. It would be wise to check with the Department that any UHF frequency used, is approved for such use.

Now, back to the subject at hand. UHF radio motion detectors broadcast a UHF radio signal in the area surveyed. If the resulting electromagnetic energy field is disturbed by any movement in its area. The disturbance causes slight changes in the continuously monitored power level of the transmitter. A pre-set disturbance over a pre-set time, will cause an alarm to be sounded. Because only the transmitted power is monitored, there is no need for a receiver or separate antenna.

UHF energy will pass through nearly all building materials, even brick to a certain degree, but is reflected by metal. Its penetrating ability is even greater than MW's. While this penetration is a disadvantage with MW detectors, it's often the very reason UHF detectors are used.

The high penetrating ability means that the detector can be concealed in

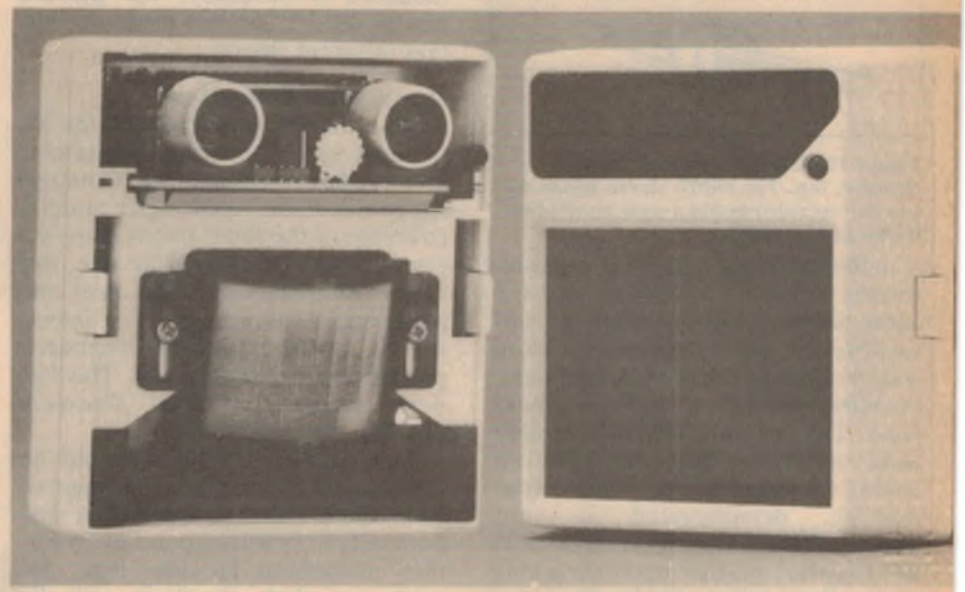

Figure 11. This unit combines PIR and US detectors. Compare the optical system of this unit with that of the PIR unit in Fig. 9; this unit uses a Fresnel lens.

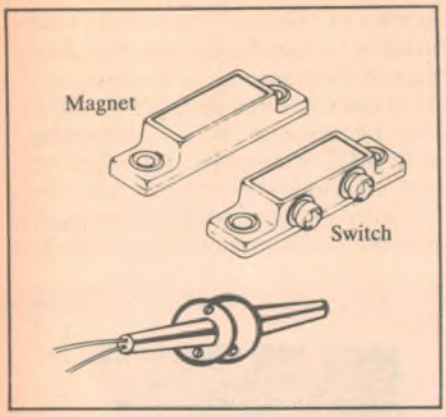

Figure 12. A simple magnetic switch detector, top. The switch shown below it, can be concealed inside a door or window frame and the jamb.

a cupboard or used to cover areas on several floors of a building. By the same token, UHF detectors are not suitable for use in homes with close neighbours, eg, home units and semi-detached terraces, or close to a busy road. Do not buy any system that uses any radio frequency with out having the exact system you are considering, demonstrated in your home. (Who knows what effect that old fireplace or the metal sheathing on the floor joists will have?)

With the detector mounted in the *normal* position, the electromagnetic field is generated equally in all *horizontal* directions. For this reason, the detector is usually placed in the centre of the area to be monitored. Typically, UHF detectors have a range adjustable up to a radius of 20m. The field may be distorted by walls or metal surfaces in it and there may be shadows thrown by impenetrable objects. Only by setting the unit up in your own home and then doing a "walk test" around the area to be protected can you determine the field's pattern.

Most units are designed so that the pattern is not spherical, but closer to a flattened doughnut shape. This avoids an excessive detection range above and below the unit when it is mounted in the normal position. It also means that with the unit mounted horizontally, the pattern can be used to protect areas on several different floors.

Combined Detectors

Now that we have covered the individual types of motion detectors, let's consider combinations. Combining two detector types to give parallel coverage of the same area is more expensive than using a single one, but there are advantages. The chief one is the increased probability of detecting an intrusion and the decreased probability of a false alarm. This last point makes combined detectors popular with neighbours.

Any combined system should be designed so that an alarm is triggered only when there is a stimulus that both detectors will respond to. A further refinement provides logic circuitry so that an alarm will be sounded only if both detectors respond within a pre-set time. Ideally, each type in a combination should not be sensitive to the false alarm sources of the other; such detectors are termed "complementary". Either detector may occasionally repond to a false alarm, but the chance of this happening to both within the pre-set time is very low.

Which detectors are complementary? This depends entirely on the specific application. For home use, the most popular choice is an ultrasonic/passive infrared detector combination. The signal from both of these is contained in the room where the detector is mounted and this combination is easy to instal. Remember though, that both detectors are prone to false alarms resulting from changes in ambient temperature and humidity. Careful attention to siting and sensitivity settings will reduce the likelihood of a false alarm from either detector and greatly reduce it from the combination.

Combined detectors are only just gaining popularity and they are relatively expensive. The advantages they offer in certain situations should certainly be considered if you are looking at any sort of system, however.

Combinations and the four types of detectors discussed, cover all of the motion detectors commonly available. There are other types available that detect an intruder using different criteria, however. Motion detectors are designed to cover a large area, but sometimes a specific object or area may want monitoring. Let's look briefly at detectors that are suitable for this.

Switch Detectors

The simple operation of electromechanical switches has kept them the most common sort of detector used with alarms. Such switches have one contact mounted, say, on a door frame and the other on the door itself. When they are positioned so that the contacts are closed with the door shut, the system can be wired to sound an alarm when the door is opened.

The most common switch detector is the 'dry contact switch' which is similar to the familiar light switch. One of this type is the 'plunger switch' for doors or window jambs that works the same way as the switch that turns your car's courtesy lights on when a door is opened. Another type you may encounter has small levers that move with a door or window and actuate the switch indirectly. Then, there is the trip switch built with the contacts normally held open against spring tension: A thin plastic strip inserted between the contacts is pulled out when an intruder walks into a wire attached to the strip.

Magnetic switch detectors are also quite common. These have two components, each housed separately. The switch itself is a pair of contacts

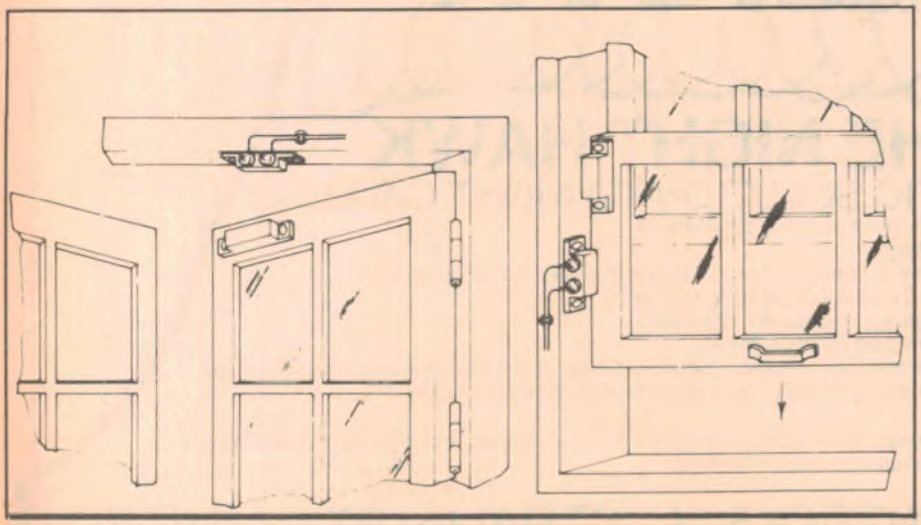

Figure 13. As these examples show, Magnetic Switch Detectors can be used with almost anything that opens and closes.

that will open or close subject to the presence or absence of a magnetic field; it's usually mounted in a fixed position, eg, a window frame. The second component is a magnet, usually mounted so that it's moveable, eg, on a window sash. While the window is closed, the magnetic field holds the switch contacts closed; when the sash is moved, it takes the magnet with it, the contacts open and the alarm is triggered.

However, a strong magnet can be placed near the switch and can prevent it from operating when the sash is opened. That is why the more refined 'balanced magnetic switch' should be used. This type uses two magnets with interacting fields producing a net field around the contacts. The balance of this field is so critical that any magnet not part of the system will upset the balance and sound an alarm.

Brief mention should also be made of mercury switches which are used as detectors on transoms, for example. These are familiar as the 'tilt' switch on pinball machines. The switch is simply a pair of contacts mounted inside a sealed unit containing a pool of mercury. When the switch is tilted, the mercury rolls between the contacts, completes the circuit and the alarm sounds, or, it can be designed to work the opposite way with a normally closed circuit.

Pressure Mats

Pressure mat switches are the most common electromechanical switch used for detection. That annoying buzz that occurs when you step into a shop is usually set off by one of these.

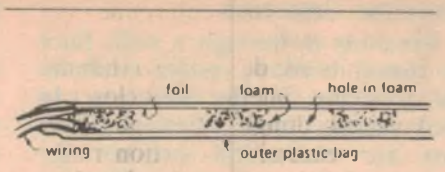

Figure 14. This Pressure Mat Switch works on the same principle as the one discussed in the text, but uses conductive foil for the contacts. Large holes in the foam allow it to compress.

The switch consists of one flat and one concave metal strip, mounted so that when weight is put on the concave strip, it flattens and makes contact with the flat one. In the switch's simplest form, this closes the circuit and sounds the alarm. However, more reliable detection comes from mats which have each of the metal strips as part of a double-pole closed circuit. When the strips touch, there is a "short-circuit" which sets off the alarm.
circuit" which sets off the alarm.

Pressure mat switches can be useful in a home security system. They can be put inside a window to detect if anyone has stepped through it. Or, they can be hidden in front of valuable appliances, or placed on stairs. Some pressure mat switches are designed to set an alarm off, if weight is removed from them; these can be useful to place under particularly valuable items.

Metallic Foil

Narrow strips of foil, usually aluminium, are often attached to the edges of windows as breakage detectors. The foil and an alarm are connected in a normally closed circuit; when the window is broken, the foil strip will be torn and activate the alarm.

This type of intrusion detector can be useful as a deterrent and early warning when mounted on windows and as a back up detector on display cabinets. To be effective, the foil needs to be carefully bonded to the glass and then protected with a water-proof varnish. The Standards Association recommend placing the foil in different locations on the glass depending on its area and use. Check with them if you have any questions.

Wire Screens

Not so widespread are wire screens or grids (commonly 100x150mm) that are used as a normally closed circuit incorporated into a flyscreen, for example. Or, the grid can be attached to a wall and then covered, eg, with wall paper, to conceal it.

Infrared Photoelectric Beams

Photoelectric detectors using visible light are often seen opening doors in supermarkets. Obviously, visible light should not be used in a security system so infrared photoelectric beams were developed.

The basic design is the same as that used for door openers, though. A narrow beam of light is directed across a doorway, along a wall with windows, or across a passageway. An infrared receiver sounds an alarm if the beam is broken. There are two types, however. The light source and receiver may be separate units, one at either end of the

beam, or, they may be housed in the same unit. In the second type, a mirror is used to return the beam to the receiver.

With a series of mirrors, each reflecting the beam onto the next, this second type can be made quite flexible. An invisible infrared beam can be directed along almost any optical path, eg, around the entire perimeter of a room, house, car or yard.

By design, the infrared receiver monitors the reception of infrared light, so it seems a simple matter to shine an infrared "torch" at the receiver and defeat the system. This is not so with the device you should use for protecting your property. Suitable detectors of this type use a modulated light source, ie, the light is not transmitted in a single continuous beam, rather as a series of closely spaced pulses. Any infrared light falling on the receiver that is not modulated with precisely the same frequency, sets the alarm off.

Sound Detectors

The idea behind sound (or acoustic) detectors is that breaking into a protected area is generally a noisy operation. If the area to be protected is so solidly built that sledge hammers and electric saws are necessary to break in, they may be useful. (The most common application is in bank vaults.)

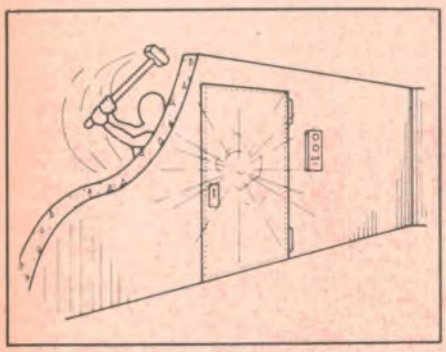

Figure 15. Sound and Vibration Detectors respond to the noise and vibration caused when an intruder tries to break in.

They are of limited use in home security and there is such a variety of diverse types, that only brief mention will be made of them. Essentially, they consist of a microphone and signal processor that react to pre-set levels of sound. As a guide, the proposed standard on detectors indicates that they should respond to frequencies that reach 30 dB above the pre-set ambient noise level and "to any total noise level above 70 dB".

Vibration Detectors

Breaking in through a wall, floor or closed window, causes mechanical vibration in the structure. In their simplest form, vibration detectors are mechanical switches designed so that a certain vibration will cause the contacts to touch and set off the alarm. They are often referred to as "shock" detectors since the earliest types needed a hammer blow or similar shock to set them off. Vibration detectors are covered in more detail in a following article, *High Frequency Vibration Detectors*.

Vibration detectors can use a microphone-like pick-up. The "microphone" is attached to a wall and hears, not sound vibrations, but the much lower frequency, mechanical vibrations caused during a break in. The microphone produces an electric signal in proportion to the vibration. If the signal goes beyond a pre-set limit, it sets the alarm off.

Capacitance Detectors

Any metal object insulated from the earthing effect of the ground will have a certain capacitance (ability to store electrical energy) associated with it and an accompanying electromagnetic field. If the capacitance detector is connected to a metal object, say a safe, it will respond to changes in the field when an intruder enters it, and sound an alarm.

There are a number of this type available with various features, eg, the ability to protect more than one object.

That completes our survey of the types of detectors likely to be encountered when shopping for property security. Choosing a detector is only one step in planning a system. A control unit is needed to tell the alarm that the detector has a response.

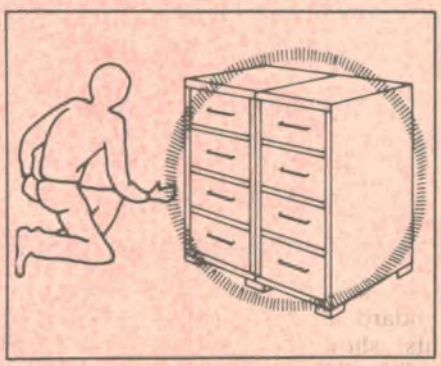

Figure 16. Capacitance Detectors respond to changes in the electromagnetic field surrounding an unearthed metal object.

Control Units

Whether a single detector or a complex combination is used in a system, the detector is connected to a control unit that sets off a local alarm or alerts a monitoring station. A simple system, such as a single US motion detector, can have the signal transmitter and receiver, control unit and alarm all in one housing.

To be effective, though, most home security systems will be more complex than this and require a more complex control unit. A typical unit would have separate input circuits for the detectors from each 'zone' and would route mains power to the detectors. The control unit must supply backup power from a battery in case of a power failure. This last feature is imperative in any security system: What good is the most sophisticated system of detectors and alarms if it can be circumvented by throwing the main switch in the (often unprotected) meter box? As a matter of fact, the Australia Standard states there shall be "a rechargeable standby battery". The battery must be within the "alarmed zone" and "mechanically protected" from tampering.

Figure 17. Every manufacturer has a different approach to Control Units. This unit can control 4 separate zones with a time delay in one of them and features an auxillary siren in the unit.

However, the type of battery to use and how to recharge it, is a moot point within the industry. Several standby systems may be equally suitable for a given system; there is

Figure 18. Sophisticated Control Units like the one above are used in high-security systems. Features include full function indicators and a rechargeable gel cell battery. Built into the unit is a digital communicator with a direct line leased from Telecom that is continuously monitored by the central station.

no hard and fast rule — Each system has to be examined in light of its own specific features and demands. The Standard only describes basic parameters for the control unit, but common sense tempered with specific data for the system should yield a choice. Each manufacturer and installer has his own ideas on standby power, so be sure you get what you need, not just what "comes with the system".

Dry cell batteries are most often used for backup power. Of course, these need to be replaced before their "Use by" date, or every six months, whichever comes first. (Within the Standard, replacing a battery is equivalent to recharging it.) Rechargeable batteries are less trouble and more reliable, in most instances. The least trouble and the most expensive backup system is automatic recharging which keeps the batteries fully charged with mains power. Any automatic recharging system must be able to recharge the battery and operate the system at the same time. More trouble, but less expensive initially, is a system that needs to have the batteries taken out and recharged as necessary. Any backup system must sound a modified alarm if the batteries are getting low on power.

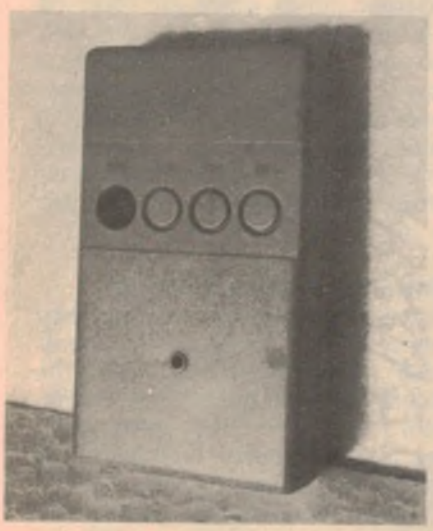

Figure 19. This wireless Control Unit directs the system from outside the home or from the bedside. This type of unit can be used to give flexibility to a master control unit.

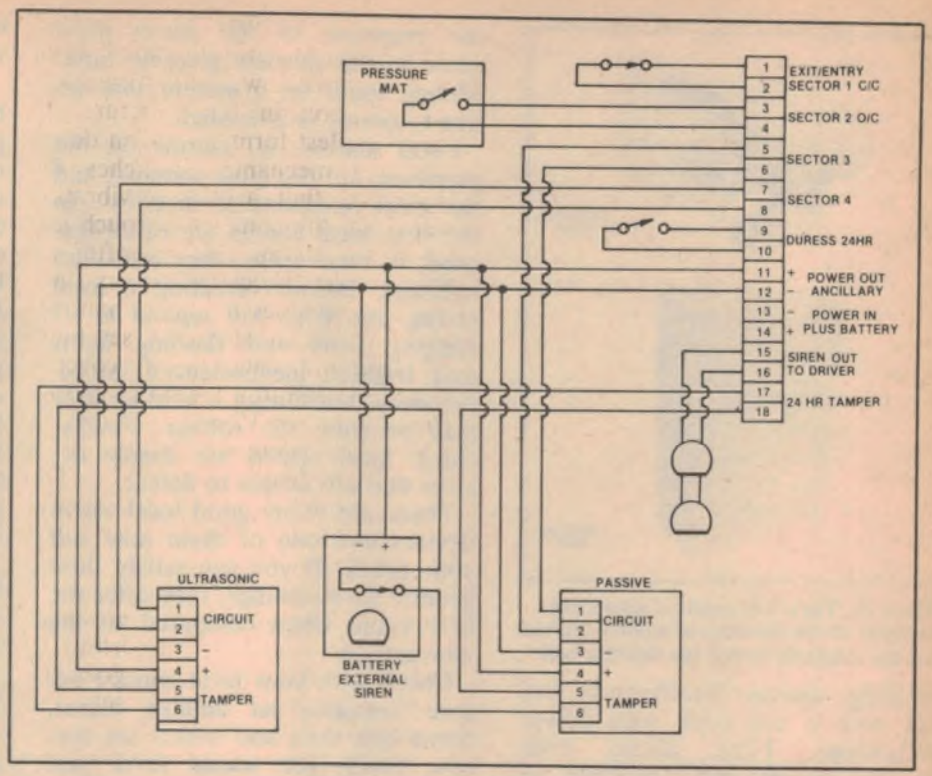

Figure 20. Block diagram of a home security system. The control panel is upper right; it features four zones (sectors) including an entry sector with a time delay (not shown); with the exception of the pressure mat, these are all connected in normally closed circuits. The *DURESS 24HR* circuit is to a 'panic button' that will sound the alarms independant of the detectors; it's usually located bedside. This system uses three US and three PIR movement detectors, bottom. Note the rechargeable battery operated external siren, bottom centre, connected to the tamper circuits of the control unit and detectors.

The control unit itself must have a switch to turn the system on and off; the switch is usually key-operated. There must also be a Test function which can be a separate button or a third position to the on/off switch. When switched to Test, the control unit allows all parts of the system to be individually checked. In order to maintain its reliability, the system must be periodically checked and maintained, so the test facility is an integral part of it. The Standard also requires that control units show "any existing alarm condition", and also show if and where an alarm has been sounded since the system was last armed. Any isolated zone within the system, mains failure and battery use must also be indicated by the unit.

There is no such thing as automatic resetting of a control unit once an alarm has gone off. Any zone that signals an alarm must be manually reset before it will operate again.

Since it is so important to the system, the security of the control unit itself should be given some thought. The unit must be located within the protected area. Additional protection is advised: Locate the unit behind an internal door with a key- or code-operated lock incorporating a switch to the alarm.

Radio frequency interference (RFI) and interference carried by the mains power supply have almost been eliminated as a source of false alarms from detectors, although they still cause a large part of false alarms from control units. RFI can have causes as various as two-way radios and thunderstorms. Another source of false alarms is fluctuation in the mains power supply. Before you have a system installed, discuss the problem of interference in detail. Ask if the equipment you are thinking of buying has adequate

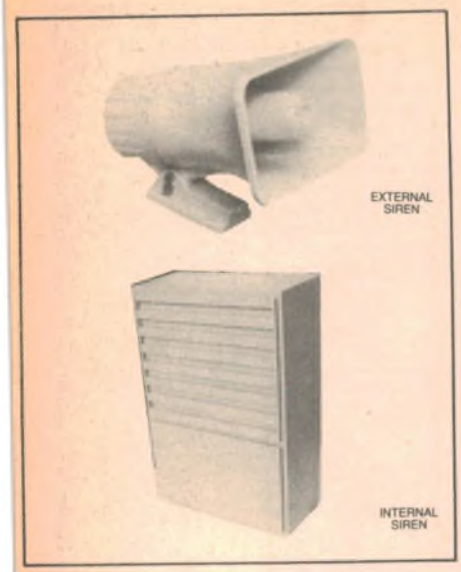

Figure 21. These two external sirens are examples of the diversity of audible alarms that are available beside the familiar bell.

shielding against interference and how well it can cope with power fluctuations. False alarms from these sources are still a problem, so satisfy yourself that you have minimised the problem.

Detectors and control units are only half a security system. An alarming situation needs to be transmitted to someone who will respond.

Alarm Systems

A local alarm, an automatic telephone dialler and a central monitoring station are the choices available. Keeping in mind your particular needs, make your choice based on the *purpose* of the alarm: to deter the intruder and summon the authorities. To minimise the intrusion, the response to the alarm must come in the shortest possible time. Money spent on a system that no one responds to is wasted.

Local alarms, ie, alarms on the premises, are the most common and the most questionable in effect. In the city, local alarms are often ignored; in rural areas, they are often unheard. Before installing a local alarm, ask *Who will repond to it?* Ringing bells and flashing lights may frighten inexperienced intruders away, but during a hold-up they may provoke the robber. Finally, cheap local alarms are simple devices that are simple to defeat.

There are many good local alarm devices and one of them may suit your needs. If you can satisfy their general shortcomings, they offer the best value when compared to the alternatives.

Check with your local council before installing an audible alarm. Some ban then and others set specific limits for sound level and alarm duration. While mechanical bells are still the most common audible alarm, electronic sounds are equally effective. Electronically produced sounds must be modulated to slide in pitch from 15600-19000 Hz to 300-900 Hz.

A local alarm is often combined with a remote alarm. An effective combination has the remote alarm sound immediately when an intrusion is detected and the local alarm delayed. This allows the police to respond before the intruder knows he has been detected and then discourages the intrusion, keeping it to a minimum. A strobe light is a useful addition to a local alarm. When it starts flashing as the alarm goes off, it further discourages the intruder. Also, most State Noise Pollution Acts require that an alarm shut off after 10 minutes; the light can be wired to stay on serving to identify the premises to the police and as warning when you return home than an intrusion has taken place.

Figure 22. A strobe light that starts flashing when the alarms sound. Such a light mounted externally, usually next to an alarm, discourages the intruder and makes the house easier for the authorities to find.

Telephone Diallers

Automatic telephone diallers use your home phone line to alert a monitoring station, an answering service or a private number. For most homes, a system of this type ensures adequate security with the least cost, given proper forethought. And, some systems can be defeated by an incoming call. Automatic diallers can send either a taped message as normal vocal transmission or an electronic, digital signal.

Any equipment connected to a telephone line requires Telecom approval. If an approval number is not on the unit, ask the dealer about it, or ring Telecom and check. With some automatic diallers, Telecom may require you to lease a coupling circuit from them. If you are going to depend on your phone line for security, it must be protected, too. On request, Telecom will run your line in conduit to the internal plug. The most useful feature found on automatic diallers is the ability to seize a line if it's engaged or even if the phone has been left off the hook.

There are many types of automatic tape diallers available. Most will not start your message until the called number is answered, and have the ability to dial a second or third number if the first is busy or unanswered. Tape diallers have gone beyond the simple recorded message stage. Several units offer a pre-recorded tape with easily recognizable series of tones. Each series indicates a different message, such as *alarm, system switched off* and so forth. The control unit selects the message on the tape, dials the number, and entones the message when the number is answered. Tape diallers are relatively inexpensive, but they all depend on mechanical components to operate. This can seriously affect their reliability.

Automatic digital diallers use a solid-state digital encoding device that sends the message as a series of electronic pulses which are received by a digital decoder. The decoded message can then be typed on a telex or appear on an alarm display. Compared to tape diallers, digital diallers can more reliably transmit more complex messages, eg, power failure, low battery, which zone has the intrustion, and system status.

Central Monitoring Stations

Central monitoring stations must comply with stringent standards which cover everything from the ownership of the premises to clocks. Before they can offer protection, they must be secure themselves. A central monitoring station certainly offers the most effective protection, but they are businesses so the degree of protection you get depends entirely on how much you want to spend.

A basic service would include

monitoring alarm signals and advising the police. Optionally, a private security guard could be despatched to your premises at the same time as the police were notified. Another service offered is periodic maintenance and repair of your equipment.

The same company can usually provide armed patrols of your premises varying from a drive past to a walk around, from random times to full time.

In gaining security, you are giving up part of the control of your system so be sure it is to someone you can rely on. Even so, do not rely entirely on the monitoring station.

Unless you frequently check the system yourself you can never be sure it's working. Don't be afraid to ask questions if you have *any* uncertainty about your security. Generally, the standards of employment in the security industry are very high, but don't take that for granted. You may be required to give the monitoring station a set of keys to your home.

Figure 24. This central monitoring station can provide services from 24hr video surveillance of your home to notifying the police when an intrusion is detected.

Think about it!

You should be planning your home security for the years to come, so a few hours spent thinking about it, is worthwhile.

Start with a floor plan which shows all doors, windows, skylights and room dimensions. Mark the location of valuable items, telephone plugs, the meter box, and any items that can cause false alarms. It's best to use builder's plans which show the electrical wiring — especially since they can save an installer hours of circuit tracing. A rough sketch will do to start planning.

Studying the floor plan will soon reveal the most likely (weakest) points of entry and routes an intruder will take once he's inside. After this groundwork, you are ready to start considering detector types and their possible locations, as well as where to site the control unit and alarms.

Once you have identified the areas that will need the most protection and have given the type of system you want some thought, you are ready to start talking to dealers and installers. Get itemised costs or detailed quotes from at least three different sources. Remember that you are not looking for the cheapest system money can buy, but the most effective for the cost. Consider the individual components of the system and the system itself, not just the cost. If one installer quotes on a particular type of detector, when two others suggest a second type, ask why. A point to remember is that no detector can be expected to work well at the limits of its range, ie, with the sensitivity set on maximum; ensure that the rated coverage for the detector is larger than the area it's protecting. Discuss all quotes in detail and compare them with your own thoughts. After the system is installed, check it yourself. Is everything working? Are the detectors properly adjusted? Do the tamperproof switches work? Does the standby power system operate as it should?

It's *your* security, don't depend entirely on others.

Figure 23. This control unit has an Automatic Digital Dialler built in.

The following generously provided illustrative material, advice and diagrams for this article—

Ademco-Sontrix (Australia) Pty Ltd
Altronics Pty Ltd
Australian Crime Prevention Hardware
Australian Protection Industries Pty Ltd
Australian Security Industries Assoc. Ltd
Australian Standards Association
Chubb Electronic Security
Dick Smith Electronics
The NSW Police Crime Prevention Unit

Car Security

by Clive Freeburn
Yellow Light Car Alarms

The general increase in crime and drug-related offences, coupled with more glass area and optional equipment in cars, has led to explosive growth in the car security industry. Here we look at the devices available, present some facts, and dispel some myths.

In the late 1970's there were only a handful of companies in Australia manufacturing or importing car security devices. Today, there are over 60, from backyard operators to multinational importers. Choosing an appropriate car alarm system can be difficult, especially since The Standards Association of Australia has not yet been asked to address them, so the industry itself has no guidance from that source. Generally you will have to rely on common sense and your own knowledge. Some insurance companies are offering discounts to premiums if a system they recommend is installed; there may be a discount for installation in conjunction with this.

The spot commercials for car alarms blaring at us from TV and radio make it seem as if every one of them has a unique system. Most of these systems use one of three types of noise maker with one of four types of sensor or various combinations.

Regardless of what type it is, a noise maker is designed to make enough *noise* to draw spontaneous attention and drive the burglar away. Even though passers-by often ignore blaring car alarms, the sudden start of an alarm causes most would-be intruders to flee.

The most basic noise maker is the car's own horn. While it's the least expensive device for the purpose, it's also often the least effective. Car horns — especially air horns — are loud but they are quite easy to disconnect either by reaching through the radiator grill or from under the car. They also have the disadvantage of drawing a lot of current from the battery. This means that a second attempt can be made to break into the car after the battery has gone flat without any worry about the alarm's going off. The high current drain also means they are unsuitable for use with standby batteries which are essential to any system meant to be effective.

Piezo sirens are the most popular noise makers because of their high efficiency in producing an effective 20 dB of noise.

High powered speaker drivers are the third type of noise maker used with car security systems. These can deliver a shattering 130 dB of noise. They draw one amp or more, so an adequate backup supply is needed.

A noise maker is most often sited under the bonnet. That's a convenient location for the installer to work in, but, more importantly it allows the noise to be heard. An auxillary piezo siren mounted in the cabin will quickly discourage a thief who has broken into a car. In the confined space of the cabin, the sound produced by the siren is painful and literally deafening.

Any effective car security system will protect the bonnet, boot and doors. The bonnet houses the main battery and the noise maker, so protection is essential. Not only does the boot hold valuables, but it's often possible to break into the car's cabin from there. Breaking to the bonnet and boot are usually detected with a variation of the dry contact switch wired to the alarm.

Attempted breakin through the doors can be detected one of two ways. The simplest method is direct connection which has the wiring run directly to the control unit from the courtesy light switches which function as detectors. The detectors are wired to work even if the courtesy lights are turned off or a bulb is blown.

