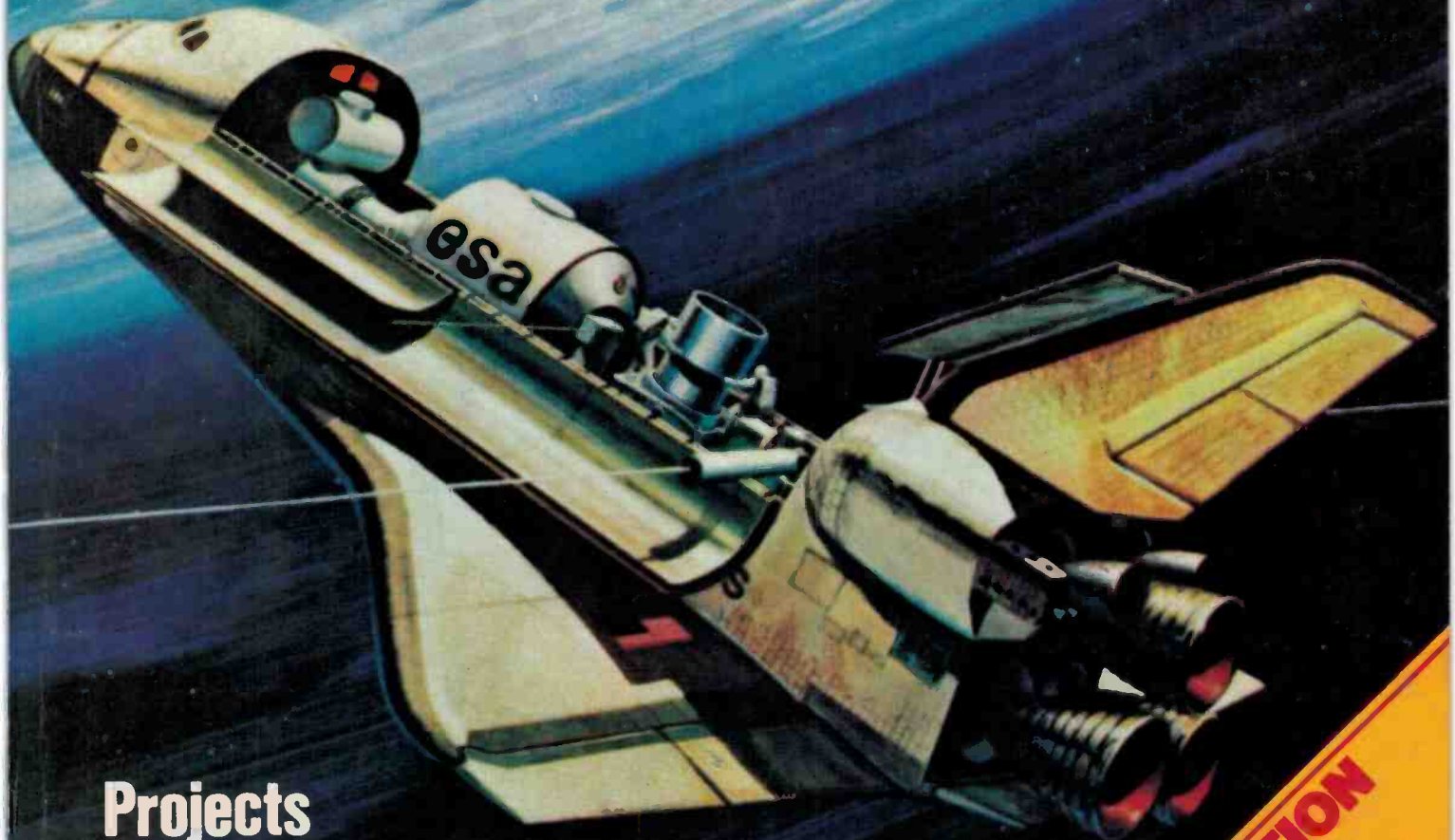
Oct. 1979
$1.40* NZ $1.60

eti
ELECTRONICS TODAY INTERNATIONAL

SPACELAB



Projects

'Series 4000' moving-coil preamp
General purpose process timer

Danger! -Beryllium Oxide
Marine electronics feature

GREAT HI-FI SECTION
* Audio Pro sub-woofers reviewed
plus two other reviews
* How to improve your sound

A new dynamic generation of Maxell tapes.

When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

Take our high level (CrO_2) position tape — the UD-XL II. Maxell engineers have succeeded in expanding its dynamic range in the middle-low frequency range by 1 dB, while also pushing its sensitivity by 1 dB in the high frequency range. Then look at our normal position UD-XL I, UD and LN tapes — our engineers expanded the dynamic range at all frequency points, while also boosting output in the high frequency range. The new dynamic range, of course, allows for better music reproduction even for LN-type tapes.

On the UD-XL I and II, we also added an exclusive shell stabilizer for significantly improved tape running and track positioning.

One thing hasn't changed on all Maxell tapes — our functional features like 4-function leader tape, replaceable index labels for UD-XL series tapes and Maxell's through-production system — your guarantee of quality and superior sound reproduction.

Tape selector position UD-XL I, UD, LN: Normal position (Normal bias/120 μsec. EQ)
UD-XL II: High level position (High level bias/70 μsec. EQ)

For details on all Maxell Recording Tape write to
Maxell Advisory Service, P.O. Box 307, North Ryde, N.S.W. 2113

Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

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maxell®
simply excellent

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eti ELECTRONICS TODAY INTERNATIONAL

CONTINUING our line of quality audio projects that we started with the 'Series 4000' stereo amplifier, this month we have a **moving-coil cartridge preamp** with performance to match the commercial jobs from many manufacturers. The **Electromyogram** is completed this month — the fairies at the bottom of the dark-room were kind to us ! For those readers who potter with pc boards or dabble in darkrooms, we have a **universal process timer** project. It uses an interesting timing technique yet is still simple to build and calibrate.

Spacelab was coming off the drawing board while **Skylab** was capturing the attention of technologists and spacewatchers around the world. By the time Skylab was causing numerous people some anxiety, **Spacelab** components were rolling off production lines around the world. Our cover story starts on **page 16.**

A calibrated rope (i.e: knotted at intervals) and a lump of wood served old sailors well. Modern sailors wouldn't be seen dead using a genuine 'log', the electronic variety is all the vogue. **Marine applications of electronics** is the theme of our other feature this month; page 24 please.

Hi-fi can be an expensive hobby - but what hobby isn't ? Nevertheless, would you believe you can **improve your sound without depleting your wallet ?** I won't say they're straight-forward, but the techniques described in our sound feature can make the effort worthwhile. Extended bass is the dream of many an audiophile. The technique being explored by many enthusiasts and manufacturers is the 'sub-woofer' loudspeaker. Our review of the **Audio-Pro Ace Bass** will open your eyes. Also this month we review a recently released amplifier and an unusual direct-drive turntable.

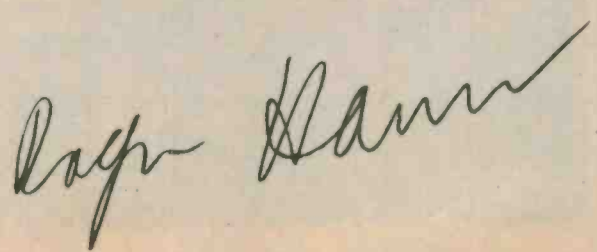
For the computer fan we have a look at Rod Irving's **64K RAM board** by Central Data and review a new book on **Programming in Basic.**

Curious about VMOS devices ? Get a close look — our data sheet this month gives device characteristics and circuits for the CTC range of **RF power VFETs.**

Letters — by popular demand a 'letters to the editor' page has been re-introduced. How about writing us some good letters then?

Get into it — **180 pages of good reading,** things to do, news and views plus a few good laughs along the way.

Roger Harrison, Editor



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eti ELECTRONICS TODAY INTERNATIONAL

COVER

Spacelab is a large-scale co-operative venture amongst a number of international agencies who are sharing the construction and the benefits of the project. Designed as a re-usable vehicle, to be carried into orbit aboard the space shuttle, its first mission, scheduled for the middle of next year, will carry 76 scientific and technological experiments.

Picture from a painting by M. Alvarez, courtesy NASA. Design by Ivy Hansen.

news

features

projects

sound

general

next month

VIDEO CASSETTE RECORDERS
A comprehensive report on the machines available, how the various systems work and what they will do.

THE DAEDALUS PROJECT
Fascinating report on a detailed study of feasibility of building and launching an unmanned interstellar probe.

ALTEC MODEL 15 STUDIO MONITORS
Review of an innovative set of speakers featuring an interesting "Tangerine radial phase plug" in a horn driver.

Z-80 S-100 CPU
That cryptic little lot will set the computer enthusiasts collective pulses racing.

At last it has arrived ! — the central processing unit to go with the ETI S-100 computer projects. Another beauty from David Griffiths - of 640 VDU fame.

COMING SOON
Another metal detector. Our last one was (still is!) very popular, this is one to beat them all. Guitar practice amplifier — play to your heart's content without annoying the neighbours, features mains or 12V operation.

Although these articles are in an advanced state of preparation circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

eti

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READER ENQUIRIES

By Mail: There is no charge for replies but a foolscap-size stamped addressed envelope **must** be enclosed. Queries relating to projects can **only** be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are otherwise than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

By phone: We can only answer readers technical enquiries by telephone after 4 pm. In enquiring by telephone about back issues or photostats, please ask for the "Subscriptions Department". **33-4282**

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LETTERS

Dear Sir

May I congratulate the magazine on its new format (June issue). I was very pleased to see the hi-fi reviews and the feature articles on computers in particular, also naturally the projects and enlarged ideas for experimenters pages.

Your rival magazine had better watch out.

A Greco
Clayton, Vic

Dear ETI and Dindy

Please find enclosed my second order for cassette tapes (No. 1 was $300 +). I would like to say thanks for the speedy service on my first order and thanks to ETI for offering such a good product in the magazine that has become a catch phrase in any electronic business – household or group.

It is good to see such quality in an Australian produced magazine. The projects cover a wide spectrum of interests and the technical articles are well researched and well explained.

Once again thanks to ETI and to Dindy for this really marvellous offer.

Matthew Howard
St. Ives, NSW

Dear Sir

After publication of your project No. 725 (SSB Generator), I for one would be very interested to see a complete SSB Transmitter design for 80 M published. Incorporation of a VFO would be desirable. A multiband unit would be nice also but maybe that's asking too much.

Other amateurs and novices I know have shown intense interest in the generator, so I'm sure it would be a welcome project overall.

T Dalziell
Wanniassa, ACT

Dear Sir

The new format is excellent, and I appreciate your broadening the mag to include such things as the flyby reports, etc. I also like the sectioning into the appropriate subject areas.

My personal interest is audio, and I thought you may like some reader feedback.

I intend building a very high quality preamp with a low output impedance (100Ω) – but whether it will interface with your unit or not I don't know. Please, how about full specs.

You've made a good start in audio with your new amp – but how do you follow it up and keep the thing alive? I've a few suggestions – how about "Project Audio" continuous extension of your design. It really should have been obvious that it's a little like a shag on a rock – it doesn't interface either with your equalizer (what a waste – how else would you control a high quality amp) – nor is it powerful enough to run your top quality TL speaker (min. 75 W!) – so how about some extensions, e.g. can the amp deliver 75 W or more (reading the specs for the output transistors, don't understand why not – could you explain?) – you suggest that they could be paralleled. Why don't you do it and check. (I'd imagine a resistor value would have to be changed) – and show how two can be coupled out of phase to give 200 W.

How about using the LED VU meter to show not only output power but the tone control input as well so that they can be attenuated to give optimum strength (it could be switchable)?

How about upgrading your active crossover to use better more modern components (the 4136 for example!). I've noticed that many companies have brought out upgraded substitutes for common ICs – how about some info on them so that existing (and aging) units can be upgraded.

Finally (thank God, I hear you cry!) how about letters and advice (including small project changes, e.g. a buffer for your power amp to make it a bit more useful).

I hope this lot is food for thought – good luck and keep up the good work (yes, you do plenty, but I don't feel the need to change it).

Ian Catt
Baulkham Hills, NSW

Dear Mr Catt

I'm glad you like the new format and presentation. With regard to the ETI 470 60W audio amp modules, the input impedance is close to 100 ohms. To successfully drive these modules and achieve the amplification 'accuracy' attainable, the source impedance should be one-tenth to one-twentieth the input impedance, i.e. 5 to 10 ohms.

Personally, as much as possible, I try to adhere to the principle 'do it properly or not at all'. In magazine publishing, it is not always possible – disasters do occur and articles have to be replaced last minute – but we are working towards improving the editorial material presented in ETI.

With regard to the 'Series 4000' amplifier project, it is being followed up. This issue includes the 'Series 4000 moving coil cartridge preamp'. The object was to suggest a group of audio components with the title – hence the word 'series'. The moving coil preamp will be followed by a number of other projects – the eventual aim being to present a cohesive set of related audio components for home construction.

We cannot present these projects one on top of the other in successive issues. Apart from the necessary development time required (five months for the stereo amp, three months for the moving coil preamp, etc.) the individual projects need time to gain acceptance – both amongst readers and parts suppliers. We exist in a symbiotic industry – we depend on the parts suppliers to support our projects and they depend on us to present well-designed, popular projects.

In summary, I think you can see we have spent a lot of time and thought very carefully about the many factors involved in this series of audio projects.

The Series 4000 will successfully drive transmission line speakers to painful levels in many a suburban lounge room. Indeed, we have given a demonstration in a very large church-style hall at Sydney University with the Series 4000 driving a pair of Tannoys in a large TL enclosure. Sound levels were quite adequate.

Extending the power level of the ETI 470 60 W module is not possible as the safe-operating area of the output devices will be exceeded. Bridging two modules can be done, but it is not simple. We have this on our list of "things to do". As for the VU meter, active crossovers, etc., there are only so many hours in a day and so many demands on our time from enthusiasts with other interests we're hard pressed to get as much done as we do!

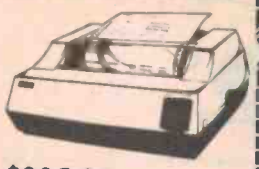
For a glimmer of hope, an interface/driver for the 60 W module is being designed. It will appear . . . eventually.

Here is the "Letters" page!, Ideas for Experimenters has already been extended and the "Lab Notes" occasional Column for such semi-project extensions as you suggest was introduced several issues back.

Roger Harrison
Editor

COMPUTER CORNER

NEW! DOT MATRIX PRINTER

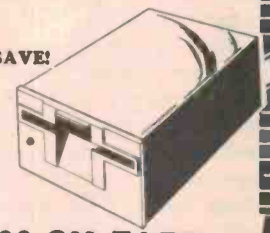


Superb line printer features 125 characters per second print speed and a one line buffer memory. The interface is 8 bit parallel-standard and paper feed is by pin feed method. Size 450w x 375d x 185h (mm). Weight approx. 10kg.

★ Uses inexpensive fan-form paper.
★ Upper and lower case characters
★ 80 columns

$995.00 Cat X-3255

OWN A TRS-80? READ THIS AND SAVE!



The Dick Smith Mini Disk Drive is 40% cheaper than the Tandy Disk Drive, and has 14% larger capacity. See our advert on page 24 of September Electronics Australia for more exciting details!

$379.00 Cat X-3230

SAVE $20.00 ON TAPE READERS!

Be quick! Easy-to-build paper tape reader kit for all computer enthusiasts. Hurry! NOW **$75.00!** Cat K-3466

NEW!

Dick Smith cassettes have been up-graded. Brilliant new packaging tells you they're different – find out for yourself just how good they really are! Try a couple of these quality tapes; better still, try ten (types can be mixed) to obtain the bonus book below!

C-60LN: $1.50 ea. (Cat C-3350)
C-90LN: $2.00 ea. (Cat C-3352)
C-90UD: $2.75 ea. (Cat C-3354)
EVEN LOWER FOR TEN PLUS!

BONUS:

Buy any ten "Dick Smith" cassettes, or any Dick Smith cassette deck or recorder and receiver FREE a copy of our new book: "The inside story on cassettes". Tells you all about this incredibly versatile recording medium, and how to get the best from your tapes and tape recording equipment. Also available separately: Cat B-6035 @ 50c

BARGAIN PACKS:

Buy your electronic components in bulk and save a fortune on one off prices. Dick Smith component packs are ideal for the hobbyist, serviceman, etc, and give real savings over one-off prices. Computer-selected values – no junk!

RESISTOR PACK: 300 resistors, around 60 values. Great value; less than 2c each! Cat R-7010 **$5.90**

GREENCAP CAPACITOR PACK: Another value-packed assortment. Not a lot of weird rubbish – 60 often used greencaps. Cat R-7040 **$6.50**

CERAMIC CAPACITOR PACK: Over 50 of the most commonly used types. Voltages no less than 50V, 10pF to 0.1uF values. Cat R-7050 **$4.50**

TAG TANTALUM CAPACITOR PACK 50 high grade TAG tantalums, high reliability capacitors. Limited quantity of this pack available. Cat R-7060 **$4.75**

WHAT'S NEW — GLASS BREAKAGE DETECTOR

Incredible! Up-to-the-minute technology gives protection for shops, offices, homes, etc. Simply glues on window; if glass breaks, it actuates alarm system. Is not affected by tapping or other sounds; sensor reacts only to sound of glass actually breaking. Approx. 25mm cube.

$29.50 Cat L-5230

WHAT'S NEW — IC INSERTING TOOL

Here's the perfect way to insert DIL IC's without damage. Special IC insertion tool has metal holder and plunger to protect MOS ICs. plunger has variable pitch for differing insertion depths. A must for the serviceman, hobbyist, production line, etc etc etc.

$4.95 Cat T-4640

WATCH THIS SPACE

AND FIND OUT WHAT YOU MISSED

Each month all of our stores feature an outstanding special which is actually BELOW COST! N.B Specials are strictly while store stocks last. Don't miss out!

LAST MONTH:

REAR WIPER KIT
Normally $39.95; reduced to $17.90

SAVING $22.05

WHAT'S NEW — STOPWATCH/CLOCK/TORCH

Now there's no excuse for anyone – even someone like Norm – to get involved in sport. Highly accurate electronic stop watch/cluck features split and lap timing, with LCD readout. Normally a six digit clock with an in-built torch for map reading, etc. Incredible value!

Cat X-1043 **$39.50**

WHAT'S NEW — CASE FOR PROJECTS

1000 deluxe aluminium case for many types of projects. Liquidated stock of CB manufacturer; think of the uses!

Front & Rear panels
Mounting bracket
Speaker holes
Heavy sub-chassis
Cut-outs for display, switches, meters, etc
Limited quantity only!

Cat. H-2507

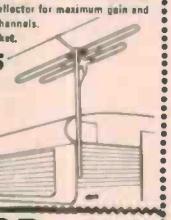
$7.95

WHAT'S NEW — AT LAST!

A go-anywhere TV antenna – for car, house, boat, etc etc.

You can mount this in vertical or horizontal mode for either polarity transmission – so it is ideal for use on a caravan. Double folded dipole with reflector for maximum gain and minimum ghosting on all channels. Comes with mounting bracket.

Cat L-4026 **$23.95**



BALUN:

Want to use co-ax? You'll need a balun. This one is weatherproof, strong.

Cat L-4452 **$2.50**

INFRARED ALARM $89

Cat L-5050

SENSATIONAL NEW ALARM SYSTEM - Infrared photoelectric relay system with projector and receiver in one case. Easy to install - simply stick reflector panel opposite the infrared unit and any person cutting the invisible beam will set the alarm off. The alarm can be a buzzer, siren or lamp connected to the 12V DC 1A (max). output of the infrared unit. Can also be used as a counter - to check number of visitors or count items on a conveyor system. Includes sensitivity control, three position alarm setting and has an effective coverage of 0.8 to 15 metres. Dimensions: 90(w)x145(h)x190(d)mm. Weight 1.55kg.

LCD CLOCK MODULE $12.50

INCREDIBLE ACCURACY!

Scoop purchase! Time & date modules, ideal for phone timers. Liquid xtal disp., buy direct from the importer and save. Battery included! Incredible value.

Cat X-1039

WHAT'S NEW — IN A WORD: BRILLIANT!

3-way light: fluoro, spot and flasher for campers, in the car, home; wherever you need a portable lamp. Hand held or use shoulder strap supplied.

Cat X-1084 **$14.95**

BACK TO 1977 PRICES!

All of the products in this section are less than, or the same, as our 1977 catalogue prices. This, despite two years of inflation and worsening exchange rates! DICK KEEPS PRICES DOWN – AND YOU SAVE MONEY

AM/FM PORTABLE RADIO
Listen in to broadcast band or new FM stations. Cat A-4364. In 1977: $12.50
IN 1979 ONLY $9.95!

FLUSH MOUNT CAR SPEAKERS:
Great tone, easy to mount. Cat A-6985
STILL ONLY $18.00 pair.

WEDGE MOUNT CAR SPEAKERS.
For rear shelf mounting, or where space is a problem. Thousands sold! Cat A-6980
STILL ONLY $16.00 pr

HORN SPEAKER
Ideal for alarms, CB, extension speakers, etc.
Cat C-2705
1977 PRICE: $8.90
NOW ONLY $6.90!

40 PIECE SOCKET SET
Includes ratchet driver, sockets. Ideal for the handyman. Cat T-4670
STILL ONLY $16.50

DC POWER TIMING LIGHT
Keep your car's timing spot on. Saves money, stops wasting petrol. Cat A-8508
STILL ONLY $23.50 IN 1979!

CAR RADIO ANTENNAS
LEFT: Combination AM/FM/CB antenna. Saves having to drill another hole! Cat D-4418.
WAS $33.00 NOW $29.25
RIGHT: Electric aerial. Why get out of the car on cold rainy nights? Stops vandals, too!
Cat A-7360.
1977 PRICE: $23.00
NOW ONLY $19.00!!

VALUE!

For computer enthusiasts, experimenters. This calculator keyboard kit with a host 'o' uses: comes complete with screws, PC board, all keys and spring pad. Ideal for combination locks, alarm systems, too. Cat K-2010

$3.75

FERRIC CHLORIDE IS NOW IN EASY-MIX PACK . . .

Yes! No more mucking about with powders, waiting for them to dissolve. Now Dick has hand packs of ferric chloride in concentrated liquid form: just pour into water and you have instant solution. Makes 600ml of etchant. Cat H-5652

20% MORE ETCHANT FOR THE SAME PRICE!

$1.90

SPEAK EASY WITH DICK SMITH SPEAKER AND ACCESSORIES . . .

A TOUCH OF CLASS!

Smart white cover for up to 20cm speakers. You've seen them in factories, offices, etc. Now available to the hobbyist. Use them in the home for intercoms, music systems, etc. Cat. C-2646

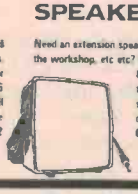
$2.75

BUDGET OVAL SPEAKERS

A speaker for $2.50? Who's kidding?? Certainly not us. These incredible value car radio/stereo speakers are 16 ohm impedance (so they'll suit anything!) and measure 100 x 150mm. Cat A-7132

$2.50!!!

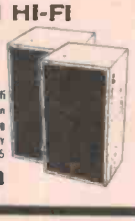
EXTENSION SPEAKERS



Need an extension speaker out near the pool, in the workshop, etc etc? This is the one for you. 8 ohm impedance, suits transistor radios, CBs, stereos, etc. With 2.6m cable and 3.5mm plug. Cat A-2451

$9.50

SCOOP EXTENSION HI-FI SPEAKERS



Incredible bulk buy bargains: famous brand Rand Arena hi-fi speakers, ideal for an extension to your hi-fi system. Were selling for $75.00 pair, our price only $49.50 pair! Cat A-2465

$24.75 each

MINI HI-FI SPEAKERS

Top performance from such a tiny speaker. If space is a problem, or if you don't want your speakers to look obtrusive, try these. They're only 120 x 120 x 190mm, and performance is equal to many speakers costing two and three times as much! Try them, you'll be pleasantly surprised! Cat A-2375

- Car
- Boat
- Caravan
- Home Units & Flats

$99.50 pair

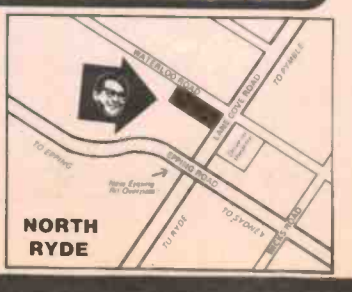
WE'RE MOVING!

Like Topsy, we've growed and growed . . .
For the third time in as many years, we've out-grown our warehouse and head office space. So in October we are moving to a brand new, multi-million dollar warehouse and head office complex at North Ryde – approximately 8km from our present head office in Artarmon.
Of course, our retail stores will stay in their present locations.

Our new address:
Dick Smith Electronics Pty Ltd
Cnr Lane Cove Road & Waterloo Road,
North Ryde. NSW. 2113. Tel. 8883200

There you will find:

- **Dick Smith Distributors** (our wholesale section)
- **Service Centre** (including quality control section)
- **Mail Order Centre** (for any mail order enquiries)
- **Purchasing and importing department**
- **Administration** (including management & accounts)
- **Advertising & Marketing** and, of course our huge
- **Bulk warehouse and distribution centre**



NEW BOOKS FOR YOUR LIBRARY:

Just a few of the many new books for technical people you'll find at Dick Smith Electronics. Call in soon for a browse!

COMPUTER BOOKS:

Basic Computer Games, by David H Ahl. 190 pages of just about every game you could think of for your microcomputer. Yes, including Super Star Trek & Blackjack!
Cat B-2351 ..... $9.95
Due in stock mid November

ZILOG S/FORM DATA BOOK
Data book of all Zilog products including the famous Z-80 microprocessor. Also includes data on memory products (6104, 6114, 6142 RAMS), PIO etc and the range of Zilog board subassemblies.
Cat B-2360 ..... $5.00

ZILOG Z-80 ASSEMBLY LANGUAGE PROGRAMMING MANUAL
In order to program the Z-80 at machine level, it is convenient to use an assembly language. This book gives the programmer all information to identify Z-80 addresses & memory locations in simpler opcodes & operands.
Cat B-2362 ..... $9.95

AMATEUR RADIO BOOKS:

ARRL ANTENNA ANTHOLOGY
The best of recent QST magazine HF antenna articles & theory presentations. 150 pages. Every ham should have a copy!
Cat B-2205 ..... $6.25

AUSTRALIAN AMATEUR CALLBOOK
Yes, it's here: the all-new up-dated 1979 edition of the WIA callbook. It's time you updated yours, isn't it — with the ever-growing number of licensees. 98 pages.
Cat B-2317 ..... $2.95

THE HAM EXAM CRAM BOOK
Another brilliant study aid from the Westlakes Radio Club. Intended for those sitting for the AOCP exam - essay or multiple choice type. Has sample question & answer section, too!
Cat B-2314 ..... $2.95

BOOK OF THE MONTH:

ELECTRONICS: A practical introduction by B. Brown & P. Carr. 92 pages. Intended as a school textbook (part of the 'fundamentals of senior physics series for HSC students) but also a great 'start-up' book for the hobbyist, too. Gives a basic introduction, with practical experiments.
Cat B-3005 ... $5.95

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Cat. B-7135

Just look at this superb relay bargain: rated at 12V DC with 290 ohm coil resistance, massive 0.4A contact rating. Mounts direct on PCB, ideal for modern circuits requiring a small relay.

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The cure: build a Dick Smith Whistle filter and install it in your tuner. Easy to build, easy to install, and it effectively removes inter-station whistles.
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We still have a few of our budget transistor packs left: 20 transistors, all brand new, prime spec devices, equivalent to BC107, 108, 157 & 158 — probably the most used transistors in Australia. But if you want a pack you'll have to hurry. (Yes, some packs have been reserved for our mail order customers!)
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$12.00

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What a great idea! Double adaptors can be dangerous: use one of these 4 way safety shutter outlets on a 2 metre cord for top safety.
$16.50
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NEW! D-TYPE Connector

25 PIN

Use to connect computers to peripherals.
Cat P-2690
$5.60
(Universal backshell available: Cat P-2692 ..... $2.60

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It's so easy! Simply list the items you want, with their catalogue number(s), and post it off with your cheque to our mail order centre (address below). Don't forget to include post and packing (charge is on total value of your order as per the table):

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Grab a few of these before they disappear: at these prices, you'd be made not to. 2200 and 3300uF can-type electrolytics bought as manufacturer's excess stock so they lose and **you save!**

They're great for power supplies (you always wanted to make a high current supply for the lineal!) and a host of other projects. Even cheaper 10 up!

Normal price for these is at least $3.00 each! look at our prices:

2200uF 50 volt: Cat R-4575 ..... 40c ea (10 up 30c ea)
3300uF 50 volt: Cat R-4577 ..... 60c ea (10 up 50c ea)

4PDT RELAY WITH 12 VOLT COIL:

Normal price for these handy relays would be over $3.00. We've made a bulk purchase from an Australian manufacturer of excess their excess stock. Brand new, prime spec relays, already with wiring loom attached (but never used). Be quick for this one!
Cat S-7005
$1.00 ea!

NEW KITS
(and new kit components)

Remember: parts for most kits in most of the electronic magazines are normal stock lines. So even if a kit isn't listed, we may be able to help you anyway. Call in and ask us!

INFRA-RED REMOTE CONTROLLER (See Oct. EA)

CQY89A Infra-red diodes	Cat Z-3235	$1.50
BPW34 Photo transistors	Cat Z-1954	$3.50
Printed circuit boards (pair)	Cat H-8365	$5.95

DISCO STROBE (similar to ETI September)

Complete kit	Cat K-3150	$29.50
Printed Circuit Board	Cat H-8572	$1.95
Flashtube	Cat S-3882	$2.95
Trigger transformer	Cat M-0104	90c
Discharge Capacitors (each)	Cat R-2855	$3.75
Reflector	Cat K-6016	$4.50

WINDSCREEN WIPER DELAY (See September EA)

Printed circuit board	Cat H-8364	$2.50

Other components for this project are normal stock lines

AUTO CHIME (See September EA)

Complete kit	Cat K 3502	$29.75
Printed Circuit Board	Cat H-8363	$3.70
TMS-1000 Integrated Circuit	Cat Z-6825	$16.50

INDUCTION BALANCE METAL DETECTOR (See ETI)

Short form kit (not including former or dowell for rod	Cat K-3100	$35.50
Printed circuit board only	Cat H-8578	$1.50

PLAYMASTER STEREO EQUALIZER (See May EA)

Complete kit including instructions	Cat K-3500	$99.50
UA4136 Quad Op Amps	Cat Z-6105	$1.95
PC Boards (set of 3 high quality boards)	Cat H-8360	$12.95
Slider pots	Cat R-1980	85c
Knobs to suit slider pots	Cat H-3782	50c

9kHz WHISTLE FILTER FOR TUNERS (See Feb EA)

Complete kit, including instructions	Cat K-3496	$19.75

(SEE MORE DETAILS ON OPPOSITE SIDE OF THIS PAGE)

INTERSIL LCD EVALUATION KIT (See Feb EA)

(As used in EA digital voltmeter)	Cat K-3450	$39.50

(See bottom of opposite page for more information on this product)

MICROWAVE OVEN LEAKAGE DETECTOR (See July ETI)

Printed Circuit Board	Cat H-8619	$1.95
5082-2800 Schottky Hot Carrier Diode	Cat Z-3230	$2.90

All other components are normal stock lines.

MAJOR DICK SMITH RESELLERS

Listed below are re-sellers who stock a large range of our products. However, we cannot guarantee that they will have all items in stock or at the prices we advertise.

A&M Electronics
78 High Street, Wodonga, Vic. Ph 244 588
Advanced Electronics
5a The Quadrant, Launceston Tas. Ph 317 075
Aero Electronics,
123a Bathurst Street, Hobart Tas. Ph 348 232
Peter Brown Electronics
9 Doveton Street North, Ballarat Vic. Ph 323 035
Coastal Electronics
43 Vulcan Street, Moruya NSW. Ph 742 545
Crystal TV Rentals Pty Ltd
66 Crystal Street, Broken Hill NSW. Ph 6897
Delta Electrix
67 Queen Street, Ayr, Nth Qld. Ph 831 357
Elektron 2000
44 Brown Road, Broadmeadow, Newcastle NSW. Ph 691 222
Fred R Hayes Electrical
28 Station Street, Bowral NSW. Ph 611 861
D & M Harrington,
6/1 Machinery Drive, Tweed Heads South, NSW. Ph 364 589
Hutchesson's Communications
5 Elizabeth Street, Mt Gambier SA. Ph 256 404
Keller Electronics
218 Adelaide Street, Maryborough, Qld. Ph 214 559
Lismore Kitronics
Cnr Magellan St & Bruxner Hwy, Lismore NSW. Ph 214 137
M&W Electronics
48 McNamara Street, Orange NSW. Ph 626 491
Power & Sound
147 Argyle Street, Traralgon, Vic. Ph 743 638
Stevens Electrical
135 Goldsmith Street, Mackay, Qld. Ph 511 723
Sumner Electronics
95 Mitchell Street, Bendigo, Vic. Ph 431 977
Sound Components
78 Brisbane Street, Tamworth NSW. Ph 661 363
Tomorrow's Electronics and Hi Fi
68 William Street, Gosford NSW. Ph 247 246
Trilogy Wholesale Electronics
40 Princes Hwy, Fairy Meadow, Wollongong, NSW. Ph 831 219
Tropical TV Services
249 Fulham Rd, Vincent, Townsville Qld. Ph 791 421
Variety Discounts
113 Horton Street, Port Macquarie NSW. Ph 835 486
Wellington Electrical Services
110 Lee Street, Wellington NSW. Ph 325

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	147 Hume Highway,	CHULLORA.	Phone 642 8922	VIC	399 Lonsdale Street, MELBOURNE. Phone 67 9834
	162 Pacific Highway,	GORE HILL.	Phone 439 5311		656 Bridge Road, RICHMOND. Phone 428 1614
	30 Grose Street,	PARRAMATTA.	Phone 683 1133	QLD	166 Logan Road, BURANDA. Phone 391 6233
				SA	203 Wright Street, ADELAIDE. Phone 212 1962
	263 Keira Street,	WOLLONGONG	Opening soon	WA	414 William Street, PERTH. Phone 328 6944

EXCEPT WHERE NOTED, ALL ITEMS SHOWN IN STOCK AT PRICES GIVEN AT TIME OF GOING TO PRESS.

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NEWS digest

Pioneer 11 proves Australian's theory correct

The solar system was created by supersonic turbulence in an enormous, hot, interstellar cloud of gas according to Australian mathematician, Dr Andrew Prentice, and Pioneer 11's recent flyby of Saturn has apparently confirmed his theory.

He says his theory is confirmed from the startling discovery that Saturn has six rings instead of the five it was believed to have.

This discovery has upturned many theories about the formation of the solar system and the origin of the sun and the planets, and was received with almost complete surprise amongst astronomers and astrophysicists.

It was no surprise to Dr Prentice as he had predicted the existence and position of the ring — inside the existing rings — some years ago.

Dr Prentice has experienced some difficulty in getting his papers on the theory published. The basis of his theory was partially worked out by Pierre de Laplace (remember — Laplace transforms?), a French mathematician, about 200 years ago. In essence, in primeval space enormous plumes of swirling gas, hot plumes moving one way, cold moving the opposite, would pass each other at speeds of around three to ten km per second. The side-by-side motion of these colliding plumes created supersonic stress in the order of 100 times normal gas pressure. This resulted in incredible turbulence inside the gas cloud. As it cooled, it contracted into a spherical shape, the gas swirl turning faster on its axis. Eventually, centrifugal force caused a bulge around the cloud's equator. As the process accelerated, the bulge became a disc and was eventually thrown off as a gaseous ring.

This event was repeated several times in a mathematical progression until there were several rings and the remainder of the gas cloud had contracted, eventually to form the sun. Each ring contracted until its components were drawn together by mutual attraction, compacting into a planet.

The theory, according to Dr Prentice, can be applied to the universe generally.

Saturn has special significance as it is still in a gaseous state and provides a test for Prentice's theory. He calculated that Saturn's rings were formed in the manner as just described and predicted the existence and position of a sixth ring — the ring that Pioneer 11 discovered.

Further, Dr Prentice says that the Sun was formed when the central core of the gas body left after the separation of the rings collapsed. Its outer layers fell inwards, triggering the chain of nuclear reactions which make up the sun as we now know it.

Biomedical symposium

"Microelectronics in Rehabilitation" is the title of a Symposium being held in Melbourne from Wednesday 24 October to Friday 26 October.

Venue is Clunies Ross House at Parkville in Melbourne.

The Symposium is being organised by The Institution of Biomedical Engineers (Australia) in conjunction with The National Advisory Council for the Handicapped and The Society for Medical and Biological Engineering (Victoria).

Papers will cover such topics as Microelectronics and Medicine, Implantation, Electrical Stimulation for the Relief of Chronic Pain, Sensory Feedback in a Powered Artificial Hand, A Teachable Robot Arm and many others.

Full registration costs $75 with sessional and student rates. More information is obtainable from Mr D.A.W. Smith, P.O. Box 5, Parkville Vic 3052.

Intelligent Typewriter

It's a pity there isn't a union for secretaries as the problems of creeping technology are going to affect them as much as anybody else. Any secretarial neo-Luddites out there can all get together and scream about the latest product from the Qyx division of Exxon Enterprises Inc (Zilog's parent company).

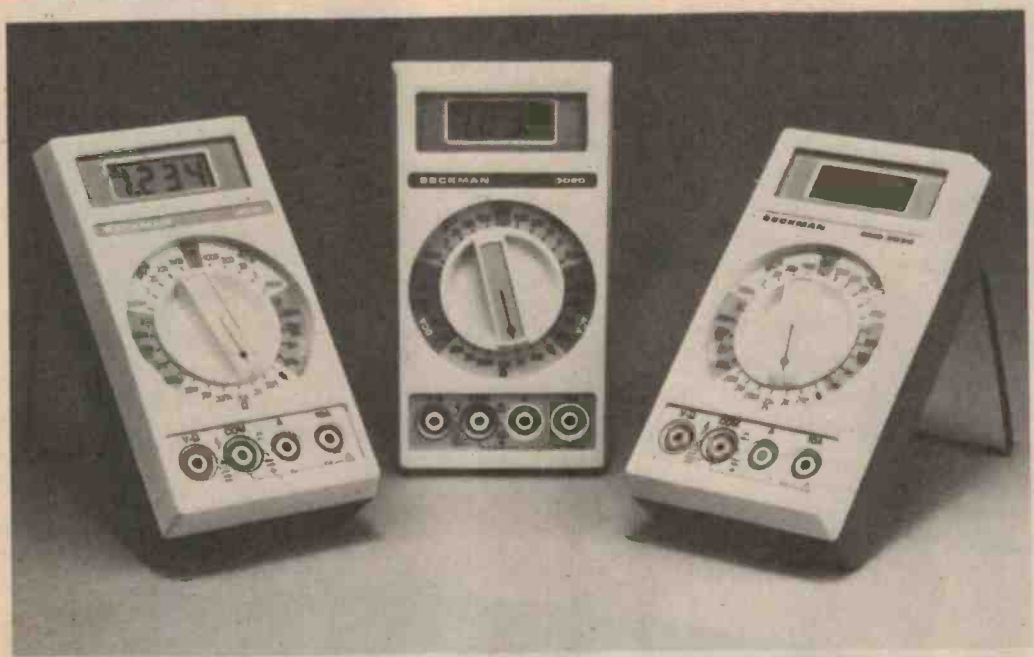
The new Qyx Intelligent Typewriter is available in several different levels, with all levels compatible with the basic unit. Level 1 is a very nice proportional-spacing typewriter with phrase and format recall, centering and self-correction. Level 2 adds a 10 000 character memory and editing features like right margin justification and pagination. Level 3 expands the memory to 60 000 characters and adds some convenience functions, while level four adds a mini-disk drive with 60 K capacity.

Level 5, the top level machine, has dual floppies, and levels 2 through 5 all offer single-line display and communications options.

Obviously, the innards are based on a microprocessor; yes, you've guessed it, a Z-80 (actually there are three micros in the unit). The print mechanism is also largely electronic, based on a stepper motor.

Further information on Qyx is available from Datronics Corporation Ltd., Information Systems Division, 168 Walker St., North Sydney 2060.

By the way, Level 6, which we deduce is still in development, will also answer the phone and tell the caller that you're in a meeting, make coffee (upon insertion of 20c), water the plants and buy you a card on your birthday (cries of 'Shame!', 'Down with technology!', 'The Telecom workers were right!', etc).



RF measurement agency for Warburton Franki

Warburton Franki were recently appointed Australian distributor for Dielectric Communications (DICOM) RF measurement equipment.

DICOM'S range is quite extensive and includes: Directional RF Wattmeters, antennas, transmission lines, Dry Pak dehydrators, waveguide switches, RF terminating loads, heat exchangers etc.

Substantial stocks of directional RF Wattmeters are already held in several Warburton Franki centres. Service and engineering support is offered Australia-wide.

Portable DMMs from Beckman

Warburton Franki recently released a range of three new portable digital multimeters made by the US-based Beckman Instruments.

Each features a 3½ digit display, long battery life, a special in-circuit semiconductor test function and overload protection on all ranges.

An unusual feature on these multimeters is the large rotary function select switch — a favourite on many analogue meters but not seen to date on hand-held DMMs. A unique feature of the display is the omega symbol that appears in the upper left corner when the ohms range is selected. Each has a speedy continuity test function, rivalling that of analogue VOMs.

Model 3030 includes an RMS measurement capability and Beckman quote a 0.1% accuracy (Vdc). The 3020 is similar, but without the RMS facility. Model 3010 has a claimed 0.25% accuracy (Vdc) and an inexpensive 'TECH' model, the 300, 0.5%.

Recommended prices are, respectively, $199, $179, $139 and $115, plus 15% sales tax where applicable.

For more information, contact Warburton Franki who have branches in the capital city of each state.

Hex thumbwheel switch

Of interest to the digital enthusiast is a new binary-coded 16 position hexadecimal thumbwheel switch that has recently been added to the C & K product range.

Compatible with the already established range of thumbwheels these hexadecimals are available ex-stock in front and rear mount with a number of options which have been available over the years for the existing range.

Yet another addition to the range, also ex-stock is a BCD switch with a "separate common to not true bits" ten-position type.

For further information contact C & K Electronics, Office 2, 6 McFarlane Street, Merrylands 2160 NSW (P.O. Box 101, Merrylands); phone (02) 682-3144.

MIDAS — a data goldmine!

The Overseas Telecommunications Commission has launched a new international data transmission service called MIDAS (Multimode International Data Acquisition Service).

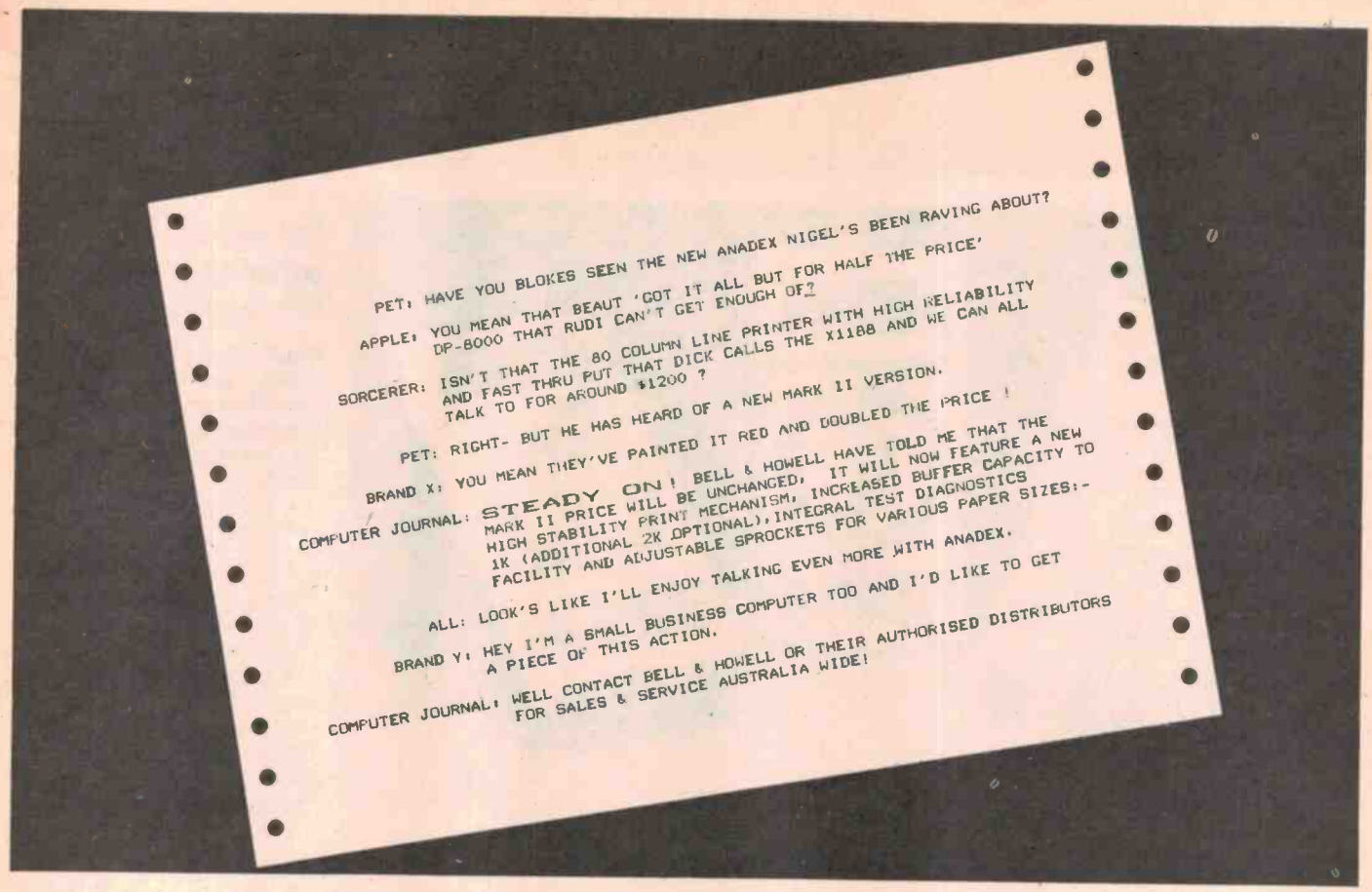
The service will provide Australian MIDAS subscribers with access to databases and computer installations initially in the USA. Other countries will join the network later.

MIDAS will have particular application to industrial, educational, research and library organisations and it will be extended to meet the needs of corporations utilising their own internationally distributed database and computer processing facilities.

A spokesman for OTC said: "In the past two years, while negotiations and tendering action aimed at establishing this service were proceeding, thorough market testing and widespread demonstration to interested groups has been carried out by OTC. This has shown conclusively that there is a significant demand for the MIDAS-type service in Australia and, with MIDAS' carefully devised and economical tariff, widespread and fast growing usage is foreseen."

The MIDAS switch will be located in OTC's International Gateway Centre in Sydney. It will be connected by satellite and submarine cable circuits through OTC's correspondents in the USA to the Tymnet network, which in turn provides access to the many database and computing services spread throughout the USA.

Other countries are providing similar packet switch interconnection to the USA, and extension of MIDAS service to these countries (e.g: UK, Europe, Japan, Canada and Hong Kong) is foreseen at a later date as the service develops.



Inter-satellite links

The International Telecommunications Satellite Organisation (INTELSAT) recently announced plans for the development and establishment of inter-satellite communications links within its system.

INTELSAT has awarded a contract to the Electron Dynamics Division of the Hughes Aircraft Company in California for the design, fabrication and testing of a feasibility model of a travelling wave tube (TWT), a vital component of the on-board satellite equipment required to operate an inter-satellite link.

Other work is under way or planned, covering the development of a prototype model and other associated equipment.

INTELSAT's objective is to advance technology in this area sufficiently to enable it to install facilities for inter-satellite links on its satellites launched after 1984.

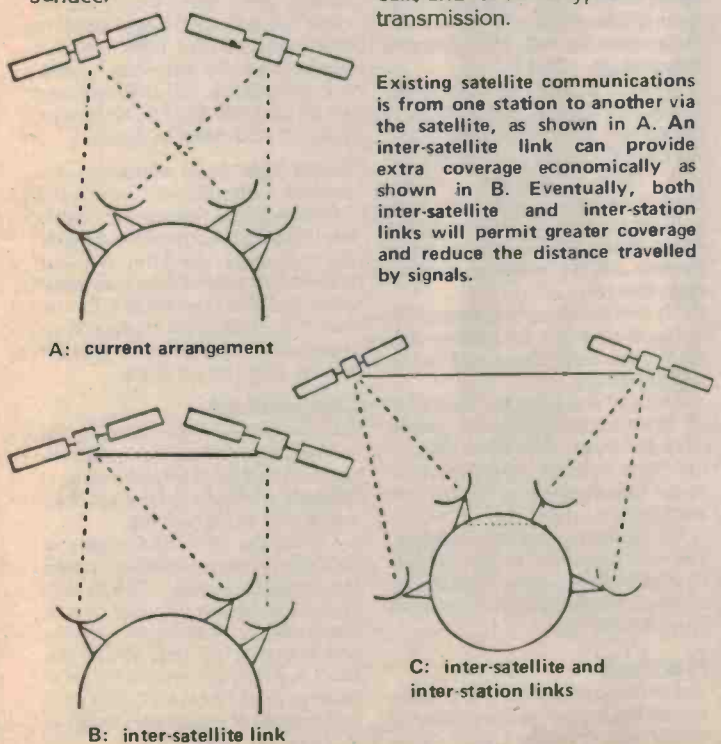
Inter-satellite links offer a number of significant advantages: at present, direct satellite transmission can only be provided between points within a single satellite coverage area — about one third of the earth's surface.

Communications bound for destinations outside the coverage area must complete their journey via land-based links or through a second satellite hop.

With inter-satellite links these signals could be switched directly from the first satellite to the second — thus saving one "down-" and one "up-link" transmission, freeing this capacity for other communications and allowing more efficient and economical use of the system as a whole.

It will enable one earth station to communicate through more than one satellite in each area thus improving system flexibility by increasing the number of receive stations which can be accessed directly.

Inter-satellite links also promise some potential for linking satellites in different coverage zones so cutting the distance travelled by signals and therefore the time taken to reach their destinations. This could be particularly important for telephone calls and for some types of data transmission.



Existing satellite communications is from one station to another via the satellite, as shown in A. An inter-satellite link can provide extra coverage economically as shown in B. Eventually, both inter-satellite and inter-station links will permit greater coverage and reduce the distance travelled by signals.

A: current arrangement

B: inter-satellite link

C: inter-satellite and inter-station links

Video disk has huge capacity

A prototype digital video disk system with a staggering 20,000 million bit capacity has been developed by the US firm Magiec, a Philips subsidiary.

The system uses a helium-neon laser to burn micron-sized holes in a layer of tellurium, which it immediately reads back to check that there are no errors.

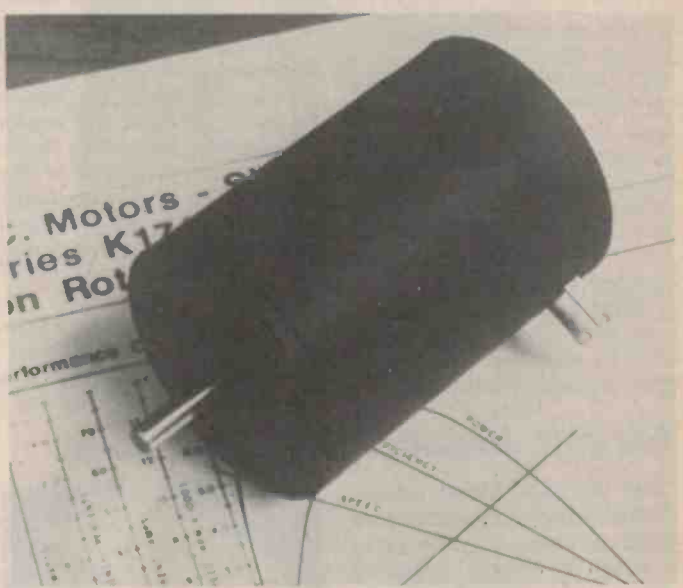
The breakthrough was made possible by enclosing the recording layer between two inexpensive plastic discs. This procedure keeps the dust off the tellurium and allows the disk to be handled by human operators. The laser burns a conventional style label on the disk automatically.

As the data, once written, cannot be erased the system merely rewrites an entire sector every time it is up-dated. This sort of redundancy is only feasible with such a low-cost medium.

The developers suggest that the final high-volume cost of the unit will be around US $10,000, with disks costing US $150.

As the need for high-density data storage increases (the Bank of America needs some 600 billion bits per year), Magiec (North American Philips' Magnavox Government and Industrial Electronics Co.) predict the need for a 1000 billion bit system by 1980.

High stall torque, low cogging for new dc motor



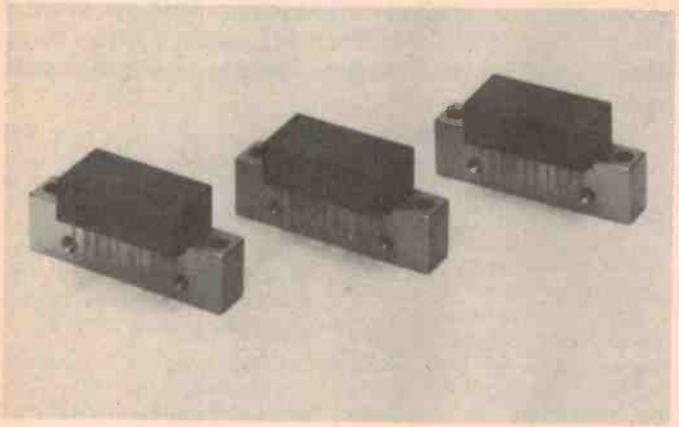
Featuring a stall torque of 110 mNm for a 24 V model, the new motor from Airpax is designed for speed control and servo applications.

Designated model K17400, it is an iron core bi-directional type having a stainless steel shaft. Bearings are permanently lubricated self-aligning sintered bronze. It offers a linear torque speed characteristic with low cogging.

The K17400 is available for either 6, 12 or 24 Vdc operation and is suited to tape drive, pen and chart drive, printer ribbon and carriage drive applications.

Distributed by Philips Electronics Components and Materials, further information is available from P.O. Box 50, Lane Cove 2066.

NEWS digest



Amplifier modules

Six new VHF hybrid push-pull amplifier modules for cable TV systems, covering the full frequency range from 40 to 300 MHz, were released recently by Philips.

There are two kinds listed: preamplifiers and final amplifiers, both of which are available in three gain versions.

The preamplifiers are designated BGY50, BGY52 and BGY54 and feature power gains at 50 MHz of 12.5 dB, 16.4 dB and 17 dB respectively. Their output voltage at -60 dB intermodulation is around 460 dBmV. The second harmonic distortion is less than -68 dB and the noise figure is quoted better than 6 dB.

Final amplifiers are designated BGY51, BGY53 and BGY55 and also have similar power gains to the preamp modules. Output voltage at -60 dB intermodulation is around 63 dBmV, and the second harmonic distortion is better than -70 dB. Noise figure is better than 7 dB, Philips claim.

All have a source and load impedance of 75 ohms and supply voltage is 24 Vdc. Return losses at the input and output are quoted as better than 18 dB. Current consumption of the preamplifiers is typically 160 mA, and of the final amplifiers 200 mA. All modules are encapsulated in a SOT-115 package.

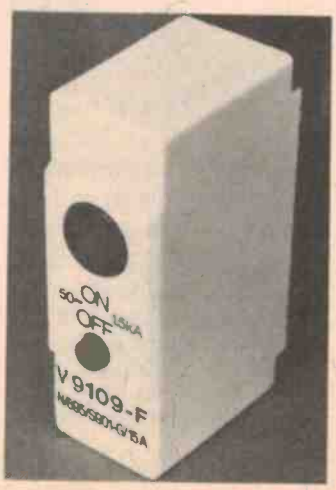
For further information contact Philips Electronic Components and Materials, 67 Mars Road, Lane Cove, NSW 2066.

Circuit breaker replaces fuse

The 'Circuit Alert' circuit breaker replaces a standard fuse, operating as a normal circuit breaker, tripping when a predetermined overload occurs.

The unit is made as a direct replacement for standard house fuses and has been tested and approved by the NSW Electricity Authority.

The device is available in ratings of 30, 25, 20, 15 and 8 amps to suit Standard A, Wilco and Federal fuse types. Price is $8.95 each. They are available from Dindy Marketing (Aust.) Pty Ltd, P.O. Box 55, Rushcutters Bay, 2011 NSW.



Position vacant on new publication

Electronics Today Int. is about to produce a new regular publication covering all aspects of electronics in sound and sound recording.

The field, which is much wider than it might at first seem, includes electronic musical instruments, electronics in musical instruments (that's two different things — not a printing error); sound recording including studio and broadcasting audio equipment; public address systems, stage lighting etc etc.

The first publication will be a 200 plus page year book and will be on-sale about the end of November.

We are now seeking a freelance or part-time editorial person to take over from the present incumbent (ex-Radio Birdman drummer, librarian and electronics nut Ron Keeley) who for some totally unfathomable reason is emigrating to the UK.

An essential qualification is a practical working knowledge of the hardware — gained either as a roadie, or as a professional or semi-professional rock musician etc. He/she should also have a journalistic background or at least basic writing talent. A practical knowledge of electronics would be useful but not essential.

Interested — or know anyone who is? Ring Collyn Rivers on (02) 33-4282 or write to us at Electronics Today Int., 15 Boundary St, Rushcutters Bay, NSW, 2011.

Hatched, matched, despatched

Brief news on company activities, new outlets, mergers, joint ventures and closures.

Hatched

Cema Electronics have opened a second Silicon Valley retail store in Melbourne (ah ha!, the weather's warming up . . . Ed.)

Located at 208 Whitehorse Rd Blackburn, the new outlet will serve the eastern area of Melbourne and will carry the range of semiconductors from Motorola, Texas, Hewlett-Packard, Philips, Signetics and others that all Silicon Valley stores stock. Philips' passive components will be available in small quantities (!! . . . Ed.)

Perth gets the gong this month for the most activity in the nursery during August. Both Cema and Tandy had hatchings.

Cema's Perth branch is located at 25 Brisbane St, East Perth, phone (09) 328-8091. Rod Champion is the head hatcher and this completes Cema's chain of locations in each State's capital city.

Tandy had a grand triple opening. The new stores are located at 208 Beufort St, Perth, Grove Plaza in Cottosloe and Park Shopping Centre in East Victoria Park.

Matched

The Melbourne-based R & D Electronics has been appointed sole Australian agents for the Ladcor range of Liquid crystal displays (LCDs). Product to be stock locally will include 3½, 4, 4½ and 6 digit displays, mostly the 13 mm high size plus some 25 and 50 mm sizes for special applications. R & D Electronics are on (03) 288-8232 in Melbourne and (02) 439-5488 in Sydney.

Soanar have been appointed Australian distributors for the Semiconductor Group of Motorola Inc. (Asia-Pacific operation). Soanar are currently stocking a comprehensive range of Motorola transistors and ICs. Technical information on the complete product range is available from them at 30-32 Lexton Rd, Box Hill Vic 3128.

Despatched

California-based semiconductor manufacturer Intersil has released a consolidated products catalogue — available in Australia through their agent, R & D Electronics.

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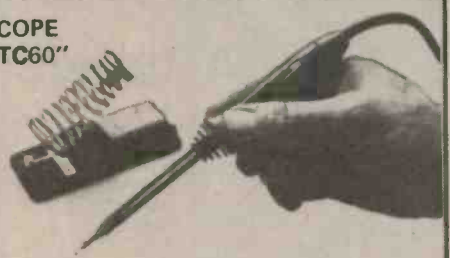
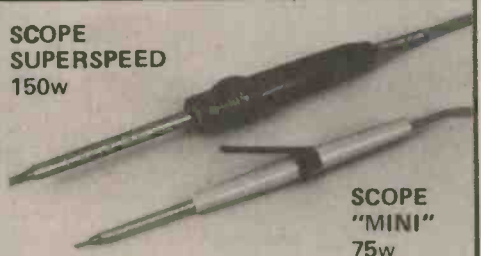
● Modern sophisticated PCB equipment. ● Accurate & automatic temp. control wanted. ● Components are heat critical.	SCOPE "TC60" 	1. Heats in 45 seconds. 2. Dial any temp. 200°–400° 3. Plugs direct to mains. No transformer needed. 4. Accept iron plated tips from 0.8mm to 6.4mm.
● Unpredictable soldering situation. ● Maybe electrical or electronic or mechanical. ● You can't come back to base for a bigger or smaller iron.	SCOPE SUPERSPEED 150w  SCOPE "MINI" 75w	1. 5 second heat up. 2. Controllable temperature. 3. Reserve heat for any normal job. 4. 4 volt safety in the hand.

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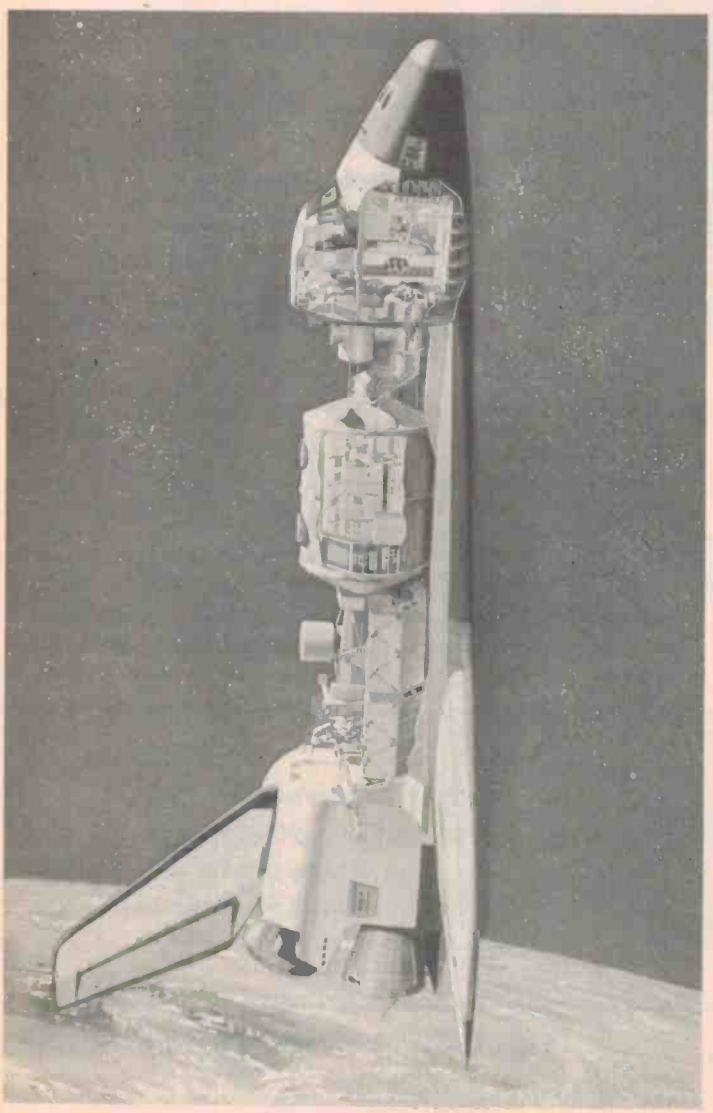
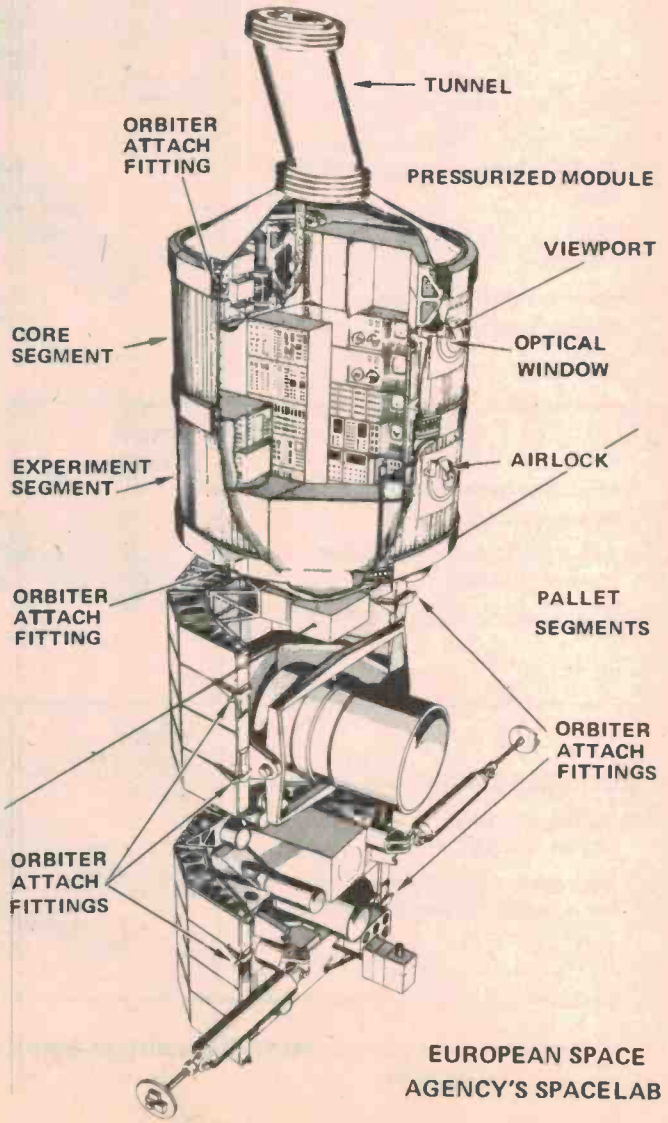
Spacelab — a giant international venture

Brian Dance

A re-usable orbital vehicle, Spacelab is being readied for its first flight, scheduled for mid-1981. The first mission will carry 76 scientific and technological experiments from European, American and Japanese agencies. The results are likely to have a profound effect on the development of science and technology into the next century. It has been said that the Spacelab missions are a greater step for mankind than man landing on the moon.





EUROPEAN SPACE AGENCY'S SPACELAB

DURING the past twenty two years quite a number of highly trained astronauts have been rocketed into orbit, carrying out much pioneering research in gravity-free environments.

These astronauts have to be able to withstand accelerations of up to about ten times that due to gravity on the earth's surface.

However, the US Space Shuttle should become available reasonably soon. It will not only allow people and other payloads to be lifted into orbit much more economically, but the maximum acceleration of a Shuttle launch is only about three times that of the earth's gravity (3 g) and that of a shuttle landing about 1.5 g.