The second method, often found in imported systems and do-it-yourself kits, is current sensing. This less familiar method senses the current drawn through the system when the light is turned on. In the fraction of a second before the cold bulb filament heats up and begins to glow, it has almost zero resistance. During this time the normal 12 volt supply from the battery drops to 11 V or so, depending on the car's electrical system. It is this momentary drop in voltage that the current sensor is detecting. Obviously, if the bulb is turned off or is blown, there will be no voltage drop to sense. There are various methods incorporated into different systems to overcome *this* problem, but, by nature of their design, current sensors are prone to false alarm from spurious pulses in the car's electrical system.

Door protection is usually easy to instal and the systems themselves are relatively inexpensive, but they won't detect a breakin through the car's windows. The answer to that problem is a cabin sensor.

One common type of cabin sensor is an ultrasonic motion detector which works the same as those used in home security systems, with the same shortcomings. A system with these is extremely effective, but is

prone to false alarm if windows or air vents are left open.

The second common type of cabin sensor is an audio discriminator. We at Yellow Light developed our car security system in Sydney in the 1960's based on this type. An "audio discriminator" is a high frequency vibration detector that is designed to respond to the frequencies generated by the unique crack of glass. Because of their design, these have proven almost false alarm free.

Other devices can be used to either detect or thwart a breakin. A familiar mercury switch is used as it is in home security to detect movement of the object it's affixed to; in this case, the object is the car and the switch is called a towing sensor. Whether the car is actually towed away or pushed by a would-be thief, the sensor detects movement and will respond. These are an effective backup to the car's primary security system since most of those cannot sense if the car is being towed away. Towing sensors shouldn't be depended on to detect the slight lifting necessary to remove the wheels, however. The best protection in that case is a set of wheel locking nuts.

Ignition cut-out devices offer a popular form of theft prevention, but they need to be approached with a little care. Remember that the system is designed to cut the ignition off; if this happens because of equipment failure or malfunction while the owner is driving, the resultant, unexpected loss of power can be dangerous. And it can be especially dangerous if the vehicle has power brakes and steering. There are safe and reliable cutout devices available, and they are effective against car theft. If you want one on your car, ensure that it will not turn the ignition off while you are doing 80 kph in the mountains.

A pocket pager that beeps when the car is tampered with offers another form of protection. The pager can be triggered by the courtesy light switch, the primary security system, a piezo sensor, or a combination of these; an alarm signal is then 'radioed' to the pocket-pager-receiver. Piezo sensors are attached to the car's bodywork and will pick up any vibration the bodywork will transmit, from the scratch of a vandal's coin on the paintwork, to the smash of a hit-and-run. Depending on the signal transmitter and receiver, and on the antenna, a typical system operating around 27 MHz with an output of one watt has a range of only about a kilometre. Most pocket pagers carry the disclaimer "depending on the terrain", which should be taken as a warning to "try before you buy." Underground car parks, large buildings and other structures can render them ineffective. Some brands are claiming ranges of well-beyond one kilometre by using up to four watts of output; but remember, four times the power *does not* mean four times the range or effectiveness.

Almost every different manufacturer's system uses a different control unit to signal the alarm that the detector has a response. Correctly fitted, most of these are effective and reliable. The most effective type keeps the time between the start of the breakin attempt and the sound of the alarm to a minimum. This is an advantage of using keyring transmitters to turn the system on and off, but they offer the disadvantage of not being able to turn the system off if the battery is flat or disabled.

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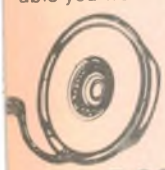

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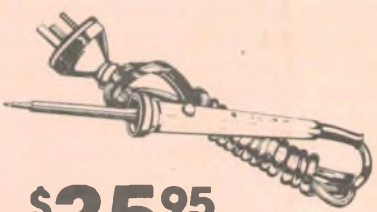

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High Frequency Vibration Sensors

by Naz Circosta
Ness Security Products

Detectors used in perimeter* security have never been "intelligent" enough to discriminate between an intrusion and normal, outdoor background noise and movement. This has left the average homeowner with the choice of alarms going off all hours of the day and night, or, no alarms. Today that choice is much broader as more reliable and effective devices are developed.

Some of the more interesting developments have been taking place in vibration detection, notably high frequency vibration detection. This is a topic that even the security industry is still learning about, and refining. Historically, all vibration sensors have been grouped together as "shock sensors". This is no longer precise since they can now sense much less than a *shock*. One of these types is frequency selective and another works from a completely different approach.

Frequency selective vibration sensors use a piezo ceramic resonator for reference. When the frequency of the detected vibration matches that of the resonator, an alarm is sounded. With this method, different resonators can "select" different frequencies. They are often used as breaking window detectors. Frequencies around 1000 Hz close to the sensor mounted on a window, are most likely *only* caused by breaking glass. The selective nature of the detector means that it is not prone to false alarms from background noise. They are expensive, however, especially since each detector has a very limited range, eg, one is needed for each window pane.

At Ness Security Products, we took another approach when developing a high frequency vibration detector — we used inertia.

Inertia-type high frequency detectors have proven themselves versatile, effective and reliable because of their simple design and wide frequency response. They are suitable for mounting on sheet metal, brick, glass or fibro. Even chain-wire fences can be protected. There are a number of brands available, but they all work on the same principle.

To understand that principle, let's look in detail at our *Nessensor* (Figure 1). The housing for this two-part device is of toughened plastic. The outer housing is attached *horizontally* to the surface to be protected. The cylindrical body is slipped inside it and rotated to select the sensitivity; it is then clipped into place. The main body is conected to the control unit by 4-core flex. Two of the wires are used for tamperproofing; the other two are in a normally closed circuit with the signal processor in the control unit.

Inside the cylindrical body are four parallel rods connected in adjacent pairs as part of the circuit to the processor. The rods are arranged so that they give three different spacings between them. When the body is slipped into the outer housing, a pair of barbell-shaped drums rest across two adjacent rods and close the circuit between them. The shape of the drums ensures high-pressure contact at the four points each touch the rods; this increases the vibration sensitivity, as does the spring brass they are made of. Both the rods, which are also of spring brass, and the drums are gold-plated to eliminate the relatively high "contact wetting" current needed with some sensors of this type. The plating also protects against corrosion.

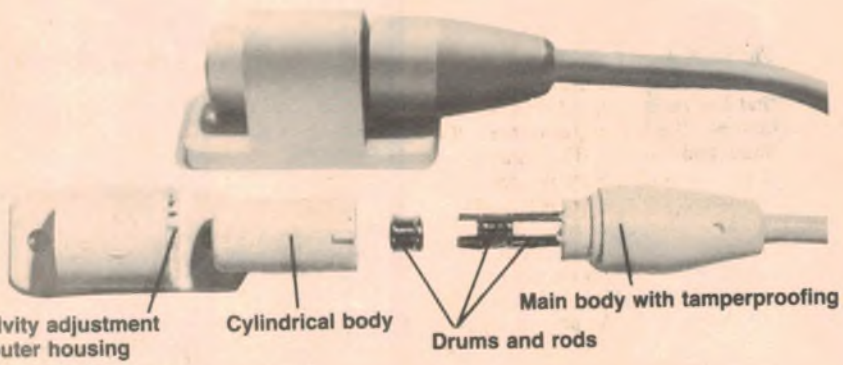


Figure 1. High frequency vibration detector developed in Australia by Ness Security Products, shown full size.

For security applications, vibration detectors that are more sensitive to high frequencies are more effective and less false alarm prone than lower frequency detectors. This is because most structural breakdown, eg, a breaking window, causes high frequency vibrations, but most false alarms are caused by low frequencies, eg, rocking motion caused by the wind.

To understand how the sensor works, let's follow what happens when we hold a fully-assembled one horizontally in our hand and move it back and forth over several hundred millimetres. We'll call one back-and-forth movement a cycle. Now if we complete one cycle in one second (a low frequency) the circuit remains closed because the inertia of the drums prevents them from losing contact with the rods. If we complete three cycles in the same time, the inertia will be overcome and the circuit will open as the drums momentarily lose contact with the rods. This same mechanical action takes place at much higher frequencies, too.

Of course, with the sensor installed, the distance covered in one cycle is much shorter, but the same effect is gained because the frequencies are much higher. Around 1 kHz, ie, 1000 cycles per second, the drums and rods start to lose contact with one another as the inertia of the drums is overcome. The rods are rigidly fixed to the housing which is firmly attached to the surface to be protected; only the drums can move.

When the drums lose contact with the rods, an open circuit "pulse" is sent to the processor, which signals the control unit. Pulses lasting less than a millisecond are reliably detected. Think how small a distance the drums can move and return to contact the rod in 1mS, then imagine the vibration that would cause that movement; that gives an idea of the sensitivity of the sensor.

High frequency vibration sensors put out a range of open circuit pulses with the amplitude and frequency varying with the vibration. Although the inertia type sensors can be connected directly to a control panel which has a quick enough response time, signal processing, either analogue or digital, is needed to control the sensitivity and reject unwanted signals.

By nature of their design, analogue processors look for total open circuit time within a short period. Most false alarms are caused by low frequency vibrations, eg, bumping a window or rocking by the wind. Since low frequency vibrations give long open circuit pulses, analogue processors place more 'weight' on them. To reduce false alarms, filters and sensitivity adjustments are included in the circuitry.

Digital signal processing is built in to the latest generation of security system, or is available as an 'add-on'. There are processors designed for various building materials and environments, and a number of all purpose ones. Our *Nessensor Signal Processor* can be DIP switch programmed to suit most applications.

If we refer to the block diagram in Figure

**In the security industry, perimeter refers to 'outside the building', eg, fences, yard, and exterior walls.*

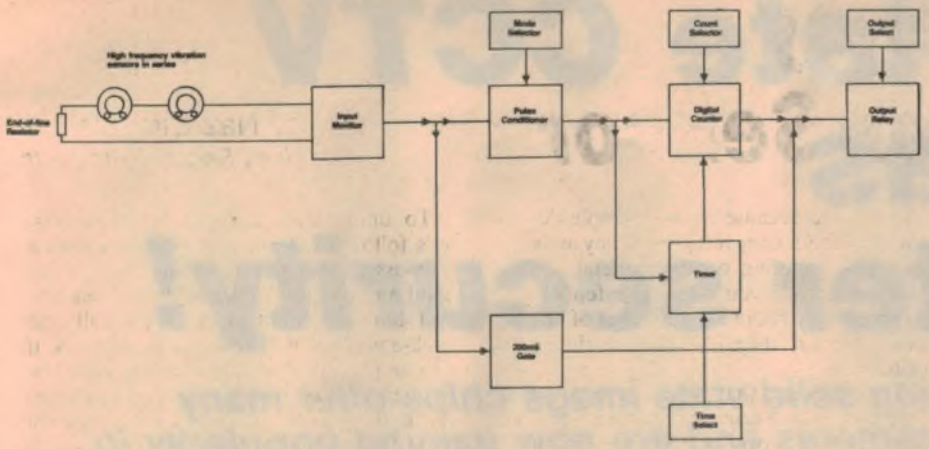


Figure 2. Simplified block diagram of the *Nessensor* digital signal processor.

2, we can see how it works: The sensors are wired in series with each other, and an end-of-line resistor for tamperproofing. Any open circuit pulse greater than 200mS is routed directly to the output via a gate to signal the alarm. Pulses less than 200mS are "conditioned" into groups of pulses, each pulse about 0.5mS long, with the mode selector in "Glass and other", or 0.5S long in "Fence". The first pulse from the conditioner starts a timer and the digital counter enumerates the following pulses. The timer is fixed at 0.5S for "Glass and other" and is adjustable up to 10.5S for "Fence". If the selected count is not reached in the selected time, the counter resets to zero. If the count is reached, the output relay is activated.

Let's look at what happens when a window is bumped, but not broken, for a better idea of how digital signal processors work in this application. The bump causes an initial long, open circuit pulse which lasts until the window glass reaches the limit of its 'bounce'. As the glass begins to bounce back, there are several short pulses caused by point bounce. The return bounce gives another long pulse (shorter than the first), followed by short pulses again. The cycle is repeated until the window returns to rest.

An analogue system, in effect, sums the duration of the pulses in a certain time; by the end of the second long pulse it will probably be close to triggering the alarm.

As we saw above, a digital processor gives all pulses equal value — either there is a pulse or there isn't. When a window is bumped hard enough to break it, there are several long duration pulses followed by many short ones as the glass shatters. These short pulses are enumerated by the counter which triggers the alarm when the pre-set count is reached.

In "Fence" mode the processor counts each group of pulses that occur within a 0.5S period, as one pulse; this detects the short groups of pulses characteristic of a wire cutter being used on the fence links. At the same time, the number of pulses needed to set the alarm off is kept to a minimum, eg four or eight. An attempt to climb the fence can also be detected if the counting time is set to some minutes.

The refinement of the sensor itself and the application of digital analysers, mean that high frequency vibration sensors have found a variety of uses in property protection. For example, one sensor can protect over 200 square metres of solid brick wall. Fibro or sheet metal walls can be protected by mounting the sensors in conduit junction boxes and connecting each box with lengths of conduit which is clipped to each wall panel; one sensor every 5-10 metres is usually adequate. With an appropriate analyser, sensors can be used to protect motor vehicles. And, a sensor mounted in a conduit junction box inside or outside a safe provides good protection.

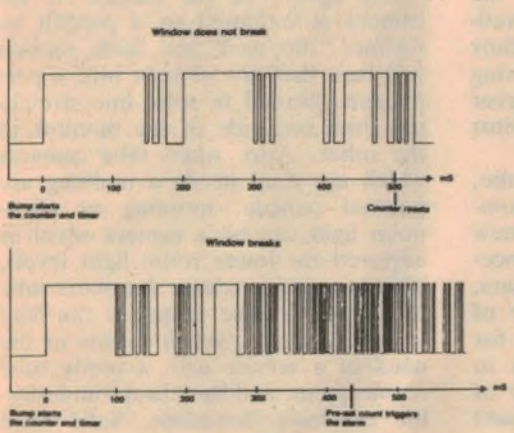


Figure 3. At left are shown the open circuit pulses from a window that has been bumped, but not broken. The initial pulse starts the timer and counter. The window stops vibrating before the set number of pulses is reached. At left are the pulses from a bumped window that breaks. As the glass shatters, it causes many short, closely spaced pulses that set the alarm off at the pre-set count.

Solid State CCTV Cameras for better security!

New video cameras using solid state image chips offer many advantages over tube cameras and are now gaining popularity in industrial security systems. Within the next few years they will come into their own for use in home security, the industry experts tell us.

by Donald T. Heckel*

As in just about every other application of electronics, the development of micro chips has had a big impact on security systems. One of the most impressive advances has been in the area of closed-circuit TV (CCTV) cameras, where a new breed of solid state or "chip" cameras is taking over from the traditional type.

The new cameras use a light-sensitive silicon chip as a base for their image sensor, instead of a vidicon or newvicon tube. This gives them many advantages over the older tube-based cameras, and opens up uses for CCTV which were previously impossible.

The light-sensitive chip at the heart of the new cameras consists of a rectangular matrix array of tiny photodiodes. Each photodiode responds to a single picture element or "pixel", so there are many photodiodes on the chip as there are pixels making up the TV image. Some chip cameras have as many as 180,000 photodiodes in the chip array, in order to produce a picture with sufficient clarity of detail or "resolution".

The more familiar way of describing camera resolution is in term of line resolution, the number of vertical lines that can be resolved across the picture width. Typically a colour chip camera can resolve around 240-300 lines, while a black and white chip camera can resolve up to 500 lines.

Vidicon and newvicon cameras use vacuum tubes for their image sensor, and these tubes are manufactured in a manner similar to the way light bulbs are manufactured. An important part of the tube is a coiled filament, which is very susceptible to shock and vibration damage. Because chip cameras have no tubes, they have no fragile tube filaments to break. This allows dealers to install cameras in applications not available to them in the past, such as inside large truck trailers, to monitor precious cargo. Many automotive companies are designing chip cameras for cars to use as "rear view mirrors", with a small monitor up front for the driver.

With the elmination of the tube, chip cameras can be made very compact and lightweight. Also, the new chips have an estimated maintenance-free service life of up to ten years, which is up to ten times the life of most tubes. This is a great bonus for dealers who must install cameras in inaccessible areas, such as on top of poles or roofs. Servicemen should never again have to adjust a tube every three months because it has "softened". In addition, chips use very little power compared to tube cameras, and their low heat dissipation makes them ideal for high temperature environments.

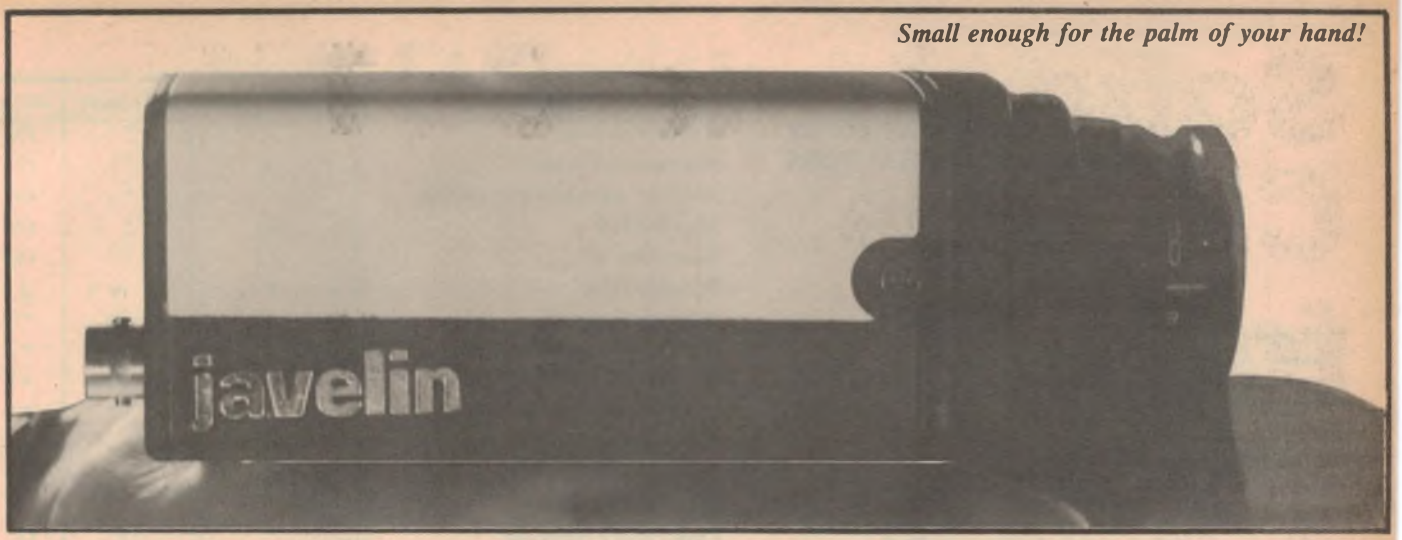
When a tube camera is pointed towards a bright light or reflection, the image is usually too intense to be faithfully reproduced. This is known as "blooming". An unfocused "glow" surrounds the bright area, obscuring most of the detail in the scene. Chip cameras have reduced this problem, because the pixels on the better cameras have spaces between them which are not light sensitive. When too much light strikes the chip, the excess spills into the non-sensitive area between the pixels, which allows the camera to reproduce the scene very accurately with little or no bloom. Some chip cameras can even view the coils of a light bulb, when the lens is stopped down.

Blooming can do more than just degrade the picture, it can also lead to tube damage. When a bright light strikes the tube, it can permanently burn the image sensor, leaving dark "dead spots" on the picture. If the camera is mounted to a pan/tilt or scanner, the back and forth motion will turn that dot of light into a permanent, burned in solid line stretching from one side of the monitor to the other. Also, when tube cameras which are used inside a building are pointed outside, morning or afternoon light can hit a camera which is adjusted for lower room light levels. This is a major reason for short tube life. Any of these examples can lead to tube damage, which results in the need of a service call, a costly tube replacement, and the always undesirable customer downtime. Solid state cameras are free of any danger from sensor burn, an added plus for careless customers.

Chip cameras have eliminated the problem of residual images (also known as ghosting, lag, sticking, and comet tailing). When a tube camera views a scene for a short time, and then the camera is moved (such as when using a pan/tilt or scanner) the lighter part of the scene leaves a "ghost" behind. If the camera has been viewing this scene for more than a couple of hours, the ghost can become permanent. And even if the camera is mounted on a stationary mount, a person moving past the lighter part of the scene will blend into the ghosted area and be difficult to observe. Most chip cameras have eliminated ghosting completely.

Any tube camera which is pointed down more than 30° from horizontal runs the risk of sensor damage. Tubes

*Mr Heckel is President of Javelin Electronics Inc, USA



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usually have small particles and solder bits left over from their manufacturing process, and these particles naturally fall to the front of the tube's image sensor when the camera is pointed down. A tube's image sensing surface is very thin and fragile, and even the slightest vibration can cause these particles to scratch it permanently. These scratches show up on the monitor, and degrade the resolution of the picture. Again, because solid state cameras have eliminated the tube, they have eliminated the problem.

Many security dealers have been looking for quality cameras which can take the strain of highly magnetic environments in applications such as power company surveillance. The high magnetic forces at these plants cause tube cameras to suffer electron beam displacement, which causes image interference. Chip cameras suffer no interference, and in the USA are even in service in nuclear power plants, perhaps the most demanding environment of all.

Currently, there are four main types of solid state image sensor chips. These are the Metal Oxide Semiconductor (MOS), the Charge Coupled Device (CCD), the Charge Injection Device (CID), and the Charge Priming Device (CPD). The "Charge" type chips are fairly similar in technology, and of the four types of chip cameras, the two most popular are the MOS and the CCD. Both of these have advantages and disadvantages.

The biggest difference between MOS and CCD cameras is their resolution. CCD cameras are limited to 240-260 TV lines resolution, but MOS cameras can have up to 500 TV lines resolution. This is not as high as tube cameras (which usually have 600-800 lines resolution), but because the chip cameras have such steady pictures, MOS cameras with at least 450 lines resolution should be suitable for security applications.

MOS cameras have two other advantages over CCD cameras. MOS cameras have no Moire patterns, which are common on CCD cameras. A Moire pattern is an interference configuration which looks like a series of rings or scalloped edges when viewed on a monitor. CCD cameras are also plagued with blemishes, or "dead cells", which are observable spots on the monitors. One CID camera manufacturer will guarantee no more than 40 blemishes per chip, and for an extra $1000.00, they will supply a camera with no blemishes. Because of the MOS chip design, blemishes are non-existent.

The only area that MOS cameras are edged out by CCD cameras is in light sensitivity. As a rule, MOS cameras require slightly more light than CCD cameras — about as much as a vidicon camera would need.

Without question, solid state cameras are more expensive to purchase than tube cameras, but long term costs provide a clearer picture of the true differences in these two technologies. Maintenance and repair costs on chip cameras are practically non-existent, and this must be weighed against the costs of a tube camera's tube replacement, its downtime for servicing, and the cost of frequent service calls to the job site. When the life of the camera and its low service costs are taken into consideration, solid state cameras may have a lower overall cost than tube cameras.

Solid state technology has also brought the advantages of colour video to the security industry. There are many situations in which colour cameras are the only type which can be used. An example is the gambling industry, which monitors gaming tables and the multi-coloured chips which are used. A $1000.00 poker chip may look identical to a $10.00 chip when viewed by a black and white camera, but the various colour differences are easily observed when viewed by a colour camera.

Colour chip cameras have the same advantages as black and white chip cameras when compared to tube cameras. There is one more advantage of colour chip cameras, and that is colour fidelity. Colour tube cameras have great difficulty in reproducing colours faithfully, especially in the orange-red shades. Because the colour filtering is accomplished by individual pixels instead of by one tube, colour fidelity with chip cameras is almost perfect.

Here are a few guidelines to observe when looking for solid state cameras. Security applications need high resolution, so make sure that the camera has a resolution of 450 TV lines as a minimum. To insure a rock steady picture, insist on 2:1 interlaced sync. Just as tube cameras have provisions for the back focus of the tube, chip cameras must have a focus adjustment which permits critical focusing between different lenses and the image sensing chip.

Auto iris is necessary for outdoor use or on a pan/tilt, but it is also desirable to have as a standard feature in case the camera is later moved outdoors. If a sync generator, screen splitter, or other special effects components will be used with the camera, external sync capability is a must.

Industry leaders expect chip cameras to replace tube cameras within the next 3-5 years. This will happen slowly, of course, and just as with calculators and digital watches, increasing sales will bring the cost down to tube camera levels.

APPLICATION OF INTRUDER ALARM DETECTORS

Reprinted by courtesy of the Standard Association of Australia from their informative booklet *Selection and Application of Intruder Alarm Systems*, available from their offices in all capital cities ($16.75).

* — General application.
⅄ — Limited application.
O — Not applicable.

Detector	Object/Point	Perimeter	Area
Contact switches	⅄	*	O
Magnetic switches	⅄	*	O
Mercury switches (tilt switch)	*	*	O
Metallic foil	O	*	O
Wire screens	*	*	O
Pressure mats	*	⅄	⅄
Acoustic detector	*	⅄	*
Ultrasonic motion detector	*	⅄	*
Microwave motion detector	*	⅄	*
UHF radio motion detector	*	⅄	*
Microwave beams	*	*	⅄
Light detector	⅄	⅄	⅄
Photoelectric beam	*	*	⅄
Capacitance detector	*	O	O
Vibration detector	*	*	O
Passive infrared motion detectors	*	⅄	*

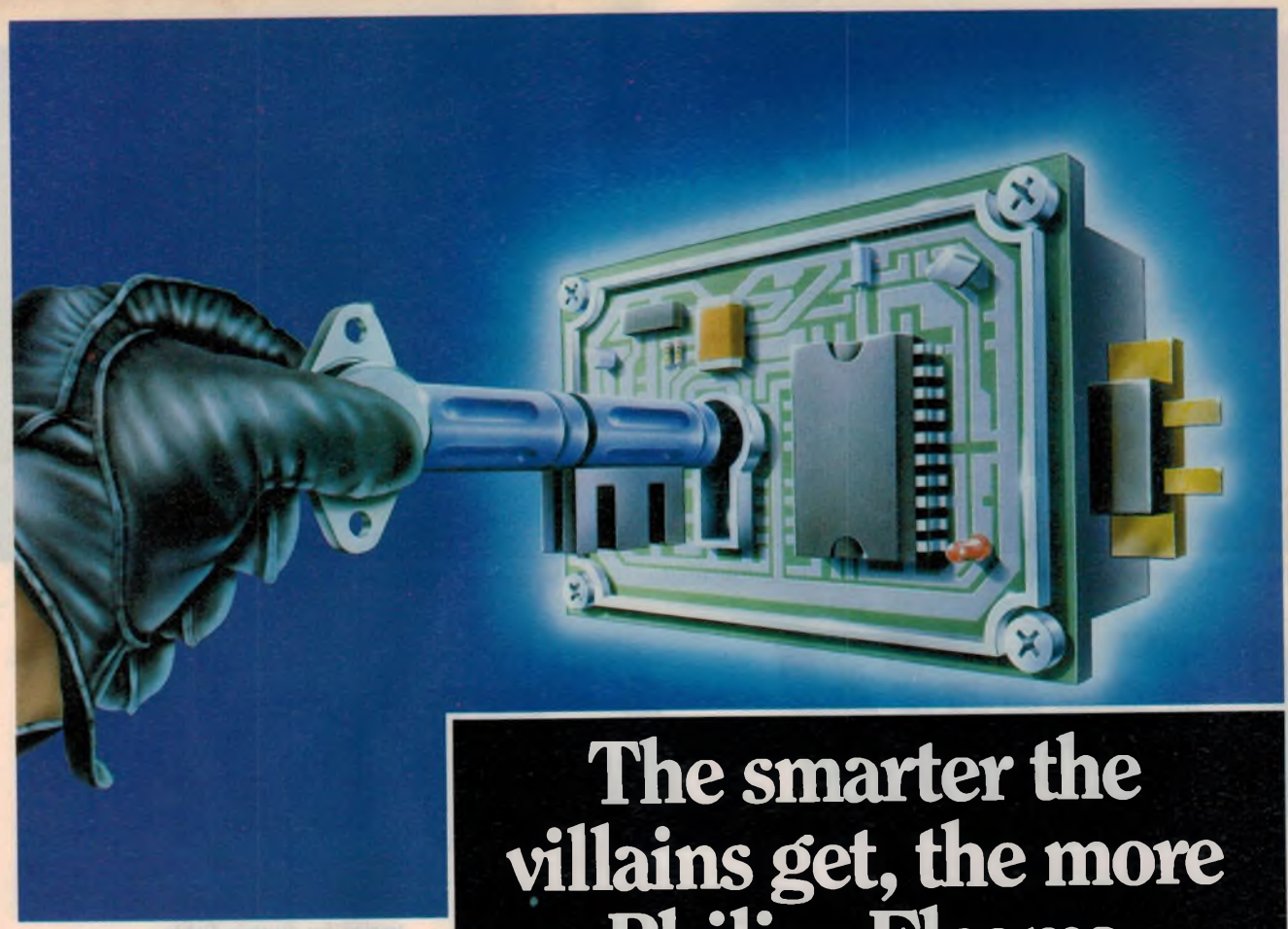
THE RELATIVE EFFECTIVENESS OF PROTECTION SYSTEMS

Type of system*	Type of threat		
	Robbery	Burglary	Theft
Physical protection (no alarm system)	O	O	O
Cooperative system	G†	E	E
Local alarm	O†	G	G
Automatic dialler	G†	G	G
Central station	G†	E	E
Proprietary system with in-house security force	E†	E	E

*The effectiveness ratings assume that the protected premises have adequate physical security. If not, each rating should be reduced one level, e.g., from excellent to good.

†Assumes that someone other than the victim can actuate the alarm.

E = Excellent, G = Good, O = Fair



The smarter the villains get, the more Philips Elcoma can help you.

By the end of the decade, insurance companies will probably be demanding that all homes, offices, cars and boats are fitted with electronic alarm systems. That's the way insurance and security is going.

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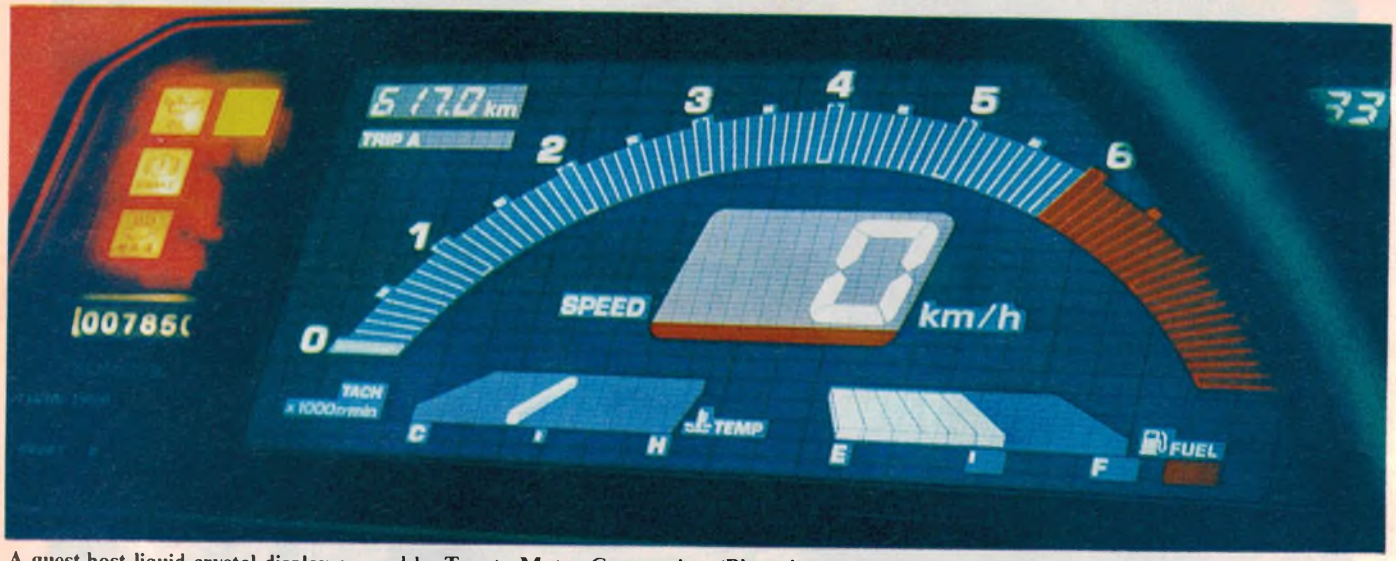

A guest-host liquid crystal display as used by Toyota Motor Corporation. (Photo by courtesy of Soanar Electronics Pty Ltd.)

Liquid Crystal

Among all the different electronic display technologies available today, liquid crystal displays, or LCDs, are the most widely used. This article gives an over-view of the subject, describes the different types of liquid crystal displays, tells how colour LCDs are made and explains how they are multiplexed.

by LEO SIMPSON

For well over 10 years now, liquid crystal displays have been widely used in electronic equipment. They first appeared in watches and calculators where their very low power consumption was important. From there, the list of applications has grown enormously to the point where they are now used in virtually every type of domestic electronic appliance, in electronic games, test equipment, portable computers, telephones, cameras, electronic typewriters, photocopiers, in automobile, motorcycle and aircraft instrument displays and, just recently, in miniature television receivers and oscilloscopes.

Liquid crystal displays (LCDs) are passive displays. Unlike active displays such as those based on incandescent lamps or light emitting diodes, which convert electrical energy into light, LCDs modify incident light, which may be scattered, reflected or transmitted.

The very name liquid crystal conjures up a substance which is not quite normal. How can a substance be both liquid and crystalline? Liquid crystals occur in certain organic fluids which can have a "meso-phase", that is, a state which is between two of the normal vapour, liquid and solid phases. The prefix meso comes from the Greek word "mesos" meaning middle.

In the meso-phase known as "liquid crystal", the substance is fluid and just as in any liquid, its molecules are free to move around. But, as in solid crystals, the molecules of these substances group together in an ordered fashion. This would be of little importance except for the fact that the optical properties of liquid crystalline substances can be varied by electric fields.

Three liquid crystal meso-phases are known and can be used as the basis of an LCD. They are twisted nematic, smectic and cholesteric. The first type is the most widely used.

In a typical LCD, the liquid crystal substance occupies the space between two parallel glass plates separated by a distance of just a few microns. The inner surfaces of these plates have transparent conductive coatings (electrodes) which define the characters, dots or shapes to be displayed. The surfaces actually in contact with the liquid are treated to induce the long molecules (nematic means "thread-like") to align in one direction, parallel to the plates.

In twisted nematic (TN) LCDs, the induced direction at one plate is at right angles to the other. Hence, the liquid crystal structure is twisted through 90°, from one plate to the other. Now, and this is crucial to the whole process, if a voltage is applied between the two plates, the twisted crystal structure of the liquid is broken up as the molecules then align themselves parallel to the electric field.

Polarising filters

Just as crucial to the operation of LCDs is the phenomenon of light polarisation. Everyone is familiar with the fact that if you hold two polaroid filters together and rotate one so that its plane of polarisation is 90° to the other,

no light passes through. If you have a pair of polaroid sunglasses, you can easily verify this fact.

As can be seen in Fig. 1, twisted nematic LCDs have two polaroid filters, one over the front glass plate, and one between the rear glass plate and its reflective coating. These two polaroid filters are oriented so that the angle between their planes of polarisation is 90°. If there was no liquid between the plates then, any light passing through the front plate would be fully adsorbed by the rear plate's polaroid filter and the glass would be dark as a result.

When no voltage is applied between the electrodes, light passes through the front polaroid filter and then follows the helix structure of the liquid crystal to the rear plate. In the process the plane of the light polarisation is rotated by 90°. The

One of the largest multiplexed LCDs presently in commercial use, this is the screen of the Data General One laptop computer.

Displays

the technology and its applications

light then passes through the rear plate, through its polaroid filter and is reflected from the reflective coating. It then passes back through the glass plates again. Note that if the light had not been rotated through that crucial 90°, it would not have been able to travel to the reflector. It would have been adsorbed by the second polaroid filter.

So with no voltage applied, what you see on a typical TN LCD is a silvery grey colour, which is dependent on the reflector (usually a brushed aluminium foil) and the liquid crystal substance itself.

When voltage is applied between the front and rear electrodes, the adjacent liquid crystal loses its twisted structure and becomes aligned with the electric field. This allows light to pass through without being rotated, only to be adsorbed in the rear polarising filter.

So everywhere an electric field is applied, is black. Since the transparent electrodes are arranged to have the shape of segments or dots, you then see the wanted characters or shapes. The pattern defined by the electrodes appears dark against a bright background.

If both of the polarising filters have the same orientation (ie, same plane of polarisation, to normally let light through to the reflector) the pattern will appear bright on a dark background.

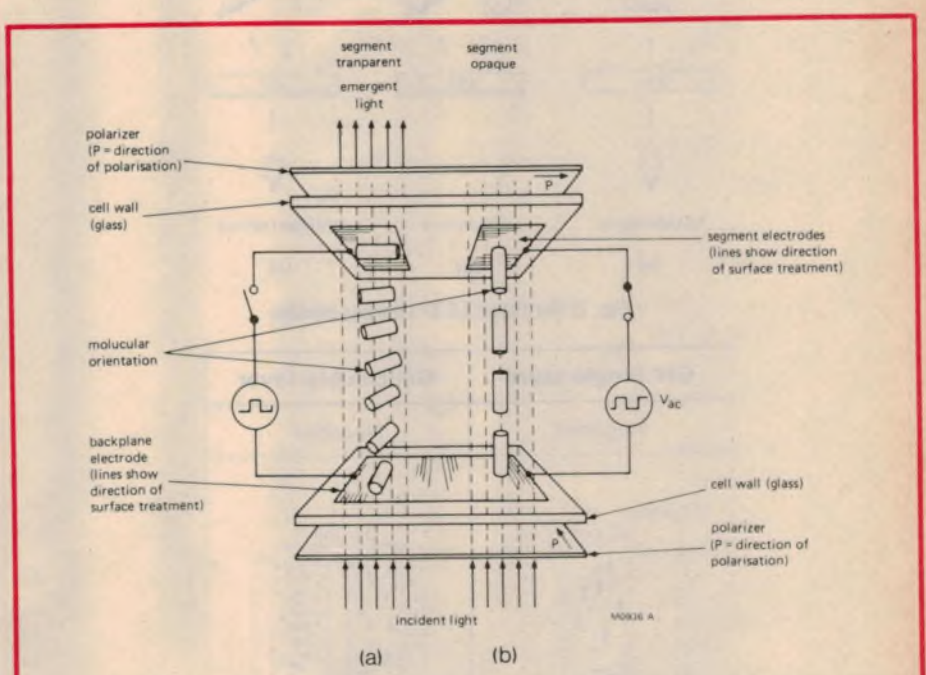

Fig. 1: (a) The polarisation plane of light entering an unenergised part of an LCD is turned 90° by the twisted nematic crystal and so passes through the front polariser. (b) In an energised part, the polarisation plane is unaffected by the realigned crystal, so the light is blocked by the front polariser. Note that this diagram applies to a transmissive display. A reflective display has a reflective foil over the rear polariser.

Viewing modes

LCDs can be designed to be used in one of three modes: reflective, transmissive and transflective. The *reflective mode*, described above, is the most common and is suitable where ever the ambient lighting is sufficient to give good legibility.

The *transmissive mode* requires the display to be illuminated from the rear. This mode is used where the ambient light level is low or non-existent. The

Liquid crystal displays

artificial light source can be an incandescent lamp or electroluminescent panel but whatever source is used, the illumination must be uniform. It is usual to use the negative display, ie, bright pattern on a dark background.

The *transflective mode* is a compromise between the other two and is used where the display is to be used under all lighting conditions. The transflector is a partially transmissive reflector, reflecting ambient light and diffusing back-lighting for night-time use. Such a display could be the basis for an automobile instrument panel. Fig. 2 illustrates the three operating modes.

Colour in LCDs

In twisted nematic LCD's, colour can be incorporated in one of three basic ways: colour selective polarising filters, coloured filters or coloured back-lighting.

Colour selective polarising filters produce coloured segments on a bright (ie, silvery) background, or vice versa, for the negative display. They are commonly available in red, blue and green.

Coloured filters can be applied to the rear glass plate of the display by screen-printing techniques. This has the advantage that complex multi-coloured displays can be obtained without the need for multiple colour selective polarisers which would inevitably have uneven polarising effects at their borders.

Guest-host displays

A relatively new kind of LCD is the guest-host display (GHD). This has molecules of a dichroic dye (guest) dispersed in a liquid crystal. A dichroic dye is a crystalline substance which exhibits different colours when viewed from different directions.

In the case of a guest-host display, the dichroic molecules align themselves with the long axis of the liquid crystal molecules. Where these molecules are parallel to the display surface, part of the incident light is adsorbed and so the display appears coloured.

Where the liquid crystal molecules are perpendicular to the display surface, as they are when voltage is applied, the incident light passes through unaffected and the display appears clear. Typically, guest-host displays have bright (usually white) segments on a highly coloured background. GH displays are available in black, brown, red, orange, green and blue.

There are several different types of guest-host display. One is the "Heilmeier" type with one polarising filter for high contrast in the transmissive mode (ie, with back-lighting). Another is the "White and Taylor" type (with no polarisers) which gives very bright segments in the reflective mode. Both of these types are capable of only one colour in the display and are referred to as single-layered.

Double-layer GH displays

Two colours can be obtained from double-layered guest-host displays. As the name suggests, this is really two liquid crystal displays placed back to back. There are three glass plates and two cavities, each several microns across. The two cavities have different dichroic dye/liquid crystal mixtures to give the two different colours. These displays are used in the transmissive mode and have no polarising filters. Fig. 3 shows the concept for single and double-layer GH displays.

The advantages of guest-host displays are that, first and foremost, they are brighter, have a wider viewing angle and less parallax distortion.

Contrast and brightness

The legibility of a liquid crystal display is a function of its overall brightness and its contrast ratio. The latter is the ratio between bright parts of the display to the dark parts of the display. For twisted nematic displays, the contrast ratio ranges between five and 50.

The limit of legibility in good light is a contrast ratio of about two and in bad light, about three. For comparison, the contrast ratio of a typical printed page, such as this magazine, is about seven.

The contrast ratio of a guest-host display is typically less than for an equivalent twisted nematic display but the higher overall brightness of the GH display gives it better legibility in all lighting conditions.

Electro-optical characteristics

The apparent contrast of a twisted nematic LCD depends on both the applied voltage and the viewing angle. The voltage at which the display first becomes visible is called the threshold voltage, Vth. As the applied voltage is increased, the relative contrast of the display increases fairly steeply, towards its maximum value. The voltage at which the relative contrast is 90% of

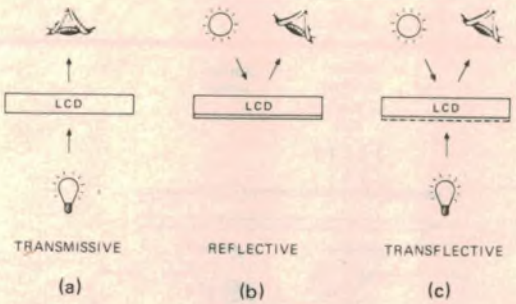

Fig. 2: the three LCD viewing modes.

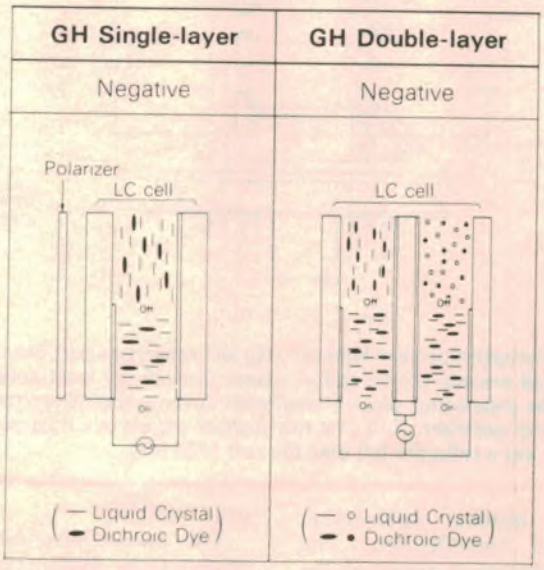

Fig. 3: These are the two types of guest-host displays. The double layer type gives two colours.

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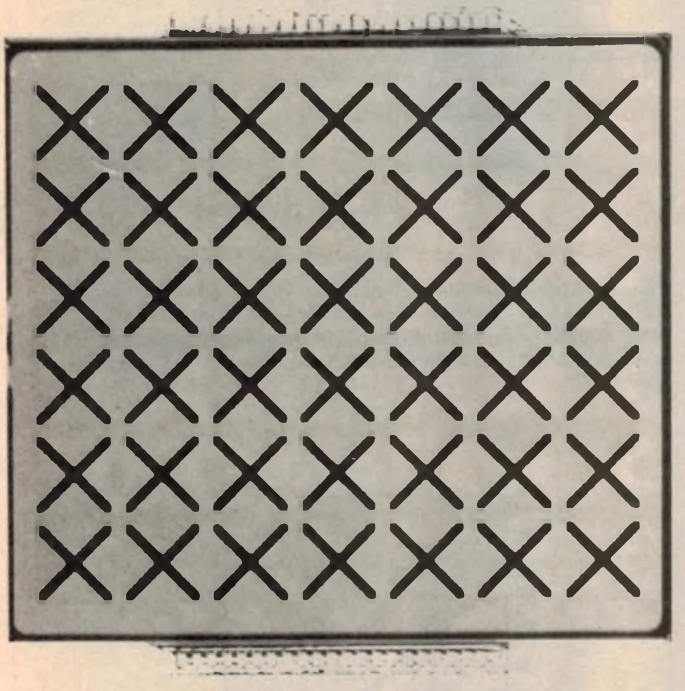

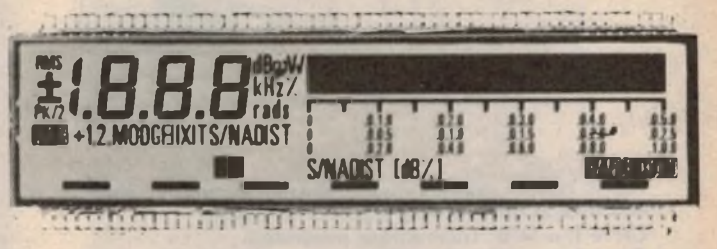

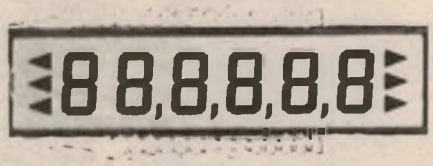

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Liquid crystal display technology

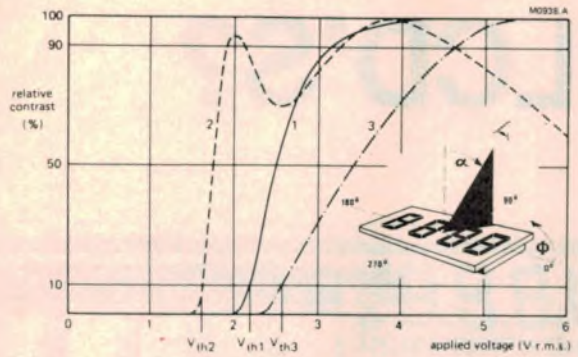


Fig. 4: relative contrast D as a function of applied voltage, measured at three viewing angles ∝ (see inset).
Curve 1: $\alpha \approx 0°$ (view normal to surface)
Curve 2: $\alpha \approx 50°$ $\phi = 270°$
Curve 3: $\alpha \approx 40°$ $\phi = 90°$
The liquid crystal molecules at the front and back surfaces are oriented at 45°/225° and 135°/315°.

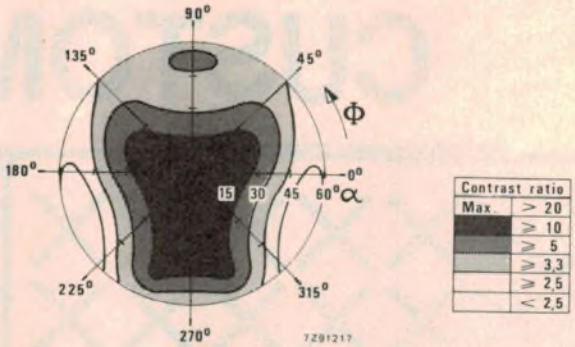


Fig. 5: Typical isocontrast diagram for a direct-driven, reflective LCD, showing the variation of contrast as a function of the two components and of the viewing angle. The liquid crystal surface molecule orientations are 45°/135° and 135°/315°.

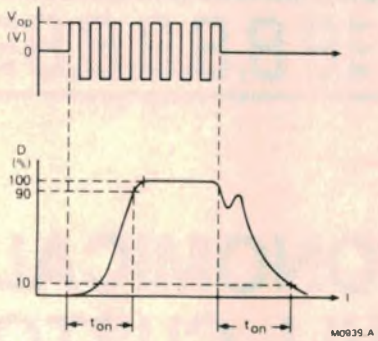


Fig. 6: on and off response of an LCD in relation to the alternating drive voltage V_{op}.

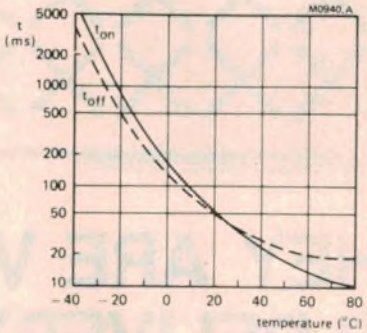


Fig. 7: response times of an extended temperature range LCD as functions of temperature. V_{op} = 4.5V at 100Hz. This is for direct drive.

that attainable is called the saturation voltage, Vsat.

Both Vth and Vsat, as well as the shape of the curve joining them, vary markedly with the viewing angle. The best viewing angle, as might be expected, is normal (ie, perpendicular) to the display. Fig. 4 shows how Vth and Vsat vary with viewing angle.

For a given applied voltage, contrast of the display also varies markedly with the viewing angle. This characteristic of LCDs is summarised in the "isocontrast" diagram, an example of which is shown in Fig. 5.

The fact that contrast and applied voltage are inter-related enables the optimum viewing angle of an LCD to be adjusted, simply by varying the applied voltage. Hence, where contrast is critical, as on portable computer LCDs, the makers provide a contrast control which varies the voltage applied to the display over a small range.

The reason why viewing angle is so critical for portable computer LCDs will become apparent later in this article.

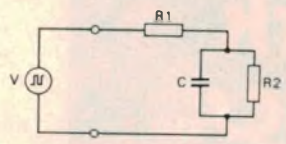


Fig. 8: simplified equivalent circuit of an LCD. R1 is the series resistance of the electrodes, R2 the series resistance of the liquid crystal and C the interelectrode capacitance. Typical values are R1 = 10kΩ, R2 = 1MΩ/cm², C = .0015μF/cm².

Temperature effects

The contrast/voltage characteristic of LCDs is temperature dependent, with a negative temperature coefficient. In effect, the threshold voltage drops as the temperature rises. This is very important for multiplexed displays, as it means that the contrast is reduced as the temperature rises.

Another important characteristic of LCDs which is temperature dependent is the on and off response. It takes a finite time for the liquid crystal to change its orientation as voltage is applied or removed. This is depicted in Fig. 6. Typically, the on and off response times are around 50 milliseconds at room temperatures and are a function of the

viscosity of the liquid (which is temperature dependent). Thus, the on and off response times increase as the temperature is reduced. Fig. 7 shows the effect of varying temperature.

Operating temperature range for standard grade twisted nematic LCDs is typically zero to 50°C and storage temperature is typically from −20°C to +70°C. For more stringent operating conditions, wide temperature range LCDs are available with an operating temperature range of typically −20°C to +80°C and with a slightly wider storage range.

Typical life expectancy of LCDs exceeds 100,000 hours. This is more than 11 years.

Driving LCDs

A liquid crystal will respond equally well to an applied voltage whether it is DC or AC but its life would be very short if DC was used, due to electrochemical breakdown. Therefore the driving voltage must always be AC, with an effective amplitude not much greater than the saturation voltage, Vsat. The maximum permissible DC component is typically no more than 100mV RMS.

The lowest permissible AC frequency is set by the onset of visible flicker, at about 30Hz. Between 30Hz and 1kHz, an LCD can be regarded as a capacitive load and above 1kHz as a resistive load. Fig. 8 shows the equivalent circuit, with typical values. At 30Hz and a drive voltage of 4.5V RMS, the current consumption is about 1.5μA per square centimetre of activated area.

Since LCDs require little drive current they can be driven directly by CMOS logic gates. This means that the driving voltage is a square waveform.

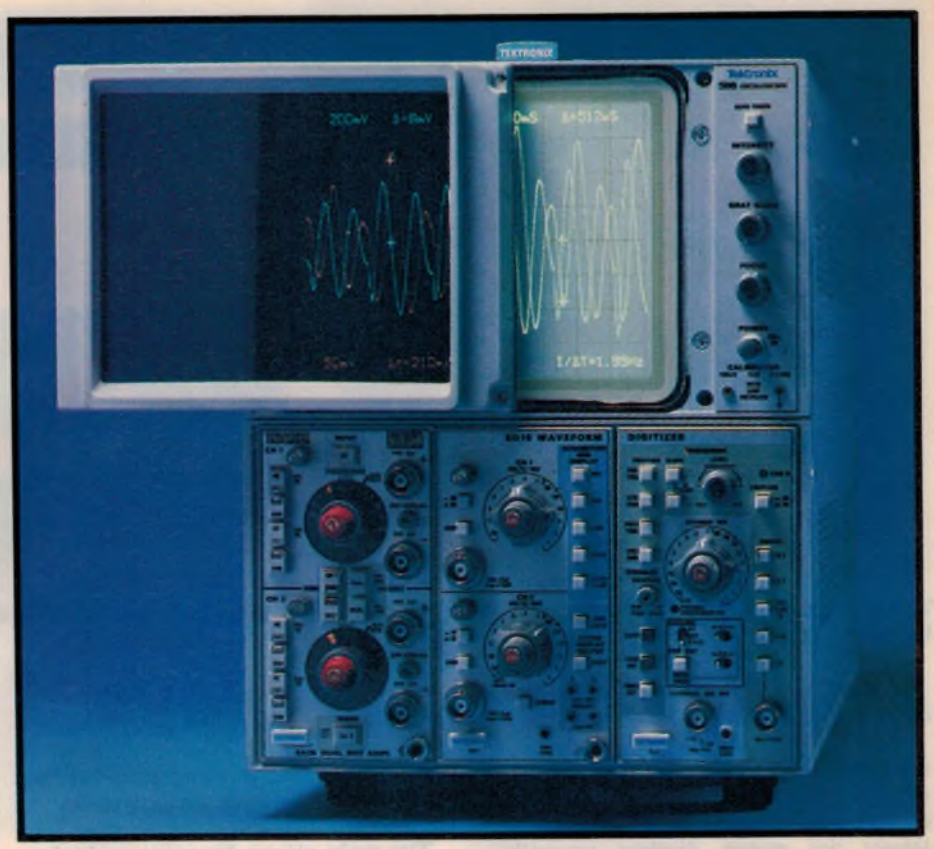
Direct drive

In this, the simplest method of driving LCDs, the backplane electrode is common and each display segment is connected to a corresponding terminal of the driving circuitry. Fig. 9 shows a commonly used phase-switching arrangement. A square wave is applied to the common backplane electrode and to one input of each of the exclusive-OR gates controlling the individual segments.

The control voltage at the other input of each of the gates determines whether the gate output is in or out of phase with the backplane signal. If the control voltage is high, the respective segment drive signal will be out of phase with the backplane signal and so the segment will be on. If the segment signal is in phase with the backplane signal there is effectively no drive voltage and so the segment is off.

The direct or static drive method is suitable for relatively simple displays having only a few digits. In this category are four digit displays for watches and multimeters and the displays for many calculators. However, even for a four-digit watch display with flashing colon, the number of points of connection to the driving circuitry is rather high at 30 (4 digits x 7 segments + colon + backplane = 30).

For more complicated displays,



One of the most innovative applications of liquid crystal technology is the Hewlett-Packard liquid crystal shutter which can enable a dual trace oscilloscope to give a two colour display when in the alternate trace mode.

LCD handling precautions

Liquid crystal displays should be handled carefully. As a component made of glass, they are fragile and may break if dropped. Apart from this risk, LCDs can be damaged by careless handling which may damage the polarising or reflecting foils, or the conductive terminal strips.

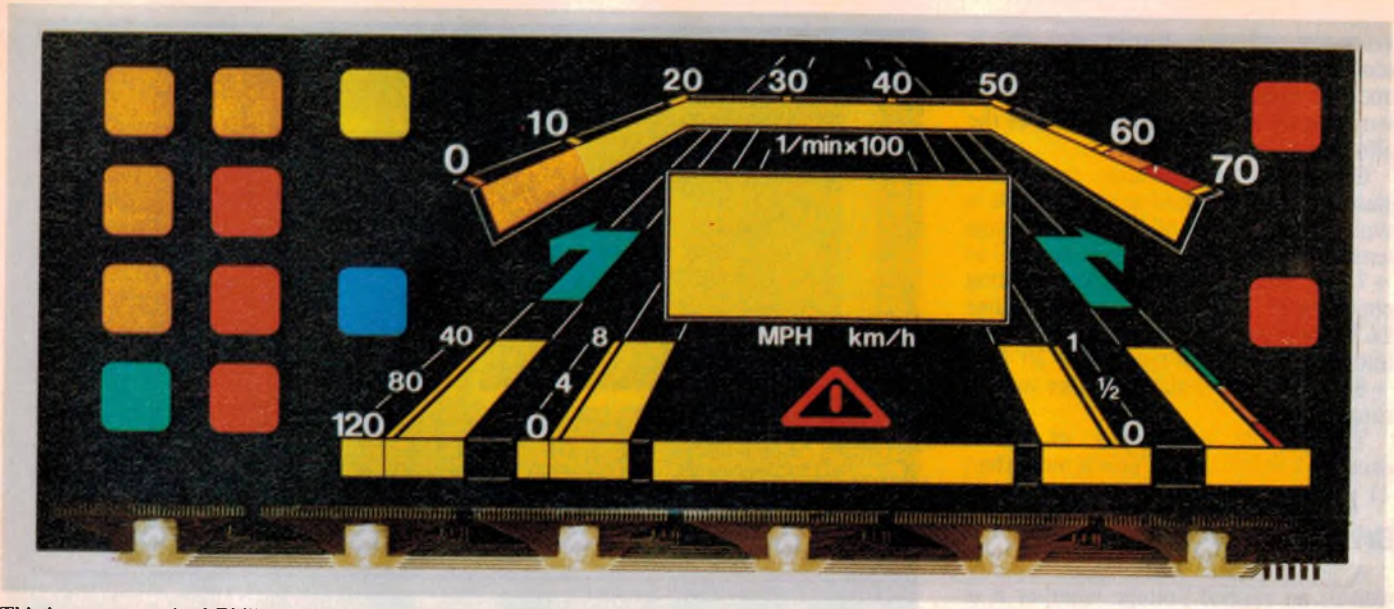
More particularly, polarising films can be easily scratched or distorted by undue finger pressure applied to the display. Such pressure may also distort the connector strips which can lead to faulty display segments due to poor terminal contacts.

Heavy finger pressure can, in some circumstances, cause the glass to crack or the glass/epoxy seal to fail. In either case, the LCD will be destroyed.

Finger-prints on the polarising films will degrade the performance and they should be avoided on the conductive terminal strips as they can also lead to poor contacts.

If a display is broken, use a tissue dampened with methylated spirits or acetone to wipe up spilt LC fluid. Avoid skin contact and wash thoroughly with soap and running warm water in case skin contact does occur.

Liquid crystal displays should always be mounted in housings with a transparent plate which should be made of glass or polycarbonate. Many transparent plastics exhibit polarising effects and should not be used. LCDs should be operated strictly within their prescribed operating voltage range. Exceeding the rated voltages will reduce the life expectancy of the display, as will DC voltages higher than 100mV RMS.



This is an unenergised Philips prototype TN display which has screen-printed coloured filters and six integrated drive chips along the bottom of the glass.

Liquid crystal displays

involving more digits and functions or those comprising a dot matrix, the direct or static drive method is impractical. The largest dot matrix displays presently available would require tens of thousands of individual connections.

Multiplex drive

Multiplex drive is commonly used for LED displays but until a few years ago was not regarded as being practical for LCDs. Even now there are drawbacks, as will become apparent.

The main reason for using multiplex drive, whether the display is LED, LCD, neon tube or vacuum fluorescent, is to reduce the number of circuit connections and the amount of driving circuitry itself. For the four digit display with flashing colon, quoted above, the number of connections required with multiplex drive is reduced from 30 to just 12.

For a 128 x 480 dot matrix (80 characters x 16 lines), multiplex drive reduces the number of connections from 57,601 to 608, a reduction of almost a hundredfold. When this reduction is also applied to the driving circuitry, the overall savings are considerable.

Put simply, a multiplex drive system is a method by which all the wanted segments (or dots) of a display are repeatedly pulsed on rather than energised continuously. This works very well with LED seven segment displays which can be pulsed at high currents to provide a display which is just as bright as if all the segments were driven continuously.

The method works like this. Consider that four digit display again. We will have four digit drive lines and seven segment drive lines (ignore the colon for the moment). The digit drive lines are each turned on, in succession, so that effectively, each digit is energised for only a quarter of the time. Then as each digit drive (transistor) is turned on, the appropriate segments for that digit are also turned on, and all the others are turned off.

As an example, to obtain a display of 1234, the process would go like this. When the first digit is energised, two segments would be turned on to display "1"; when the second digit is energised, the five appropriate segments would be turned on to display "2"; for the third digit, five segments are turned on to display "3" and for the fourth digit, four segments are turned on to display "4". Each number to be displayed requires a different combination of segments to be displayed, from two segments for "1" to

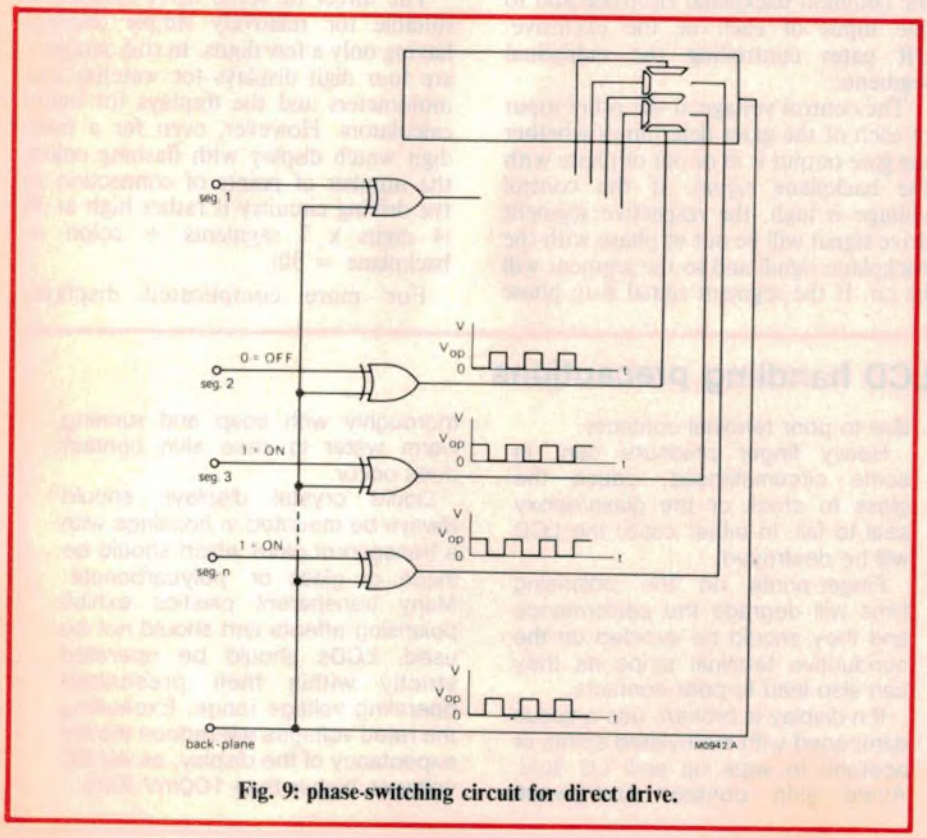


Fig. 9: phase-switching circuit for direct drive.