It is therefore logical that the Shuttle should be used to launch a manned space laboratory, known as Spacelab, in which scientists, engineers and technicians rather than astronauts will be able to conduct experiments in earth orbit.

No long and rigorous pre-flight training courses are envisaged for the Spacelab crew. Those men and women who fly in Spacelab should be in good health, but their training will be short, and will include experiment operation briefings on flight plans and procedures, familiarisation with zero gravity conditions, exercises in spaceflight "housekeeping" and emergencies, and total system simulation.

Spacelab, like the Space Shuttle, will be re-usable – probably about fifty times. The Shuttle Orbiter vehicle, with Spacelab in its cargo bay, will be boosted into earth orbit by two solid fuel booster rockets (jettisoned at a height of 69 km) and by the main engines of the Shuttle vehicle which obtain their fuel from a huge external fuel tank which is jettisoned just before the orbital altitude is attained.

The Shuttle and Spacelab, will orbit for up to twelve days, although this may be extended up to thirty days in later flights.

The nominal duration of a typical mission is seven days. Although the Shuttle is a space vehicle, it is unique in that it can land like an aeroplane and will return Spacelab to earth.

A team of up to four experimental operators (women as well as men) will be able to work in Spacelab in orbit. They will be able to make adjustments to the orbiting equipment and to control the measurements being made.

On their return to earth they will bring the acquired data back with them.

The Spacelab crew will eat and sleep in the cabin of the Orbiter Shuttle vehicle with the four astronauts who form the Shuttle crew, but they will be able to move through a connecting tunnel into Spacelab when necessary.

The first Spacelab mission is scheduled for about the middle of 1981.

Spacelab is being constructed for the European Space Agency by an industrial team of nearly 40 manufacturers in 10 European countries, the leading contractor being VFW-Fokker/ERNO of Bremen, Germany.

Detailed design and development work on Spacelab began in June 1974. A Memorandum of Understanding was signed by the European Space Agency and the US National Aeronautics and Space Administration (NASA) in August 1973 which provides for the delivery to NASA (who will be responsible for the launching) of one Spacelab engineering model and one flight unit.

NASA has undertaken to buy more Spacelabs from the European Space Agancy, subject to certain conditions. The engineering model is scheduled for delivery in the second half of 1979 and the first flight unit proper about a year later.

Earlier spaceships

The early astronauts had to be content with very uncomfortable living quarters in spacecraft designed to ensure survival rather than to transport a large amount of equipment into orbit.

The Russian Salyut 1 was perhaps the first orbiting laboratory designed to carry many instruments into orbit, the role of the crew being to ensure their satisfactory operation.

This satellite was 14 m long with a maximum diameter of 4 m. The internal volume of nearly 100 cubic metres included about 36 cubic metres for the crew. They could sleep in beds, enjoy a dining room with a kitchen corner with reheated dishes, and had a bathroom and toilet room.

Later Salyut spaceships were of the same general design, very like that of a submarine; this is not surprising, since in both spaceship and submarine there is a great pressure difference between inside and outside the ship.

In 1973 NASA launched the Skylab orbital and scientific space station, this being an extension of the Mercury-Gemini-Apollo programs.

The internal volume of Skylab is about 600 cubic metres, of which about 100 cubic metres are inhabitable.

Salyut and Skylab were launched unmanned, since if the rocket were to explode, the station would be destroyed. Neither can they be brought safely back to earth, since they could not withstand the mechanical and thermal strains of re-entry.

The crew of these stations therefore had to travel separately to and from the vehicle. Salyut had an engine, but Skylab had no engine of its own, although it could use the Apollo ship to which it was coupled as a locomotive. A main disadvantage of both of these craft is that almost all the equipment on board is lost except for a few small rather precious items which the astronauts can bring back to earth with them.

The space available in the vehicles used for transporting men to and from the space station is very limited; the astronauts in Soyuz II returning from the Salyut I station died because they were so encumbered with the equipment they were bringing back to earth that they could not move to reach a device to stop the accidental depressurisation of the craft. Such problems will not occur in this form with the future Spacelabs.

Neither should Spacelab vehicles cause danger to people on the earth. After the fiery death of Cosmos 954, the nuclear reactor equipped Russian satellite which crashed in northern Canada in January 1978, people are becoming wary of space equipment which may crash down on to their country even if there are no radiation dangers involved.

NASA is concerned both about the possible hazards of such craft striking a populated region and also about losing its investment in the station, which cost about US$2000 million.

Spacelab modules

The Spacelab station has been designed on a modular basis so that it can be changed to meet specific mission requirements. The two main components are a pressurised module or laboratory which provides a "shirtsleeve" working environment and an open pallet in which materials and equipment can be directly exposed to the space environment.

The pressurised module is made in two segments, each being a cylinder 4.1 m in diameter and 2.7 m long. The core segment will be used in all Spacelab missions in which a pressurised module is required; it contains various supporting facilities (such as data processing equipment) and laboratory facilities such as working benches, floor-mounted racks, etc.

The second pressurised module, known as the experiment segment, is used to provide more laboratory working space. It will not be used unless this additional space is required. This segment contains only floor-mounted racks and benches.

When both segments are assembled with their end cones, the maximum external length is seven metres.

Five pallet segments, each three metres long are also available. These are designed for large instruments, for ex- ▶

periments requiring direct exposure to the space environment and for work requiring unobstructed or broad fields of view.

For example, various telescopes, antennae, sensors, radiometers and radar antennae will be carried in one of the pallets. Each pallet can also be used to cool equipment, to provide electrical power and to furnish connections for commanding and acquiring data from experiments.

If the pallets only are used without any pressurised module, the essential support systems for various experiments, including power and communication systems, are protected in a small pressurised and temperature-controlled housing called an igloo.

The pressurised cabin of the Orbiter Shuttle vehicle is connected by a tunnel with the pressurised module of Spacelab. The tunnel is segmented so that its length can be changed as required. An airlock module can be attached to the tunnel to provide an additional access to external space.

Pallet-mounted instruments will normally be powered and controlled from within the pressurised module, but could be controlled from the Orbiter Shuttle vehicle cabin when the flight is a "pallet-only" mode with no pressurised module. The pallet can accommodate a variety of experiments in which manned attendance is unnecessary, but where services such as electrical power, temperature control, etc. are needed.

Several kilowatts, both AC and DC will be available to operate experimental equipment during a Spacelab mission. Continuous voice and data transmission

Atmospheric physics

The first Spacelab flight will be in the relatively low circular orbit of 250 km +/-5 km altitude with an inclination of 57° favourable for experiments in atmospheric physics. It is expected that important new results about the physics of the atmosphere will be obtained during this flight in which various groups from the USA, France and Belgium are involved.

The University of Michigan Group will be responsible for an imaging spectrometric observatory which will simultaneously observe the 20 nm to 1200 nm wavelength region with a resolution varying between 0.3 nm and 0.6 nm over the spectral range. This permits the study of the airglow spectrum by observing radiation emitted by excited atomic and molecular ions and also neutral particles in the atmosphere.

The Jet Propulsion Laboratory of California are working on an ATMOS (Atmospheric Trace Molecules Observed by Spectroscopy) project using interferometry. Groups from France and Belgium are planning a Grille spectrometer for the high resolution passed through the atmosphere at sunrise and sunset.

French and Belgian groups will also study Lyman-Alpha emission by hydrogen and deuterium in the atmosphere.

Plasma Physics

Plasma physics experiments for the first Spacelab flight have been designed by groups in Japan, the USA, France, Norway, Germany and Austria. Although magnetospheric research is one of the earliest fields of space research, Spacelab offers a new dimension for such work, since on-board particle accelerators can be used to investigate the electric fields parallel to the magnetic field lines; gas plumes, optical and electron detectors and, on later Spacelab flights, small satellites can be employed.

Artificial auroras produced by particle accelerators on board will be observed by a low light television system, whilst natural auroras and the small partical contamination around the Orbiter will be observable.

The latter is an important parameter for the success of the astronomical observations from Spacelab. A similar system for the detection of low-energy electrons can detect the natural electron flux and fluxes induced by the particle accelerators.

Sun-earth relations

Various groups of European and US workers are preparing equipment which will provide data about the influence of the sun on our daily weather. For example, Figure 1 shows that there is a very strong correlation between the 22 year sunspot cycle and the July temperature in central England, but much more information is required about the energy input from the sun to the earth.

Two absolute solar radiometers on the first Spacelab mission will measure the total energy flux from the sun over the whole spectrum from the far ultra-violet to the far infra-red. It is hoped to achieve an accuracy of 0.1%, which is why two instruments making the same measurements are to be used on the same flight.

A further instrument will measure each part of the solar spectrum over the range 190 to 4000 nm; three precision monochromators will achieve a relative accuracy of 0.1% and will permit the identification of the particular spectral elements responsible for any changes in the amount of energy reaching the earth.

This work is regarded as the first of three flights spread over a period of about ten years so that long term changes in the solar energy input can be studied.

Astrophysics

The Far Ultraviolet Space Telescope (FAUST) has been designed for the observation of extended and point sources in the 120 nm to 300 nm wavelength range, flown on previous rocket flights. It can be used for objects down to magnitude 18.

Another instrument is the wide field camera which will form images of a large fraction of the sky to assist in the study of large scale phenomena in the Universe. A 60° angle will be used with filters for 130 – 300 nm for stars down to the 11th magnitude. This camera will be used for investigations of the milky way, nebulae, dark clouds and the distribution of galactic and extra-galactic matter.

Another piece of equipment will involve the use of a gas-scintillation-proportional counter for X-ray spectroscopy. This will be the first time this type of detector will be used in orbit.

Materials sciences

Quite a number of materials science experiments will be carried by Spacelab on its first mission; they have been designed to test the capability of the system for producing desired results in conditions of virtually zero gravity rather than to produce materials in commercial quantities.

A tribology experiment will test the characteristics of lubricants for bearings under zero gravity (such as their spreading, wetting and operating characteristics). A geophysical flow experiment will permit laboratory studies of the dynamics of the oceans and atmospheres of rotating planets and stars; a dielectric fluid will be employed between concentric rotating conductive spherical shells with an electric field between them to generate a gravity-like force in the miniature model. This work is impossible in a ground based laboratory.

There will be a total of 37 materials science experiments in the first Spacelab payload. The equipment will include three furnaces and a fluid physics module.

Earth observations

Two instruments to be carried aboard the first Spacelab flight are designed to test its capability of performing earth-surface remote sensing work. The metric camera will be attached to the optical window of Spacelab to produce small-scale high-resolution photographs of the surface of the earth from space and to test the capability of making maps and revising maps from such photographs at scales of 1:50000 or smaller. The camera is similar to that used on aeroplanes.

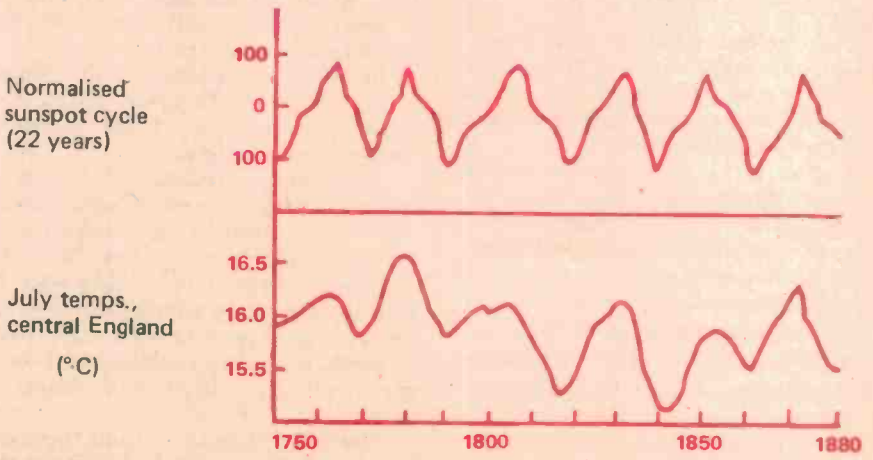


Figure 1. Temperature and sunspot cycle relations

facilities will normally be made available between the experimenters in Spacelab and the ground observers so that the experimenters can obtain expert advice rapidly.

The relationship between Spacelab and the Shuttle has been compared with that between trailers and tractors.

A number of Spacelabs are in various states of preparation for their voyages, but relatively few Shuttle Orbiter vehicles are required, since the turnaround time of the Orbiter vehicles is quite short.

Maximum use can be made of the Shuttle Orbiter vehicles, while the Spacelabs can be outfitted at the user's premises. But in most cases, the individual experiments will be brought to a central location and integrated into one of the Spacelabs.

Flexibility

The Spacelab missions offer flexibility. The Shuttle Orbiter flight parameters can be varied so that the orbit inclination and the orbit altitude meet the requirements of the particular mission concerned. For example, the altitude of the orbit can be varied between 200 km and 900 km.

The Kennedy Space Centre on the East coast USA will be used during the first few years of operation of the Shuttle, providing a possible range of inclinations of 28.5° to 57°.

Later the Vandenberg site on the West coast will become available and this will make orbital inclinations of up to 104° possible.

The orientation of the Orbiter vehicle can be adjusted as can the flight time. For example, the Orbiter may fly inverted to give a view of the earth.

Mission flexibility is also provided by the choice of various module-pallet configurations – such as module only, module plus pallet or pallet only – and variations of the module and pallet lengths.

In general only equipment required for a particular mission is carried so as to reduce the weight. Up to five pallets may be flown on the Orbiter.

The Spacelab can carry greatly increased weight and volume compared with other space transportation systems, and at relatively low cost. The cargo bay of the Shuttle Orbiter vehicle is 4.5 metres in diameter by 18 metres long.

The ability to carry experts in their field with the experimental apparatus so that they can immediately make adjustments will maximise the usefulness of the results obtained. The return of the complete Spacelab equipment to the ground after every mission is also

The microwave facility is rather remarkable in that it measures the long wave energy spectrum of the ocean waves as a function of wave number and direction. The long wave region of the ocean spectrum (taken as the 10 to 500 metre section) contains the largest part of the wind-induced surface wave energy. The global distribution of these waves is closely related to the global wind fields and to the atmospheric pressure distribution at sea level. It is intended that this technique will be used from future satellites to help improve weather forecasting.

This microwave facility, which employs a 2 metre by 1 metre antenna, can also be used as a synthetic aperture radar from orbital altitudes. This technique makes it possible to use the craft's velocity for scanning the spatial electromagnetic field near the craft created by backscattering from the surface of the earth. The data obtained should provide an all-weather day and night time surface mapping of the earth with high spatial resolution by a process which is the microwave analogue of optical holography.

Life Sciences

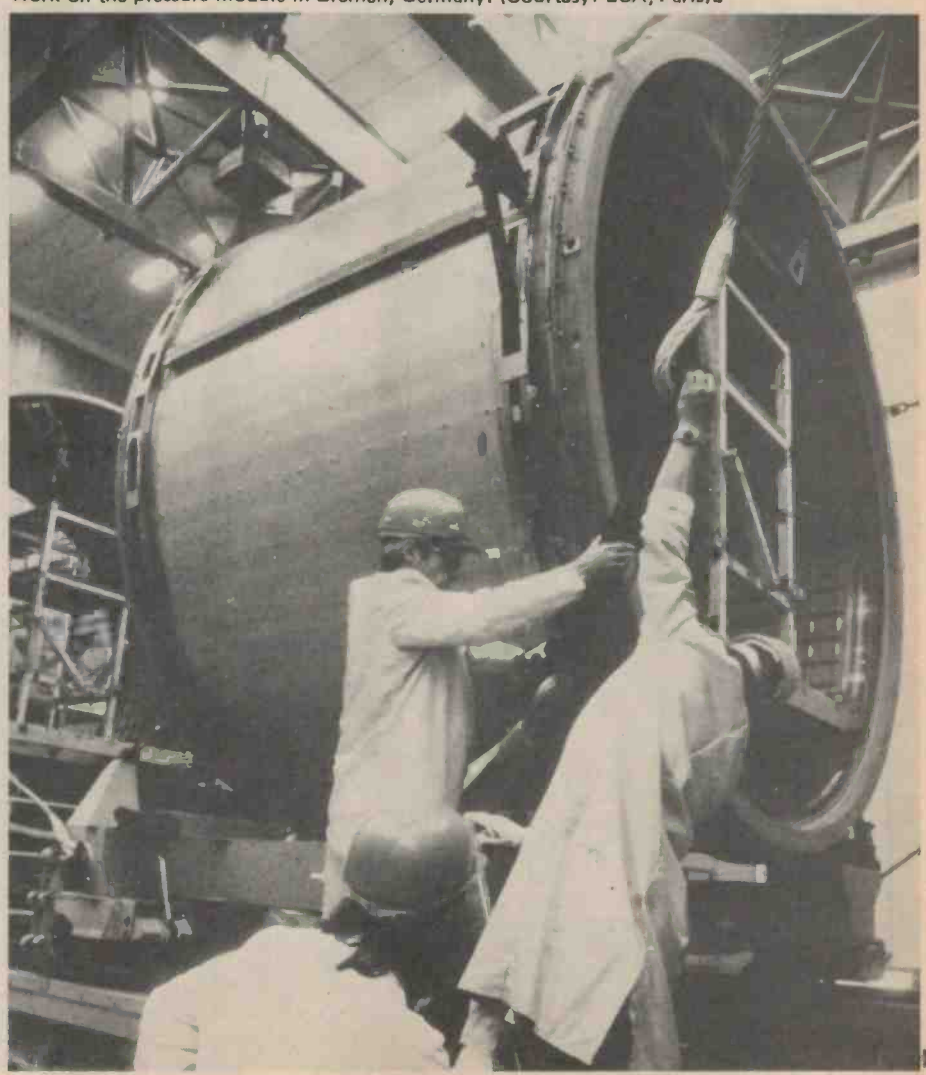
The Spacelab environment enables experiments to be performed on the behaviour of man and other organisms in a gravity-free environment, whilst the effects of high energy cosmic particles from space can also be investigated. In the life sciences field 16 experiments have been accepted for Spacelab's first flight.

Blood samples will be taken from the crew members at regular intervals during the concentrations after the flight. Other work will investigate how the body fluid pressures react to near zero gravity, whilst further experiments will investigate any changes in the numbers of cells in the blood and whether the cells which provide our immune responses are altered.

During their growth plants exhibit helical movements and an experiment with *Helianthus annuus* will test how this is affected by gravity. Other work will look into the effect produced by the absence of the normal daily variation of light and darkness on a fungus which produces patches of extensive growth once every 24 hours; this may shed light on the 'biological clock' mechanism.

Ballistocardiography experiments will record the body accelerations in three dimensions of the crew by attaching accelerometers and the effect on the heart activity and blood movement will be found. The crew members will be equipped with personal miniature tape recorders to monitor their electrocardiograms, electroencephalograms, etc. under gravity free conditions. They will also wear various radiation dosimeters.

Work on the pressure module in Bremen, Germany. (Courtesy: ESA, Paris).



very attractive and economical.

Shared mission costs also keep expenditure down, but there are some types of work for which the Spacelab system is not ideal – such as work requiring more time in space than the Shuttle Orbiter is designed to spend.

Overview

The cost of Spacelab is about US$500 million, provided by ten European countries – Italy, France, West Germany, the United Kingdom, Belgium, Spain, The Netherlands, Denmark, Switzerland and Austria.

NASA provides the launching facilities. The importance of Spacelab can be seen from the following figures of its frequency of Shuttle launchings.

During the first 12 years of Shuttle operation about 1000 payloads are scheduled on 487 flights up to 1992. Spacelab will be carried on 201 or 41% of these flights, the number of Spacelab payloads being 464.

The other 54% of the Shuttle launches will be used for free flying satellites (46% of launches will be for communications satellites, deep space-craft for inter-planetary missions, high altitude explorer craft, research satellites, etc.).

Other Shuttle launches will convey the Space Telescope and various Landsat, Seasat, earth resources, meteorological and astronomical satellites.

The Spacelab missions provide the first opportunity for a European to orbit in space. There will be only one non-American on the first Spacelab flight, which will be the Shuttle's seventh mission.

The European Space Agency put forward 54 candidates (including one woman) who had been pre-selected to travel on the first Spacelab mission. In May 1978 the Agency selected three of these candidates from whom the one European to travel on the first Spacelab mission will be chosen. The three are:

Mr Ulf Merbold, a 37-year old German physicist who has worked as a solid state physicist on crystal lattice defects and low temperature physics.

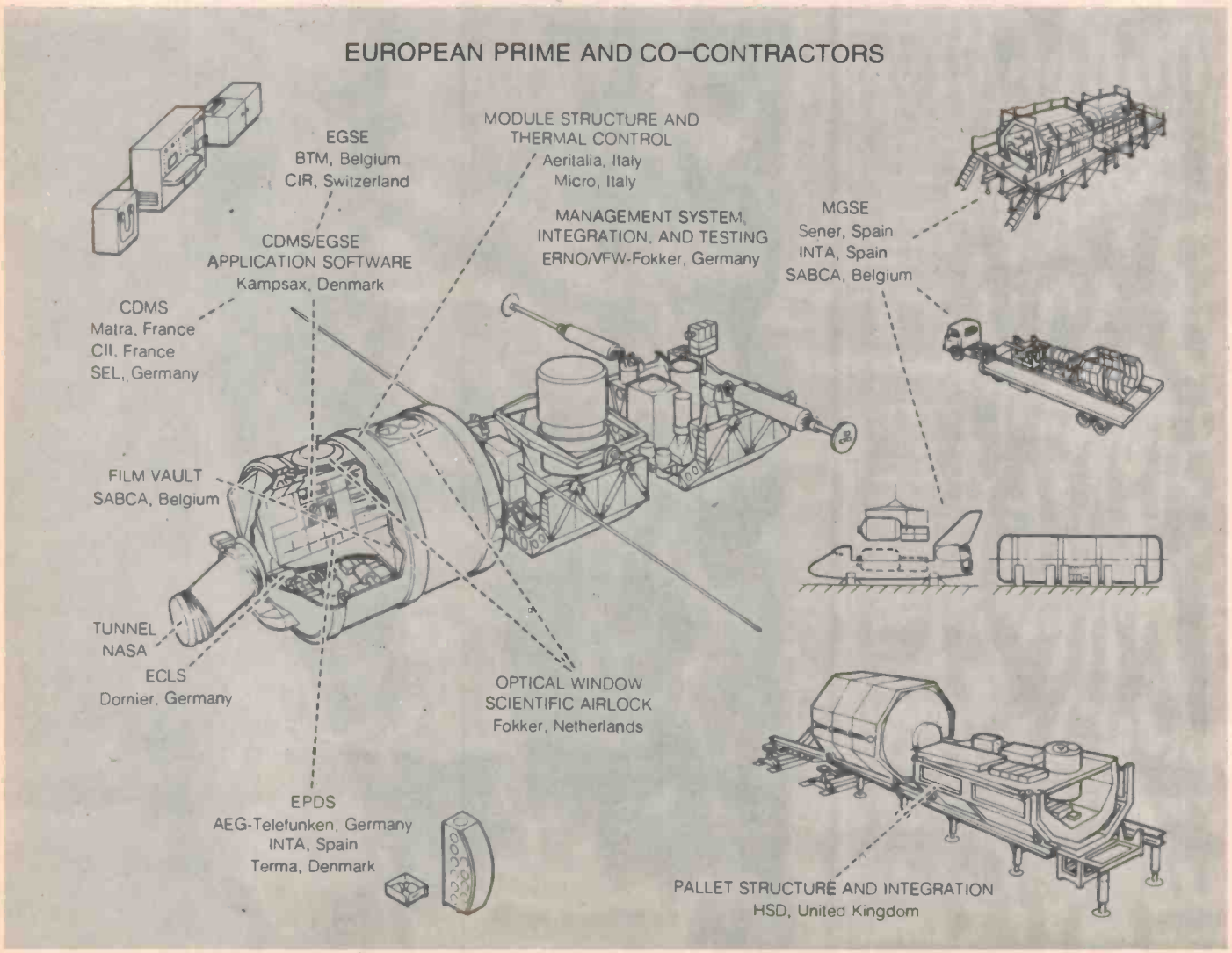
Mr Claude Nicollier, a 34-year-old Swiss astronomer who has worked on the photometric classification of the supergiant stars and who is a qualified professional pilot. He is a part time pilot in the Swiss Air Force.

Wubbo Ockels, a 32-year-old Dutch physicist who has been involved with prompt gamma ray decay and position sensitive detectors, apart from developing a data handling system.

These three were chosen from a maximum of five candidates put forward by each country.

The maximum age was 47, a degree was required in natural sciences or engineering with at least five years' experience, and fluency in written and spoken English.

The candidates had to undergo psychological tests to ensure they will be able to cope with the considerable stress of the Spacelab workload and environment. Very good memory and reasoning ability, good concentration, low aggressiveness and high motivation



were among the requirements.

NASA has selected Mr. Michael L. Lampton, a 37-year-old-physicist and Mr. Byron R. Lichtenberg, a 30-year-old scientist for the first Spacelab flight. One of these two Americans will accompany the selected European.

The experimenters aboard Spacelab are called the payload specialists. These people are nominated for the flight by the particular organisation which is sponsoring the payload concerned. They are accepted, trained and certified for a flight by NASA.

They co-ordinate their activities in space with experimenters on the ground and with the crew of the Space Shuttle Orbiter.

The Orbiter crew includes its commander, the pilot, and the mission specialist who is responsible for the management of the Shuttle resources and equipment which supports Spacelab.

Experimenters aboard the earlier Skylab craft found it uncomfortably large. The crew found themselves floating out of reach of all of the grip bars, whilst time was lost in moving considerable distances and they became tired very quickly.

One cannot use one's lower limbs for walking in conditions of near zero gravity. It was therefore decided that the ideal space station is one composed of compartments, each not much bigger than a man.

In such a compartment a man can stand erect, but can always touch somthing. This principle has been used in the design of the Spacelab pressure module (which is much smaller than that of the Shuttle Orbiter payload bay), but the bay can be filled with pallets.

The Shuttle Orbiter also contains a two-deck living unit with the control station on the top deck and the quarters for both the Shuttle crew and the Spacelab specialists on the lower deck.

The specialists will work in the pressure module in shifts during missions when this module is carried and will return to the Shuttle living quarters to eat, sleep and relax.

Salyut I carried 1000 kg of instruments, Salyut 4 more than 2000 kg, but Spacelab will initially carry about 5790 kg, increasing to 9350 kg on later flights in which three pallets are used.

Principal uses

The early manned orbiting vehicles involved experimental programs mainly biological in nature. Aboard Spacelab a much wider variety of experiments will be undertaken.

Spacelab offers an environment where gravity is extremely small (about one millionth of that on the earth), although strictly speaking the gravitational field is only zero at the centre of gravity of the whole Orbiter (including Spacelab) when there is no retardation by the atmosphere.

Such a micro-gravity environment should offer entirely new possibilities for separating biological materials to obtain pure preparations of cells for transplantations, for preparing concentrated antibodies for the treatment of certain diseases and for purifying vaccines, etc.

Ultra-pure metals, semiconductors and glasses can be processed free of contact from any container for research applications in electronics. Perfect crystals for computers, communications and other electronics uses may be processed in Spacelab as well as new materials of improved strength at high temperatures.

Spacelab will be flown above the atmosphere, so it will provide for experimental work in the fields of astrophysics, ultra-violet, optical, infra-red and X-ray stellar, planetary and solar astronomy.

Atmospheric ionospheric (plasmas) and magnetospheric physics can also be investigated by flying Spacelab at an appropriate height. Remote earth sensing for meteorology, land-use planning, resources, pollution control and other purposes can be carried out with more flexibility than is available from existing satellites dedicated to one of these purposes.

Biological experiments will be some of the most important work aboard Spacelab. There is still much to be learned about the growth and behaviour of cells in conditions of zero gravity – apart from the effect of such an environment on such a complex creature as a man.

It is intended to use Spacelab to study sea sickness phenomena for which purpose a special "sled" has been designed. A man will be rocked in a seat with various amplitudes at frequencies of between 0.01 Hz and 1 Hz; this movement can also be combined with a rotary movement.

The first mission

The total number of scientific and technological investigations chosen by NASA and the European Space Agency (ESA) for the first Spacelab mission scheduled for 1981 is 76; of these experiments, 60 are European, 15 American and one Japanese.

This first mission has been jointly planned by NASA and ESA, the available Spacelab weight for equipment, power and crew time being shared between these two organisations. The ESA will provide some of the basic experimental equipment such as a microwave sensor, a metric camera and a vestibular sled.

About 130 investigators from Europe, 80 from the USA and a few from Canada, India and Japan will be involved in the 76 experiments.

The primary objective of the first Spacelab flight will be to verify the performance of the various systems and subsystems. The second objective will be to obtain useful data and to confirm the broad capability of Spacelab for a wide variety of space research.

The first flight will last 165 hours (about seven days), but the time for experimental work will be 140 hours.

No access to the payload will be available during the final nine days before the launch nor during the first 30 hours after landing.

As the Shuttle verification equipment on the first flight will be much more extensive than on succeeding Shuttle flights, the total payload carrying capacity will be reduced to about 4000 kg and the total energy available to about 100 kW-hr. A total of 100 man-hours will be available from the two payload specialists.

The experiments to be performed by the first Spacelab mission have been deliberately chosen from a wide range of disciplines including atmospheric physics, plasma physics, sun-earth relations, astrophysics, material sciences and technology, life sciences and earth observations.

Conclusion

It is often said by people who know little about the subject that they feel it disgraceful huge sums of money should be spent on space research when man cannot cure many forms of human disease. It seems likely that the availability of the Space Shuttle together with Spacelab will bring an enormous number of advantages to the human race, both to people who are ill and to those in good health, but progress in this expensive field of technology is inevitably limited in pace.

However, if one thinks back a few years, one can appreciate how rapidly the developments in space work have actually occurred. Man has been on the earth for a very long time yet it is only in the last twenty-two years that he has been able to leave his world temporarily and return safely to it.

It is interesting to note that the first element of Spacelab hardware has already been delivered to the USA. One of the pallets (fabricated by British Aerospace at Stevenage) was delivered to the Kennedy Space Centre in 1978 so that NASA can use it for Orbital tests of the Space Shuttle in 1980 as part of a pre-operational Orbiter payload. ●

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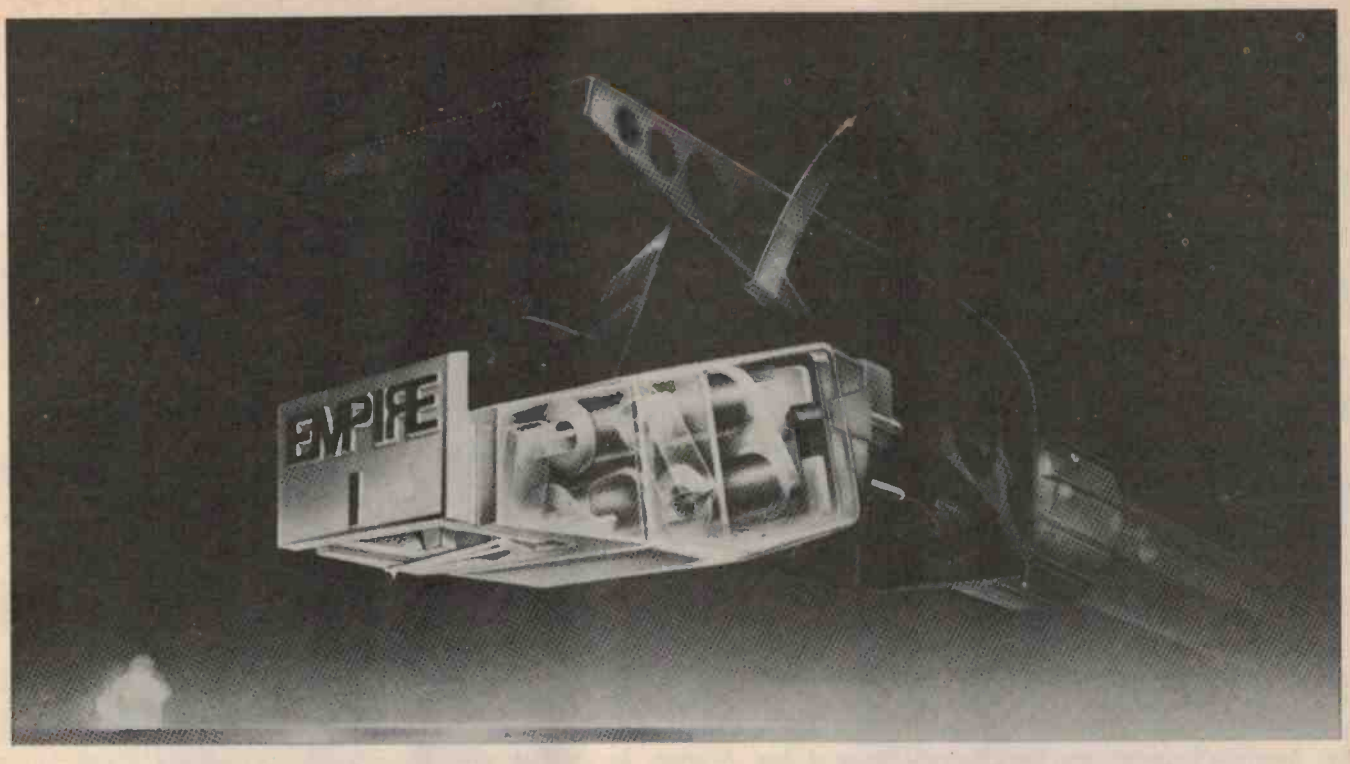

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Electronics rides high on the boating boom

Les Bell

Over the last five years there has been a considerable increase in the sale of pleasure boating craft including everything from rubber dinghys to opulent power pleasure cruisers. Parallel with this development has been an increase in the number of electronic instruments for a wide variety of maritime purposes. Here is an up-to-date report.

ANYBODY WHO TAKES a look at Sydney Harbour on a summer weekend would have to agree that boating must be Australia's most popular leisure activity. The Harbour is so crowded that the onlooker can hardly see the water between the boats!

For thousands of years, men managed to sail boats over quite long distances without electronics or indeed, instruments of any but the most rudimentary kind. Fortunately, in the Middle East astronomy was developed to an advanced stage in early times and celestial navigation was developed from this.

For dead reckoning on coastal passages, the earliest 'instrument' was probably the log, and yes, it actually was a log. A rope, knotted at even intervals, was attached to the log which was then dropped over the stern of the boat. The rope was payed out for a known length of time while the knots were counted. This method is not very accurate, particularly due to inaccuracies in timekeeping.

The situation was remedied in the 17th century when the British Admiralty offered a prize of ten thousand pounds for the development of an accurate chronometer. In 1762 the winning design, by English horologist John Harrison, kept an accuracy of better than two minutes on a six week voyage – a phenomenal achievement for the time.

Instrument technology has progressed somewhat since then, particularly since the introduction of electronics. Today boats of all kinds, both work and pleasure craft, carry a wide range of electronic equipment and instrumentation.

Electronics can take a lot of the hard work out of boating – calculators and computers, for example, can take a lot of the tedium out of navigation calculations, while satellite navigation systems make it an absolute snap. More important is the contribution of electronics to safety – radio is almost mandatory on any boat for this reason. Instruments which used to be mechanical, such as knotmeters and logs, have now been replaced by electronic equivalents offering improved performance and added features.

Latitude, longitude and time can be obtained from this satellite navigation system receiver, enabling a navigator to fix his boat's position within a few metres.

Radio communications

Probably the most important facility provided by electronics at sea is that of radio communication, both for safety and convenience. For the pleasure boat owner, there are three different types of radio communication system, each of which has its particular advantages and disadvantages (is nothing simple these days?).

Briefly, the three systems and their important parameters are as follows:–

27 MHz: cheap, medium quality, short range, undependable for safety;

VHF marine: medium cost, medium range, high quality with constant watch on distress frequency;

HF marine: expensive, variable quality, long range capability with constant watch on distress frequencies.

The correct system should be chosen bearing in mind your boating activities. A speed boat which never ventures outside the harbour would obviously require a totally different radio from an ocean-going yacht or fishing boat.

The primary consideration in all cases, however, should be safety rather than convenience. Radio has saved so many lives at sea that its value is inestimable – and this should be borne in mind when considering an installation on any boat.

Apart from safety, a radio has many uses on board a boat. Members of fishing clubs, for example, can keep each other posted on their activities using a 27 MHz 'chatter channel', while ocean racers, in the Sydney-Hobart for example, report their positions every few hours by HF radio.

At present, marine radio is undergoing rapid change with many boat owners contemplating the installation of new equipment.

The 27 MHz service uses sets similar to CB rigs but on different frequencies. Power input is limited to five watts on AM, and although transmission is over water, distances for reliable communication are still only of the order of 15 to 30 km. Being an HF band the service is subject to interference through long distance "skip", so it cannot be relied upon for important communications.

Unfortunately the 27 MHz channels are not officially monitored by any professional full-time agency in the way that the HF and VHF services are supported by OTC. All monitoring of the safety channel (27.880 MHz) is by volunteer organisations such as the Volunteer Coastguard, who cannot provide round-the-clock service. It would be very unwise to depend upon this service for safety on a winter weekday – there may be no-one listening.

The major advantage of the 27 MHz service is the low cost. A complete installation, including the fibreglass whip antenna, (just like a CB mobile whip), will cost around $100 to $250. Hand-held units (walkie-talkies) are even cheaper, and have many uses, including the ability to be transferred to a dinghy (or a life raft – if ever things get that bad!), or taken onto the beach (while barbecuing?) to get weather updates, etc.

The AWA Pilotphone 6 is a 24 channel, 25 watt VHF/FM transceiver which will operate on the Seaphone channels.

Because of its low cost, it would be unwise *not* to have a 27 MHz radio on board any boat that is bigger than a dinghy. For weekend use or fishing in the harbour, it provides safety and convenience without breaking the bank.

Where offshore trips of any length are contemplated, or where added facilities are required, then the more expensive VHF/FM or HF/SSB services should be considered.

VHF FM radio

This type of radio provides clear, interference-free communications over relatively short distances, generally in-shore and short-range ship-to-shore and to coordinate traffic in major ports. Some countries have recently extended this service to small commercial and pleasure craft. It's a sort of sea-going equivalent to the 'land mobile' service used by taxis, couriers, etc.

VHF has several advantages over the cheaper 27 MHz system and HF single sideband equipment. Firstly, for the ranges required for general in-shore and coastal communications, it is inefficient to use a transmission medium that covers both long and short distances.

On HF, interference from man-made and atmospheric noise interrupts communications – sometimes quite severely. FM receivers are not affected by this sort of interference, except on very weak signals, and clarity of reception is

Services and Frequencies on marine radio

SERVICE	VHF/FM	HF/SSB	27 MHZ
International Safety/Distress & Calling	chan. 16	2182 kHz (AM)	–
Supplementary Distress/Safety and Calling	–	4125 kHz	–
Supplementary Safety/Distress and Calling	–	6215.5 kHz	–
Weather/Working and Telegrammes	chan. 67	2201 kHz 4134.3/4428.7 MHz	–
Pleasure craft ship-ship-shore safety info and search and rescue	chan. 67	2524 kHz	27.880 MHz
Club freq.	chan. 73	1725 kHz 2032 kHz	27.890 MHz 27.900 MHz 27.910 MHz
Pleasure craft ship-ship only	chan. 70	2284 kHz	–
Radiotelephone 'Radphone' to OTC coast stations	–	2760 kHz 2056 kHz	–
Seaphone	chan. 26/23	–	–
Sth. Pacific cruising – guarded by VIH Hobart during hours of operation	–	4143.6 kHz	–

Although Emergency Position Indicating Radio Beacons (EPIRBs) have been commonly available overseas for some years, lack of appropriate standards, plus tough type-approval specs have delayed their introduction here. The model illustrated incorporates a two-way radio and is (regrettably) not licensable in Australia.

consistently very high. Secondly, interference from unwanted signals from faraway stations ('skipping' via the ionosphere) does not occur. A 'capture effect' results in only the strongest station received being heard. Consequently, two close stations may converse satisfactorily despite other operational stations nearby.

Many VHF transceivers are switchable to low power when operating over short distances to avoid unnecessary interference to other users.

Recent expansion of the VHF service in Australia to match international standards allows for five classes of service: port operations, commercial (oil refineries, tugs, etc.), professional fishing, non-commercial, and public correspondence. The last two classifications apply to pleasure craft, and allow ship-shore, ship-ship and telephone (Seaphone) calls.

The VHF channels are between 156 MHz-162 MHz, and are a mixture of simplex and duplex channels – on some channels, the station transmits and receives on the same frequency, while on others the frequencies are different. Full duplex working is used and has the advantage that both stations can transmit and receive simultaneously, allowing a natural conversation to take place (important for calls made by people not acquainted with radio procedures).

Unlike the 27 MHz band, the VHF service is monitored round the clock by a professional safety service – in this case, the Overseas Telecommunications Commission. In the Sydney area, for example, channel 16 is monitored by operators at Sydney Radio (VIS) at La Perouse.

The range of communication on VHF is extremely dependent on transmitter power and antenna heights. Ship to ship communication is generally possible up to 20 nautical miles, while Sydney Radio can communicate reliably over 60 nautical miles and sometimes further. Basically, VHF is limited to 'line of sight', and some areas, notably around the Hawkesbury, are in radio 'shadow'.

The service will be expanded in 1980 with the addition of transmitters near Wollongong and Newcastle, which will provide coverage to Tuncurry in the north and south of Batemans Bay in the south. At the same time, the west coast of Australia will be brought into the fold, with installations in Perth, Dampier and Port Hedland. All these locations will monitor the distress channel (channel 16). It is expected that the service will eventually be expanded to cover the entire east and south coasts from Cairns round to Adelaide, providing Australia with one of the most advanced VHF radiotelephone services in the world.

A typical VHF/FM installation costs between $450 and $1350 including the antenna. Perhaps the major advantage of the VHF service is high speech quality, coupled with ease of use, which makes possible communication between a VHF station at sea, and any telephone in Australia or overseas, through the OTC Seaphone service.

HF radio

HF is usable over long distances, providing fairly reliable, if somewhat unpredictable, communications. HF radios are usually larger than other kinds, require more power, and are more difficult to install. They're more complex to use too.

Three major HF bands are usable by pleasure craft around Australia – 2 MHz, 4 MHz and 6 MHz. Each has different propagation characteristics dependent on the time of day, time of year and position in the sunspot cycle. Operation depends on the ability to pick the right band for communication over the appropriate distance.

At present all communications above 4 MHz must be on SSB, and by 1982 all double sideband (AM) equipment will be obsolete, except for 2182 kHz, the international distress frequency. SSB offers clear advantages over AM.

The major objection that most people have to HF radio is cost and complexity of installation. For a start, an HF radio consumes more power than other kinds, and may require an extra battery or heavier alternator.

HF is particularly susceptible to interference from ignition and other sources (such as fluorescent lights) as the receiver will have to cope with much lower level signals than with 27 MHz and VHF radio. Hence all on-board electrical equipment must be adequately suppressed.

Another problem is that an HF radio antenna requires an earth, as most are loaded whips which require a ground plane. This can be a major problem, particularly on metal hulled craft, as any junction of dissimilar metals which is exposed to salt water forms a voltaic cell and the resultant current degrades the metal, causing rust.

For a wooden or fibreglass boat, the best earth is a large (at least $\frac{1}{4}m^2$) metal plate beneath the hull. A modern alternative is the Dynaplate, a 50 x 125 x 12 mm (approx) block of metal beads which, because it is porous, has an effective surface area of over $1\frac{1}{4}$ m^2.

Antennas for HF, (on smaller craft at least) are usually 3½-5m fibreglass whips, although in yachts the rigging wire from the stern to the top of the mast will make a much better radiator. The total length of the backstay antenna and its lead-in should be less than 17m for best results on the Australian bands i.e. up to 6 MHz.

Total cost of an installation can be $1000 to $7000, depending on power output and facilities and performance offered.

The major importance of HF radio is in its contribution to the safety of life at sea. To this end, Australian coastal radio stations maintain 24 hour watch on the international distress frequency of 2182 kHz, as well as 4125 kHz and 6215.5 kHz. Other frequencies are reserved for ship to ship working, traffic between OTC stations and ships, and other purposes.

Reliability of communications is dependent on propagation conditions and the choice of frequency. On the 2 MHz band, daytime communications are limited to 160 km or so, but at night greater ranges can be expected. This band suffers least from interference from distant stations, but in tropical areas a high static level can be a problem. The 4 MHz band is more versatile, giving distances up to 500 km in the day and considerable further at night. Best communication over long distances is on 6 MHz, but this band is prone to interference from foreign stations. Choice of correct band therefore depends upon the distance from the station to be contacted, as well as the time of day and, ot a limited extent, propagation conditions in general.

Operation on HF is a bit more tricky than on the other bands, and so the licensee is required to pass a test in order to obtain the restricted operators' certificate of proficiency. This test is not difficult — the candidate has to have a knowledge of operating procedures and equipment controls, an ability to repair minor faults and a general knowledge of the appropriate rules and regulations.

Seaphone

Seaphone is a high quality VHF duplex link using channels 23, 26 and 27 to provide a ship-shore telephone link. It now operates in Sydney and Melbourne following a two-year pilot scheme.

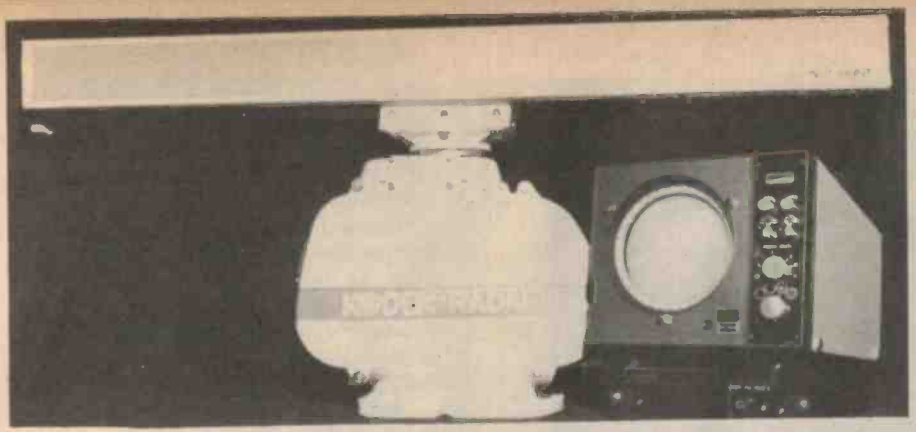
The system is accessed by dialling a prefix and requesting the Seaphone service. If the required vessel is within range and on channel the connection will be made within minutes. (See "Communications" news, p. 86)

Seaphone channel 67 is held for 'less than full distress' messages which are nevertheless still urgent. OTC Coast Radio stations also use channel 67 to broadcast weather and navigation hazard reports at set times throughout each day.

The LX40 speed/distance indicator has a large, easy to read LCD display and has been designed to mount on the dashboard of a power craft.

The Seafix hand-held RDF incorporates a compass to give true bearings to 1° but only covers 'long wave' for shipping weather forecasts and the beacon band.

The Seafarer 3 is fairly typical of the 'rotating LED' type of echo sounder, offering depth measurements to 100 fathoms (180m).



A typical radar installation consists of a scanner unit, which houses the transmitter, and a display unit, which contains the CRT with its associated electronics and controls. This Koden unit has an output of 6 kW and a range of up to 32 nautical miles.

Radar

One of the greatest contributions to the safety of larger vessels manoeuvering in busy shipping lanes has been made by radar and a modern solid state technique has made it feasible to install radar in smaller vessels such as pleasure craft.

Typical modern radars have ranges from 16 to 100 nautical miles, basically dependent on the power output. They are transistorised throughout, except for the magnetron and display tube. A 10 kW peak output power unit, for example, would have a range of up to 64 miles, with a power consumption of 160 W on a 24 V supply. Most operate in the X band around 9400 MHz, and have interference rejection circuitry to reduce the effect of other ships' radars on the display.

The use of semiconductors, particularly integrated circuits, to reduce the size and power consumption of radar sets has also made possible the inclusion of sophisticated and conventional features, such as digital indication of range, and automatic collision warning alarms. Most sets consist of two units, a console which contains the display circuitry and controls, and a transceiver/scanner unit which contains the RF electronics as well as the rotating antenna. Often the sets have two or more scanners, the larger antennas having reduced beam-width with consequent improvement in definition and range.

A radar-related item which boat owners should consider, especially if they take their craft into or near busy shipping lanes (particularly in conditions of poor visibility) is a masthead mounted radar reflector. This will enable radar-equipped large vessels to spot small craft in heavy weather, eliminating the danger of collision.

Echo sounders

Echo sounders work by transmitting an impulse and measuring how long it takes for echoes to return. Unlike radar, which transmits radio frequencies, echo sounders operate by transmitting ultrasonic energy. All echo sounders operate on similar principles, varying only in type of display, operating frequency and output power.

The basic type operates on a frequency of around 30 kHz, and indicates depth of water below the keel. The display usually consists of a LED or neon tube which is spun around the circumference of a calibrated scale at constant speed. At the time that the acoustic pulse is sent, the LED is flashed, and this should appear at the zero mark on the dial. The return echo also flashes the LED, but by this time it has moved around the dial an angle proportional to the time since the transmit pulse.

Reflections from shoals of fish also appear on the display, making the echo sounder a useful device for fishermen. Most fish finders, as they are known, are fitted with a pen recorder to indicate echoes so that a good spot can be returned to. The chart-type fish finders provide considerably more information than rotating neon or LED types, and use special circuitry to show the nature of the bottom.

Autopilots

Several different types of autopilot are available, the major distinction being between those intended for power craft and those for sailboats.

A powerboat can be set in a particular direction and will keep going that way, more or less regardless of changes in the wind or tide, taking its heading from a compass. A sailing boat, however is much more dependent on the direction of the wind. Were an autopilot to attempt to keep a boat on the same heading regardless of wind change the sails would be wrongly set, and the boat could well drop speed or be put in an uncomfortable or dangerous situation. Hence most autopilots for sailboats, attempt to keep the boat on the same heading relative to the wind, (although some units offer a choice of compass or wind vane to generate the control signal).

Basically, an autopilot is a straightforward servomechanism: the actual heading is compared with the desired course – the error signal being used to drive a servomotor, applying correction to the rudder.

The effects of swell and waves will however cause the rudder to move, and the servomechanism will hunt, perpetually trying to correct an error that is not particularly significant. To avoid this, most autopilots have a sea-state control, which introduces a low-pass filter into the signal path, thus eliminating the hunting action. Some models have switchable settings, to compensate for different sea conditions.

The Coursemaster 100, manufactured by Coursemaster Autopilots in Sydney, for example, is designed for power vessels and offers a wide range of features. Using a compass for heading information, the Coursemaster 100 has a 'dead band' of 4° around the desired course, as well as a five position 'sea-state' control. On boats which have a large turning inertia, the Coursemaster can even apply counter rudder to eliminate overswing.

Although some autopilots require a course to be steered and the autopilot to be switched on to hold that course, the Coursemaster is slightly unusual, the autopilot can automatically bring the boat onto a preset correct course.

Satellite navigation

A very accurate electronic/satellite are available, the major distinction system, which uses the US Navy's Transit satellites. Six of these satellites, in polar orbits, circle the globe 960 km up at a speed of 7½ km/s. As each satellite orbits the earth in about 96 minutes, it comes into view at every point on the earth's surface at least four times in every 24 hours. The satellites can provide positional information 19 or 20 times each 24 hours. The passes are not evenly spaced however but the worst delays under normal circumstances are 2½ to 3 hours.

Every two minutes as it orbits, each satellite transmits a time signal with an accuracy of better than 33 μs. Because the orbital parameters of the satellite are already known, a hyperbolic line of position for the observer can be obtained using doppler techniques. To ensure accuracy, the satellites constantly transmit details of their exact orbital parameters on 150 and 400 MHz. This information is updated every sixteen hours, based on observations made by four dedicated tracking stations in the USA. Using the most sophisticated dual-frequency receivers, a positional accuracy of a few metres can be achieved anywhere in the world.

Using a single-frequency receiver the

The Coursemaster 100 autopilot, which offers controls for all sea conditions.

accuracy reduces to about ±400 m; still more than adequate for most commercial applications. Cost of such an installation is about $14 000.

Current satellite navigation receivers often incorporate extra features such as predicting the next satellite pass, the ability to perform dead reckoning navigation between passes, and the ability to ring an alarm when the destination is approached. Various options are available, such as printers and interfaces to logs and gyro inputs. One model, the Furuno FSN-20B, will even automatically apply corrections to its matching Omega receiver!

Knotmeters and logs

The most common transducer for speed measurement is a small impellor monitoring water flow. As it rotates it pulses a reed relay or similar switch to provide a signal suitable for subsequent analogue or digital processing and display.

These devices are accurate to about 2% if correctly installed and calibrated, but may become clogged by seaweed and other flotsam.

To get around the problem of keeping the hull shape clean, with no protrusions, there are a couple of electronic systems with no moving parts.

The first transmits ultrasonic pulses through the hull into the water and listens for reflections from bubbles or other particles moving past the hull. The frequency of the returned signal will differ slightly from that transmitted due to Doppler shift – and this will be proportional to the velocity of the water flow, the instrument thus displays the difference frequency, normalised to units of speed. Further circuitry compensate for variations in the speed of sound in water at different temperatures and salinities.

A second, more common system, exploits Fleming's left hand rule for generators. A hull-mounted electromagnet creates a magnetic field at right angles to the motion of the boat, with the lines of flux passing vertically through the hull. Since seawater is conductive, a voltage is induced in the water, proportional to the velocity at which the water cuts through the field. Two small studs, protruding through the hull, pick up this voltage, and there you have it; a beautifully simple, accurate and elegant knotmeter with no moving parts which indicates speeds from 50 knots plus!

Typical of this type of log is the Seafarer Log, marketed by AWA. This unit has a low profile retractable transducer, and has three switchable speed ranges (8, 16 and 32 knots). It is energised by an internal nine volt battery, or ship's supply of 10.8 to 40 volts. The log includes a counter which records in hundredths of nautical miles.

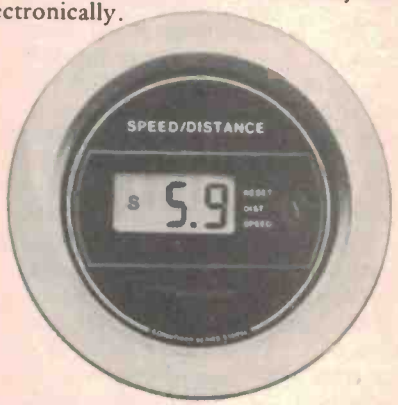
As well as the traditional analogue meter these instruments can have digital liquid crystal displays (LCD). The Corinthian S100L distance recording log and the S100K knotmeter, for example, are a matched pair of units operating from one impeller. The units mount flush in a bulkhead through a 100 mm aperture. The S100K records to tenth-knot accuracy between 0.1 and 15 knots. For powerboats, the LX40 combines a 35 knot speedometer with a 19.9 mile trip log in one bracket or console-located instrument.

Probably the most important sailing instrument is the log, often combined with a knotmeter. The log is needed for dead reckoning navigation, and the knotmeter gives an indication of the efficiency of the sails setting – more effectively than can be done by eye.

For sail craft, special expanded-scale knotmeters can resolve changes of as little as 0.01 of a knot. To reduce spurious readings, averaging techniques provide a continuous indication of performances – very important when tuning racing yachts.

Wind direction may also be measured. Perhaps the best way is via a pair of selsyns, one at the top of the mast, the other, in the indicator, at the bottom. These will provide round-the-compass indication of wind direction in convenient analogue form.

Wind speed is still commonly measured by a rotating anemometer. Early devices consisted of a rotating cup coupled to a dc generator, the output voltage of which was proportional to the angular velocity. A simpler method using large scale integrated circuits is simply to generate pulses and count them for digital display. This technique is more reliable both mechanically and electronically.



This Datamarine depth/speed indicator features an LCD display and is housed in a weatherproof case.

The major problem with both wind speed and direction indicators is mechanical reliability in the mast-head unit. There can be few more hostile environments in which an electro-mechanical device has to work reliably and repeatably, with only infrequent maintenance due to its inaccessability.

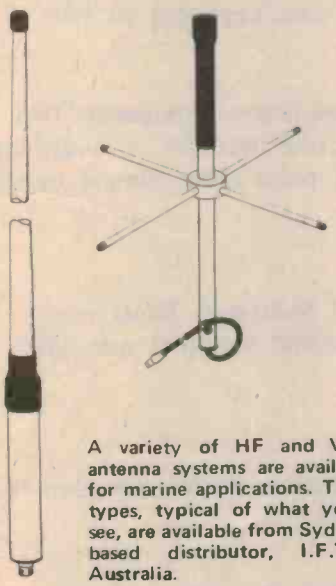
An anemometer with no moving parts is made by Telcor. The unit operates by measuring the cooling effect of the wind passing over a heated element. This element is held at a fixed temperature above ambient. Wind passing over the sensor has a cooling effect directly related to wind velocity. Owing to this cooling effect more current is required to maintain the sensor at its constant temperature as the wind velocity rises, and by monitoring the current, wind velocity can be displayed.

This type of anemometer has no stiction or friction. It can follow even minor changes in wind velocity and will provide reliable indication at very low wind speeds. Its sensing element is small and light and its principle of operation lends itself to a form of readout that can be readily expanded at the lower end so as to allow quick recognition of the smallest change at the masthead. Lighthouses and lightvessels have radio beacons which extend their usable range far beyond the horizon. Areas of 'civilization' invariably have broadcasting stations, many of which transmit from known fixed locations 24 hours a day. Transmitters such as these may be used for quick and accurate direction finding.

Radio direction finding (RDF) equipment enables the user to take a bearing on a fixed station relative to his boat — and the resultant bearing will usually be accurate to within at least 2°.

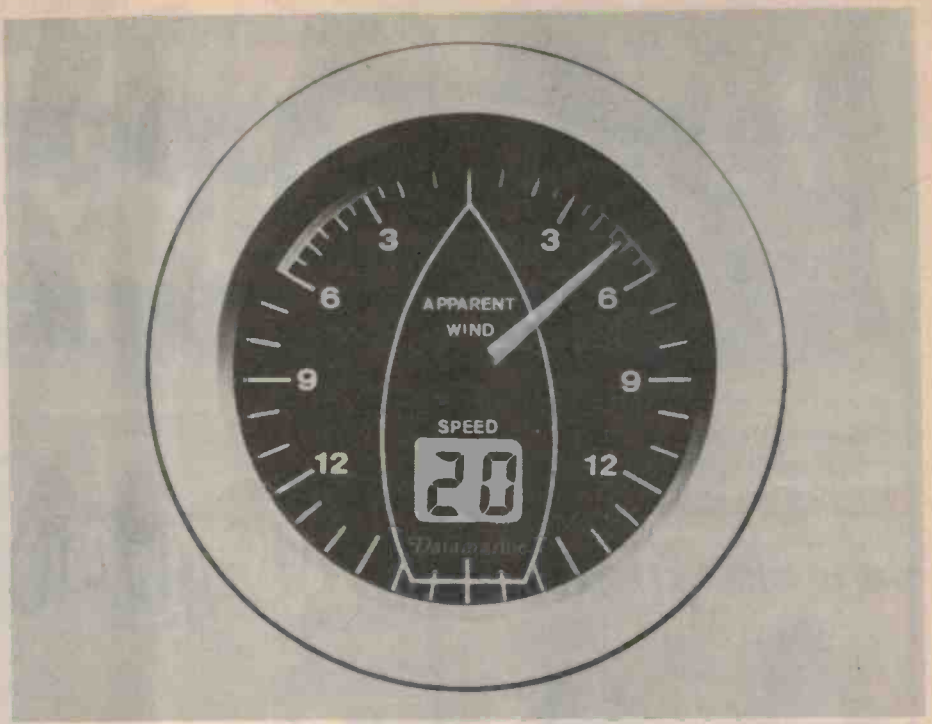
The simplest types of RDF receivers are operated by manually turning a loop or ferrite antenna until the required beacon is heard at minimum signal strength. Beacon direction is then read off a calibrated scale. A separate sensing antenna must be used to tell whether the beacon is in front of you or behind you. This sensing antenna is often incorporated in the receiver — as in the Fujion F-2000A RDF shown.

Some hand-held RDFs, such as the Seafix, have a built-in compass. Using a unit such as this, it is possible quickly to obtain a fix plotting two or more bearings.



A variety of HF and VHF antenna systems are available for marine applications. These types, typical of what you'll see, are available from Sydney-based distributor, I.F.T.A. Australia.

Fully automatic direction finders, such as the JMC 2206D, are now available, many offering digital display of frequency and electromechanical or digital display of bearing. These units generally have full-size external loop antennas.



The Datamarine 'Corinthian' model LX360 'Wind Machine' sensibly uses digital readout for the wind speed display but analogue dial type indication of wind direction through 360°.

Many small RDFs will double as broadcast receivers, and are useful for obtaining weather forecasts, etc. The Fujion F-2000A, for example, covers AM and FM broadcast bands, LW, marine band and the VHF marine band. It will run either on internal cells or on an external 12 V dc supply.

Omega

The only hyperbolic navigation system to provide good coverage of the Australasian area is Omega, which is a global system designed and operated by the US Navy. It is a VLF (10-14 kHz) system, and because of this, is primarily intended for use by submarines, as only VLF radio waves can penetrate seawater to any depth.

A basic Omega installation costs between $4000 and $7000, and in good conditions can give a fix to within 2000 metres. However, in unfavourable conditions, errors as large as 8-10 km may occur. To correct this, there is a version of Omega called differential (or micro-) Omega, which uses a fixed Omega monitoring station in the area of operation transmitting local corrections which can be applied by users to the basic Omega hyperbolic information. This brings the accuracy of Omega to a par with the short range hyperbolic systems such as Decca.

Miscellaneous gear

For celestial navigation a lot of the tedium and possibility of errors has been taken out of sight reductions by the use of pre-programmed special-purpose calculators. A well known example is the Tamiya NC-77. This can handle a wide range of navigation calculations to solve latitude and longitude from sextant sights of celestial bodies. In addition, it can calculate a fix by dead reckoning, and perform numerous other calculations.

The major benefit of these calculators is to the offshore navigator who often has to perform complex calculations when tired, wet, hungry or generally finding difficulty in concentrating. Under these circumstances, it is easy to make mistakes, but if a calculator can do all the legwork, it becomes feasible to take more sights than are necessary, as a check.

To power all the electrical equipment it is possible to put on a small yacht one must either run the engine regularly for a fairly long period, or if one is lucky enough to berth at a marina, install a battery charger. An alternative, now starting to become economically feasible, is to install a small solar cell panel as a trickle charger.

Amongst those supplying solar panels are Amtex of Chatswood in Sydney, Challenge Eelctric of Brookvale and Greenwich Marine, both also in Sydney. Philips also stock a range of solar panels, some specifically for this application.

In general, a 330 mm square panel produces around 400 mA or so at 14 V. Battery charging models generally deliver about 10 watts or so, models for lighting applications, somewhat less. ●

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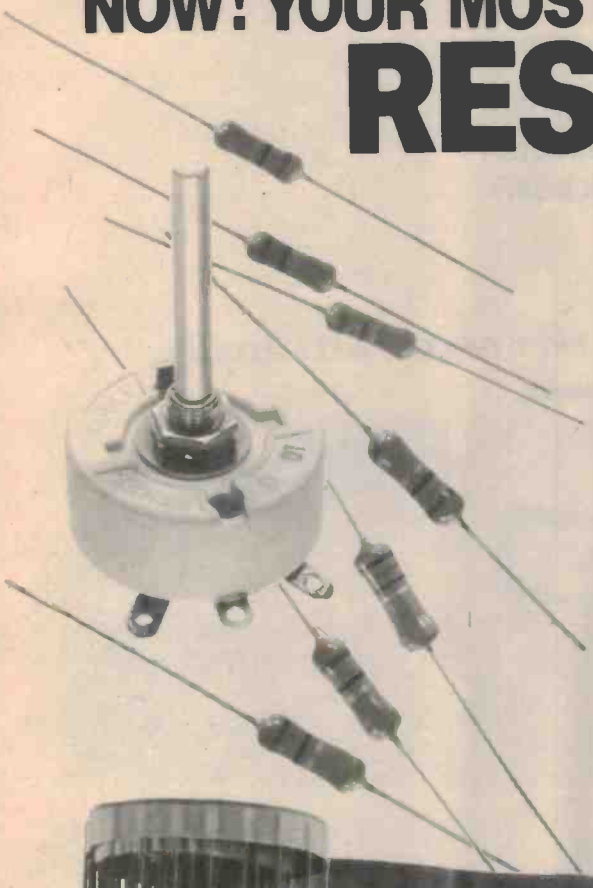

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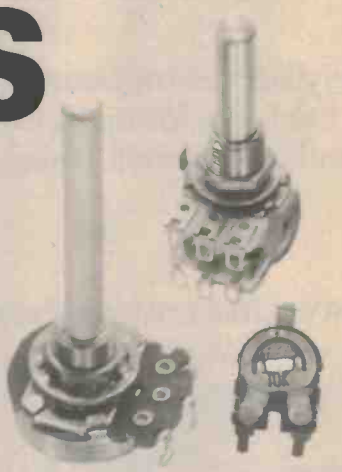

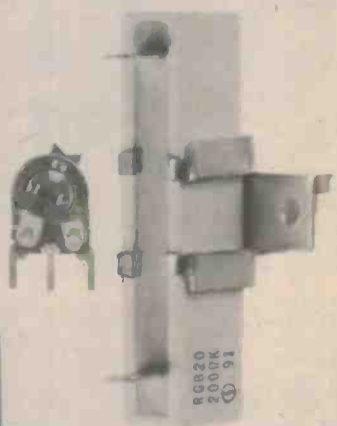

Technical Information available on request.