GOOD VIEWING ANGLE

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1977
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1980
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Foundation of HIROSHIMA OPT CORPORATION.
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1982
In March, OPTREX's LCD for car instrumentation was first used in MITSUBISHI "CORDIA".
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1983
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1984
Increase of capital (capital: 640 million yen; equity participation: 60% Asahi Glass, 40% Mitsubishi Electric)

Introduction of Parent Companies

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Founded: 1907
Capital: 51.7 billion yen
President: Takeo Sakabe
Employees: 9,256
Annual sales: approx. 541.1 billion yen (for fiscal 1983)
Profits: 23.1 billion yen (for fiscal 1983)

Mitsubishi Electric Coporation

Founded: 1921
Capital: 84.8 billion yen
President: Nihachiro Katayama
Employees: 48,194
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Profits: 28.4 billion yen (for fiscal 1983)

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Liquid crystal displays

Two separate liquid crystal displays are employed in this BBC Metrawatt/Goerz scope/multimeter. The scope display is a 128 x 64 dot matrix type. (Photo by courtesy of Kent Instruments Pty Ltd.)

all seven for "8".

The same methodology can be applied to LCDs but whereas LEDs can be pulsed at high currents to obtain the same brilliance as for static drive, LCDs cannot be driven harder under multiplex drive. They respond differently.

The problem is not the relatively long response times of LCDs as referred to earlier and shown in Fig. 6. That is irrelevant since, even for static drive, the period of the driving square wave signal is much less than the on and off response time for an LC display. The way the multiplex signals are applied overcomes any problem as far as response times are concerned but presents a much more serious quandary for the designers of LCDs.

The way LCDs are multiplexed is to provide two or more backplanes. These are turned on in succession (just as for the four-digit LED display example given above) and the wanted segment groups for each backplane switched on in accordance with the characters to be displayed.

A complication when multiplexing LCDs is that the individual segment driving signals must be AC rather than the DC signals required when multiplexing LED displays. Therefore, the voltages on the backplanes are no longer simple square waves as in the case of static drive but are staircase waveforms. Fig. 10 illustrates the case of a display with two backplanes (ie, with a multiplex duty cycle of 1:2).

Note that the two backplane waveforms are simple staircases while the segment group waveforms are square waves. The resultant waveform for any segment/backplane combination is the difference between the segment drive waveform and the respective backplane.

It is here that an interesting point emerges. There is always some voltage across all segments, even when they are nominally off. It is only when the effective segment/backplane voltage is above the threshold voltage that the segment is turned on.

Putting it in another way, because the liquid crystal responds to the RMS voltage across it, the Off voltage for a multiplexed display is not zero, as in static drive, but some fraction of the On voltage. It is the non-linearity of the contrast/voltage characteristic which makes multiplex operation possible.

To obtain maximum contrast and keep the Off segments invisible, the operating voltage Vop has to be chosen such that the Off voltage is just below the threshold voltage Vth. With too high an operating voltage, the Off segments become visible and with two low an operating voltage, the contrast between on segments and the surrounding display becomes too low for legibility.

As discussed earlier, the viewing angle for a liquid crystal display is a function of driving voltage. Multiplexing reduces the effective drive voltage and thus reduces the permissible viewing angle. For displays with very high multiplex ratios, the viewing angle is very narrow and the contrast is poor.

Practical multiplex ratios for good contrast and a reasonable viewing angle range up to 1:16 but dot matrix displays are now becoming available with multiplex ratios of as high as 1:100. Significantly, the relative contrast of these displays is very low at around two and so they can only be viewed in good light. No doubt this will improve as LCDs with multiplex ratios of only four had poor contrast when first introduced only a few years ago.

Design considerations

A considerable number of custom designed or off-the-shelf LCDs are being used in equipment manufactured in Australia. When it comes to specifying LCDs, a number of parameters must be considered, other than type of display and viewing mode. These include:

(a) Viewing angle: Displays can be manufactured to have optimum viewing from above or below or from either side. Contrast from the wrong viewing angle will be poor.

(b) Temperature range: Most suppliers have displays with normal or extended temperature ranges. The latter will usually also have superior response times.

(c) Static or multiplex drive: Whether or not the display is to be multiplexed has important ramifications for design of the backplane(s) and pattern interconnections. If the display is to be multiplexed, the duty cycle must also be specified. Some suppliers, such as Philips, can also supply LCD driver ICs and most suppliers can supply complete LCD modules, with in-built drivers. At the time of writing, Philips is the only supplier with chip-on-glass technology.

(d) Method of connection: Three methods have become standard; elastomer (zebra strip), conductive tape and in-line pin connectors. Designers should discuss the characteristics of these types with suppliers before deciding.

Liquid crystal displays

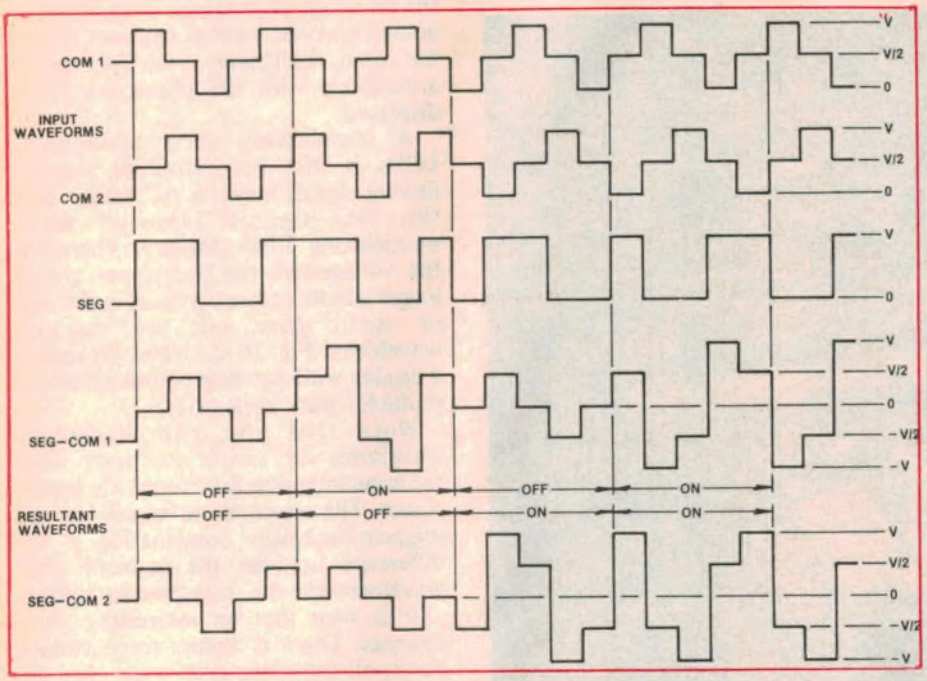


Fig. 10: Waveforms for multiplex operation with a duty cycle of 1:2, ie, two backplanes.

Guest-host LCDs do not work well with multiplexing and are presently only available for direct drive or for multiplexing ratios of 1:2.

Multiplex drive circuitry

While multiplexing does lead to a considerable reduction in the number of circuit connections to LCDs and in the driving circuitry, the circuitry itself does become very complicated. To address this problem, a number of companies make special driving ICs which are compatible with microprocessor-based systems and which provide all the driving signals.

In addition, it is now becoming normal practice to sell LCDs as modules, complete with driving circuitry, housing, mounting board and connectors.

An even more recent innovation, from the Philips subsidiary Videlec, is to bond the driver IC chip or chips directly onto the glass of the LCD. This elegant approach drastically reduces the number of external connections to only five or six, for power supply and serial data bus.

Further developments

While all of the large dot matrix LCDs have been twisted nematic types, a team at STC's Standard Telecommunications Laboratory at Harlow in England is developing a large display based on smectic liquid crystals. Smectic LCs have a different rod structure to twisted nematic types and the rods tend to become "knotted" together after they have been switched on and remain so after the switching voltage is removed, retaining the image.

A high frequency switching voltage has to be applied to the liquid crystal to "untie" the knots and thus switch the display off. Special multiplexing ICs have been developed by the laboratory to drive the smectic crystals.

The attraction of the smectic crystal display is that it has the potential to give a much higher resolution with high contrast. A prototype smectic liquid crystal display with an array of 780 × 420 dots and a contrast ratio of 7:1 has been developed by the STC laboratories. The screen area is 25cm × 19cm.

The technology is not fast enough for television as a full screen write takes almost a second but it is ideal for computer displays and the potential is there for colour displays.

Television

A number of Japanese manufacturers are producing portable television receivers with small LCD screens, some in colour. These have low resolution and poor colour saturation but show some of the potential of the medium with future development. At the time of writing, we had no information on the technology used for LCD television screens.

At the other end of the scale, Matsushita has produced a very large LCD television screen although again the picture quality does leave a lot to be desired.

Oscilloscopes

At least two oscilloscopes are being made which use LCD technology. The first is the M2050 Digital Scope Multimeter made by the German company BBC Metrawatt/Goerz. This instrument combines a 3-1/2 digit LCD multimeter with digital storage oscilloscope which has a 128 × 64 dot matrix LCD panel. It uses a maximum sampling rate of 512kHz which allows it to store transient and steady-rate waveforms up to 50kHz.

As such, the M2050 represents an elegant marriage of digital sampling techniques with LCD dot matrix technology.

Another oscilloscope using LCD technology is the Tektronix Model 5116

LCD construction

While there are several different types of LCD, they all have the same basic construction: rigid, front and rear glass plates with transparent electrodes deposited on their inner surfaces; a spacer to seal the cell and set the spacing; and various light-modulation foils to define the optical properties of the assembly.

Most liquid crystals are complex organic compounds based on two benzene (aromatic) rings bridged by alkyl, alkoxyl or cyano groups.

The front and rear glass plates have several important functions. They provide rigidity; protect the liquid crystal from contamination and evaporation and provide accurate, flat substrates for electrodes and director-orientating layers. The liquid-crystal layer should be between 10 and 20μm thick and parallel to within 2μm. Thus the maximum size of the display depends on the flatness of the glass plates.

Transparent electrodes are vapour-deposited indium-tin oxide which are etched through to provide the required pattern using photo-resist or screen-printed masks. Indium-tin oxide electrodes have 100% transparency relative to glass at a wavelength of 550nm (the peak sensitivity of the eye).

The electrodes are covered with an insulating layer and the inner surface is treated to obtain the required director-orientation. The insulating layer prolongs the life of the liquid crystal by blocking the flow of direct current and so preventing electrolytic decomposition. The surfaces are treated with chemical surfactants and polished or abraded to obtain the director-orientation.

but this is an instrument of a different calibre.

The Tektronix 5116 uses a conventional dual trace CRT display which has an LCD colour shutter in front of it. The CRT phosphor is selected to have peak light emission in the orange and blue/green regions of the visible spectrum. The colour shutter is synchronised so that one trace is displayed in orange and the alternate trace in blue/green.

The LCD shutter is effectively a conventional twisted nematic LC assembly with two colour polarisers and one linear polariser (ie, passes all colours). When the cell is on, one colour is able to pass and when switched off, the other colour passes.

What makes the LCD shutter practical is its fast switching time. Instead of the usual response time of around 50 to 100 milliseconds, the colour shutter operates in 1.7 milliseconds. At the relatively slow sweep speeds provided for in this particular oscilloscope, this response time is adequate.

Tektronix also have a 7-inch version of their liquid crystal shutter which can be used with monochrome computer monitors whether raster or vector-scanned. In this way it is possible to obtain a high-resolution colour display.

Welding helmet

An even more unusual application for LCD technology is being used in a welding helmet to be marketed by an Australian company. Instead of using a conventional helmet with a darkened glass viewing panel, this new helmet uses a liquid crystal panel with two polarising filters arranged so that when no voltage is applied, the panel is transparent.

The helmet incorporates circuitry to sense the "pilot" and thus switch the panel to the dark condition, in time to block out the main arc and prevent any damage to the welder's vision.

LCD shutters of this kind also have an application in photography where they can be used to obtain precisely timed exposures, without the need for mechanical linkages.

Acknowledgement

This article has been based on information published mainly by Philips in their journal "Electronic Components and Applications" Vol. 5, No. 4, September 1983. Other information has been gathered from Philips Elcoma "Technical Information 044" published June 1978. Most of the diagrams in this article are also from these Philips publications. We thank Philips for their assistance in preparing this article.

Thanks is also due to Soanar Electronics Pty Ltd, distributors of Stanley LCDs; Promark Electronics, (Varitronix LCDs); Amtex Electronics (Optrex LCDs); Daneva Australia Pty Ltd (Sharp LCDs); VSI Electronics Australia Pty Ltd (Seiko LCDs); Epson Australia Pty Ltd; and Tektronix Australia Pty Ltd; all of whom provided catalogs and background information.

This large screen TV consists of 25 LCD dot matrix panels.

Other references:

"Liquid Crystal Displays for Portables" by Glenn J. Adler. *Byte* Magazine, Vol. 10, No. 7, July 1985.

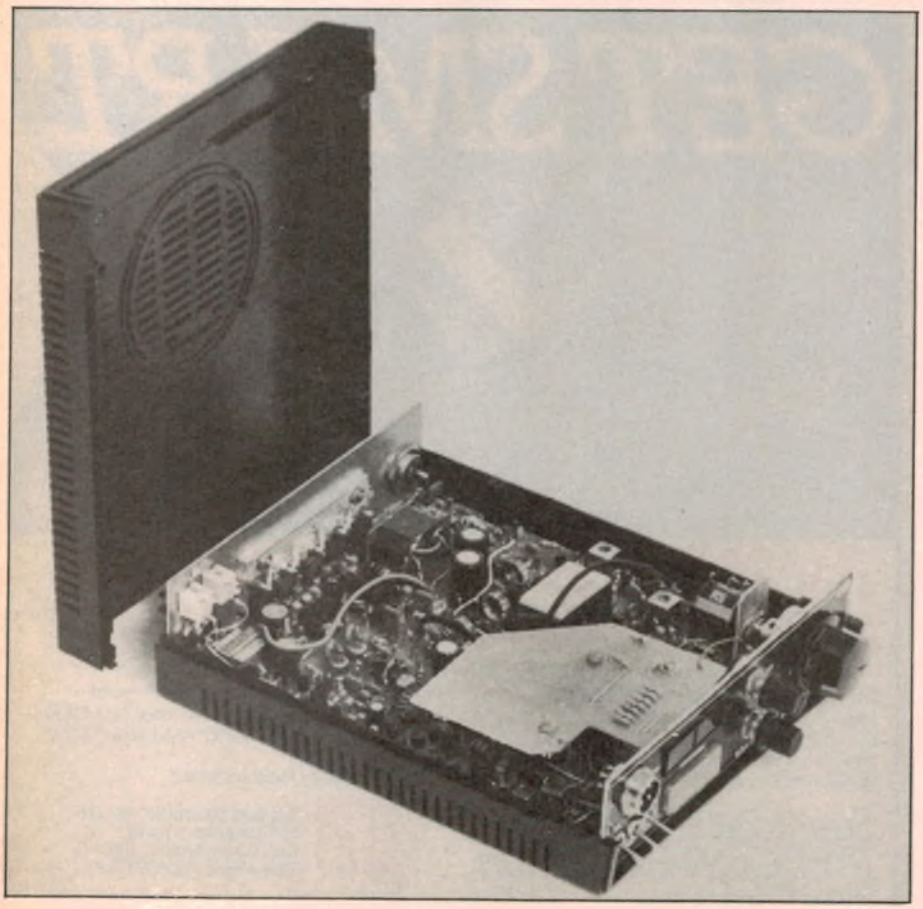
"Oscilloscopes in Colour" by Carl Laron. *Radio-Electronics*, Vol. 55, No. 11, November 1984.

Build this HF amateur transceiver

Part 1

Here at last is an HF amateur band transceiver that you can build yourself. This up-to-the-minute design can cover any single 500kHz band within 2-30MHz, features CW, LSB and USB transmission modes, and boasts a power output of 30 PEP (SSB).

by GREG SWAIN



The new transceiver is housed in a compact plastic case.

This new design is the third in a series of do-it-yourself amateur band transceivers from Dick Smith Electronics. In September, October and November 1983 we described a 40-channel UHF transceiver and followed this up with a VHF unit in June and July 1984. Both designs offered good value for money and many hundreds of each have now been built.

We're sure that this new unit will be just as successful. It was developed by Garry Crapp VK2YBX/T and Gill McPherson VK2ZGE, the same team that produced the previous versions. As before, it will be marketed as a complete kit by Dick Smith Electronics.

For the keen amateur, it represents an ideal opportunity to build a really worthwhile piece of gear. Despite the relative circuit complexity, construction is straightforward and alignment is a breeze.

Perhaps the most attractive aspect of the design is the price. For just $349 you get the whole kit and caboodle, including a press-to-talk (PTT) dynamic microphone and all the features pictured! That has to be a really good deal.

Features

As the accompanying specifications panel shows, the new design offers good performance without the fancy "bells and whistles" found on some commercial models. In line with standard practice, it can transmit both LSB (lower sideband) and USB (upper sideband) signals, as well as operating CW. Tuning is by means of a multi-turn pot while a four-digit LED readout indicates the tuned frequency.

To keep costs to a minimum, the transceiver is designed to cover only a single 500kHz band within the range 2-30MHz. This eliminates the need for costly band switching. As a further economy measure, those digits to the left

of the decimal point have been omitted from the digital readout (ie, there is an assumed decimal point in front of the first digit of the display).

Thus, if the transceiver is set to 3.568900MHz, the readout will be 5689. This is quite OK in view of the single band operation.

The front panel controls are straightforward. The tuning and volume controls require little comment, as does the signal strength-cum-power meter. The microphone socket is a standard configuration for PTT operation.

Immediately above the microphone socket are three toggle switches. The first two switches set the transmission mode, either LSB, USB or CW. The third switch, on the extreme right, switches a noise blanker stage in the receiver circuit.

Below the volume control is a control labelled "RIT". This stands for Receiver Incremental Tuning which is just a fancy expression for a clarifier control.

How it works

Let's now go through the block diagram (Fig. 1), before attacking the main circuit diagram. This will give a general idea of the circuit operation and make the subsequent circuit description much easier to follow.

The block diagram shows that the transceiver can be split into two sections — receiver and transmitter — which come together in the antenna filter. Both these sections employ a common voltage tuned oscillator (VTO), frequency counter, heterodyne mixer, and offset (carrier) oscillator.

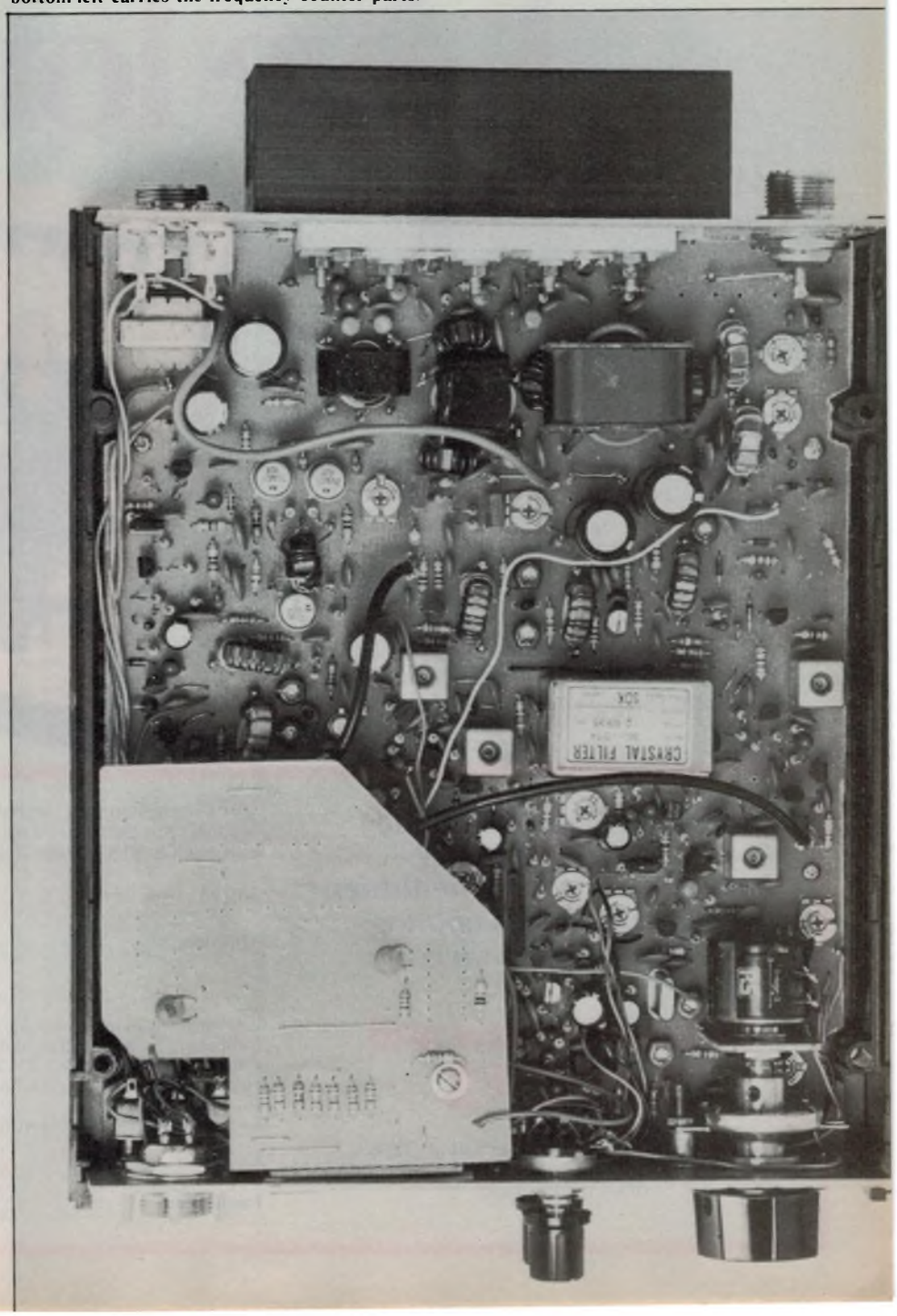
In the transmit mode, the VTO frequency is mixed with crystal oscillator IC1. The added signal is then mixed in IC2 with a 10.7MHz SSB signal to produce a difference signal and this is fed to an RF linear amplifier (Q1-Q8). From there, the signal passes via the antenna filter circuit (LPF) to the output socket.

The SSB signal is derived using balanced modulator IC5 and the offset oscillator. The offset oscillator produces a nominal 10.7MHz carrier which is modulated by audio from the microphone preamplifier. Because IC5 is a balanced modulator, the carrier is suppressed and a double sideband (DSB) signal appears at the output.

This DSB signal is filtered by a crystal filter which removes one of the sidebands. The output from the crystal filter is then amplified and fed to IC2 where it is mixed with the signal from IC1.

The receiver is a conventional single conversion superheterodyne with an intermediate frequency (IF) of 10.7MHz. The received signal is fed via a variable attenuator network to RF amplifier stage Q21 and thence to mixer stage

Despite the apparent complexity, construction and alignment is straightforward. The PC board at bottom-left carries the frequency counter parts.



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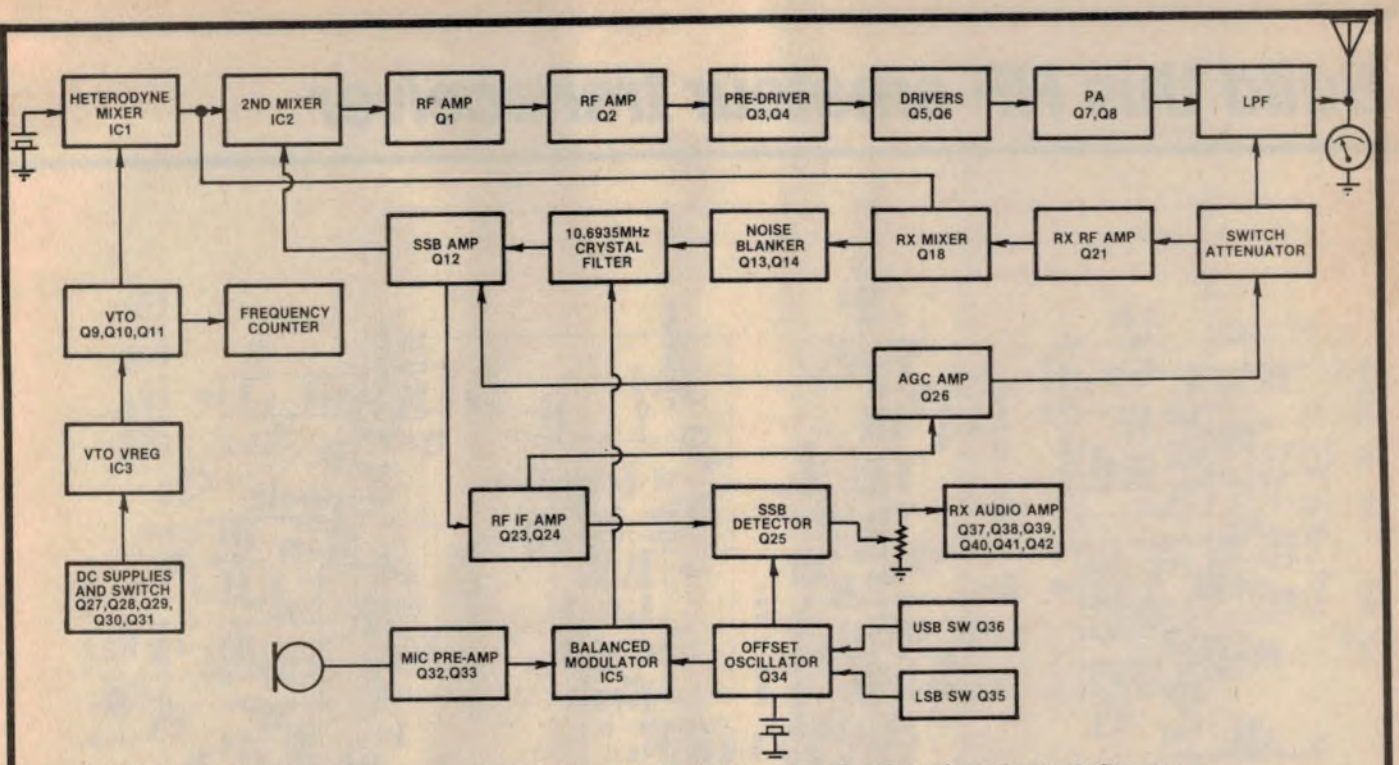


Fig. 1: block diagram of the new transceiver. The transistor and IC numbers relate directly to the main circuit diagram.

Build this HF amateur transceiver

Q18. Here the signal is mixed with a local oscillator signal from heterodyne mixer IC1 to derive the 10.7MHz IF.

The output from the mixer is fed to a noise blanker stage (Q13 and Q14), thence to the crystal filter, SSB amplifier and IF amplifier stage Q23, Q24. AGC amplifier Q26 samples the output from the IF amplifier and produces a DC voltage which controls the variable attenuator and the gain of Q12.

Finally, the signal from the IF amplifier is fed to SSB detector Q25 and the resulting audio fed to the audio amplifier. The offset oscillator provides carrier re-insertion at the detector.

Circuit details

Now let's take a look at the main circuit diagram. Looks complicated doesn't it? Don't worry — we'll go through it stage by stage and relate each section back to the block diagram. We'll consider the transmitter circuitry first.

The transmitter circuit is activated by the press-to-talk (PTT) switch on the microphone and this controls the various supply rails. We'll come back to that. The signal from the microphone is fed via gain control VR11 to Q32 and Q33 which form a two-stage common emitter amplifier. Feedback resistor R140 provides base bias for Q32.

The amplified signal appears at the collector of Q33 and is fed via C160 to pin 1 of IC5, an AN612 balanced modulator chip. Here the audio signal modulates the carrier signal generated by the offset oscillator (Q34 to Q36) to produce a double sideband (DSB) signal at pin 7 (ie, the carrier is suppressed).

Q34 and crystal X2 form a standard Colpitts oscillator circuit which provides the carrier signal referred to above. It generates one of three different frequencies, depending on the positions of switches SW2 and SW3. SW2 selects either LSB or USB transmission while SW3 selects either SSB or CW mode.

Let's assume initially that the SSB mode is selected. When SW2 is switched to LSB, both Q36 and Q37 are off and Q34 supplies a 10.695MHz carrier (set by VC6) to pin 3 of IC5. When SW2 is switched to USB, Q36 turns on and switches in trimmer capacitor VC7 which pulls down the carrier frequency to 10.692MHz.

The DSB signal from pin 7 of IC5 is fed to 8-pole crystal filter X3 via C167, R152 and switching diode D11. X3 is a bandpass filter with steep skirts. Its job is to remove one of the sidebands and pass the required sideband.

Let's take a closer look at this. When S2 is switched to LSB, the carrier frequency is 10.695MHz and sidebands will be generated either side of this frequency. Since X3 is centred on 10.6935MHz, only the lower sideband will pass through to the output. The upper sideband falls outside the passband and is eliminated.

Similarly, when USB is selected, the carrier frequency is 10.692MHz and the upper sideband passes through to the output. Note that X3 has a passband of about 3kHz.

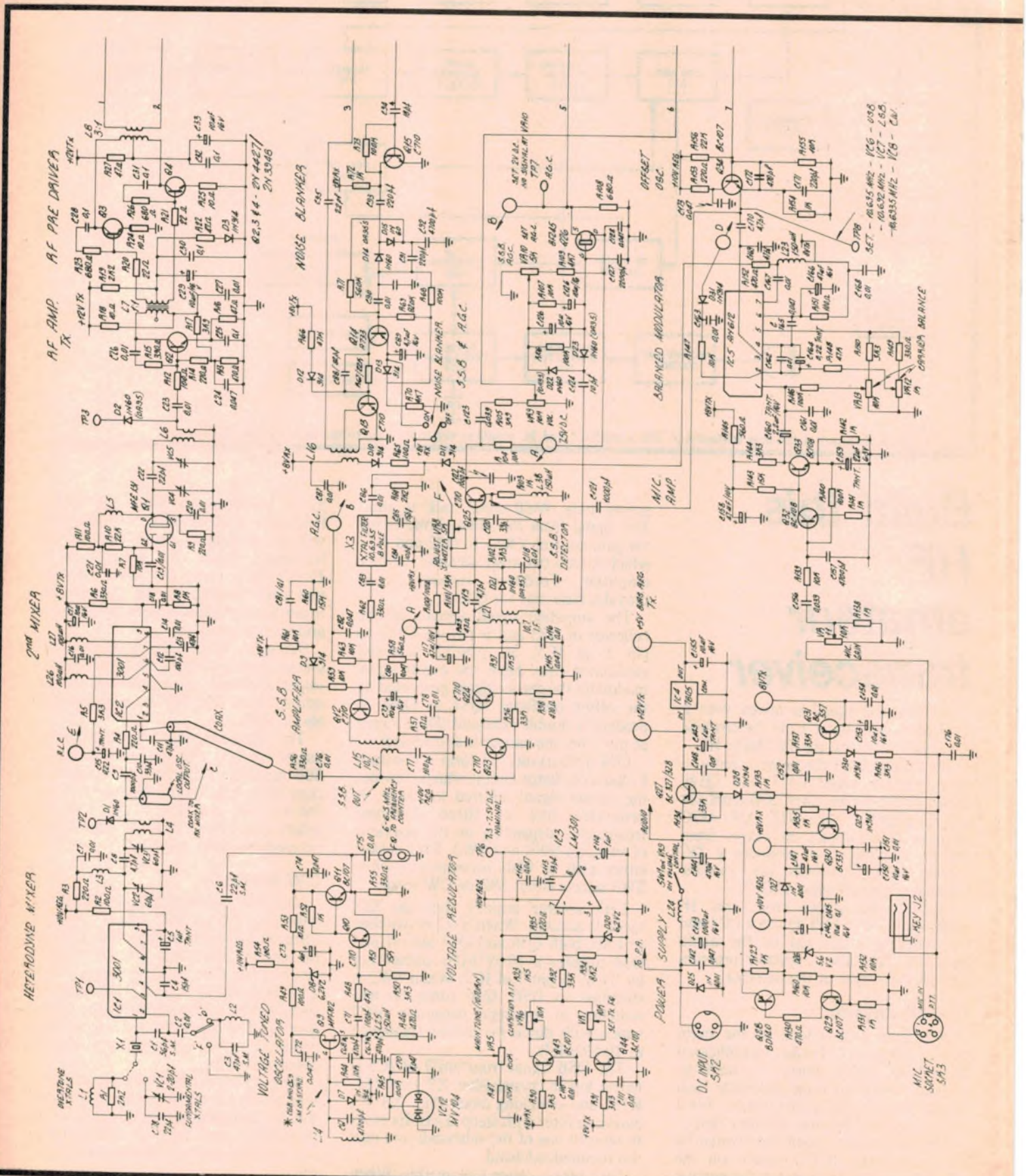
The resultant SSB signal from X3 passes via C83 and R62 to the base of SSB amplifier stage Q12. The signal is then filtered by IF transformer L15 and fed via C76 and R56 to pin 1 of IC2 where it is mixed with the signal from heterodyne mixer stage IC1.