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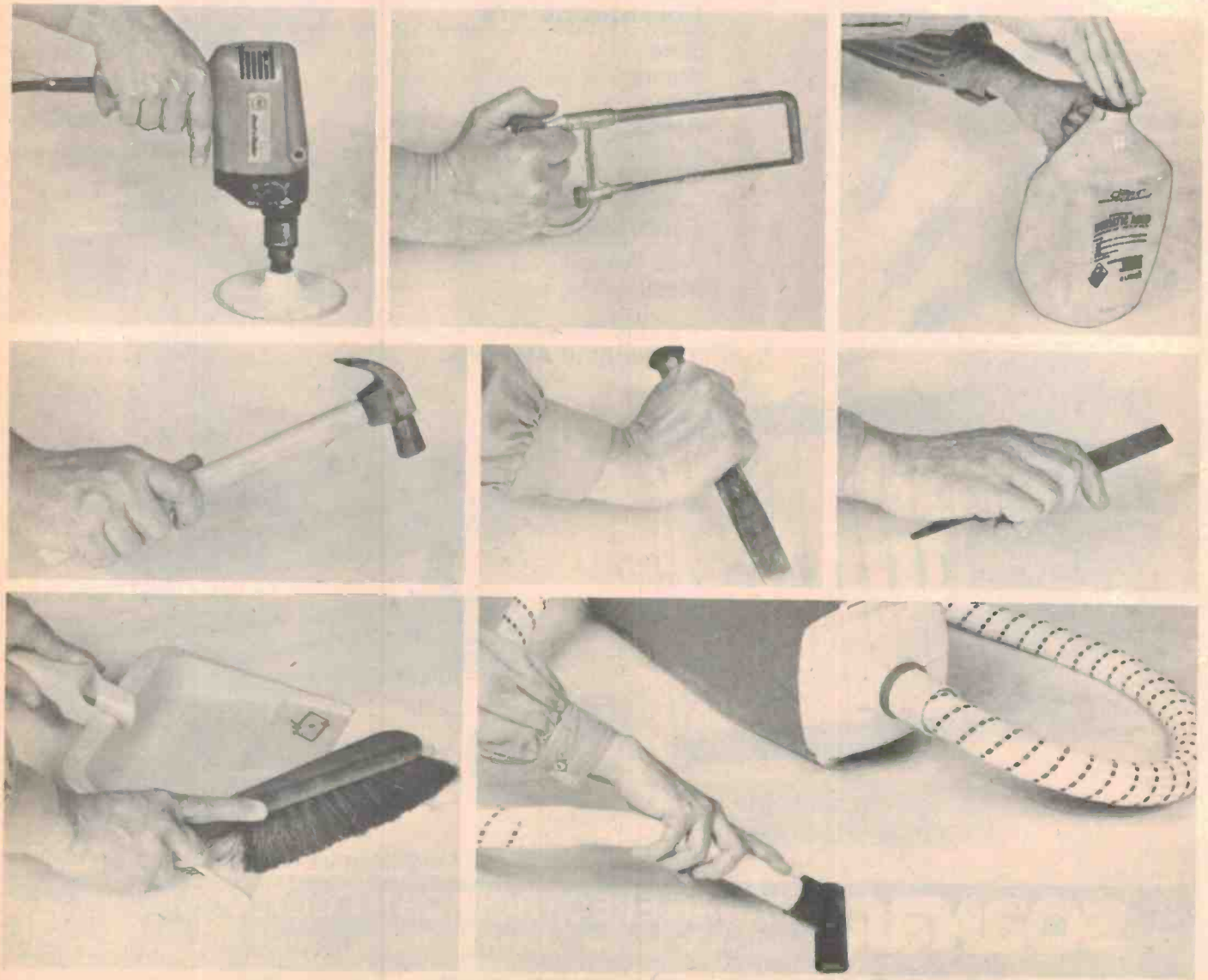
Beryllium — how dangerous?

Beryllium compounds are insidious poisons — they can lie in the body for up to five years before showing any effects - and they can kill. Have you any beryllium in your junk box?

BERYLLIUM COMPOUNDS ARE QUITE SAFE – *PROVIDING THEY'RE LEFT WELL ALONE*

DO NOT: **grind, saw, put with acid, crush, chip, file, brush or vacuum the material!**



THERE IS a lot of controversy these days about the toxic effects of everyday substances – saturated hydrocarbons in food, cancer-producing hair dyes, lead in petrol and so on.

It may surprise you to know that you are in contact with one very toxic substance which has cost the lives of many people over the years and which may have no warning notices or labels attached to it – it's harmless in its present form, but is only waiting for the unwary to tamper with it to turn it into a deadly cancer-forming agent.

The substance is beryllia, long used for its low thermal conductivity and high electrical insulation resistance in applications such as RF power transistors and some 'heat sink compounds'.

In its solid state, beryllia (or beryllium oxide, to give it its proper name) is fairly innocuous. It won't explode, give off noxious fumes or even catch fire. But grind or cut it in any way, and the dust formed may produce insidious lung disease. Cases have been reported in which workers who came into contact with the substance did not exhibit symptoms until five years later, and some in which the damage appeared within one or two months.

It doesn't take much dust to produce toxic effects, either. Some forty years ago, beryllia was used widely in fluorescent lighting tubes, and the number of cases of poisoning were much greater. Because of the incredible virulence of the poison, toxie effects have been reported in people who visited the homes of beryllium workers. Tests have been carried out with soiled clothing that showed that shaking even a lightly-soiled lab apron can give rise to dust concentration five times the recommended maximum.

Imagine, then, the effect of sawing a piece of beryllia in your workshop (or, worse still, in your kitchen). The worst of it is, you may not realise the effects until five years from now.

Having said all that, solid beryllia is safe enough if treated with respect.

- If there is an alternative, don't use beryllium compounds.
- Don't ever mutilate, grind, cut or even scratch beryllia.
- Always make sure that any beryllia you have is adequately labelled in such a way that there is no way that you, or anyone else, can mistake it for something harmless.
- When you want to throw out a device containing beryllia (which you probably feel like doing round about now), send it back to the manufacturer – it's pretty certain that they know how to dispose of it properly.

There is another route through which beryllia can be harmful – through the skin. Experiments with animals have shown that introducing beryllium compounds into open wounds may form tumours. If you're using a heat-sink compound that you think contains beryllia, try not to touch it – use plastic gloves and other safety devices.

If you think that beryllia has come into contact with you in any way which could prove harmful – see your doctor.

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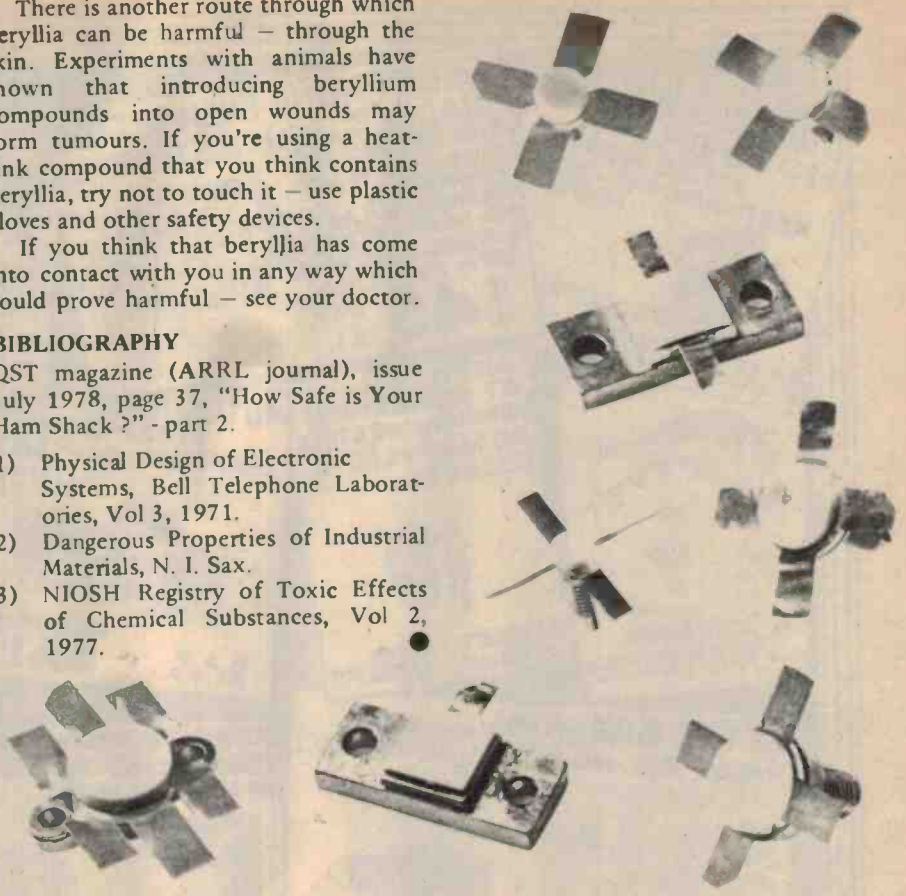

Some of the fairly common types of devices constructed using Beryllium oxide are shown above. RF power transistors use the material as a heat transfer material between the chip and the copper stud. Stripline terminations – such as the central device in the upper group and the central device in the lower row – are less common but have construction similar to the RF power transistors. These devices are perfectly safe to handle providing you do not do any of the things suggested in the pictures on the opposite page.

BERYLLIUM OXIDE, BeO *(Beryl, Beryllia, Bromellite)*
PHYSICAL, CHEMICAL AND MEDICAL CHARACTERISTICS

VOLUME RESISTIVITY: 6 x 10^{11} ohm.m at 300°C (98% BeO)[1]

THERMAL CONDUCTIVITY: 210 W/m. °C (98% BeO at 25°C)[1]

SOFTENING TEMPERATURE: 1600°C (98% BeO)[1]

THERMAL EXPANSION: 6.1 ppm/°C (98% BeO)[1]

TOXIC HAZARD RATING: High (acute local irritation, inhilation: may cause death or permanent injury after very short exposure to small quantities)[2]

LOWEST TOXIC AIR CONCENTRATION: 49 mg/m^3 (rat, inhilation, four weeks continuous. Cancer)[3]

LOWEST TOXIC UNDER-SKIN DOSAGE: 7 mg/kg (pig, benign tumour)[3]

OSHA STANDARD AIR CONCENTRATION: 2 μg/m^3 (time-weighted average)[3]

OSHA STANDARD PEAK AIR CONCENTRATION: 25 μg/m^3 (30 min per 8 hours)[3]

Jonathan Scott

CONFESSES being born in Brisbane in 1956 – claims British descent in compensation. Beats us too, but it's always a good start for an argument!

His first exposure to technology was an electric train set, ostensibly bought for him. This was a bit odd as he was only 2.5, but daddy was surprisingly helpful. Jonathan could wire the points when he was three and was allowed to drive it when he was four. The error rate in this early electrical work has resulted in a sense of smell that can pick an overheated solenoid at 400 metres and a sense of hearing that can get the bearing of a short circuit to within 3°.

Jonathan was educated at a Sydney GPS school which "turned out lousy human beings, but great assassins", and hence it doesn't rate a free plug here. By now the electrical fetish, mutated into electronic obsession, was blooming into radio amateurhood. Having hated every second spent at school, the attraction of Sydney University's vast reserves of CROs, computers, girls, bars, concerts, girls, colleges, plays, girls, interesting lectures, clubs, societies and girls came as a welcome opportunity to expand his interests. Amazingly, between all this a BSc in Physics was squeezed from the system in 1976.

After this, Jonathan went to live in Wesley College (the only co-ed one on SU campus), to get closer to the action, figuring that one hour per day spent commuting is an intolerable inefficiency to any perfection-minded engineer. Two years later, a BE (Hons) popped up, which would have been great had it not heralded the threat of having to get a full time job! Here, ETI came to the rescue, and in 1979 Jonathan could be found taking refuge from the hard labours of the outside world in their hallowed lab.

Having taken up residence in a share-house (with a female economist, a female lawyer, a PhD and a policeman – just to keep him on his toes) everything looked stable. Alas, the establishment made him an offer he couldn't refuse – money. Not a lot, but it was going cheap; free in fact, in exchange for a Masters degree in Pure Electronic Design. So now he may be seen frequenting SU in the day, ETI at all sorts of times, and various places of raging in between.

Star sign: Taurus = Leo

Likes: Building better electronics, photography, girls, ergonomics, strategic games, timepieces, motorbikes, rock (heavy), Monty Python, Hewlett-Packards (symbols of perfection in engineering), food (especially Italian), cars (German and Italian), skiing, squash, and winning.

Dislikes: Imperfection, inefficiency, ordinary, unspectacular and boring things; slow people.

Quotes: "Between the women, the cars and the food, I should have been born Italian"; "If you can build a better one, the builder of this one hasn't got an excuse in Hell!"

All you ever wanted to know about ETI . . . but were afraid to ask

David Tilbrook

BORN in Sydney as a young lad (circa 1954), David lived here until a move to Adelaide forced him to live there. At the ripe old age of eight he built his first electronic device – a profoundly complex gadget consisting of two switches (240 V light switches – off the bedroom wall), a 3 V torch globe (from his father's torch) two giant 1.5 V batteries and fuse wire for hookup cable. He learned very quickly about short circuits! It wasn't long before he progressed to crystal sets, doorbells and various concoctions he still can't fathom!

Extradited to Sydney in 1964 he was thrust into St Pius' College at Chatswood who steered him through his Higher School Certificate . . . they had to get rid of him somehow!

Leaving the cloistered shadows of St Pius', David progressed to servicing pinball machines – the experience was good for him for he developed a healthy disrespect for electromechanical things.

From this highlight in David's career it was only natural that he study electronics at university. He refuses to say which one and none will admit having him . . .

At the end of his first year David secured a job as a laboratory technician testing coal and mineral samples at Casco. He relates that it was thus even more discouraging when chemistry proved his downfall at university.

To expunge his sins he took up servicing electronic equipment (car radios, transistors and stereos), this being more fun than servicing electro-mechanical equipment. Finding this marginally better than pinball machines, David soon left to join Convoy International where he rose to fame and fortune . . . well, notoriety and a modest income, anyway.

His interest in hi-fi had been kindled many years before and he found working on top-quality equipment (Nakamichi, B & O, Teac, Electrosonic A/V gear . . .) a stimulating experience. After several years he was appointed Service Manager at Convoy which, among other things (washing coffee cups, answering the 'phone) involved designing equipment for audio-visual applications.

Following those happy years at Convoy, David spent some time doing freelance electronic design. Amongst

other things, he worked on animating monsters using electronic control.

We found David supporting a telegraph pole in a back street of Woolloomooloo. Being in a charitable mood that week we took him in, thrust him through the lab door and said: "go to it!" And he did. His cunning circuits now grace the pages of ETI.

Star sign: non-Leo. (Aquarius)

Likes: sophisticated audio gear, physics, good loudspeakers, tennis, astronomy, cunning circuits, pre-1975 Toranas.

Dislikes: pre-1975 Holden Toranas!, bad loudspeakers, poor electronic design, low-fi audio gear, chemistry, salesmen and mechanical contrivances.

Quotes: "If it takes more than 10 amps, I don't want to know about it!" ●

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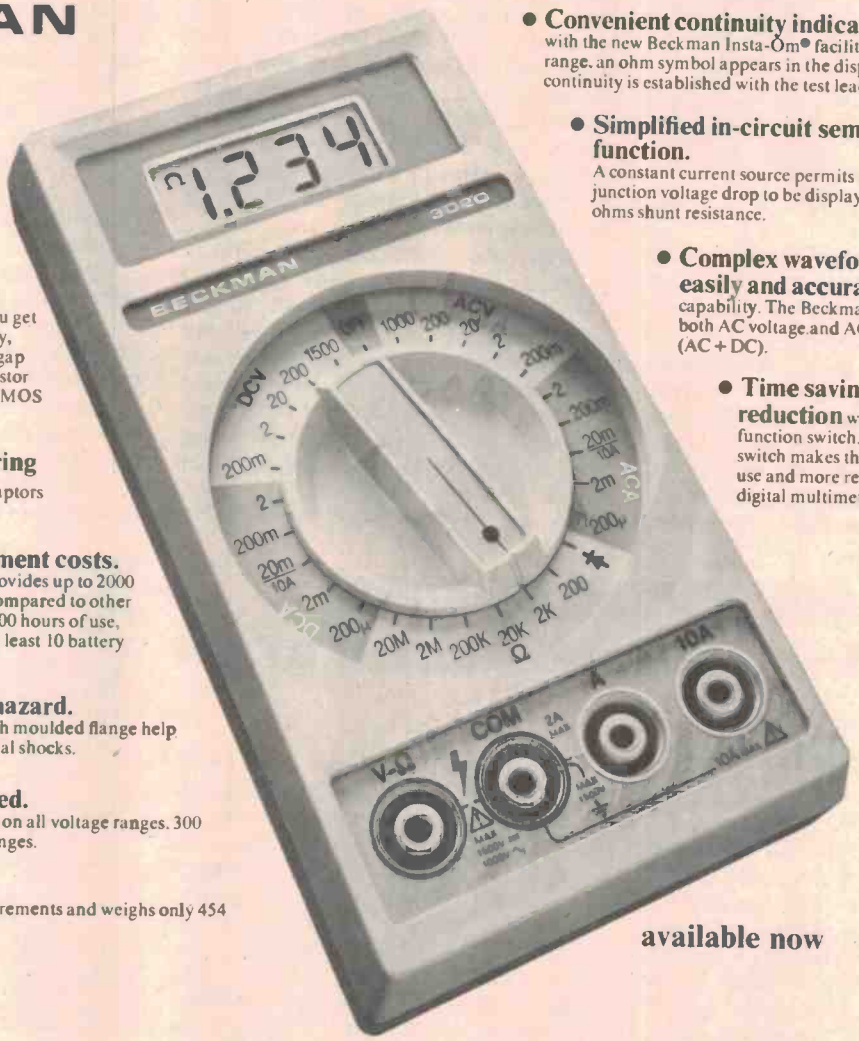

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Project 473

Series 4000 moving-coil cartridge preamplifier

David Tilbrook

Designed to complement our popular Series 4000 stereo amplifier, this project features performance equal to, or better than, top quality commercial preamps currently available.

OVER THE LAST several years there has been a dramatic increase in the number of moving coil cartridges released. The design of this type of cartridge results in a number of advantages over the more usual phono cartridge which works on a moving magnet principle.

Modulations on the wall of the record are tracked with a diamond stylus attached to a long arm called a cantilever. In the moving-magnet cartridge a small magnet is attached to the cantilever so that stylus movement causes movement of the magnet. Two pick-up coils are mounted close to the magnet so that the windings of the coils intersect the lines of magnetic flux from the magnet. As the stylus moves the magnetic flux seen by the pick-up coils varies in direct proportion to the stylus movement, and small electrical signals are generated in the coils.

The moving-coil cartridge works in a similar way but inverts the roles of the pick-up coils and magnet. The magnet assembly is held stationary while the pick-up coils are mounted on the cantilever assembly and move with the stylus modulations (hence the name 'moving coil').

The pick-up coils are reduced drastically in size and weight compared to the coils used in moving magnet cartridges. This results in a total cantilever weight that is much smaller than in the typical moving magnet cartridge. Since the weight is greatly reduced the ability of the stylus to react to transients is increased and an overall improvement in signal accuracy results. Moving coil cartridges generally have superior frequency response characteristics and improved phase response at high frequencies. But they also have disadvantages.

The small pick-up coils have a very low impedance resulting in much lower

signal levels than available from normal phono cartridges. In fact, the voltages present on the typical moving-coil cartridge at a recording velocity of 10 cm/sec can be in the order of 150 μV! This is generally insufficient to drive an amplifier to anything like full power. Furthermore, since the output level is some 30 dB below that expected by the amplifier then a great reduction in the signal-to-noise ratio will result. An amplifier with a short circuit signal to noise ratio of 80 dB for example, which is quite a good figure, will end up with a signal noise ratio of about 50 dB – which is distinctly *bad*.

The internal impedance of moving-coil cartridges is around 5 ohms and to achieve the low recommended load impedance required it is clearly not satisfactory to simply load down the input of the average phono input with a resistor since this does nothing to overcome the signal-to-noise ratio problems.

The solution to these problems is to insert some voltage gain between the output of the cartridge and the phono input. This can be done in two ways. Firstly, it is possible to use a transformer to boost the voltages up to the desired level and they are capable of very good results. But, transformers are still limited in transient performance and noise. To obtain the necessary voltage gain the turns ratio must be relatively high. Since the impedance ratio is related to the square of the turns ratio, the output impedance must, of necessity, be high also – usually around 30 k for a 50 Ω input impedance. This is substantially higher than the output impedance of normal phono cartridges and degrades the noise figure of the phono input stage. A solution to this is to use a pre-preamplifier instead of a transformer to achieve the necessary voltage gain.

Preamp requirements

Preamplifiers have their disadvantages also. The biggest problem by far is the design of an extremely low noise input stage with the correct input impedance to load the cartridge according to the manufacturers' recommendations. The distortion must be kept to a minimum and the frequency response should be as flat as possible. These design goals are not unique to a moving coil cartridge preamplifier but they are difficult to achieve owing to the very low output voltage of the moving coil cartridge.

The required low input impedance can be achieved in several ways. Firstly, we can make the input stage a common base configuration. In this type of circuit the input is connected to the emitter of the transistor so that the input impedance is determined by the emitter resistor in parallel with the base-emitter junction of the input transistor, which can be quite low. However, this does not solve the problem of input stage noise.

The other possibility, and the one I elected to use in this design, is common emitter configuration. The impedance of the base-emitter junction of a bipolar transistor is a function of the amount of current flowing in the emitter of the transistor. This will be largely determined by the collector current and not by the base current, which will contribute only a small amount of the total emitter current. A study of base-emitter turn-on characteristics shows that the impedance of the base-emitter junction is approximately equal to:

$$\frac{26\beta}{I_e\ (mA)}$$

where 'β' is the small signal current gain of the transistor.
and 'I_e' is the current in the emitter of the transistor in mA.

So, to reduce the input impedance of the first stage it is simply necessary to increase the emitter current. But this increases the current density in the input transistors, increasing the noise generated by the input stage.

To understand why this happens it is necessary to look more closely at the causes of noise.

Noise

There are two main sources of noise in transistors: shot noise and 1/f noise. Shot noise is the main cause of noise at middle and high frequencies and is generated when an electron attempts to cross a potential barrier. It is therefore directly related to the amount of charge flowing in the device. More specifically, it is given by the equation:

$$\overline{I_s^2} = 2qi_{dc}B\ (amps)^2$$

(mean shot noise current)

where 'q' is the charge of an electron, in coulombs
'i_{dc}' is the dc current in amps
and 'B' is the noise bandwidth in Hz.

1/f noise has a random amplitude like shot noise but its spectral density has a 1/f characteristic. This means that the noise amplitude increases as frequency decreases and becomes the dominant source of noise at low frequencies. As with shot noise, its equation reveals that it is directly related to the current flowing in the transistor.

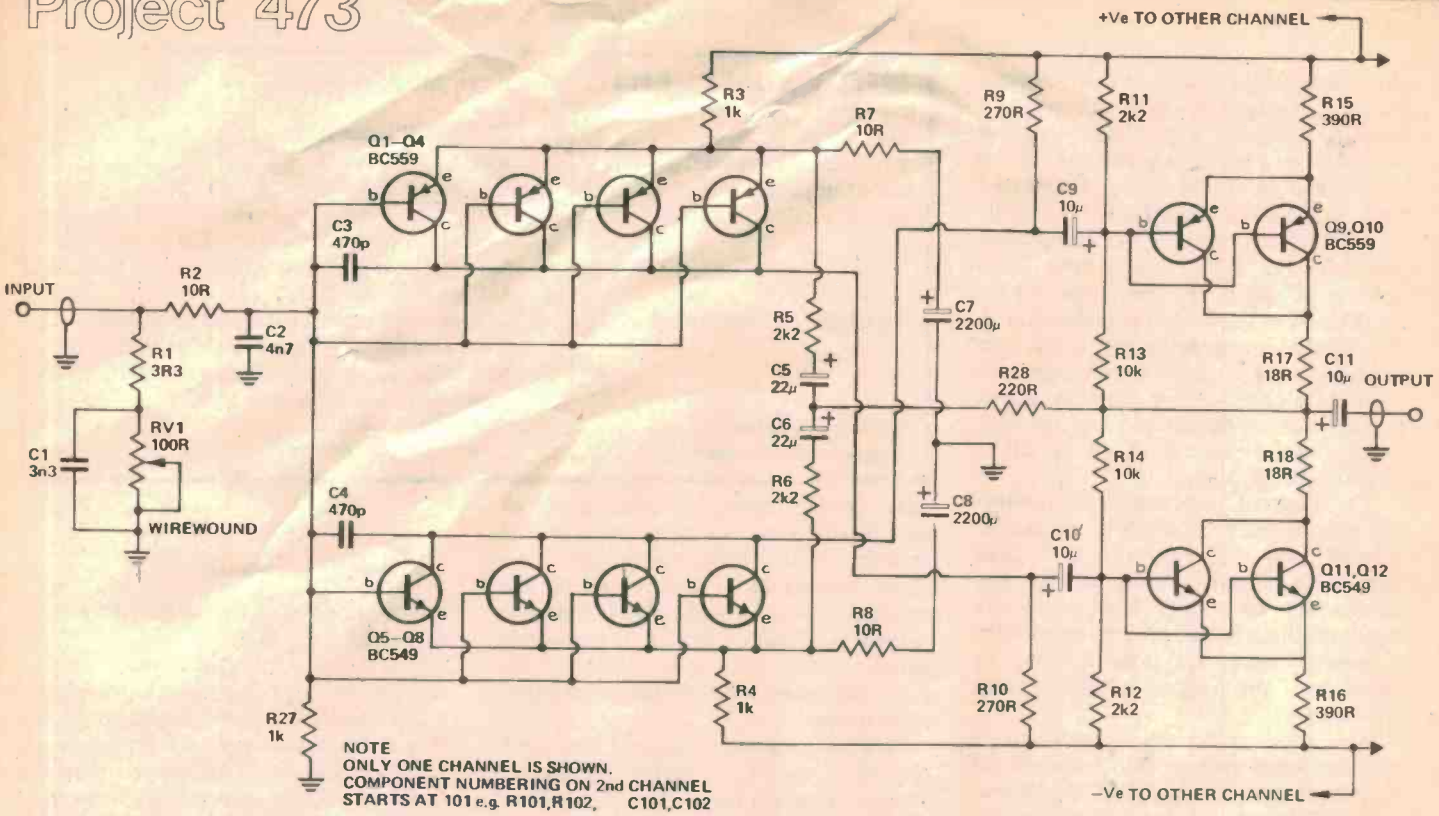
$$\overline{I_f^2} = K\frac{(I_{dc})^a}{f}B$$

where 'I_{dc}' is the dc current in amps
'K' and a are constants that are a function of the particular device
'f' is the frequency in Hz
and 'B' is the noise bandwidth.
Notice that as I_{dc} is increased, so too is the 1/f noise (I_f^2)

It is clear from this that, in order to keep noise generated by shot and 1/f noise to a minimum, it is necessary to keep the current density in the input stage low. But, as we saw earlier, to obtain the necessary low input impedance we have to increase the emitter current. The solution to this is to use several transistors in parallel to form the input device. This decreases the current density in each of the transistors since the necessary emitter current can be shared by all of the input devices. It also places the impedances of the base-emitter junctions in parallel, further decreasing the input impedance of the first stage. Furthermore, since each transistor is a completely independent noise generator their noise voltage will tend to reduce each other (a process too complex to examine in detail here). ▶

SPECIFICATIONS – ETI 473 moving coil cartridge preamp.

Gain	28 dB (x 25 approx).
Frequency response	29 Hz to 48 kHz ±1 dB.
Input impedance	Adjustable 3.3 to 100 ohms.
Noise	Total equivalent input noise 0.3 nV√Hz. Over a 20 kHz noise bandwidth—42nV. Signal-to-noise ratio, with respect to an input level of 150 μV: -71dB.
Total Harmonic distortion	With respect to an input level of 0.2mV, unmeasurable (below noise). Calculated to be 0.0015% (see text). Rising to 0.015% for a 30 mV input signal at 1 kHz.
Channel separation	Better than 61 dB.
Input overload margin	better than 80 dB.



HOW IT WORKS – ETI473

The input stage consists of Q1 to Q8 plus associated circuitry. Q1 to Q4 and Q5 to Q8 are in parallel to reduce the current density providing a low input impedance stage having very low noise. A detailed account of how this works is given in the text.

Capacitor C1 and C2 fix the upper frequency roll-off characteristics as well as shunting the input with the desired load capacitance for the moving-coil cartridge. The configuration of R1 and R2, C1 and C2 was found to give the best loading for a variety of moving-coil cartridges.

The potentiometer RV1 allows the input impedance to be varied over the range most commonly recommended by cartridge manufacturers.

Negative feedback is applied via the network consisting of R28, capacitors C5 and C6 and resistors R5 and R6. Some degenerative feedback for the input stage is applied to the first stage by the emitter resistors R7 and R8. Capacitors C9 and C10 are coupling capacitors to the second stage while bias for this stage is determined by R11, R12, R13 and R14.

The power supply consists of a series regulator Q13 and Q14. The potential dividers R21/R23 and R22/R24 divide the voltage present at the output of the regulator and drive the transistors Q15 and Q16, and the LEDs. The transistor base-emitter junction in series with the LED will drop 0.6 + 1.65 volts. Therefore, whenever the voltage present at the centre of the potential divider tries to increase above 2.3 volts the transistor increasingly, conducts decreasing drive to the pass transistors Q13 and Q14.

This is a relatively low noise regulator since the voltage reference is LED and not a zener diode which is a noisy device. Resistors R19 and R20, together with capacitors C12 and C13 form 6 dB per octave low-pass filters on the supply rails to further reduce noise that may be generated by the regulated supply. . .

This configuration works very well and the noise levels of this preamplifier rival any of the commercially available units.

To see just how difficult it is to obtain a satisfactory signal to noise ratio at these signal levels it is necessary to look at another form of noise called 'thermal noise'. This is caused by the agitation of charged particles in any conductor due to their temperature. Every passive component will generate thermal noise and short of dunking the whole thing in liquid helium to cool it off, there is simply no way of getting rid of it. Thermal noise is given by the equation:

$$\overline{e_R^2} = 4kTRB \text{ volts}^2$$

where 'T' is the temperature in degrees Kelvin (K).
'R' is the value of the resistance.
'B' is the noise bandwidth
'k' is Boltzmans constant, equal to 1.38×10^{-23} W-sec/K.

From this equation we can calculate the theoretical noise that will be generated by the moving coil cartridge itself. This clearly is the absolute lowest noise figure that is possible with the input stage generating no noise of its own (which is very unlikely!).

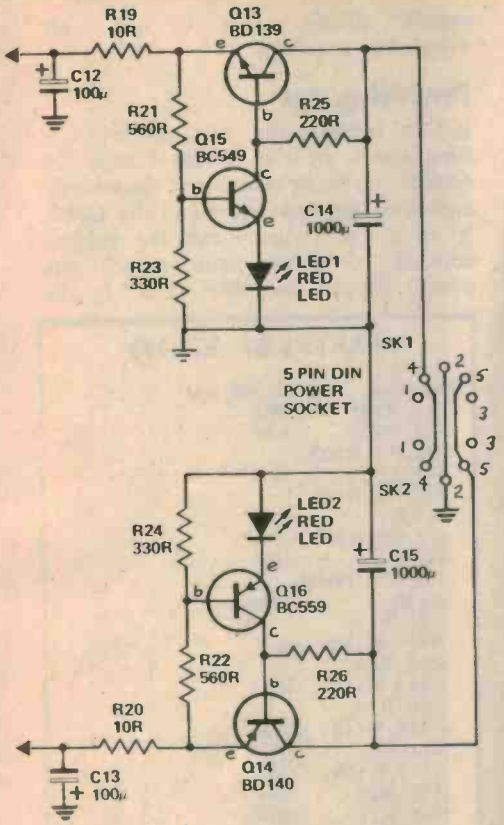
If we let the temperature of the transistor be 300 Kelvin (i.e.: mean atmospheric temperature) and the noise bandwidth be 20 kHz (the hi-fi audio band), then since the dc resistance of the cartridge is about 5 ohms the equation becomes:

$$\overline{e_R^2} = 4 \times (1.38 \times 10^{-23}) \times 300 \times 5 \times (20 \times 10^3)$$

Therefore $\overline{e_R} = 4.07 \times 10^{-8}$ volts or 41 nV.

So, the thermal noise of the cartridge itself is 41 nV.

Actually, this calculation is not quite right since the noise bandwidth is defined as having a 'brick wall' response. An amplifier with 3 dB point of 20 kHz that is falling at a rate of 6 dB per octave will actually have a noise bandwidth much greater than 20 kHz. Furthermore, if we want to be able to quote noise figures to enable comparison between different input stages, it is valuable to quote noise voltages independently of noise bandwidth. This can be done quite easily by dividing the noise voltage by the square root of the bandwidth. The dimensions of this new figure will be "volts per root Hz",



and our result for the thermal noise of a moving coil cartridge becomes:

$$\frac{41}{\sqrt{20\,000}}\ \text{nV}/\sqrt{\text{Hz}}$$

or 0.29 nV/√Hz

Now, if we are aiming at a signal to noise ratio of 70 dB with respect to a signal voltage of 150 nV (0.15 mV), which is the expected signal level at a recording velocity of 10 cm/sec., then the equivalent input noise of the amplifier will be given by the equation:

$$-70 = 20\log\left(\frac{N}{0.15\times10^{-3}}\right)$$

and is equal to 0.33 nV/√Hz.

The necessary equivalent input noise is in the same order of magnitude as the noise being generated by the cartridge itself!

Designing an input stage with this sort of noise isn't easy, especially when it is considered that the noise generated by even the quietest transistor is in the order of several nV/√Hz for usable emitter current. This is substantially worse than the requirement.

Performance features

The total equivalent input noise of this unit was measured at 0.3 nV/√Hz. With respect to a noise bandwidth of 20 kHz, this corresponds to an input noise of 42 nV, giving a signal to noise ratio with respect to an input signal of 150 nV (0.15 mV) of 71 dB. At this level, the noise generated by the cartridge itself will be one of the dominant noise sources.

The circuit uses a symmetrical configuration with NPN and PNP transistors set up in such a way that asymmetrical distortions tend to cancel. Normally distortion products are generated differently for positive and negative signal excursions and this tends to produce second harmonic distortion products. The configuration used in this circuit results in very low second and third harmonic distortion. This has enabled a total harmonic distortion figure of around 0.0015% to be obtained.

The problem with quoting distortion figures of this order is that they are too low to be measured directly, being well hidden under the noise level. The only way a figure can be obtained is to remove the overall negative feedback, measure the distortion and then divide by the gain difference when the feedback is reapplied. Unfortunately, feedback does not affect all the distortion products equally, but the figure is still meaningful.

Another advantage of the symmetrical design of the input stage is that it does away with the need for an input capacitor. This is a definite advantage when dealing with low input impedances since the value of the capacitor would have had to be very large to obtain a flat frequency response at low frequencies.

The signal voltages present in the preamplifier are naturally extremely low and for this reason the power supply has been kept as a separate unit to reduce the possibility of 50 Hz induction from the power transformer.

A voltage regulator supplies the necessary ±6 volts. As it is critical to achieve low noise it is important that the regulator does not put noise onto the supply rails which would degrade the noise performance of the unit. Normally the voltage reference used for regulators of this type is a zener diode but, as the zener is reverse biased, it generates a comparatively large amount of noise. In this design an LED was used as the voltage reference. A red LED operated in the forward-biased mode drops a constant 1.65 volts and generates very little noise.

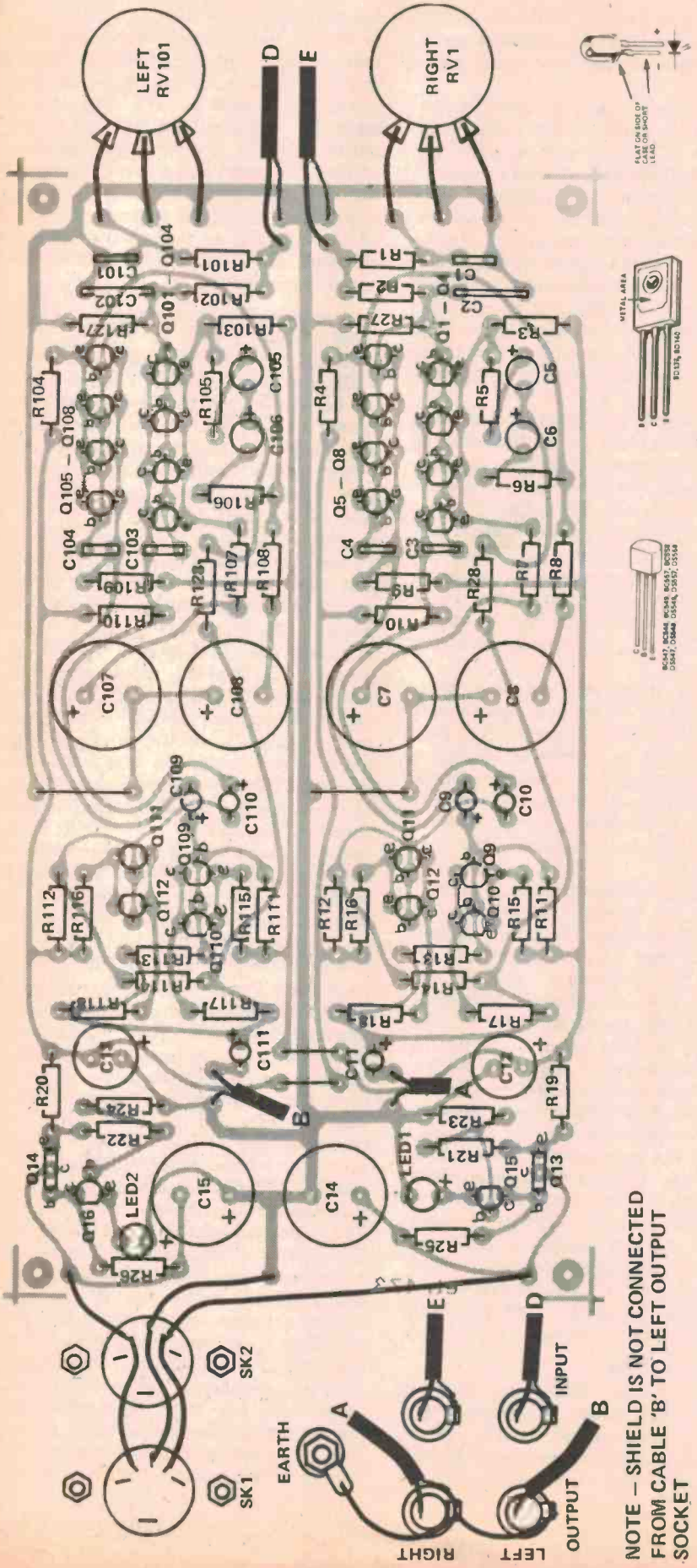
Construction

Construction is relatively straightforward since most components are on the mounted pc board. Other construction methods are possible but performance may not match that of our prototype.

Mount the resistors and capacitors first, followed by the transistors. Since there are quite a few transistors on the board placed close to each other, don't make the mistake I did and get them mixed up! Cut the necessary lengths of shielded cables and solder them onto the board keeping the ends as short as possible. Solder the necessary lengths of hookup cable to the board and after checking all components mount the board in the chassis.

I used a diecast aluminium box and quite frankly wish I hadn't. The shielding to external magnetic fields really isn't good enough. I found I had to be careful where the preamp was placed or it would pick up hum from the magnetic field produced by the power amp's transformer. Use a steel box if you can, if not, just be careful where it is placed.

Once the board is mounted in the chassis, the pots and rear panel hardware can be mounted and the wiring completed according to the wiring layout diagram shown. Here again I came unstuck. The first system I used to ground the shielded cables caused a monumental hum loop (and I still don't really understand why!). The final method tried is shown in the wiring diagram and this works very well. The shielded cables coming from the outputs on the board have only one of their shields connected to the output RCA sockets which are wired together and connected to the chassis at the ground terminal. This type of terminal is supplied with the necessary hardware to insulate them from the chassis. In this case however, we want the terminal to connect firmly to the case to provide the necessary ground connection. It is important that the RCA sockets be insulated from the case and that the ground connection made to them is according to the wiring diagram. If the unit is going to be used with the recommended power supply there should be no hum problems. This power supply, ETI 557, is described later in this issue. It is wired so that the O volt line is not connected to the chassis of the power supply. This is important, otherwise a hum loop around the units' mains grounds will result. If you wish to use a power supply other than the 577 then it will be necessary to ensure that the O volt line from the supply does not connect to the power supply chassis. Do not 'cure' the problem by disconnecting the ground wire at the 240 volt plug as this will remove any ground connection from the power ▶



NOTE – SHIELD IS NOT CONNECTED FROM CABLE 'B' TO LEFT OUTPUT SOCKET

supply chassis. This is not only dangerous, it's illegal.

Powering up

Before turning the unit on make a final check of the board. Check the orientation of the transistors, electrolytic and tantalum capacitors and the LEDs. If all is right, turn down the volume control completely and switch the power supply on. The LEDs in the

PARTS LIST - ETI 473

Resistors all ½W, 5%
R1, R101 . . . 3R3
R2, R102 . . . 10R
R3, R4, R103, R104 . . . . . 1k
R5, R6, R105, R106 . . . . . 2k2
R7, R8, R107, R108 . . . . . 10R
R9, R10, R109, R110 . . . . . 270R
R11, R12, R111, R112 . . 2k2
R13, R14, R113, R114 . . 10k
R15, R16, R115, R116 . . 390R
R17, R18, R117, R118 . . 18R
R19, R20 . . . 10R
R21, R22 . . . 560R
R23, R24 . . . 330R
R25, R26 . . . 220R
R27, R127. . . 1k
R28, R128. . . 220R

Capacitors
C1, C101. . . . 3n3 ceramic
C2, C102. . . . 4n7 ceramic
C3, C4, C103, C104 . . . . . 470p ceramic
C5, C6, C105, C106 . . . . . 22µF 16V tantalum
C7, C8, C107, C108 . . . . . 2200µF 25V electro
C9–C11, C109–C111 . . 10µF 16V tantalum
C12, C13. . . . 100µF 25V electro
C14, C15. . . . 1000µF 25V electro

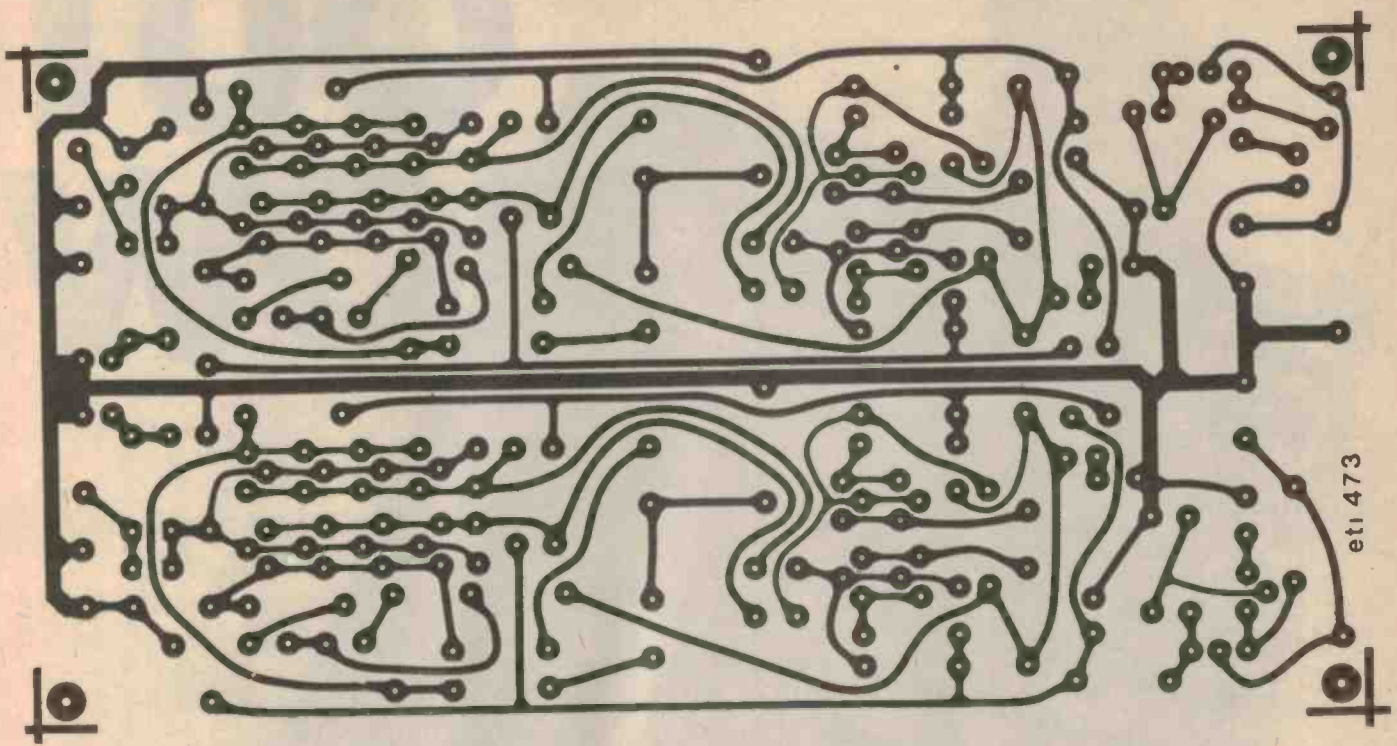
Transistors
Use only types specified - substitutes may result in inferior performance.

Q1–Q4, Q101–Q104. . BC559
Q5–Q8, Q105–Q108. . BC549
Q9, Q10, Q109, Q110 . . BC559
Q11, Q12, Q111, Q112 . . BC549
Q13. . . . . BD139
Q14. . . . . BD140
Q15. . . . . BC549
Q16. . . . . BC559

LED1, LED2 . standard red LED

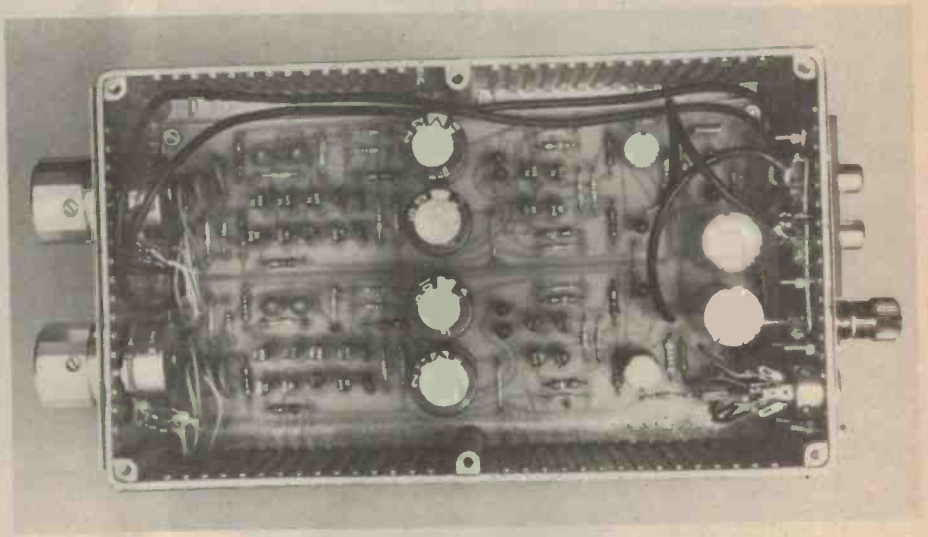
Potentiometers
RV1, RV101 . 100R wirewound linear

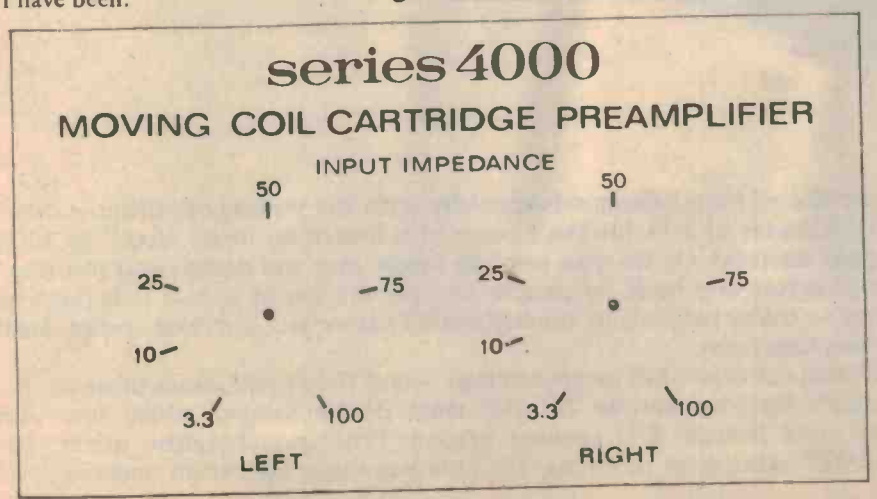
Miscellaneous
SK1, SK2 . . . 5 Pin DIN socket
Four RCA sockets (Insulated from case), One black terminal, mains lead, plug and mains cord securing grommet, two knobs, box to suit, 190 x 60 x 110 mm.

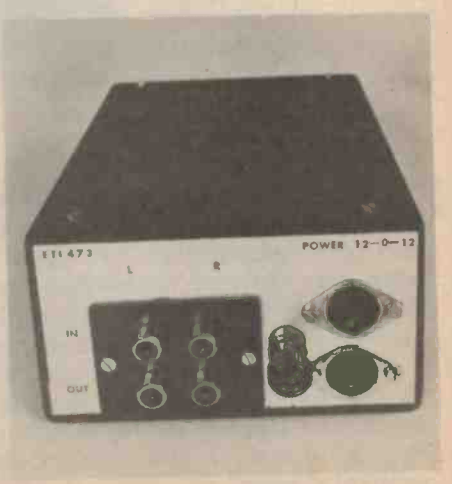


preamp's regulator should come on immediately. I used standard RCA to RCA cables from the output of the preamp to the phono input and had some trouble with hum induction into the leads. Fortunately, we had been sent a set of Audio-Technica type AT620 cables for evaluation several days before and these cured the problem completely.

Perhaps I am biased, but the sound quality of this preamp is extremely good! Using a Nakamichi MC1000 cartridge, this preamp showed distinct improvement over the transformer I was using previously. There is an openness that never existed before and the bass end showed a great improvement being firmer and much more defined. I trust you'll be as satisfied with your project as I have been. ●







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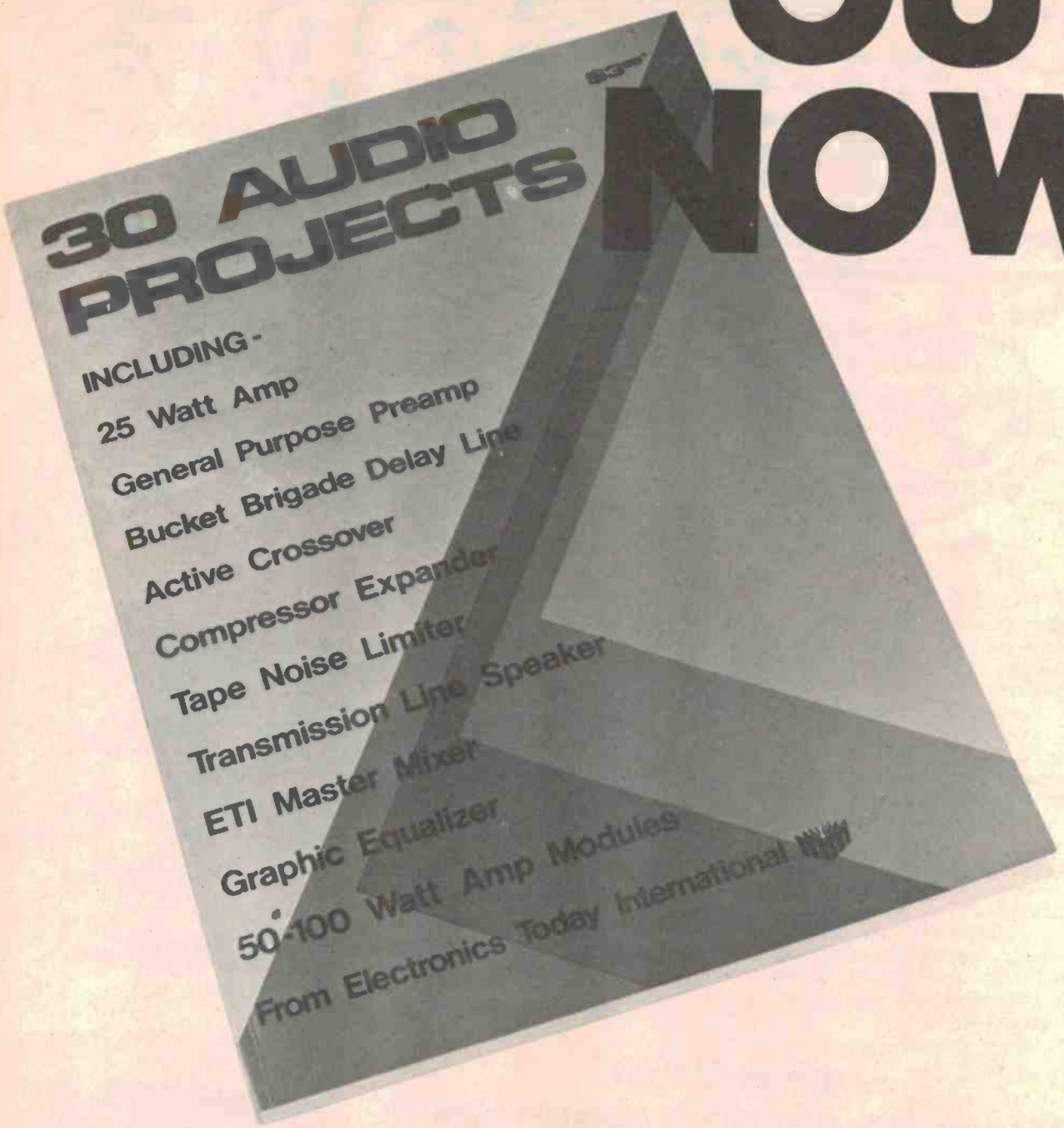

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A general purpose, dual 12 V supply

David Tilbrook

Whilst this supply was designed specifically to power the Series 4000 moving-coil cartridge preamp it should find application in many electronic projects.

Our prototype was housed in a diecast box to match that used for our Series 4000 moving-coil cartridge preamp, although any suitable box may be used if the power supply is intended for another application. Scotchcal front panels should be available from kit suppliers or separately from Radio Despatch Service in Sydney.

THIS POWER SUPPLY provides the +/-12 volts needed by the Series 4000 moving coil cartridge preamplifier. We intend designing a range of hi-fi system 'add-ons' like the M.C. preamp and rather than have a power supply in each unit they will be powered from this supply. This decreases the cost of of building the units and just as importantly removes the major source of hum from within the chassis.

The supply delivers positive and negative 12V dc at 1A while the IC series regulators provide short circuit and temperature protection. These regulators have a tendency to oscillate at around 3 MHz and for this reason must have their output pins bypassed to ground through an appropriate capacitor. If they are allowed to oscillate the device quickly overheats and its thermal protection cuts in.

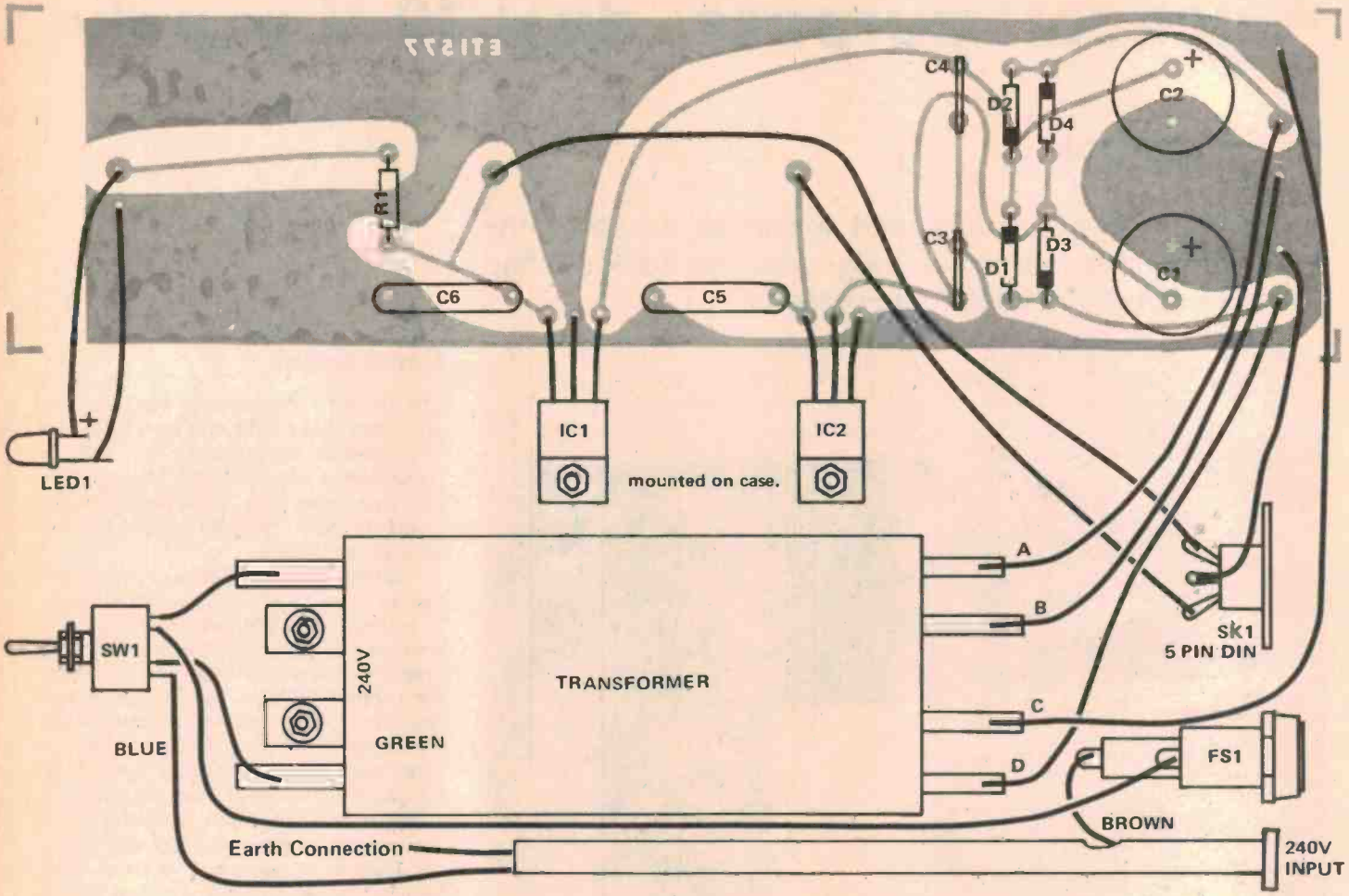
The regulators are mounted onto the chassis which acts as a heat sink. If the recommended power transformer is used, the voltage after rectification is approximately 17 volts. The regulators must drop 5 volts at a worst-case current of one amp, so they are dissipating a maximum of five watts which is well within their ratings.

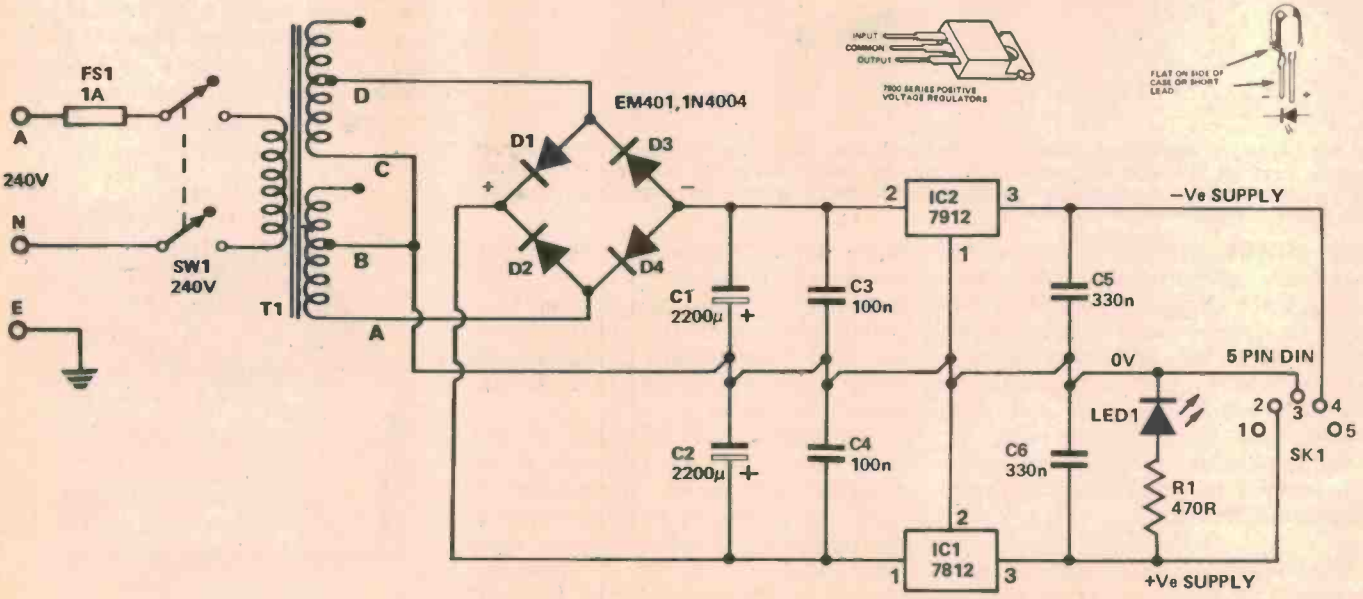
Construction

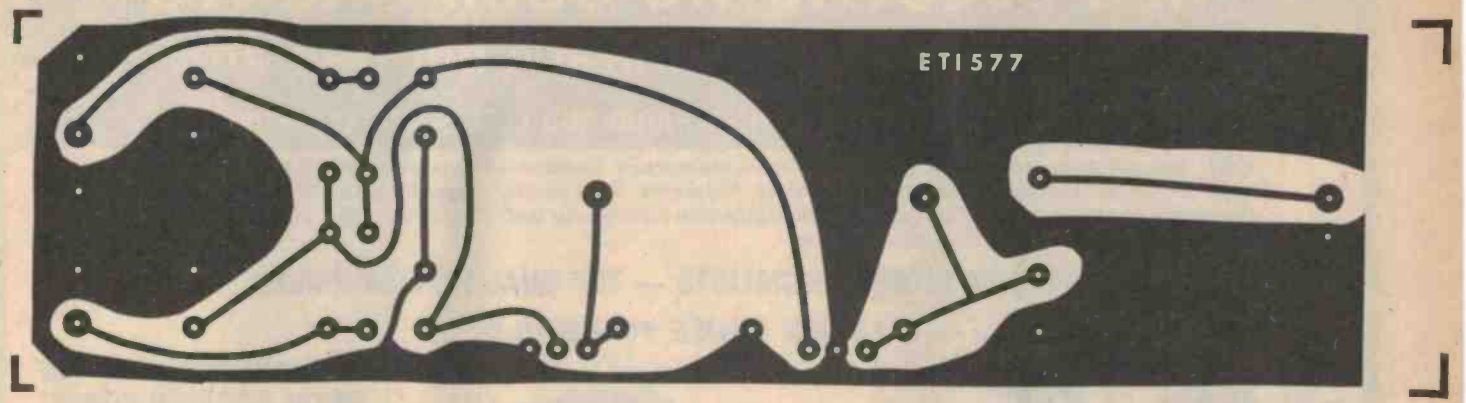
The power transformer used in the prototype was a Ferguson type PL30/40 VA. This is one of their low profile transformers and fits easily into the die-cast aluminium box. The printed circuit board has been designed to slot into the grooves in this box.

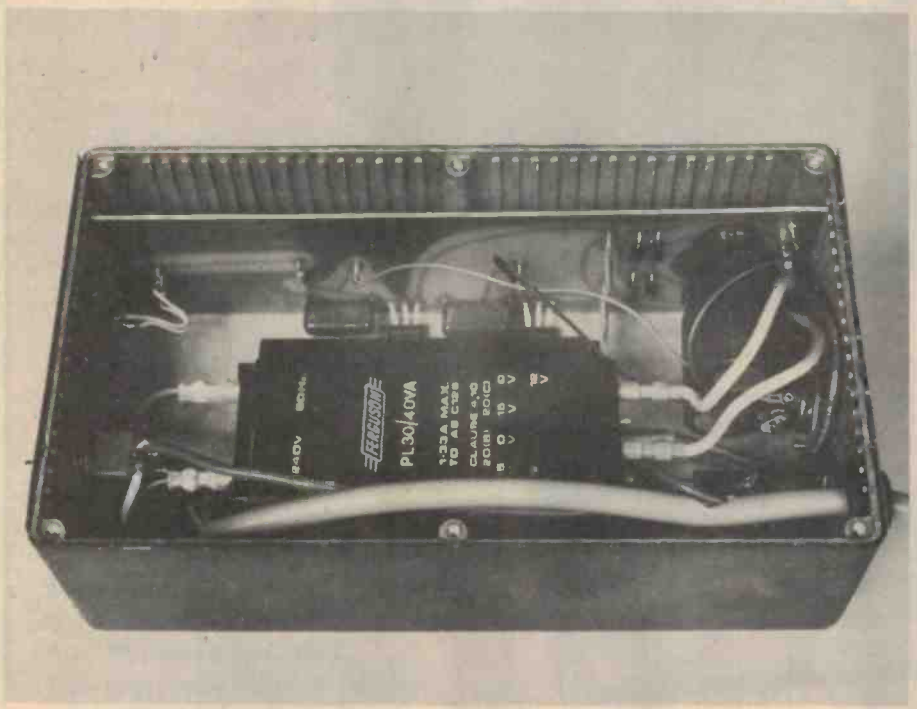
Assembly of the pc board is not difficult as it has relatively few components. If you are using the same box we did it is easier to solder pc board pins onto the board, slot the board into place, bolting the regulators down, and then make the necessary wiring interconnections. Both regulators must be insulated from the case using the appropriate mounting hardware. The case of these regulators is connected to pin 2. For the 7812 this is the ground connection, and accidental connection to case will cause a hum loop when the unit is connected to the moving coil cartridge pre-amp. In the 7912, pin 2 is the input to the regulator and as such has 17 volts directly from the bridge rectifier connected to it. Accidental connection of this to ground will probably damage the rectifier diodes, so check with a multimeter that the case of this regulator is well insul- ▶

Rear view of the power supply showing placement of the major components.


C4
D2
D4
C2
C3
D1
D3
C1
R1
C6
C5
IC1
IC2
mounted on case.
LED1
SW1
240V
TRANSFORMER
GREEN
BLUE
A
B
C
D
SK1
5 PIN DIN
FS1
BROWN
Earth Connection
240V
INPUT


FS1
1A
A
240V
N
E
SW1
240V
T1
D
C
B
A
EM401,1N4004
D1
D3
D2
D4
C1
2200µ
C3
100n
C2
2200µ
C4
100n
IC2
7912
IC1
7812
C5
330n
C6
330n
0V
LED1
R1
470R
5 PIN DIN
SK1
-Ve SUPPLY
+Ve SUPPLY
INPUT
COMMON
OUTPUT
7900 SERIES POSITIVE VOLTAGE REGULATORS
FLAT ON SIDE OF CASE OR SHORT LEAD





Internal view of the power supply showing how the pc board was mounted, the position of the power transformer and the general wiring arrangement. General parts placement is not at all critical and a variety of layouts is possible. Be sure to insulate the regulator ICs.

ated from the chassis before powering up.