CW mode

The CW mode functions somewhat differently. When SW3 selects CW, Q35 turns on and trimmer capacitor VC8 sets the carrier frequency to 10.6935MHz. At the same time, +5V is applied to pin 2 of IC5 via D31 and R147 and this switches the carrier signal to the output (pin 7). The unmodulated carrier now passes via X3 and Q12 to IC2 as described above.

Key J2 at the microphone socket is used to key the carrier on and off. It does this by switching the supply rails to the transmitter and receiver circuits. This will be discussed in greater detail later on.

Build this HF amateur transceiver



Voltage tuned oscillator

Thus far, we have our SSB (or CW) signal on pin 1 of IC2, ready to be mixed with the heterodyne signal from IC1. This heterodyne signal is derived using mixer IC1 and voltage tuned oscillator (VTO) Q9 to Q11. Let's see how the VTO works.

FET Q9 forms a Colpitts oscillator with output frequency variable over the range 6-6.5MHz by means of varicap diode VC12 in the tuned gate circuit. The tuning voltage on VC12 is set by VR5 and derived from voltage regulator IC3.

The circuit of IC3 is straightforward. Diode D20 provides a 6.2V reference at the non-inverting input of op amp IC3, while R93 and R94 set the gain to give a regulated output voltage of about +7.5V at pin 6.

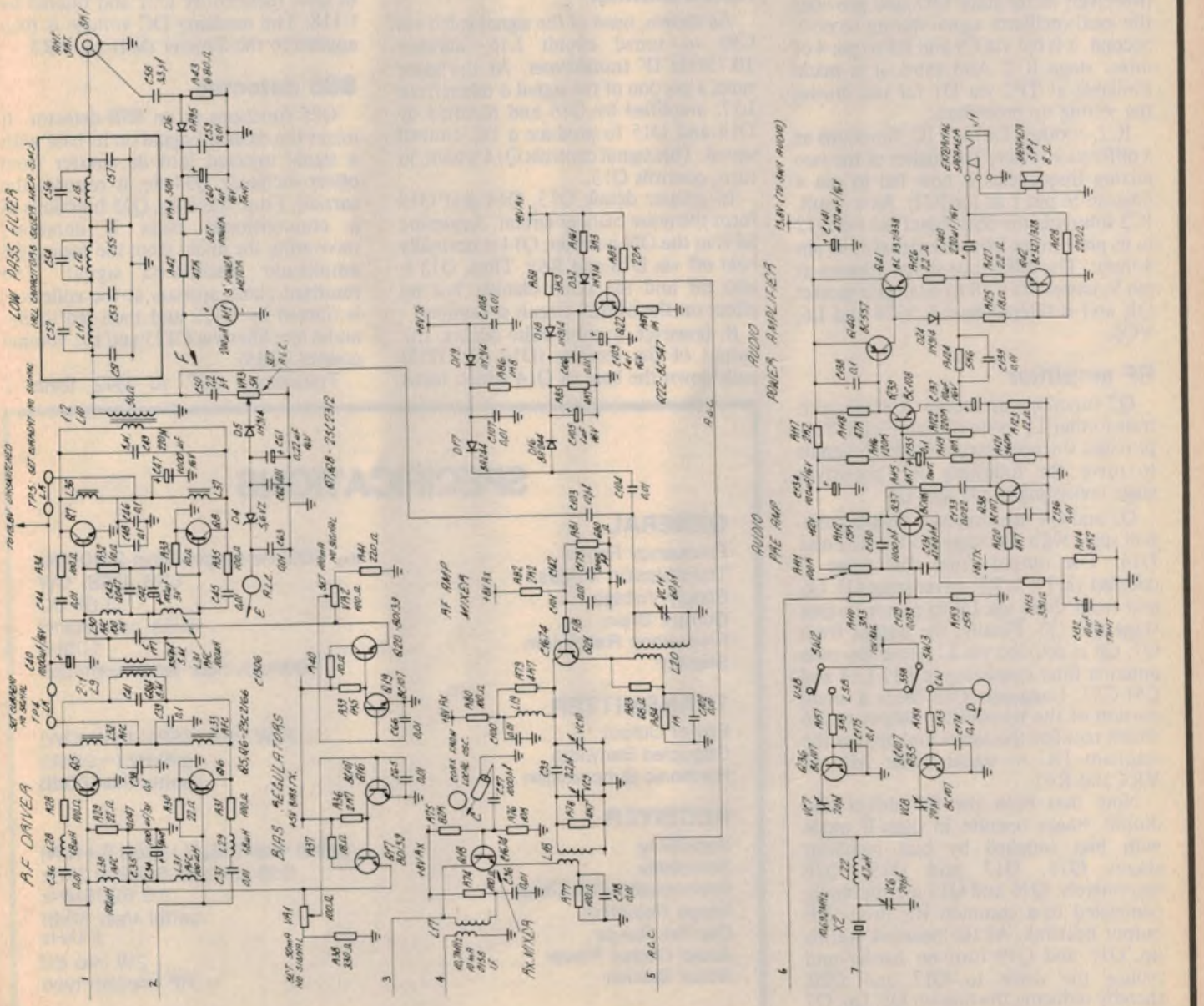
Q43 and VR6 form the RIT clarifier circuit. In the receive mode, Q43 turns on and VR6 shunts the feedback network to modify the gain of IC3. This varies the output voltage of IC3 and thus the output frequency of the VTO.

Similarly, during transmit, Q44 turns on and preset trimpot VR7 shunts the feedback network. VR7 thus sets the transmit frequency.

The output of the VTO (Q9) is buffered by Q10 and Q11 which form a two stage amplifier. Q10 is a common emitter amplifier while Q11 is an emitter follower. The output from Q11 is fed via C75 to the frequency counter and via C66 to pin 4 of IC1.

IC1, in association with crystal X1, is

This circuit diagram should be read in conjunction with the block diagram on page 77.



Build this HF amateur transceiver

a TA7310 oscillator-cum-mixer stage. X1 sets the oscillator frequency and is selected according to the band required. The oscillator frequency and the VTO frequency are added together in IC1 and the output appears on pin 6.

From there, the signal is filtered by bandpass filter L3, VC2 and L4, VC3 and fed to several points in the circuit. First, it is fed via C97 to the base of Rx (Receiver) mixer stage Q18 and provides the local oscillator signal during receive. Second, it is fed via C9 and R4 to pin 4 of mixer stage IC2. And third, it is made available at TP2 via D1 for use during the setting up procedure.

IC2, another TA7310 IC, functions as a difference mixer. The higher of the two mixing frequencies is now fed to pin 4 (instead of pin 1 as for IC1). As a result, IC2 subtracts the SSB signal fed via Q12 to its pin 1 input from the signal at its pin 4 input. The difference signal appears at pin 9, passes via C18 to dual gate mosfet Q1, and is filtered by L5, VC4 and L6, VC5.

RF amplifier

Q2 functions as a class A stage with transformer L7 as its collector load. This provides the necessary anti-phase signals to drive the following RF pre-driver stage consisting of Q3 and Q4.

Q3 and Q4 function as a class-B push-pull stage with bias supplied via R22 and D14. The output from this stage is coupled via L8 to RF driver stage Q5, Q6 and from there via L9 to power output stage Q7, Q8. Finally, the output from Q7, Q8 is coupled via L10 to a low-pass antenna filter consisting of L11-L13 and C51-C57. Capacitor C58 feeds a small portion of the transmitter output to D6 which rectifies the signal and applies the resultant DC to signal meter M1 via VR4 and R42.

Note that both the RF driver and output stages operate in class-B mode with bias supplied by bias regulator stages Q16, Q17 and Q19, Q20 respectively. Q16 and Q19 are thermally connected to a common RF driver/RF output heatsink. As the heatsink warms up, Q16 and Q19 turn on harder and reduce the drive to Q17 and Q20, thereby reducing the bias on Q5, Q6, Q7 and Q8.

The receiver

Input signals from the antenna are fed via the low pass filter network to tuned circuit L20 on the righthand side of the circuit diagram. The signal is then coupled to the emitter or RF amplifier Q21.

Q21 is a grounded base amplifier with tuned circuits L19 and L18 as its collector load. These form a bandpass filter which only accepts signals in the wanted frequency range. The output of L18 is coupled to the emitter of Q18 which functions as the receiver mixer.

The local oscillator signal is applied to the base of Q18 via C97 and the mixer output at the collector is the difference frequency, nominally 10.7MHz. This signal is coupled to IF (intermediate frequency) stage L17. At this point, the signal is split into two paths.

Noise blanker

As shown, most of the signal is fed via C95 to tuned circuit L16, another 10.7MHz IF transformer. At the same time, a portion of the signal is taken from L17, amplified by Q15 and rectified by D14 and D15 to produce a DC control signal. This signal controls Q14 which, in turn, controls Q13.

In greater detail, Q15, Q14 and Q13 form the noise blanker circuit. Assuming S4 is in the ON position, Q14 is normally held off via D13 and R69. Thus, Q13 is also off and the noise blanker has no effect on the overall circuit operation.

If, however, a noise pulse occurs, the output of the rectifier (D14 and D15) pulls down the base of Q14 which turns on. This switches on Q13 which shunts the signal applied to L16 to ground. The low value assigned to C94 (18pF) assures that only noise pulses get through to activate the noise blanker circuit.

Note that in the transmit mode, Q13 is permanently held on via R66 and D12. This prevents any received information from finding its way into the transmitter circuit.

Following L16, the received signal passes via switching diode D10 and R65 to X3, the 8-pole crystal filter. The output from X3 then passes via C83 and R62 to SSB amplifier Q12, a common emitter stage with L15 as its collector load. Q23 and Q24 provide further amplification of the IF signal and apply it via L21 and C119 to Q25.

Q24 is also used to drive the S-meter circuit. A portion of the IF signal is taken from the low impedance winding of L21, rectified by D21 and filtered by C118. The resulting DC voltage is then applied to the S-meter (M1) via VR8.

SSB detector

Q25 functions as an SSB detector. It mixes the received signal on its base with a signal injected into its emitter from offset oscillator Q34 (ie, it restores the carrier). From there on, Q25 functions as a conventional class B detector, recovering the audio from the composite amplitude modulated signal. The resultant audio appears at the collector, is filtered by C122 and then fed to the audio amplifier via C123 and the volume control (VR9).

Transistors Q37 to Q42 form a

SPECIFICATIONS

GENERAL

Frequency Range	any 500kHz range within 2-30MHz
Transmission Modes	LSB, USB, CW
Supply Voltage	13.8V DC
Current Drain	4.5A on transmit
Frequency Resolution	100Hz
Stability	100Hz/¼ hour (after warm-up)

TRANSMITTER

Power Output	30W PEP (SSB); 15W (CW)
Occupied Banwidth	±8kHz (−25dB)
Harmonic Suppression	better than 60dB

RECEIVER

Sensitivity	better than 0.3μV (10dB S+N/N)
Selectivity	6dB at 4kHz; 60dB at 7kHz
Intermediate Frequency	10.6935MHz
Image Rejection	better than 50dB
Clarifier Range	±1kHz
Audio Output Power	2W into 8Ω
Noise Blanker	RF impulse type

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It looks so good your friends will never believe you built it!

Hurry: limited stock!
Some of the special components in this transceiver are difficult to get. Stocks are limited — and at the low, low price of this kit they're sure to disappear fast. Place your order now at your nearest Dick Smith Electronics store!

As described in EA October & November.

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Build this HF amateur transceiver

conventional audio amplifier. Q37 is a straightforward common emitter stage with high frequency rolloff provided by C130 and C131. The signal on the collector of Q37 is fed to common emitter stage Q39 which has negative feedback applied to the emitter via R124.

Q40 is a class-A driver stage with bootstrapping supplied via the output capacitor C140. This stage drives Q41 and Q42 which form a fully complementary output pair. R125 and D24 set the output stage quiescent current while emitter resistors R126 and R127 provide good bias stability.

Resistors R124 and R123 set the gain of the amplifier to around 250 (ie, 5600/22) while C137 rolls off the response below 1kHz.

Q38 functions as an audio switch. In the transmit mode, Q38 is biased on and shunts any audio signal across R121 to ground. This means that the audio amplifier is muted when the PTT button is pushed.

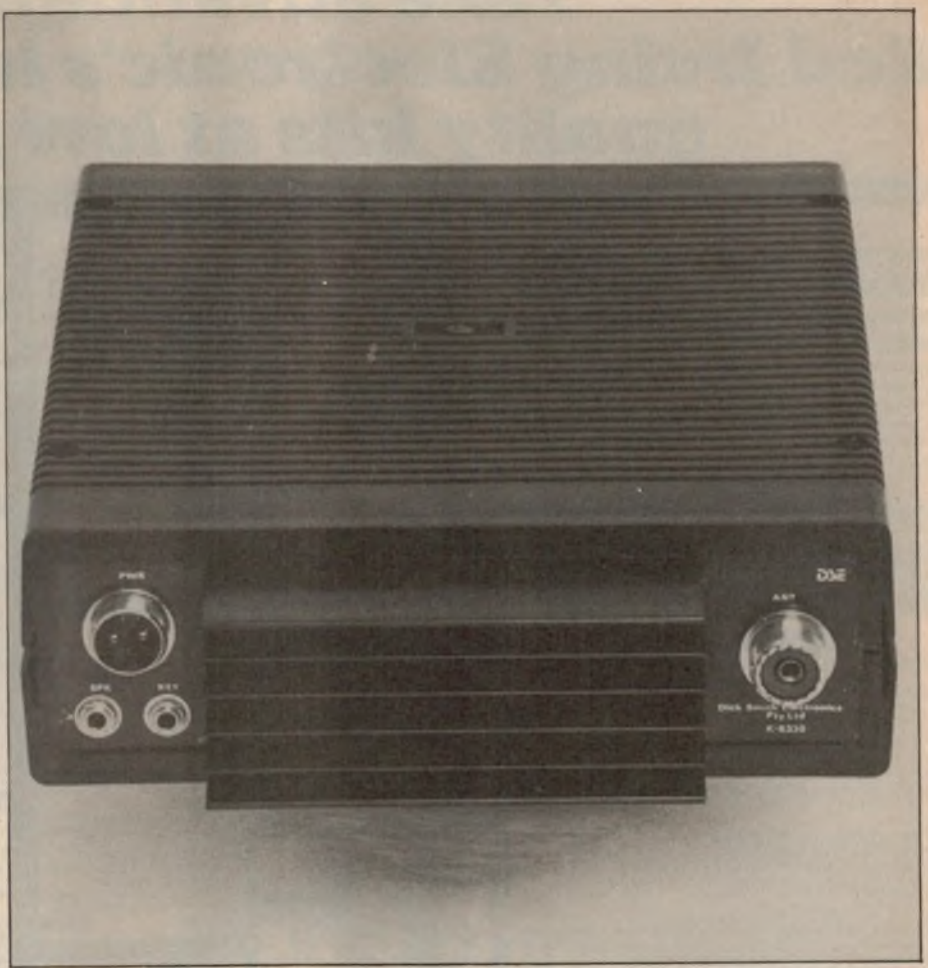
Receiver AGC

Let's now examine how the receiver AGC works. To do this, we need to back-track to IF amplifier stage Q24. As shown on the circuit, part of the signal from Q24's collector is fed to C124 and rectified by diodes D22 and D23. The resulting DC signal is then coupled to the gate of FET Q26.

With no input signal, VR10 and R109 provide a preset 2V bias at the source of Q26. When a signal is received, the output of the rectifier pulls down the gate of Q26 and the voltage across R108 decreases. The higher the signal level, the more the gate is pulled down and the lower the voltage across R108.

This voltage is the AGC signal and is applied to two separate stages in the receiver circuit. First, the AGC signal controls the gain of SSB amplifier Q12 via R63. The lower the AGC signal, the lower the gain of Q12.

Second, the AGC signal controls the current through Q22 which, in turn, controls PIN diodes D16 and D24. This circuit functions as a variable attenuator for input signals from the antenna, the degree of attenuation being controlled by the AGC voltage.



The rear panel carries sockets for power, speaker, key and antenna, together with a hefty heatsink for the transmitter output.

The circuit works as follows. In the receive mode, Q22 controls D17 and D16 via R86. D17 and D16 are BA244 low impedance switching diodes. As the AGC voltage decreases, Q22's collector voltage rises and D17 and D16 conduct more heavily. Thus, by varying the current through D17 and D16, a variable impedance path is provided which shunts the input signal to ground via C104.

In the transmit mode, +8V is applied permanently to D17 and D16. The diodes now provide a very low impedance path to keep the transmitted signal out of the receiver input (L20).

Power supply

A +10V regulated supply, consisting of Q28, Q29 and D26, supplies power directly to the voltage regulator (IC3), voltage tuned oscillator (Q9 to Q11) and offset oscillator Q34 to Q36. Q28 functions as a conventional series regulator, while D26 sets the reference voltage at the emitter of error amplifier Q29. The voltage on Q29's base, as set by R160 and R132, is compared with the reference voltage on Q2 which then varies the drive to Q1.

The +10V rail is also coupled via D27 to transistor switches Q30 and Q31. These supply +8V regulated supply rails to various other sections of the circuit, depending on whether the transceiver is in the receive or transmit mode.

In the receive mode, the PTT switch is open and D28, D29 and D30 cannot conduct. Therefore Q30 turns on to supply the +8V Rx rail. When the PTT switch is closed for transmit mode, D29 and D30 conduct, Q30 turns off and Q31 turns on to supply the +8V Tx rail. D28 also conducts, turning on Q27 to supply the +12V Tx rail to the transmitter and to 3-terminal regulator IC4.

IC4 provides a regulated +5V rail to the bias regulators (Q16, Q17, Q19 and Q20) in the transmitter circuit.

The final two stages of the RF power amplifier are powered directly from the 13.8V (battery) supply, as is the audio amplifier. This is OK since Q5 to Q8 are normally biased off and can only operate when the preceding transmitter stages are turned on by the PTT switch. Diode D25 and fuse F1 protect against reverse polarity connection to the battery.

That's all for this month. In Part 2, we'll describe the counter circuitry and give the construction details.

Continued next month

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SERIES 5000

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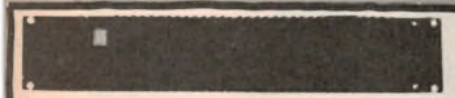
For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.



POWER AMPLIFIER

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

- 1% Metal Film resistors are used where possible.
- Aluminium 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 filters.
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 $319, **now only $289**
Assembled and tested $499
packing and post $10

PREAMPLIFIER

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

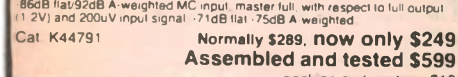
- 1% Metal Film Resistors are supplied.
- 14 Metres of Low Capacitance Shielded Cable are supplied (a bit extra in case of mistakes).
- English "Lorlin" switches ae supplied (no substitutes here.)
- Specially imported black anodised aluminium knobs.

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 $289, **now only $249**
Assembled and tested $599
packing and postage $10



THIRD OCTAVE GRAPHIC EQUALIZER

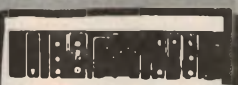
SPECIFICATIONS:
BANDS: 28 Bands from 31.5Hz to 16KHz.
NOISE: -0.008mV, sliders at 0, gain at 0 (= 103dB0).
20KHz BANDWIDTH DISTORTION: 0.007% at 300mV signal, sliders at 0, gain at 0, maximum 0.01%, sliders at minimum.
FREQUENCY RESPONSE: 12Hz = 105KHz, +0, = 1dB, all controls flat.
BOOST AND CUT: 14dB

Cat. K44590

1 Unit ... **$199**
2 Units ... **$379**
packing and postage $10

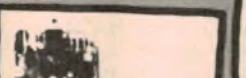
50 W AMPLIFIER MODULE (ETI 480)
Cat. K44480 **$27.50**
(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)
Cat. K44801 **$29.95**
(Heatsink optional extra)



150W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive commercial ones. It delivers 150 watts into 4 ohms, has a 1 band graphic limiter, line out and bi-amp facilities. (ETI Aug. 84) ETI 1410
Cat. K54100 **$299**

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**



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. K84101 **$27.50**

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**

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 **$15.00**

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 PF43611 **$49.50**

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 **$28.00**

300W "BRUTE" AMPLIFIER
The "Brute" develops 300W into 4 ohms, 200W into 8 ohms!
For many aduio applications there is no substitute 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 **$79.50**
(Heatsink not included)

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-wooter 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**

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. **$14.95**

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**

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
$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**

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. (ETI 445) (ETI July 76)
Cat. K44490 **$8.95**

4 INPUT PREAMP
Easy construction and versatile operation, this preamp is for coupling with the 300W "Brute" Power Amp. (ETI 467) (ETI July 80)
Cat. K44670
$26.50

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**

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**

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
$63

MICROBEE ENHANCER 1
This brand new, 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, say, 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 Ennancer 1s many powerful features inlcude:

- Two ATARI/COMMODORE COLECO/SEARS type joystick inputs.
- Two TRS COLOR COMPUTER type joystick inputs.
- Allows the connection of Touch Pads, Paddles, Propotional Joysticks, Trakballs, Mice, temperature sensors, 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 8 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.

Cat. **$149**

Integrated system has compact 3-inch floppy disk

Amstrad CPC664 personal computer

The Amstrad CPC664 Integrated Computer/Disk System is a powerful personal computer which follows on from the successful CPC464 model. It includes a compact floppy disk drive, 64K of RAM, colour, music generation and other powerful enhancements.

By JOHN CLARKE

Our review sample comprised the CPC664 keyboard with disk drive and GT65 Hi-Res green monitor. Both CP/M and Dr LOGO software is provided as standard on disk with the computer.

A large range of software specifically for the CPC664 is also available. These include language and programming, music and graphics, educational, business and games. CP/M based software can also run on the Amstrad with minor modifications.

The computer keyboard is a conventional QWERTY layout together with cursor keys and separate numeric and function keys. The overall length of the keyboard unit is substantial at 570mm, but this also includes the floppy disk drive located to the right. The standard typewriter keys and the numeric keys are grey while the cursor and other oft-used keys are a light blue shade, contrasting with the dark grey of the case.

A 30cm Amstrad monitor completes the computer system. This monitor has a high resolution green phosphor CRT giving the standard 80 column by 25 line display format. The monitor connects directly to the video output from the computer via a coiled cable. The computer power supply is also contained within the monitor and both 12V and 5V regulated supplies connect from it to the computer via coiled cables.

Apart from the video and power connections at the rear of the keyboard console, there are sockets for a joystick, stereo sound socket, tape socket and three printed circuit board outlets. These latter ports are for a second disk drive, Centronics printer interface and finally, an expansion socket comprising the Z80 data, address and signal bus.

For colour use, the Amstrad CTM644 colour monitor or alternatively a colour television can be used. For the latter case, the computer will require 12V and 5V power supplies and an RF modulator if the TV set does not have a direct video connection. Amstrad can provide an MP-1 MK2 modulator/power supply, specifically for this purpose.

The floppy disk drive is the now popular Sony 3-inch standard. The disk is divided into 40 tracks and 9 sectors. Each track within a sector can store 512 bytes to give an overall storage of 180K bytes for each side of the disk.

The microprocessor is the good old-

The Amstrad CPC664 includes a compact floppy disk drive and 64K of RAM.

faithful 8-bit Z-80 teamed up with the 6845 picture tube controller. The latter is an intelligent device which performs video timing and refresh memory addressing functions. It provides a screen resolution of 256 × 256 pixels with each pixel separately addressable.

The 64K of random access memory consists of eight 4164 ICs. These are 64K bit dynamic RAMs. A 32K ROM contains the BASIC interpreter and also the firmware. The latter performs the keyboard scanning via an 8255 PIO and takes care of other operating tasks.

An Uncommitted Logic Array (ULA) is used to allow the ROM to share part of the same address space as the RAM. The ULA decides whether RAM addressing or ROM addressing is required and directs the chip enable signals from the CPU to the correct memory.

For music generation, a General Instruments AY-3-8912 sound generator is included. Programming of the tone period, duration, volume, volume envelope, tone envelope and noise period is available. In addition, the music can be directed out of the left channel, right channel or both channels for a stereo effect.

Testing the Amstrad

As supplied, the computer comes without a mains plug and it is therefore necessary to install this yourself. For safety reasons, we would prefer to see these computers sold with mains plugs fitted and we assume that this will normally be the case.

When first powered up, the computer responds with 1984 Amstrad BASIC 1.1. This is a very comprehensive version of BASIC which apart from including the common commands such as PRINT, RUN, ABS, GOSUB, POKE, etc, includes interrupt, graphics and sound commands.

Interrupts

The interrupt commands are AFTER, EVERY, DI and EI. The AFTER command calls a subroutine (interrupt) after a given period of time has elapsed. Four separate timers are available for AFTER interrupts. Timer 3 has the highest priority and an interrupt will occur as soon as timer 3 calls the interrupt. For the lower priority timers; 2, 1 and 0, an interrupt can only occur when the higher number timer or timers are not serving an interrupt.

The EVERY command calls a subroutine repeatedly at the specific period. There are four timers also available with this command and they also have priority in a similar manner to the AFTER timers.

Two separate commands, the DI and EI commands disable and enable the interrupts respectively.

Graphics

There are many graphics commands for the CPC664 most of which could be put to best use with a colour monitor. One of the major commands is DRAW. This draws a line from the cursor position to specified x,y coordinates. The colour of the line can also be allocated as one of 16 colours. How the line interacts with the graphics already on the screen can also be specified. A similar instruction, DRAWR, specifies a relative x,y offset.

The GRAPHICS PEN command sets the colour of the line and options the background mode as either opaque or transparent. GRAPHICS PAPER sets the colour of the area behind the graphics drawn. When animating these graphics, the colours will merge behind, or cover up the background depending upon whether the AND or OR option is used and the particular code number of the colour specified. The terminology for this effect is colour plane sprites.

As well, there are other graphics control commands which FILL in areas bounded by a line, MOVE the graphics cursor and change the BORDER colour. The SPEED command can alternate two colours at a specified rate.

A particularly interesting command is FRAME. It allows synchronising of the writing of graphics onto the screen with the frame flyback of the monitor. This is an important command since without it any animation on the screen would flicker or tear.

Sound

Several BASIC commands allow a tone to be generated over eight octaves. SOUND provides for seven parameters to be controlled. These are the channel status, tone period, duration, volume, volume envelope, tone envelope, and noise. Most of these parameters are self explanatory with the exception of the first and the last.

Channel status provides direction of the sound from one or more separate A, B or C channels. In addition one channel can be specified to rendezvous (merge together) with another channel. If the sound channels are connected to a stereo amplifier then the A channel will be the left channel; the B channel, right and the C channel both left and right.

The noise parameter refers to a white noise source which can be switched off or mixed with the sound.

Separate envelope controls are also available. The ENT command provides control of the tone envelope, while the ENV command controls the volume envelope.

Arcade-style games will benefit from this complex sound programming facility. The stereo provision allows the sound to follow action on the screen adding realism to the visual effects.

Disk Operating System

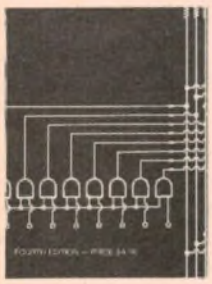
Included with the 664 is a selection of software on a 3-inch floppy disk. This comprises a Disk Operating System called AMSDOS, version 2.2 of CP/M and Dr LOGO. The DOS system is accessed from BASIC merely by pressing the upper case and "/" keys. Once the DOS is accessed, the command following "/" has control over data within the compact floppy disc.

The DOS provides facilities for creating file names, saving files, copying and screem dumping. It also has commands for saving onto tape.

A wide range of software is available, including business and games packages.

Special Publications from Electronics Australia

FUNDAMENTALS OF SOLID STATE. Now in its second reprinting — which shows how popular it has been! It provides a wealth of information on semiconductor theory and operation, delving much deeper than very elementary works but without the maths and abstract theory which make many of the more specialised texts heavy going. Starting with a background chapter on atomic theory, the book moves easily through discussions on crystals and conduction, diode types, unijunction, field effect and bipolar transistors, thyristor devices, device fabrication and microcircuits. A revised glossary of terms and index complete the book. *Fundamentals of Solid State* has also been widely adopted in colleges as recommended reading. **$4.50**



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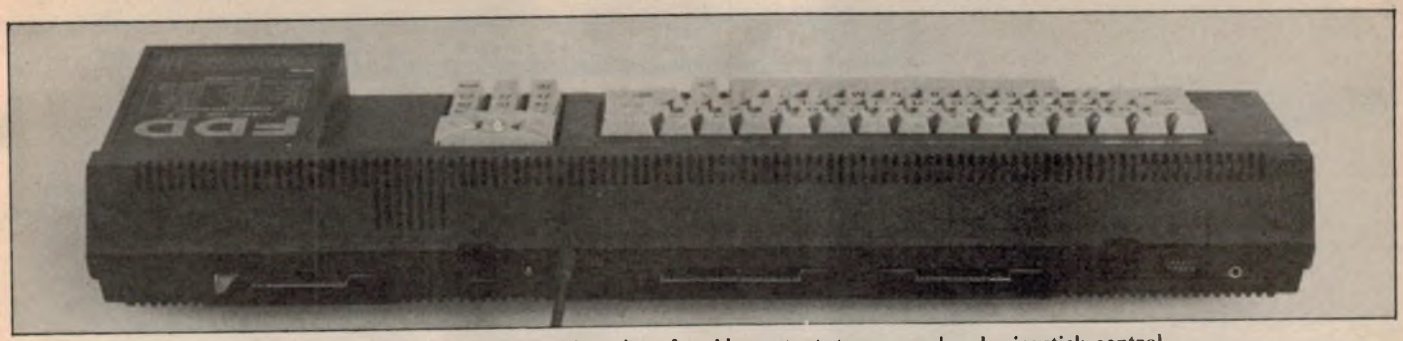


The rear panel carries the three output ports, together with sockets for video output, tape, sound and a joystick control.

Amstrad CPC664

In addition to the normal range of commands offered by CP/M, the same disk incorporates an 8080 assembler, an 8080 assembly code debugging aid, a hexadecimal file dump utility, a simple context editor, a Console Command Mode batch processing package and a transient program batch processing package.

Dr LOGO

Dr LOGO is a customised version of LOGO, a programming language which is a collection of procedures called primitives. These primitives are used to build up a program.

It includes turtle graphics commands that allow an arrow head (turtle) to be moved about the screen and so draw. There are forward, back, rotate right and rotate left as well as turtle up and down statements.

Apart from graphics, logic and arithmetic commands, keyboard and joystick controls and sound commands are included. The language is easy to learn and has proved popular with young children and newcomers to computers.