The LED is mounted onto the front panel with a standard LED mounting grommet and connected to the board by two short lengths of hook-up cable.

Make absolutely certain that all 240 volt connections are secure and that the mains cable ground lead is connected to chassis as shown in the wiring diagram. The mains flex must be secured to the chassis, either with a clamp-type grommet where it enters the box or with a cable clamp on the inside.

Before applying power to the unit make a final check of the board and all connections to the power transformer. Check the 240 volt connections and ensure that the regulators are satisfactorily insulated from the chassis. If all is correct, turn the power supply on. The LED on the front panel should come on immediately. Check the voltage present on the output DIN socket which should be very close to 12 volts (certainly within 0.25 V). Make sure the positive and negative supply connections terminate on the correct DIN socket pins. ●

HOW IT WORKS – ETI 577

Mains 240 Vac is applied to the primary of the transformer via a 1A fuse. The transformer secondary consists of two 15 V windings with tappings at 12 V. The 12 V tapping of one is joined to the 0 V of the other – this junction (effectively a centre-tap) forming the volt rail.

A bridge rectifier D1-D4 rectifies the ac voltage from the transformer and supplies around 17 volts to the inputs of the regulator ICs. Capacitors C1-C4 filter the input to the regulators while C5 and C6 ensure high frequency stability of the regulators.

The IC regulators provide a stable, regulated output very close to the specified 12 Vdc and can supply up to one amp of dc current. Overload and thermal protection is provided internally on the IC chip. These regulators are convenient, inexpensive and require the minimum number of components.

PARTS LIST - ETI 577

Resistors	all ½W, 5%
R1	470R
Capacitors	
C1, C2	2200µF 25V electro
C3, C4	100n greencap
C5, C6	330n greencap
Semiconductors	
D1–D4	IN4004, EM401 or sim
LED1	Red led, TIL220R or sim
IC1	7812 or LM340-12 voltage regulator (positive)
IC2	7912 or LM320-12 voltage regulator (negative)
Miscellaneous	
T1	transformer, 15V-0-15V, 1.3 amps (Ferguson PL30/40VA)
SW1	DPDT 240V switch
F1	1A, 3AG type fuse
SK1	Chassis mounting 5 pin DIN socket

Chassis mounting 3AG fuse holder, 5 pin DIN plug, 240V mains plug, 240V/3 core cable, rubber mains cable grommet, Die-cast aluminium box 190 x 60 x 110 mm.

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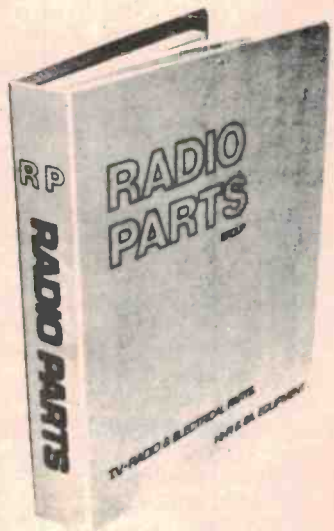

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A universal process timer

Phil Wait

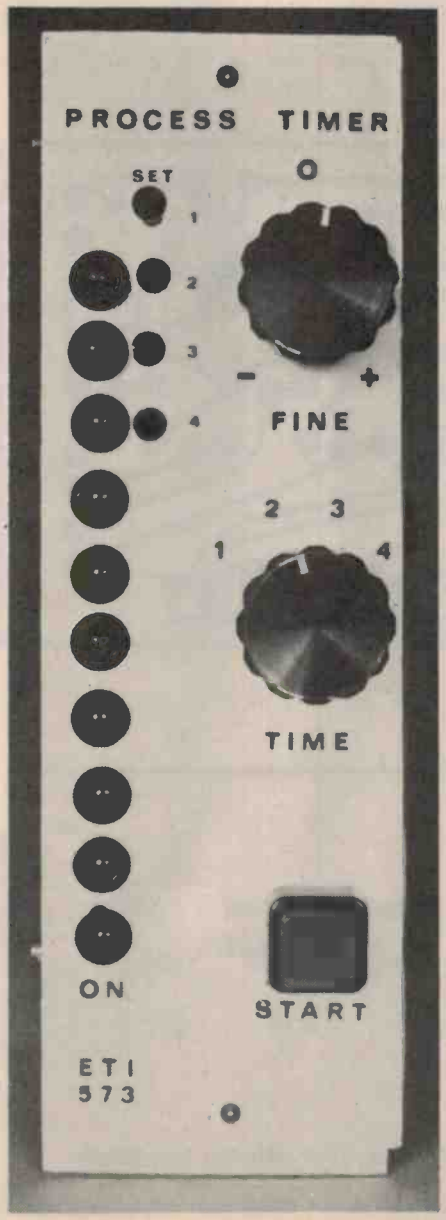
This simple timer has myriad applications in electronic and photographic work. It features a LED display that "counts down", indicating elapsed time, that is readily visible in daylight or in a darkroom.

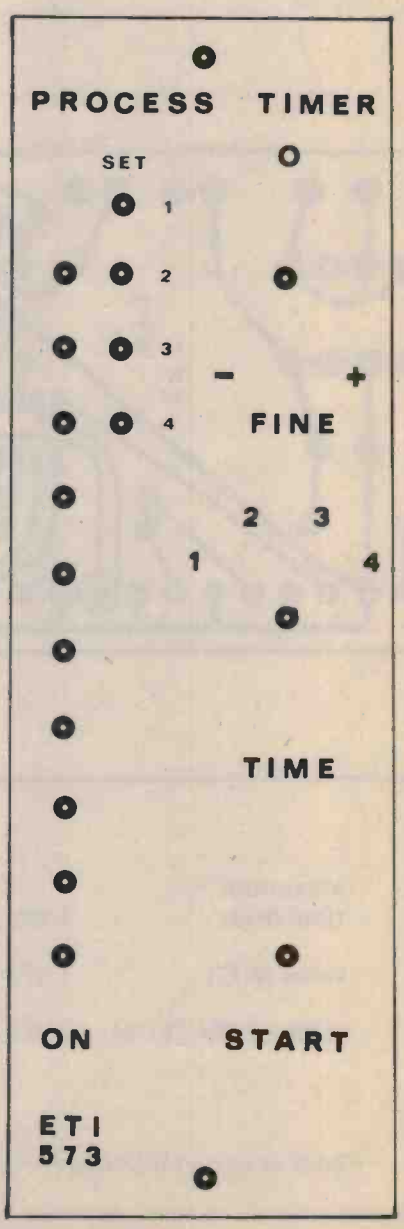
VARIOUS PROCESSES in fabricating electronic projects require timing a chemical reaction or process – developing photoresist in making printed circuit boards being a prime example.

Following the completion of our darkroom here at ETI which we use for making negatives and printed circuit boards, it was decided a simple timer was needed to control the light source used for exposure. Because different times are used for exposing film, printed circuit photoresist and Scotchcal, the timer had to have switchable ranges which could be pre-set between a fraction of a second and ten minutes. Some form of elapsed time indication was considered necessary for the longer exposures as was some form of fine adjustment for either slightly under- or over-exposing the film. Finally, the unit had to switch 240 volts at several amps to control a bank of UV-fluoro tubes used for exposing photoresist.

Someone then suggested it would make a good project – after all, there's very little we do here that many of our readers don't do themselves at home.

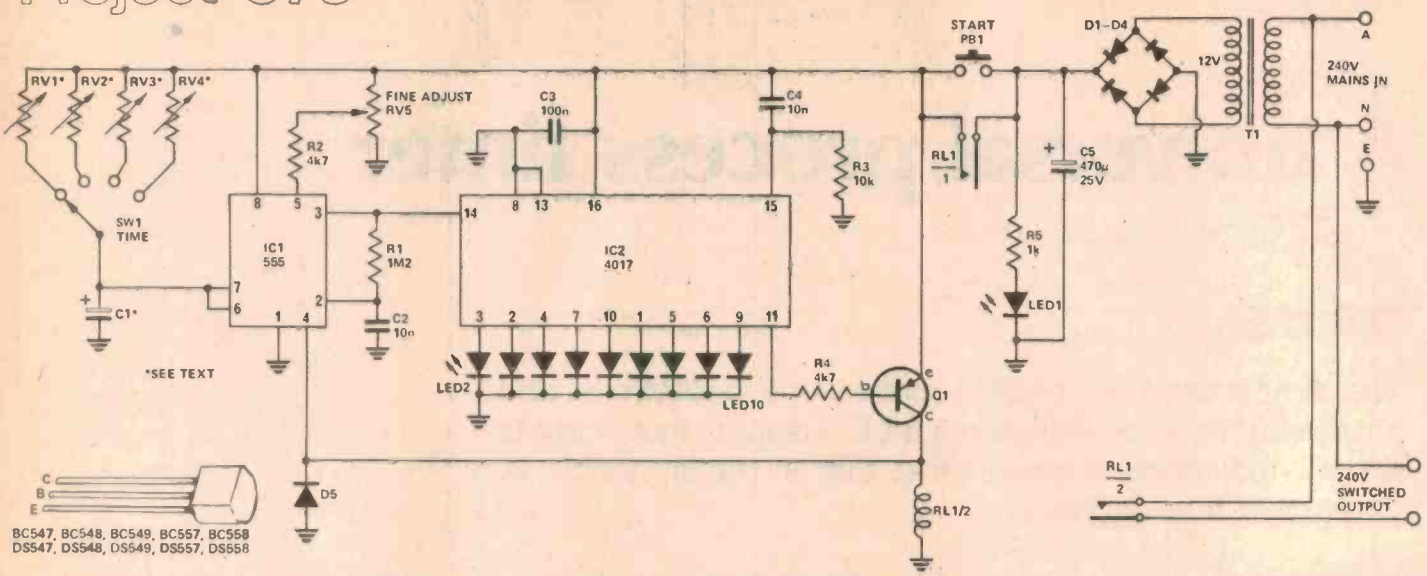
In fact, this timer is not just limited to the applications we use it for, but can be used to control anything from an egg timer to an injection moulding machine. Judging from some of the calls we get from readers, this timer should find its way into all sorts of applications.

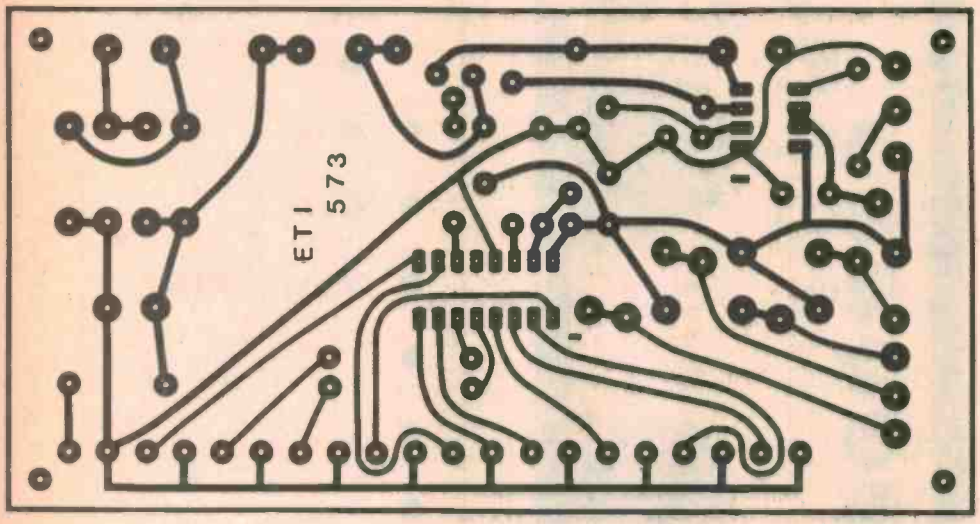




The technique

The easiest way of producing a time delay is by using a 555 timer IC, but a glance at the data sheet shows that it should not be used for periods in excess of 100 seconds. By using the 555 as an oscillator and feeding its output into a 4017 counter/decoder IC the maximum





timing period can be increased ten fold. The unused decoded outputs can then be connected to a column of LEDs which will give an indication of elapsed time.

Each pulse from a 555 clocks the 4017, moving a high level along its ten decoder outputs, lighting each of the LEDs in turn. When the high level reaches the last output it is used to operate the relay and thus the time delay has been multiplied by ten.

A permanently-lit LED has been included at the bottom of the row to show when the unit is on. This also gives a better indication of elapsed time in a darkroom, as the LEDs can be seen to step towards a reference light.

Four time ranges have been provided with a trim pot on each one for easy adjustment. The table gives the values for each trim pot and C1, for a variety of times. The minimum time is limited by the time taken for the relay to operate, maximum time by the limitation of the 555. In practice, times from 100 mS to twenty minutes can be achieved. For very short times the time elapsed indication will not be much use and the LEDs can be left off the board.

Fine adjustment of the timing is achieved by adjusting the threshold voltage on pin 5 of the 555. When the voltage on pin 5 reaches a set value, the output (pin 3) of the 555 goes 'low' (i.e: the 555 triggers). This voltage is normally set at two-thirds the value of the supply rail, fixing the time during the charging cycle of C1 when the 555 triggers.

If the threshold voltage is increased, the time taken for C1 to charge to the required value increases, and the frequency of oscillation decreases. Thus, the total timing period is increased.

What device you want to control

Maximum time delay	1 sec	10 sec	100 sec	1000 sec
value of C1	1 µF	1 µF	10 µF	100 µF
value of RV (1 - 4)	200 k	2 M	2 M	2 M

Table of values for C1 and RV1 - RV4 required for differing time delays

HOW IT WORKS – ETI573

The timer consists of a 555 timer IC used as an oscillator driving a 4017 counter/decoder IC, the decoded outputs being used to drive a row of LEDs and switch a relay.

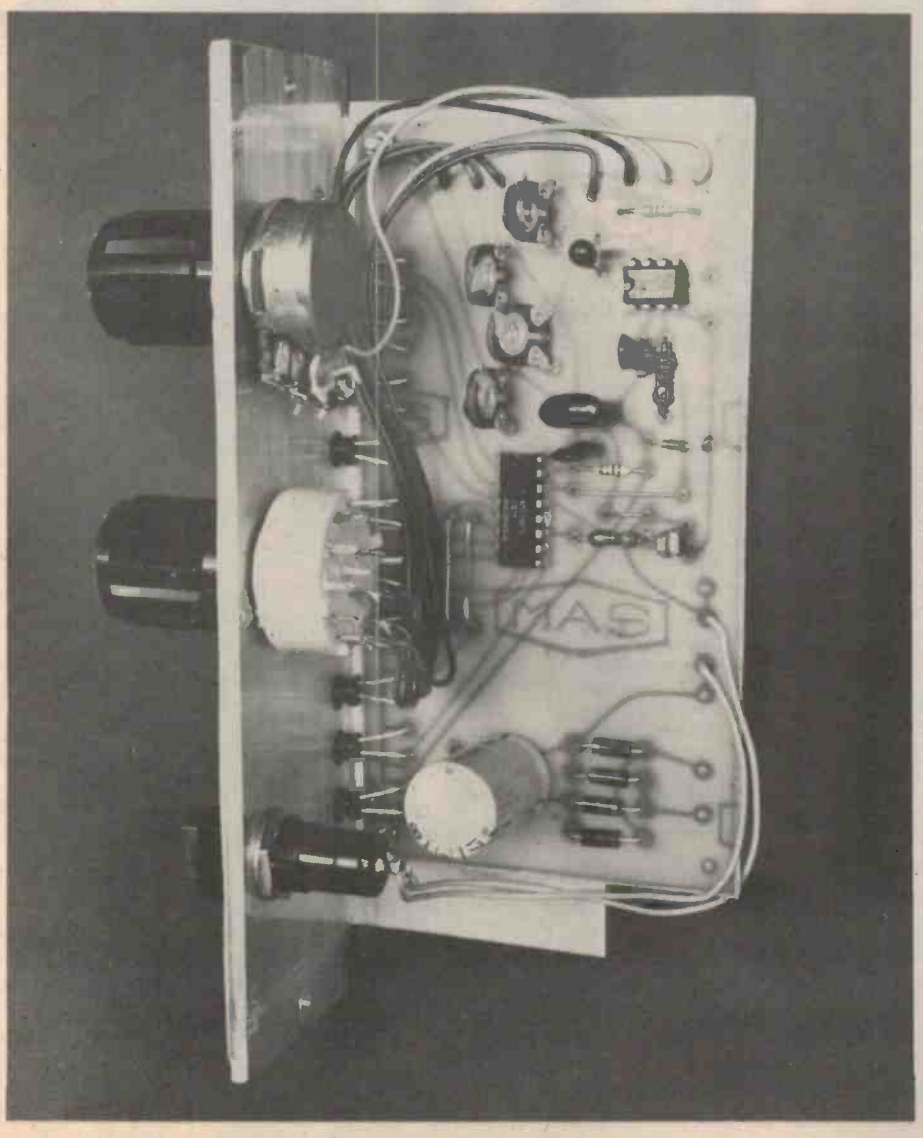
The timing period is set by the frequency of oscillation of IC1. This is dependent on the time constant of RV1-RV4 and C1. As either of these components are increased in value the time constant will increase and the frequency of oscillation decrease. Fine frequency adjustment is provided by RV5 which adjusts the threshold voltage on pin 5 of the 555. This voltage is normally set at two thirds of the supply voltage, but here it is adjusted varying the required voltage across C1 to the 555.

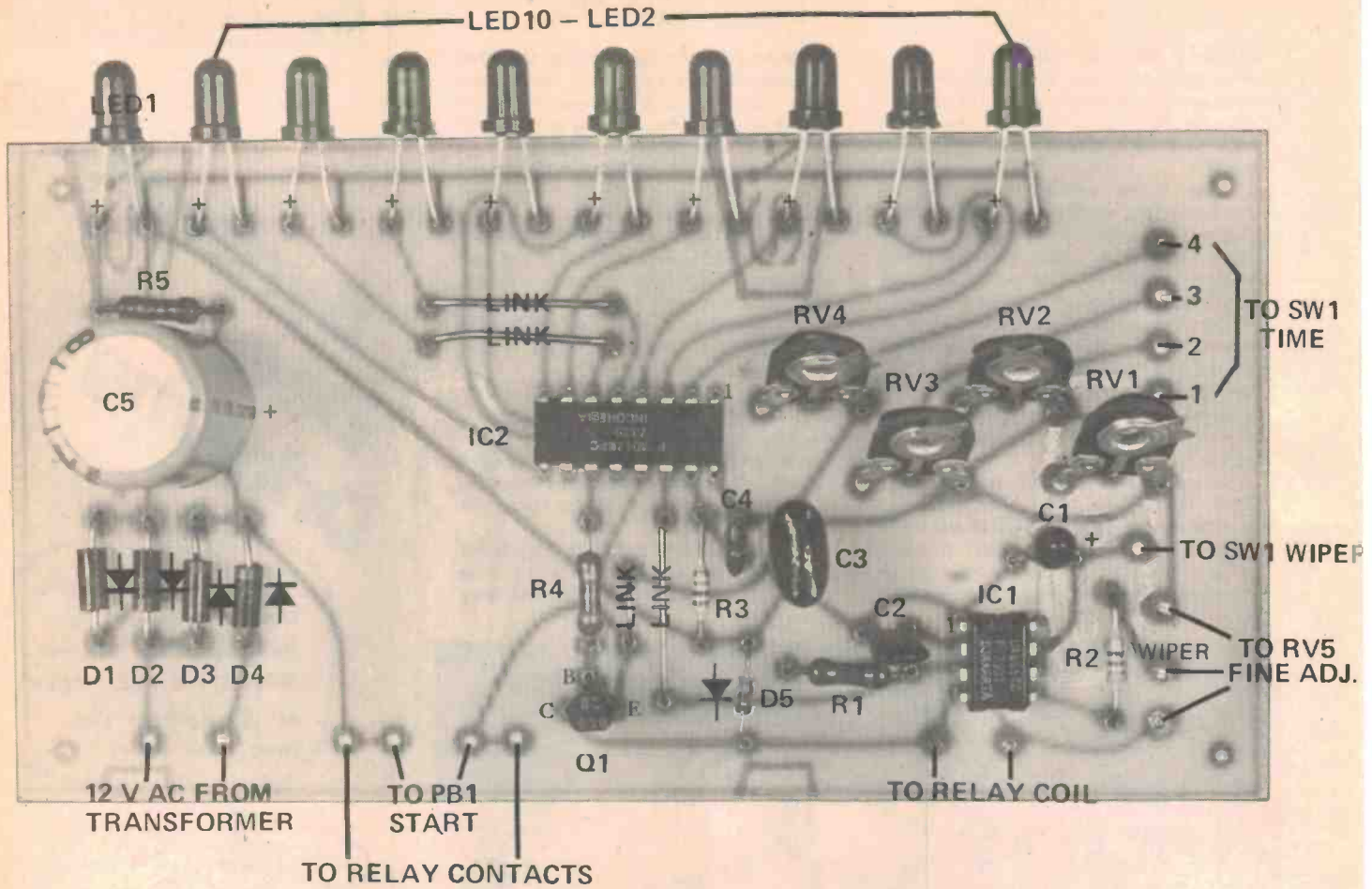
Output from the 555 is fed to the clock input of the 4017. After each pulse a different decoded output of the 4017 goes high, lighting each LED in turn. After the tenth clock pulse the output on pin 11 of the 4017 goes high. We shall come to what that does shortly.

When power is first applied, the relay contacts RL1/1 are open and the bottom LED (LED 1) is lit. When the 'start' button is pressed the 4017 is reset to zero by a positive pulse applied to pin 15. This pulse is provided from R3 and C4. Pin 11 goes low, turning on the PNP transistor Q1, and the relay operates. The now closed relay contacts (RL1/1) short out the start button and sustain the power after the start button has been released. The transistor also drives the reset line of the 555 (pin 4) which commences to oscillate. This ensures accurate timing of the first cycle.

On the tenth pulse from the 55 pin 11 of the 4017 goes high, turning off Q1, stopping the oscillator, and the relay is de-energised. The contacts RL1/1 open removing the supply to the timer returning it to its original condition, ready for the next sequence.

During the timing period, the second set of contacts RL1/2 close and can be used to switch up to 5A using the relay specified.





with the timer will determine the type of relay you use. This unit is capable of driving quite large relays, however, we used a commonly available Omron type having contacts rated at 10 amps.

Construction

First, you will have to determine from the table the correct values of RV1-RV4 and C1 to provide the times you want for your application.

Next, mount all the components taking care to correctly orientate the semiconductors. The LEDs are best mounted by inserting them into their holes and bending them over flush with the edge of the pc board. The photo shows the way I mounted the LEDs.

The completed unit can be mounted in a variety of ways to suit individual applications. Either in a box, together with its relay and a mains female output socket for the switched output, or on a panel with a remote transformer and relay as I did.

To mount the unit against a front panel, drill a row of ten holes for the LEDs and four holes to line up with the trim pots for screwdriver adjustment of the timing. The start button, timing switch and fine adjustment pot can be mounted anywhere convenient. The pc board should be mounted against the panel so the LEDs protrude through the holes.

PARTS LIST - ETI 573

Resistors all ½W, 5%
- R1 . . . . . 1M2
- R2 . . . . . 4k7
- R3 . . . . . 10k
- R4 . . . . . 4k7
- R5 . . . . . 1k

Potentiometers
- RV1–RV4. . . See text
- RV5 . . . . . 10k lin pot

Capacitors
- C1. . . . . See text
- C2. . . . . 10n greencap
- C3. . . . . 100n greencap
- C4. . . . . 10n greencap
- C5. . . . . 470µ 25V electro

Semiconductors
- D1–D4. . . . IN4004 or sim Power Diode
- D5 . . . . . IN914 or sim
- Q1 . . . . . BC558, BC178, DS558
- IC1 555
- IC2 4017
- LED1–LED10 . . . . . TIL220R or sim LED

Miscellaneous
- SW1. . . . . One pole, four pos. oak switch
- PB1. . . . . Momentary Push Button
- T1. . . . . 12V, one amp transformer (Ferguson type PS12/15 VA or sim.)
- RL1. . . . . 12V relay with two changeover contacts, Omron type LY2 or sim

ETI 573 pc board, knobs, suitable box or bracket.

Setting up

Having assembled the unit, all that remains is to calibrate the ranges. This is easily done with the aid of the second hand of a watch. For shorter times, say under five seconds, an oscilloscope is best.

Simply monitor the positive supply after the relay contacts RL1/1 and measure the time the contacts operate. For other purposes it may be best to set the ranges by trial and error, such as when the unit is being used for a pc board or Scotchcal development timer. In either case, the fine adjustment control should be set in its mid position when calibrating. ●

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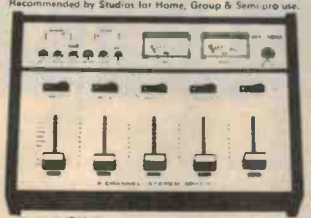

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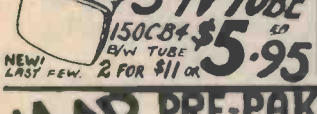

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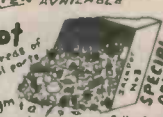

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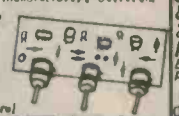

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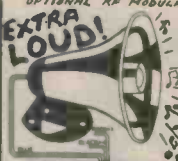

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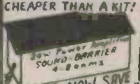

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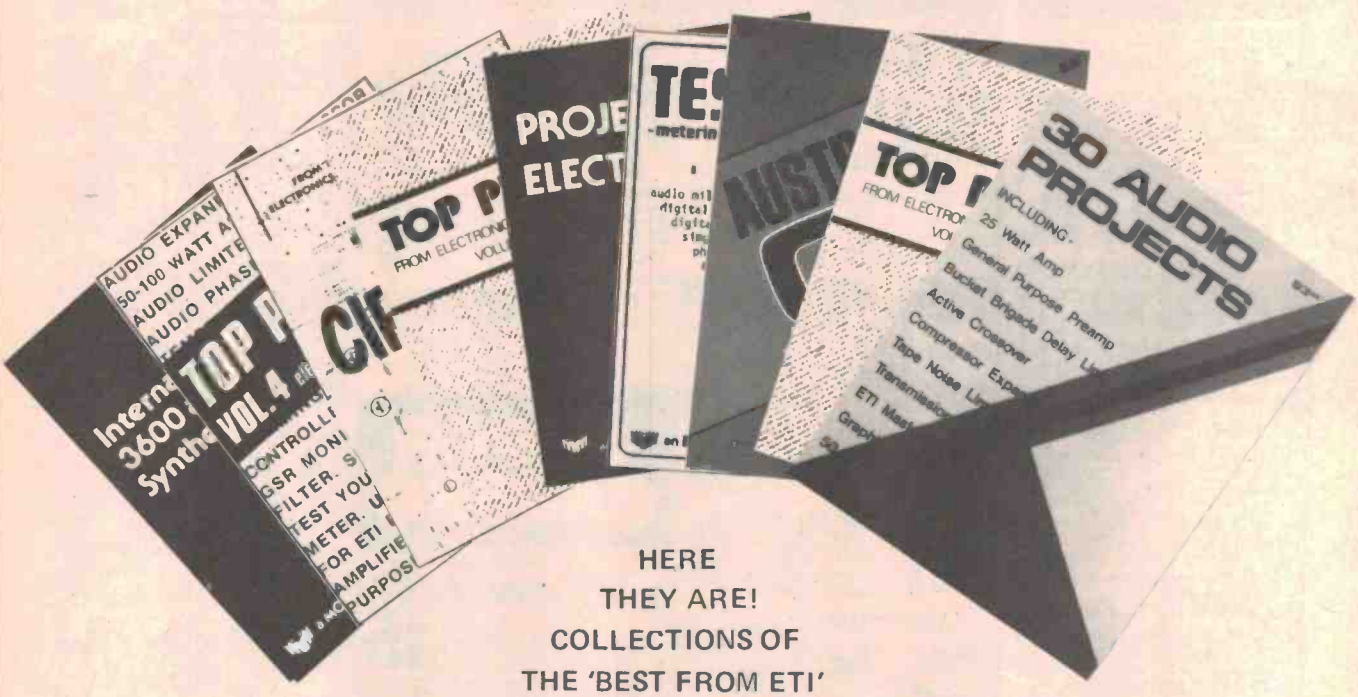

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This giant compendium of circuits has been assembled from the 'Ideas for Experimenters' section of Electronics Today and is packed full of ideas and suggestions for the experimenter. The chapter headings cover Alarms, Amplifiers, Automobile, Batteries, Comparators, Conversion Tables, Crossovers, Crystal Oscillators, Detectors, Digital, Filters and so on.

Whenever you're looking for a circuit, this is the book to turn to.

Price: $2.95 plus 45 cents post and packing.

30 Audio Projects

For the Audiophile who wants good sound at a good price plus the satisfaction of having built it himself, 30 Audio Projects is required reading. The contents include our most popular audio projects: 25 watt Amp, General Purpose Preamp, Bucket Brigade Delay Line, Active Crossover, Compressor Expander, Tape Noise Limiter, Transmission Line Speaker System, Master Mixer, Graphic Equalizer and the 50/100 Watt Amp Modules.

If you're building up a system from scratch, or if you're contemplating some add-ons for your system, you'll find them here. Available from newsagents or directly from ETI.

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Top Projects Vol. 4

Available from newsagents or directly from Electronics Today International this book, published in June 1977, contains the following projects: Audio Expander/Compressor, 50/100 Watt Amp Modules, Stereo Amplifier, Dynamic Noise Filter, Audio Phaser, Audio Limiter, TV Game, Swimming Pool Alarm, Temperature Alarm, Active Antenna, GSR Monitor, Universal Timer, Mini-Organ, GP Power Supply, Temperature Meter, Train Controller, Car 'Scope Testing.

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Simple Projects Vol. 2

A collection of some of our most popular, less complex projects. Includes: Induction Balance Metal Detector, Train Controller, Telephone Bell Extender, Photographic Strobe, Transistor Tester, Selecta-game, Breakdown Beacon, Simple Loudness Control, Touch Switch, Courtesy Light Extender, Rev Monitor/counter, Auto-amp, Car Alarm, General Purpose Power Supply, Code Practice Oscillator, Emergency Flash, Drill Speed Controller, Three Simple Receivers, One-transistor Radio, Mini-organ, Accentuated Beat Metronome, Active Antenna, Simple Intercoms, as well as constructional information, and lots of helpful data on component markings and values.

Available from newsagents or directly from ETI.

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Top Projects Vol. 5

Once again, this 'Best of ETI' publication is available from many newsagents or directly from ETI. Published in 1978 it is crammed with projects: Shutter Speed Timer, Ultrasonic Switch, Accentuated Beat Metronome, Marine Gas Alarm, House Alarm, White Line Follower, Induction Balance Metal Detector, Photographic Strobe, Simple Compressor/expander and CB Power Supply.

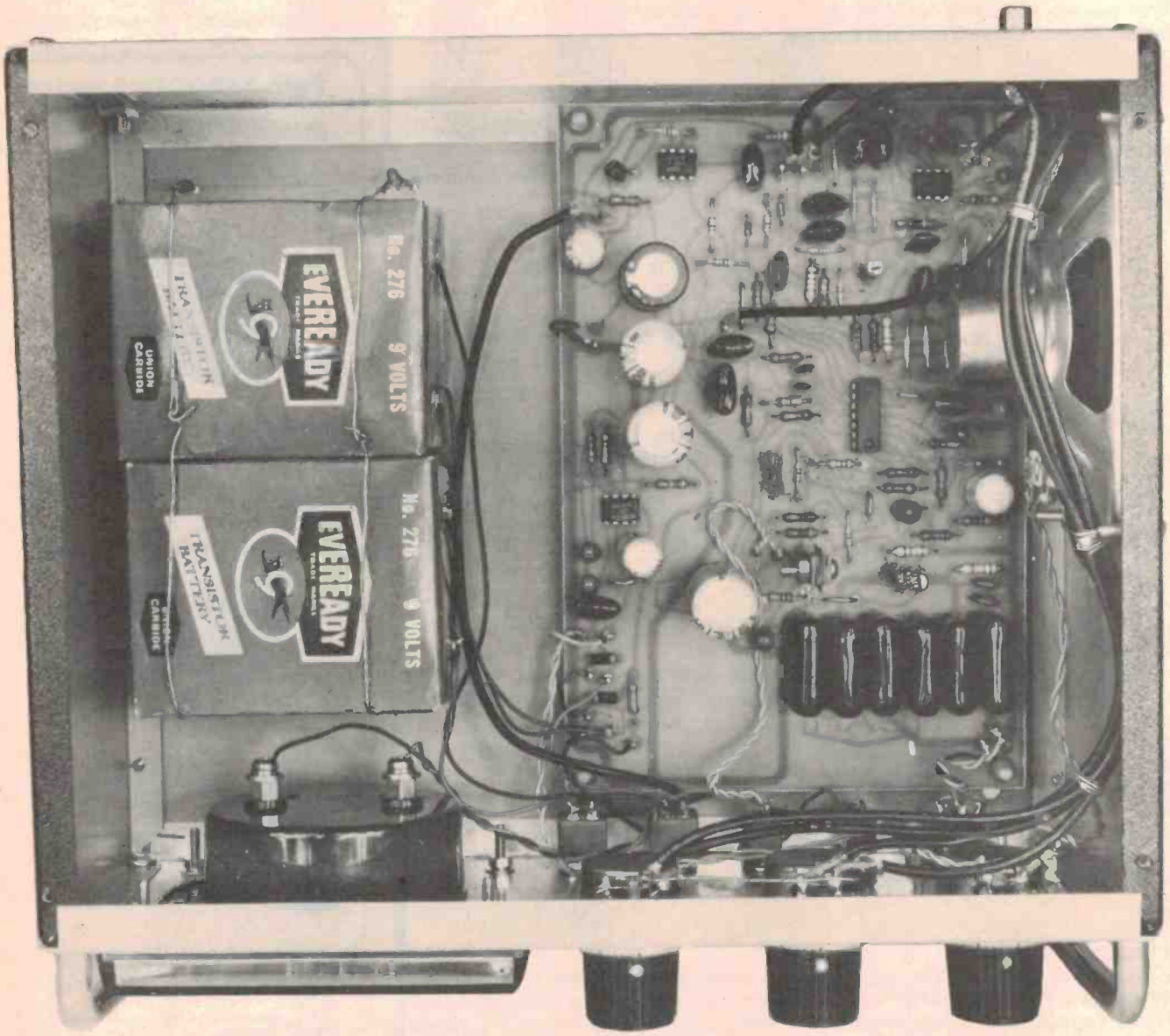
Price: $3.00 plus 45 cents post and packing.

Project 576

The electromyogram — part 2.

David Tilbrook

This month we present construction details and some suggestions on using the instrument



OUR PROTOTYPE was housed in a Horwood instrument case measuring 254 mm wide by 203 mm deep by 102 mm high. These are available from quite a few component suppliers but any box with similar dimensions should suffice. The advantage of this particular case is that it is supplied with steel top, bottom and side panels which provide better shielding from stray hum fields than does aluminium.

Construction is best commenced with the pc board. This method of construction is recommended as layout of the various stages is critical to avoid feedback or interaction between stages as one LM3900 package does sterling service in several parts of the circuit!

Assembly of the pc board should start with the resistors and capacitors. I found it easier to leave the six 1 uF input capacitors until the input transistors (Q1-Q4) were mounted. Be sure to check the polarity of the electrolytic and tantalum capacitors.

Finish loading the pc board by inserting the diodes, transistors and ICs. The input transistor pair, Q1 and Q2, must be mounted so that their flat faces are touching to provide thermal coupling. The best way to do this, to avoid straining anything, is to solder only the collectors and emitters of Q1 and Q2 at first. Smear some thermal paste on the two flats and then tie the two transistors together using a link of enamelled (coil) wire – this prevents the possibility of shorts to the transistor leads should the loop slip off at some time. Tighten the loop by taking the ends in a pair of pliers and twisting until the transistors are held tightly together. Once this is done, solder the base leads.

The two BD140s, Q3 and Q4, also need to be mounted together. As they are in TO-126 packages they may be bolted together. It is necessary to use an insulating washer between them to prevent the collector contacts touching. Use thermal paste to improve the thermal coupling.

Once these devices are mounted, six 1 uF input capacitors may be soldered into place.

If you use pc board pins, the external connections to the board may be made after it is mounted in the case, otherwise, now is the time to attach all the leads going to the externally-mounted components.

As high gain stages are used in several places, the circuit is sensitive to noise or signals radiated from other parts of the board. The 555 VCO output can be especially troublesome, so use shielded cable to connect the output of the 555 to the volume control. The only resistor not mounted on the pc board (R50) is mounted between the wiper terminal of the volume control and one of the loudspeaker terminals.

There are a number of other connections that should be made with shielded cable and these are shown in the wiring diagram.

There is sufficient room inside the cabinet to accommodate a variety of 9 V batteries. The type of connection to the battery will depend on the particular style of battery used.

The speaker is mounted on one side of the cabinet and the monitor output (and RCA coax socket) is mounted on the back.

On the front panel, the switches should be mounted first, followed by the pots and the meter. Juggle the pc board into the case last.

Electrode construction

Although the common mode rejection of the input is better than 100 dB this will be degraded drastically if the contact to the skin is not good enough. To enable the input stage CMRR to effectively reduce 50 Hz hum it is necessary to ensure that the hum is exactly the same level on both inputs. For this reason the construction of the electrodes is very important.

The diagram on page 65 shows the electrodes we built. Three lengths of shielded cable were used (RG174 coax). The two input leads are made by soldering the centre conductor of the shielded cable to small metal discs about the size of 5c pieces. Cut the earth braid back enough so that it cannot touch the electrode. The braids of the two input cables are connected to pin 2 of the five-pin DIN plug (the grounded pin). This pin is also connected to the shield of the third cable which becomes the ground electrode. The centre conductor of this cable is not used and the other end of the braid is soldered to another metal disc. Use a slightly larger disc (about the size of a 10c piece) as this helps to ensure a good ground connection to the body.

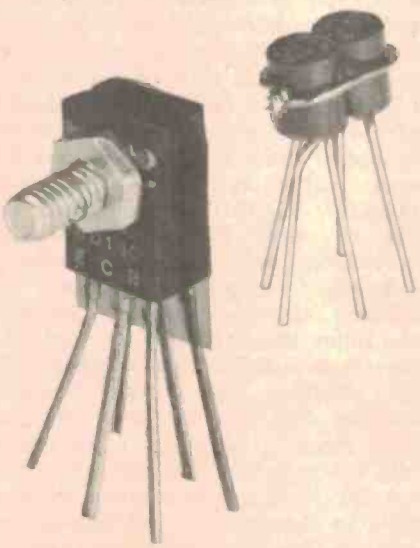
How to use it

Before powering up, check the pc board. Check the orientation of all the polarised components – electrolytic and tantalum capacitors, transistors, ICs and diodes. If everything is all right, switch the unit on with the battery switch in the test position. With 9 V batteries the meter should read about 9. If the battery switch is now switched off the meter should immediately fall to zero provided the gain control is turned fully down. If the volume control is turned to full on a slow clicking should be heard. Now, measure the voltage (with respect to earth) at the test point (TP1) at the output IC1a (pin 4). With the x10 switch in the x1 position adjust the preset pot to obtain zero volts.

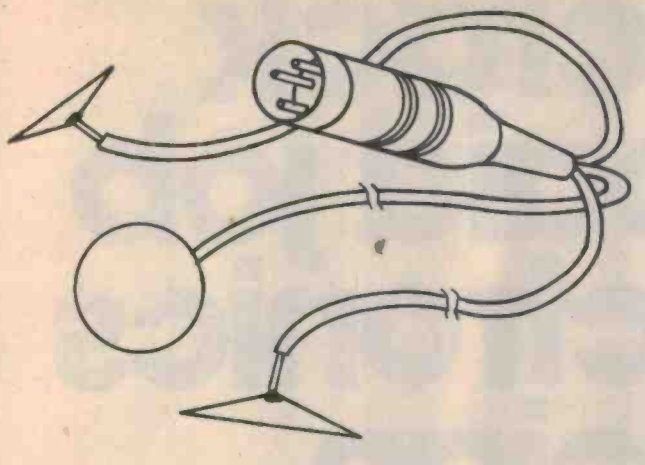
If the gain control is now increased, the meter reading will move along with the frequency of the clicks.

Now, advance the threshold control and the meter reading and click frequency should decrease. This threshold control works by varying the minimum signal required to cause a meter response. The higher the threshold control is set, the higher the input signal must be to cause a meter response. The threshold can be set just above the noise level so that even a very small input signal can be detected.

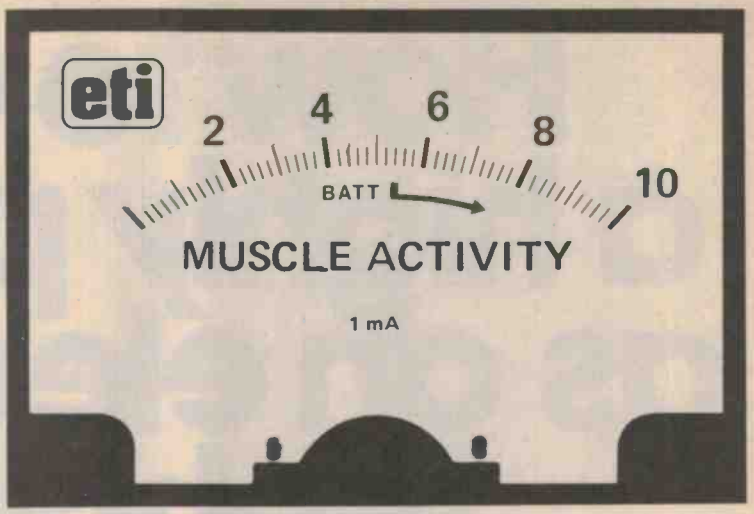
The electrodes can now be connected to the body and plugged in. The ideal way to secure the electrodes to your skin is to use a band of Velcro (Tm) tape, although we found Bandaids okay. If all three electrodes are placed reasonably close to each other along the inside of the arm (earth between the others) they can be secured in place all



Thermal stabilisation is achieved by mounting the input transistors together as shown and described in the text. Note the insulating piece between the BD140s.



The three electrodes.



Full size reproduction of the meter scale.

at once with a single wide band of Velcro wrapped right around the arm. Some electrode paste may be used between the electrodes and the skin to improve the contact. This is available from some distributing chemists and medical suppliers, although it is relatively expensive. We found moistening the electrode to be a good alternative.

Once the electrodes are attached to the arm and plugged into the EMG monitor a reading should be easily obtained. Start with the gain and threshold controls set fully anti-clockwise, the gain switch in the X1 position and the integrate switch off.

If the arm is tensed the meter should indicate muscle activity readily. With these settings the EMG is really acting as a strength meter. Relaxing the arm, the gain switch can be switched to the x10 position and the gain control slowly increased. With each gain increase, the threshold can be increased slightly to cancel any increase in noise that may have occured, although don't overdo the use of the threshold control until you are familiar with the unit as it is easy to cover up muscle activity as well as noise.

Eventually you should reach a stage such that the gain control can be set at maximum but with muscle activity held so low that the meter reads about 2 to 3.

This isn't easy! In fact the only person who has been able to do this so far has been Tom Benjamin, the author of our article on biofeedback, and quite a few of us have tried!

Some experimentation with electrode placement will indicate how to get good results on particular muscles.

For some background reading on EMG instruments, an article in the March/April issue of "Physiotherapy Canada" (published by the Canadian Physiotherapy Association) on EMG biofeedback, pages 65 to 72, gives an overview and a very comprehensive list of references. ●

PARTS LIST - ETI 576

Resistors all ½ watt, 5%

R1, R2	220k
R3	4k7
R4	100R
R5, R6	2M2
R7	4k7
R8	1M
R9	4k7
R10, R11	1M
R12	1k
R13	8k2
R14–R17	47k
R18	220k
R19	270k
R20	10k
R21	100k
R22, R23	1M
R24	10k
R25, R26	100R
R27–R30	47k
R31	220k
R32	270k
R33	10k
R34	330k
R35	560k
R36	5M6
R37	3M3
R38, R39	10k
R40, R41	1M
R42	10k
R43	390k
R44	470k
R45	1k
R46	680R
R47	10k
R48	2k7
R49	18k
R50	27R (mounted on volume pot)

Capacitors

C1–C6	1µ greencap
C7, C8	1n greencap
C9, C10	33µ 16V tantalum
C11	100µ 25V electro
C12	33µ 16V tantalum
C13	100n greencap
C14–C17	68n greencap
C18	22n greencap
C19, C20	33µ 16V tantalum
C21	100n greencap
C22	1000µ 25V electro
C23	33µ 16V tantalum
C24–C27	68n greencap
C28	47n greencap
C29, C30	1n greencap
C31	100n greencap
C32	220n greencap
C33	150n greencap
C34	100n greencap
C35	33µ 16V tantalum
C36	100µ 25V electro
C37	470µ 25V electro
C38	47µ 25V electro
C39, C40	1000µ 25V electro
C41	33µ 16V tantalum

Semiconductors

D1, D2	IN914 or sim
D3, D4	EM401, EM4001, IN4004 or sim
Q1, Q2	BC559, BC179, DS559
Q3, Q4	BD140
Q5–Q7	BC549, BC109, DS549
IC1	LM3900
IC2, IC3	741
IC4	555

Potentiometers

RV1	1M linear
RV2	5k linear
RV3	1k linear
RV4	1k vertical mounting trim pot

Switches

SW1, SW2	SPST miniature toggle
SW3, SW4	DPDT miniature toggle

Miscellaneous

M1	1mA meter, 100 mm x 80 mm, square face MRA 658 or similar;

5-pin DIN socket; 8 ohm small speaker; panel mounting RCA socket; two 9V batteries type 276 or 2364; knobs, instrument case Horwood 203 x 102 x 254 mm or similar; power cord and plug.

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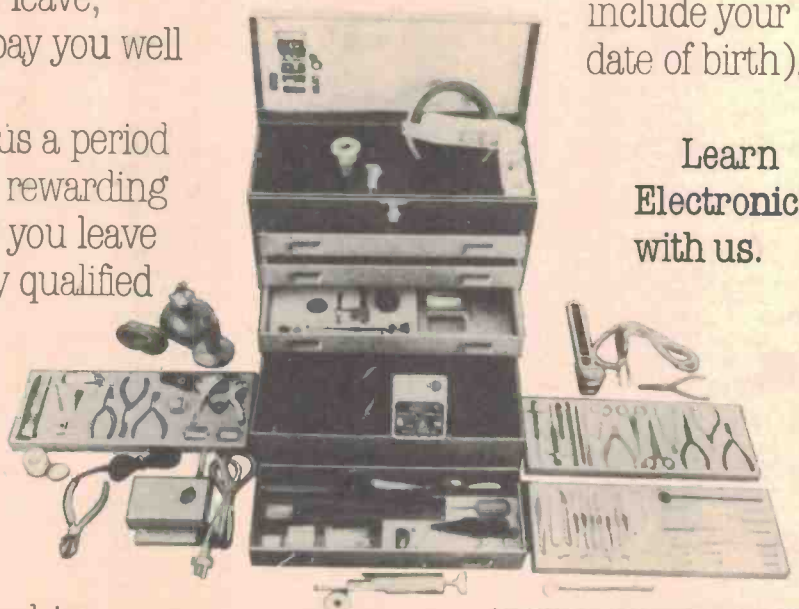

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Lab Notes

An occasional series in which we discuss interesting circuit techniques, circuits we have tried in our own laboratory but not developed as a project, practical notes on projects, measurement techniques for hobbyists etc.

The ETI-III IC power supply revisited

WE RECENTLY received a letter from a reader who had built a number of our ETI-111 IC Power Supply projects (keen lad . . . Ed.). Now this versatile little unit was first published in our November 1972 issue and subsequently in our 25 Top Projects and Test Gear books.

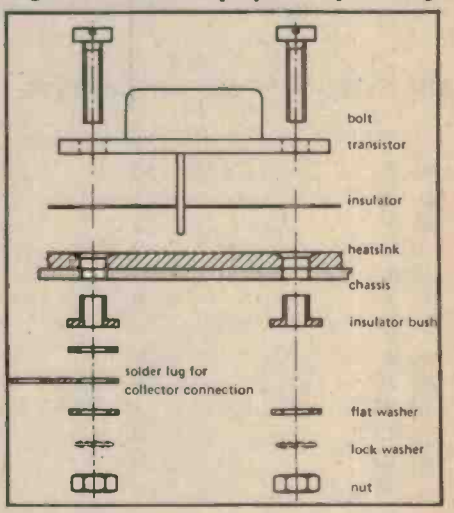
Based on the common 723 regulator IC, the supply is variable between 1.5 and 15 volts and will deliver up to 1A maximum current. It was designed to be simple to construct with a number of optional configurations (fixed, variable or preset output) and has surprisingly good performance.

Our reader, Mr. T.J. Greenfield, has pointed out a number of drawbacks in the original design – which we think justified in the light of developments since 1972 – which he set out to correct.

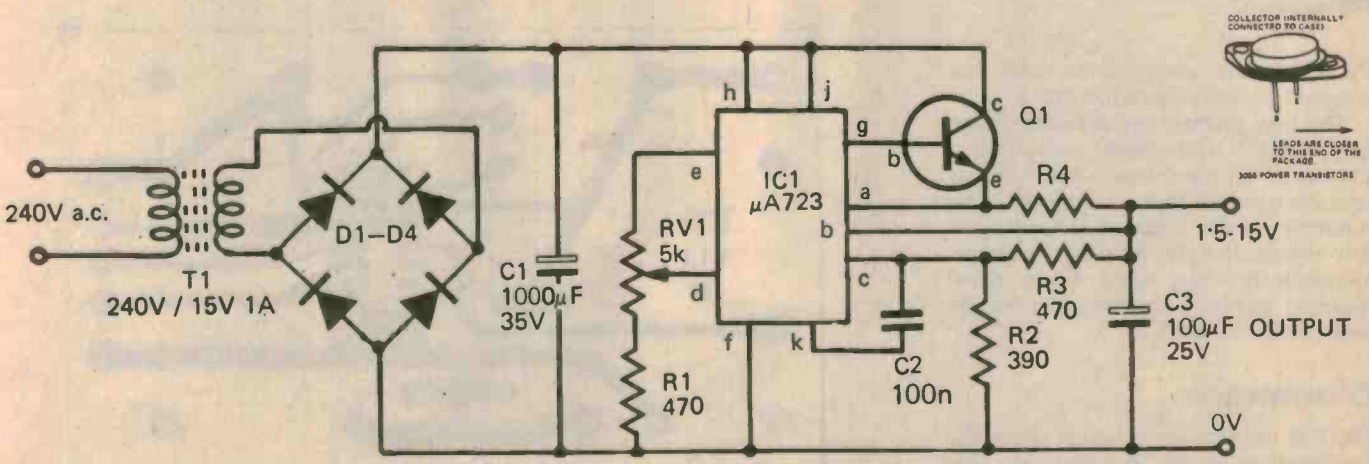
The original design called for a regulator IC in a metal can encapsulation. This happened to be the most commonly available type of encapsulation for 723s at that time. These are now as scarce as tail feathers from a Dodo (or hen's teeth, whichever is the lesser), so Mr. Greenfield has designed another printed circuit to accommodate the standard 14-pin dual-in-line (DIL) package in which 723s are commonly supplied these days.

In addition, the 1972 design had the main 'series pass' transistor, a 2N3055, mounted on a heatsink, which assembly was mounted to the pc board instead of mounting the transistor on the case, but insulated from it. This construction method prevented accidental short-circuiting of the 2N3055 – and subsequent destruction – certainly a consideration, being mindful of the 'universal' nature of the supply and that the project would likely be built by many newcomers to electronics.

Mr. Greenfield has made provision for the 2N3055 (or similar) series pass transistor to be mounted off the pc board. This allows a number of more flexible configurations for the power supply. The flat-pack style TIP3055, in the TO-220 package, may now be pressed into service – these were not generally available until quite recently, and are very handy for applications such as this. A series pass transistor in this package may be mounted on the case which you might use for this project – providing ▶

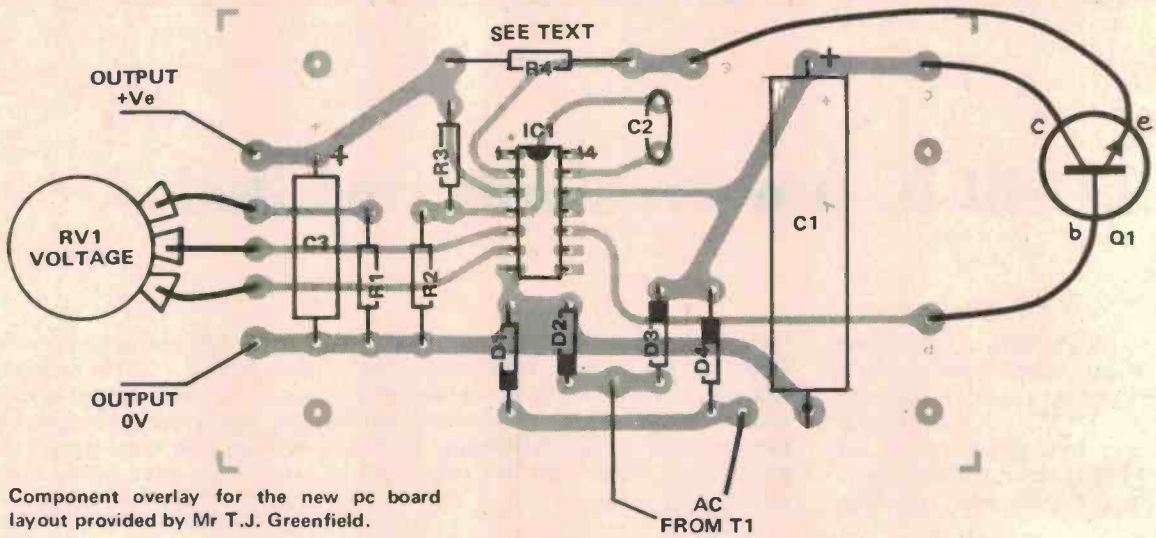


General mounting details for a TO-3 2N3055.



Pin numbers are not shown on the circuit diagram for the regulator IC as either DIL or CAN type packages can be used. A table for pin connections is shown on page 70.

Lab Notes



Component overlay for the new pc board layout provided by Mr T.J. Greenfield.

DIL TYPE	METAL CAN TYPE
1	–
a) 2	10
b) 3	1
c) 4	2
d) 5	3
e) 6	4
f) 7	5
– 8	–
– 9	–
g) 10	6
h) 11	7
j) 12	8
k) 13	9
14	–

Pin cross connections for DIL and CAN TYPE 723 regulators.

it's of metal construction and has adequate heatsinking properties.

The new printed circuit board design from Mr. Greenfield, designated ETI-111B, is reproduced here. It has been designed so that a trimpot may be mounted on the board if the supply is only required to deliver a fixed voltage. Alternatively, the usual front panel mounted pot for variable output voltage control may be used.

Construction

There is nothing very critical about the construction of this project. Just take the usual precautions and see that the polarity of the diodes and electrolytic capacitors is correct. Also, ensure that the series pass transistor (Q1) is correctly connected.

If less than the rated 1A current is all that is required, almost any small metal case used to house the unit should be more than adequate. Even the metal panel of a 'zippy' or 'jiffy' box would be adequate for currents of 300 mA or so.

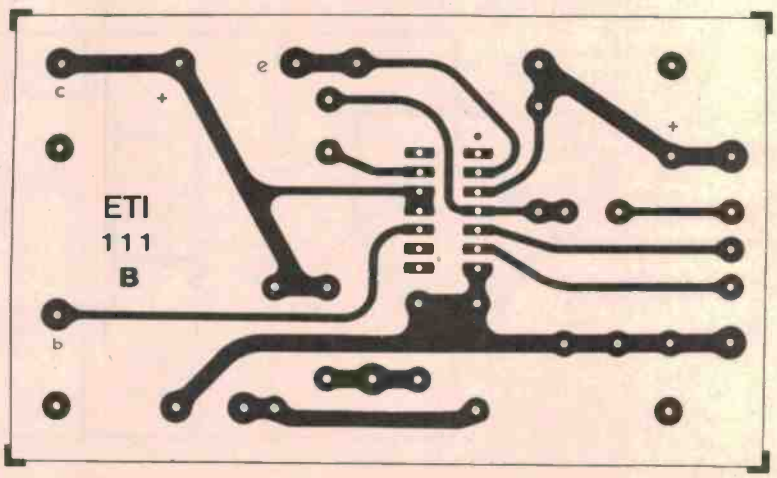
The 723 alone will deliver as much as 150 mA which is more than adequate for a host of small projects and circuits.

When mounting a TO-220 flat pack series-pass transistor, take care to insulate it electrically – use one of the insulator/mounting kits available (refer to the diagram to see how it's assembled). See that the mounting bolt, if exposed, is insulated from the metal part of the package to avoid the possibility of a short circuit (the rectifier would be shorted – which may not be good for its health).

Details for mounting a TO-3 style 2N3055 are also given here.

Selecting the current limit

By developing a voltage across pins 10 and 1 of the 723, its output voltage can be made to 'fold back' at a selected load current. That is, the voltage output starts to fall when the limit is



Full size printed circuit board artwork.

PARTS LIST - ETI 111B

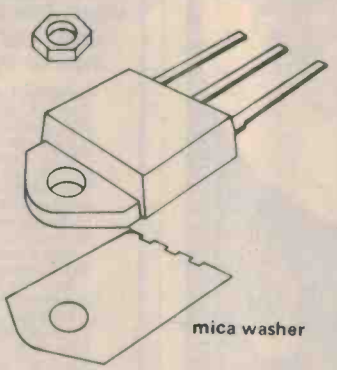
Resistors all ½W, 5%
R1 . . . . . 470R
R2 . . . . . 390R
R3 . . . . . 470R
R4 . . . . . Shunt resistor - see text

RV1 . . . . . 5k lin pot

Capacitors
C1. . . . . 1000µ 35V electro
C2. . . . . 100n greencap
C3. . . . . 100µ 25V electro

Semiconductors
D1–D4. . . . . EM4001 or sim 1A power diode
Q1 . . . . . 2N3055
IC1 . . . . . 723 Regulator IC

Miscellaneous
T1. . . . . 15V 1A transformer - Ferguson Type PL30/ 15VA or sim
Box to suit, ETI 111B pc board, terminals, mica insulation and insulating bushes for transistor, power cord and plug.



TO220 PACKAGE
Insulator and bolt assembly diagram

approached, finally falling to zero and hence protecting the power supply against destruction from overload.

By changing the value of R4 the 'foldback current' can be varied. If the resistor is switched, a number of current ranges may be included in the power supply. If you are testing a circuit which should only draw say 100 mA, the limit can be set just above this current to protect the circuit.

The table gives current limit values for common resistors.

R4	Limit
10R	65 mA
1R	650 mA
0.5R (1/2 ohm)	1.4 A
0.2R (1/5 ohm)	3.2 A

Mr. Greenfield says he has used his ETI-111 projects for: a slot car power supply, mini drill supply, a trickle charger and a general purpose power supply.

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HOW'S YOUR BLOOD PRESSURE?

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Introducing the Unitrex Home Blood Pressure Monitoring Kits!

A SPHYGMOMANOMETER can help protect you and your family against one of the most dreaded human killers in the world – heart disease and other illnesses associated with abnormal blood. It is not surprising then that hundreds of thousands of people world-wide are buying their own personal blood pressure monitoring devices – NOT as replacements for regular medical checks. But simply as an extra precaution for peace of mind.

One of the best known home units is the Home Blood Pressure Monitoring Kit from Unitrex. A substantial quantity of these were imported by Australia's Caldor Corporation and sold extensively via chemists – they were also offered via mail order.

Caldor have a number of these units still available which they are offering to our readers for the very low price of $29.95 – plus $2.50 post and packing. The kit includes the professional blood pressure unit itself, a nurse's stethoscope, a complete instruction book and three month's supply of blood pressure recording forms.

Please note: This offer is made by the Caldor Corporation, 12 Terra Cotta Drive, Blackburn, Vic., 3130. This magazine is acting as a clearing house for orders only. Cheques should be made out to 'Caldor Offer' and sent together with order to 'Caldor Offer', Electronics Today Int., 15 Boundary Street, Rushcutters Bay, NSW, 2011. ETI will process orders and pass them on to Caldor who will then send out the units by certified mail. Please allow approximately four weeks for delivery.

Caldor Offer

Please send me:

. . . . . .Quantity – Unitrex blood pressure monitoring kit/s at $29.95 each $ . . . . . .

plus postage at $2.50 each $ . . . . . .

TOTAL $.

Name . . . . . .

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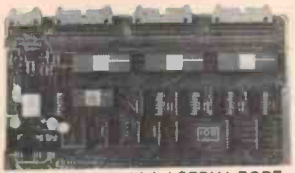

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Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project – check with our advertisers if it is not mentioned here. Also, for a list of suppliers who stock the ETI projects published over the last 2½ years, our "Kits for Projects" page may always be found on the page immediately before the DREGS page (inside the back cover).

First up this month, a note about our **Induction Balance Metal Locator, ETI 549** (May 1977 issue) – it seems everyone's gone metal detector mad these days! The Sunday papers have been giving the latest gold rush(es) a good run these last few months and metal detectors have figured in a few 'finds'. Even if you don't plan on using our metal detector for such speculative ventures, but more mundane/pragmatic applications like finding water pipes in the back garden – the following suggestion will be of interest.

A number of readers, having successfully constructed this project, found the sensitivity control somewhat 'coarse' in adjustment. Thinks . . how to improve it without restricting the overall range? (very necessary). Solution . . . replace it with a ten-turn potentiometer. Simple, but where do you get them? Many frustrated hobbyists have found them to be almost as rare as rocking horse dung (or wing feathers from a Dodo, hen's teeth – etc.).

Fear not dear readers . . we have cast our net far and wide to the four corners of the land (well, round and about anyway). We found two stores could oblige. Namely:

Radio Despatch Service
869 George Street
Sydney, NSW 2000

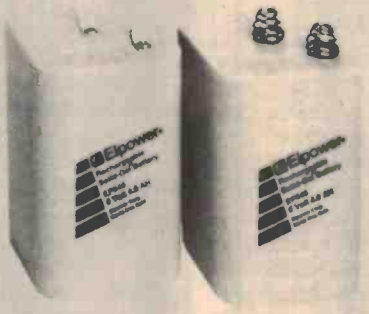
and

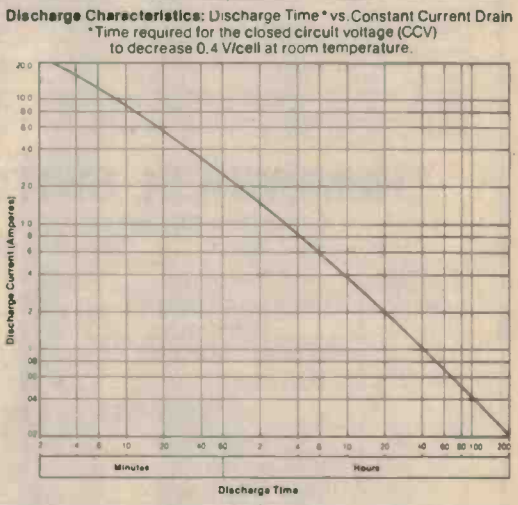
Stewart Electronics
33 Sunhill Road
Mount Waverley, Vic 3149

They stock the shaft-drive types, required by the project, in a suitable value (5k). Price: around $6-$7.

Concerning the item on Instrument cases from Adaptive Electronics in last month's Shoparound, the Director, Steve Tusack, advises that they can now supply screen-printed front panels for the Series 4000 stereo amp. While we're on the subject, David Tilbrook suggests it might be worthwhile putting the Moving-coil Cartridge Preamp, and its power supply, each in a suitable-sized Adaptive case with the steel top and bottom plates as this should improve rejection of external hum fields.

Having mentioned the subject of front panels, in case you've already forgotten last month's item, Radio Despatch Service advise that they will be able to provide Scotchcal front panels and meter scales for ETI projects in red, blue or black on a silver background. All new projects, and a number of past ones, which use Scotchcal front panels will be stocked.





The Elpower 6V lantern battery style gel electrolyte rechargeable batteries (above) and their discharge characteristics (right). Data courtesy Ampec Engineering.

Rechargeable batteries can save you money in the long run. They're particularly attractive if they match the standard Leclanche dry batteries so widely used in a myriad of appliations. Ampec Engineering of Sydney are importing a range of rechargeable solid-gel electrolyte batteries in sizes to match the popular dry batteries.

These batteries, made by Elpower, can be charged and discharged from 100 to 1000 times. They can be recharged from a fully discharged state in less than 14 hours, according to the manufacturer. They may be left on float charge without damage and have the marvellous ability to be mounted in any position – the gel electrolyte will not leak.

The most popular sizes – and obviously most useful to constructors – are the 6V lantern style, EP640-21 with spring terminals and the 12V 'Big Jim', with screw terminals. Both have a capacity of 4 AH (ampere-hours) about one-tenth that of a car battery, which is plenty for a whole host of battery-operated projects.

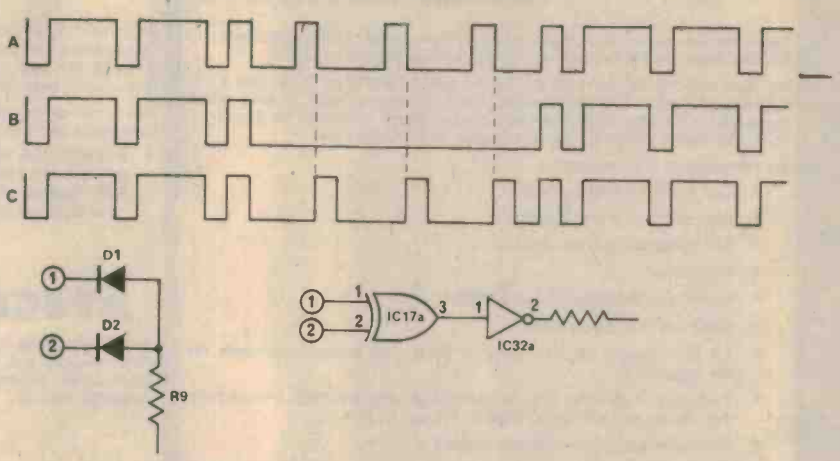
The lantern style battery (EP640-21) costs around $12. Over their lifetime, these batteries would represent quite some saving over standard dry-cell batteries which cost up to several dollars and may be used only once.

Any charger can be used to recharge the batteries as long as the output voltage is greater than the fully-charged open-circuit voltage of the battery. For a 6V battery the charging voltage should be about 7.5V and the float voltage about 6.75V. For a 12V type, charge and float voltages should be 15V and 13.5V respectively. Charging current should be no more than one-tenth of the battery's AH capacity. The simplest charger would consist of a transformer, diode bridge and current limiting resistor. The limiting resistor should be chosen to limit the current to the correct value for a fully-discharged battery.

A number of suppliers are expected to have stocks shortly but at present they are only available from Radio Despair . . . er, um I mean – Despatch or Martins Laundry . . . oops, that is, Martin de Launay, in Sydney.

Ideas for Experimenters

Improved sync for the 640 VDU



Having spent some time getting his 640 VDU to produce sync which his modified TV would lock on, Mark Johnson of Wahroonga in Sydney, sent us this remarkably simple modification. This change will improve the stability of the display, particularly on the first lines following the vertical retrace.

True composite television sync has horizontal sync pulses during the vertical retrace. A *simplified* TV sync pulse waveform is shown in A in the diagram here, compared to the original 640 VDU sync in B and the sync produced by this modification in C.

The simple sync pulses generated by the 640 VDU are often not adequate to drive modified TVs which many 640 owners may be using. Whilst the sync pulses produced by this modification are not ideal, life is made a little easier for the TV's horizontal oscillator during retrace (or just after!).

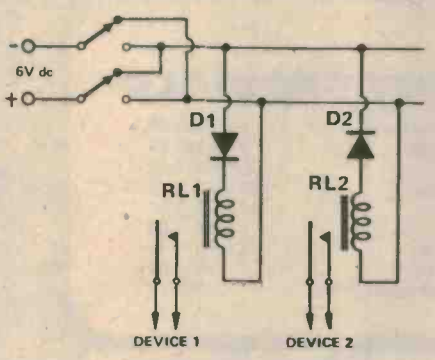
The changes are simple. The diode OR gate, D1 and D2, is replaced by an exclusive -OR gate, followed by an inverter. As both the ex-OR and the inverter are available spare in packages on the VDU board, this modification can be made without extra parts or cost!

Diodes D1 and D2 are removed and their cathode pads connected to the inputs of the ex-OR (in IC17) by flying leads. The output of the ex-OR (pin 3, IC17) is linked to the inverter (in IC32) input, the inverter output being returned to the anode pads of D1 and D2.

In normal TV sync, horizontal sync pulses are transmitted during the vertical sync period, allowing continued phase lock of the horizontal oscillator. The ex-OR approximates this characteristic allowing horizontal sync pulses during the vertical retrace. While not ideal, this modification enables quicker phase lock after the retrace, stabilizing the first few lines.

At the same time, without the diode voltage drops, the overall sync magnitude available is a little greater, generally resulting in better locking.

Two-wire relay control



The problem of how to operate two relays independantly from just two wires always produces a lot of head scratching – and not just with beginners! This circuit, from the ETI files, shows how it's done.

The relays RL1 and RL2 are each connected to the two-wire line via a series diode. However, D1 is connected the opposite way round to D2. A reversing switch at the end of the line, before the dc voltage required to operate the relays, is used to set which relay will be activated. With the dc voltage connected in the polarity shown, and the reversing switch set as indicated, D1 will conduct and current will flow through RL1 which then operates Device 1 connected to its contacts. D2 will be reverse biased and will not conduct. When the reversing switch is set the opposite way D2 will conduct, D1 being reverse biased now, and RL2 will operate.

If you want both relays off for some purpose, the dc voltage will have to be disconnected. The simplest way to do this is to have a three-position two-pole toggle switch, the centre position being 'off'.

Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item – depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

DREAM 6802 —COMPLETE KIT

Learn as you build this fascinating microprocessor project designed by Michael Bauer and published in Electronics Australia, May, 1979.

We have redesigned the PCB to use the latest 6802 chip which has a self contained clock driver (eliminates 6875 problems) and is fully 6800 compatible. We have also designed a special touch keyboard on a separate PCB, containing power supply, modulator and loudspeaker.

All components are included:

- Top quality fibreglass PCB.
- Low cost touch keyboard.
- Self contained power supply.
- Modulator.
- CHIPOS in preprogrammed 2708 EPROM.
- 6802 with full data sheets.
- All components as described in parts list, including sockets for the larger IC's.
- Exclusive Assembly Manual with full step by step instructions, data sheets and exciting programs for you to run.
- Full technical support (details in each kit).

This kit is complete to the last bolt, and requires about 6-8 hours of assembly time for an experienced constructor.

DREAM 6802 **$149.50 (including Sales Tax).**
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Build this top performing Hi Fi amplifier as described in ETI, May, 1979. Our engineers have gone to great lengths to make sure this is a real pleasure to build. We have prepared a detailed Assembly Manual with step by step instructions and troubleshooting hints.

Our repair service is available on this kit (full details in each kit). The case supplied is identical to that used in the article but with timber sides.

ETI 470. 60W module kit (2 required)	$29.50 each.
ETI 471. PREAMP KIT (1 required)	$47.50. *P/P $2.00.*
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This is complete to the last bolt. Includes 2 x 470 kits, 1 x 471 kit, 1 x power supply kit, 4000 case with timber sides, silk screened prepunched front panel, knobs, sockets etc. Also includes our detailed step by step Assembly Manual.

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DG640 VDU

Our most popular product to date. This memory mapped VDU was designed by David Griffiths and published in ETI, March, 1978.

Features
- 16 line 64 characters.
- Upper/lower case,
- Full graphics.
- Quality plated through hole PCB with gold S100 edge connectors.
- Detailed manual with software.

DG 640	(Kit)	$139.50
	Assembled	$149.00
	PCB with Manual	$ 35.00
	Certified post	*$ 2.50*

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16K Conversion Kit (8 x 4116 Rams)	$115.00
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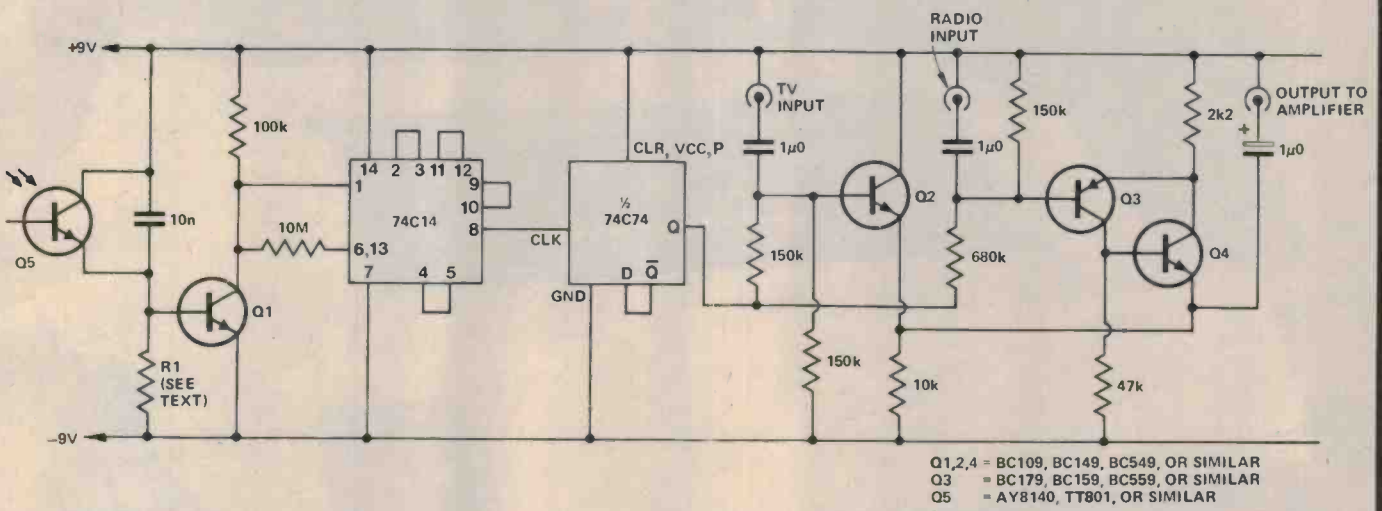
Ideas for Experimenters



TV ad blanker

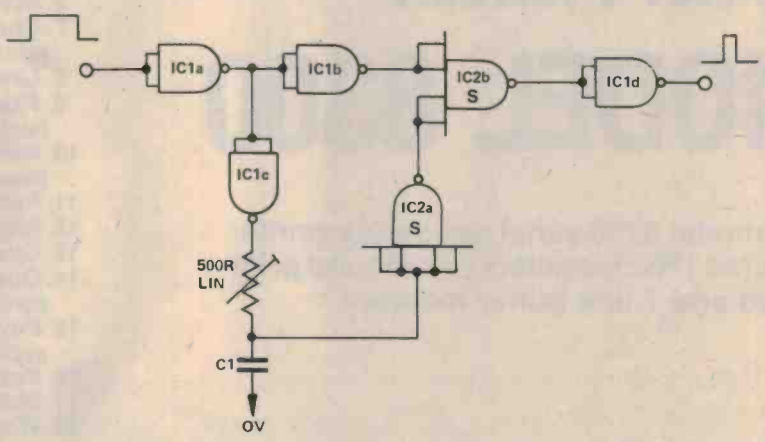
If you dislike having to watch TV adverts, then this idea, from Graham Taylor of Glen Iris, may be to your liking.

Basically, it's a light-controlled AB switch. When the photo-transistor receives a pulse of light — from a hand torch held by the person watching the TV — it toggles the bistable IC2 and changes the state of its Q output. Depending on whether this output is at +9 V or −9 V, either the TV sound input or the radio sound input will be fed to the amplifier output. This can either be connected to your hi-fi amplifier or, if you feel capable of tackling it, back into the sound section of your TV set.

Operation is simple. You're watching TV, and suddenly the action is interrupted by a commercial. Quick as a flash, you pick up the torch (which you keep on the coffee table) and point it at the Ad Blanker, which sits on top of the TV set. The circuit senses the light and cuts off the advert's sound, replacing it with some soothing intermission-like music from the radio. As soon as the ad is over, you fire another light beam at the unit and it reverts to its original state.

The use of this device has another, hidden advantage. Listening to the TV with the radio sound playing instead sometimes produces hilarious combinations.

Pulse compressor



This circuit will prove useful in any application where it is required to reduce the width of a digital pulse by a pre-set amount.

Using only two ICs, it can achieve pulse width reductions up to about 10 milliseconds. The following table gives some examples of the width reduction achieved by using different capacitor values:

Width reduction	C1
3 ms	8 u
5 ms	4 u
9 ms	1 u
9.5 ms	470 n
9.9 ms	100 n

Before the input pulse is applied, the output of IC1c is low and so IC2b's output is high. The circuit output is thus low.

When the input pulse is applied, the output of IC1c starts to rise, but the output of the circuit remains low because of the high on the output of IC2a. When C1 charges to the threshold voltage of IC2a, the output of IC2a will go low and the output of IC2b will go low while the input to the circuit is still high. Thus the start of the pulse is delayed by the amount of time taken for C1 to charge.

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MODEL 8300

The model 8300 serial dot matrix printer features 125 characters per second print speed and 1 line buffer memory.

1. Print speed: 125 CPS (50 Hz) 60 LPM (50 Hz)
2. Interface: 8 bit parallel-standard RS-232C/TTY-option
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4. Code: ASCII (96 characters)
5. Character font: 7 x 5 dot matrix (7x9 option)
6. Number of columns: 80 column
7. Character spacing: 10 CPI (Enlarged character printing is available)
8. Line spacing: 6 LPI
9. Paper width: Width: from 4.5 inch to 9.5 inch (including sprocket margin)
10. Number of Copies: Original plus 3 copies nominal (max. total thickness 0.013 inch)
11. Paper feed method: Pin feed
12. Ribbon: 13mm width, purple color
13. Operating temperature: 10°C-35°C (50°F-95°F).
14. Operating humidity: 10 percent-80 percent (Non condensed)
15. Power input: 220 or 240 VAC 10 percent/50Hz available
16. Power Consumption: Printing 100W. Non printing 7W
17. Dimension: approx. 449(W) x 375(D) x 185(H) mm
18. Weight: approx. 10Kg

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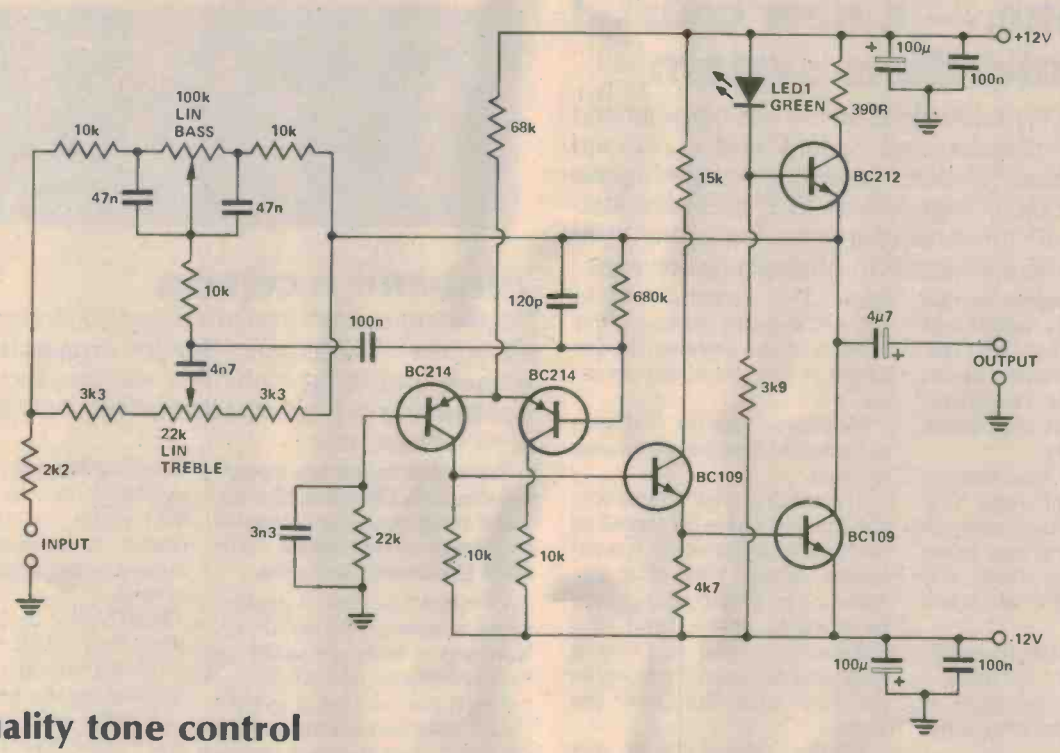
Ideas for Experimenters



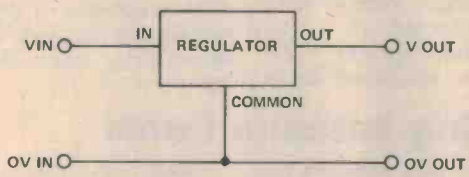
High-quality tone control

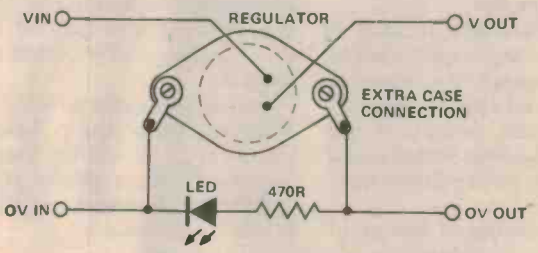
When designing a high-quality preamp, the tone control is sometimes a problem. Op amps such as the 741 are commonly used, but have a poor slew rate, give rise to distortion and exhibit rather a high noise figure.

The circuit shown here is based on an inverting op amp – but using discrete transistors to overcome the above problems. The output stage is driven by a constant current source, biased by a green LED to provide temperature compensation.

With the controls flat, the circuit has unity gain and the stage may be switched out as required.

The design is suitable for inputs between 100 mV and 1 V, and will provide a good overload margin at low distortion for the accurate reproduction of transients.





IC Regulator fail-safe

One of the problems with using power supplies based on IC voltage regulators is the chance that the common (case) connection could come adrift. This allows the voltage after the regulator to rise to the full value of the un-regulated supply. If the supply is driving a board crammed with TTL, the result could be disastrous.

By using the regulator as shown, taking the output from a connection to the case which is separate from the input connection, the output will always drop to zero if a lead is disconnected.

An LED can be connected as shown to provide an indication of a fault condition.

COMMUNICATIONS

Seaphone — a new coastal communications system

A new public communications facility has commenced operation in Melbourne and Sydney and is planned soon to be available in other coastal areas of Australia to provide a reliable, high-quality VHF radio link between vessels off the Australian coast and any connected telephone installation in Australia or overseas.

Known as Seaphone, the service is OTC's advanced radio telephone system. The use of VHF provides clear, interference-free reception and reliability at moderate installation costs.

Owners and/or operators of marine craft which have VHF equipment connected through Seaphone channels may make direct calls to or from any shore-based location which has a telephone.

In the ship-to-shore direction, the time lapse in securing a person-to-person connection is expected to be less than a minute.

Seaphone also has other important benefits, including marine surveillance. For the protection of marine craft and seafarers in coastal waters, a continuous and disciplined watching system is essential. Seaphone will provide a 24-hour emergency cover for marine craft and their passengers during the hours when volunteer rescue organisations are normally inactive.

OTC's Seaphone network is always on standby and ready to alert the necessary emergency services if and when required. At regular times, Seaphone will broadcast weather bulletins and navigation information over channel 67.

The operational range of Seaphone extends up to 150 km seaward. However, the range is largely governed by the height of the shipboard antenna.

Melbourne was the first area in Australia to get full Seaphone facilities.

The existing pilot VHF service in Sydney is being upgraded to full Seaphone capability. It is expected during 1980 that stations near Wollongong and Newcastle will extend the Seaphone service to cover a wide area between Tuncurry in the north and Moruya in the south.

Further installations are planned in Perth, Dampier and Port Hedland to provide coverage of the major regions along the west coast of the continent. All locations will have a round-the-clock listening watch on emergency channels.

The Seaphone system, when fully operational, should provide a coastal VHF service comparable with any in the world.

A comprehensive booklet explaining the Seaphone system has been produced by OTC. Copies will be posted on request.

Enquiries may be directed to Manager (Telephone & Television) OTC, 32 Martin Place, Sydney 2000; or phone (02) 230-5681 (Sydney), or (03) 60-0351 (Melbourne).

Amateur history research

Bill Tanner VK7TE is endeavouring to collate a history of all Tasmanian radio amateurs, past and present.

He would like a photo of each, colour if possible, plus a short autobiography covering life activities, hobbies, work etc. Details especially required are: date of amateur qualification, call allotted, calls held and other relevant details.

This is undoubtedly a worthwhile contribution to the radio history of Australia as many amateurs were involved in the early days.

If any readers can assist, please contact The Secretary, Northern Branch WIA, Lucy Lockett VK7NSB, P.O. Box 275, Launceston 7250 Tas.

Air band receivers

Monitoring aircraft transmissions has long been a requirement of emergency service organisations, flying schools and flying clubs and aviators themselves as well as being of interest to a small band of communications enthusiasts.

Two new receivers covering the 108-136 MHz aircraft band were recently released by Melbourne-based firm GFS Electronic Imports.

One is a 12-channel pocket-sized receiver, model AP-12, featuring a high sensitivity of half a microvolt (for 10 dB signal to noise ratio) and in-built NiCad batteries allowing around 24 hours of continuous operation.

The squelch circuit of this receiver is claimed to be highly effective; unlike carrier-operated circuits it is not triggered by ignition noise.

The AP-12 is supplied complete with NiCad batteries, charger, three crystals and a telescopic antenna. Options include a leather carrying case, short rubber antenna and car adapter/charger. Price is $212 including sales tax.

The other model, The R-1010, is intended as a base/mobile unit and may be operated from a nominal 12 Vdc supply or the 240 Vac mains. It features a phase-locked loop synthesizer and covers 108 MHz to 136.975 MHz in 25 kHz steps, providing 1120 channels. A LED digital frequency readout is featured on the front panel.

A noise blanker is included and the unit claims a sensitivity of one microvolt for 20 dB signal to noise ratio.

The unit weighs just 3 kg and measures a compact 160 mm wide by 56 mm high by 250 mm deep. It is supplied complete with built-in telescopic antenna (external antenna connector provided) for a price of $509 including sales tax.

Information on these transceivers can be obtained from GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic 3132. Phone Greg Whiter (03) 873-3939.

Orbiting antenna farms

A US$100 000 contract has been awarded to Comsat to study the "future generation" of communications satellites called Geostationary Platforms or Orbiting Antenna Farms.

These giant orbiting structures are being envisioned as permanent communications centres which may replace several individual satellites.

They offer potential advantages of increased capabilities, easier maintenance and lower cost, according to Comsat.

Large, high power communications platforms may result in less space congestion, smaller earth stations and a " . . . wide variety of services to many users at different frequencies".

Awarded by the NASA Space Flight Centre, the Comsat study contract will last nine months. It will include geographical coverage of existing communications satellites, future requirements in America and Europe as well as technological requirements of necessary equipment and antenna configurations.

Communications computer

The latest in microprocessor technology for the communications hobbyist, is the Tono Theta-7000 communications computer.

Specially designed for the amateur radio operator, the computer offers facilities for both transmission and reception of RTTY, CW and ASCII plus video output for monitoring and a parallel port for a hard-copy printer.

Firmware provided includes the usual housekeeping, cursor and scrolling functions plus the ability to interface with another microprocessor unit.

Information can be recorded and played back using an external tape recorder.

The unit is imported by Vicom International and is the first of its type ever offered in Australia.

"The Tono is packed with features and tricks not previously available with other units. A number of enterprising amateurs are using the units to completely control their ham shack functions" a Vicom spokesman said.

The Theta-7000 retails at $739 and is available throughout Australia and New Zealand from the distributors, Vicom International Pty Ltd, via their dealer network.

Low cost broadband HF antenna

A new broadband antenna now available will be of interest to many users of the HF spectrum.

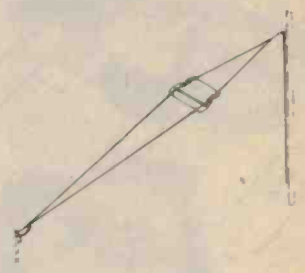
Rated at 400 W PEP, this low cost antenna gives an omnidirectional pattern and requires no matching adjustment over its operating range of 2MHz to 14MHz.

Installation is extremely simple according to the manufacturers, Antenna Engineering Australia Pty Ltd.

For best results, they say the antenna should be supported at one end, approximately 15m above the ground, by a pole, tree or building. The other end should be supported 2.5m above ground. Length of the antenna, between supports, is only 26m.

The antenna is supplied assembled ready for use, complete with halyard, pulley and installation hardware. A support mast is not included, but a range of models is available to order.

Designated the Model 4104 antenna, it is derived from their family of travelling wave dipoles.



For more information, contact Antenna Engineering Australia Pty Ltd, Garden Street, Kilsyth Victoria 3137, phone (03) 728-1777

The company has available a short form catalogue describing their VHF and UHF base station antennas. The condensed information covers simple groundplane and vertical dipole antennas to high gain omnidirectional colinear arrays, dipole arrays, yagis, corner reflectors and mounting hardware.

Individual data sheets for all new models will be available shortly.

Antenna positioner claims accuracy to half a degree

The Watkins-Johnson Company's new model WJ-7810-1 heavy duty azimuthal antenna positioner features a claimed positional accuracy of plus or minus 0.5 degrees and a backlash of one-tenth that.

The unit has a slewing speed of one rpm and is operated by a controller complete with computer interface.

The transmission system is an all-gear drive with an in-built lubrication system. The dc motor and control electronics are positioned outside the main body of the rotator to allow easy service access. The unit includes RF interference suppression to reduce motor and control circuitry noise.

Complete details, including price and delivery, are available from R.H. Cunningham Pty Ltd, branches in Sydney and Melbourne.

RF power amps

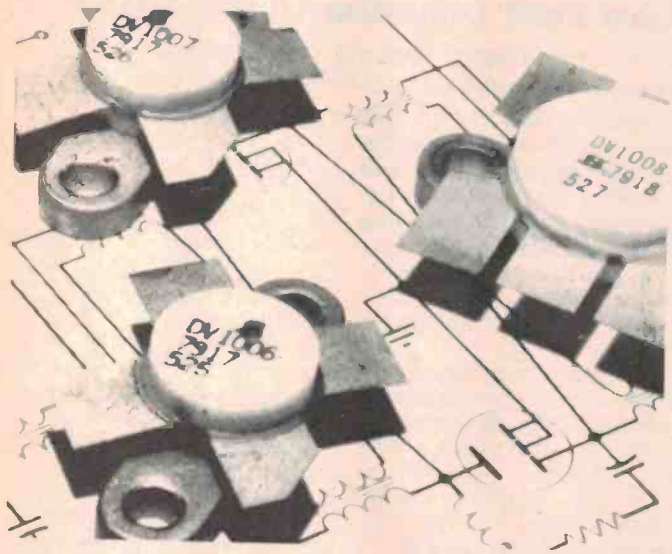
If you're looking to boost the output of your HF or UHF transceiver, these two amplifiers, recently released by I.F.T.A., are worth inspecting.

On the left is the HF version delivering 100 watts PEP and featuring a unique sand-cast heatsink. A power switch is incorporated, along with SWR protection. It is designed to run from a nominal 13.8 Vdc supply. Input-output connectors are on the rear, using SO239 coax sockets.

At right is the UHF model, also powered from 13.8 Vdc, and featuring the same sand-cast heatsink. Standard Belling-Lee input and output connectors are used.

For further information, Contact I.F.T.A. Australia, 1 Greville St, Randwick NSW 2031, (02) 665-8211.

COMMUNICATIONS



Fibre optics and microprocessors move into communications

It seems that these two, seemingly disparate, technologies will have an increasing impact in communications development, not always independantly.

A microprocessor-based terminal has been developed that leans heavily on specially developed software for multiple accessing of a fibre-optic link.

Digital multiplexers, a vital part in particular communications networks, are lately having microprocessor controllers installed to operate them, according to recent reports from overseas.

New transistors for 2 GHz.

Two new small signal NPN bipolar transistors have been introduced by Hewlett-Packard.

Optimized for operation at 2 GHz, the HXTR-2102 is a general purpose transistor with minimum tuned gain (guaranteed) of 13 dB. In addition, its typical linear output power of 100 mW (20 dBm) makes this versatile transistor suitable for use in driver or output amplifier stages.

The HXTR-6106 is a low noise device with a guaranteed noise figure of 2.7 dB maximum at 2 GHz. With an associated gain of 11.5 dB typical at 2 GHz and characterization from 500 MHz to 6 GHz, this transistor can be used in a wide variety of low noise communications, radar and ECM applications.

Both transistors are offered in the HPAC-70GT package, a rugged, hermetically sealed metal/ceramic package with a grounded top. The small size of the package ensures that the loss in gain due to package parasitics is minimal and that circuit designs make efficient use of available space.

The HXTR-2102 and HXTR-6106 complete the family of new HP transistors specified at 2 GHz. These two transistors are functional replacements for the similarly packaged HP 35800 series devices.

In quantities of 1 to 9, the HXTR-2102 is priced at $25, and the HXTR-6106 is $33.

For further information contact Hewlett Packard Australia's component distributors: Cema Electronics Pty Ltd,21 Chandos St, St. Leonards. NSW, phone (02) 439-4655

Siliconix predict VFETs will 'grow like gangbusters'

The advantages VMOS FET RF power devices have over bipolar transistors will see them superceding bipolars in new equipment very shortly, according to Siliconix.

In applications requiring class A or class B operation, as in SSB transmitters, VFETs can dissipate 50 W with no trouble while bipolar transistors have to suffer serious specification derating.

A bipolar device rated at 100 W is probably only good for 10 W in class A service. VFETs do not suffer the same derating. Furthermore, they have a considerably lower noise output enabling co-location operation of transmitters with 10 dB to 20 dB improvement in system performance over equipment with bipolar output transistors.

Being majority-carrier devices, they cannot suffer from thermal runaway. When operating or ambient temperature rises their silicon resistivity increases and they tend to turn off. This characteristics also prevents current hogging when VFET units are operated in parallel.

According to Siliconix' Engineering Manager, Dick Moss, "... these features will make VMOS FETs grow like gangbusters", which we thought a charming little American colloquiallism.

The latest offering in VFET devices from Siliconix operate from a 28 volt supply rail, cover the 2 MHz to 200 MHz range and deliver power outputs up to 100 W. The DV1006 is rated to deliver 25 W output, the DV1007 is rated at 50 W while the 100 W device is the DV1008. Hundred-off prices (in US $) are about 70 cents per watt.

Instant Component Service are the Australian representatives for Siliconix

GE-STC gets aggressive in mobile radio market

An aggressive campaign is planned by the recently-formed GE-STC Mobile Radio company to market their range of two-way mobile and portable equipment in Australia and Papua New Guinea.

Formed early in March this year, the company is a joint venture between Australian General Electric and Standard Telephones and Cables Pty Ltd.

The company is headed by Mr P.J. Dellwo who has had extensive experience in Europe and North America. Marketing manager is Brian Nobbs, ex-STC's Mobile Radio Division. Sales manager for Sydney is Trevor Olrog, who is well-known in the trade, while Melbourne will be covered by Donald Warring. The mobile radio market in Australia is showing a significant growth rate according to Mr Nobbs.

Equipment will range from a simple base station and basic mobiles to sophisticated data and computer aided dispatching systems used by Police, utilities and mass transportation organisations.

The energy shortage and desire by Government and private enterprise to reduce vehicle fuel and operating costs in recent years has more than justified the use and cost effectiveness of mobile two way radio installations, GE-STC Mobile Radio say.

The company is located at Moorebank Avenue in Liverpool, with branches in Melbourne and Adelaide.

Norwegian Radio breaks new ground

Radio Norway is currently carrying out its first test broadcasts using single sideband.

They will continue until 3 November.

Oslo joins Swiss Radio International and Radio Sweden in venturing into this new method of reaching overseas listeners.

Single sideband (SSB) transmissions eliminate the carrier and one sideband of a transmission (AM) providing greater efficiency and increased immunity to interference over normal AM transmissions. However, listeners need to have a beat frequency oscillator (BFO) on their sets in order to make SSB intelligible.

Norway will be carrying out sideband tests, up to November 3rd, as follows:

On 21 610: 0500-0630, and 0700-0830 for East Europe and the Middle East.
and 1100-1230 directed to listeners in South Europe and West Africa.
On 21 615: 1500-1630 for South Europe and West Africa.
1700-1830 directed to South Europe, the Mediterranean and Africa.
On 15 125: 1900-2030 for North and Central America.
2100-2230 for the Americas.

The Swedish Telecommunications Administration (STA) introduced single sideband transmissions on behalf of Radio Sweden some two years ago, mainly for Swedish diplomatic missions abroad, and other Swedes overseas. The initial tests proved quite successful, and the STA has continued relays of the Home Service in Swedish ever since.

Radio Norway's essential aim is to keep in touch with fellow countrymen abroad, especially Norway's 40 000 seamen scattered world wide. For this reason the station broadcasts almost exclusively in Norwegian.

Norway's shortwave transmissions began in 1947, with a 100 kilowatt and two 10 kilowatt units. At first, transmissions were directed to the North Atlantic and the east coast of USA, but by the early 1960s Radio Norway was directing its transmissions world-wide. Today, Radio Norway operates one 100 kW, two 120 kW and one 250 kW transmitters. These are located just outside the town of Fredrikstad in the south east of the country.

A new shortwave centre, to be equipped with four 500 kW transmitters, is currently being built on an island in south west Norway. The first of the 500 kW units should be on the air around 1981-82. By 1985, all four high power transmitters should be in operation, with a fifth in reserve.

With the present up-swing in the sunspot cycle providing better reception on the higher frequencies, Radio Norway is currently using a frequency in the uppermost broadcast band, the 11 metre band. Oslo is using 25 730 for broadcasts to Australia and the Asian region, between 1100 and 1230 daily. The 11 metre outlet is used in conjunction with 21 730 in the 13 metre band. Remember that although most of Radio Norway's programmes are in Norwegian, they do have a half-hour English program on Sundays during all transmissions.

UTENLANDSPROGRAMMET NRK RADIO NORWAY OVERSEAS SERVICE

Asian reception

As we move towards summer, reception on the lower frequency bands should favour stations in Asia. Sunset in Asia will now be progressively earlier, so earlier fade-ins of Asian stations should occur in our local evenings.

The domestic service from Ho Chi Minh City makes interesting listening on 9623, and is heard from around 1100 with good signals.

The Ho Chi Minh City station broadcasts mostly local programmes, however, there are occasional news bulletins on relay from Hanoi. Though programmes are in Vietnamese, the local musical programmes are a highlight.

The political division of Jammu and Kashmir (usually known simply as "Kashmir") is reflected in the broadcasting scene in this region which continues as disputed by India and Pakistan.

In the Indian region, there are stations on shortwave at both Srinagar and Jammu. Srinagar is heard on 3277, and is audible until evening sign-off at 1740.

The Jammu station is somewhat more difficult to hear, being of lower power, but is sometimes heard on 3345, with extensive relays of All India Radio until sign-off at 1734.

In the Pakistani zone, Azad Kashmir Radio, at Muzzafarabad, broadcasts on 6020 from 1200 until 1800.

As summer approaches, this station should be audible from sign-on time of 1200, beginning most transmissions with recitations from the Koran.

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett, VIC 3190, or from PO Box 79 Narrabeen, NSW 2101, for a 30c stamp.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert GMT to Australian Eastern Standard Time, add 10 hours. To convert to Central Time, add 9 hours, and for Western Time, add 8 hours. All frequencies are in kHz.

loggings

1980 World Radio and Television Handbook

The Australian Radio DX Club is once again co-ordinating advance orders in Australia for this annual publication, essential for all shortwave enthusiasts.

The Handbook, known as the WRTVH, is published around mid-January in Denmark.

The Handbook includes details of all the World's broadcasters on both shortwave and mediumwave, including station schedules, personnel, postal addresses and verification policies.

Write to the ARDXC address to receive an order form.

The WRTVH 1980 will be sent airmail direct to your door around late January next year, months in advance of the book being available via normal Australian retail outlets.

Costa Rica in English

Radio Reloj de Costa Rica, at San Jose, has recently retimed its weekly English programme, entitled "Aqui Costa Rica" (This is Costa Rica).

This programme for tourists is now broadcast each Sunday 0700-0730 on the usual Radio Reloj channels of 6006 and 4832.

Special QSLs are available for reception reports of the Aqui Costa Rica segment, and reports may be sent to: Aqui Costa Rica, Apartado 2936, San Jose, Costa Rica.

Surinam returns

This recently-independent country, at the top of South America, has returned to shortwave after being silent for some months.

Radio SRS at Paramaribo uses 4850 and is audible in east Australia from sign-on at 0830.

The station is pleased to receive reception reports from listeners and has in recent months begun verifying correct reports with an attractive QSL card which includes details of the station, and Surinam in general.

New Arab voice planned

Dubai, in the United Arab Emirates, has plans underway for an international service on shortwave.

At present, a major shortwave centre is being built with three transmitters of 300 kW each to be installed in the near future.

Dubai has registered a number of frequencies with the International Telecommunications Union (ITU) in Geneva for the transmission period up to November this year. These frequency registrations are tentative assignments, and may be regarded as "bookings" in advance of any actual shortwave transmissions.

The World Radio and Television Handbook, a reliable source for information about shortwave, says Dubai plans to have the international shortwave service in operation during 1980. Dubai is currently recruiting technical staff to operate the new shortwave centre.

The Tentative High Frequency Broadcasting Schedule (THFBS) issued by the ITU in Geneva, shows that Dubai has registered 21 480 with 300 kW between 0600 and 1630 for broadcasts to Europe. This should be put in the "ones to watch" file for the months to come.

Kampuchea: English service

The Voice of the People of Kampuchea, broadcasting from Phnom Penh, now has a daily International programme in English, French and Thai, on 9695.

The English programme is on air 1200-1215, French 1215-1230, and Thai 1230-1245, and provide good reception currently into east Australia. The English programme consists of a news bulletin and a political commentary, interspersed with Kampuchean music.

The station announces additional outlets for these broadcasts of 11 940 and 6090, but these channels are inaudible in Australia at the time of going to press.

Guinea

This country is not often heard here in Australia, yet as we approach summer, watch for their high frequency outlet, on 19 metres, of 15 310.

This frequency has an English programme on Mondays, Wednesdays and Fridays between 1800-1900, while on Sundays the programme is broadcast 1815 until 1900.

Tibet on air!

With the recent opening up of this remote region of China to foreign tourists, Tibet has become of interest to shortwave enthusiasts.

The Tibet People's Broadcasting Station in Lhasa has several outlets on shortwave, which carry both local programmes and relays of the Peking Domestic Service programme.

Best reception here in Australia is on 5935 and 4750, both well heard nightly between 1300 and 1545.

Peking has recently changed its attitude to listeners' reception reports of Chinese regional stations.

Previously, these reports would never be verified. However, Radio Peking will now QSL reports of its programmes beamed over regional transmitters. The World Radio and TV Handbook includes details of the locations and frequencies of most Chinese regional stations.

PREDICTIONS OCTOBER 1979

Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time — commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

ETI — Predictions
3rd floor 15 Boundary St
RUSHCUTTERS BAY NSW 2011.

These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . . path open 50 - 90% of days in month.

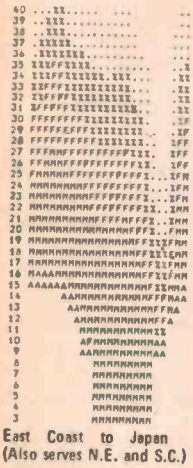
F . . . . . path open at least 90% of days in month.

B . . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

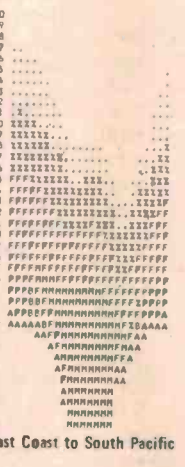
M . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

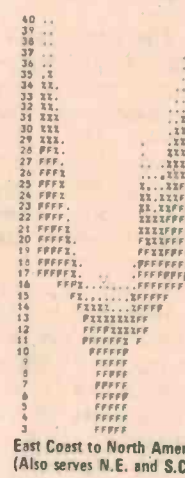
A . . . . . High absorption indicated. Expect weak signals.



East Coast to Japan
(Also serves N.E. and S.C.)



East Coast to South Pacific



East Coast to North America
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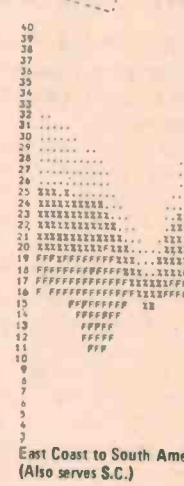

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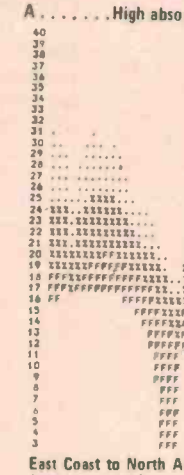

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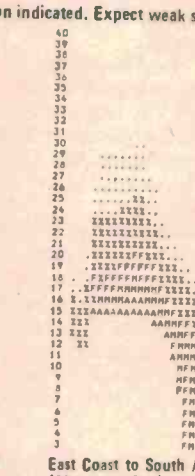
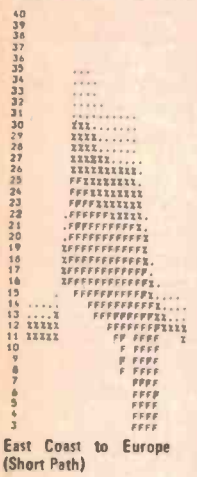
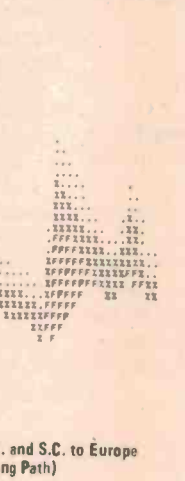


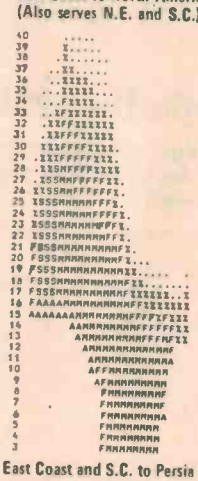
East Coast to South Africa
(Also serves S.C.)



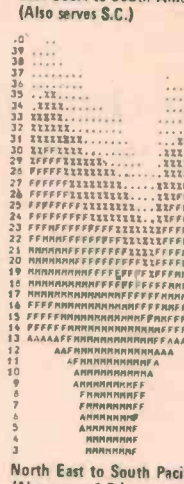
East Coast to Europe
(Short Path)



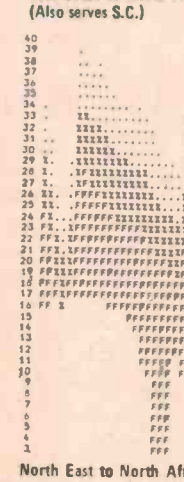
E.C. and S.C. to Europe
(Long Path)



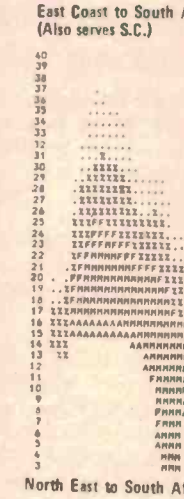
East Coast and S.C. to Persia



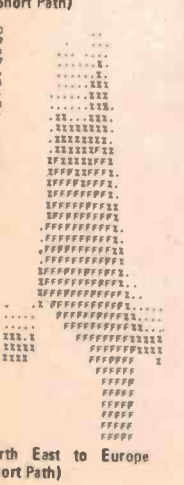
North East to South Pacific
(Also serves S.E.)



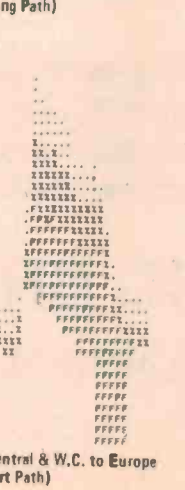
North East to North Africa



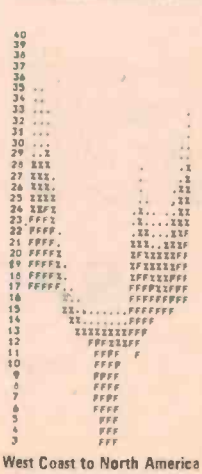
North East to South Africa



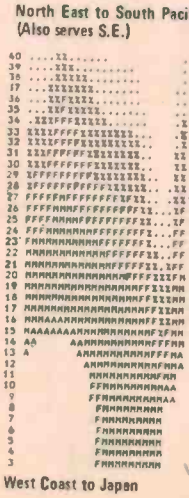
North East to Europe
(Short Path)



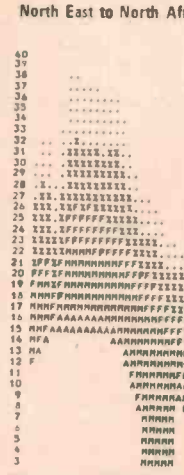
S. Central & W.C. to Europe
(Short Path)



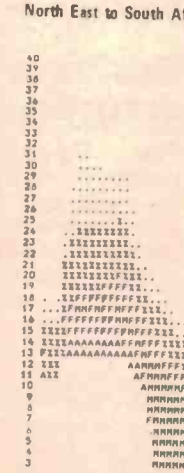
West Coast to North America



West Coast to Japan



West Coast to North Africa



West Coast to South Africa

DON'T MISS OUT!
6 metres is coming alive . . .

NOW IS THE TIME to chase the 6 metre DX – as the sunspot cycle nears its peak. And what better way to get into the action than with Yaesu from Dick

Cat D-2886

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INTRODUCING: The Yaesu FT-625R All Mode 6 Metre Transceiver.

Designed for today's demanding 6 metre operator. 25 watts output (SSB/CW/FM) with inbuilt AC & DC power supplies. Automatic mic gain control, built in noise blanker, variable power output, RF speech processor – a truly magnificent transceiver. And because it's a Yaesu, it is quality through and through. Quality fully backed by Dick Smith's fully equipped service centre. Call in today and have a test drive of this magnificent unit!

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- AC & DC supplies inbuilt
- 3-way metering: S meter; relative power o/p & disc. centre meter.

We welcome bankcard **or offer easy terms with** BFC FINANCE LIMITED

HOW ABOUT SOMETHING FOR THE HF BANDS?

Here it is: Yaesu's new up-graded and up-rated FT-7B. Built for today's demanding amateur operator.

Cat D-2868

$625.00

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Yes, the famous Yaesu FT-7 has had a facelift. Now with:

- AM operation too (previously only SSB & CW)
- 100 watts output (SSB & CW)
- Provision for full 10 metre band in 4 switched segments

Whether you want an HF transceiver for base or mobile use, you can't go past the brilliant Yaesu FT-7B. Many thousands of its predecessor, the FT7, are in continuous use throughout Australia (and the world)! Now you can have the very latest in solid state transceivers working for YOU. Small size and light weight make it a favourite for active amateurs. Call in to any Dick Smith store and check out this superb transceiver soon. You won't be disappointed!

YAESU MOBILE ANTENNAS

The greatest mobile system you'll find: Buy the gutter mount base and 2 metre stub and you're on the air immediately on 2 metres. Then as you need them, buy the whips for the HF bands you want to operate on. It's that simple. Now there's no excuse not to go mobile. It's easy with Dick Smith and Yaesu!

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Gutter Mount	2 metre stub	6 & 2 metre antenna	80 metre antenna	40 metre antenna	20 metre antenna	15 metre antenna	10 metre antenna
Cat D-4100	Cat D-4102	Cat D-4104	Cat D-4110	Cat D-4112	Cat D-4114	Cat D-4116	Cat D-4118
$32.50	$10.95	$23.95	$19.95	$19.95	$20.95	$20.95	$20.95

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	162 Pacific Highway,	GORE HILL.	Phone 439 5311	656 Bridge Road,	RICHMOND. Phone 428 1614
	30 Grose Street,	PARRAMATTA.	Phone 683 1133	QLD 166 Logan Road,	BURANDA. Phone 391 6233
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eti data sheet

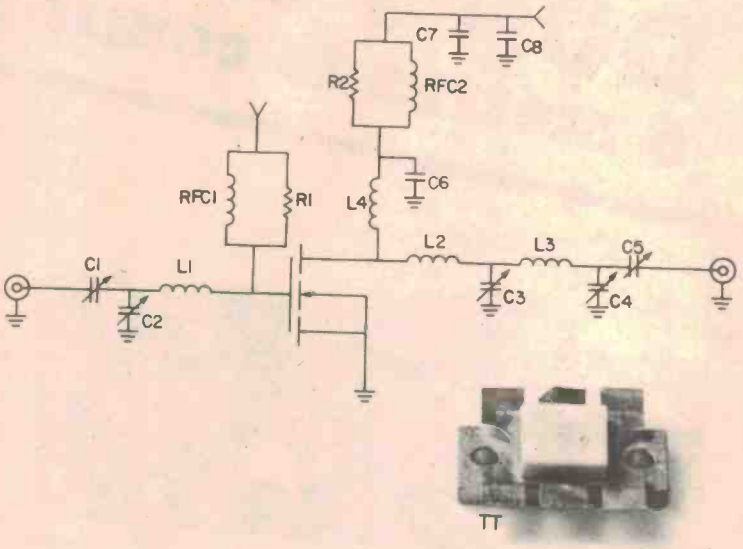
HIGH POWER VFETs will gradually supercede bipolar transistor technology in RF power amplifier applications in the next few years. Cost, on a dollar-per-watt basis, is rapidly decreasing on VFET devices, and when the overall cost of a complete amplifier — or amplifier chain — is considered, the circuit simplicity using VFETs brings cost benefits of its own.

VFETs have a negative temperature coefficient and are not subject to thermal runaway. Severe load mismatch presents few problems to these devices in RF power amplifiers.

This range of VFET devices is from the Communications Transistor Corporation (CTC), represented in Australia by Ampec Engineering, 1 Wellington St., Rozelle NSW 2039 (02) 818-1166. The three devices presented here are N-channel types, suitable for HF and VHF amplifier applications (linear — class B, or saturated — class C), running from a 28 to 35 volt supply rail.

CAUTION

Users are cautioned that these devices use Beryllium Oxide ceramics in their construction. Any mechanical or chemical treatment of these ceramics which produces dust or fumes, even minute amounts, can be dangerous. Care should be taken to ensure that those who handle, use or dispose of these devices are aware of this. The package should never be crushed, filed, chipped, sawed, sanded, ground or come in contact with acid. In the event of failure, return to the manufacturer.

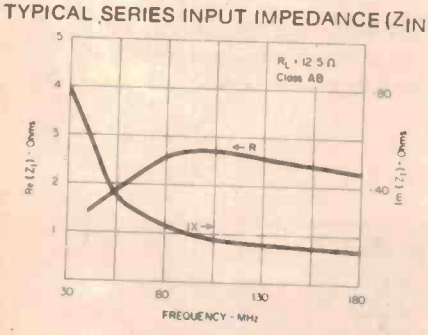


Package, BF100-35

TEST CIRCUIT 175 MHz 100 Wout BF100-35

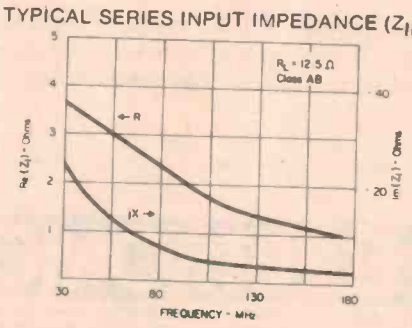
C1, C2, C4	5-70 p compressed mica
C3, C5	25-240 p compressed mica
C6	470 p ceramic chip
C7	100 n ceramic
C8	10 µ electrolytic
L1	half turn No. 18 wire, 10 mm ID
L2	1 mm thick copper strap 5 mm wide, 16 mm long, 10 mm ID loop
L3	1½ turns No. 18 wire, 10 mm ID
L4	6 turns No. 18 wire, 10 mm ID
RFC1	6 turns No. 18 wire on Indian General F627-8 Q1 toroid.
RFC2	18 turns No. 18 wire on Micrometals T106-2, toroid with 15 R, 2 W resistor in parallel.

TYPICAL SERIES INPUT IMPEDANCE (Z_{IN})



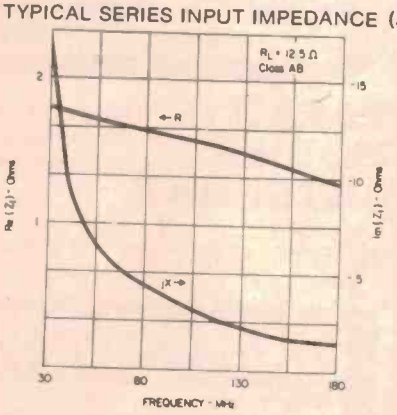
BF25-35

TYPICAL SERIES INPUT IMPEDANCE (Z_{IN})



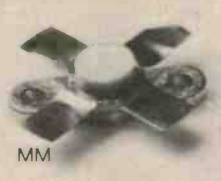
BF50-35

TYPICAL SERIES INPUT IMPEDANCE (Z_{IN})

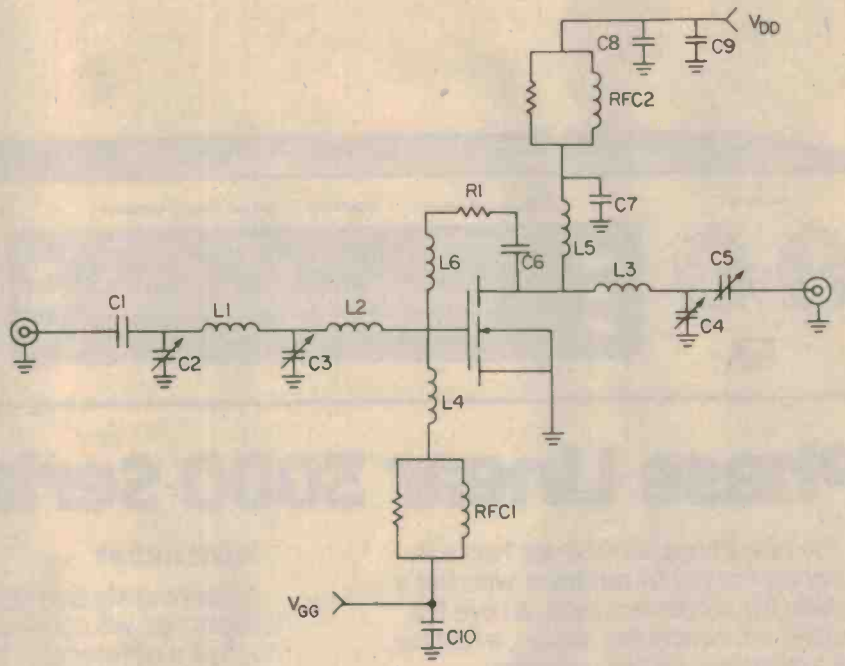


BF100-35

BFXX-35 power FETs



Package, BF25-35 and BF50-35

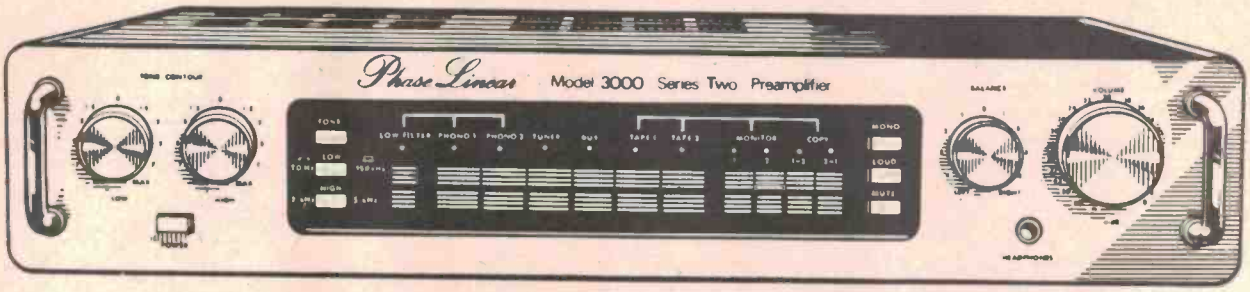


TEST CIRCUIT 80 MHz 50Wout/BF50-35, 25 Wout/BF25-35

C1	1 n ceramic chip	L5	6 turns No. 18 wire, 10 mm ID
C2	5-70 p compressed mica	L6	150 nH (0.15uH)
C3-C5	10-180 p compressed mica	RFC1	16 turns No. 22 wire on Indiana General T106-2 toroid with 15 R, ½ W resistor in parallel
C6	100 n ceramic		
C7	470 p ceramic chip		
C8, C10	10 n ceramic	RFC2	18 turns No. 18 wire on Indiana General T106-2 toroid with 15 R, 2 W resistor in parallel
C9	10u electrolytic		
L1	3 turns No. 18 wire, 10 mm ID		
L2, L3	2½ turns No. 18 wire, 10 mm ID	R1	150 R, ½ W
L4	330 nH (0.33 uH)		

	Symbol	BF25-35	BF50-35	BF100-35	units
Maximum power dissipation with 25°C case temperature		75	125	250	W
Maximum drain to source voltage	BV_{DSS}		65		V
Maximum gate to source voltage	BV_{GS}		25		V
Maximum drain current	I_D	5	10	16	A
Power output with f=175 MHz, V_{DS}=35 V	P_{out}	25	50	100	W
Power input under above conditions	P_{IN}	2.5	6	16	W
Drain efficiency under above conditions	η		50		%
ON-state drain current	$I_{D(ON)}$	3.5	5	10	A
Small signal forward transconductance	g_M	0.7	1.5	2.2	MHO
Drain-source capacitance with f=1 MHz, V_{DS}=28V and V_{GS}=0 V	C_{DS}	37	77	170	pF

A new preamp for the perfectionist who can appreciate the difference.



Phase Linear 3000 Series Two.

The new Phase 3000 Series Two was designed for the music-lover who has a passion for accurate sound, an eye for elegant, yet functional design, a feel for craftsmanship, and an unfailing determination to maximise return on investment.

The Phase 3000 incorporates the latest technological advancements in preamp design. Transient overloading that plagues preamps has been virtually eliminated, whether amplitude, frequency, or slew induced. Now you can enjoy the flexibility, performance and features that are priced substantially higher in other equipment.

CMOS Logic Memory System.

Most preamps use dated mechanical switching devices that force signals to travel long, noisy, circuitous routes from the inputs to the front panel, then back to the outputs. Ours doesn't. The Phase 3000 uses CMOS-digital logic to energise switching relays located where they belong, at the input jacks. This shortens critical signal paths. Noise, hum, and the "crosstalk" that's characteristic of mechanical switching is virtually eliminated.

Want more?

A listening session with a pair of headphones will convince you just how much of a difference a true headphone amp makes. Turn the 3000 around, and see how easy it is to patch in your noise reduction unit. Two complete taping circuits allow you to copy between decks while listening to another source.

If you're serious about state-of-the-art performance it's time for you to do some listening.

Hear the difference at your audio specialist's, or write for complete information.

Distributed in Australia by Acoustic Monitor Co Pty Ltd (Member of the Thomas & Coffey group), 12-18 Gould Street, Enfield, NSW 2136. Phone: (02) 642-7888. Telex: 26778. Cables: "Tomcoffy" Sydney.

Phase Linear®
THE POWERFUL DIFFERENCE

Phono Cartridge Flexibility
The two independent RIAA phono stages eliminate all low-level switching. As a result, noise is reduced to theoretical limits.
Phono 1 is designed for moving-magnet cartridges and has three selectable capacitance values.
Phono 2 is used with moving-coil cartridges and has three selectable resistance values. The expensive outboard head amp usually required for a moving-coil cartridge is already built into the 3000.

SMA/AM5

sound news

Teac's heavy metal

Teac released a range of metal tape-compatible cassette decks in July, along with a range of other hi-fi components, all demonstrated at the CE Show.

First in the new metal tape-compatible decks is their A-430. Featuring selectable bias or auto-bias, where the deck determines the bias required before recording, the A-430 is a three-head machine with Dolby noise reduction, and memory rewind stop function.

Teac quote very good specifications for the unit: 30 Hz to 17 kHz frequency response for metal tape, 30 Hz to 16 kHz for Cr02 and 30 Hz to 13 kHz for standard ferric tape. Wow and flutter claimed is only 0.03% (NAB weighted). Drive is from a single servo-controlled dc motor. Recommended selling price is only $366.

Next comes the C-3 featuring 'LSI logic soft-touch operation'. Transport control is via a set of soft-touch switches. This unit is also a three-head machine. Record bias and level adjustment for any tape is possible using an optional test-tone oscillator (T0-8) in conjunction with the input selector while monitoring levels on the front panel meters.

Optional extras for the C-3 include a dbx unit (RX-8), a mixer (MX-8) and a remote control unit.

Last in Teac's heavy metal line-up is the C-2. This is also a three-head machine but incorporates a two-motor dual capstan closed loop transport mechanism. Plug-in bias/eq cards allow any type of tape to be used with this machine. It features the same soft-touch operation as the C-3 and may be used with the optional RX-8 dbx unit.

Both the C-2 and C-3 incorporate memory stop and memory play facilities. Recommended prices? for the C-2, $734 and the C-3, $524.

Teac equipment is available from Harman Australia Pty Ltd, 271 Harbord Rd, Brookvale 2100 NSW, (02) 939-2922.

Three-way from Audio Reflex

Joining in the boom demand for speakers, Audio Reflex has released a flurry of designs in recent months, the SB485 model being the latest.

The SB485 is a three-way system incorporating a 375 mm long-throw bass driver, a 125 mm mid-range and 50 mm wide-dispersion cone tweeter. The enclosure is a high efficiency vented design of front-to-back bracing construction. It stands 700 mm high and measures 450 mm wide by 375 mm deep. It is finished in walnut grain and features a tapered cloth grille. Each unit weighs 24 kg.

The crossover network has a claimed 12 dB/octave roll-off and the speaker's handling capacity is rated at 100 watts RMS. Audio Reflex quote a frequency response of 30 Hz to 22 kHz.

Interested?, contact Audio Reflex (Australia) Pty Ltd, 7 Orchard Rd, Brookvale 2100 NSW, (02) 938-4188.

sound news

New speaker from British designer

British speaker designer, Jim Rogers launched a 'twin-bass' speaker system recently, housed in an unusual 'tensioned aluminium' cylindrical enclosure.

Called the JR150, it uses two long-throw 130 mm diameter Bextrene cone bass drivers which are said to be electrically and acoustically in parallel. Rogers claims his design increases radiation, reduces distortion and provides superior transient response.

Claimed performance figures are certainly impressive — frequency response 40 Hz to 40 kHz; power handling to 100 watts on programme. The JR150 is recommended for use with amplifiers delivering from 15 to 100 watts.

The Australian agents, International Dynamics, are confident the system will emulate the success of the smaller JR149s which readers may know, on which the new speaker is based.

As with the JR149, the JR150 is available in a variety of wood and leather finished tops and has an acoustically transparent foam cover which can be removed for cleaning. An optional stand is available if floor-standing operation is envisaged.

International Dynamics are at 23 Elma Rd, Cheltenham 3192 Vic., (03) 95-0366.

Leader sound level meter

Leader recently announced an addition to their range of well-known audio instruments — the Model OS11 sound level meter.

Conforming to JIS and IEC standards, the OS11 features a built-in calibrator and a measuring range from 25 dB to 130 dB.

The small size and low weight of the unit make it ideal for sound pressure measurement where portability is essential, especially in industrial applications.

The manufacturers' claim a frequency response of 25 Hz to 10 kHz. A, B, and C weighting filters are incorporated. The unit weighs 900 gm and is powered by a standard 9 V battery.

Australian agent for Leader is Vicom International, 68 Eastern Rd South Melbourne, Vic 3205, (03) 699-6700.

"Care for tapes..."

Some enthusiasts have been known to lavish more care on their tapes and tape equipment than on their own children. Maxell's new tape care kit should speed their chores and allow them to attend to their domestic duties.

The office wag, punster and funny business man started whistling the well-known International Kid's Year melody and then burst into lyrics which spawned the above headline!

The Maxell tape care kit contains all the necessary cleaning aids and tools that make the job a 'snack' where, previously, improvised utensils and medical alcohol (on occasion, vodka ...) were employed, albeit somewhat inexpertly.

Packaged in a small plastic case with clear plastic lid, the kit comes complete with instructions and a small booklet on the rudiments of tape recording. It is available wherever Maxell tapes are sold for a recommended retail price of $13.85.

According to Maxell, the wise thing to do is to clean the heads of a deck every eight to ten hours of use when recording, and every 15 to 20 hours when playing pre-recorded tapes. For critical recordings, the deck should be cleaned immediately beforehand.

The importance of tape head care can never be over-emphasised. Inappropriate cleaning methods or agents can damage heads and rollers and may subsequently result in tape damage. Neglect will have debilitating effects also. The tape care kit is clearly designed to sit close to the tape deck, a constant reminder of the necessity to use it.

For more information, contact Hagemeyer (Australasia) BV, 25-27 Paul St, North Ryde 2113 NSW.

Australian-designed amplifier range

Shown at this years CE Show in July were a range of audio amps, preamps, equalizers and mixers from the Brisbane-based firm of Audio Design.

All Australian designed and manufactured, the equipment of interest to hi-fi buffs includes a class A power amp, a two-way stereo active filter (for crossover applications) and a stereo preamp.

The stereo power amps are available in power levels of 50 W, 100 W and 200 W per channel. All feature low TID and SID and have claimed specifications of: 100 dB(A) signal/noise ratio; 20 Hz to 20 kHz plus 0 dB, minus 0.2 dB bandwidth (50 kHz power bandwidth) and total harmonic distortion below 0.1%.

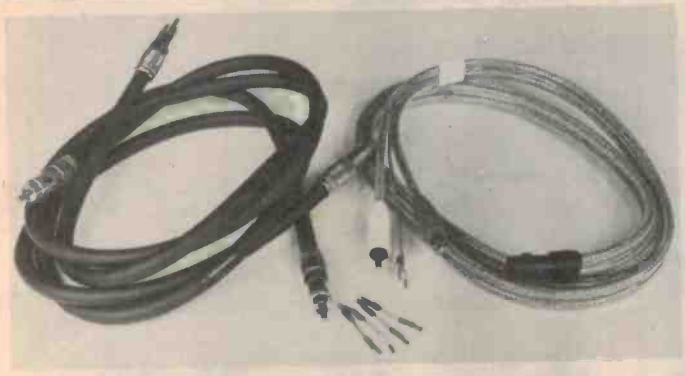
Each amplifier incorporates voltage sensitive current limiting protection circuits allowing the output stage to drive loads down to four ohms at up to plus/minus 45 degree phase angle.

Fast acting LED displays on the front panel of each unit indicate the onset of clipping, irrespective of load condition.

For more information, contact Audio Design at 3/7 Harvton St, Stafford 4053 QLD, (07) 356-9191. Distributors are: Pro-Sound in Sydney, Insound in Adelaide and Audio distributors in Perth.

Brief passages

Audiocom, well-known for their Advent speakers amongst other goodies, opened their fourth store on 5 September at Birkenhead Point shopping complex. They're located at Shop 4 and the Phone No.is (02) 81-3132.



"Super conductivity" cables

Providing high noise immunity and reliable connections between the tone arm output and preamp input is a necessity with low output cartridges, particularly moving-coil types.

These "Vital Link" cables by Audio-Technica were designed to provide superior performance over conventional cables by using extremely low resistance plated wires and tight-wound shield braid together with tarnish-free connectors.

The cable set on the left of the picture is the Vital Link AT620, a one metre long stereo coax cable set featuring low capacitance foam dielectric for minimum high frequency losses and an unusual conductive polypropylene sheath over the shield braid claimed to improve hum, noise and RF rejection. The coax inner conductor is made of multi-strand 'Litz' wire for best flexibility, good conductivity and minimum high frequency loss. The connectors are 'ultra-gold' plated RCA phono types which feature a strain-relief knurled finger grip and low contact resistance.