Instruction manual

The CPC664 user instruction manual provides virtually all the information required to skilfully use the computer. For beginners it includes a foundation course in the first two chapters of the book. It is very well written and includes examples of using the computer to load a disk, run a BASIC program and to develop skills with the sound, colour graphics generation.

A complete list of Amstrad CPC664 BASIC keywords is given in chapter 3. Chapter 4 discusses using disks and cassettes. A complete chapter is given to CP/M and AMSDOS and to LOGO. The final two chapters include some vital information about the computer to include external connection diagrams and some data on the hexadecimal number system. The appendices also include some game programs, written in BASIC.

Although the manual is well written, we found the information to be VERY scattered throughout the book. Looking for information on sound generation, for instance, means looking up chapter 1, chapter 3, chapter 7 and chapter 8. If this aspect could be improved, it would be so much easier to use this manual.

Software

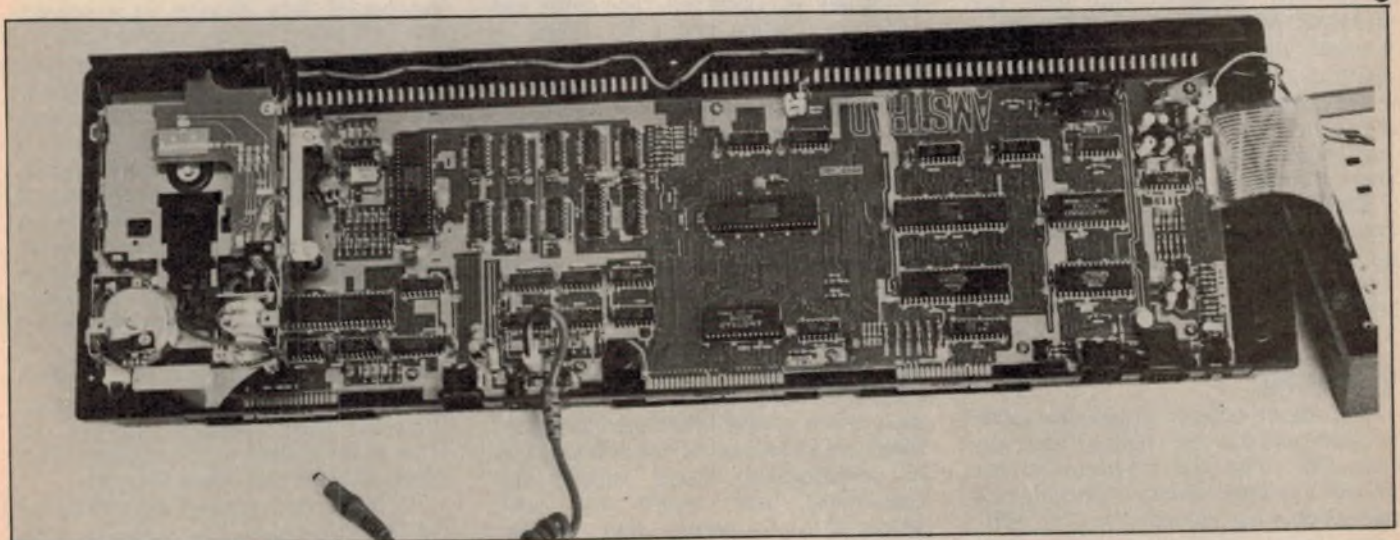
A wide range of software is available for the Amstrad CPC664. We were provided with some Electronic Home software including Bill Payer and Bank Manager. For the business software, we sampled the Amsword Advanced (word processing package) and Masterfile 464, an information filing and retrieval system.

The business software included loose leaf documentation of the package but all the packages were easy to use and well documented within the software itself. Programs without documentation had prompts and, where needed, notes to explain the software.

Conclusion

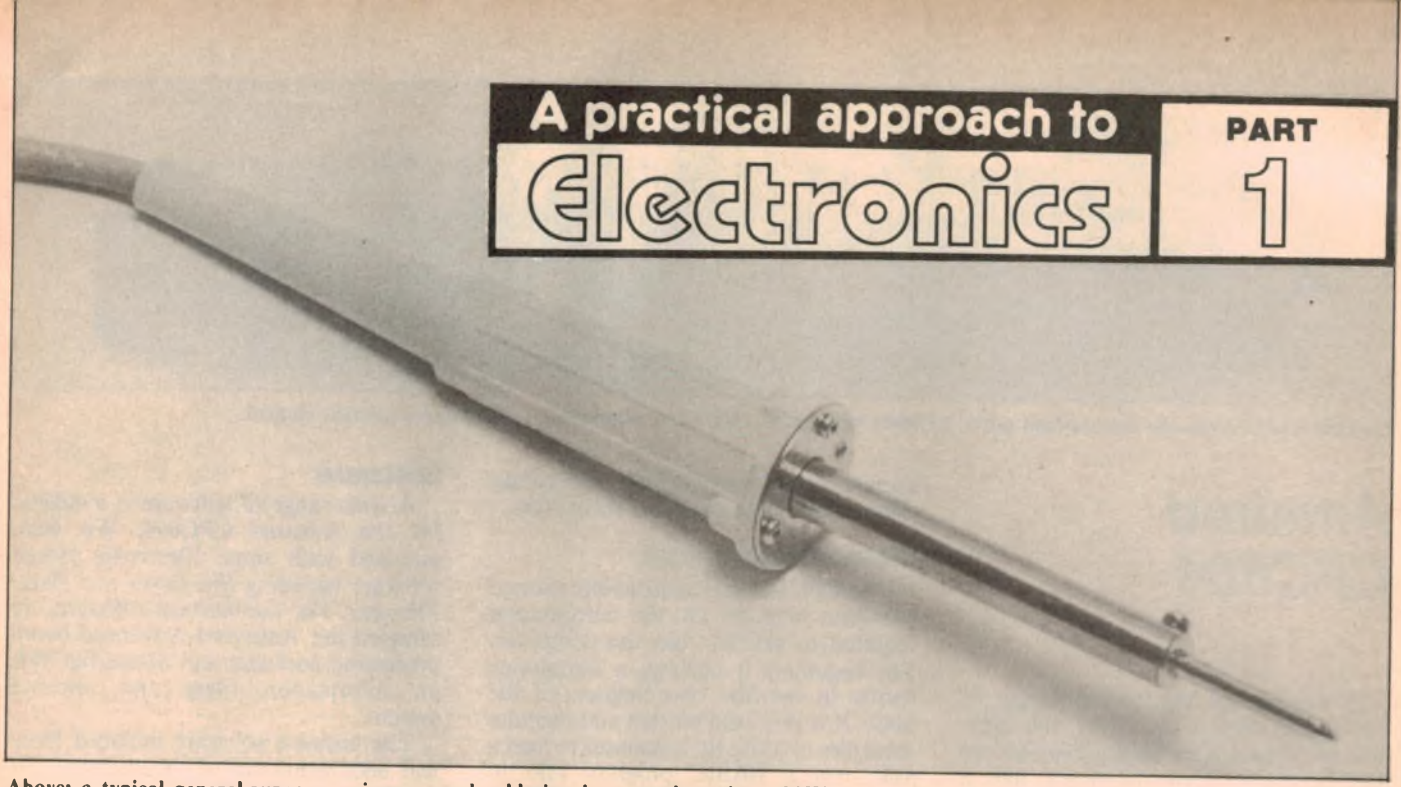
The Amstrad CPC664 is a modern 8-bit personal computer which appears to be well designed and easy to use. It includes an excellent version of BASIC and the bonus CP/M operating system allows a vast amount of CP/M based software to run. The combination of good graphics, sound, 64K of memory and compact floppy disk drive, helps make the unit an attractive contender in this hotly contended segment of the computer marketplace.

Recommended retail price of the CPC664 together with the GT65 high-resolution green screen monitor is $949.



View inside the Amstrad CPC664. The unit is well-designed and well-constructed.

A practical approach to Electronics PART 1



Above: a typical general-purpose mains-powered soldering iron rated at about 20W.

The care of your soldering iron

Iron hot? Ready to solder? Stop! Switch off, find a quiet corner, and read this first!

by KINGSLEY HOWE

If you have followed all the instructions properly and still find problems with soldering, don't blame yourself. Over a 30 year period I have made an uncountable number of joints in the manufacturing sector and also in the service field and I still strike trouble. Just what sort of trouble you find yourself facing depends on many factors.

Because there are so many factors involved, the text of this article is broken up into sections for easy reference, and should prove useful for both beginner and advanced constructor alike.

Soldering

The actual method of applying solder in electronics has not changed for many years but, with the invention of the transistor, a huge variety of entirely new components has entered the field. With valve based equipment, bulky components and heavy leads were the order of the day. A typical iron then in use had a 50 watt rating and a bit 12mm in diameter. Using a bit this size on today's boards would destroy all components and the board as well! In fact the face of the iron would completely cover all the pins on a 741 IC!

All electronic components have been greatly reduced in size, and entirely new materials developed for their manufacture. Many of the plastics employed do not stand high temperatures and, because of this, smaller irons and lighter gauge solders are used. The application of heat to a joint is nowadays more closely controlled and more skill is required than used formerly. Much credit belongs to the development of sophisticated fluxes; indeed the electronics field would not have advanced to its present state without them.

Starting out

The first item on the list is of course a good mains-powered iron of around 15 watts. This rating is ample for most work but it will become too hot if left switched on for long periods. To avoid too much expense, a light dimmer in a suitable standard mounting box may be used.

The type of box I use employs a plain front cover which is marked with a felt pen to denote various temperature settings. Turning the control knob to a position below the main mark enables the iron to "idle" at a lower temperature than normal, avoiding a burnt bit. A slight twist of the knob quickly raises the iron to a suitable soldering temperature when required. The fully clockwise position is "flat out", and proves useful for heavier work.

Each iron may vary slightly so, when setting the most used temperature, start from the "cool" position, turning the knob in small steps until a practice joint proves satisfactory. Mark this spot.

Probably, the most common shape for the tip is the chisel. This will cope with both heavy work and closely spaced IC

pins alike. Always wipe the tip before soldering. This removes any oxides and burnt flux from the bit. After every five joints, again wipe the bit. Not all the solder applied will flow onto the joint; some will hang in a blob directly under the tip. With the continuous heat, oxides form and evaporation of the flux and tin occur. This is not visible from above, where the surface may appear bright and shiny.

I have found the most useful wiper to be a piece of cellulose sponge pad. These are available from supermarkets at about three for a dollar. They have large open pores, and are fairly heat resistant. Mine is used dry, as I found that damp pads cool off the bit surface too quickly. The solder then sets hard and traps contaminants, which then re-emerge when the solder melts again. On top of that, steam rising from the pad causes corrosion near the end of the barrel.

However, should you prefer a damp wiper instead, a handy setup can be made with a coffee jar lid (plastic) and two pieces of pad cut to fit inside. A dry rag is better than wet foam rubber for most soldering stations.

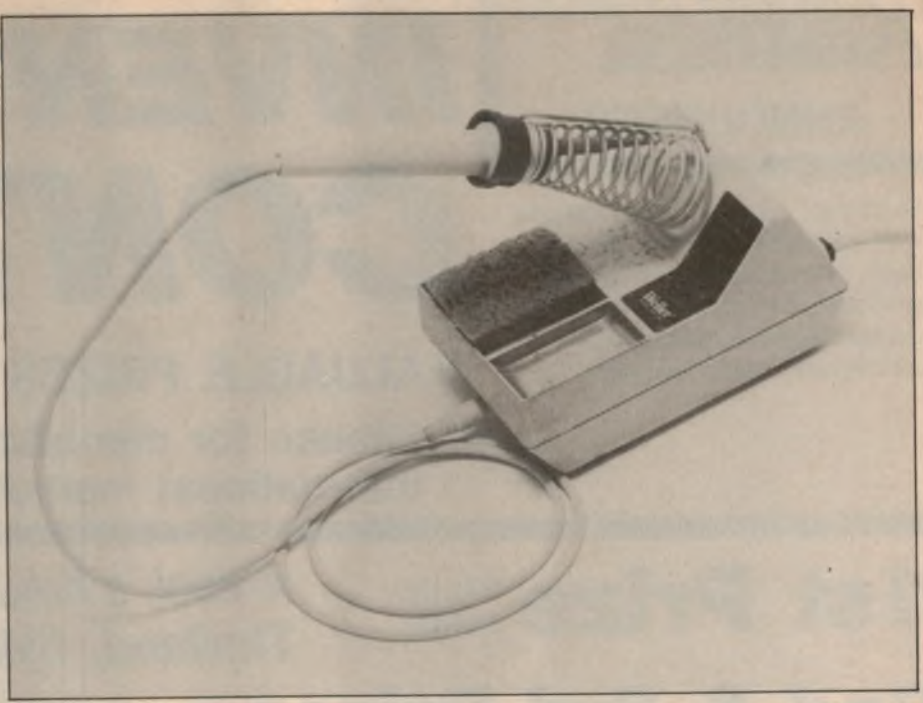
A bonus with this type of open pore sponge is that the holes trap loose solder blobs, which can be shaken out after use. If you still have a dirty tip, and find the pads are not removing everything completely, try folding a large piece of dry pad around the bit and draw it towards the tip, giving it a final extra squeeze as it leaves the end. Don't burn your fingers!

Maintenance

One problem with both push-in type bits and screw-fixed bits is gradual loss of heat. The iron will take longer to heat a joint than when new. The cause of this is not a fault in the heating element, but a gradual buildup of oxide in the barrel. This results in a slow transfer of heat. All bits, even iron plated types, will burn in the barrel. The burnt layer is a poor heat conductor, and if the iron is to perform properly, this must be removed. Wait until the iron is cold then grip the bit near the barrel with a pair of pliers. Use a slight twisting motion to slip the tip from the barrel. Do not use excessive force!

Should the bit be difficult to remove, it may be jammed in with oxide. To extract a bit in this condition, combine the twisting movement with a slight rocking motion. If, after removing the bit, the surface appears badly pitted, do not re-use it. Pitting causes a loss of heat transfer, and this may cause the element in the iron to overheat. Permanent damage will also occur should a shorter bit be used than that recommended by the manufacturer. One easy trap to fall into is filing the tip of a plain copper bit and trying to maintain a fixed length outside the barrel. As the bit becomes shorter, less and less copper is left inside and eventually the barrel lining will overheat and "blow".

All tips must be pushed in firmly, until contact with the bottom of the holder is made. A word of caution on screw-held bits. Do not apply too much force in attempting to tighten the bit. There are only two or three turns of thread in the side of the barrel, and this may strip. If this happens the iron now becomes unusable. If the tip does feel loose, try applying slight pressure to the screw. This should leave a mark on the bit. Loosen the screw and remove the bit. Now file a flat directly on the mark. If the bit still feels loose after this, it is too small in diameter, and should be discarded.

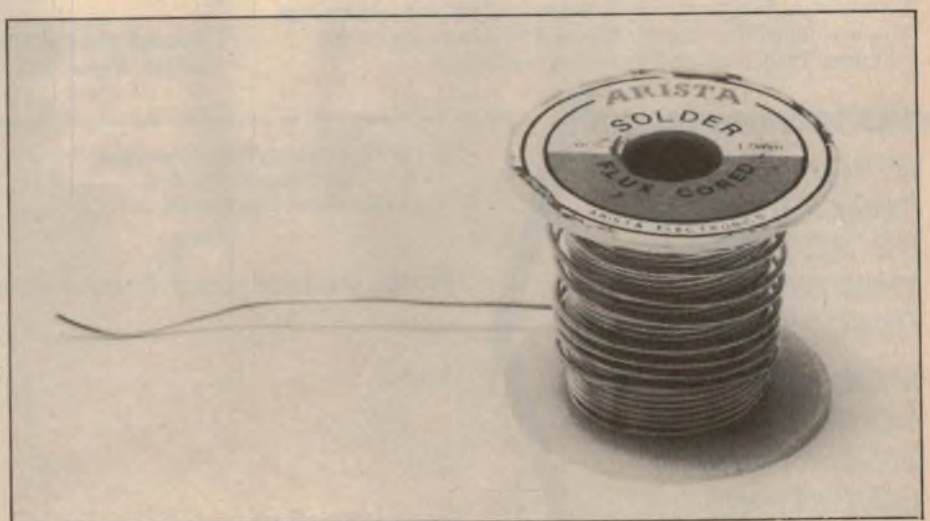


This constant-temperature soldering station is made by the Weller company.

On the bench

What position should an iron rest in when switched on? Some say horizontal, others vertical, and still others say somewhere between these two. The choice is really a matter of personal preference. However, do not position an iron with the tip pointing down. Heat will rise up, causing failure of the plastic handle (it cracks). Also, the handle will become uncomfortable to hold, and the electricals in the handle may burn out.

Mine sits in a cuphook screwed into the side of the bench. The tip points up to allow heat dissipation and the handle is within easy reach. The hook is set horizontally, and is large enough to allow the tapered handle to slide into it. This lets the power cable hang down out of the way.



Always use good quality resin-cored solder for service and assembly work.

Electronics Australia

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If you have devised an original electronic invention you think could be commercially viable, why not fill in the coupon below to obtain the comprehensive details of the contest? These include all details of obligations of all parties, royalties and so on.

Only when you have all this information can you enter. Filling in the coupon below does not impose any conditions on you and does not oblige you to disclose any details of your invention. When you decide to enter you fill in separate forms.

Entries to the contest must be received on or before Monday, December 2. All entries will be acknowledged and will be kept strictly confidential. The winners will be announced in the February 1986 issue of Electronics Australia.

First Prize: A week's holiday for two in Thailand, flying Thai International. Value: $4000.

Second and third prizes: Sony D-50 portable compact disc player. Value: $429 each.

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The care of your soldering iron

Bits

After trying all sorts of bits over the years, the one proven to be most useful and economical is the iron plated type. The quality of work from it is superior, and it maintains its shape for long periods.

Plain copper bits require frequent filing and tinning if they are to be effective. The point of these bits dissolves in the solder with use, and the original shape is soon lost. This may not be apparent to the user, as it is often covered by solder. Positive contact with the joint may be lost, and heat transfer may not take place at the point needed.

With plain copper bits, particles of oxide are constantly building up on the surface. These must be removed at regular intervals or contamination of the joint takes place. However, they do have their uses. For very fine work, and for special shapes, they are ideal. They can also be made with 45° or 90° bends, for use in work where a standard bit just won't reach.

Solders

In choosing a suitable solder, which one do you pick? Cheap solders are available, and may appear to be a bargain. Many of these are of poor quality, both in metal and flux. The alloy may be of dubious origin and composition, or even reject.

Some of the fluxes are almost useless, or in such small amounts, that the whole lot evaporates before the solder has flowed over the joint. Some cheap solders I tried were so bad that most of the solder pulled off the joint when the iron was lifted.

If you are buying solder, deal with a well known firm. When deciding on a purchase, read the label attached to the reel end. If patent numbers are listed, you can be sure that it is of high quality, and that both alloy and flux are laboratory certified.

The most outstanding solder I have used is Savbit (Type 6 Alloy). This contains a synthetic flux and is a joy to use. It copes with "hard to solder" work with little effort and is fast to work with. So next time you intend buying solder, avoid future trouble. The small saving made will soon be eaten up by heat damaged parts, possible destruction of copper tracks and hours of frustration resulting from dry joints.

New Products...
Product reviews, releases & services

Philips PM2519 Automatic Multimeter

At first sight, the Philips PM2519 multimeter looks fairly typical for a bench instrument of this nature. With the title of Automatic Multimeter, we thought it was perhaps a trifle large for a recent release. But it turns out that the prosaic title belies the sophisticated range of test functions available in the instrument. In fact, the Philips PM2519 is rather more than just a multimeter.

Having skimmed through the instruction manual, a number of tests were quickly performed. Although normal measurements presented no difficulty, buttons labelled "Zero Set", "RCL" and "Preset" proved rather frustrating. After reading the manual thoroughly, it soon became apparent that several unusual modes of operation were possible. Furthermore, it was quite a simple matter to take advantage of these powerful test operations by following step by step instructions.

By virtue of its microprocessor based circuit, the PM2519 is able to store a reference value and make various comparisons with the test value. The facility is available for any of the voltage, current, resistance, temperature or frequency ranges. The reference can either be loaded manually, digit by digit, or captured from a measurement.

With a preset value loaded, the meter can display the difference between this and the test value, along with a plus or minus indication. A separate reference value can be loaded and stored for each multimeter function — a memory back up battery retains the values even when power is turned off.

These features alone qualify the PM2519 as an outstanding instrument, but there is more; for the voltage ranges, the difference can be expressed in terms of decibels. Further, the DC voltage ranges can be configured to sound a warning should the input exceed the preset.

For dB measurements, the load resistance can be selected to one of 16 values between 50Ω and 8kΩ. The resistance value in use is indicated by the display when the appropriate mode is selected.

Automatic or manual modes of operation are available. There is a rotary switch on the front panel for mode selection, but all other functions are controlled by a series of small calculator style push-buttons. Automatic or manual range selection can be performed by pushing a button, as well as range selection for the manual mode and presetting.

The PM2519 has a 4 1/2 digit liquid crystal display incorporating a bargraph. In addition to the actual test value, the display has symbols indicating the mode of operation.

The bargraph concept for a digital multimeter is not new (first seen in the Fluke 70 series a few years ago) but the PM2519 is one of the few instruments with it. The advantage of a bargraph display for a digital is that it gives a more useful response to changing inputs and makes nulling measurements much easier.

The Philips bargraph has a logarithmic response, making it particularly good for nulling procedures but not so good where the bargraph is being used to check a measurement which is fluctuating over a range of values. If the bargraph had some scale calibration this facet would be improved.

AC values are indicated in true RMS. A crest factor (peak to RMS ratio) of up to two for voltage ranges and up to nine for current ranges can be accommodated. Where the crest factor is exceeded, a special annunciator is brought up in the display.

Input impedances are fairly typical for this type of instrument on the DCV and low ACV ranges — 10MΩ and 2MΩ respectively. For AC ranges above 10V, the input resistance is extremely high at 1,802MΩ. Frequency response for all AC ranges is specified as 10kHz.

Frequency measurements

Most unusual for a multimeter is the inclusion of a frequency meter the five ranges available are 1000Hz, 10kHz, 100kHz and 1MHz. Input sensitivity is specified as 1.5V peak-to-peak up to 100kHz and 5V peak-to-peak up 1MHz. These figures are apparently the sine wave response — we were able to do somewhat better for square wave inputs.

The gating time is 10s for the 1kHz range and 1s for all other ranges. Accuracy on all ranges is claimed as 0.02% of full scale.

Although our review sample did not come thus equipped, there is a rechargeable battery power supply available for the PM2519 series. With the standard version weighing in at 2kg, the large lead acid battery would probably put the rechargeable version at around 2.5kg. Considering that the

battery power supply gives a life of only 25hrs before requiring a charge, the device is definitely best suited to the bench top.

The PM2519/51 version is compatible with the IEEE 488 system, having a suitable connector on the rear panel. This permits remote control of the meter by means of a computer as well as access to the displayed value. The range (there are five for each mode) but not the mode can be selected by the computer. The sampling rate, reference value, trigger point and start cues can also be controlled via the interface.

Oddly, the polarity of the test leads for diode testing is reversed with red becoming the cathode lead and black the anode. Generally, the standard for electronic multimeters has the red lead connecting to the anode and the black to the cathode.

One other minor criticism concerns the front panel rotary switch which does not have the precise action of those found on some other multimeters.

A comment should be made about the quality of the documentation. The operating manual is better than average and the service manual is excellent. It contains detailed operating instructions as well as device information for all of the ICs in the PM2519. Of special value would be the fault finding flow charts, of which there are many.

Also available is the Philips PM2521 multimeter. This boasts all of the features of the PM2519 with greater accuracy (0.03% compared to 0.1% for DC voltages), as well as 10MHz frequency range, timing and selectable trigger levels.

A particularly interesting feature of the PM2521 is that it has no burden voltage for current measurements. The measured current is balanced against an internally generated source — hence there is close to zero voltage drop across the internal load.

In conclusion, the Philips PM2519 automatic multimeter is a particularly powerful measuring system. Technicians able to take advantage of its sophisticated features would find it a great asset. For those situations requiring a computer based test set-up, the Philips multimeter would be a powerful tool indeed.

Recommended prices (tax exempt) for the new Philips PM2519 series are as follows: the base model is $655 and $856 with the rechargeable option, the IEEE interface version is $1050 and the 2521 version is $905. These models are only part of a large range of multimeters carried by Philips. Further details can be obtained from Philips on the toll free number (00) 822 6661 or at 25-27 Paul St, North Ryde 2113. (C. D.)

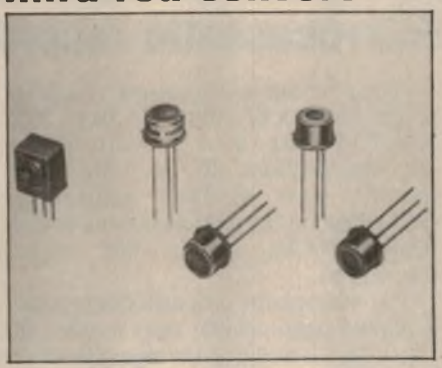
IDC "D" connectors

IRH Components have released a range of new connectors from Fujitsu, including the FCN770 series of printed circuit board D connectors in both metal and plastic.

All connector contacts are phosphor bronze with gold palladium over nickel plating. The full range of Fujitsu insulation displacement ribbon cable connectors and headers and the new generation connectors are detailed in a 40-page catalog.

For further information contact IRH Components, 32 Parramatta Road, Lidcombe, NSW, 2141. Telephone: (02) 648 5455.

Pyroelectric Infra-red sensors



Murata's IRA series pyroelectric infra-red sensors have a comparable performance with that of existing sensors using single crystal elements.

The IRA series shows stable sensitivity in a wave-length range from 0.2μm to 20μm at normal temperature and unlike the quantum type, the pyroelectric infra-red sensors require no cooling and thus have a wide field of applications. It has quick response with built in FET for impedance conversion, to be used to detect people, flames and visible light.

Eight models are available in all, with both single and dual elements. The dual element sensor type IRA EOO25X4 uses two light-receiving elements in series, to detect a body within a field of vision, a 7μm filter protects it against sunlight influence and ensures high reliability. Both resin case and hermetic sealed types are available, and they can be used in a variety of situations.

For further information on this product contact IRH Components, 32 Parramatta Road, Lidcombe, NSW, 2141. Telephone: (02) 648 5455.

New Products...

Panel mounted electromagnetic buzzer

The EAO Series 31 electromagnetic buzzer has a sound level of typically 100dB at 0.1m, adjustable with an external 1MΩ resistor or potentiometer.

Units are available using operating or supply voltages from 10-55V AC and 10-75V DC. The output sound can be either continuous or intermittent as required. The main features of the buzzer are low power consumption, wide operating voltage range, no mechanical contacts, rugged construction.

For further information contact Associated Controls Pty Ltd, 55 Fairford Rd, Padstow, NSW, 2211. Telephone: (02) 709 5700.

Pulsar's MS-DOS and CP/M based multi-user computer system

Pulsar Electronics has released a 16-bit multi-user microcomputer that runs all standard CP/M and MS-DOS software.

The system caters for up to 60 users and supports local area networks of IBM, NEC and Microbee PC architecture.

The System 9000 supports eight-inch or 5.25 inch floppy disks (either single or dual drives) with an option of up to 1000M-bytes of hard disk, using a new laser storage system.

Five megabytes of removable hard disk and 45 megabytes of streaming tape come with the package.

For further details, contact Pulsar Electronics, Catalina Drive, Tullamarine, Victoria, 3043. Telephone: (03) 429 2977.

Microcassette recorder from Matsushita

This new miniature cassette recorder is just 54mm x 85.7mm x 14.3mm. The RN-Z36 has a 1.5 volt drive recording/playback IC, a 1.5V drive motor, new surface mounting technology on the flexible printed circuit board (FPCB), and a low torque mechanism.

The microphone is detachable and has a remote pause switch next to the mic clip. There is a two speed tape selector, a three digit tape counter and a two step (high/low) tone control among the model's features. The weight of the main unit is 97 grams with battery and the weight of the speaker unit with batteries is 270 grams.

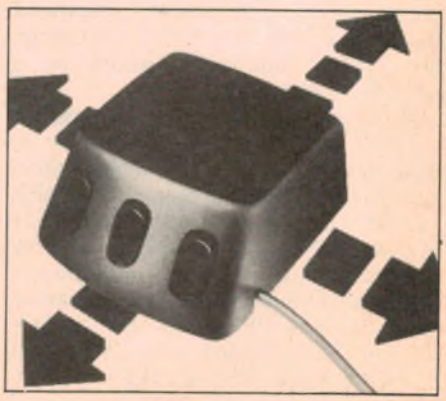
For further information contact National Panasonic (Australia) Pty Ltd, 95-99 Epping Road, North Ryde, 2113.

Mouse package for the BBC

The AMX Mouse package includes an EPROM incorporating the driving firmware, and a line of graphics programs available on cassette or disc.

The Mouse can be used for designing Icons, Windows and Pointers, and can also be programmed for use with commercial wordprocessing packages. Additional software including a Desk Diary, Utilities and Paintpot are also available.

The AMX Mouse is distributed in Australia by Absolute Electronics, 483 Centre Road, Bentleigh, Victoria. Telephone: (03) 557 3971.



"Surprised? Believe me: Nothing's wrong in this picture!"

Philips' PM 2519 is a real "double-DMM"

"It's true: PM 2519 really doubles up on versatility and measuring functions. So you might well think it's really two DMMs in one handy package. Take the double display – digital or a 50-point analog bar graph. Or the double-bus system: IEEE 488 external for easy system hook-up, and I^2C internal for electronic calibration.

Double measuring, too: absolute or relative zero. Plus double functions – frequency and dB, as well as VAΩ. And mains or battery power to give you double the choice. In fact, just about all that's single about PM 2519 is the signal input and its full autoranging capability but even that means double the convenience!

Get full information from: Philips Scientific & Industrial Equipment Division Centrecourt 25-27 Paul Street, North Ryde, Sydney, NSW 2113. Tel. Sydney 888 8222 or Melbourne 542 3600 or Toll Free (008) 22 6661

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Fibre optic power meter

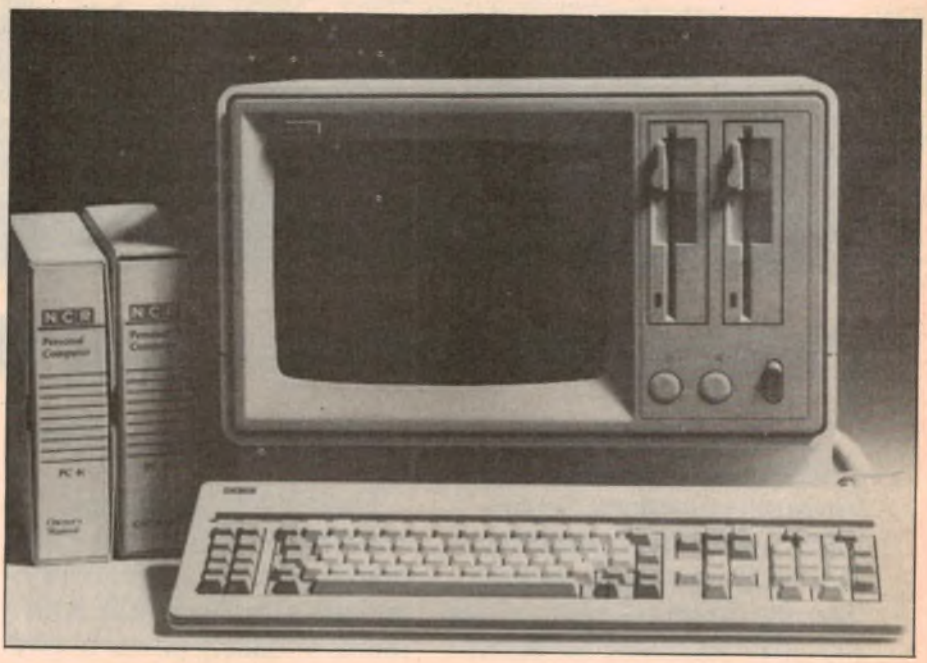
The Fotec M200 from Data Cable is an ideal field service instrument.

Data Cable has introduced a new fibre optic power meter from Fotec. The M200 is designed for testing computer and process control data communications links. Using a silicon photodetector for typical 820nM LED sources, the M200 offers both dB and watts ranges.

Fotec uses an autoranging pre-amplifier which provides the watts readout and follows with a dB converter that offers very good accuracy. The dynamic range of the instrument covers +3 to −60 dBm and 2mW to 10nW. The readings are displayed on a large 18mm liquid crystal display with annunciators showing the range selected.

The M200 is ideal for testing and troubleshooting computer datalinks, since its dB ranges make cable loss measurements easy, and the watts ranges allow simple monitoring of source and received power. It is powered by a single 9V battery that lasts 200 hours. A battery eliminator and over 200 adapters for the fibre optic connectors and bare fibres are optional.

For further information contact Data Cable Pty Ltd, 80 Alfred St, Milsons Point, NSW, 2061. Telephone: (02) 929 8217.



Low cost PC compatible from NCR

The PC4i is NCR's newest personal computer. Built in Germany it provides high resolution (600 x 400) in monochrome and colour. Disc utility to speed operation is included and the keyboard includes separate cursor and data entry pads.

For further information on this product contact Logo Computer Centre, 305 Henry Lawson Business Centre, Birkenhead Point, PO Box 389, Drummoyne, NSW, 2047. Telephone: (02) 819 6811.

Businessmen & Hackers finally see eye to eye on printers.

Businesspeople will welcome it as a new price break-through in near letter-quality printers. Hackers will welcome it as a whole new standard in low-cost printers.

On appearances, you'd never suspect it was a low-cost printer. And when you see its superb, near letter-quality printing, you'll find it hard to believe that the recommended retail price (excluding sales tax) is under $440!

The Epson® "NLQ Special" gives you so much more than you've learned to expect from a printer in this price range.

It offers superb, near letter-quality printing in a variety of type styles and sizes.

It prints up to 100 characters per second, and includes a 1024 byte input buffer which reduces the time your computer is tied up during printing.

It produces charts and graphics with a crispness and definition that's seldom been seen on a printer in this price range.

It comes with standard friction feed, optional tractor & cut sheet feeders, and uses standard interfaces.

In its GX-80 configuration, it emulates Commodore, Apple and IBM printers and operates directly with these computers without modification.

In LX-80 configuration, it offers a variety of built-in word processing functions – so you can produce professional-looking documents even without word processing software – and is compatible with almost all other computers.

There is so much more to the Epson GX-80 and LX-80 that you won't find on other low-cost printers. Call in to your nearest Epson dealer and see what's so special about the "NLQ Special."

The "NLQ SPECIAL" by **EPSON** AUSTRALIA

Epson Australia Pty Ltd, 3/17 Rodborough Road, Frenchs Forest. Sydney (02) 452 5222. Melbourne (03) 543 6455. Brisbane (07) 832 5400.

*Registered Trademark of Epson Corporation. EPS0051/R

New Products...

New range of headphones

Goldring Industries have released a range of headphones. Prefixed by the letters GH, the new series range from the micro GH5, a place-in-the-ear stereo headset, to the top-of-the-range GH11, with coaxial polyester diaphragms, and heavy duty volume control.

The miniscule GH5 earphones are being used in safety helmets and with personal tape recorders. The larger headphones start with the GH9 and GH9V Mylar-coned models continuing up through the GH10 and GH10V and the GH11 and GH11V unit.

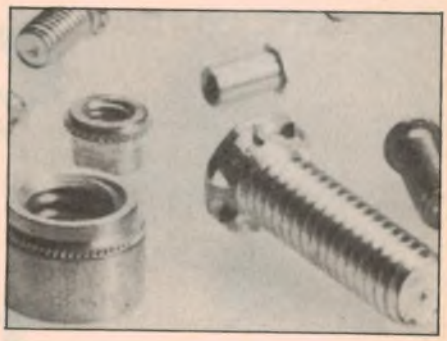
For further information contact Goldring Audio Industries, 89 Chandos St, St Leonards, NSW, 2065. Telephone: (02) 439 3100.

Universal test socket and fasteners

The range of universal test sockets, marketed in Australia by Ampec Electronics Pty Ltd, accepts all devices from six through to 40 pins on either .300, .400 or .600 centres. The plastic housing is UL94V-0 rated polyphenylene sulphide. Normally the closed contact design provides consistent normal force and prevents contact deformation from oversized leads.

The PEM brand of fasteners, marketed by Ampec, provide strong, permanent threads in metal and plastic sheet too thin to be tapped. They are easily installed by inserting them into punched or drilled holes and applying parallel squeezing forces above and below the fastener. The PEM brand of fasteners are available in many variations, in carbon steel, stainless steel and aluminium.

For further information on these products contact Ampec Electronics, 21 Bibby St, Chiswick, NSW, 2046. Telephone: (02) 712 2466.

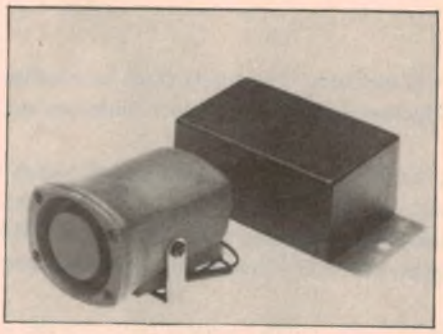


Alarms for all occasions

Dick Smith Electronics Pty Ltd have introduced a security system which can produce an immediate response. Fitted to the L-5100 alarm (fitting extra) is the dialer which can monitor your home at any time of the day or night. Once the alarm is tripped it automatically calls Voice Call who monitor your system and a pre-arranged action will take place.

Also from Dick Smith Electronics Pty Ltd is an alarm system specifically designed for use on a motorcycle. It features all the necessary connections for the sensor input and alarm output. The sensor povides for protection in either of the normal modes of motorcycle parking, centre or side stand.

Installation of two modules is required along with the mercury switch. For further information on both these products contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW, 2113. Telephone: (02) 888 3200.



Cycle Sentry motorcycle alarm.

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

INTENSIL CHIPS IN STOCK

ICL 7106 CPL	16.96
7107 CPL	16.96
7109 CPL	30.00
7611 DCPA	2.30
7660 CPA	5.90
8212 CPA	5.09
ICM 7211 IPL	15.20
7217 AIPI	20.60
7217 CIPI	20.60
7218 BIJI	21.60
7224 IPL	23.80
7226 AIJL	67.20
7240 IJE	8.70
7555 IPA	2.50
7556 IPD	3.10
IM 6402 IPC	10.40

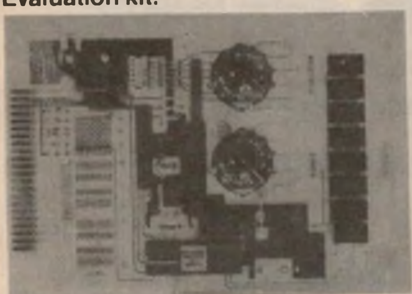
EACH INC TAX

PCB MOUNTED 90° "D" CONNECTORS

Plug **$5.00**
Socket **$6.00**

INTERSIL COUNTER KIT

Build yourself a 10MHz Counter the easy way - with the ICM 7226 Single Chip Counter Evaluation kit.



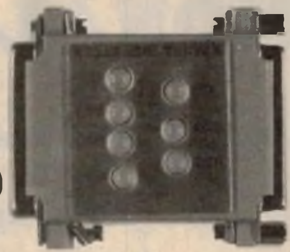
$120.00 inc tax

Features

- *Frequency, Period, Time Interval, Frequency Ration and Event measurement*
- *1, 10, 100, 1000 cycle averaging*
- *10MHz crystal timebase*
- *Double sided PCB*
- *Eight digit LED display*
- *Breadboarding area built-in*

We found about eight of these kits hidden in our store so we're almost giving them away - just check the chip price on this page! Comes complete with 48 page instruction booklet giving circuits for 10, 40 and 100MHz counters and discussing other applications. Runs on 5V 300mA supply.

COMPUTER ACCESSORIES

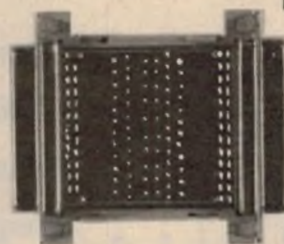


$38.70

CAS6
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
R.D. - Receive Data
R.T.S. - Request to Send
C.T.S. - Clear to Send
D.S.R. - Data Set Ready
C.D. - Carrier Detect
D.T.R. - Data Terminal Ready



$26.40

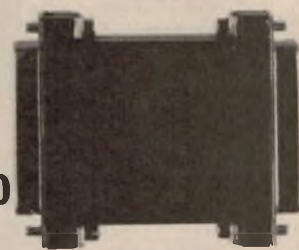
CAS4
RS232 MINI PATCH BOX

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

CASI
RS232 SURGE PROTECTOR

- Avoids costly damage from large voltage peaks caused by lightning or other power problems
- Uses metal oxide varistors (M.O.V.) to suppress any voltage above 26V on pins 2, 3 & 7
- Will handle up to 1 Joule & 250A peak current

$32.10



$19.90

CAS8
MALE TO MALE GENDER CHANGER
CAS9
FEMALE TO FEMALE GENDER CHANGER

- Saves modifying or replacing non-mating RS232 cables by changing from male to female to male
- All 25 pins wired straight through

CAS11
RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

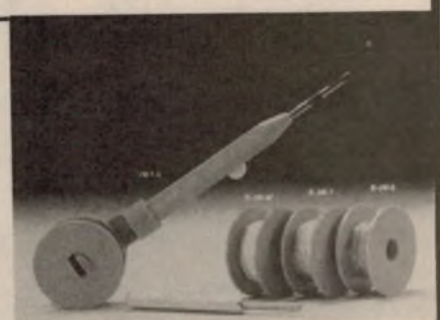
$19.90

NOW STOCKING PRODUCTS FROM OKI INDUSTRIES

IF YOU'RE INTO WIRE WRAP THEN TALK TO US!

Why Cut? Why Strip? Why Slit? Why Don't you JUST WRAP?

A really handy little tool for 30AWG wire and 0.025" (0.63mm) square posts. Does daisy chains or point to point. No slitting, no stripping. Built-in cut off. And it's so easy to load the wire. The really convenient way to do your wrapping since it's all in the one tool. **$44.50**



Hobbyist Wire Wrap Tool suits 30AWG wires and 0.025" posts
Wraps, strips and unwraps **$23.75.**

Reels of wrapping wire, 50 feet in blue, white, yellow or red. Suitable for daisy chaining **$10.70**
Normal wire wrap wire. 100 feet in same colours **$8.50**

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.

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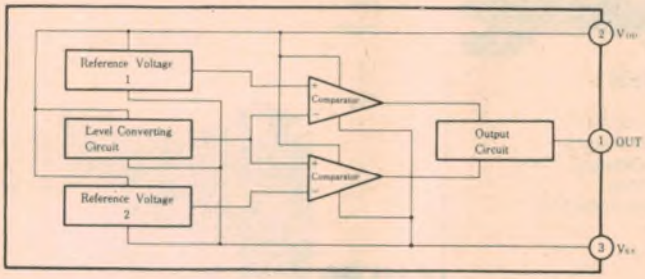
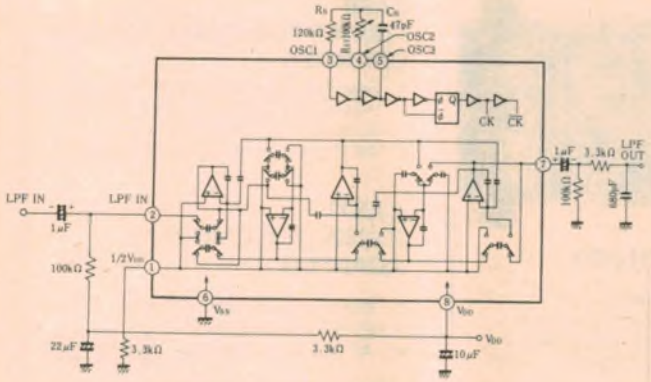
NEW DEVICES FROM NATIONAL PANASONIC

MN1280 CMOS LSI/CMOS LSI for Power Supply Voltage Detector



Designed for use in 5V systems, the MN 1280 generates a predictable reset signal both at power up and when the supply voltage falls below an acceptable level.

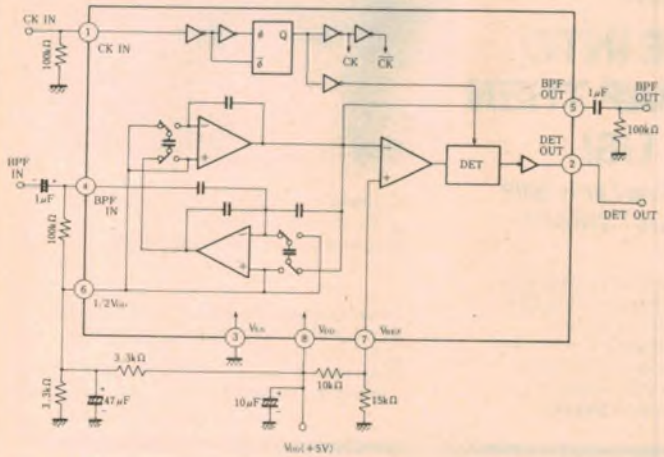
MN6514 Switched Capacitor Low Pass-Filter CMOS LSI



The MN6514 is a 5th order CHEBYSHEV LP Filter. THD better than 40dB, Insertion loss of 4dB, frequency range of 5Hz to 3KHz

Supply Voltage — Typ 5V
Supply Current — Typ 4mA.

MN6515 Switched Capacitor Band-Pass Filter CMOS LSI



MN6515 is a 2nd order bandpass switched capacitor filter with a centre frequency of 100Hz to 2KHz.

Supply Voltage — Typ 5V
Supply Current — Typ 400uA

Perth Electronics Show forges ahead

This year's Perth Electronics Show, the seventh since it was started, was considerably bigger than in 1984. Held at Perth's showground from July 31st till August 4th, it would have to be rated as the biggest electronics show to have been held in Australia so far.

by LEO SIMPSON

So big and significant has this show become that the major consumer electronics companies, all of which have their headquarters in Sydney or Melbourne, are using it as the first venue to display their new products.

While the number of exhibitors and the size of their stands certainly emphasises the importance of the Perth show, the venue itself is not the most exciting. Perth's Claremont showground is only a fraction of the size of Sydney's showground and Perth's three largest pavilions would probably fit into the Hordern pavilion with space to spare.

Such is the level of professionalism being adopted by exhibitors in Perth that the Show committee is contemplating a change in venue for next year, to more salubrious surroundings. Be that as it may, what the Perth Show has lacked in luxury surroundings, it has more than made up in popularity, with exhibitors and visitors alike.

AWA was probably the biggest spender at the Show, having spent $60,000 to set up its exhibition embracing the Aussat satellite, a laser light show, plus displays of Mitsubishi domestic electronic equipment and Amstrad computers.

Also featured was the Mitsubishi home automation system which was touted as the electronic home of the future with interconnected phone, security system, computer and everything else electronic.

Other companies which were at the Show in a big way were Sony, Philips, Sharp, Marantz, Commodore and Pioneer.

Video equipment was much in evidence and there were no less than four different camcorder (integrated camera and VCR) systems being pushed. Two we have seen before in the form of the Sony Betamovie, using the full-size Beta cassette, and the JVC Videomovie, using the small VHS cassette. The new contenders were Sony's 8mm camcorder abut the same size as the JVC Videomovie but offering much longer shooting time, and National's bulky M1 VHS-Movie, which uses a full-size VHS cassette. Akai also had its version of the VHS-Movie on display.

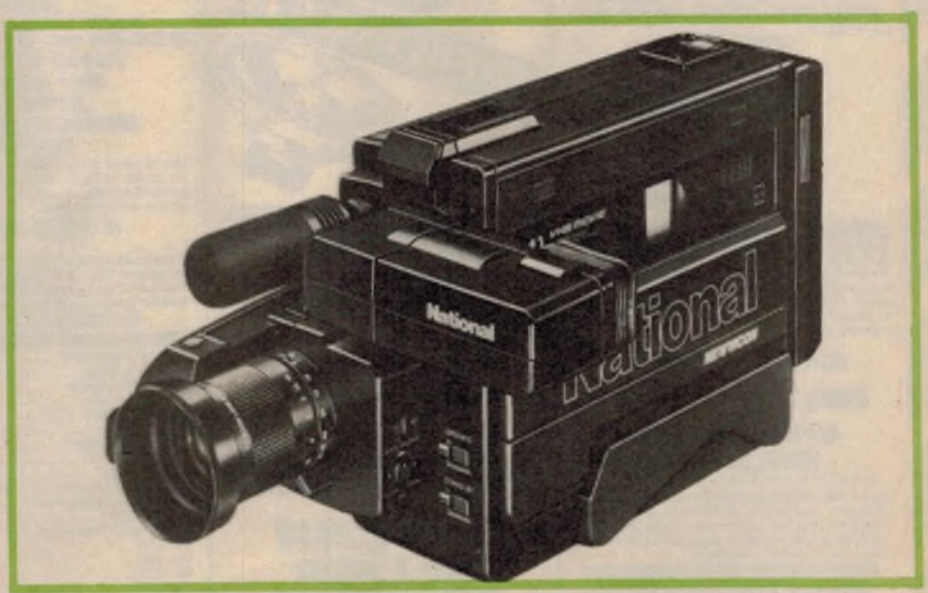
As far as audio equipment was concerned, it was clear that compact disc is gaining ground. Most demonstrations used CD players and turntables were few and far between.

Pioneer had two models of car CD players being demonstrated and several companies had AM stereo equipment on display although none were properly connected and set up to give good sound quality.

One of the highlights of the Sony display was a giant-size version of the D-50 portable CD player. This enormous unit, about a metre square, provided all the functions of the real miniature player, which was actually inside, playing the music.

This year was the first time that

continued on page 116



Sony's new 8mm camcorder is shown at left while at right is National's much bulkier VHS-Movie system.

HI FI SPEAKERS at

PIONEER 12" GUITAR SPEAKER
65W RMS

Strictly limited quantity. Crazy price. They won't last.

USUALLY $59.50
SAVE $20.00

Cat. CG-2381

SAVE $20.00

★ Impedance 8 ohms ★ Power rating 65W RMS ★ Sensitivity 97dB/w ½ metre ★ Frequency range 60 - 6kHz ★ Resonance frequency 80hz

ONLY $39.50

PIONEER DOME TWEETER
LESS THAN ½ PRICE

A dome tweeter for under $10! Ridiculous! Only 250 available.

USUALLY $18.50
SAVE $9.55

Cat. CT-2020

★ Impedance 8 ohms ★ Power rating 25W RMS - 100W RMS system power ★ Crossover frequency 2000Hz ★ Sensitivity 95dB/w ½ metre ★ Frequency range 2000 - 20,000Hz

PIONEER

SAVE $9.55

ONLY $8.95

PIONEER HORN TWEETER

Great sounding black anodised square metal horn. Two together sound great. Limited quantity.

LESS THAN ½ PRICE
WAS $13.50 SAVE $7.00

Cat. CT-2014

PIONEER

★ Impedance 8 ohms ★ Power rating 12W RMS - system 60W RMS ★ Crossover frequency 2000Hz ★ Sensitivity 101 dB/w ½ metre ★ Frequency response 2000 - 20,000Hz

SAVE $7.00

ONLY $6.50

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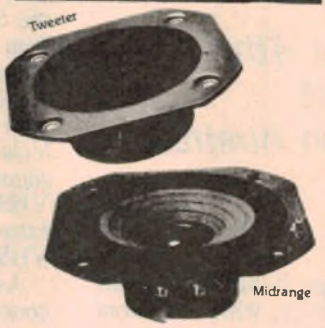
GREY MIDRANGE & TWEETER

TWEETER Cat. CT-2040
USUALLY $5.95 ea
MIDRANGE Cat. CM-2042
USUALLY $12.50 ea
BUY 2 OF EACH FOR
ONLY $23.90
SAVING YOU $13.00

More than the two tweeters!

PIONEER



NEVER TO BE REPEATED
PIONEER 6" WOOFER
4 OHMS

Another huge scoop once only purchase. Ideal woofer for cars, or a small speaker box, or even two in a tower box.

★ Power Rating 15 watts RMS ★ Nominal Resonant Frequency 40-45Hz ★ Nominal Sensitivity 97dB/W ★ Response Range fo - 4,000Hz

WE STOCK THIS IN A TWIN CONE VERSION for $17.50 A REALLY SPECIAL PRICE WOULD BE $10. BUT WE HAVE SLASHED THEM TO ONLY $6.00 ea.

THAT'S CRAZY. Limited Quantity

Cat. CW-2105

SAVE $11.50
ONLY $6 ea

IMPORTERS DISTRESS STOCK
6" PIONEER WIDERANGE

4 ohm impedance. As used in ETI projects

USUALLY $6.95
SAVE UP TO $4.45

Cat. AS-3011

ONLY $2.95
10 up $2.50 each

MAIL ORDER HOTLINE
(02) 747 1888

JAYCAR
No1 FOR SPEAKERS

5" MIDRANGE

This large magnet cone midrange really delivers the sounds. Sealed back, cloth surround

★ Impedance 8 ohms ★ Frequency response 1kHz - 12kHz ★ Sensitivity 96dB ★ Power 60WRMS system.

USUALLY $12.50
SAVE $5.00

Cat. CM-2062

SAVE $3.00
ONLY $9.50

MONO-TO-STEREO ADAPTOR - VCR STEREO ADAPTOR

This unit will take a mono line input and convert it to 2 x "Psuedo" stereo outputs. You can use it to create a stereo effect from mono sources such as TV, AM radio, VCR's etc. (It is not a stereo decoder for AM radio or TV).

Inputs and outputs RCA sockets. Dimensions 110 x 130 x 32mm. Comes complete with 240V plug pack).

Cat. AV-6506

WE'RE GIVING THEM AWAY AT ONLY

$15

EACH

VIFA SPEAKER SENSATION

European Style 2-way Speaker Kit
Sensational NEW design by Dave Tillbrook

SEE AEM JULY

SPEAKERS:

Tweeter DZ5TG 8 ohm Cat. CT-2020
$45.00 ea - $90.00 pair
Woofer PZ1WO 8 ohm Cat. CW-2132
$122.00 ea - $244.00 pair
Crossover Network (Kit) Cat. CX-2630
$39.95 ea - $79.90 pair
Total $413.90 for stereo
SPECIAL INTRODUCTORY OFFER

The low value of the Australian dollar may mean that the prices of these components will go up. As a goodwill gesture, we will sell the speaker/crossover set (for stereo) for only:

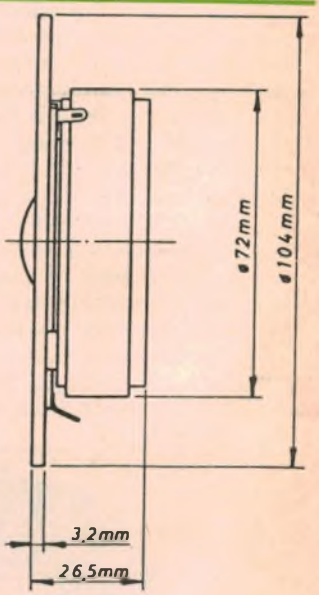
$399.00!!!

We estimate that you will be able to build the cabinets for around $50 - $90 (depending on finish). This means that you can end up with a superior 100 watt speaker system for under $500!!!

UNBELIEVABLE!!

Technical Data - Woofer

Nominal Impedance	8 ohms
Frequency Range	26 - 4000Hz
Free Air Resonance	33Hz
Operating Power	2.5W
Sensitivity (1W @ 1m)	92dB
Nominal Power	60 watts
Voice Coil Diameter	40mm
Voice Coil Height	12mm
Air Gap Height	6mm
Voice Coil Resistance	5.8 ohms
Effective Diaphragm Area	222cm²
Moving Mass	20 grams
Thiele/Small Parameters	
Qm : 2.4	
Qe : 0.41	
Qt : 0.35	
Vas : 80 l	
Weight	1.65kg



NOW AVAILABLE

This offer has been extended for October, as they were not available in August.

NOW OPEN: Core Hill is open till 4 pm Saturdays

Technical Data - Tweeter

Nominal Impedance	6 ohms
Frequency Range	2 - 24kHz
Free Air Resonance	1500Hz
Operating Power	3.2 watts
Sensitivity (1W @ 1m)	90dB
Nominal Power	90 watts
Voice Coil Diameter	25mm
Voice Coil Height	1.6mm
Air Gap Height	2.0mm
Voice Coil Resistance	4.7 ohms
Effective Diaphragm Area	7cm
Moving Mass	0.3 grams
Weight	0.53kg

GREAT PRICES. . .

PLESSEY POT PACK BARGAINS BACK!

BRAND NEW STOCK

You get over 50 assorted pots (mostly English made by Plessey) in a pack weighing just under ½ a kilo. All have plain shafts, most with a flat, some are log, some are linear and some are switched. This pack is a great bargain at under 12¢ a pot how could you go wrong? The price of pots has recently risen and even if you only use 3 out of the 50 you could be in front.
Cat. RP-3900

ONLY $5.95

MIDI CONTROLLED SAMPLER

• Ref. Sonics July 1985
LAST STOCK · Kit $1,500
Built $2,000 · BELOW COST

RESISTOR NETWORKS

50 assorted values, top quality, 10 lead resistor networks. This pack would normally be worth **$40.** Values range from 680 Ohms to 1M Ohm.
Cat. RR-3380

ONLY $10.00
That's 20¢ per network!

22 PIN IC INSERTER

USUALLY $6.50
October only $2.50

CMOS safe conductive plastic · exclusive bent pin alignment guides in handle · ground strap can be connected · one hand operation

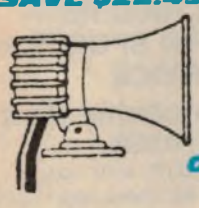
NO FRILLS KEYLESS CAR ALARM GIVE AWAY

No frills burglar alarm complete with siren.
FEATURES:

- Easy to install
- No key lock switch required
- Alarm sounds whenever the boot or bonnet is opened, or stereo/radio is removed
- Highly sensitive to any attempt to enter the car
- Low current drain
- Solid state, professionally designed product

Many people want car alarms with all the gadgets included, like ultrasonics and glass break detectors. If you've been thinking of a car alarm for your second car, then now is the time to buy it!
Cat. LA-5315

USUALLY $49.95
this month $27.50
SAVE $22.45



EXPERIMENTERS RF MODULATOR

We have a quantity of Video Modulators to clear. We call them experimenters because we cannot offer a warranty, but at the price who would expect one. Complete in its own metal box and with 3 metres of 75 ohm coax with plug attached. (That alone is worth $2.00)
Cat. LT-3805

LIMIT 5 PER CUSTOMER

ONLY $2 each

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MICROCHARTS are professional, comprehensive, plastic summary cards packed with key time-saving information on: microprocessors, electronics, programming, and tools for business. Colourful, 100% plastic MICROCHARTS are carefully organised for fast use at home, work, and in the classroom.

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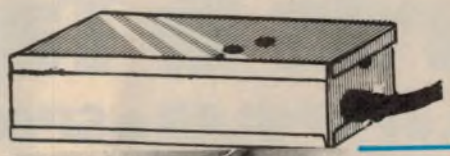
Z80 CPU
Cat. BM-8500
WORDSTAR
Cat. BM-8506
6502 (65XX)
Cat. BM-8502
8086 & 8088
Cat. BM-8508
'C' LANGUAGE
Cat. BM-8512
BASIC INTRO
Cat. BM-8510
ALGORITHMS
Cat. BM-8504
8080 & 8085
Cat. BM-8501
HOW TO SAMPLE
Cat. BM-8514

ALL ONE PRICE
$11.95 each



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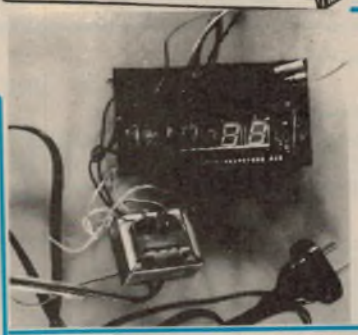

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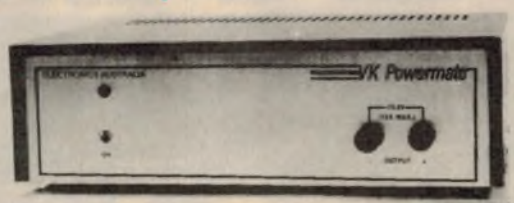

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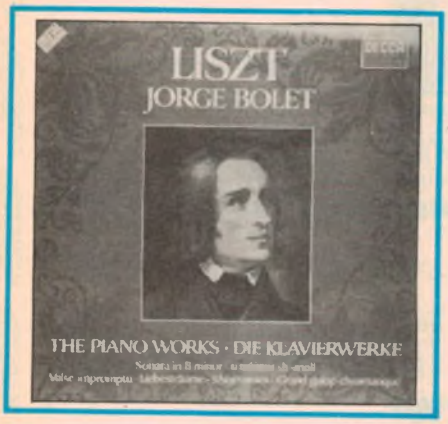
LISZT

Sonata in B Minor. Valse Impromptu. Three Nocturnes and Grand Galop Chromatique. Jorge Bolet (piano) Decca Digital Disc 410 115/1.



The picture on the sleeve shows a handsome young man who I think must be Liszt. I am uncertain because I have become so used to the white haired image of the pianist composer. This handsome face goes far to explain Liszt's great attraction for women who pursued him so energetically, even going to the extent of putting his cigar stubb down into their bosoms, that he finally sought refuge from marriage by gaining the appointment of abbé in the Roman church.

There is nothing poetic about the appearance of his interpreter here, the Cuban pianist Jorge Bolet, who looks like a well tailored businessman. But he is none the less a brilliant musician with a dazzling technique and a feeling for the picturesque. His playing is a mixture of bravura and lyricism.

His articulation is brilliant with never a note missed, and he shows a fine sense of the sweeping form and weighty arguments of the great B Minor Sonata. His detached treatment leading to the exciting treatment of the climax is notable indeed. Altogether a most impressive performance.

On the other hand the Valse Impromptu that follows is in complete contrast — light hearted, graceful and mellifluous. It gives the player plenty of opportunities for show and has just the right rubatos and delightful harmonic changes. The famous Liebestraume is one of a suite of three nocturnes the other two pretty well neglected. The first is not sentimentally treated but has its many lyrical moments. The sound is lifelike all through the recital.

No. 2 will be unfamiliar to most listeners. It shows Liszt in a meditative mood with many strong hints of the second Hungarian Rhapsody. The Third is the one often enough played to be hackneyed. Bolet plays it beautifully with a lovely singing tone. It is a most impressive performance of well used material. The recital ends with a head-clearing galop, an exhilarating piece with foot-tapping rhythms. Altogether a most impressive recital. (J.R.)

DEBUSSY

La Mer. Prelude a L'Apres-midi d'un Faune. Rhapsodie No. 1 for Clarinet and Orchestra. Scottish March. Concertgebouw Orchestra conducted by Bernard Haitink. Philips analog 412 920/1.

I am seldom disappointed with Concertgebouw recordings but this was one of those occasionals — happily rare. In a phrase, they lack French idiom in their playing of Debussy. They have accuracy, verve, immaculate phrasing but lack just that sensibility that is the hall mark of French music. In other words they are heavy handed.

In La Mer the orchestral balance is not good. Lacking is the fine French touch. And soundwise the recording had the gaping range that makes the pps inaudible and the ffs unbearable. I suppose it is because the Dutch and French are so vastly different

temperamentally. The playing is so accurate that you can almost pick out in the first movement (From Dawn to Noon at Sea) the little bit at a quarter to 11 mentioned by Erik Satie.

In the second movement, Wave Play, there is no froth on the top of the wavelets. Yet it is all so demoniacally accurate. But the scoring is more like that of Brahms than Debussy. The Finale, The Wind and the Sea, everything is very heavy and the climaxes are quite frenzied. It is all too coarse and noisy.