The cable on the right is the Vital Link AT662 cable set. This stereo coax cable assembly comes complete with a universal tone arm connector, colour-coded phono plugs and an independant grounding wire with gold-plated lugs. This assembly is recommended for use with moving coil cartridges.

The four small links in the lower centre of the picture are another set of Vital Link components. These are for cartridge connections and consist of lengths of insulated multi-strand Litz wire with gold-plated socket pins on each end for positive low resistance, corrosion free connections.

We compared the stereo coax cable sets against standard audio coax cable connecting a Nakamichi MC1000 moving-coil cartridge to the ETI 'Series 4000' preamp (See page 40) and found the Vital Link cables gave a considerable improvement.

For more information on the Vital Link set of cables, contact Maurice Chapman Pty Ltd, 44 Dickson St, Artarmon 2065 NSW.

The Acoustic Monitor Company has been appointed exclusive Australian distributors of Mobile Fidelity's "Original Master Recordings". For more information, and perhaps a copy of an intersting reprint from the US 'Audio' magazine, contact them at P.O. Box 204 Enfield NSW 2136, (02) 642-7888.

Akai Australia were visited in August by Mr A. Horie, Director and General Manager of the Foreign Trade Department of Akai Electric, Tokyo. He inspected the various subsidiary's of Akai's operations in Australia. Combined Australian sales for Akai are 220% above 1978 levels and current forecasts predict a turnover exceeding $15 million, a marginal increase.

Concise Component series

Featuring an unusual "pulsed power supply unit", and diecast cabinets this series of audio components from Technics, were shown off for the first time at the July CE Show.

The 'concise' term refers to the size of the units, all measure only 300 mm wide and none is more than 50 mm high.

The pulsed power supply is an unusual innovation in audio equipment. The ac line input is first rectified directly to dc then converted into a 20 kHz square wave pulse train which drives the primary of a high frequency transformer. This technique permits a very compact transformer, resulting in reduced weight. A diecast cabinet is used for the power supply, along with special shielding to reduce high frequency interference leakage.

The SE-C01 dc-coupled power amp delivers 50 watts RMS per channel and Technics claim a THD of 0.03% and a power bandwidth of 20 Hz to 20 kHz. Power metering on the front panel is provided by a high-speed LED array incorporating nine yellow LEDs up to the 50 W level and three red LEDs beyond that. The scale goes from 0 to 160 W per channel and may be switched to indicate 0 to 16 W per channel for low power monitoring. Full protection is provided for the output devices and the unit is housed in a diecast cabinet.

The SU-C01 stereo preamp features moving-magnet and a moving-coil input, a subsonic filter, tone controls with centre-defeat (flat) and gold-plated connector jacks. Technics quote a signal-to-noise ratio of 88 dB (to 2.5 mV sens.) for the M.M input and 78 dB (to 250 uV) for the M.C. input.

The FM/AM tuner, the ST-C01, incorporates an 'active servo lock' circuit to maintain correct tuning. An unusual LED indicator set shows when the receiver is tuned to a station correctly. Two arrow-shaped yellow LEDs and one thin red LED are mounted on the dial pointer. All three are lit when the receiver is not set to a station. When a station is approached, one arrow LED goes off and the other will indicate which way the tuning knob is to be turned. If you pass the station that LED goes out and the other LED will light, indicating that you should tune back a little. When the station is correctly tuned, both arrows go out, leaving only the red LED lit. If the servo tuning switch is on, the 'lock' LED will light.

Technics have incorporated three ceramic IF filters to ensure a flat group delay for low distortion. A five-stage differential amplifier provides good limiting characteristics, according to Technics and this is followed by a quadrature detector and PLL MPX stereo decoder. Technics claim a S/N of 46 dB (IHF) for stereo quieting sensitivity of 20 uV, a THD of 0.15% on stereo and frequency response of 20 Hz to 15 kHz (plus 0.5 dB, minus 0.2 dB).

The Concise Components are sold as a system, not as separate components. Recommended retail price is $1200.

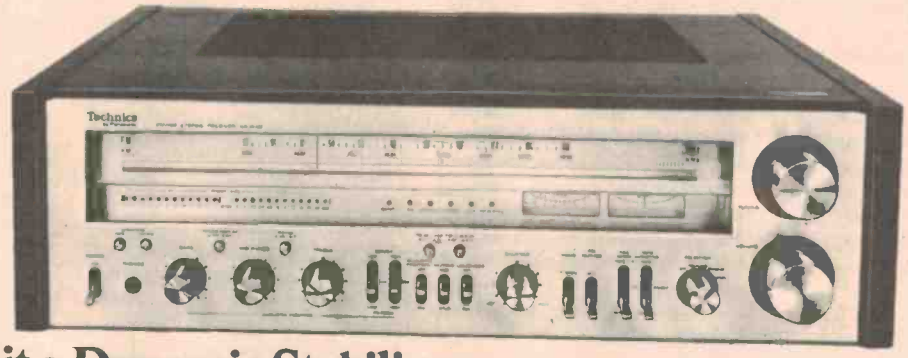
More information is available from National Panasonic (Aust.) Pty Ltd, 57-69 Anzac Pde, Kensington 2033 NSW, (02) 662-1222.

Briefly

Etone have released a range of five speakers for professional sound reinforcement and musical instrument applications, four 380 mm (15") models with 100 mm (4") diameter voice coils and 9.5 kg ceramic magnets. For more information, see Etone Pty Ltd, 53 Stanley St, Peakhurst 2210 NSW, (02) 534-3569.

fact: calling this a "brush"

is like calling this a "radio"



we call it a Dynamic Stabilizer ...critics call it a major innovation

True, the device on the front of a V15 Type IV cartridge bears a superficial resemblance to a cleaning brush. In reality, it is a complex, exquisitely engineered subassembly which performs several complex functions that measurably enhance the quality of record reproduction!

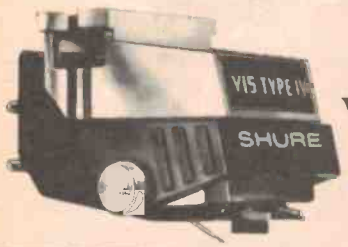
Each one of its 10,000 conductive carbon fibers is positively grounded to discharge ever-present static electricity from the surface of your records. This eliminates static clicks and pops, as well as the tracking distortion produced by the varying electrostatic attraction between the record surface and the tone arm.

What's more, the Dynamic Stabilizer incorporates Shure-developed viscous damping that results in a uniquely efficient suspension system which maintains precise cartridge-to-record distance and uniform tracking force—even on severely warped records. The stabilizer also acts as a shock absorber to cushion the stylus in case you accidentally drop the tone arm onto the record.

Finally, the tiny carbon fibers are so fine that 10 of them can fit *inside* a single groove to sweep free minute dust particles.

This integrated approach to pure sound reproduction extends throughout the design of the V15 Type IV. It sets a new standard of high trackability at ultra-low tracking forces—even on records that are warped, dusty, and charged with static.

If faithful reproduction of *all* your recordings is of paramount importance to you, we invite you to audition the V15 Type IV with the Dynamic Stabilizer. Or, write for the complete story (ask for AL569).



V15 Type IV...the stabilized cartridge

SHURE®

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DISCO LASER

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The Disco Laser is a complete, ready-to-go unit, which operates from a lineout or aux output of your music source. The unit can be run stereo or mono, and when hooked into an audio signal produces scintillating patterns on the target area. The brilliant red beam of Laserlight cuts through the hazy atmosphere of your venue, producing visible shafts of light travelling to the target area. The brilliant radiating patterns produced by the Disco Laser will hold your audiences in awe and wonderment!

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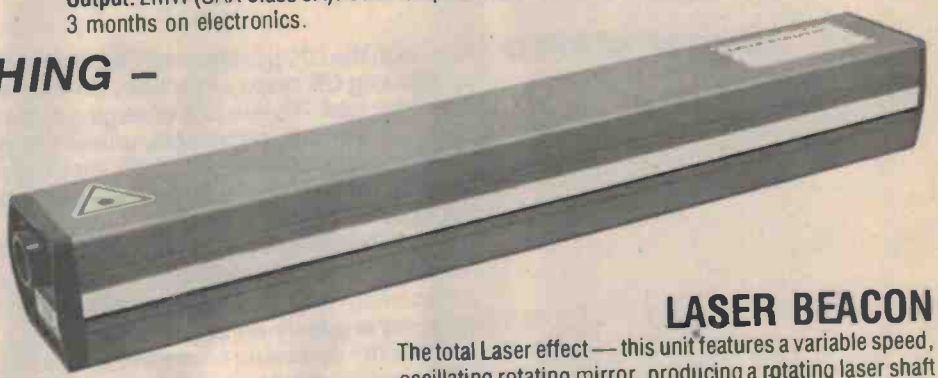

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sound briefs

Cartridges with integral headshells

There's a growing move from cartridge manufacturers to make their product integral with the plug-in headshell. The benefits are improved mounting accuracy, rigidity, compatibility and freedom from uncontrolled resonances. Naturally the integral units plug straight into the standard four-pin bayonet connector.

The principle has now been adopted by Audio-Technica (AT-30), Ortofon (Concorde), Yamaha (MC-1S) and Nagatron for their top-end ribbon cartridge. Many other cartridge manufacturers are known to be actively considering a change-over.

Metal tape standards

Japan's Electronic Industry Association says that the guidelines formulated some time back for a world metal tape standard will be submitted to the IECS very soon.

The major specifications proposed include coercive field strength of 1050 Oe ; residual magnetism of 3000-3500 G, maximum output level balance of 3180 Oe at 70 us and magnetic layer thickness of four microns. These specifications are in fact those already used by Japanese companies currently producing metal tapes and hardware.

Super stereo

Although the UK-govt backed Strathearn audio company is currently being wound up (costing UK taxpayers a hefty 20 million pounds) a number of patents applied for in the mid-70s are just emerging from the UK Patent Office. This presents an interesting situation because, unless the patents are sold before the company is finally wound up (wound down?), they'll expire as they come up for annual renewal because the fees will be unpaid and unpayable — hence all the efforts will pass into the public domain.

One interesting patent (BP 1 545 489) is a device which enables the apparent width of "stereo image" to be varied over a wide range. As a control is varied the stereo image changes from a mono blend of the two channels, through "normal" stereo to a greatly enhanced stereo.

We're not quite sure where this leaves the patent but Mullard published details of an apparently similar device nearly a decade ago — we modified it and ran it as a project called Super Stereo in our May 1972 issue. It worked well too.

Super Sony speaker soon

Sony in Japan has just introduced a totally new line of top-end audio products. The range will be marketed under the brand name "Esprit".

Among the new products is the APM-8 speaker — this incorporates a ribbon tweeter, separate midrange driver and a flat honeycomb bass driver. The price is said to be $5000 . . . each.

Class A hybrid

Infinity have just started to market a hybrid (valves and transistors) class A power amplifier. The unit was shown at the recent Harrogate (UK) hi-fi show — the makers claim the design "combines the musical honesty of the old tube amplifier with the practical features of the best new transistor amplifiers" . . .

Computer-controlled speaker

American speaker manufacturer KLH has developed a bass enhancing technique. Cone excursion is anticipated by monitoring the output of the power amplifier via a module which they call an Analog Bass Computer. This device apparently compensates for the fall off in bass response characteristic of speaker drive units by winding up the gain as and when required.

US propose audio tape tax

West Germany has for years placed a special tax on tape recorders — the collected money being passed on to GEMA (their equivalent of our Performing Rights Society) to compensate music copyright holders for sales lost due to home record copying.

Now, a similar tax is being proposed in California — in the form of a 5% impost on blank audio tape. However, unlike the German system the proposers suggest the money be used to sponsor concerts, workshops and musical tuition.

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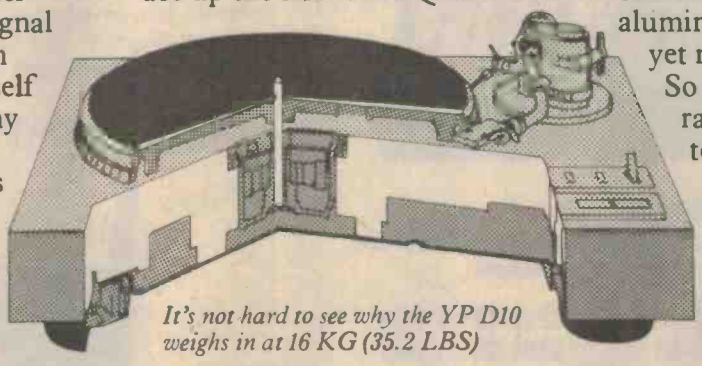

It's not hard to see why the YP D10 weighs in at 16 KG (35.2 LBS)

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The YP D10 has its own precision-designed tone-arm. It's an aluminium alloy which is lighter yet more rigid than aluminium. So while it tracks more accurately, it's also more resistant to feedback vibration. The support is a gimbal, to allow it freedom to move up, down and sideways and thus follow every nuance of the recording. Even the cable is different from conventional signal cables. It has ⅓ the normal resistance to transmit every subtlety your cartridge is capable of.

Our base blocks feedback.

Some turntables are sprung to avoid vibration and feedback. We've gone one better by sinking ours into a solid base. It absorbs all vibration before it can produce howl. And to make doubly certain, we've stood the whole unit on felt and rubber feet.

Not so long ago the truly musical turntable was hard to find. And when you found it you had to buy an arm separately. But now there's Yamaha YP D10. Hear it.

It won't make an unwanted sound.

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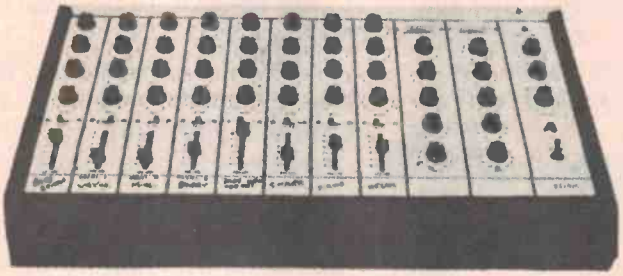

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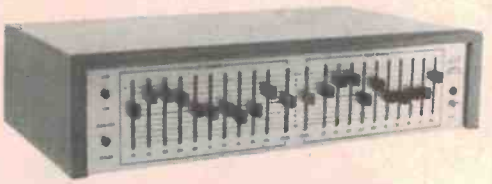

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You'd be surprised how dramatic an improvement can be achieved by carefully optimising the adjustments on your record player cartridge. Allen Wright and Rowan McCombe of Sydney's Audiolab show how it's done.

How to improve your hi-fi's sound

MARK LEVINSON Audio Systems claim that their electronically controlled straight line tracking arm will extract up to 30 dB more dynamic range from a disc than is normally achievable with conventional arms.

If this is so, it is primarily due to the accuracy with which the cartridge is held in the groove, and that the stylus assembly is used simply to extract information from the groove – and *only* that.

It thus follows that it should be possible to improve the dynamic range of conventional tone arms by using similar principles.

The authors of this article have spent many years designing and building audio equipment to provide the best possible standards of reproduction (remember the Wright AM tuner?) and have found that a very considerable increase in dynamic range can indeed be obtained by very careful attention to the cartridge/arm/disc combination.

First, some definitions of terms used and the theory behind these ideas.

Definition: The ability of a system to resolve fine detail in the signal.

Depth: The perception that the reproduced performers are placed at varying distances from the listener, sometimes in front of the speakers, but more commonly behind the speakers.

Theory: Assume the musicians have played one note and continue on to play more. In the recording environment, that note would decay in volume at a rate determined by the acoustics of the room or hall. A listener at the live performance would hear this note decay, and perceive a dynamic range from the original level of the note (say 110 dB) down to and below the ambient noise level of the room (say 30 dB). This would be a range of 80 dB.

The listener uses this reverberation data to compute the distance and direction of the individual performers, and to gain an impression of the size and shape of the space in which they are playing. To obtain a similar dimensional accuracy and realism in a disc playback system, the system must be able accurately to reproduce a similar dynamic range, as well as maintaining precise phase accuracy over the whole frequency range and *between channels*.

Effective dynamic range: A system of 100 watts output and a noise level 70 dB below full output, may in theory be considered to have a dynamic range of 70 dB, i.e., from noise level up to full output. With a sine wave input, under laboratory conditions, such a range may well be achieved — but it won't effectively reproduce *music* with this wide range, for when this amplifier is called upon to amplify a complex music signal to full output, the distortions created (harmonic, intermodulation, transient intermodulation, and any others not yet isolated), cause a loss of low-level signals through masking by these distortions, and by modulating background noise.

These are the factors which cause the 'compressed sound' from some equipment, and poor performance under listening tests, in particular lack of depth.

In the above example of a listener at a recording session, 80 dB of dynamic range is acoustically available in the studio. But played back over a system with only 30 dB of Effective Dynamic Range (E.D.R.) 50 dB of dynamic range is lost. And there goes the realism of the live performance — and the "depth".

The system

As the arm/cartridge/cartridge/disc system is the starting point in the replay chain, any losses of information in the signal at this point cannot be retrieved later in the chain, no matter how superb the electronics or speaker system.

We have proved beyond any doubt that, even with very high definition cartridges, electronics and speakers quite small errors in setting up cartridge tracking parameters caused stereo image shifts, loss of definition and serious loss of E.D.R.

As the errors increase from a perfect set up, the first property to go is depth. The three-dimensional stereo image reduces to a flat perspective, but with the left to right data maintained accurately.

As errors increase, the image may only be accurate in the region of one speaker, the other speaker putting out sound but this sound seeming to be divorced from the stereo image. Beyond this, no accurate stereo image is present, either the performer seems to be either "over there" to the left or "over there" to the right.

To obtain really three-dimensional imaging the ultimate in transducers and electronics is required, but any good system can be improved by following the procedure to be described. However, the better the equipment, the easier it is to hear and appreciate the improvements.

Equipment

Turntable: Naturally the best possible unit will give the best possible results. We strongly favour the new range of belt-drive turntables that are being made in England, as giving noticeable sonic improvements over other top-line equipment.

Arm: Our set-up procedure involves critically adjusting the antiskating correction, arms that have a fixed amount of antiskating applied are not suitable, in our opinion, for a high-quality system. No high definition cartridge can give its best in terms of stereo imaging and E.D.R. without antiskating being correctly applied.

Some cartridges work only in damped arms, others are already well damped and need an undamped arm to avoid sounding "mushy". Experimentation is required to decide the best for your cartridge.

Cartridge: We use specially rebuilt Decca Mk VI's, but other cartridges that use a positive pivot point for the cantilever rather than a hysteretic rubber pivot should perform well and be worth the effort required to set up correctly.

Set-up procedure

Your ears must be the only judge of how things are working. The final settings will be close to the "by the book" settings but as the only test is "how does it sound", any adherence to "the book" may inhibit you obtaining the best results.

Be warned that this set-up method can take a long time to optimise. At first you may not be able to hear changes in the sound from adjustments made. Persevere and your awareness of sound qualities will improve and you will come to be able to hear very small changes with certainty.

This procedure is much easier to do if your preamplifier allows you to monitor either the left or right input over both speakers or good headphones. This allows instant comparisons between channels, which is the key to this procedure.

STEP 1: Refer Fig. 1. The stylus must be perfectly vertical in the groove as viewed from the front. Any slightly "off vertical" alignment must be corrected. A unipivot arm can pose problems in ensuring this adjustment is stable and accurate. If it is not, no other changes will optimise the system.

STEP 2: Refer Fig. 2. Set the vertical tracking angle of the cartridge by using the *mounting platform of the cartridge* as the guide, not the arm. This may be changed later but level the cartridge for the present. ▶

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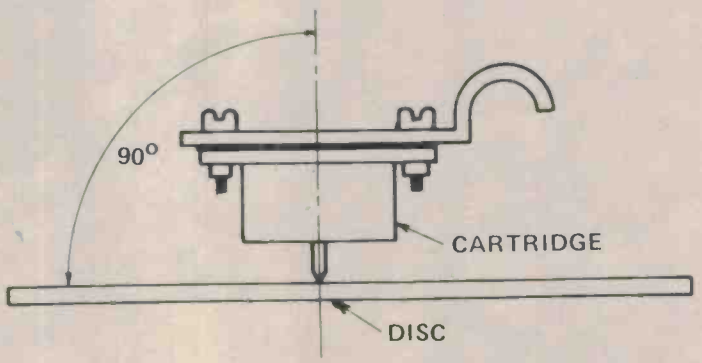

Fig. 1. The stylus must be perfectly vertical in the groove.

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System Type	12" 4 way 5 Speaker
Speaker Component:	
Bass Driver	12" Roll Surround High Compliance Bass Drive Unit
Mid Range	5" Curvlinear Cone Type
Tweeters	Two x 2" Cone Type and one x 3" Super Horn
Power Capacity	50 watts RMS Integrated Programme
Frequency Response	25 Hz to 20,000 Hz ± 3 dB
Crossover Frequency	1,000-5,000-10,000 Hz
Nominal Impedance	8 ohms at 1,000 Hz
Dimensions	685mm H x 470mm W x 340mm D
Colour	Australian Walnut

Model LD-D-104H

System Type	10" 3 way 3 Speaker
Speaker Component:	
Bass Driver	10" Roll Surround Bass Drive Unit
Mid Range	4" Curvlinear cone type
Tweeter	3" Horn
Power Capacity	30 watts RMS integrated Programme
Frequency Response	35 Hz to 18,000 ± 3 dB
Crossover Frequency	1,000-5,000 Hz
Nominal Impedance	8 ohms at 1,000 Hz
Dimensions	610mm H x 360mm W x 270mm D
Colour	Australian Walnut

Model LD-D-1555H

System type	15" 3 way 4 Speaker
Speaker Component:	
Bass Driver	15" Cast Chassis — Edge Treated High Compliance Bass Drive Unit
Mid Range	Two x 5" Curvlinear Cone Type
Tweeter	High Efficiency 3.5" Metal Horn Super Tweeter
Power Capacity	65 watts RMS Integrated Programme
Frequency Response	20 Hz to 20,000 Hz ± 3 dB
Crossover Frequency	1,000-5,000-10,000 Hz at 12 dB/octave
Nominal Impedance	8 ohms at 1,000 Hz
Dimensions	795mm H x 510mm W x 360mm D
Colour	Australian Walnut

Model LD-D-125H

System Type	12" 3 way 3 Speaker
Speaker Component:	
Bass Driver	12" Roll Surround Bass Drive Unit
Mid Range	5" Curvlinear Cone Type
Tweeter	3" Horn
Power Capacity	40 watts RMS Integrated Programme
Frequency Response	30-18,000 Hz ± 3 dB
Crossover Frequency	1,000-5,000 Hz
Nominal Impedance	8 ohms at 1,000 Hz
Dimensions	685mm H x 390mm W x 340mm D
Colour	Australian Walnut

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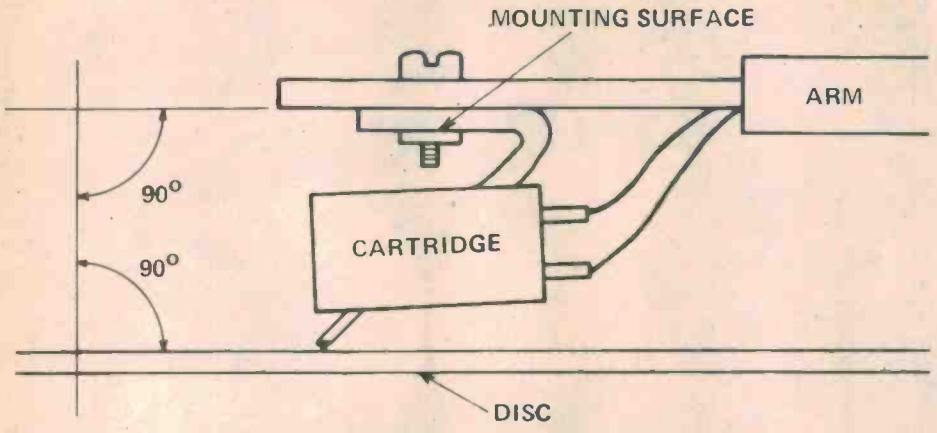

Fig. 2. The cartridge's vertical tracking angle is initially set as shown.

STEP 3: The stylus overhang at this point should be set per the alignment adjustments issued with the arm. Set it accurately!

STEP 4: The tracking weight should be set to the light end of the cartridge manufacturer's recommended value.

STEP 5: Buy a new (preferably import) copy of a record well known to you, of either a live recording with lots of natural reverberation, or a studio disc with good artifical reverberation.

STEP 6: Play an outside track and switch the preamp between the left and right channels. Adjust the balance controls to get the sound level accurately balanced (It is assumed that the speakers you use are in phase and hence give a definite centre image in mono mode). This step must be done after each adjustment to ensure the level is equal before doing other comparisons.

STEP 7: Switch to stereo, and sitting dead centre between the speakers as per Fig. 3 (if not using headphones), listen carefully to the test track.

STEP 8: One channel will almost certainly seem to have more life, more dynamics than the other, which will sound a little "flat" in comparison. Switch to each channel in turn to get a real impression of this. Do not blame the record for this unequal effect. Good records are very consistent between channels.

STEP 9: Reduce the antiskating adjustment to zero and increase it a little at a time. After each change, listen for a shift between channels of this "liveness". (Usually the right channel loses E.D.R. first for *small* changes of antiskating either side of optimum.)

STEP 10: Having found what you are certain is an optimum point for the antiskating, you can now move on. What you are actually listening for is an increase in E.D.R. If you are not using phones, listening to the speaker from a distance of one foot or so will allow a better judgement of changes.

The final purpose is to optimise the "depth" in each channel and to equalise it between the channels, to obtain optimum definition and steoeo image.

Using the same method of checking, i.e., an optimum balanced E.D.R. in each channel, slide the arm fore and aft in its mounting base to vary the cartridge overhang distance. Vary it by *very* small amounts, 0.25 mm or less at a time.

If the arm is fixed on the base, the cartridge may be moved in the headshell. This is, however, rather dangerous as it's easy to change the offset angle as well as the overhang, giving two variables at once which makes for an almost impossible situation to optimise. It's far better to cut a slot in the base to allow the arm to be moved rather than adjust at the headshell.

The same effects heard when changing the antiskating will occur. One channel will get better, then the other will also come in until an overall balanced increase is obtained.

STEP 11: With the overhang optimised, the antiskating is again varied to find a new optimum as per Step 9. It should only need a small change to again optimise it.

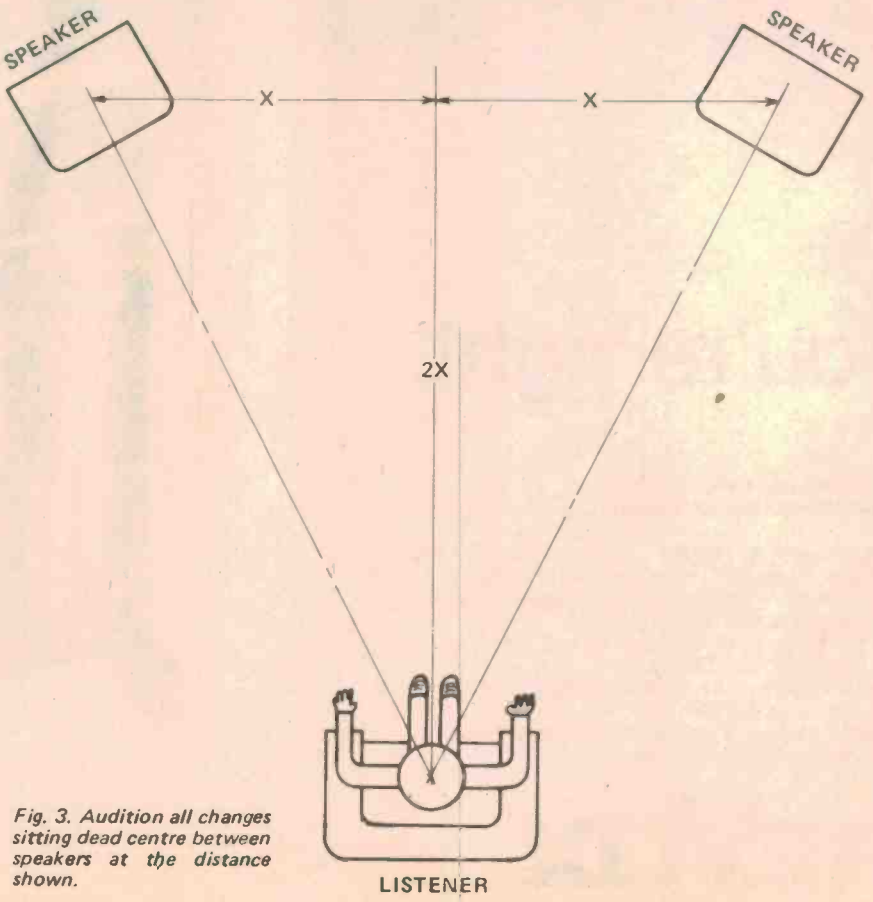

Fig. 3. Audition all changes sitting dead centre between speakers at the distance shown.

STEP 12: Now repeat Step 10 and Step 11 as a sequence, i.e., 10, 11, 10, 11, etc., until the absolute is obtained. Three times through should be enough.

STEP 13: Now the offset angle of the cartridge in the headshell can be varied small fractions of a degree to see if an improvement can be found. NB. Do not lose the overhang setting while changing the angle!

If a change does improve matters, Steps 10 and 11 will need to be repeated in the sequence 13, 10, 11, 13, 10, 11, etc.

STEP 14: At this point the vertical tracking angle can be varied by raising or lowering the arm in its mount. This may or may not show an improvement.

An article in the September 1977 issue of the UK magazine "Hi-Fi for Pleasure" claims that certain cartridges may show an actual tracking angle of 25° to 30°, rather than the design value of 15° to 20°, which can cause high distortions. Decca's, however, never seem to need more than a degree or two to optimise.

STEP 15: By now, with the geometry near perfect, a benefit may be heard by reducing the tracking weight, thereby reducing stresses on the stylus assembly, and allowing it to work a little more effortlessly. As the tracking geometry is now optimised, the tracking should be improved, and the system not requiring so much weight to track accurately.

Any change in tracking weight will require an antiskating correction, but not normally the other variables.

Problems

Even after all these adjustments, it may not be possible to get the channels equal. This indicates that either the cartridge or the preamp is not adequately channel matched. Correction of this is beyond the scope of this article but it is possible to find out which component is at fault.

Switch the preamp to the "good" channel only. Then reverse the leads from the cartridge at the amplifier input. If the E.D.R. remains, the cartridge is OK and the preamp at fault. If the E.D.R. drops down, the cartridge is faulty.

Conclusion

By now the stereo and depth performance of your system should be noticeably improved.

There appears to be a lot more information on discs than has been considered in the past. It takes the absolute best in components and their set up to get this information to the preamp, but the results will be seen to be worthwhile. The concept of dynamic range and stereo image as the major value in a hi-fi system is new, but exposure to such a system is an experience not soon forgotten.

Real audiophile systems are getting away from the specifications race and into realism and using listening as the only valid test. We hope this article helps in furthering this move. ●

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...is a Nakamichi, of course!

Imagine being able to record *three hours* of music on a C-90 cassette with the kind of fidelity only Nakamichi can deliver. Wishful thinking? Not with the new Nakamichi 680 2-Speed Discrete Head Cassette Deck. In addition to the standard tape speed of 1⅞ inches per second (ips); the 680 is capable of record and play at half-speed, namely 15/16 ips. And what's really amazing is that the 680's performance at half-speed is equal to or better than that of many modern component-quality cassette decks running at normal speed! Especially when combined with the new metal particle cassette tapes, the 680 at half-speed provides more than ample dynamic and frequency range for the recording of high-quality commercial program material (disk or FM).

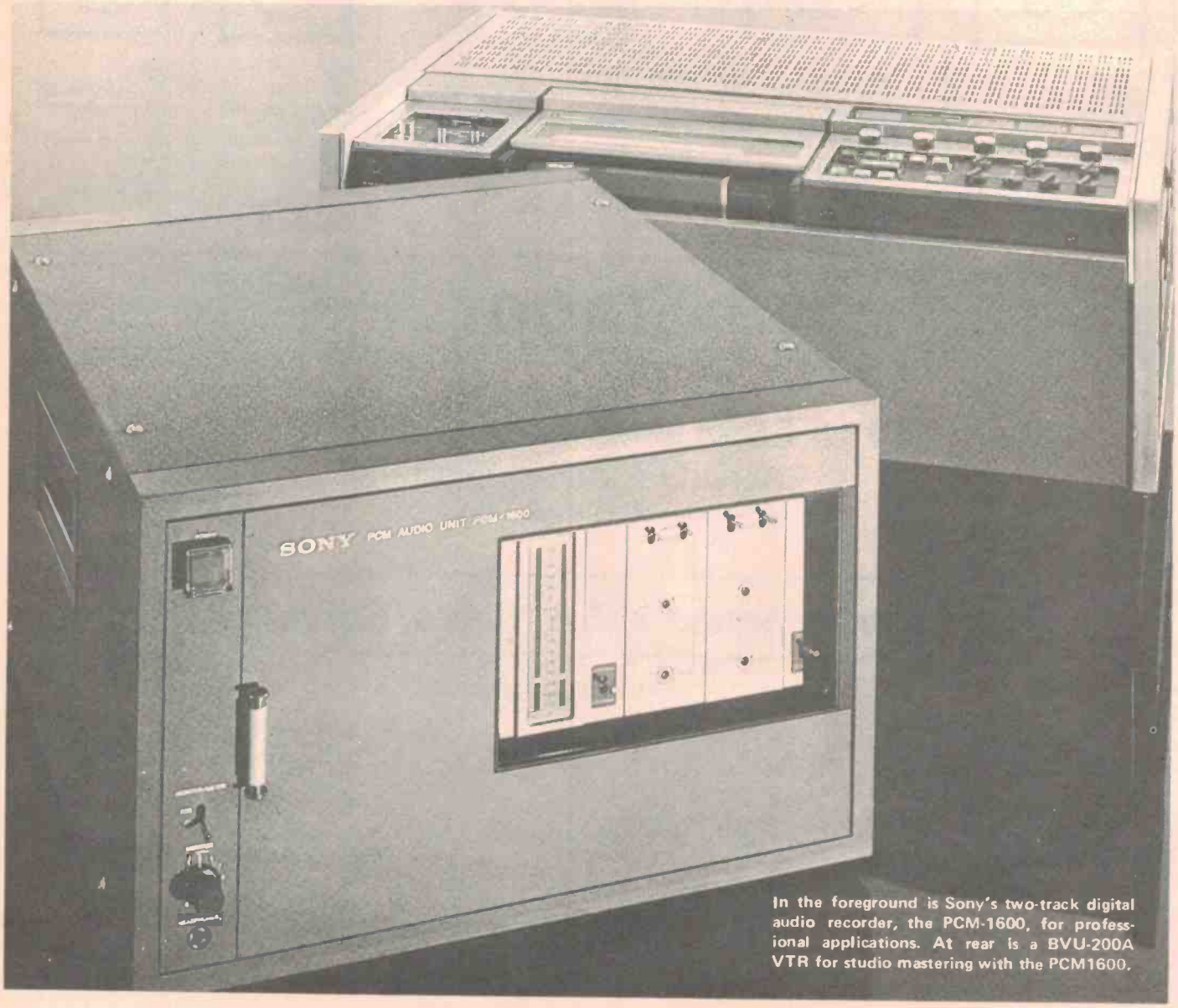
As you might imagine, there is some formidable technology embodied in the Nakamichi 680. This technology not only makes half-speed a reality, but also elicits the last ounce of performance from today's advanced tape formulations at standard speed.

Nakamichi

From CONVOY INTERNATIONAL, 4 Dowling Street, Wooloomooloo, Sydney. 2011.

Digital recording, the next revolution in audio

Digital recording techniques will undoubtedly revolutionise sound reproduction in a few short years. They promise marvellous quality but the price you'll pay at the moment is prohibitive. Professional recording organisations are just now considering the digital gear on offer. Here is a short overview of what the digital recording revolution is all about.



In the foreground is Sony's two-track digital audio recorder, the PCM-1600, for professional applications. At rear is a BVU-200A VTR for studio mastering with the PCM1600.

DIGITAL recording involves recording audio signals as a series of fast pulses. This is unlike conventional recording which involves analogue systems for the recording of instantaneous voltage or current waveforms which are analogous to the sound signal itself. Although digital recording equipment is only just becoming available, there is tremendous interest in the industry and research fields in this technique – which is expected to have a greater impact than any development since the introduction of stereo recording about twenty years ago.

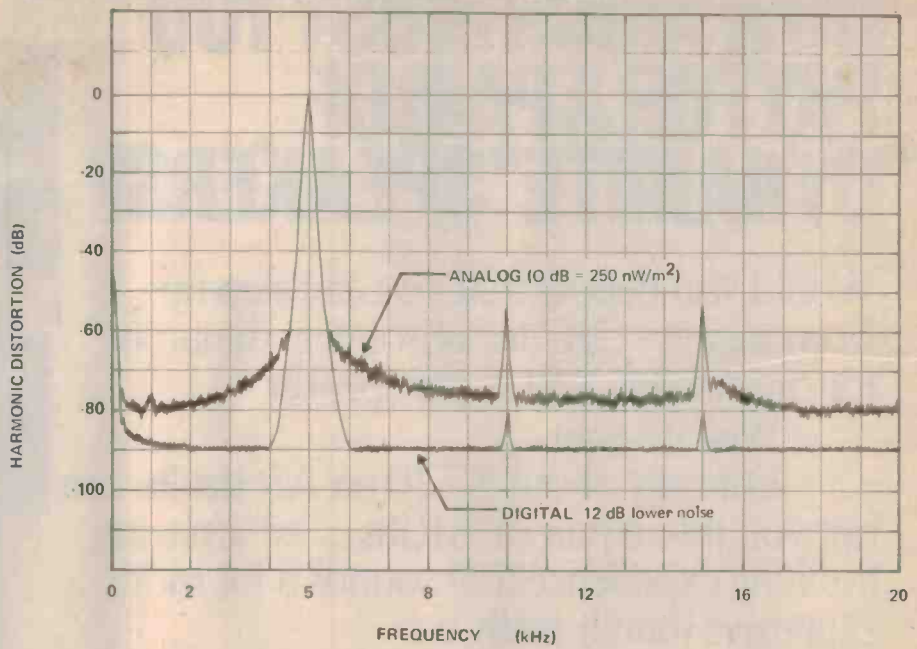
Performance

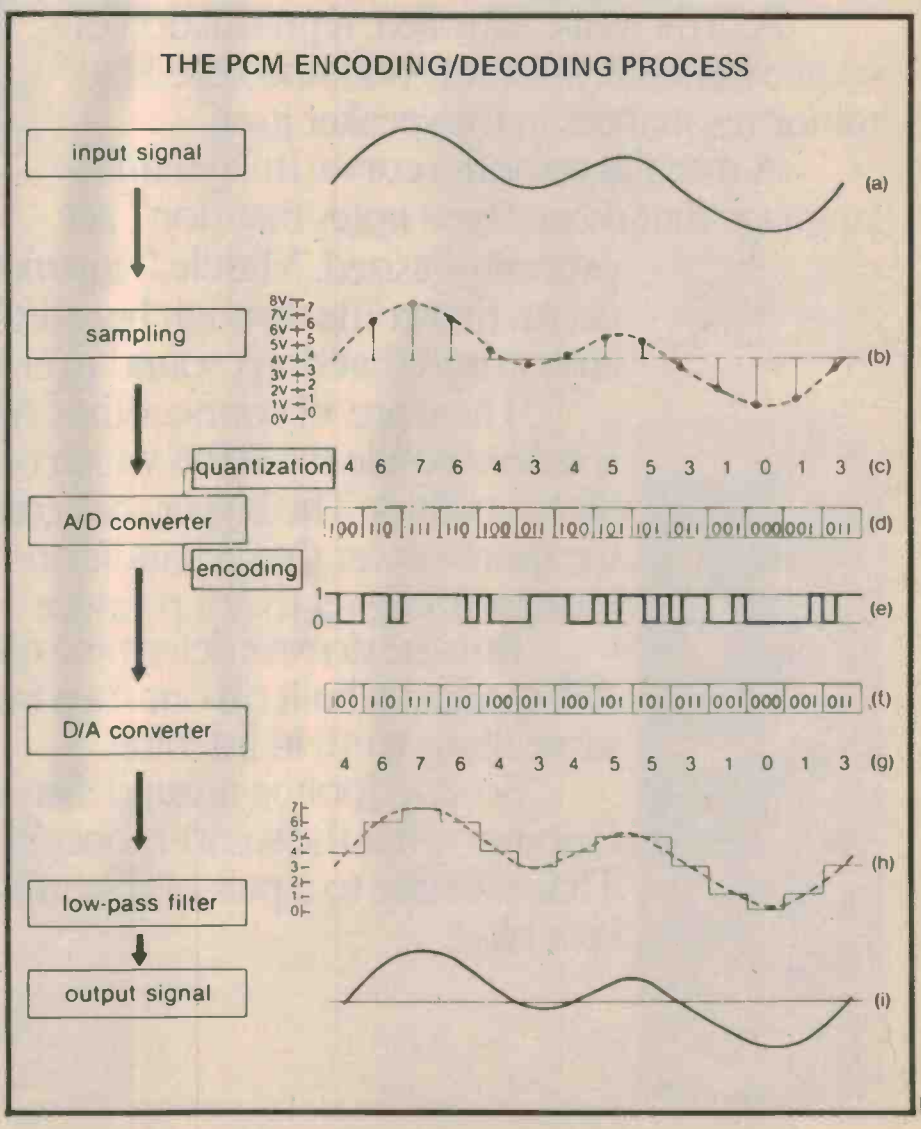
To appreciate some of the advantages offered by digital recording, let us take a quick look at the performance one may reasonably expect from a digital reel-to-reel tape system of the highest quality which it is hoped will become available within the next year or so. It seems that signal-to-noise ratios as great as 90 dB will be normal, compared to around 70 dB from currently available high-quality reel-to-reel recorders and considerably lower values from most hi-fi recorders. Cassette recorders (even with Dolby B) have still lower signal-to-noise ratios, owing to their slow tape speed and narrow tape, and are not commonly used in high quality equipment.

The low distortion level obtainable in digital recording equipment is well illustrated in Fig. 1. This shows comparable curves obtained using a 3M digital recorder and a 3M analogue high quality recorder. A 5 kHz signal is fed, at the same level (which we will call the 0 dB level), to both recorders. The peak at 5 kHz is therefore at the same height in both graphs. If one looks at the height of the second harmonic peak at 10 kHz, however, it is about -54 dB in the case of the analogue recorder output and only -78 dB in the case of the digital instrument. Thus, one gains some 24 dB in second harmonic rejection by the use of the digital equipment. Alternatively one may express these figures as a second harmonic distortion of about 0.2% in the analogue recorder and about 0.012% in the digital recorder.

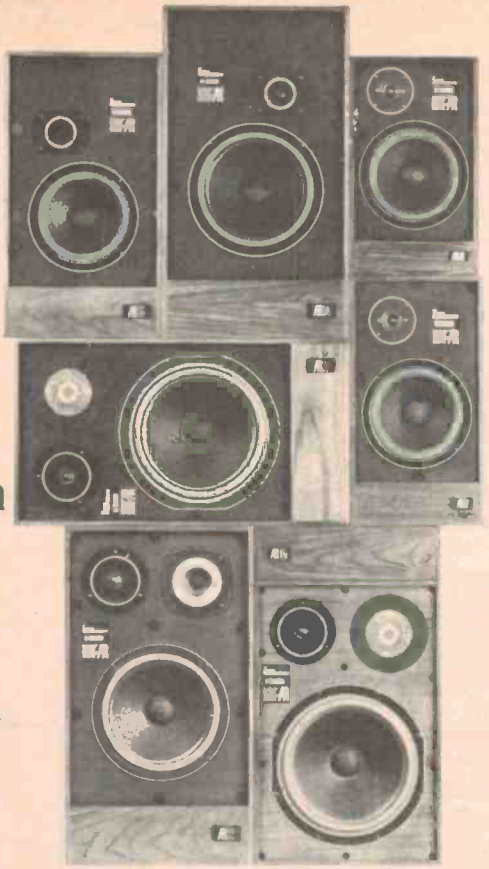
Third harmonic distortion is much more offensive to the ear than second harmonic distortion, but the reduction obtained by the use of digital techniques is even greater than for the second harmonic. In the case of an analogue recorder, third harmonic distortion is approximately -53 dB down relative to the 5 kHz fundamental, whereas in the digital instrument it is at about the -83 dB level; thus an improvement of around 29 dB can be obtained using the digital instrument. The cor-

Figure 1. How digital and analogue recording systems compare.





HOW MUCH MUST YOU PAY FOR A PAIR OF "DYNAMITE" SPEAKERS?



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ACOUSTIC RESEARCH AUSTRALIA
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Most of the common video cassette recorders (VCRs) available may be used to record PCM encoded audio when used in conjunction with a special digital processor.

responding third harmonic distortion figures are 0.22% and 0.0079%.

Although these figures are approximate and only apply to one particular digital and analogue system, they nevertheless illustrate why digital systems show very great promise. The lower signal-to-noise ratio of the digital system can also be seen in Fig. 1. The noise corresponds to the signal level at points well away from both the 5 kHz fundamental and from the 10 kHz and 15 kHz harmonics; it can be clearly seen that the noise in the digital system is over 10 dB less than that in the analogue system at all of the high audio frequencies (which are the primary noise sources in tape hiss).

It is claimed that wow and flutter are totally inaudible in a high quality digital system, whilst the frequency reponse is quite flat over the whole of the audio range. A further advantage of digital recording is that the tape is more stable with time and is less readily affected by small magnetic fields. Digital recordings can be copied to produce a copy which is, for all practical purposes, as good as the original even if a number of successive copies are made from the copied tape. On the other hand the copying of analogue recordings always increases the noise level, this increase depending very much on the quality of the equipment employed; however, it is never less than a few decibels for each successive copying operation.

Digital systems

One of the problems connected with the digital recording systems at present being developed is their lack of compatibility. That is, a digital recording made using a system developed by one manufacturer cannot be replayed on equipment made by another manufacturer.

In general, the digital systems proposed for professional equipment employ 14 or 16 bit linear pulse-code-modulation encoding systems. An input analogue signal to be encoded is first fed to an analogue-to-digital converter which has a typical sampling rate around 40-50 kHz. The output from this converter undergoes an error detection process which generates correction pulses to be compounded with the signal. The resulting output is suitably formatted and recorded on a digital tape recorder which is rather similar to the recorders used in digital instrumentation applications.

The replay operation involves the recovery of the digital signal from the tape and error correction for any bits of information which have been lost or for any noise pulses introduced. A digital-to-analogue converter is then used to generate the analogue audio signal. Digital pulses are removed by a suitable filter.

Such a digital recording system is complex and its design is made more difficult by the high data rates at which it must operate. Bit rates of the order of 2 Mb/s are required in a good audio system with full error correction facilities. Undoubtedly large scale integrated circuits will be developed in due course for digital recording systems, but at the present time prices seem to be of the order of several tens of thousands of ▶

dollars for any equipment likely to be released for high quality work during the next year or two. This is around fifteen to twenty-five times the price of high class analogue equipment.

One of the most important problems discussed by the International Audio Engineering Society at a meeting in New York was the standards which are to be adopted for the encoding format and for the sampling rate. One cannot conveniently convert a recorded signal at one sampling rate to a digital signal at another rate without first changing to the analogue form and this would result in a loss of most of the advantages of the digital technique. Direct digital-to-digital conversion involves complex and expensive equipment, although Sony, at least, offer a unit. It is therefore vital that a suitable standard is adopted so that digital tapes can be replayed on any standard equipment of any manufacturer.

Many manufacturers are very interested in the use of digital techniques. In Europe Philips are almost certainly the leaders, whilst the US manufacturers Ampex, 3M and Soundstream are strong competitors. The Japanese are very strong with Matsushita, Sony, JVC and Pioneer all working in the field; indeed, the Japanese commenced the work on audio digital recording.

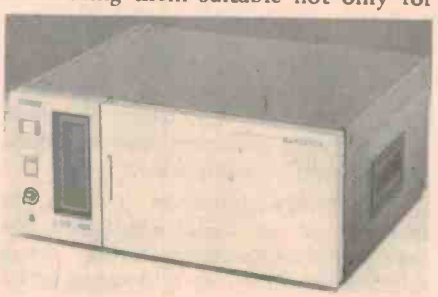
Until the equipment for digital recording has been available for a long enough period for prices to fall, no manufacturer can expect high volume sales to the domestic user. Indeed, we have the familiar chicken-and-the-egg situation where volume sales will not occur until prices fall and prices will not fall until volume sales take place. In any case, it seems likely that it will be about a year before the first digital high quality recording systems become available to those able to afford them. At the present time only the 16 bit conversion has become accepted as a standard and we must wait for standardisation of sampling rates, tape speed, error correction systems, data formatting and tape track size. System standards must be adopted before there can be any question of a substantial fall in the projected price or even the ready availability of digital recording equipment.

Discs

In the field of digital recording on disc, the Dutch Philips Company seems very confident that a compact digital hi-fi system which was introduced early in 1979 will become widely accepted by the audio trade. One of the great advantages of the Philips system is its relatively small size. The discs are about 114.5 mm in diameter and the complete equipment is relatively small; this brings various advantages such as its convenient use in a car.

Digital disc systems provide ultra-high density recording – 2½ hours per side for Sony's DAD-1X, and feature claimed dynamic ranges better than 90 dB with THD figures around 0.03 - 0.05%. A helium-neon laser 'reads' the disc in the above machine, signals consisting of 16-bit linear quantized PCM pulses. Surface wear, dust and handling do not affect the discs. Wow and flutter is claimed to be undetectable, even though the disc rotates at 450 RPM!

Other manufacturers currently developing digital disc recording systems are making them suitable not only for audio, but also for videodisc equipment which enables television programmes to be recorded. Competition comes mainly from the Japanese in this field in which Pioneer, Sony and JVC are very active.



This digital processor, a Sony PCM100, enables recordings to be made on a video cassette.

Philips expect to market their "Compact Disc" system early in the 1980s and they claim this will provide sound reproduction superior to anything currently available on either disc or tape for the domestic market. Philips say the price of this system will be comparable with that of good quality conventional hi-fi record players.

The "Compact Disc" player employs a diode laser in the pick-up arm for play back. The sound is recorded digitally using a 14 bit linear pulse code modulation encoding system. One of the supreme advantages is that there is no physical contact between the head and the disc during playback and therefore the audio recorded signal can be protected by a layer of material which will prevent damage from dust or scratching.

The signal-to-noise ratio is said to be better than 85 dB (which is really first class), and the response 20 Hz to 20 kHz. Information is recorded at a tangential velocity of 1.5 m/s and a single-sided record of 110 mm diameter will provide a playing time of one hour in stereo. Multiple channel systems can be easily realised with excellent channel separation.

Conclusion

Completely new recording techniques will become available in the reasonably near future which will revolutionise hi-fi systems and provide the highest possible standards of reproduction, although they will be considerably more complex than currently used audio equipment. One wonders if any further improvements will be needed. ●

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*Available either with perspex cover as illustrated or conventional metal cover. *Suggested retail $399.

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This is the top-of-the-line system — even the internal illuminated cabinet has its own deluxe touches. DC-Servo amplifier (100W × 2, IHF Music Power), Digitally Quartz-Locked tuner and Full-Auto Quartz-Servo DD turntable.

Matching speakers. Wide-range quality speakers systems are available to fully realize the fine features of SUPER COMPO systems.

Audio Cabinets. Each SUPER COMPO system comes with its own audio cabinet specially designed to accommodate the system's components.

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sound review

Audio Pro B2-50 sub-woofer system

IT IS REMARKABLE that only a few weeks ago a client building a new and rather expensive house rang to ask where he could buy a subwoofer to cover the frequency range 20 Hz to 50 Hz. He wanted to incorporate it into his high fidelity system to play organ music and faithfully reproduce the original low frequency signals on his tapes. Whilst we discussed with him the merits of various options including 15" (375 mm dia.) and 18" (450 mm dia.) speakers in various enclosures, the most pragmatic solution for his problem had to wait a little longer, until the B2-50 Ace-Bass Subwoofer turned up for review.

The problem

As you undoubtedly know, a very basic problem with most loudspeaker enclosures is that their low frequency response rolls off somewhere between 40 Hz and 150 Hz. The bigger and generally better the enclosure, the more likely its low frequency response extends down to the lowest audible octave, band 1. This octave, centred on 31.5 Hz, extends from approximately 22 Hz to 44 Hz and most domestic speakers do not produce a significant output within the band.

If you know anything about music, you will realise that this octave band is important with many musical instruments — drums, organs, pianos, basses, tubas and double bassoons — and many electronic instruments (including moog synthesisers). The problem is that speaker systems capable of performing adequately in this octave band, generally do so with a pronounced non-linear response, often with significant distortion at high sound pressure levels and generally requiring extremely large vented or ported enclosures.

Thirty years ago I can well recall a Philips advertisement showing a man with his house designed like a large conch shell. He had loudspeakers at the apex so that he could faithfully reproduce the lows as well as the entire audible frequency range. In the August 1973 issue of ETI we described the closest approximation to that house that I have seen, but even there the ability of the system to faithfully reproduce the frequency components in the lowest octave bands were architecturally complex.

In his paper entitled *"Performance Limitations and Synthesis of Direct Radiator Loudspeaker Systems"* (Proc. IREE (Aust) August 1973) Dr Richard Small of the University of Sydney, shows how complex (if not impossible) it is to make a conventional speaker (with reasonable efficiency in a reasonable box volume) produce a flat response in the lowest bass tones. Obviously, a technical breakthrough is required to circumvent the limitations of conventional enclosures.

Neville Thiele presented a basic theoretical analysis as to how this could be achieved in his paper entitled *"Loudspeakers in Vented Boxes"* (Proc. IREE (Aust) August 1961) and showed that by introducing amplifiers and feedback networks, the dynamic performance limitations of the ordinary loudspeaker could be overcome.

Karl Erik Stahl, the designer of the B2-50, in fact makes use of both Small's and Thiele's work to design a network to circumvent the mechanical problem. The most significant feature of the system is the utilisation of positive feedback around the amplifier and negative feedback around the bandpass filter circuitry, to achieve high outputs and acceptable distortion levels. This is achieved through the strategy of making the electrically synthesised characteristics of the combination of speaker enclosure and driver amplifier, predominate over the real characteristics and mechanical parameters of the two small 160 mm drivers. These operate with controlled motional feedback to perform *Herculean* tasks considering their size.

Stahl overcomes the most significant problem of the driver non-linearity to achieve acceptable distortion levels optimised to cover the lowest three ▶

Louis A Challis and Associates Pty Ltd

Our Ref: E13

MEASURED PERFORMANCE OF

AUDIO PRO B2-50 SUBWOOFER, SERIAL NO. 911893

FREQUENCY RESPONSE:	21Hz to 160Hz $^{+0}_{-3}$dB			
	(set to maximum cutoff frequency)			
CROSSOVER FREQUENCY:	Separately adjustable low pass and high pass filters covering frequency range 40Hz to 200Hz.			
SENSITIVITY:				
(for 90dB at 2m, 100Hz)	90mV			
	(Preamp input, maximum sensitivity)			
HARMONIC DISTORTION:		30Hz	45Hz	100Hz
(for 90dB at 2m)	2nd	-52.0dB	-48.7dB	-31.1dB
	3rd	-26.3dB	-37.1dB	-42.4dB
	4th	-37.4dB	-51.0dB	-49.8dB
	5th	-29.3dB	-51.0dB	-50.7dB
	THD	*6.1%*	*1.5%*	*2.9%*

(3rd September, 1979)

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Agfa Ferro Color Cassettes offer superb reproduction of sound and a convenient colour-coded reference system.

With a choice of three colours and three tape durations – 60, 90 and 120 – you have up to nine combinations for a comprehensive, easy-select library.

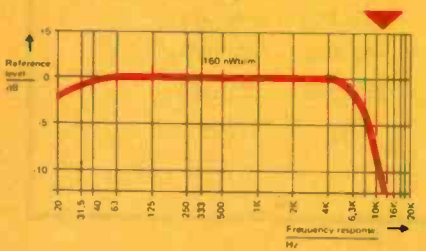
Add colour-coding to the many other features and it's easy to choose Agfa Ferro Color Cassettes.

COLOR CODE

z.B.: e.g.:	FOLK	POP	JAZZ
C60			
C90			
C120			

High Dynamics: Agfa Ferro Color Cassettes have a high quality iron oxide coating to increase dynamic range and frequency responses.

The result is a rich, clear, transparent sound ideal for the recording of all types of music.

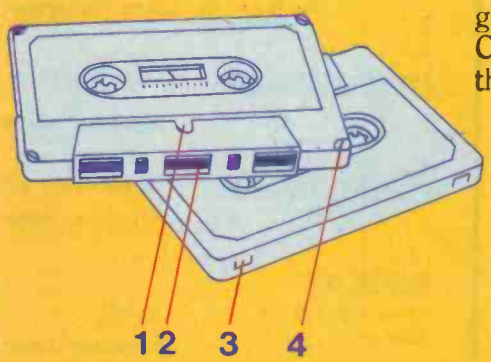


A Better Designed Case: Cases are of smooth lines, with rounded edges and corners to improve handling and efficiency.

A Better Designed Cassette: The Cassettes are of the screwed type and side one can be easily identified.

Inside the cassette is a special noise shield to avoid unwanted 'hum'.

To prevent unintentional erasure, knock-out tabs are located in the rear. These are optional either side.



Practical aids in Agfa-Gevaert cassettes:

1. immediate positive identification of side one.
2. metal noise-shield avoids unwanted "hum".
3. knock-out tabs at rear of cassette prevent unintentional erasure (optionally either side).
4. screwed cassettes.

For the convenience of colour-coding and for superb sound reproduction you'll be glad you chose Agfa Ferro Color Cassettes – there's more to them than meets the ears!

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Agfa-Gevaert for still cameras, flash-guns, colour film for slides, prints and movies, magnetic tapes.

K381

octave bands of the audible spectrum.

The lower the frequency, the greater these problems become. Stahl has taken special precautions to protect the speaker and amplifier from inputs below 20 Hz by introducing a 12 dB per octave filter to prevent significant cone excusions in that region.

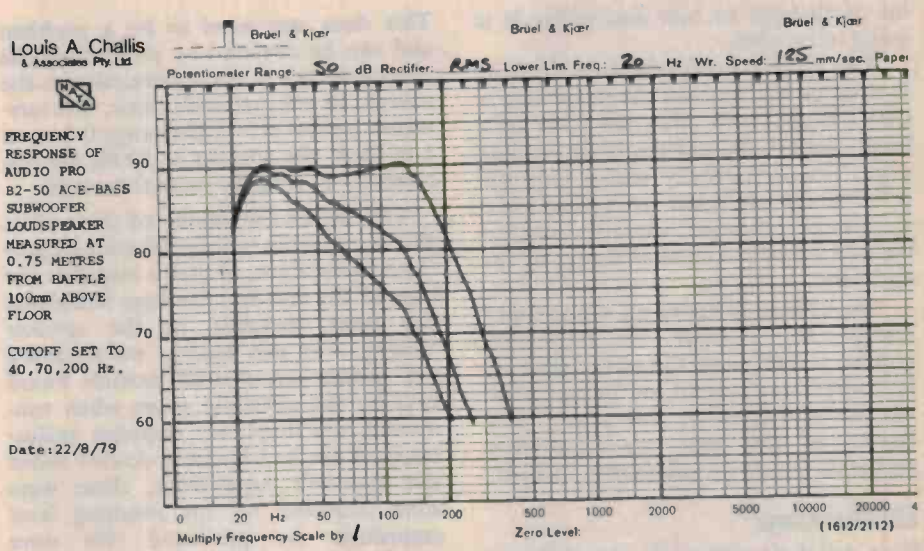
Description

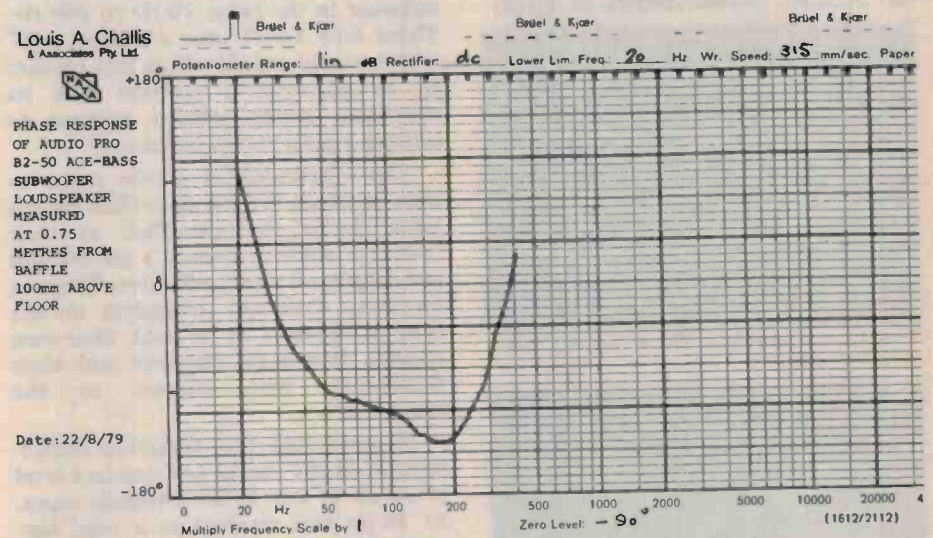
In appearance, the B2-50 Ace-Bass Subwoofer is very different from what you would expect in a speaker designed to operate at such low frequencies. The unit consists of a 25 mm thick fully veneered particle board enclosure, which is very small. The unit that we evaluated is timber veneered but sprayed black to match a European furniture concept that is currently in vogue. The face of the unit is equipped with a removable panel which is a conventional open weave black cloth on a wooden frame. This covers the main power amplifier, input sensivitivy controls, power on/off switches, the crossover frequency controls for the subwoofer (30 Hz to 200 Hz) and high pass crossover frequency settings for the main speaker system (40 Hz to 200 Hz).

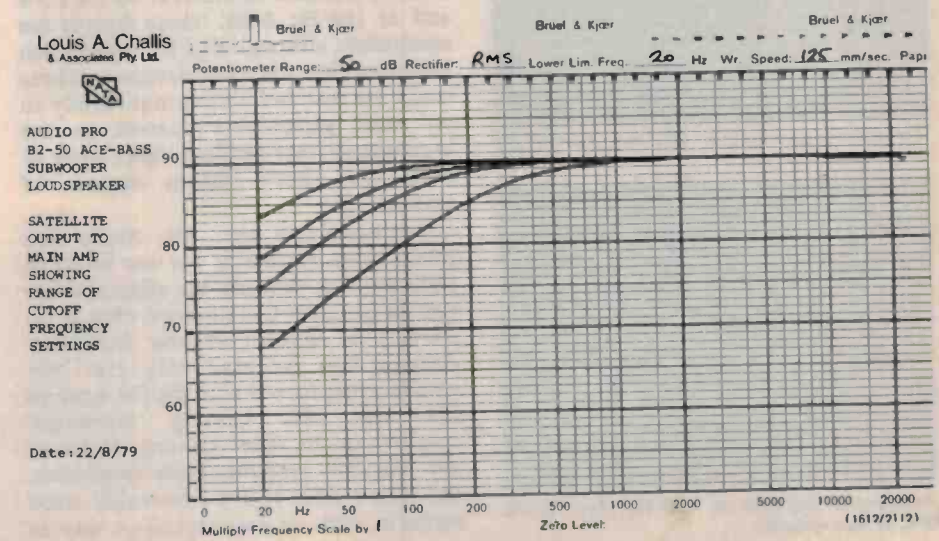
The response characteristics are plotted on a graph so that the response selected can be assessed in terms of the subwoofer's resulting output. A comparison of our measured data and the manufacturer's data is rather interesting and shows reasonable agreement, except that the attenuation rate at both the lower and upper side bands of the response that we measured in the anechoic room are steeper than those shown by the manufacturer.

At the bottom of the front face of the unit, a voltage selector (for 117, 220, 235 and 250 Volts) is located along with fuses. The speaker connections and preamplifier input/output connections are provided by means of DIN sockets. These are, regrettably, only readily accessible with the unit on its back or upside down. Two small 150 mm drivers arranged in a push/pull configuration are mounted on a 25 mm recessed veneered panel which provides even greater stiffness and damping for the enclosure.

The designers and manufacturers have not skimped in the provision of clamps and brackets for retention of cables or penetrations for cables. The unit gives an immediate impression that the people who designed it have given a







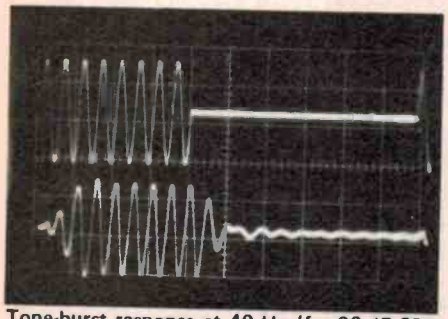
lot of thought to how and where it is going to be used.

The venting port for the enclosure is located on the bottom of the cabinet, is well designed and takes the form of a long, smooth moulded plastic loading port. This is carefully sealed into the side of the enclosure to provide the accurately controlled inertance characteristics for the acoustical design of the enclosure.

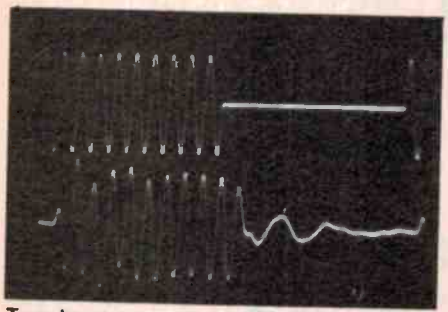
The unit is mounted on four quality casters to facilitate its movement around a room and the unit creates an immediate impression of being workmanlike and efficient. Fortunately, the testing of the unit presented fewer problems than we would have expected.

Evaluation

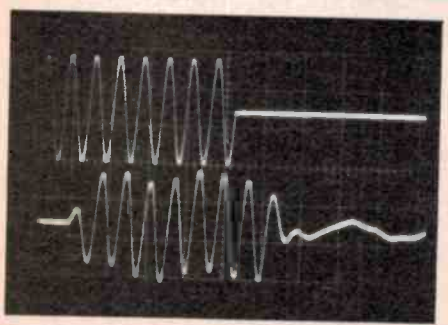
Most anechoic rooms are not designed for accurate measurements at 20 Hz.



Tone-burst response at 40 Hz (for 90 dB SPL at two metres).



Tone-burst response at 100 Hz (for 90 dB SPL at two metres).



Tone-burst response at 150 Hz (for 90 dB SPL at two metres).