The oboe solo that opens L'Apres-Midi is quaveringly sentimental. Later instead of getting slumberous erotic thoughts you get something very much more like porn. It is quite without magic.

The clarinet Rhapsody owes much to L'Apres- Midi but on a much lower pitch of invention. I suspect it to have been a commissioned work tossed of by Debussy in an indisposed moment. It is very rhapsodic in form but is played very slowly and heavy-handedly.

The Scottish March is a strange work with parts sounding more like an Irish jig. There are sections where it slows down to a funeral pace. My reluctant advice is that you'll do better elsewhere. (J.R.)

BLOCH

Schelomo. Rhapsody for cello and orchestra. Voice in the Wilderness. Suite for cello and Orchestra. Janos Starker (cello) and the Israel Philharmonic Orchestra conducted by Zubin Mehta. London Enterprise 414 166/1/

Swiss-born Ernest Bloch is the most Jewish — religio-nationalist — composer of any I have heard. There is a powerful Old Testament atmosphere about everything he writes. By this I mean that it is mostly based on a falling cadence reminiscent of Jewish synagogue cantillation. A characteristic that can also be heard in Arabic music as heard in the muezzin call to prayer.

There is a general air of lamentation about the whole exercise. And the cello, used here as a solo instrument, is eloquently equipped for the sad, almost despairing atmosphere of the concerto. Its title Schelomo means Solomon, the greatest of all the Jewish kings, but while the work calls up some of his splendour it lacks any of his brilliance. It is very thickly scored even in a Brahmsian sense and bears a close relationship with its brother work, the Violin Concerto, which is just about ready for another recorded run — and the Quintet, too with its quarter-tones.

I do not like Schelomo as much as the violin concerto. After a time it begins to grow monotonous in its limited vocabulary. But its similarity is immediately apparent — indeed dominating. Its origin started with Bloch's idea of setting the Mook of Ecclesiastes to music, of which Solomon was the legendary author. The resultant work is rhapsodic in form.

Bloch employs the Eastern atmosphere most expressively. Indeed one might be inclined to describe it as intuitively. Here and there a quarter tone emerges to further emphasise the music's orientalism. The whole is redolent of Jewish nationalism with its mixture of pride and desolation, of reaching for God and finding only humiliation, of a bitter triumph.

To quote Christopher Almer's sleeve notes Boch was reluctant to be classified as a "Jewish" composer. "In music as in all else to classify is to limit". Yet the more avowedly Jewish of his compositions make the stronger and more consistent appeal. Bloch's racial impulses are clear. You must take them or leave them.

Voice in the Wilderness is in a similar strain with an unmistakeable likeness to Schelomo without its vehemence. It is on a smaller scale though a few minutes longer. The sound is fine analogue with the solo cello more part of the orchestra than in the concerto, that is, in all but the finale. Its scoring is sometimes smudgy but the whole should make a strong appeal to all with inherent Jewish sentiments. (J.R.)

CHOPIN

Piano Concerto in F Minor.

SCHUMANN

Piano Concerto in A Minor. Andras Schiff (piano) with the Concertgebouw Orchestra conducted by Antal Dorati. Decca Digital Disc — 411942/1.

It is difficult to imagine more different styles in the playing of Chopin than that of Cecile Licad reviewed a few issues ago

and Andras Schiff at present under review. Licad is open air, fragrant, happily conceived and never afraid of giving a fortissimo its full value. Schiff, on the other hand is redolent of the boudoir, relaxed, ultra refined and with a silken Chopin touch. Of the two I prefer the first. The second is redolent of late pupils of the 19th century teacher Leschitisky, the famous teacher of Pachmann, Paderewsky and countless other greats.

I might mention here that Ms Licad's is the more contemporary style and one will recognise its relationship to modern youth.

Yet in its own way the Schiff version has many merits if you can find any enthusiasm for its style and there are undoubtedly thousands who do. His result is more conventional than Licad's and not so fresh sounding. Another of his advantages is that his recording is much less reverberant than Licad's. Also the orchestra is more aptly prominent.

Schiff's technique is very fluid and the first movement goes perfectly in his manner. His playing may be of the boudoir type but it never swoons. His slow movement is very pretty indeed.

But in the finale I missed Licad's young robustness. When the players come to the coda Schiff takes it conventionally brilliantly while Licad brandishes it like a drawn sword. Indeed this one passage advertises the gap between their respective styles. But for Chopin lovers of last century's type I can heartily recommend the Schiff, but for me the Licad.

Dorati tries to make the Schumann more masculine sounding but Schiff resolutely continues in this Chopin style. At times he comes close to tinkling despite Dorati's efforts.

Dorati in no way sentimentalises the great melody in the cellos in the slow movement and the Finale is conventionally effective in its way. It is in fact a must for lovers of the dainty style. Others stay away. You will be asked, when comparing it to Licad, to exchange the fragrance of a garden for the perume of a boudoir. (J.R.)

ORGAN RECITAL

Dietrich Buxtehide: The Complete Works for Organ — Volume 1. Wolfgang Rubsam playing the organ at St Martin's cathedral, Colmar. Compact disc, Bellaphon 690-01-007. (From PC Stereo Pty Ltd, PO Box 272, Mt Gravatt, Qld 4122. Phone [07] 343 1612.)

I needed to check in my atlas to confirm that Colmar is in western France, not far from the borders with West Germany and Switzerland. I gather from the notes that Wolfgang Rubsam chose the organ in St Martin's Cathedral because it is a relatively new instrument but modelled on the North German baroque tradition. The cathedral itself is apparently quite large, to judge by its two to three-second reverberation period.

Rubsam adds that, in interpreting the works of Buxtehude, he has sought also to apply the fingering and pedal techniques of the North German school, which "imply old rhetorical performance practices", as opposed to "metronomic" playing.

Rubsam was himself born in the North German town of Giessen in 1946, subsequently studying piano and later organ under Helmut Walcha. He took his Master of Music degree at the Methodist University of Dallas Texas, completed his organ concert examinations in Frankfurt and spent a further three years with Marie-Claire Alain in Paris. Now, several major awards and concert tours later, he is Professor of Church Music and Organ at the Northwestern University in Evanston, Illinois, USA.

All these resources are brought to bear in this first of the "complete works" recordings, for the German Bellaphon label.

It carries 10 separate items whose German titles, unfortunately, would tax both patience and space. Sufficient to say that there are four Preludes and Fugues averaging about seven minutes each, suitably identified and discussed briefly in the notes. The first of these, the opening track, is the notable Praeludium in C, which begins with a quite flamboyant pedal solo.

In addition, there are six choral preludes, averaging about three minutes each and suitably varied in style.

Rubsam plays them with the understanding and authority one would expect and, in the generous environment, they gain a true "cathedral" sound without, however, sacrificing delicacy and definition in the lighter, more open passages.

The recording itself is completely clean and well balanced, underlining the effortless ease with which a digitally mastered compact disc can handle the extreme dynamics and the massive sound of a large cathedral organ. A good one. (W.N.W.)

OUTSTANDING RECORDING

Shostakovich: Symphony No. 5, Op. 47. Played by Lorin Maazel conducting the Cleveland Orchestra. Telarc digital compact disc CD-80067. [From P. C. Stereo Pty Ltd, PO Box 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612]

While this performance dates back to 1981, it should not be discounted for that reason, having been mastered in the well proven Telarc manner — with Schoeps Colette series microphones and transformerless electronics, free from limiting, equalisation, etc, and feeding Soundstream digital recorder.

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Born in St Petersburg in 1906 to a pianist mother and an engineer father, Dimitri Shostakovich entered the St Petersburg Conservatory at age 13 to study piano and composition. In the wake of the Russian revolution, however, he finished up having to support himself by playing piano for seemingly endless hours in a run-down cinema.

Nevertheless, at age 19, he managed to complete his first symphony, which was well received and still in the repertoire; (EA review, Dec '82). But his second and third symphonies were not successful, while the fourth ran into other problems, with Shostakovich — now back at the conservatory as a lecturer — under party pressure for being more responsive to the avant garde movement then to the perceived musical needs of the proletariat.

Shostakovich finally cancelled the premiere and abandoned the orchestral scoring after the 10th rehearsal, determined nevertheless to plot a course that would enable him still to speak his mind musically, without directly alienating the regime that could frustrate his work.

His Fifth Symphony was successfully premiered by the Leningrad Philharmonic in 1937 and had its first American performance in the following year with Rodzinski and the NBC Symphony Orchestra. But it was Stokowski and the Philadelphia Orchestra that probably established the Shostakovich Fifth in the concert repertoire.

I quote David Hall's note from a Stokowski recording in the late '50s: "The course of its emotional expression is the familiar victory-through-struggle pattern . . . Its musical style represents a compromise between the familiar romantic manner and modern linear polyphony."

It is scored for a full "romantic" orchestra, including piano and celesta and comprises four very distinct movements: Moderato (17'56"), Allegretto (4'58"), Largo (14' 28") and Allegro non troppo (9'21").

Within those four movements, you encounter a whole palette of orchestral colour, style and mood, and dynamics ranging from the full resources of the Cleveland Orchestra plus (I tip) a Bosendorfer grand out front, through to the delicate sound of lone instruments.

All this reaches the microphones without sonic clutter, thanks to the acoustics of the Cleveland Masonic Auditorium, and is faithfully captured on the all-digital system, free from distortion, imbalance or noise. A recording that I can thoroughly recommend. (W.N.W.)

CHRISTMAS ALBUM

Kenny & Dolly: Once Upon a Christmas. Stereo LP, Starcall SFL1-0112. Distributed by RCA.

This album reached me too late to review for last Christmas but RCA assure me that it will be on display again this year, so I include it here, by way of possible interest.

Lest there by any misunderstanding, it is not your average devotional, or traditional or even sentimental Christmas album but one that might well be re-titled "Once Upon an (American Showbiz) Christmas"!

Perhaps that's not altogether surprising, because all the songs came from a Kenny Rogers/Dolly Parton CBC TV special and, in that form, may have appealed quite differently. But as heard on disc, the sound is thick with reverb, the diction is so-so and even the sentiment comes across as contrived rather than spontaneous.

There are 10 tracks in all, of which five were written by Dolly. They are variously presented as solos and duets:

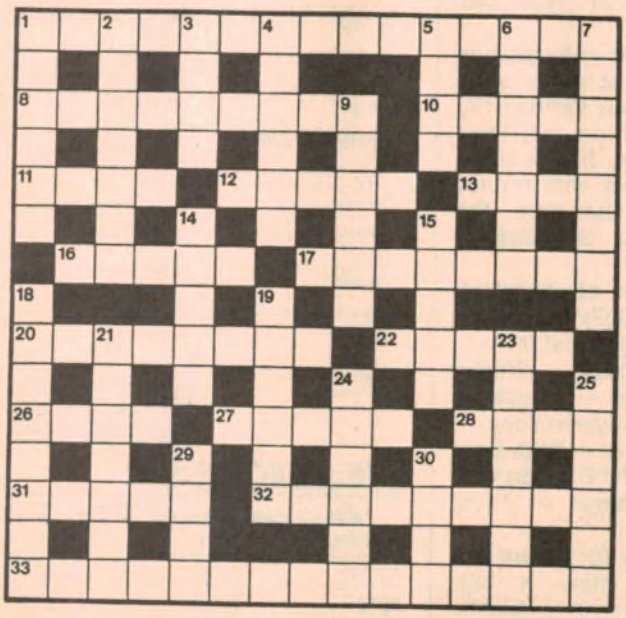
I Believe in Santa Claus — Winter Wonderland, Sleigh Ride — Christmas Without You — The Christmas Song — A Christmas to Remember — With Bells On — Silent Night — The Greatest Gift of All — White Christmas — Once Upon a Christmas.

If you have a soft spot for Kenny and Dolly, you'll maybe enjoy it but, otherwise, see what else is available. (W.N.W.)

OCTOBER CROSSWORD

DOWN

1. Said of a device, etc, tending to maintain a set condition. (6)
2. Image. (7)
3. Type of switch. (4)
4. Magnitudes of differential equations or filter networks. (6)
5. Common term for capacitors. (4)
6. Vocal output of a good speaker. (7)
7. One-off sale offers. (8)
9. Data interrogator. (6)
14. Short thick conductor. (5)
15. Abrasive material. (5)
18. Develops a design, etc. (8)
19. Colloquial term for a kind of light-fitting. (6)
21. Illuminating device based on mercury, etc. (3,4)
23. Type of cell. (7)
24. Badly judge the beginning of an operation. (6)
25. French physicist who discovered the laws of electromagnetism. (6)
29. Who sent the first woman into space orbit? (1,1,1,1)
30. Prefix given to highly pitched instruments. (4)



ACROSS

1. Substances in which the Josephson effect occurs. (15)
8. Industrial electric appliance. (3,6)
10. Fraction of a period. (5)
11. Volume setting. (4)
12. A thyristor. (5)
13. Top-quality reproduction. (2-2)
16. Triangle connection for three-phase transformers. (5)
17. Connecting point. (8)
20. An EPROM is such. (8)
22. Representative diagram. (5)
26. Points to which rays converge. (4)
27. Computer design is based upon this. (5)
28. Structure used in certain microcircuits. (4)
31. Graded group of components, etc. (5)
32. Vary periodically, as L-C circuits do. (9)
33. Radio reception system. (15)

SOLUTION FOR SEPTEMBER

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50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

October 1935

Debate: 7.0pm—2FC, National Talk (Sydney). This discussion entitled "Is the League of Nations Finished?" to be broadcast from 2FC on Sunday, October 6, at 7 o'clock, will be between Professor A. H. Charteris, Challis Professor of International Law in the University of Sydney; Mr Raymond G. Watt, Secretary of the League of Nations Union, and Dr W.G.K. Duncan, Director of Tutorial Classes in the University of Sydney.

The League of Nations was formed after the Great War, mainly to prevent a repetition of such a disaster. Its aims, as stated in the Preamble to the Covenant, are "to promote international co-operation and to achieve international peace and security". The League started in 1920 . . . Recently many persons have been expressing the opinion that the League is finished. Today in view of the Italian attitude regarding Abyssinia, many persons are beginning to believe that it is true.

The Midgets: Cars weighing a little over 600lb, capable of doing 100 miles an hour! Take note of that, all you straight eights and other present day representatives of luxury and speed.

These midgets — MIGHTY midgets they are called — will be seen in action every Saturday night, and the racing is to be broadcast by 2UW.

Television progress: Berlin crowds flock to television viewing places. Using 180 lines, Germany lays down an excellent picture, of high entertainment value. Licence fees on sets, plus a Government appropriation, finance television experiments. In comparison to the rest of Europe, Germany is moving along at a swift pace, with thorough technique.

Discourteous radio: The Japanese language, we understand, is different for different classes, and different for the sexes, and from the first the Japanese announcers have been in danger of offending their superiors by unknowingly omitting the proper ceremonial terms. Also, until lately, men were forbidden to use "feminine" vernacular, and women "masculine" vernacular. But now, they say, broadcasting has invented a hybrid language which will probably become the new Japanese language.

Battery valves: Mr Langford Smith of the Amalgamated Wireless Valve Co., has two new productions from the Ashfield laboratory, in the form of battery valves designed to have a better performance than the existing 2-volt types.

The RF pentode has been designed with a considerably higher amplification than the present 34, and is capable of a very much higher gain per stage.

October 1960

From the Editorial: . . . There has been a good deal of speculation in the US, in recent months, about the future of stereo in relation to present AM, FM and TV services. It looks, at the moment, as if FM will gain priority in the derivation and establishment of standards for compatible stereo transmissions and it may give FM a much-needed "shot in the arm".

In Australia, FM broadcasting has never got beyond the experimental PMG transmissions. But who knows? A buying public which is gradually becoming stereo and hi-fi conscious may just go for FM, if it is exploited as the companion medium.

Ceramics: An entirely distinct category of high-temperature ceramic materials, born in the white heat of advancing propulsion concepts, is being developed by materials-research engineers of the Boeing Aero-Space Division in Seattle. The ceramics are resistant to the intense oxidation and gas-flow erosion encountered in environments simulating combustion chamber conditions at material temperatures above 4000 degrees F.

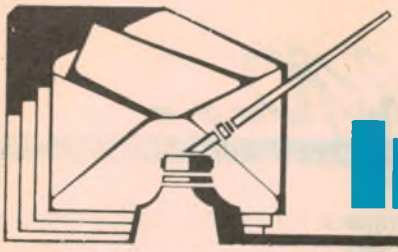
Satellite news: US Project Bounce saw the 100ft balloon Echo 1 in orbit mid-August. Daily papers carried the story of trans-American and trans-Atlantic communications via the balloon. Australian amateurs were active during suitable orbits of the balloon endeavouring to bounce a signal to New Zealand.

New era: A new era in electronics is gradually developing. The transistor, discovered in 1948 by Bell Laboratories and named for the two words "transfer resistance", already has significantly influenced the design of electronic devices.

Although smaller, more rugged, and requiring less operating voltages than the valve, the transistor in many cases can perform the same functions with better efficiency.

Colour television: Of all the jobs undertaken by TV, and colour TV in particular, that of medical instruction is one in which its unique qualities have been most dramatically demonstrated. A medical colour TV unit at present touring Australia has been enthusiastically praised by doctors who have seen it in operation . . . The colour set not only shows the mechanics of an operation but can better portray the graphic differences between healthy and diseased tissues.

Oxygen-in-space: One of the major problems connected with space exploration is the oxygen for the space traveller. Many suggestions — including hibernation — have been made, but a completely self-contained system based on normal animal-plant life relationship appears to be the most logical. Researchers have calculated that 25 square feet of growing Lemna (a form of duckweed) would supply enough oxygen to support one man.



Information centre

TV antennas and marital harmony

I am writing to you hoping that my difficulty may suggest a project to you.

I am a caravaner and when arriving at a site one never knows in which direction to point the TV antenna. A look at the antennas on the surrounding vans is usually more confusing than helpful, so, after extending my mast I turn it until it is picking up the maximum signal.

This process involves standing on a short ladder at the side of the van and yelling out to my wife inside while I turn the mast. This should be simple enough, but for some reason it seems fraught with peril for the marital state, so in the interest of harmony I am looking for a better way.

My ideal would be a small, cheap, battery operated meter which I could plug on the end of my lead-in cable at the mast, giving me a needle deflection proportional to the power being received.

I really don't expect to see my complete ideal.

It seems to me that a very sensitive voltmeter would be a good starting point and to this end I have considered making a FET amplifier to increase the range of my very second rate multimeter. However, another part of the problem worries me: I think I should separate the various frequencies by filters before I can measure them. If so, this complicates the problem no end and puts it beyond my ability to solve.

Here's hoping you know a simple solution to the problem and find it worthy of a project. (H.W., Wentworthville, NSW.)

● We can certainly endorse your findings that matrimonial harmony can be severely disrupted by technical exercises which involve a spouse (to wit, the little woman) in making a judgement about picture quality while antennas are being pointed.

Unfortunately, the solution to the problem is not a small cheap battery-operated meter. What you are asking for is a conventional TV signal-strength meter. Essentially, this is a conventional TV tuner with no AGC applied and with its output signal fed to a calibrated meter. It's no good looking at the total signal from the antenna where more than one station is likely to be received.

In any case, the best instrument to judge signal quality is a TV set itself. In your circumstances, the best way to judge signal quality would be to set the TV set up so that you can actually see it while you are pointing the TV antenna. That way, marital bliss will be maintained and your wife can make you a nice cuppa afterwards.

Cudlipp — what does it mean?

While I lived in the UK, I read and was satisfied with *Everyday Electronics* and, when I moved here in 1981, I continued with it. Towards the end of 1982, I realised that *Electronics Australia* was much more appropriate, so I changed to it and I am very glad I did as I find it a much superior publication.

Having said that, perhaps you will not mind my asking two questions:

1. What does "Cudlipp" mean? Every now and then the word crops up in the magazine as if readers knew the meaning, but I have been unable to trace it.
2. Have you ever described a stud finder? Here in Queensland a common problem is to locate wooden studs within a hollow wall surfaced with various types of building board. Such an instrument is on the market, made by Consolidated Technology (Australia) Pty Ltd, but I feel sure that one properly designed by one of your engineers would be much more effective. (R.C., Yorquay, Qld.)

● An electronic "Nail Finder" was described in our October 1983 issue (File No. 3/MS/105). A copy of this project is available through our Information Service for $3.00.

"Cudlipp" is a nonsense name that was given to a novelty project described in our February 1982 issue. Basically, it was a circuit that emitted a series of chirps when a noise was made. It was later modified to be light sensitive.

Incubator for quail eggs

I would like some information, and/or possibly a wiring diagram on how to construct at a reasonable cost an electronic thermostat to operate a 100W light bulb for incubating quail eggs at about 37°C.

If you are unable to supply the above information could you please advise me on who I can contact. (M.T. Beresfield, NSW.)

● In July 1984 we published a project on "Heat Controllers" (2/PC/42) which may be of use to you. A copy of this article can be obtained from our Information Service for $3 post paid.

Ultrasonic Movement Detector

I built your May 1984 Deluxe Car Burglar Alarm and was pleasantly surprised when it worked like a charm.

I subsequently built the Ultrasonic Movement Detector and fitted it to the alarm, but it proved too sensitive and prone to false triggering when the alarm was set. I thus removed it from the car and set it up in my den to troubleshoot the circuit, as far as my limited electronic skills would permit.

The first symptom was that I got a 1V AC reading at point A, and rotating VR1 had no effect whatsoever. The LED flashed intermittently. The junction on the schematic diagram adjacent to Q2 collector gave a 6V reading instead of 4.6V as per the diagram. The junction adjacent to Q1 gave a reading of 3V instead of 1.7V and the junction between the two 3.3kΩ resistors gave a reading of 1V instead of 0.6V.

I have checked out all the components on the PCB for correct values and correct polarity, and the PCB for cracks, bridges and dry joints. I used sockets for the two ICs which are HEF40106BP and HEF4046BP. I changed VR1 to 50kΩ but there was no change.

I have been anxiously scanning each subsequent issue hoping for an answer to my problem in your columns but to no avail. I am particularly anxious to use this valuable circuit in other projects and I hope you will publish ideas on coupling

this circuit to a trigger circuit for an alarm.

I have just finished the House Alarm and it works like a charm apart from pin 32 on the PCB and a "crook" LED switch. Your comments on page 122-124 of the June EA were appreciated.

NB: the transmitter (MA40LIS) and receiver (MA40LIR) are Murata types. (J.D., Auckland, New Zealand.)

● Since the voltages on Q1 and Q2 are considerably different to those measured on our prototype, it's quite possible that one (or both) of the transistors is faulty or has been installed incorrectly. The other possibility is that one of the resistor values is incorrect.

You can check the transistors by measuring the diode conduction between base and collector and base and emitter using the ohms range on your multimeter. Alternatively, use the diode test facility if this is provided.

Why no IC sockets?

What is the reason for your reluctance to specify IC sockets in all your projects? Judging from the photographs of your prototypes, you never seem to use them. In a previous article "What to Do if Your Project Won't Work", you went to great lengths to reassure readers on the heat tolerance of ICs. Is it not more sensible to encourage the use of IC sockets instead?

I have had to desolder supposedly high quality op amps more than once. It is a messy affair, even with a solder sucker. So now I reach for IC sockets for all ICs except where some of the pins are required to be connected to a heatsink. (S.K. Hobart, Tasmania.)

● We do not specify IC sockets for most projects because they add to the cost. Also, unless they are high quality sockets, they are a source of trouble.

Having said that, there is no reason why IC sockets cannot be used for most of our projects if that is your wish.

Digital pH Meter

In your December 1982 issue, you published a Digital pH Meter. Not long ago, I constructed the meter which seemed to work for the last couple of swimming seasons but recently, when I was checking it, I found that I was unable to adjust the slope control low enough for the pH 4.00 buffer.

I checked my wiring and found that by lifting the 27kΩ resistor in the temperature divider network, the problem was solved very nicely. However, this disconnects the temperature control which, fortunately, does not have a great effect provided that the sample and buffers are left standing for some time.

It is possible that the probe may be the cause of the problem though I have doubts about this as it is barely two years old and I have been careful to ensure that it is stored in distilled water. You might please let me have your comment on the cause of my problem. (H.H., Wagga Wagga, NSW.)

● The pH probe is the most likely suspect for the loss of range available to calibrate at pH 4.00. These probes do age, which causes the output voltage to drop. The slope control is designed to compensate for this.

Your solution of lifting the 27kΩ resistor has effectively increased the range of the slope control. An alternative solution, which would keep the temperature calibration facility, is to slightly increase the value of the 270Ω resistor in the slope control divider.

Electronics Australia Reader Service

"Electronics Australia" provides the following services:

PHOTOSTAT COPIES: $3 per project, or $6 where a project spreads over multiple issues (price includes postage). Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries. We reserve the right to supply complete back issues instead of photostats, where these are available.

CHASSIS DIAGRAMS: For the few projects which require a custom metal chassis (as distinct from standard cases) dyeline plans showing dimensions are normally available. $3 including postage.

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.

BACK ISSUES: Available only until our stocks are exhausted: $3 (includes post and packing and storage fee).

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.

Information Centre . . . ctd

Crossover for Bailey speakers

Five years ago I built some speaker cabinets from a design by Dr A. R. Bailey, which you published in *Electronics Australia,* July 1972. The speakers and crossovers that I used were available in a kit (KEF components B139, B110, T27 and DN12 crossover).

I now have to build three more pairs of these boxes for various friends, but find that KEF no longer sells the crossover. The article recommends a Radford FN10 crossover.

1. Would you happen to know where I would be able to obtain circuit diagrams of the Radford crossover and/or the KEF DN12?
2. Would you happen to know of any other drivers that might sound better in these boxes? (I am, however, fairly satisfied with the KEF components). (D.S., North Melbourne, Vic.)

● We have consulted with the local KEF agents, Falk Electrosound Pty Ltd, who advise that the DN12 crossover is no longer available. Instead, they recommend that you use a DN26 crossover with the B139 woofer, B110 mid-range and T33 tweeter. These components will be available from Falk Electrosound towards the end of the year. The address of the company is 28 King St, Rockdale, NSW 2216. Phone (02) 597 1111.

50V/5A switchmode power supply

In reference to the 50V/5A laboratory power supply published in May 1985, can you give an Amidon equivalent for the Neosid 17-146-10 iron powder toroid and the 17-143-10 toroid?

This design seems to be a good idea, particularly for the series transistor. Has any consideration been given to increasing the current to say 20-25A by paralleling Q2 and increasing the value of the inductors? Any help would be appreciated. (R.P., Curtin, ACT.)

● Unfortunately, we have no catalog information on the Amidon cores and so cannot nominate equivalents for the Neosids. However, the Neosid cores are readily available from Jaycar and Altronics.

We have not considered increasing the output current rating of this power supply. However, if there was sufficient demand we would have another look at it. Any interest from other readers?

Automatic telephone dialler

I am interested in either purchasing or preferably making an automatic telephone dialler for the Home Burglar Alarm system featured in your January 1985 edition. I write, therefore, to ask you whether you have considered including this as one of your future projects.

In the event that you are unable/unwilling to do so, could you please supply me with either some details of how to construct this device or provide me with the names of some suppliers who sell these devices at reasonable prices. I would term reasonable as being no more than $150. Thank you. (S.G. Asquith, NSW.)

● We have no plans to describe an automatic telephone dialler for our Home Burglar Alarm. However, a number of commercial devices are available. We can only suggest that you shop around various firms in the security business for the best price.

Transistor Assisted Ignition System

I have just completed and installed the Transistor Assisted Ignition using Hall effect triggering (EA, September 1984) in my 1968 Holden with 186 motor. However, you mention on refitting of the distributor to get 5V at the output of the Hall sensor.

The trouble is the best I get is 1V, and I am very concerned. Perhaps you could inform me as to why? The motor started and appeared to run well, but in fear of damaging the unit I reverted to standard ignition with a spare distributor as you suggested, to await your advice. (T.C. Redhead, NSW.)

● We're happy to advise that your TAI is working correctly. The only way to get +5V at the output of the Hall sensor is to disable the dwell extension feature by removing Q1 (the text should have mentioned this). The 1V that you are measuring is simply the saturation voltage of Q1 which turns on approximately 1ms after the Hall sensor turns off.

An errata has been prepared and appears in this issue.

Notes and Errata

12/230V 40VA Inverter (August 1985, file 3/IT/13): Diode D2 is shown reversed on the circuit diagram. The parts layout diagram is correct.

Hall Effect Transistor Ignition (September 1984, 3/TI/20): the instructions for refitting the distributor are in error. The distributor should be rotated for a reading of approximately 1V at the Hall sensor output, not 5V as stated in the text.

Perth Electronics Show . . . ctd from p103

seminars for the trade were held. Three seminars were delivered by Parry Corporation Ltd, Philips Industries Ltd and Sony, in that order. They were well attended too, considering that they were inaugural performances.

The first was on the subject of Interactive Laser Disc Technology. The laser video disc, presently marketed in Australia by Pioneer, is being used in conjunction with computers to provide high level training programs for defence and industrial markets.

It is already used in Australia for General Motor's training programs. In the future, it could shortly become the basis of extensive shopping catalogues for use by department store customers.

The second seminar, delivered by Philips, was on the subject of the compact disc. Australia is right at the forefront as far as market acceptance of the compact disc player is concerned, just as we have been for video cassette recorders. CD players will also be upgraded in the future, to provide still pictures. They are also envisaged for use in cars as an alternative to our present street directories.

Predictably perhaps, Sony's seminar was on the subject of the new 8mm video format which has been agreed to by 127 companies worldwide. The new format certainly represents a formidable technical challenge to the existing VHS and Beta formats, as it already incorporates hifi sound quality and has the potential for PCM stereo sound channels which will rival the compact disc for sound quality.

The most shatteringly loud stereo demonstration was easily the new NAD 2200 "super-brute" amplifier driving the award-winning Kef 10.2 loudspeakers. Most often-used CD demos: the latest albums from Supertramp and Dire Straits.

Perth is a long way from Sydney but as far as video and hifi shows are concerned, it is the best Show in Australia.

Leo Simpson

Next month in Electronics Australia

Bookshelf Loudspeaker

With a design based on Thiele-Small parameters, this compact 2-way loudspeaker system uses the 6MV woofer and 3AC tweeter from the Magnavox range. It delivers a punchy wide-range sound with good efficiency and makes an ideal match for any amplifier with a power output of 30-100W per channel.

Hands-free Telephone Adaptor

Most low-cost hands-free telephone adaptors suffer from acoustic feedback and offer poor audio quality. This new high-performance design effectively eliminates acoustic feedback problems yet can be built for less than $80.

Ultrasonic Pest Alarm

Rampaging rodents and creepy cockroaches on the loose? Cat lost his get up and go? Throw away that house brick and build the EA Ultrasonic Pest Alarm. Our design uses a proper piezo tweeter and operates beyond the limit of human audibility.

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Note: Although these articles have been prepared for publication circumstances may change the final content.

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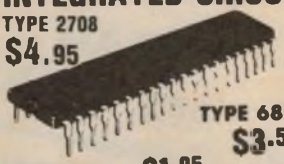

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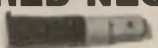
240V AC  INDICATOR LAMP

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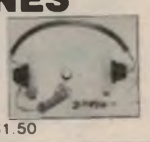

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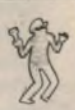

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LM24003G	240 x 128	241 x 125.3 x 14	LR3691
LM48003G	480 x 64	290 x 70 x 12	LR3691
LM48004G	480 x 32	290 x 52 x 12	LR3691
LM48008G	480 x 128	261 x 96 x 12	LR3691
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LM64004G	640 x 200	272 x 109 x 12	LR3692*

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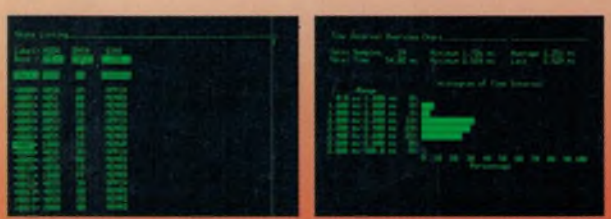

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