This does not need to be a problem and can be obviated by performing the measurements in close proximity to the source. In our particular case, measurements performed in the range 0.1 m to 1 m from the speaker at 20 Hz are not normally in error by more than 1 dB.

One significant factor of this unit is that the speaker is designed with its port close to the floor, in such a way that the base of the unit and the floor constitute the final elements in the speaker loading. For this reason, we mounted the speaker on a small particle board base in the anechoic room when conducting the frequency response evaluations. If we had had any doubts about the speaker's capabilities, these were soon dispelled by the resulting level recordings we produced. We were equally impressed by the unit's phase response in the range 20 Hz to 200 Hz. These only varied over a modest 250° which would readily allow this speaker to be adjusted in position with its associated stereo speaker systems to achieve a good spatial balance.

The characteristics of the crossover filter network for the main filter system (that Audio Pro described as their "satellite speaker system") are smooth and in general terms, effective. They are however, obviously dependent on the type of speakers to be used, their own natural frequency response and their positioning with respect to the subwoofer.

We evaluated the distortion characteristics of the unit at our standard level of 90 dB at 2 m in the anechoic room. At 30 Hz this resulted in a total harmonic distortion of 6.1%; at 45 Hz 1.5% and at 100 Hz 2.9%. These figures are acceptable, although slightly higher than indicated by the manufacturer. These levels are just audible but not readily so on most programme content as the instruments that produce these sorts of levels also have various degrees of colouration.

In subjective use, the Audio Pro B2-50 does something for our listening pleasure that virtually no other speaker system has ever done before; that is, to provide a breadth in the frequency domain that we have only ever previously experienced with profile systems like the JBL Lansing 'Sovereign' speakers or the Altec Lansing 'Voice of the Theatre' systems. More important, the B2-50 does it in a reasonably sized room in such an inconspicuous way as to be completely deceptive.

We tried the B2-50 out with a number of different systems (some good and some mediocre) and were immediately impressed by this new presence and extended balance in the overall spectrum. The B2-50 sounded the best on demonstration records produced by other speaker manufacturers. Drums took on a new dimension and organ pieces gained a new realism so that, by closing one's eyes, one could imagine being there at the time of the original recording. Also, records recorded in large auditoria made you think that you were right there.

Summary

The greatest benefit of a subwoofer system of this type is undoubtedly in use with high quality speakers, such as the Quad Electrostatic, which have excellent frequency responses in the 100 Hz to 20 kHz region but ineffectual in the lowest two octave bands. By combining the B2-50 with Quads, the most disturbing limitation in their overall performance is neatly side-stepped and their flexibility for modern, as opposed to classical, music is enhanced. We were frankly at a loss to know what to do with our Quads and this opens the door to a practical and reasonably economical solution for general monitoring purposes.

The Audio-Pro B2-5 Ace-Bass subwoofer, for the first time, offers a practical solution to the problem of accurate reproduction of the lower bass octaves in a way that even those fastidious about their decor will not be able to object on the basis of size, appearance or even performance. ●

THE AUDIO-PRO ACTIVE B2-50 SUBWOOFER SYSTEM, SERIAL NO. 911893

Dimensions: 540 mm high x 460 mm wide x 450 mm deep
Weight: 28 kg; Price: under $1000
Manufactured by 3Dgruppen ab, Stockholm, Sweden.
Supplied by Depro Industries Pty Ltd, Suite 5/83 Walker St, North Sydney 2060; (02) 92-6561.

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It took twenty years of technological experience to make a videorecorder that will do all this and still be compact enough for the home.

Sony experience also made the difference in the Betamax videocassette. It's easy to store and handle because it's the smallest cassette on the market, yet it holds more than three hours of continuous programming.

And there's the Betamax U-loading system. Experience has proved it to be the most reliable, most stable tape transport system for videorecording. It delivers a picture that is picture perfect.

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Sony Betamax

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SHEFFIELD LAB 1
LINCOLN MAYORGA & DISTINGUISHED COLLEAGUES VOL. 3

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SHEFFIELD LAB 3
HARRY JAMES. "THE KING JAMES VERSION"

Harry James and his Big Band in a repertoire encompassing old and new. Tracks include Cherokee, Sweet Georgia Brown, Don't Be That Way, Lara's Theme.

SHEFFIELD LAB 4
"BRAHMS, HANDEL, CHOPIN"

Sheffield's first classical album. Pianist: Lincoln Mayorga. Tracks — Brahms: Variations and Fugue on a Theme by Handel. Handel: Air with Variations from Suite in B flat Major. Chopin: Mazurka in A Minor.

SHEFFIELD LAB 5
DAVE GRUSIN. "DISCOVERED AGAIN"

Light, vibrant jazz with Dave on piano; Ron Carter, Bass; Harvey Mason, Drums; Larry Bunker, Percussion. Tracks include compositions by Dave, Thad Jones and Antonio Carlos Jobim.

SHEFFIELD LAB 6
HARRY JAMES. "COMIN' FROM A GOOD PLACE"

Harry James and his Big Band in an easy-going jazz oriented mood. Tracks include the Footstomper, Two O'Clock Jump, Opus Number One, Tuxedo Junction.

SHEFFIELD LAB 7
ERICH LEINSDORF AND THE LOS ANGELES PHILHARMONIC "WAGNER"

Recorded July, 1977. Includes Die Walkure, Ride of The Valkyries; Tristan and Isolde, Prelude to Act 1; Die Gotterdammerung, Siegfried's Funeral Music.

SHEFFIELD LAB 8
ERICH LEINSDORF AND THE LOS ANGELES PHILHARMONIC "ROMEO AND JULIET"

This record includes Act 1 Introduction, Masques, Gavotte, Act 2 Finale, Juliet's Funeral, Juliet's Death.

SHEFFIELD LAB 9
LARRY McNEELY AND FRIENDS "CONFEDERATION"

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For the serious audiophile and guitar lover hear Michael Newman play guitar in the direct cut mode.

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amc/mf 52

Audio Reflex ARA665 stereo amplifier

Released in July, this amplifier "... offers excellent performance at a reasonable price".

THE ARA-665 Stereo Amplifier is a conventional medium powered integrated stereo amplifier well presented in a ventilated steel cabinet. The front panel is solid and the brushed aluminium escutcheon is flanked at both ends by two, large well-made diecast handles.

Some features would lead one to believe that the unit is constructed for rack mounting but it is 80 mm too short for that purpose. The handles have another function, however, as they provide a degree of protection for the controls not only in transit, but also when mounted on a shelf.

The controls are conventional. The primary controls are located on the upper row, whilst the secondary controls are located on the lower row. The unit features speaker "off"; A + B connections; bass and treble controls; a balance control; and a very sensible mechanically-indented volume control which is rear-illuminated when the unit is switched "on". The phono control provides selection for two phono inputs; two auxiliary inputs as well as tuner; and the tape dubbing control switches for tape recorder A to B and tape recorder B to A, Monitor A and Monitor B, and are both sensible and practical.

Features

The unit incorporates low pass and high pass filters, loudness control and a front-mounted single microphone mixing socket and separate volume control.

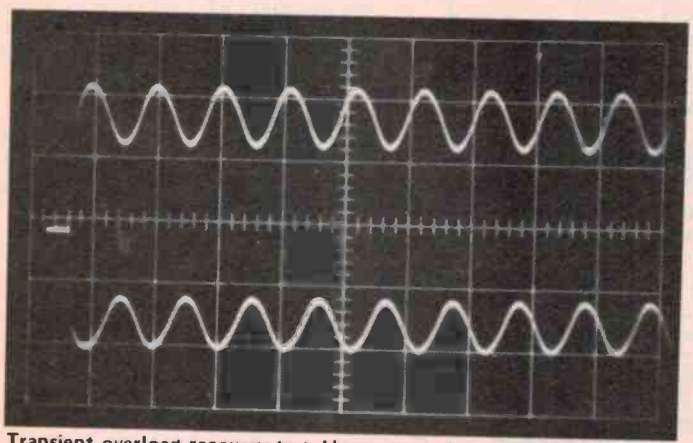
The front panel features are sufficiently comprehensive to satisfy all normal requirements. The rear of the cabinet features an array of coaxial sockets with preamplifier out and main amplifier in, which are mechanically linked, instead of the more conventional switch-linking. It also incorporates conventional tape sockets for the Tape Recorder A and Tape Recorder B and a DIN socket for connection to Tape Recorder A.

The speakers are sensibly connected by well designed spring loaded terminals to accept cables up to 3 mm diameter. The power fuse is located on the rear panel and in keeping with the latest trend the unit does not provide auxiliary two-pin ac outputs of the type which are no longer permitted by the Australian Electrical Industries Authority.

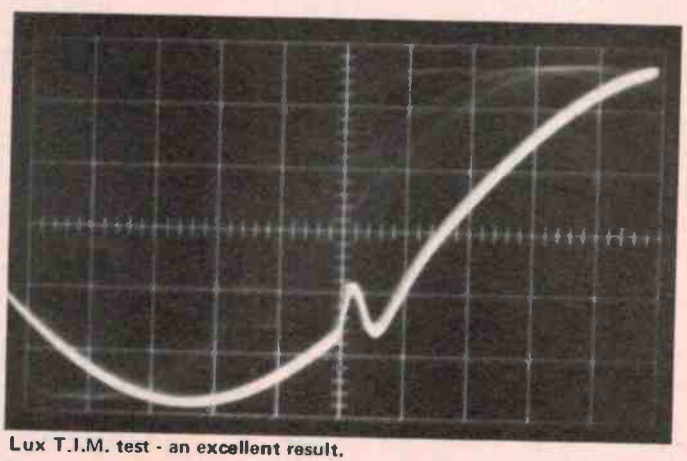
The unit is well constructed, the chassis and cabinet being quite well made. The layout of the circuitry on the four internal printed circuit boards makes maximum use of the ventilation slots at the rear of the amplifier. These are disposed under and over the large heat sinks needed to dissipate the 70 W continuous rating with both channels driven.

The printed circuits feature conventional electronic components, are well labelled and are easily accessible for service. But, we did not like the use of internal fuses on the rectifier board. These are inaccessible unless the cover of the amplifier is removed. We consider that fuses are user serviceable and should be accessible.

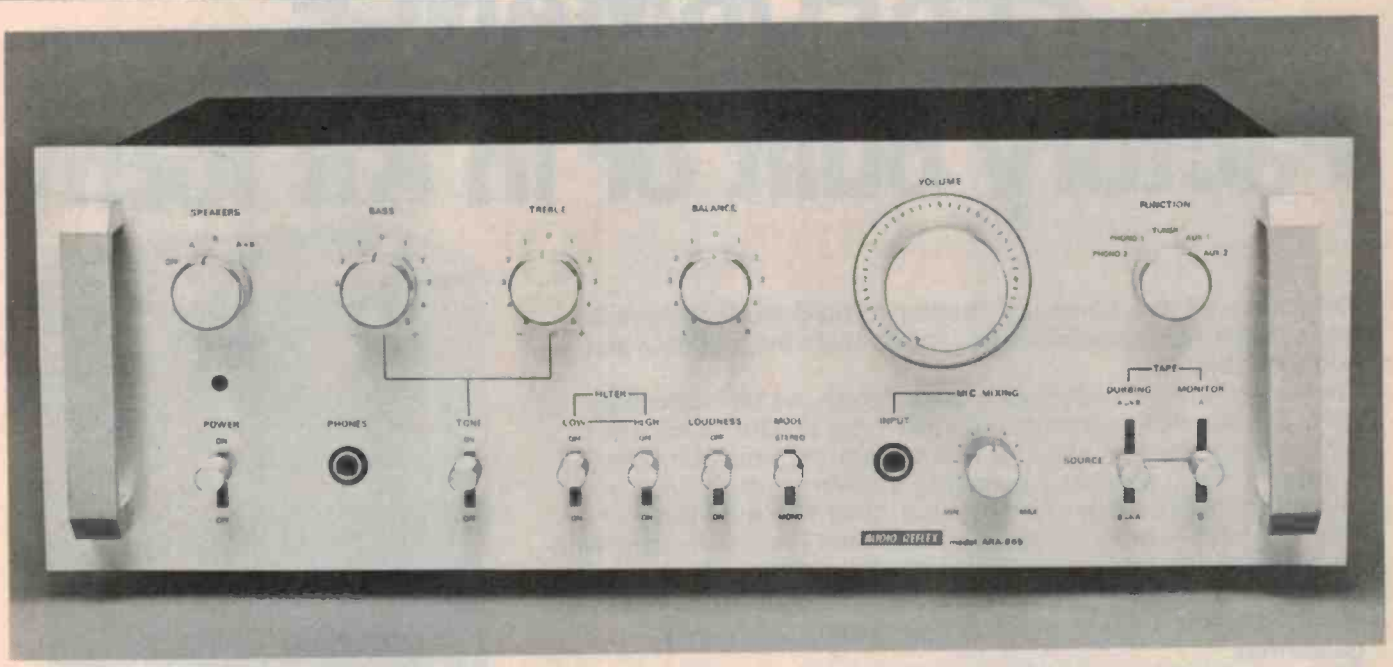
The amplifier packs a lot of componentry into a reasonably small space and does so without prejudicing accessibility for servicing or its ventilation.



Transient overload recovery test. Upper trace, input - lower trace, output. (1 ms/div.).



Lux T.I.M. test - an excellent result.



Evaluation

From our previous experience with the unit, we expected it to perform well but were still surprised at some of the results.

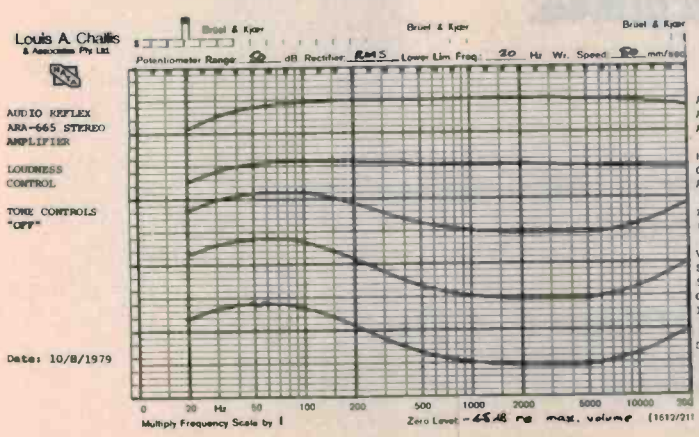
With the tone controls in their centrally indented position and with the tone defeat switch inoperative, the frequency response was from 11.5 Hz to 49.5 kHz. The sensitivities for 1 W into 8 ohms are all normal and the phono sensitivity of 375 mV is particularly good. This would allow almost any conventional magnetic cartridge to be used with this unit. The phono margin of 250 mV which is 36 dB (re 70 W sensitivity) is excellent and would prevent the unit from saturating in the early stages during overload.

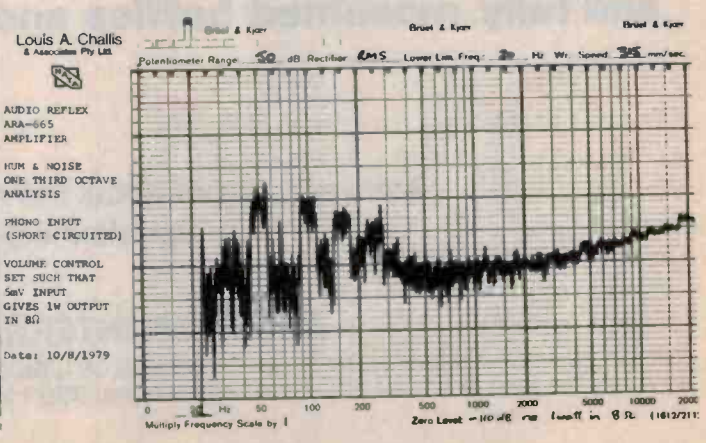
The harmonic performance of the unit at 70 W level into 8 ohms was excellent, being below 0.015% with both channels driven at 1 kHz. Surprisingly, the distortion at 1 W did not vary significantly from the distortion at the 70 W level. Our LUX transient intermodulation distortion analyser showed that the TID performance was excellent.

The hum and noise level (re 1 W) for both the auxiliary and phono inputs are excellent being -77.5 dB (A) on the phono input and -78 dB (A) on the auxiliary input. The maximum power output of the amplifier (according to the IHF A202 test) provides an 81 W peak level and a dynamic head room of 8 dB (re 70 W) rating. The crosstalk between channels is also excellent, being -55 dB at 100 Hz and significantly better at all other frequencies.

Apart from the discrepancy between the tone defeat switch on/off, we were unable to find any anomolous or untoward behaviour in the amplifier. In all tests it either equals or exceeds all of the manufacturer's specifications. In fact, many of the manufacturer's specification figures were exceeded by this unit.

The amplifier's performance from an instrumental and objective standpoint ▶





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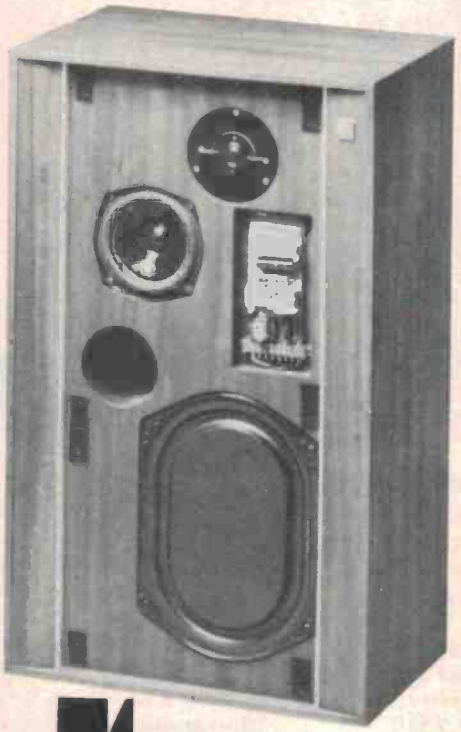

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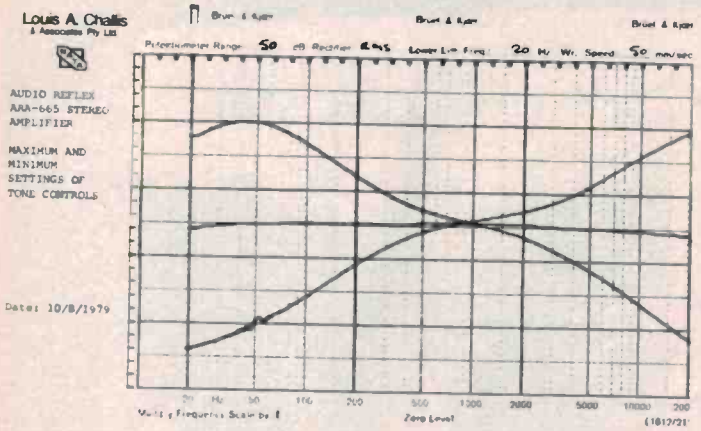

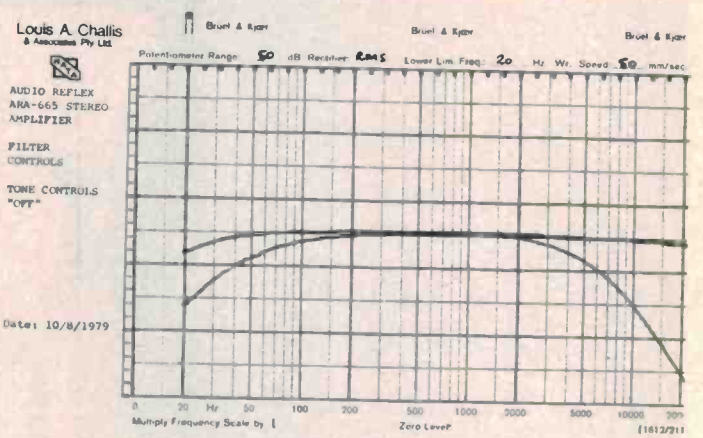

was excellent. We already knew that it produces a low total harmonic distortion and that the transient intermodulation distortion figures were excellent. It only remained to see how well it performed on real programme content. We played a series of new direct recorded test records from Sheffield Laboratories, selected material from the International Electro-Technical Commission and test records produced by speaker manufacturers, to evaluate the unit. The evaluation was carried out with Quad electrostatic speakers and Pioneer electrostatic headphones.

The unit adds negligible colouration to the original signals. It provided extremely pleasant and easy listening on all of the content which we evaluated.

We particularly liked the tape dubbing feature. This allowed easy transfer of reel to reel data onto cassette and simultaneous monitoring without any complications.

Our impression of the ARA-665 is that this amplifier offers excellent performance at a reasonable price and would be a reliable basis for a home high fidelity system. ●

AUDIO REFLEX ARA-665 STEREO AMPLIFIER – S.N. 901165A

Dimensions: 440 mm wide x 132 mm high x 290 mm deep
Weight: 12.3 kg; Price: $399
Manufactured in Korea for Audio Reflex Australia, 7 Orchard Rd, Brookvale, 2100 NSW (02) 938-4188.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF AUDIO REFLEX ARA-665 STEREO AMPLIFIER S.N. 901165A

FREQUENCY RESPONSE:
(-3dB re 1 watt)

Tone Controls Centred: 11.5Hz to 49.5kHz
Tone Controls "Off" : 22.5Hz to 57.5kHz

SENSITIVITY:
(for 1 Watt in 8Ω)

AUX/TUNER/TAPE:	23.7mV
PHONO:	375μV
MIC:	810μV

INPUT IMPEDANCE:

AUX/TUNER/TAPE:	24kΩ
PHONO:	45kΩ
MIC:	61kΩ

OVERLOAD MARGIN: PHONO: 215mV (i.e. 36dB re 70 Watt sensitivity)

OUTPUT IMPEDANCE: 0.33Ω

TOTAL HARMONIC DISTORTION:
(at rated power -70 watt in 8Ω)

	100Hz	1kHz	6.3kHz
2	-86.1dB	-78.9dB	-82.6dB
3	-81.7dB	-81.1dB	-78.3dB
4	-95.6dB	-98.0dB	-94.9dB
5	-92.6dB	-93.4dB	-
THD	*0.010%*	*0.015%*	*0.014%*

TOTAL HARMONIC DISTORTION:
(at 1 watt in 8Ω)

	100Hz	1kHz	6.3kHz
2	-81.9dB	-80.5dB	-77.8dB
3	-84.6dB	-85.4dB	-83.6dB
4	-94.8dB	-94.0dB	-85.5dB
5	<-101.0dB	<-99.0dB	-
THD	*0.010%*	*0.011%*	*0.015%*

TRANSIENT INTERMODULATION DISTORTION:
(see attached photograph)

NOISE AND HUM LEVELS:
(re 1 watt in 8Ω)
volume control set for 1 Watt output with 0.5V input (AUX) and 5mV input (PHONO) - input short circuited.

AUX :	-72dB(Lin)	-78dB(A)
PHONO:	-72dB(Lin)	-77.5dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:
1HF-A-202 72V p-p in 8Ω
20mS burst repeated at 500mS intervals = 81 watts
∴ Dynamic Headroom = 8dB (re 70 watts)

CROSSTALK:
re 2.828V rms pink noise in each 1/3 octave in other channel

100Hz	1kHz	6.3kHz
-55dB	-64dB	-55.5dB

A trio for your living room

Professional musicians play the best musical instruments they can afford.
And there is now no reason why you shouldn't play their works with the best hi-fi you can afford.
Like the moderately priced Kenwood KA-405 integrated amplifier.
It's a virtuoso performance in audio engineering all by itself.
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And the KX-550 is equipped with two-belt drive, Dolby* noise reduction and separate bias and equalization. So you can make and play tapes that even a seasoned pro will admire.
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Bringing professional performance to your living room.

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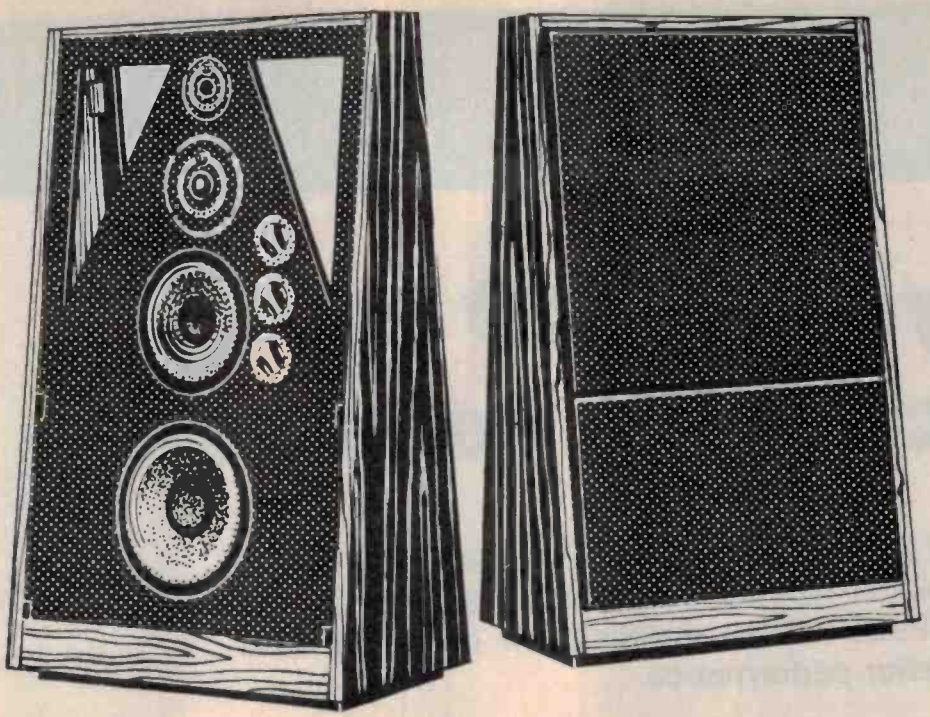


New shape of sound from RTR: The trapezoidal 800D 4-way system.

RTR has applied its most advanced technology to the development and integration of transducers, crossover and enclosure to achieve virtually the ultimate in a single system. The RTR 800D soft dome speaker.

Its flawless, faithful reproduction more closely resembles the original musical source than you thought possible. Instruments sound exactly as they do in life; performance realism is retained while maintaining linearity, focus, imaging, sublety and sense of depth perspective.

An incredible performance you must hear to appreciate.

The 800D 4-way system

1 A 10" woofer specifically designed for accurate low bass response, from 30Hz to a cut-off at only 190Hz. With 1½"high-temperature voice coil assembly and 4 lb. magnet structure, it employs special fibre cone and foam surround impregnated with damping and sealing fluid for better air seal, greater resistance to break-up and optimum energy absorption.

2 The 8" upper bass/lower mid driver is of similar construction, and covers the range from 190 to 1900Hz.

3 The 1½" soft dome midrange radiator employs a unique carbon-fluid damping and sealing compound applied to the dome for greater longitudinal and torsional rigidity for true piston action and high power operation. Covers the range from 1900 to 9500Hz.

4 The new 1" soft dome tweeter for performance from 9500Hz to well beyond audibility at 25,000Hz perfectly complements the midrange.

Significant achievements

The high efficiency and ruggedness of the 800D permits it to be driven by 25 watts, yet it takes 125 watts with ease. Lightning fast transient response combines with wide dynamic range to respond to sudden changes in programme level without clipping or distortion. Bass is smooth, tight and accurate without muddy or boxy sound. A new, sophisticated crossover has virtually no transient or IM distortion, with driver parameters precisely determined. Level control on 8" upper bass/lower midrange permits compensating from room response.

Hear the RTR 800D difference at your specialist dealer, or write for specifications.

Distributed in Australia by Acoustic Monitor Co Pty Ltd (Member of the Thomas & Coffey Group) 12-18 Gould Street, Enfield, NSW 2136. Phone: (02) 642-7888. Telex: 26778. Cables: "Tomcoffy" Sydney.

Listen... you'll be hearing more from RTR.

SMA/AM2

Sanyo TP929 direct-drive turntable

This turntable features an unusual 120-pole 'linear' motor to drive the platter directly — the platter itself being the rotor. The TP929 offers simplicity in operation and generally superior performance.

IN A BURGEONING FIELD of direct-drive turntables it seems that there are many ways of achieving "direct-drive". Obviously, the type of motor, its speed stability, torque and freedom from pulsations are important factors.

The TP929 is one of the newest units from Sanyo, who offer a number of different direct-drive turntables. The most significant difference between this and their other units is undoubtedly the use of a 120-pole linear motor.

The TP929 is an attractive unit. In keeping with most of the other available Sanyo models, it features a high quality plastic injection-moulded plinth; an excellent clear plastic detachable dust cover with spring loaded hinges; and the minimum number of operational controls.

Controls

These controls are nearly all located on a raised metallic type escutcheon near the front edge of the plinth. These consist of a speed selector push button for either 33 RPM or 45 RPM, a large reject button at the extreme right hand end and two vernier speed controls for 33 RPM and 45 RPM at the extreme left hand end, adjacent to the strobe light which projects onto indentations cast into the side of the turntable.

The normal pre-set controls consisting of the anti-skating adjustment and the tracking weight adjustment are on or next to the conventional S-shaped tone arm. This is fabricated from aluminium alloy. The tracking weight balance adjustment is a well-machined

threaded element for which the tracking weight indication is a small engraved plastic insert on its leading edge. This is adjusted to read zero grams at the balance position and follows the threaded adjustment in an anti-clockwise movement to indicate the tracking weight (selected in the range zero to 3 grams). The gimbal is unusual, it has long, cantilevered dual bearings and an open yoke structure which is striking in appearance. Whilst seemingly fairly rugged, the length of the gimbal bearings would subject them to a larger dynamic stress than normal and could put them at risk from inadvertent abuse or unusual dynamic loading, especially during transportation.

Notwithstanding our concern, they performed beautifully in the unit being evaluated and showed absolutely no signs of weakness. The anti-skating adjustment works well although, as subsequent testing showed, the adjustment did not agree completely with the optimum setting called for by testing. The viscous-damped cueing lever is particularly well designed and performs extremely well, whilst the locking control for the tone arm is neat and functional. Below the tone arm, on the plinth, the designers have placed a stylus guide for correctly setting the stylus position. Whilst this is a good idea the low fixed height of this guide detracts a little from its functional concept.

One feature we particularly like is the label stuck onto the plinth, immediately below the head shell, to indicate the stylus replacement – type ST-500 – for the cartridge actually fitted, so that in the event of replacement being required you would know which stylus to fit.

The motor

We were intrigued by the concept of a 120-pole motor and initially thought that this must be an expensive wound-motor configuration. Sanyo's concept is in fact a result of re-examining the basic attributes of direct-drive turntable motors. The 120 poles in this case are achieved through the use of a permanent magnet ferrite strip in which the 120 poles are moulded. This is fixed to the underside of a metal ring on the turntable so that the turntable itself becomes the rotor, whilst three drive coils (A, B & C) and a sensor located in a quadrant under the turntable, become the stator. In real terms, nothing could be simpler and almost nothing approaching this refinement could be cheaper.

Because of the diameter of the ring (106 mm) the driving torque is fairly high. By driving the three coils from a 3-phase circuit, smooth driving torque is assured. The normal fluctuations that occur in dc or other forms of ac motors are virtually eliminated. Because of the number of rotor magnet poles, the frequency of the electromotive voltage induced in the stator winding, is 33.3 Hz at 33-1/3 RPM and 45 Hz at 45 RPM. These frequencies are used to drive the servo feedback control system which allows the designers to achieve a very low frequency drift. The stator construction is interesting as it consists of the three driving coils (each driven from a different phase) and a sensor which detects both the position of the rotor magnets and the phase of current passing through the drive coils.

The stator is made of three saturable magnetic cores as well as a bias magnet, which applies a 140 gauss magnetic bias field to each of the cores. These coils are aligned at a 2° pitch to one another ▶

MEASURED PERFORMANCE OF

SANYO TP929 LINEAR MOTOR DIRECT DRIVE TURNTABLE

S.N. 98100851

RANGE OF SPEED ADJUSTMENT:	33 1/3 RPM:	(+ 0.3% (- 0.4%		
	45 RPM:	(+ 0.3% (- 0.4%		
WOW AND FLUTTER:	Wow	0.2% peak to peak		
	Flutter	0.03% weighted RMS		
		0.065% unweighted RMS		
RUMBLE:	-29.8dB unweighted			
(re 2.24cm/sec)	-55.8dB weighted (BS4852)			
FREQUENCY RESPONSE:	20Hz to 16.5kHz ±1.5dB			
SENSITIVITY: (at 1kHz)	Left	Right		
	1.19mV/cm/sec	1.22mV/cm/sec		
	Channel Difference: 0.2dB			
CROSSTALK:		100Hz	1kHz	6.3kHz
	Left to right	-27dB	-28dB	-27dB
	Right to left	-21dB	-21dB	-23dB
TONE ARM RESONANCE:	6.4Hz (see attached graph)			
TOTAL HARMONIC DISTORTION: (2.24cm/sec at 1kHz)		100Hz	1kHz	6.3kHz
	Left	1.6%	1.2%	11.6%
	Right	1.6%	2.3%	13.0%
SENSITIVITY TO EXTERNAL VIBRATION:	Main resonances at 20, 32, 52, 86Hz			

31st August, 1979

THE AUDIBLE EDGE

SUPERCOMPO

More unusual facts audiophiles will want to know about Sansui's new systems.

Sansui's new SUPER COMPO units are a bit different than your conventional systems. Particularly noteworthy is the fact that all SUPER COMPO units are designed from the very beginning for in-depth matching.

In-depth matching means more than simply adjusting quantitative aspects such as signal levels but meticulous matching of qualitative aspects including the dynamic response characteristics of every single element in the system.

Matching qualitative as well as quantitative factors is possible because Sansui has decades of experience as a hi-fi specialist. Application of advanced technology is constantly monitored by the feedback of tested musical human judgment.

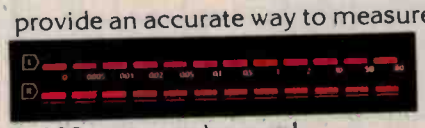
The proof is in the hearing, and the superior sound quality of SUPER COMPO receivers, for example, clearly rivals that of separates. How this is achieved will become more evident by a close look at the R-70 FM/AM receiver.

New DC-Servo Amplification

The advanced DC-Servo configuration has important audible benefits. Not only is THD low (0.08% at full rated output of 65 RMS watts x 2) but TIM (transient intermodulation distortion) is also low. Low TIM means even complex pulsive signals are reproduced in all their original purity.

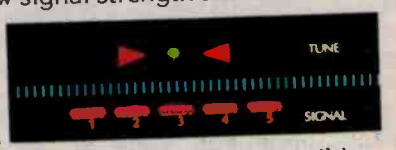
DC SERVO

Rapid-responding rows of LEDs let you know how much power is being fed to your speakers and provide an accurate way to measure music source signals. An output as low as 0.008 watts can be seen!



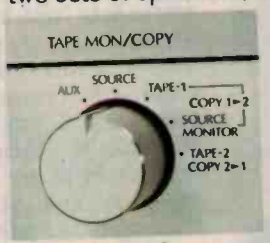
New electronic tuning indicators

Instead of mechanical needle tuning indication, electronic LEDs show signal strength and station center. Five LEDs show signal strength and a unique arrow-head-dot-arrowhead display instantly lets you know when you are tuned for the best possible reception. And reception is quite clear thanks to the MOS FET frontend, ceramic filters, PLL, and new quadrature detector.



Versatile audio refinements

Conveniences include speaker system selector for two sets of speakers, inter-tape dubbing and source monitor, one-touch-lock speaker connections and antenna terminals, high filter, loudness and FM mute switches.



The facts show there can be no doubt about it. With a fine choice from the wide range of SUPER COMPO systems — to meet every requirement and everyone's budget — SUPER COMPO gives you the audible edge.

Sansui

Only hi-fi, everything hi-fi.

SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Suginami-ku. Tokyo 168, Japan
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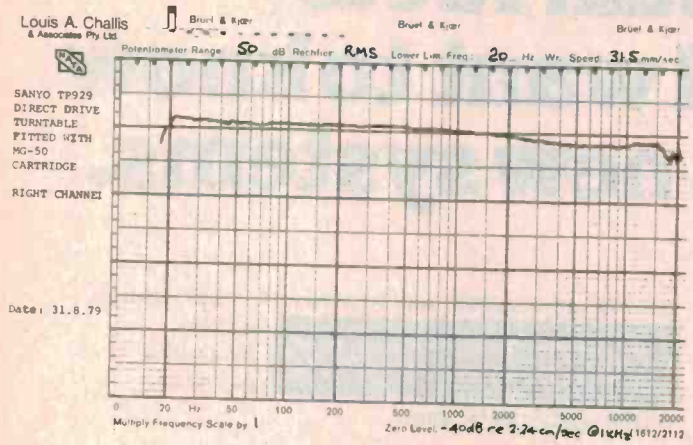
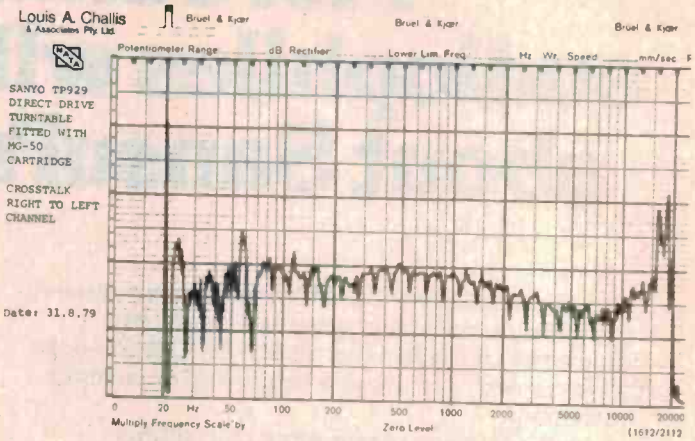
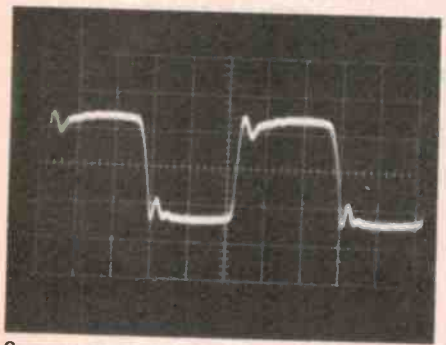




and are thus electrically positioned for 120° phase difference. They are spaced from the rotor magnets by a 3 mm air gap. The driving coils drive two rows of four triangular poles at the top and bottom of each coil, and thus 25 poles drive the rotor. The feedback circuit employs operational amplifier integrated circuits to amplify the signals, detect the actual turntable speed (according to the frequency of the voltage in the sensor) and thereby maintain the speed of the turntable at a stable and constant value. The net result is an unusually simple form of construction with superb electrical characteristics.

In playing the unit, the tone arm is intended to be manually placed onto the record with or without the use of the cueing lever. Tone arm return is fully automatic or can be activated at any point during the playing cycle by pressing the reject button.



Square wave response at 7 cm/sec. equivalent RMS velocity.

On test

The objective testing of the unit immediately highlighted the differences between this and the Sanyo Model TP1030 direct-drive turntable which we evaluated two months ago. Whilst the wow was virtually the same at 0.2% peak-to-peak, the flutter was significantly lower at 0.3% (weighted RMS) and the unweighted flutter significantly lower at 0.065%. The unweighted rumble was significantly lower at -29.8 dB (re 2.24 cm/sec) whilst the weighted rumble was more than 25 dB lower at -55.8 dB (BS4852). The tone arm resonance frequency was lower at 6.4 Hz with a characteristic which was slightly smoother than that provided by the TP1030.

The main difference in the plinth was the level of its vertical vibration isolation. This exhibited a smaller number of resonances which were also less pronounced and generally of lower level. The degree of vibration isolation of the plinth still falls short of our expectations for a top-line turntable. Such vibration is dependent on the type of shelf or furniture on which the unit is mounted and the structure of the building or room in which it is located.

The MG50 cartridge, which comes as a standard fitting on the unit, is interesting. Firstly, it has a frequency response which is remarkably smooth from 20 Hz to 17 kHz. The indicated droop and subsequent rise at 18 kHz is a function of the test record and not of the cartridge. Although the response is not absolutely flat it is as flat as any purist would reasonably desire. The channel separation of this cartridge is excellent and the harmonic distortion characteristics at frequencies up to 6.3 kHz are reasonable. The crosstalk from left to right and right to left channels is also reasonable. The channel level difference at 0.2 dB is remarkably well balanced and better than most cartridges we have seen. The square wave response is also clean and remarkably free of ringing. If anything, this indicates the lack of response in the ultrasonic region.

Summary

Considering the performance of the rest of the turntable, the MG50 cartridge tends to be the weak link. Whilst it has a good frequency response and performs well on general recorded content, its transient performance falls far short of what one would expect from such a good turntable. In particular, with the Shure TTR101 Test Record, "Orchestral Bells" section, the cartridge cannot reproduce Level 4 and starts to distort significantly at Level 3. With the Shure TTR103 Test Record "Phono Trackability Test Record" it can only reproduce record peak velocities of up to 24 cm/sec beyond which it distorts badly. This is regrettable as the other performance parameters of the system are really excellent.

The TP929 Linear Motor Direct Drive Turntable is an excellent unit offering simplicity of operation and a generally superior performance. Fitted with a top line cartridge, its performance would be exemplary. ●

THE SANYO TP929 LINEAR MOTOR DIRECT DRIVE TURNTABLE, SERIAL NO. 98100851

Dimensions: 450 mm wide x 152 mm high x 374 mm deep
Weight: 7.8 kg
Recommended Retail Price: $299
Manufactured by Sanyo Electric Company Ltd., Tokyo, Japan.

Microprocessor University Program from Texas Instruments

Features of the Texas Instruments Microprocessor University Program

Today's marketplace demands scientists, engineers and technicians who are proficient in the use of microprocessors. These "computers on a chip" have found their way into virtually every industry and profession. As a result of this impact, business and industry is looking to our universities, colleges and technical schools to furnish specially trained, microprocessor-educated individuals. In addition, learning aids are necessary to bring industry's practicing engineers into the world of microprocessors.

Texas Instruments has developed a Microprocessor University Program as an aid to institutions of higher learning as they prepare their students for careers in this demanding profession, and as an aid to hold in-house courses on microprocessors or for a self-taught course for engineers.

The Microprocessor Program consists of the following for the attractive price of $299.00*:

- An assembled and tested University Module (TM990/189) offering hands-on experience with microprocessors, I/O, memory, and *assembly language programming*.
- A 570 page Tutorial Text suitable for university courses, in-house courses for industry, or as a self-taught course for engineers or serious hobbyists.
- A 300 page User's Guide to acquaint the user with the full capabilities of the TM990/189.
- Local Technical Support.
- Additional Microprocessor Modules, Development Systems, Software are available.

In addition:

- Schools may obtain free software from Texas Instruments.
- A Power Supply is available for use with the TM990/189.

* Suggested resale excluding sale tax

Tutorial Text

The 570-page *Introduction to Microprocessors* is a tutorial text written to satisfy textbook requirements at universities, colleges, and technical institutes for a three credit-hour course.

Emphasis has been placed on providing lab experiments at the end of most of the chapters to both test the student's progress, and to give them "hands-on" experience to reinforce their understanding of microprocessor concepts.

Tutorial Text Chapter Contents

Chapter 1. Overview of Computers, Microprocessors, and Microcomputers
- A. Basic Computer Architecture
- B. Example of Computer Operation
- C. Architectural Enhancements of Microprocessors
- D. TMS9980 Microprocessor Description

Chapter 2. Arithmetic, Logic, and the Arithmetic Logic Unit
- A. Number Systems
- B. Arithmetic Logic Unit
- C. On-Board Terminal (Terminal on University Board)
- D. On-Board Monitor Commands
- E. Exercises

Chapter 3. Introduction to Computer Addressing and Program Development
- A. Computer Addressing: Explanation of What It Means
- B. Instruction Set of Texas Instruments TMS9980 Microprocessor
- C. Programming Example, Exercises, and Lab Experiments

Chapter 4. Assembly Language
- A. Overview of Assembler Functions
- B. University Board Symbolic Assembler
- C. Directives, Labels
- D. Program Example and Lab Experiments

Chapter 5. Memory Systems
- A. Description of Memory Systems – Data Buffers, Manipulation, Memory Map
- B. Memory Characteristics, Systems
- C. Programming an EPROM for the University Board
- D. Program Example and Lab Experiments

Chapter 6. Input/Output Concepts
- A. Overview of I/O Operation
- B. Program Example and Lab Experiments

Chapter 7. Input/Output Design
- A. I/O Interfacing Considerations
- B. I/O Peripheral Components
- C. Program Example and Lab Experiments

Chapter 8. Modular Programming
- A. Definitions and Advantages of Modular Programming
- B. Subroutines
- C. Program Example and Lab Experiments

Chapter 9. Software Engineering
- A. Hardware/Software Tradeoffs
- B. Structuring the Software
- C. Linking Program Modules
- D. Interrupt Servicing
- E. Real-Time Considerations
- F. Program Example and Lab Experiments

Chapter 10. Product Development
- A. Product Overview and Definition
- B. System Design and Development
- C. Software Development
- D. Debugging, Testing, and Development Tools
- E. Program Example

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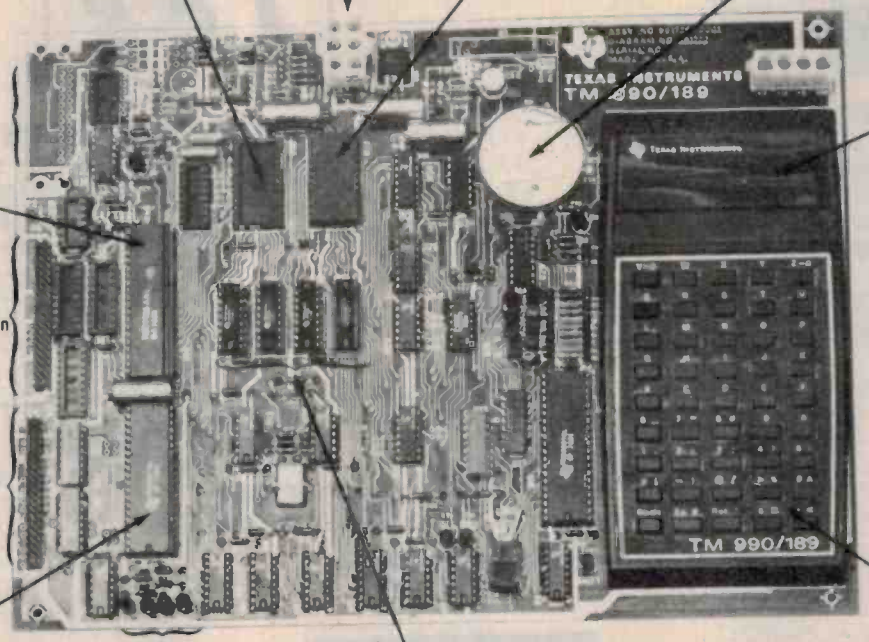
TM990/189



The TM990 University Module is a complete learning aid that, in conjunction with the Tutorial Text, offers hands-on experience with microprocessors, I/O, memory, and *assembly language programming*.

This powerful learning tool offers advanced features such as an alphanumeric keyboard that does away with the drudgery of programming in hexadecimal. With the TM990/189 the programming is done in meaningful assembly language.

The microprocessor on the University Module offers a powerful instruction set. Multiply and divide, vectored interrupts, single bit I/O manipulation, parallel I/O, and seven addressing modes, point out just a few of the advantages of programming with a true 16-bit microprocessor and, also, the ease of learning and applying microprocessors.

Software development aids include a monitor and symbolic assembler which are contained in Read Only Memory and reside on the University Module. These aids help with both the writing and debugging of programs.

The student may connect* an inexpensive Audio Cassette to the University Module, if desired, for off-board program storage. The on-board RAM may be used for checking out a program and, after verification, the finished program may be put into EPROM, using a programmer, and plugged into the EPROM socket on the board.

*Optional extra parts required

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9900 FAMILY SYSTEMS DESIGN BOOK

1016 Pages

Texas Instruments has developed and is manufacturing a family of microprocessor products and systems based on the architecture of its 990 minicomputer. The purpose of this book is to present enough factual information about the 9900 and the family of devices and systems surrounding it to serve not only as a guide for deciding to use the 9900 in an application, but also as the primary reference for design and programming activities. The book is much more than a data book or a collection of application notes. It contains basic concepts, presents methods and techniques, and most important of all, shows how the architecture of the 9900, substantially superior to other microprocessor architectures, can be translated into cost effective applications.

In reading this book, you will see the 9900 product as more than a single microprocessor. You will find a family of processors, peripherals, boards, minicomputers and systems all based on a single architectural concept called *memory-to-memory architecture.* It is this basic principle which, when fully understood at the fundamental level, will help you understand why and how the 9900 can be used to implement outstanding products. In addition, you will see why Texas Instruments has made the commitment to the continued support of the 9900 family in both hardware and software. New microprocessors and peripheral devices will retain and complement the basic architectural features—the 16-bit word length, the instruction set, the I/O techniques. etc. Texas Instruments software support goes beyond the standard assembler, editor, linker and PROM programmer software. New design tools such as POWER BASIC and PASCAL are now available. These powerful software products bring structured programming disciplines into focus and help you to attain an advanced programming capability.

LCC4400
— Suggested resale price $15.95

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Imagination Machine

Latest in the series of home computers being released in the States by calculator/watch/TV game manufacturers is the Imagination Machine from APF Electronics Inc.

Technical details at the moment are skimpy — it seems that this type of machine is marketed on user appeal rather than nitty-gritty technical comparisons.

The standard features include colour (American NTSC colour with something missing), 10 K of ROM and 9 K of RAM (the ROM probably contains an 8 to 9 K BASIC plus monitor, while the RAM is probably split so that 512 bytes is devoted to the VDU and another 512 to cassette and I/O buffers, the remaining 8 K being user space).

The keyboard is typewriter style with 53 keys including a unique shifted 'BASIC' keywords button, while the VDU has 32 characters in each of 16 lines. Also standard is a built in cassette deck, microphone jack and cartridge connector plus two game-style controllers.

At US $499, the Imagination Machine will be marketed in the US through department stores, audio stores and through catalogue showrooms. The software support is heavily biased towards interactive educational programs, and floppy disk and modem interfaces are in development.

PACE System

A new system from an Australian company, JED Microprocessors, 28 Anderson Street, Boronia, Vic 3155, is based on a National Semiconductor INS8900, the 16-bit PACE microprocessor.

Several cards are available in the series which is centred around the MP16-100 CPU card, a stand-alone single card computer. This card carries 4 K words of RAM as well as up to 6 K words of EPROM containing a monitor program.

There is also a serial interface on board, and a special 256 word RAM segment used by the monitor. The PACE microprocessor has a minicomputer-like architecture, not unlike the Data General NOVA, with 45 instruction types.

Other cards in the system include a DMA-type VDU, a 32 K memory board and a multi-interface card. A floppy disk interface is on the way, along with a selection of other interface cards.

Software support includes an assembler and editor, industrial BASIC, an exceptionally powerful monitor, and two other languages are in development — UCSD Pascal and BCPL, a subset of the C programming language developed at Bell Labs.

Further details from JED Microprocessors.

New Sort/merge Program

A new sort / merge program which runs in systems with UCSD Pascal has been announced by Oblong Software Products, 19 Cedarleigh Rd, Kenmore, Qld 4069, ph. (07) 378 2415.

PSORT operates with fixed or variable length fields and records, can include or exclude records from the sort or merge process and supports multiple disks for input, output and work files. Up to 10 sort keys can be defined by the user, with mixed ascending/descending sequences, and the program will merge up to 10 pre-sorted files. The program, which is written in Pascal, is callable as a procedure from a user program. Distribution is on a 203 mm (8") single density floppy disk, and the full Pascal source code is provided (for UCSD Pascal Ver. 1.5). The price for PSORT is $100.

Rumours Dept.

Any truth in the rumour that 3M are going to start retailing Scotch floppy disks through stationers' shops?

Lack of management expertise combined with undercapitalization has forced some US microcomputer manufacturers out of business. The problem has been exacerbated by an acute shortage of some LS TTL ICs which has left companies unable to completely assemble boards, kits or systems. Recent casualties have been Processor Technology (manufacturers of the SOL) and Imsai, one of the earliest companies in the market. Although both these companies have filed bankruptcy petitions, it seems likely that their product lines will continue to be available from other firms who buy the manufacturing rights. Other companies, like the Digital Group, have undergone management restructuring to gain financial know-how. Virtually all companies are quoting long delivery times due to the chip shortage.

Not everyone's in difficulty, however. There is some speculation in the industry that Pertec are considering reintroducing the MITS Altair products they shelved a few years back.

Will Winchester knell the toll for floppies? With data capacities of 10 Mbytes and up for not much more than the cost of a floppy, many microcomputer systems are going to be based around the new Winchester-technology 8" (203 mm) hard disks now being announced by companies such as Shugart and Micropolis. Being non-removable, though, they don't offer the capacity for transport of software, a function which may be left to mini-floppies (or maybe even cassettes). Looks like the end for the 203 mm floppy!

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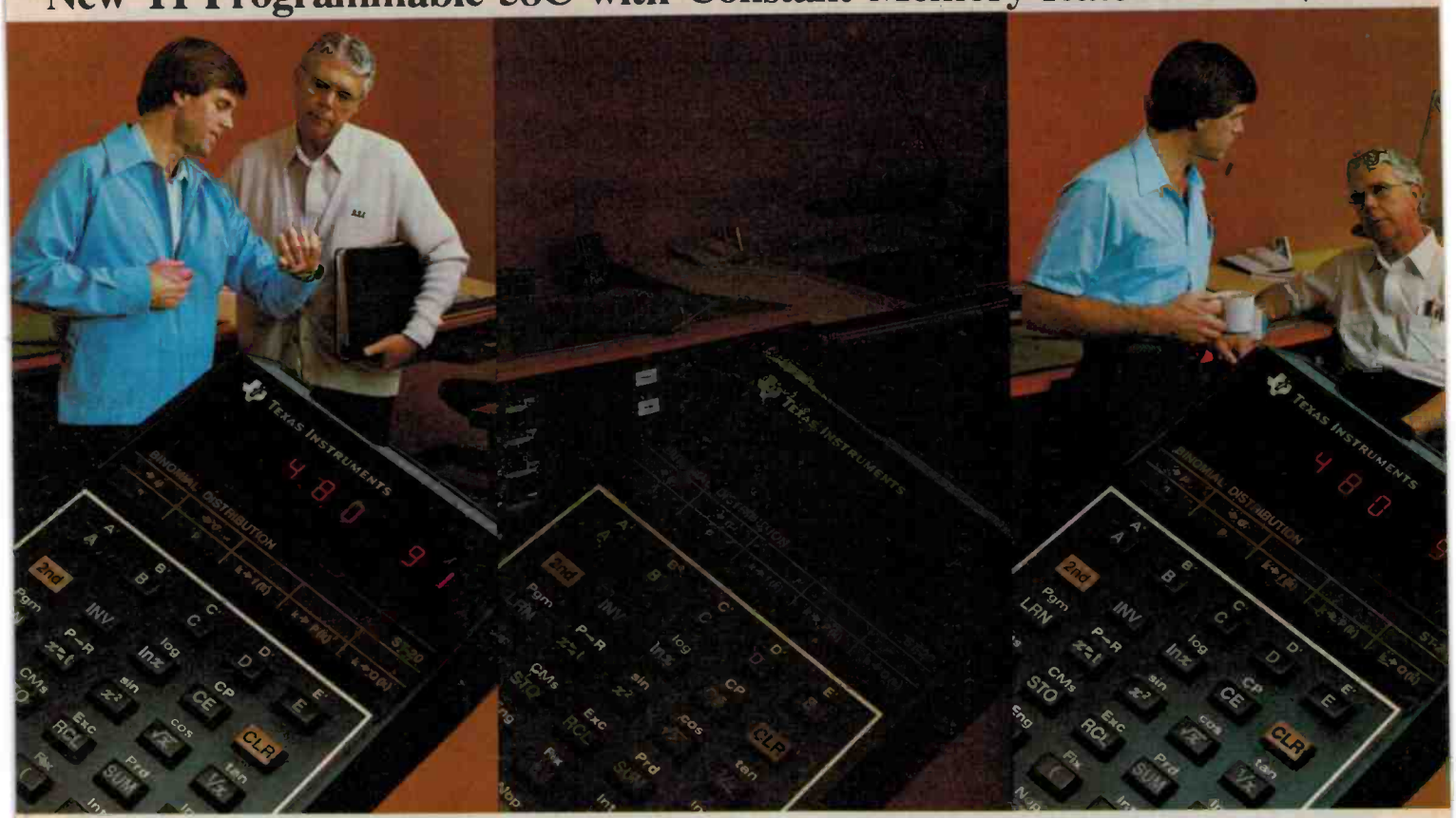
OEM enquiries welcome

New TI Programmable 58C with Constant Memory™ feature: now $165*



If you enter a 480-step program today, the new TI Programmable 58C will remember it tomorrow...even if you turn it off overnight!

Now you can hold the power of a computer in the palm of your hand. Power that can dramatically increase your productivity. Provide the answers you need for rapid, accurate decision making. For exploring hypothetical "what if" situations. It's part of what the new era of "Personal Electronics" is all about.

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Take advantage of the versatility of the new TI Programmable 58C and new software. Twelve optional *Solid State Software*™ libraries are now available. Each plug-in library module contains dozens of prewritten programs. Solid-state libraries are available in a variety of fields including engineering, science, statistics, and business. From $36*

The *Professional Program Exchange* lets you exchange programs with members. Over 1,500 programs are already available.

Specialty Pakettes are conveniently formatted program listings available in 16 subject areas. Just follow the program listings and tackle a wide variety of problems without the need to do any conventional programming. With the TI Programmable 58C's Constant Memory feature, you won't lose your program if you have to turn the calculator off. $9.10* per subject.

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Rumours, Part II

A new device from Advanced Micro Devices, the Am9513, contains five 16-bit general purpose counters, and can perform all the timing and counting functions for the majority of microprocessor applications. With its internal clock (up to 7 MHz), and up, down, binary or BCD counting modes (22 modes in all), the Am9513 is the most advanced counter/timer chip to appear on the market . . .

For those suffering from the octal TTL shortage: Motorola have announced a new part which is electrically and mechanically compatible with the 74LS373 octal latched buffer. The MC6882B will sink up to 48 mA into a low output — roughly twice the capability of a standard LS373, and will also drive a 500 pF load . . .

Intel's analog microcomputer, the 2920, is now available, with a price tag of US$250 in100 lots. The 2920 includes a 25-bit arithmetic processor, 192 x 24-bit EPROM, and a 40 x 25-bit scratchpad RAM. The processor converts analog signals to digital, processes the resulting digital information, and converts it back to analogue for output . . .

A new speech synthesizer from the Votrax division of the Federal Screw Works is intended for telecommunications application and can service up to 64 telephone lines simultaneously. So next time your call doesn't go through and you get a tape-recorded message, it may not actually be a tape-recorded message . . .

Colour comes to computers: perhaps prompted by the colour video displays becoming increasingly 'de rigeur' in personal computing circles (e.g. Apple II, Compucolor), both IBM and DEC are set to release colour terminals . . .

Control Data are test marketing their Plato terminals in 100 Minneapolis homes in an attempt to find out if home residents will 'use the terminal in a meaningful way'. The system, which was originally developed for education, offers moving graphics capability and is extremely interactive. A Plato terminal normally leases for over $1100 per month to commercial users, but apparently the home terminals are being leased for only $100 per month . . .

Rumoured to be coming for the 8080: a version of the Unix operating system, which was developed at Bell Labs. This multi-user OS was originally written in the programming language C, another Bell Labs creation which is now available for micros . . .

After growing and growing, the UCSD Pascal project has finally outgrown the University of California at San Diego. The successful licensing activities of the university project were threatening the school's tax-exempt status, and so Softech Inc, in Waltham, Mass. has taken over full responsibility for UCSD Pascal, including the right to improve the basic package, increase fees and draw up licensing agreements with others . . .

Nixdorf Computer, a major West German manufacturer of small business computers, is expressing some interest in the personal computer market and are negotiating a deal with Lexicon Corp. (of language translator fame) to market Lexicon's products internationally. Add-ons coming for the Lexicon translator are said to include an RS-232 interface, turning the machine into a portable terminal, as well as the Personal Program, which enables the user to program in 1 K of appointments, business notes, phone numbers, etc . . .

Anadex updated

The Anadex DP-8000 80 column line printer released early this year by Bell and Howell and successfully marketed through Dick Smith, Computerland, EAI-Electronic Associates Pty Ltd and other systems suppliers, has been re-released with a range of new features giving what is claimed to be the best price/performance ratio of any 80 column dot matrix printer currently available.

The fast throughput and high reliability of the earlier model, its universal interface and 9 x 7 character set, have now been augmented by the addition of a new high stability print mechanism, 1 K standard storage (extra 2K option), integral test diagnostics facility and movable sprockets for various paper widths.

These additional features have not increased the selling price of the DP-8000, and the new model is now available ex-stock from Bell and Howell's distributors. Comprehensive spares and support is provided Australia-wide by Bell and Howell for the entire range of Anadex printers and peripherals.

Petsoft

An interesting catalogue which landed on our desk the other day offers an enormous selection of programs for the Commodore PET computer.

These include the Petact business system software (sales accounting, purchase accounting, sales invoicing, stock control and payroll, all for disk or cassette) and a plug-in ROM called the 'Programmers Toolkit', ('10 powerful new commands for your PET!'). There is an enormous list of programs, under such headings as business programs, programming aids and tutorials simulations and games, and educational mathematical and scientific. For PET owners, this catalogue is a must. Petsoft, Radclyffe House, 66-68 Hagley Road, Birmingham B16 8PF, England.

Darling Downs Group

A new group for your notebook, if you're in the Toowoomba area: Darling Downs Microprocessor Group, meeting algorithm not given, but deduced to be the first Tuesday of the month, at the RMC Theatre of Darling Downs Institute of Advanced Education.

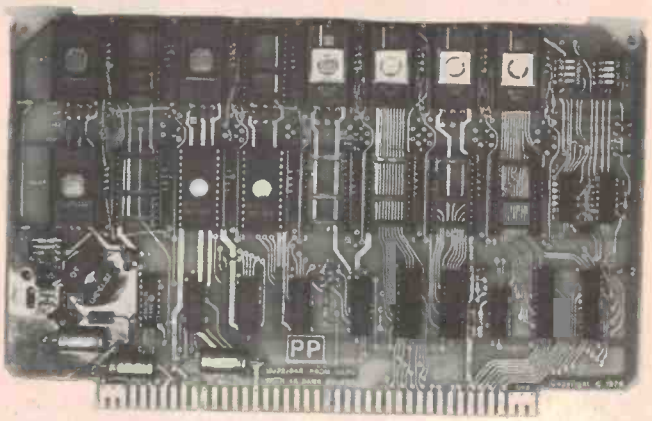
For further details contact Ken Griffiths, School of Business Studies, DDIAE, on (076) 30-1300. Recent meetings have covered a variety of topics, and the group also runs programming courses and displays.

Printout

6800 ROM/PROM

A new PROM card from Pennywise Peripherals can accommodate any mixture of 1 K PROMs (2708,2758), 2 K PROMs (Intel 2716, TMS2516, TMS2716), or 4 K PROMs (2732, 2532). It has space for 16 PROMs and can be configured to have a total capacity of 16 K, 32 K, or 64 K.

Further details from Pennywise Peripherals, 19 Suemar St, Mulgrave, Victoria 3170.



TRS-80 gets full-size floppies

The real power of a small computer is not so much in the speed or extended instruction set of its CPU as in the speed and capacity of its mass storage and the capability of its VDU interface.

An 80 x 24 memory-mapped VDU with lower case, for example, can present information much better than a serial-linked 32 x 16 with upper case only.

This is where full-size floppies have it all over mini-floppies. The 203 mm floppy (that's the Australian metricated equivalent of the US-style 8-inch floppy) offers about double the capacity of the 133 mm floppy (sorry about this, but metric units are required by law) and runs considerably faster. The speed factor is not significant for most personal computing applications but the greater capacity of the 203 mm disk makes a heck of a difference.

For example, the well-known CP/M operating system was designed for full-size floppies and the version which is available for 5" (oops, sorry, I meant 133 mm) disks runs like a lame dog in comparison. CP/M is an important piece of software for most disk-owning computer buffs, because a lot of software is available to run under it, so that it has provided a de facto standard for software exchange.

The major problem with the TRS-80 has been its inability to run CP/M because CP/M lives at the bottom of memory, where Radio Shack have thoughtfully placed a great lump of ROM. There is a non-standard version of CP/M around which lives higher up in memory, but this will not run the bulk of the nice CP/M-compatible software which is available.

This is why a company called Parasitic Engineering (1201 10th St, Berkeley, CA 94710, USA) has done the TRS-80 community a great service with their latest two products. The first is a 203 mm floppy drive with controller and patches to TRS-DOS, called the Maxi-Disk. With this alone, it is possible to run TRS-DOS on both 203 mm and 133 mm disks, mixed together if need be — the controller allows both disk sizes at the same time.

The second, more significant, offering is called the Shuffleboard. This board plugs into the Z-80 socket and moves the ROM in the TRS-80 from the bottom of memory up near the top, and brings the RAM down, through some judicious tinkering with the address lines. This will allow the TRS-80 to run a proper CP/M without modification or reassembly of programs — probably the most worthwhile innovation yet for the TRS-80. When will somebody do a modification for the VDU circuitry?

With upper and lower case, the Radio Shack machine would be a very nice system.

The Maxi-Disk is priced at US $995, and the Shuffleboard, complete with CP/M on an 8" (damn, I meant 203 mm) disk, is $245.

Parasitic don't seem to have a representative or agent in Australia, but it can only be a matter of time before some enterprising company grasps this opportunity — provided they can overcome the problem of converting 8" disks!

IMS software

Readers who intend to use a microcomputer in their business should check out the software offered by IMS Computer Systems, 582 St Kilda Rd, Melbourne 3004.

IMS, which is a division of Integrity Management Services, has for some time been marketing a range of very competitively priced software for small businessmen, and have just released version 2.0 of their payroll system.

The new program caters for such niceties as the two termination amounts which must be shown on group certificates from July 1st. It also has ten rates of pay, 20 allowances and/or deductions (all of which can be before or after tax) and caters for weekly, fortnightly, and monthly pay by cash, cheque or bank transfer.

Source code on disk is $1,500 and the object code is $300. An update service is available which will keep the tax scales and other government related variables up to date.

The new payroll program complements the standard commercial software (invoicing, stock control, debtors, creditors, general ledger, etc.) which IMS have had available for some time.

Cromemco User's Group

Adaptive Electronics, of 77 Beach Road, Sandringham, Vic 3191, agents for Cromemco computers, are starting up a Cromemco User's Group.

The group will provide a facility for the exchange of Cromemco-compatible software, as well as assistance with technical hardware/software problems. Potential members should contact Adaptive for further details.

Computer Faire

For those planning a holiday in the US in the near future, here's a tip: the 5th West Coast Computer Faire has been finally scheduled to take place in San Francisco's Civic Auditorium & Brooks Hall on March 14th to 16th, 1980 (Friday through Sunday).

Apple II Plus

At the New York Computer Conference (NCC), Apple released the new Apple II Plus. Intended for the professional and business user, this model has the popular Applesoft floating point extended BASIC as the standard language in on-board ROM. In addition to BASIC, a plug-in extension is available offering UCSD Pascal, a high level language of special interest to education institutions and commercial software houses.

The Apple II Plus is priced at $1995 including tax — this price includes a 330 mm monochrome monitor and a PAL colour generator for connection to standard domestic colour TV receivers, 16 K of user RAM and Applesoft BASIC in ROM.

Apple are represented in Australia by Electronic Concepts Pty Ltd and are available from Computerland stores. ●

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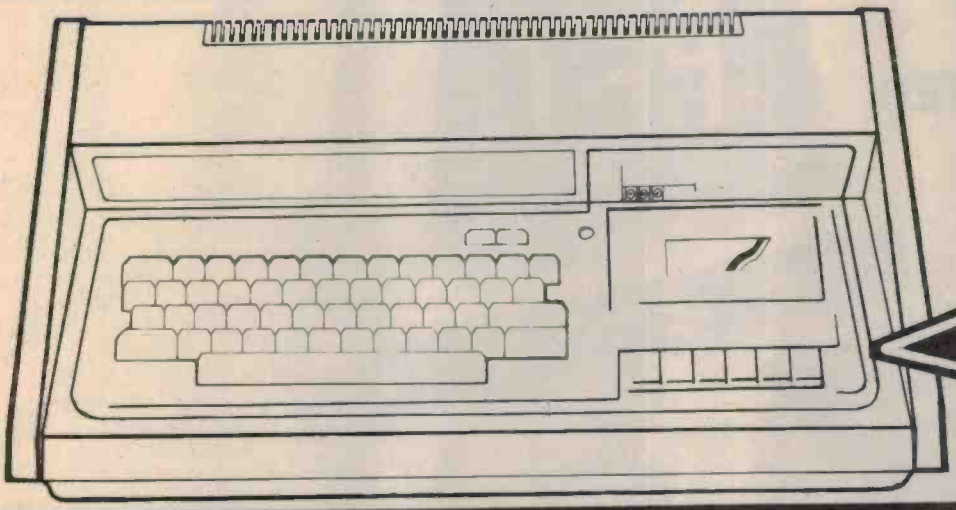

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and features have been added. In our opinion, the greatest disadvantage of the TRS-80 is the fact that it is not S-100 Bus compatible, meaning that the fantastic range of S-100 products (speech synthesizers, disk controllers etc.) are not readily usable. This problem has now been solved with the

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Dealer enquiries invited

For further information or a demonstration call the Business Equipment Division.

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HAN4/79

The Central Data 64K RAM board reviewed

Made in USA by Central Data Corp., Champagne Illinois
Reviewed by Les Bell

Board supplied by Rod Irving Electronics, Shop 499, High St, Northcote Vic 3070.

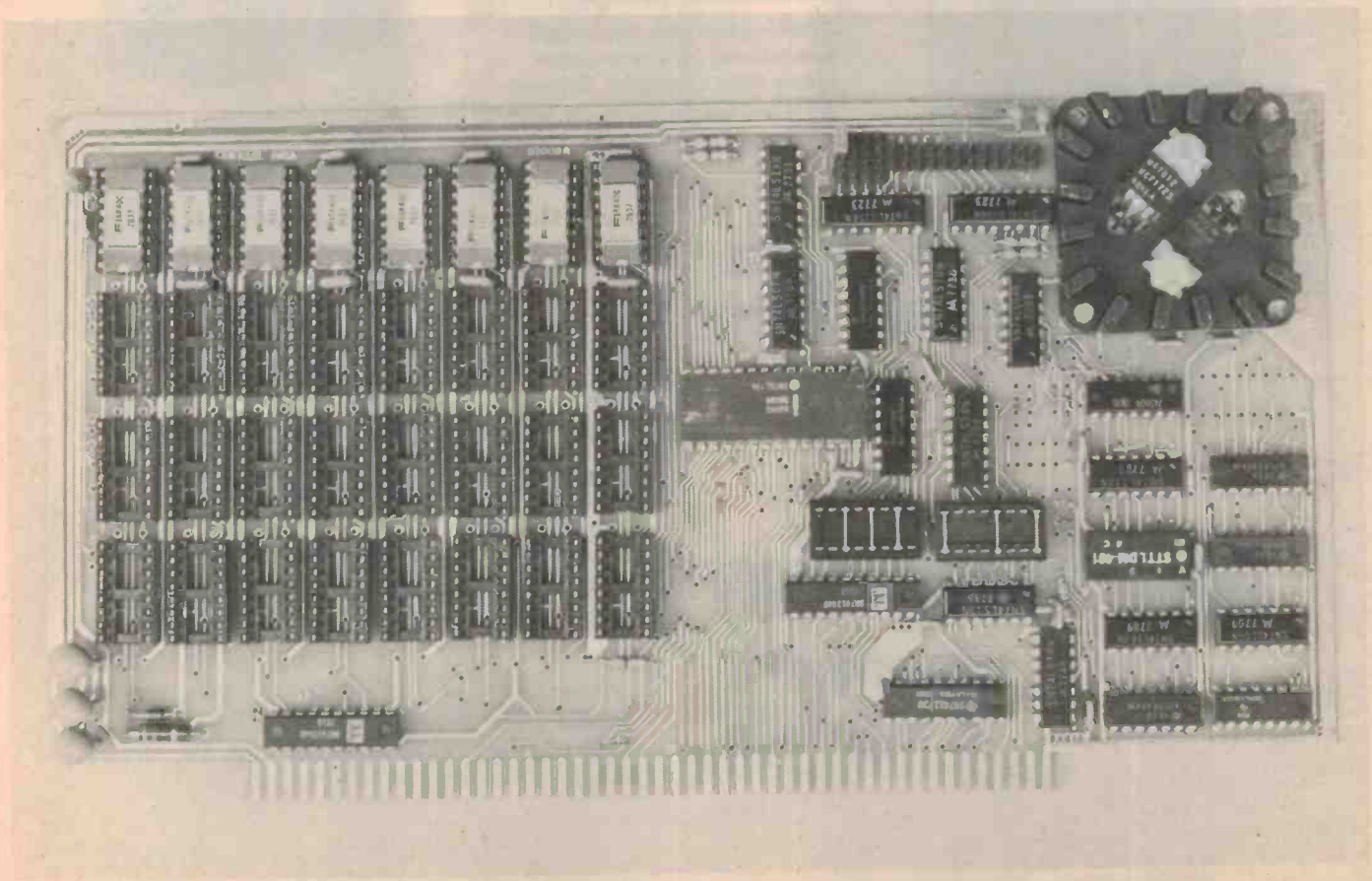
CENTRAL DATA are perhaps best known for their 2650 systems which are compatible with the S-100 bus. By designing this compatability into their system, they have been able to reap one important advantage: their memory card will also work with 8080 and Z-80 systems on the S-100 bus, ensuring them plenty of sales, especially in the United States where the 2650 is not particularly popular.

Their 64K RAM Board is a dynamic type, which some people would regard as an open invitation for trouble. In the words of Sporting Life (I think), 'It ain't necessarily so'. In fact this card has been very cleverly designed to avoid problems while still being fairly simple. These two considerations are quite possibly related.

Although the card has sockets for a full 64K of 2117-type 16K RAM chips, this is too much of a blow to the pocket-book for many buyers and it is supplied with only one row of chips installed with sockets for the remaining 48K. These can be installed later, when the bank balance allows. This means cheap upgrading to a large system, as there is no further investment in pc board real estate (always expensive) or refresh electronics.

The circuit design is fairly straightforward, making use of the Intel 3242 address multiplexer and refresh counter IC. This IC considerably reduces the system complexity and relieves the designer of a number of options at the design stage. In order to get all the address signals into a 16K chip (it needs 14 bits of address) which is encapsulated in a 16 pin package, the address lines must be multiplexed into two batches of seven, the low order bits (A0 to A6) being referred to as the row address, and the high order bits (A7 to A13) as the column address.

The 3242 automatically takes care of ▶



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Microsoft's 8K BASIC-in-ROM avoids lengthy loading from cassette and features full string manipulation, floating point and trigonometric capabilities. A machine code monitor in ROM, plus an Assembler allow access to machine code programming. A large range of programs are a available for education and entertainment.
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multiplexing the address lines, so that's one less problem for the designer. In addition, it contains a 7-bit counter, which can also be multiplexed onto the output pins, thus cycling through the row addresses to ensure that each row is refreshed. Remember, if the memory is not read every 2 ms, then the charge on the memory cell will leak away, thus losing the data. The 3242's counter will, if provided with the right signals, cycle through all the rows every 2 ms, thereby achieving the refresh.

The refresh timing seems to be derived from a delay line (at least, I'm assuming that an STTLDM-401 is a delay line, having no data on it). This means that the refresh timing and arbitration is done independently of the system bus timing, or at least asynchronously to it, thus making the system relatively independent of the processor's address set-up and strobe timing. This means that the board is comparatively processor independent, and will work with 2650, 8080 and Z-80 processors, whether they provide true S-100 bus timing or not. Most non-8080 CPU's don't – a point to bear in mind when choosing a system.

The card is set up to work with different processors by re-wiring a couple of DIP headers, and complete instructions on how to do this are given in the manual. There is no complicated set-up procedure, no one-shots to tweak, and the board seems to be free of the bugs that troubled earlier delay line based designs. *Our review sample has given glitch-free operation in an 8080 system for approximately 100 hours.*

The board is of good quality construction and is supplied assembled and tested. It really is not worthwhile building memory boards these days, some manufacturers even price their kits higher than their assembled and tested boards, figuring in the cost of repairing the boards returned to them by constructors who lack the experience and/or equipment to get the boards to work. Finding an IC that's been inserted 180° the wrong way is quite an expensive and time consuming procedure, even if it is a silly and obvious error with the benefit of hindsight. (Yes, Virginia, even I have done it.)

Sockets are provided for the memory ICs, but the rest are soldered directly into the board. I can never make up my mind on the wisdom of this: one school of thought says that sockets are an invitation to pins to bend up under the IC and not make contact, or to other problems such as oxidation and mechanical failure. Another philosophy is that sockets make fault finding easy by the substitution approach as well as enabling rapid repair. I can only say that every other board in my computer is fully socketed, and I've had no trouble with sockets at all. Still, each to his own (but just try and buy a 28-pin desoldering tool). (Yes, Virginia, I *have* heard of solder wick).

The manual supplied with the board is nicely produced and clear in its instructions about setting up. Curiously, nowhere does it explain the operation of the circuit which is why I have to assume that the STTLDM-401 is a delay line. This is rather disappointing – better the devil you know, I always say.

Unfortunately, we were unable to try the board out with any other type of CPU apart from the nice old, safe, dependable 8080 and so cannot vouch that it will get up and go with the more unusual or exotic machines. There is no reason to doubt that if your CPU can provide a half-decent facsimile of the S-100 signals then this board could survive quite nicely on a diet slightly deficient in XRDYs, MWRITEs and so on.

The board is probably not foolproof (if someone designs a foolproof system, only a fool will want to use it), but if you have an S-100-ish system, then the Central Data 64K RAM Board is a good inexpensive way of packing a lot more bytes into it. ●

Manufacturer's Specification – Central Data 64K RAM Board

Capacity:	64K bytes, addressable as four 16K blocks
Access time:	450 ns
Cycle time:	480 ns
Maximum input load:	One LS TTL load
Maximum DMA rate:	1 MHz
Wait states generated:	none
Power Consumption (typical):	
+16 V:	150 mA
+8 V:	300 mA
−16 V:	20 mA
Price:	$399 for 16K

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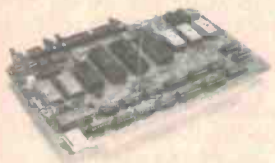
32K	$569	$599
24K	469	499
16K	359	389
8K	249	275

CMS 9600 CPU MODULE



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- MC14411 Baud rate generator

(One ACIA may be replaced with SSDA)

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New from Semcon 6809 Based CPU Module

Semcon now has production quantities of the new MC6809 CPU chip in stock. A new Exorciser compatible module featuring this device will be available late Oct. '79 subject to supply of OS9 operating system.

- Pin & outline compatible with Exorciser cards
- 6809 CPU
- Programmable timer
- 14411 baud rate generator
- 2 x 6821 PIA's
- 2 x 6850 ACIA's with RS232
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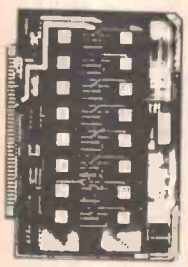

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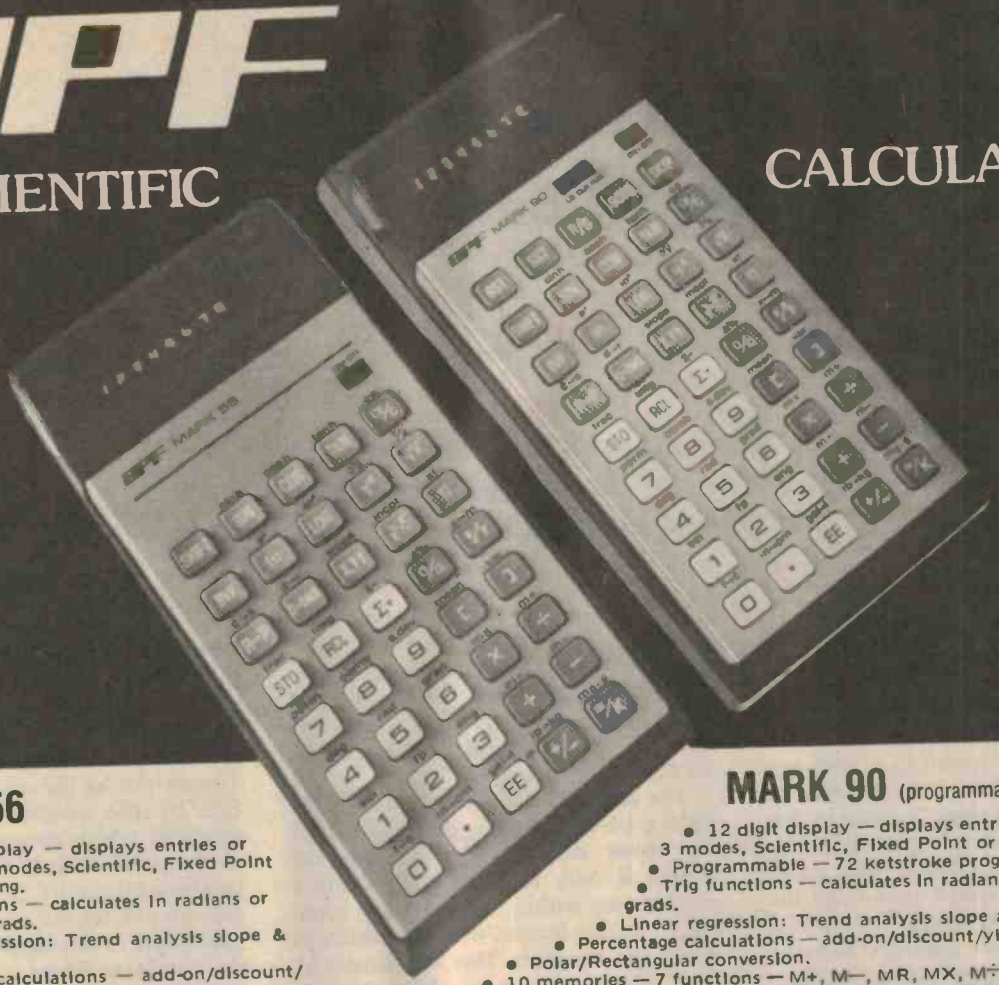

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- Linear regression: Trend analysis slope and intercept.
- Percentage calculations — add-on/discount/yield percentage.
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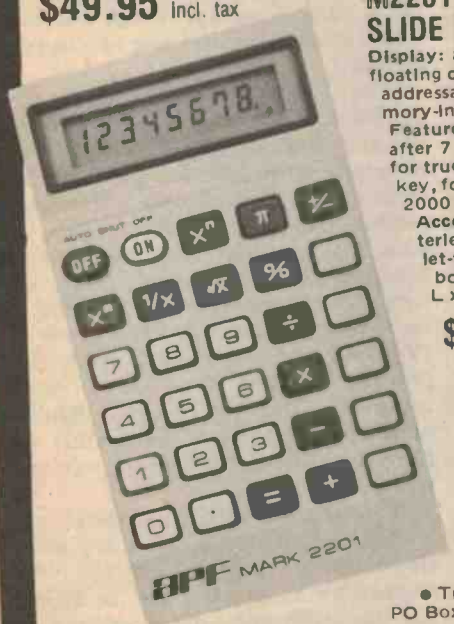
- 10 memories — 7 functions — M+, M—, MR, MX, M÷, Store, MEX.
- Operates on rechargeable batteries or AC current (recharger/adaptor incl).
- Dimensions — L 6" x H 1 1/8" x W 3".

incl. tax **$65**



M2201
SLIDE RULE LCD CALCULATOR

Display: 8-digit LCD. **Decimal System:** floating decimal point. **Memory:** fully addressable 4-key memory, memory-in use indicator. **Special Features:** automatic shut-off after 7 minutes, minus indicator for true credit balance, percent key, four functions of x, approx 2000 hours battery life. **Accessories included:** batteries, simulated leather wallet-type case, instruction book. **Dimensions:** 4½" L x ¼" H x 2½" W.

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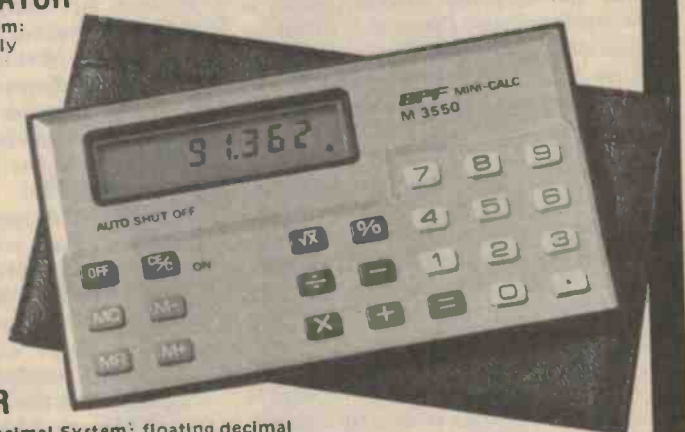

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An automatic audio equaliser system

R.J. Carpenter 2/104 Camegie Cres., Griffith A.C.T. 2603

This article describes a novel system for an automatic audio equaliser employing a dedicated low cost microprocessor as its controlling element.

AN AUTOMATIC audio equaliser has many applications, ranging from domestic hi-fi systems to audio amplification and sound reinforcement systems for auditoriums, concert halls and the like.

An equaliser is useful in a hi-fi system because it allows the listener to overcome the inherent nonlinear frequency response of the speaker system and listening environment. The audio frequency signals which pass from the output of the power amplifier of a hi-fi system, through the speakers and the listening room, are relatively accentuated or attenuated according to the frequency characteristics of the speakers and listening room. The extent of this accentuation and attenuation is measured with respect to a reference level.

The modification of the AF signals by the speakers and listening room is undesirable because the sounds heard by the listener are no longer a close approximation to the sounds recorded at the original musical performance, that is, there is a loss of fidelity.

This loss of fidelity can be largely overcome by coupling an equaliser between the preamplifier and the power amplifier of the hi-fi system. The use of corrective equalisation is discussed more fully by Wally Parsons in his article entitled "What is equalisation?" in the March 1979 issue of ETI.

The most common type of equaliser in this application is the 'graphic equaliser'. This allows the listener, by himself adjusting a multiplicity of controls to "cut" (i.e.: attenuate) those frequencies which would otherwise have been accentuated, and to "boost" (i.e.: accentuate) those which would otherwise have been attenuated. An equaliser of this type is described in the June 1[illegible] ETI (page 28, Project 485 Graphic Equaliser). The proper setting up of a graphic equaliser usually requires specialised equipment (such as a spectrum analyser) and technical competence on the part of the listener.

The automatic equaliser, which is the subject of this article, does not suffer the above disadvantages because the listener is only required to position a microphone within the listening room and to push a button when he wishes to set up the equaliser. This will usually be done infrequently in any case. All subsequent steps are performed automatically by the equaliser without the use of specialised external equipment.

For the purposes of the subsequent description, the hi-fi system will be assumed to be a monophonic system because the additional components and steps required for a stereophonic system will become obvious.

A block diagram is shown in Figure 1. I will describe the setting-up mode first. In this mode the switches S1, S2 and S3 are in the positions shown. The power amplifier of the hi-fi system receives the output of the pink noise generator. Pink noise has equal energy per octave and differs from white noise which has equal energy per unit bandwidth. As an example, if pink noise is passed through each one of two different ideal bandpass filters which pass frequencies in the bands 1 kHz to 2 kHz and 2 kHz to 4 kHz respectively, then the same noise energy is passed by both bandpass filters. Pink noise (and white noise) contains random frequency components at every frequency and this property is useful in setting up an equaliser.

The pink noise is amplified by the power amplifier which then provides the input to the speakers of the hi-fi system. A high quality microphone is positioned in the listening room to receive the acoustic noise output of the speakers. The output of the microphone is amplified by the variable gain microphone amplifier which then provides the input to the parallel bank of series connected bandpass filters F1 . . . F10 and variable gain amplifiers A1 . . . A10. The bandpass filters in this equaliser are similar to the bandpass filters of a graphic equaliser. Typically, the nominal centre frequencies of the filters F1 . . . F10 are spaced one octave apart at frequencies of 32, 63, 125, 250, 500 Hz, 1, 2, 4, 8 and 16 kHz respectively. The gain of each variable gain amplifier is controlled by a control voltage which has been stored on a respective one of the capacitors C1 . . . C10.

The outputs of the variable gain amplifiers are then summed together in the summing amplifier which provides the input to the rectifier and filter. The rectifier and filter provide a dc voltage output indicative of the amount of noise energy passed by the bank of bandpass filters and variable gain amplifiers. The output of the rectifier and filter is compared with a reference voltage (V_{ref}) by the comparator which then provides a binary input to the microcomputer. This binary input signifies whether the output of the rectifier and filter is greater or less than the reference voltage.

The microcomputer consists of a microprocessor, ROM and RAM which are connected together in the usual manner by a data bus and an address bus. The ROM stores the program of the microcomputer, and the RAM stores the

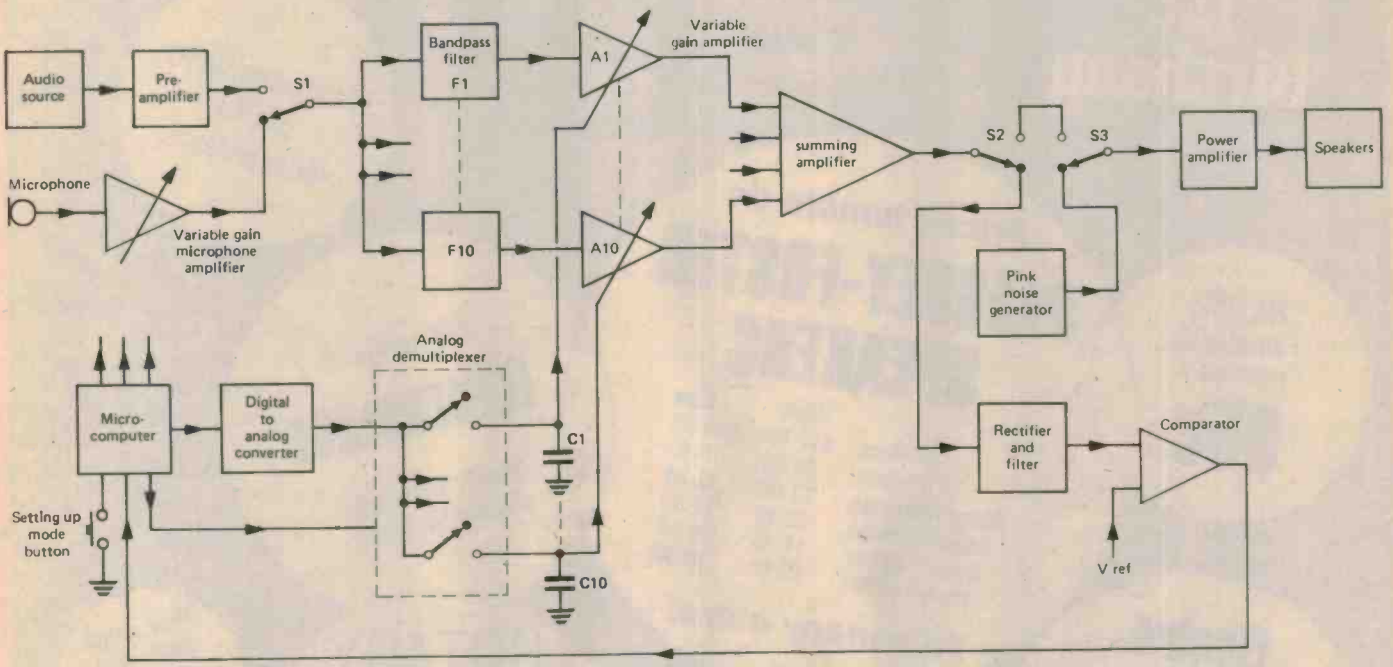
most recent binary values of the various control voltages of the variable gain amplifiers A1 . . . A10. The various control voltages are applied across the capacitors C1 . . . C10 by the use of the digital to analog converter in conjunction with the analog demultiplexer. The digital to analog (D/A) converter successively receives the binary value of each control voltage from the microcomputer via the data bus. The corresponding successive voltage outputs produced by the D/A converter are demultiplexed by the analog demultiplexer to the respective ones of the capacitors C1 . . . C10.

At the commencement of operation in the setting up mode, and under the control of the microcomputer, the gain of one selected variable gain amplifier from A1 . . . A10 is set to unity. The gains of the other amplifiers are set to their lowest possible values or alternatively, the outputs of these other amplifiers are minimised in some other convenient manner, such that the output of the summing amplifier is predominantly influenced by only the output of the selected variable gain amplifier. This step nearly corresponds to setting one of the control knobs of a graphic equaliser to the 0 dB mark, and setting the other control knobs to the lowest mark (typically -14 dB). Under the control of the microcomputer, the gain of the variable gain microphone amplifier is progressively adjusted until the output of the rectifier and filter is just about equal to the reference voltage V_{ref}. This step takes into account variable factors such as the distance of the microphone from the speakers and the gain of the microphone. The approximate equality is signified by the change in the binary output of the comparator. The gain of the variable gain microphone amplifier is then set at its present value for the remainder of the setting up time. In other respects, the operation and the associated circuitry of the variable gain microphone amplifier may be similar to that of the variable gain amplifiers A1 . . . A10.

Another of the variable gain amplifiers from A1 . . . A10 is then selected, and the outputs of all the other amplifiers (including the first selected amplifier) are minimised as before. The gain of the newly selected one is then progressively adjusted until the output of the rectifier and filter is just about equal to the reference voltage. The corresponding binary value of the control voltage, at the just obtained correct gain of the selected amplifier, is then stored by the microcomputer for future use in the normal mode. The steps mentioned in this paragraph are then repeated for each of the other amplifiers which have not previously been selected. The setting up procedure has now been completed, and the equaliser then enters the normal mode of operation.

At the commencement of operation in the normal mode, and under the control of the microcomputer, all of the variable gain amplifiers A1 . . . A10 are set at their previously obtained correct gains, and the positions of the switches S1, S2 and S3 are changed over. Thus, the parallel bank of series-connected bandpass filters, F1 . . . F10, and variable gain amplifiers, A1 . . . A10, is coupled between the preamplifier and the power amplifier in a manner which corresponds to the coupling of a graphic equaliser between the preamplifier and the power amplifier of a hi-fi system.

During both the setting up and normal mode of operation, the appropriate control voltages of the variable gain amplifiers A1 . . . A10 are cyclically reapplied across the respective capacitors C1 . . . C10 otherwise the capacitors would eventually lose their charge. These capacitors should preferably be low leakage types, and the voltage control inputs of the variable gain amplifiers should preferably be buffered to provide high input impedance so that current drain from the capacitors is minimised.



It is generally inconvenient to set up the equaliser in the above manner for each listening session. However, by selecting low power CMOS RAM as the RAM for the microcomputer, and by providing a rechargeable battery as the backup voltage supply for this type of memory, the microcomputer then has RAM which is effectively non-volatile for long periods of time. Consequently, the equaliser need only be set up once for each change in the listening environment.

An automatic equaliser similar to the equaliser as described above is the subject of an application for a patent by the author. At present, this equaliser is not commercially available, but it may be in the future if it receives commercial backing by a manufacturer. ●

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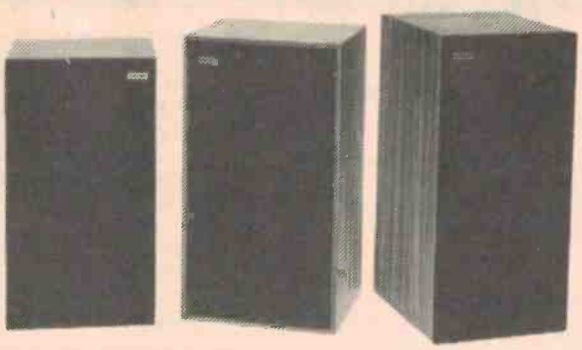

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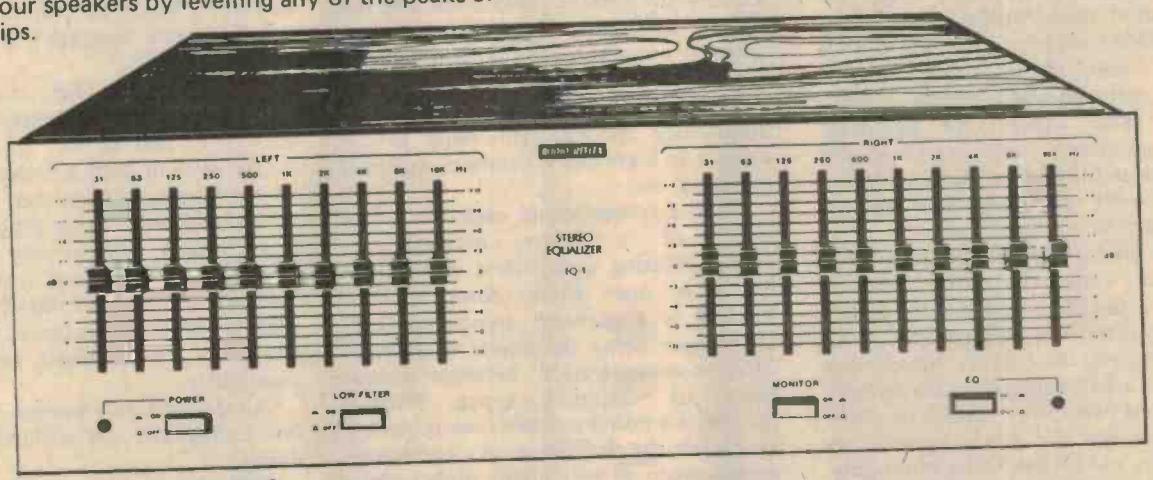

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Thoughts on doing something with a microcomputer

So you've had your micro for some time now, have figured out its little quirks and can play Star Wars or Inspector Cluseau — where do you go from here?

Les Bell

THERE MUST BE many hobbyists out there who are in much the same situation I am — built up a computer over a period of time just to learn more about it, had a lot of fun doing it, but the flaming thing still doesn't *do* anything.

It really is a genuine and honourable computer and really can solve mathematical problems and play games, but it just isn't working for its living. It's been great fun and intellectual satisfaction writing programs which, in turn, make it easier to write other programs but frankly, I'm looking around for a big project to get my teeth into.

Looking at the current state of the microcomputer industry several interesting points are evident. First of all, it is possible to draw a line between two types of computers and the hobbyists who own them. Many are what I shall term 'hobby' computers. Those which have been built up by their owners — who are very familiar with both the software and hardware of their systems. The others are primarily 'home' computers, are marketed by companies as fully assembled and tested products, only requiring their owners to plug them in and switch on.

At the risk of being labelled a died-in-the-wool cynic, I'm afraid that I can't see a terribly good future for the home computer. The average man in the street is happier to balance his cheque book with a $10 calculator. He doesn't need a word processing system to write 'Thank you for the lovely present' to Auntie Flo, and he finds that Monopoly is just as much fun for the kids as 'Star Trek' on the TRS-80 (and cheaper).

In short, virtually all of the average man's activities in his personal life would be hindered, rather than helped, by a personal computer.

There are, of course, exceptions to every rule and this is no exception. But, most are too specialized for home computers to sell in reasonable quantities and software for such applications will be expensive.

Several unrelated developments in the hobby computer scene may offer a way round this, however. First is the availability, in the US, of modem boards for microcomputers.

PCNET and similar

It often seems that a lot of interesting computer applications are open to US hobbyists that just aren't possible here. Perhaps the prime example of this is the easy access to data transmission facilities US computer hobbyists enjoy, using modems or acoustic couplers. This has led to the development of several interesting projects. For example'

In Chicago Ward Christensen and Randy Suess, of the Chicago Area Computer Hobbyists' Exchange, have implemented what they call the Computerized Hobbyist Bulletin Board System. This system allows people with modems to call in and leave or retrieve messages. It is highly interactive, offering first-time users assistance in learning the system commands, and has many ancillary features, such as allowing users to leave comments on the system when they sign off.

The system has proved to be an unqualified success with many people using it to leave news, rumours, personal messages, etc.

Such a system could easily become a node of a larger network of communicating computers, and indeed work is now being done on this. PCNET is a personal computing network now being developed which will offer communication between computers of different types. Such a project is a rather massive one, requiring as it does the definition of a communication protocol which will allow widely different computers to talk to each other.

Now, mull these ideas over for a few minutes. Ask yourself what you are doing with your computer, or what you would do if you had one.

An integral part of amateur radio is the ability to communicate with fellow enthusiasts; computer hobbyists would benefit tremendously from the same facility.

In the UK, information is now being distributed in digital form through the Prestel (Viewdata) system, and the Teletext scheme, which inserts digital information into the TV signal. A similar system will soon be operational in Australia.

Although the pages of information in these systems are no doubt copyright, and copying them into the memory of your computer may well infringe that copyright, there is no technical reason why the operators of these services could not supply computer programs and/or data to be used in programs.

This opens up a wide range of possibilities for the home computer.

Imagine being able to leave messages for your friends, even when they are not at home. Imagine being able to compose long letters at your leisure, using your system's text editor, and then instantly send them to their destination, by phone, not mail (often cheaper). How about placing 'for sale' ads on a hobbyist bulletin board, and remove them, instantly, as soon as the items are sold?

Best of all, for the computer hobbyist, general enquiries (does anyone have a manual for . . .) could be left on the system with a reasonable chance of the message being seen by someone who could help. Long programs can be interchanged without any dependence on physical media (e.g. Tarbell cassette, TRS-80 cassette, CP½M 8" disk), for instant use. A few minutes thought will reveal a tremendous number of possibilities.

All this will only become possible if a few enthusiasts get together and start doing it.

With this in mind, I am interested in hearing from other enthusiasts who are as intrigued as I am with the communications potential of their computer, with a view to seeing what can be done in this area within the constraints imposed by Telecom and the different computers involved. Perhaps we could get together for some preliminary discussions, along the lines of our Synergistic Beer Drinking. Any suggestions? Write to me, Les Bell, at ETI, 15 Boundary Street, Rushcutters Bay, NSW 2011, and we'll see what develops.

Watch this space for more news.

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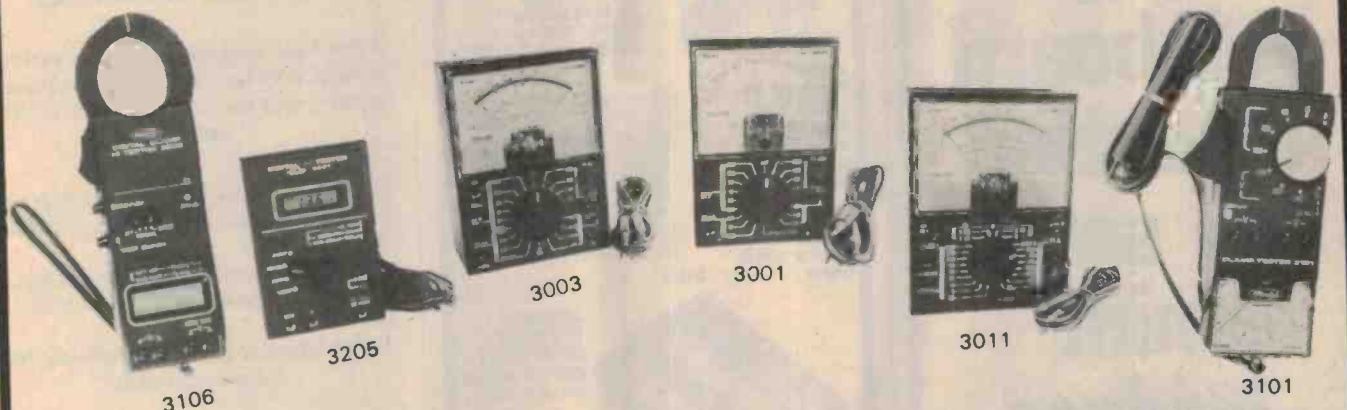

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10/50/250/1000V AC 2kΩ/V ±3%
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3002 PRACTICAL COMPACT TESTER
0.5/2.5/10/50/250/1000V DC 20kΩ/V ±3%
50 A/25/250mA ±3%
10/50/250/500/1000V AC 9k /V ±3%
10k/100k/1M ±3%F.S. R.C.100Ω
L.F. Output —20 to +36dB ±4%

3003 PRACTICAL MEDIUM CLASS TESTER
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50μ A/2.5/25/250mA/10A DC ±3%
10/50/250/1000V AC 13.5kΩ/V ±3%
10A AC ±4%
5k/50k/500k/5M ±3%F.S. R.C.50Ω
L.F. Output —20 to +36dB ±4%

3005 HIGH CLASS TESTER WITH RELAY PROTECTION
0.25/1/2.5/10/50/250/1000V DC 50kΩ/V ±3%
50uA/2.5/5/50/500mA/10A DC ±3%
10/50/250/1000V AC 10kΩ/V ±3%
10A AC ±4%
2k/20k/200k/2M ±3%F.S. R.C.20Ω
L.F. Output —20 to +36dB

3010 HIGH SENSITIVITY (10μ A OPERATING CURRENT) TESTER WITH RELAY PROTECTION
0.1/1/2.5/10/50/250/500/1000V DC 1000kΩ/V ±3%
10 A/100μ A/1/10/100/500mA/10A ±3%
10/50/250/500/1000V AC 10kΩ/V ±3%
10A AC ±4%
2k/200k/2M/20M ±3%F.S. R.C.20Ω
L.F. Output —20 to +36dB

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2.5/5/10/25/50/100/250/500/1000V AC 10kΩ/V ±3%
25μ /50μ /100μ /250μ /2.5m/25m/250mA/2.5A/10A AC ±3%
3k/30k/300k/3M ±2%F.S. R.C.20Ω
L.F. Output —20 to +36kB

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AC V 0-200mV/2000mV/20V/200V/1000V 10MΩ
Ω 0-200/2000/20k/200k/2M/20M
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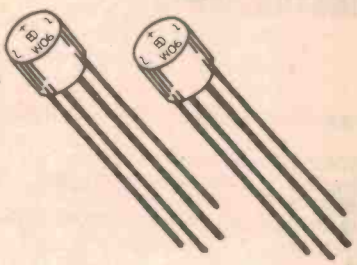

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New Zealand	7-9 Kirk Street, Grey Lynn, Auckland. 76-1169

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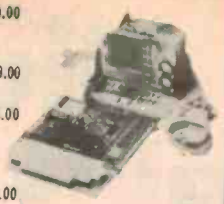

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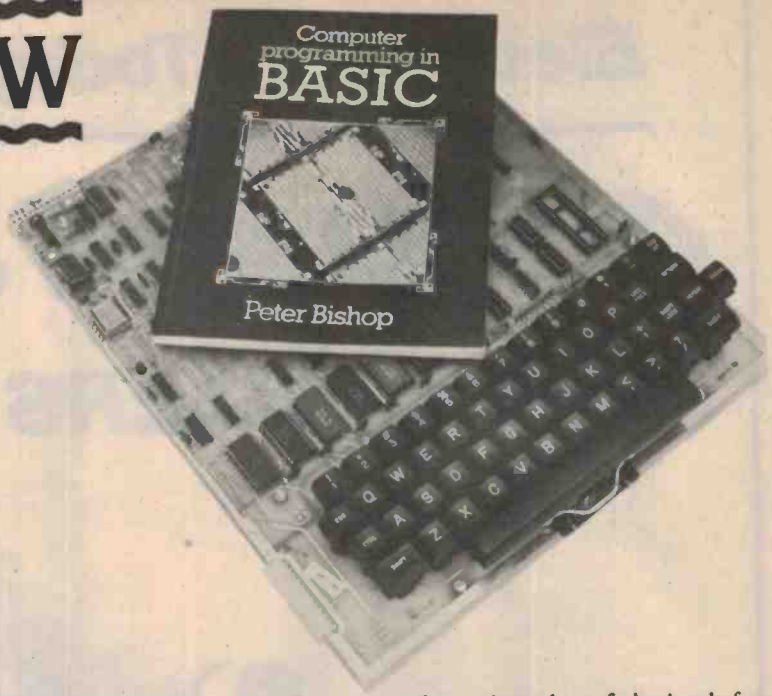
BOOK REVIEW



Computer Programming in BASIC

Written by Peter Bishop

Head of Computer Studies,
Denes High School, Lowestoft UK
Published by Thomas Nelson & Sons, UK
Review copy from
Thomas Nelson Aust. Pty Ltd
89-97 Jones St, Ultimo NSW 2007

Les Bell

THERE ARE SO MANY books already on the market covering BASIC programming that any new book would have to have some kind of novel twist to achieve any kind of popularity. This book has such a twist, as it is intended mainly for British school pupils sitting an O level or CSE (Certificate of Secondary Education) in Computer Studies. This will almost guarantee the book a market in Britain, but in the rest of the world it will have to stand or fall on its merits.

The treatment is based almost entirely on worked examples, questions and projects, and this is the way it should be. In the reviewer's opinion, there is only one way to learn programming and that is by programming.

In 140 pages, the author covers a useful subset of the BASIC language, with only a few notable omissions, the major one being the absence of any examples of string handling. The reasons for this are not hard to deduce: the dialect of BASIC used in the book is run on an ICL 1900, and it is in this area that inter-machine translation difficulties would probably start to make themselves felt.

This probably gives rise to the other 'quirk' in the book — repeated references to punched cards. To the reviewer, this is almost as anachronistic as referring to stone tablets as an I/O medium, and will intrigue the majority of microcomputer-oriented readers of the book, nevertheless it does not detract from the value of the book for teaching.

The accent of the book is on number-crunching, particularly for commercial applications, with some material on sorting. The projects are particularly interesting, leading the student into some backwaters of computer science such as queuing theory and computer art. This part of the book could have been expanded a bit perhaps, to include a more formal introduction to these topics for more advanced (or just plain curious) students.

Notable omissions: a bibliography or any form of index. But otherwise, this is an excellent book for the student who has access to a computer and wants to teach himself BASIC.

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STEREO amp for sale: 12 W RMS per channel using Sinclair modules with separate pro-built preamp and tone controls, in presentable case C/W power supply $50 or offer. Roger Harrison (02) 33.4282.

PLAYMASTER - 75L 80W speakers, AM FM stereo clock tuner, 40/40 amplifier & graphic equaliser, all expertly constructed, must sell, all offers considered & will sell separately. Ring Leon (062) 54.2662 AH (ACT).

PLAYMASTER 40/40 for sale. Speaker protection professionally constructed $120. Realistic TM-800 AM-FM tuner 12 months old $120. Sony TC-188SD cassette deck $250. J Pitman (08) 45.4372.

COMMUNICATIONS

WANTED good used CB around $20–$40. prefer hand held. Contact A Francis, 21 Bream St, Coogee, NSW 2034.

MARCONI AM/FM signal generator TF995A/2 220 MHz $200 or swap good CRO Cambridge portable milivolt potentiometer recond $200. Phone John (02) 521.4768 AH.

SHORTWAVE listeners: Australia's National Southern Cross DX Club welcomes new members. Write for sample bulletin to George Kuznecovs, 87 Cashel Street, Pasadena, Adelaide, SA 5042.

WANTED: Circuit diagram, construction details for external BFO to suit allwave receiver. J Crichton, 4 Howard Court, Waverley Road, Coolbellup, WA 6163.

TELETYPE station: Model 15 printer ST6 demodulator, loop supply active filter TD14 tape distributor. All excellent condition Caloundra (071) 91.1172. Price complete at cost $190.

WANTED: ASR33 teletype, preferably with paper tape reader and punch, particulars to G Rand, 185 Tarleton Street, Devonport, Tas or phone (004) 27.8992.

AUSTRALIAN Radio DX Club, for shortwave, and mediumwave DXers. Monthly magazine published write for details with 30 cent stamp to PO Box 67, Highett, Vic 3190 or PO Box 79, Narrabeen, NSW 2101.

COMPUTING

2650 computer system, fully operational, with - 4k, EA VDU, cassette interface, keyboard - software includes, Microbasic Editors, plus hosts of games. $300 ONO. Call Eric on (02) 90.2577.

MICROPOLIS disk drive for sale. S-100 controller, double density (143k). Software - BASIC, editor, assembler, DG640 driver plus more. $800 value for $650. S Dennis, 9 Immarna Place, Dundas (02) 630.5552.

FOR sale: TRS-80 or Exidy 16k memory expansion, new, 250 ns, Mostek chips, $75/16k. Graham, 4 Pryton Court, Balwyn 3103, tel: AH (03) 89.6918.

TRS-80 programme required. Level 2, 16k. Payroll suitable for use in large hotel. Have for sale or swap advanced job costing and technician productivity programme. PO Box 533, Albury, NSW 2640.

TRS-80 Micro. Level 1 BASIC. 4k RAM. 3 months old. Selling complete. $650 ONO. Contact Dru Booker, 33 Ashburner St, Higgins, ACT. Phone (062) 54.5657.

WANTED: Disassembled listing of TRS-80 level II, with comments if possible. Richard Lyons, 523 Beatty Road, Acacia Ridge, Brisbane, Qld 4110.

KT9500 632 VDU P/S cassette interface 7k RAM 2650 M/B KBD5 keyboard 2 BASICS 2 games packs documentation built and working. No cabinet $450. J Williams, Elizabeth, SA. Phone (08) 255.1053.

KT9500, EA VDU, 6k RAM, cassette interface, keyboard in cases. 10A power supply. Full documentation, fully working $350. Phone AH (02) 428.3335.

SELL: Unused "Pipbug" monitor ROM (ceramic), as used in 2650 systems. Bargain at $17. Clive Conway, 80 Third Ave, Joslin, SA 5070.

WANTED: Computer and/or equip't of any type, age or condition suitable for teaching business data processing. Neish, 3 Brisbane Road, Castle Hill 2154 (02) 634.1419.

S100 computer 4 MHz Z80, North Star Dual Disk Drive, flashwriter, 32k RAM, Teletype 43 Printer, 9 parallel 2 serial I/O, software. $4500, Greg Francis. Bus (065) 43.1066, home (065) 43.3088.

WANTED Tandy TRS-80 Level I computer with recorder VDU CPU. Phone (07) 284.3462 after 5 p.m. Mon-Fri.

SELL MEK 6800 D2 with power supply card cage and back plane ½k RAM. Buffered faultless conditon with full documentation $300 (044) 23.755.

SELL Sheen 100 step programmable calculator plus 852 Scientific National Semiconductor $42. After 6 p.m. ask for Roy, phone (068) 42.1470.

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TRS-80 owners - add a printer - no expansion interface required - RS232 output, including documentation and software to use LLIST and LPRINT commands. For more info write PO Box 122, Bondi Beach, NSW 2026.

TRS-80 Lev II owner would like to correspond with others. Swap programs and ideas on uses, publications, modifications, etc. R Rider, PO Box 26, Weston, ACT 2611.

051 Superboard or C1 owners. Anyone interested in forming a club/users group contact Geoff Cohen, PO Box 73, Lyneham, ACT 2602. Phone (062) 49.3493 (work), 54.7608 (home).

FOR sale computer back plane, 115 edge card sockets - all wire wrap terminations build a super micro. Phone (02) 587.7906 AH. Mr J Freeman $600 ONO.

COMPUTER system. 2650 4k RAM, EA VDU (110/300 BAUD). Software including BASIC. System complete and working. $400 phone Ray (02) 938.4767.

MINI computer system complete in single console 2650 4k RAM, VDU, cassette interface, manuals tapes with 28 programs $600. Phone Paul, Wollongong (042) 61.5451.

TRS-80 program exchange - for more info write R Gareb, 17/37 O'Donnel St, Bondi 2026 or ring (02) 30.8261 AH.

WANTED: Interesting programs for TI 58 e.g. " decimal to N base conversions" or other - will pay. RJ, 14 Dixon Ave, French's Forest, NSW 2086.

COMPLETE 2650 S100 system, 16k RAM, VDU, 300B cassette interface, software, 4k BASIC, 6 slot mother board, PS's, self-supporting cabinet, circuits, etc $800, Adelaide (08) 270.3115.

FOR sale: ICL 1901A computer 24 bit 16k core storage, twin disc memory 3.7 Megbyte, 40 spare disc, 600 line per min page printer 120 characters wide, ASR33 teletype with service manuals, Holerith card punch and veritier, card reader, complete books 23 volumes, engineering programs on cards. Best offer (077) 72.1111 ex 366 (8 a.m.-4 p.m.).

FOR sale: Micro-computer ICs. New 6800 $9; 6820 $5.50; 6821 $6.50; 6852 $5.50; 8080A $9; 8255 $8; 4 MHz crystals $4.50; 6875 $11; S-100 edge connectors, gold-plated, solder-tail, $4.50 ea. Wire-wrap IC sockets, gold. 14 pin 55 cents; 16 pin 65 cents, All new. Graham AH (03) 89.6918.

MISCELLANEOUS

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WANTED: Equivalent numbers for two transistors, HP-100, P-404 American PNP's. Write: S Waye, 59 Albatross Ave, Victor Harbour, SA 5211. Will be most grateful.

EA 40 MHz Frequency Counter. Kit cost $99. Sell built up and working for $60. Phone Chris (Sydney) 85.6098.

RADIO and hobbies wanted May 1939 August 1940 November 1940. Jim Gordon, 6 Graeme Ave, Ringwood, Vic 3134. (03) 870.1745.

FOR sale: AY-3-8760 IC for motorcycle TV game ETI 810. Unused, with circuit and instructions, price $18. Phone Gary at Goodna (07) 288.2730.

WANTED. Buy or borrow to photostat. Valve-tester model 45C. Please write. George Causbrook, 5 Fox Ave, Orange, NSW. Will pay well.

OSCILLOSCOPE Tektronix type 7603 including plug-in logic analyser, display formatter, dual time base, dual trace amplifier and lab cart. Only 12 months old, rarely used. To be sold to best offer. Mike Kilroy (03) 783.7547.

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KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have only listed the projects published in the last two years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). Any companies who wish to be included in this list should phone Jan Collins on 334282.

Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project ever published in ETI are available through the following companies (to the best of our knowledge):

RCS Radio	Radio Despatch Service
651 Forest Rd	869 George St
Bexley NSW	Sydney NSW 2000

Work on updating this list is currently in progress. Letters have been sent to suppliers and a full update will appear shortly.

Key to Companies

A: Applied Technology Pty Ltd, 1A Paterson Avenue, Waitara, NSW 2077.
B: Bill Edge Electronic Agencies, 115 Parramatta Road, Concord, (PO Box 1005, Burwood North 2134).
C: J.R. Components, PO Box 128, Eastwood NSW 2122.
D: Dick Smith Electronics P/L, PO Box 747, Crows Nest, NSW 2065.
E: All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000.
J: Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000.
K: S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109.
L: Tasman Electronics, 12 Victoria Street, Coburg Vic 3058.
M: Mode Electronics, PO Box 365, Mascot, NSW 2020.
N: Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011.
O: Orbit Electronics, PO Box 7176, Auckland, New Zealand.
P: Pre-Pak Electronics, 718 Parramatta Road, Croydon, NSW 2132.
R: Rod Irving Electronics, Shop 499, High Street, Northcote, (P.O. Box 135), Vic 3070. Phone (03) 489-8131.
T: Townsville Electronic Centre, 281E Charters Towers Road, Rising Sun Arcade, Townsville Qld 4812.
V: Silicon Valley, 23 Chandos Street, St Leonards, NSW 2065.

Project Electronics

041 Continuity Tester . . . . . T,D,B
042 Soil Moisture Indicator . . . . . T,D,B
043 Heads or Tails Circuit (Oct 76) . . T,D,E,A,B,L
044 Two Tone Door Bell (Oct 76) . . T,D,E,O,A,B,L
045 500 Second Timer . . . . . T,D,O,A,B
047 Morse Practice Set . . . . . T,D,O,A,B
048 Buzz Board . . . . . T,D,A,B
061 Simple Amplifier (Oct 76) . . . . . T,D,O,A,B
062 Simple AM Tuner (Mar 77) . . . . . D,E,B
063 Electronic Bongos . . . . . D,A,B
064 Simple Intercom (Nov 76) . . . . . T,O,A,B
065 Electronic Siren . . . . . D,O,A
066 Temperature Alarm (Dec 76) . . . . T,D,E,A,B
067 Singing Moisture Meter . . . . . D,B
068 LED Dice Circuit (Oct 76) . . . . . T,D,E,A,B
070 Electronic Tie Breaker (Jan 77)
071 Tape Noise Limiter (Jan 78) . . . . . E,L
072 Two-Octave Organ (Jun 78) . . . . . D,B
081 Tachometer (Mar 77) . . . . . T,E,O
082/
528 Intruder Alarm . . . . . T,E,A
083 Train Controller
084 Car Alarm . . . . . D,A,B
085 Over-rev Alarm
086 FM Antenna
087 Over-LED
088 Hi-Fi Speaker

Test Equipment

132 Experimenter's Power Supply (Feb 77) . . . .E
133 Phase Meter (Apr 77) . . . . . .E
134 True RMS Voltmeter (Aug 77) . . . . . .E
135 Digital Panel Meter (Oct 77) . . . . . .E
136 Linear Scale Capacitance Meter (Mar 78) . . .E
137 Audio Oscillator (May 78) . . . . . .E
138 Audio Wattmeter (Nov 78)
139 SWR/Power Meter (May 78)
140 1 GHz Frequency Meter-timer (Mar 78) C
141 Logic Trigger (Jan 79)
142 High Current Power Supply (Feb 79) . . . . . E
143 Curve Tracer (Jan 79)
144 Expanded-scale RMS Voltmeter (Jun 79)
148 Logic Test Probe (Jul 79)

Simple Projects

243 Bip Beacon (Apr 77)
244 Alarm Alarm (Feb 77)
245 White Line Follower (Nov 77)
246 Rain Alarm (Apr 78) L
248 Simple 12V to 22V Converter (Jul 78)
249 Combination Lock (Apr 79) . . . . . .E
253 'Hot Potato' Game (May 79)
254 Egg Timer (Jun 79)

Motorists' Projects

316 Transistor Assisted Ignition (May 77) . . D,O,E
317 Rev Monitor Counter (Jul 77) . . . . . .E
319 Variwiper MK II (Sep 78) . . . . . .E
320 Battery Condition Indicator (Apr 79) . . . D,E

Audio Projects

448 Disco Mixer (Nov 76
449 Balanced Microphone Amp (Nov 76) . . . J,E,L
450 Bucker Brigade Audio Delay Line (Dec 77)
451 Hum Filter (July 79) . . . . . .D
470 60 W Amp Module (May 79) . . . . A,B,E,P,R,S
471 Stereo Preamp (June 79) . . . . . A,B,E,P,R,S
480 50-100 Watt Amp Modules (Dec 76) . . . . . J,E,D,O,R,A,,B,L
481 12 V 100 Watt Audio Amp (May 77) . . . . . .E
481 High Power PA/ Guitar Amp (Jun 77) . . . . .O
482 Stereo Amp (Jan 77) . . . . . O,E
482 Stereo Amp Part 2 (Feb 77) . . . . . O,E
483 Sound Level Meter (Feb 78) . . . . . .E
484 Simple Compressor Expander (Jul 77) . . . . .E
485 Graphic Equalizer (Jun 77) . . . . . .J,E
486 Gowl-round Stabilizer (Nov 77) . . . . . .J
487 Audio Spectrum Analyser (Feb 78) . . . . . .E
489 Audio Spectrum Analyser 2 (Apr 78) . . . .J,E
490 Audio Compressor (Dec 79)
491 Graphic Equaliser (Mar 79)
495 Transmission Line Speakers (Aug 77)

Miscellaneous

546 GSR Monitor (Mar 77) . . . . . .E
547 Telephone Bell Extender (Jun 77) . . . . . .E
548 Photographic Strobe (May 77) . . . . . .E
549 Induction Balance Metal Detector (May 77) . .E
550 Digital Dial (Aug 78 . . . . . .E
551 Light Chaser (Sep 78) . . . . . .E
552 LED Pendant (Sep 78)
553 Tape/Slide Synchroniser (Oct 78 . . . . . .E
556 Wind Speed/Direction Indicator (Dec 79)
557 Reaction Tester (Feb 79) . . . . . .E
558 Mast-head Strobe (Feb 79)
559 Cable Tester (Mar 79)
581 Dual Power Supply (Jan 77) . . . . . .E
582 House Alarm (Jul 77) . . . . . T,O,E,A
House Alarm — Installation Instructions (Aug 77)
583 Marine Gas Alarm (Aug 77) . . . . . E,E
585 Ultrasonic Switch (Sep 77) . . . . . R,O,E,T,L
586 Shutter Speed Timer (Oct 77) . . . . . .E
587 UFO Detector (May 78)
588 Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78) . . .N
589 Digital Temperature Meter (PCB135) (Dec 77) . . . . . .E
590 LCD Stopwatch (Oct 78) . . . . . .N
591 Up/Down Presettable Counter (Jul 78) . . . . .E
592 Light Show Controller (Aug 78) . . . . . .E
593 Colour Sequencer (Dec 79)
594 Development Timer (Apr 79)
595 Aquarium Light Controller (May 79)

Electronic Music

602 Mini Organ (Aug 76) . . . . . .O,E,D,B
603 Sequencer (Aug 77)
604 Accentuated Beat Metronome (Sep 77) . . . .E
605 Temp Stabilized Log-exponential Converter (Sep 78)

Computer Projects

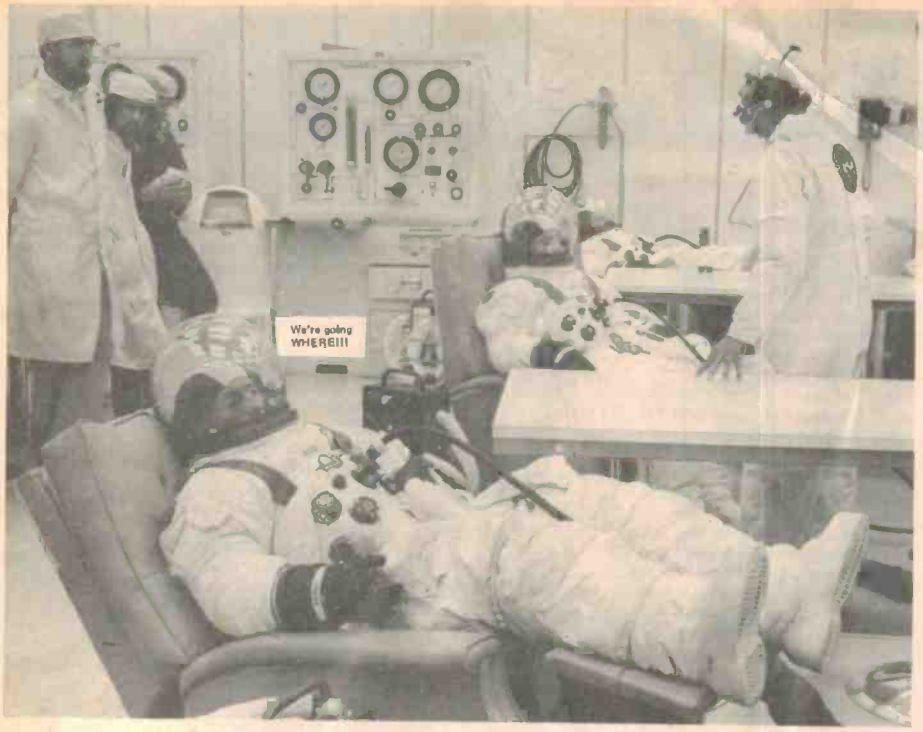
630 Hex Display (Dec 76) . . . . . E,A
631 ASCII Keyboard (Dec 78) . . . . . O,E,A
631 Keyboard Encoder (Apr 77) . . . . . O,E,A
632 Video Display Unit (Jan-Mar 77) . . . . . O,A
633 TV Sync Generator (Jan 77) . . . . . E,A
634 8080 Educational/ Prototyping Interface (Jul, Aug 78)
635 Microcomputer Power Supply (Sep 77)
637 Cuts Cassette Interface (Jan 78) . . . .V,O,E,A
638 Eprom Programmer (Jul 78) . . . . . E,A
639 Computerised Musical Doorbell (Mar 78) . . .A
640 S100 VDU (Apr, Jun 78) . . . . . V,O,A
641 S100 Printer (Sep 78)
642 16k S100 RAM Card (Feb 79) . . . . . .K
650 STAC Timer (Nov 78)
651 Binary/hex Trainer (Jun 79)

Radio Projects

712 CB Power Supply (Jun 77) . . . . . O,E
713 Add-on FM Tuner (Sep 77)
714 VHR-Log-Periodic Antenna (Feb, Mar 78)
715 VHF Power Amplifiers (Nov 77)
716 VHF Power Amplifiers (Jan, Feb 78)
717 Crosshatch Generator (May 78 . . . . . .E
718 SW Radio (Oct 78) . . . . . .E
719 RF Field Strength Indicator (Nov 78)
720 2 m VMOS Power Amp (Jan 79)
721 Aircraft Band Converter (Mar 79) . . . . . D,E
722 Antenna for ETI-721 (May 79
724 Microwave Oven Leak Detector (Jul 79) . . . .D

Electronic Games

804 Selectagame (Nov 76 . . . . . .O
804 Selectagame (Rifle Project) (Mar 77) . . . . .O
805 Puzzle of the Drunken Sailor (Oct 77)
806 Skeet (Jan 78)
810 Stunt Cycle TV Game (Jun 78) . . . . . O,D,B
811 TV Tank Game (Oct 78) . . . . . .O,E,D,B
812 Wheel of Fortune (Dec 79)
813 Race Track Game (Jan 79)



DREGS

DURING the early years of the editor's career (!) he worked for a period as a development technician with a Melbourne firm that, amongst other things, produced pipe and cable locators. These illustrious machines (solid-state ... even then!) were not advertised generally to the public at large but were sold to Government departments, some large excavation firms and local utilities. For their purpose, they performed very well and it was pleasing to see the occasional device being used by some public service technician tracing buried pipes or cable beside the roadway.

By some means or other that one can only guess at, the pipe and cable locators came to the attention of certain individuals of the public at large who had other interests in mind. From time to time the firm would receive slightly baffling phone calls from said individuals of the public at large. The poor woman who answered incoming calls would have to sort out, from a lengthy and often incoherent diatribe, what the caller wanted. Inevitably, the "technical" staff would have to deal with the call. What did they want? A metal (read "precious metal") detector!

Would our pipe and cable locator find gold? (always the first question ... or the first coherent question, anyway). "No", was the gentle reply. Or, not unless it was a nugget having the dimensions of the local sewer main or at least as big as the famous 'Welcome Stranger' (which weighed damn near 70 kg and was the size of a small car engine). Well, the devices could do better than that but the firm really didn't want to get into retailing them. Dealing patiently with people who do not understand the principles involved, let alone the technicalities, is great for teaching one patience.

One nutter a week was about average and the calls were all very similar ... except for one notable exception.

This fellow wanted an instrument that had a meter on the front panel that would indicate 'gold', 'silver' 'iron', 'diamonds', etc would work in water, underground or from an aircraft, and ... he was willing to pay a large sum of money for the firm to develop such an instrument!

The firm is still producing the same pipe and cable locator to this day (with minor improvements). They still get calls ...

One day, one day ...

Some time next year there's going to be ten very happy PR people in Sydney and Melbourne. They'll be happy because we're planning an issue in which we'll print their releases just as they sent them.

The ensuing jollity may be shortlived because our readers and their benefactors will read them too — and see just what taurutic coprolitia is often made of technical news by non-technical PRactioneers.

And when the law of defamation is changed we might even describe the odd press function as it **really** happened.

Like when the man told us six times that his cassette deck "was so simple even a child could use it". And how, two hours later — and in front of 50% of Oz's technical writers — he and his colleagues were still unable to demonstrate even the simpler functions — on three identical units. And how he later cancelled several thousand dollars worth of advertising when we had the temerity to question the wisdom of it all.

Or like the function we and four score engineering heavies attended recently — where two hours and ten minutes after kick-off, technicians were still frantically setting up the demo equipment. How the lengthy introductory speech was presented **in Japanese** to an astonished 100% -Australian-speaking audience. We might even be able to tell you more about the audio presentation following that speech — how, throughout a demonstration of the system's extended dynamic range a man was clearly visible kneeling under the table winding the amplifier gain up and down in sync. And we are **not kidding.**

There are in Australia about thirty or so good electronics PR people. Some of these work for the big organisations who know what it's all about anyway. Like Philips, HP, Rank etc. The remaining few are free-lance or work for agencies. And they are worth their weight in gold.

But if you need PR and you don't employ one of those estimable gentlepeople then for the sake of your name and our sanity do it yourself. It's inconceivable that you'd do it worse than many of the remainder. (Writs etc should be served on the writer — who was Collyn Rivers — Ed!).

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