SEPT. 1980
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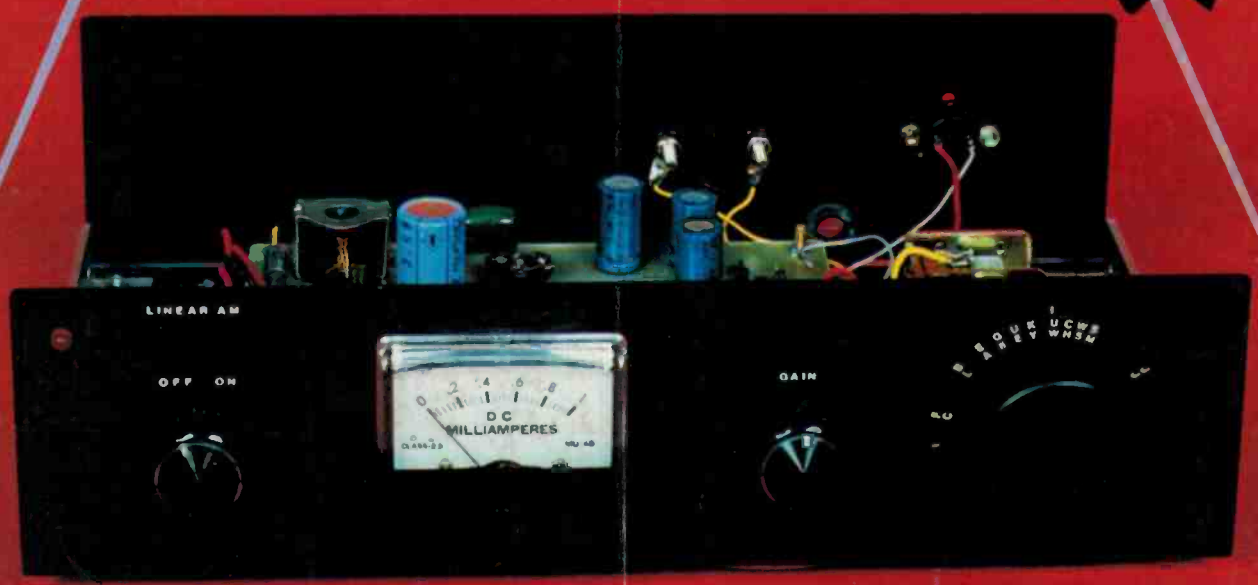
ELECTRONICS TODAY INTERNATIONAL

SUPERB AM TUNER

Win a Dick Smith Computer!

Using the 3080 IC



Exploring the comets

Hi-Fi: Recording tape and tape recording
Review of the dbx 3 BX dynamic range enhancer

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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ELECTRONICS TODAY INTERNATIONAL

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QUICK INDEX

THE IMPOSITION of duty on imported electronic products, whether items of complete equipment or components, is a complex and many-faceted affair. The object of import duty is, ostensibly, to protect Australian industry, technical skills, jobs etc. However, I have heard of, and been involved in, a variety of situations over the years that lead me to believe that our customs laws are framed and administered by people who (a) do not necessarily understand the 'industry' or 'technical skills' they seek to protect so zealously, and (b) do not understand or attempt to work out the consequences of removing or applying duty on particular items.

Recently, we heard that some keen and over-zealous customs official discovered that **one** local firm was assembling record player cartridges. The duty on imported items promptly jumped from **2% to 35%!** It would have been fair enough, perhaps, if the firm employed a large number of people solely engaged on that task. However, said firm had been in business **for several decades** (no prior protection) and employed fewer people than could be counted on one hand. The local product does not compete with the huge variety of imported cartridges, yet the duty was applied unilaterally . . . to protect whom ? This ludicrous situation was pointed out to the customs authorities, forcefully and often, and the duty was removed some five weeks after it was applied.

The manner in which the customs authorities categorise items often shows abysmal ignorance of the 'industry' they're attempting to 'protect'. Take hi-fi amplifiers for example. Currently, customs don't differentiate between hi-fi amps and PA equipment. As a great deal of PA and sound re-inforcement equipment is currently manufactured in Australia, and there is strong competition in that market, customs protection seems in order but domestic hi-fi equipment is entirely a different matter. There are a few very small Australian companies producing hi-fi amplifiers but their combined output — even **with** tariff protection — is miniscule. Why should the tariff 'umbrella' cover both sorts of equipment ? There may be difficulties in where you draw the line, but I believe that could be resolved after a little intelligent investigation.

It seems the whole subject is in serious need of review.

Roger Harrison
Editor

advertisers

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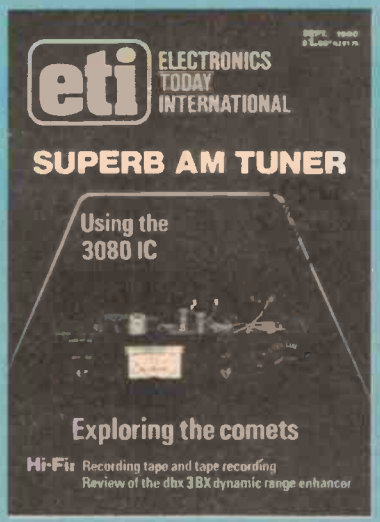
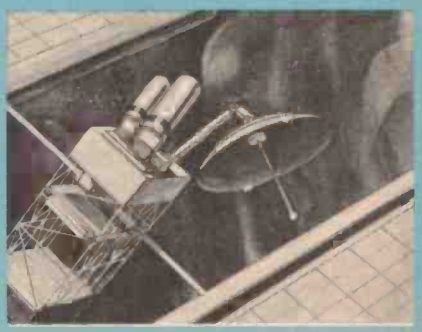


COVER
Naked and unashamed! A topless view of our AM tuner project whose most intimate details are revealed later in these pages. Photo by Ivy Hansen.

features



news

projects

sound

general

next month

SOUND AND LIGHT OPERATED FLASH TRIGGER
It's many years since we did a project of this sort, so we thought it about time to look at the subject afresh. This one's simple to build, features trigger delay and you can do all sorts of tricks with it.

ELECTRONIC THERMOMETER
This simple project is suited to measuring air temperature over the range from −10°C to +40°C or −10°C to +90°C according to your fancy. It's great as an electronic thermometer or it can be used to check air conditioners, heating systems etc.

PROJECT GALILEO
In our January issue we reported on Voyager 2's visit to Jupiter. This time we look at the next mission to the giant planet which will involve international co-operation.

NAKAMICHI 482 STEREO CASSETTE DECK
Not a Rolls Royce, more like a Mercedes — lower cost, easier to drive and superb engineering!

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.

NEWS digest

Video makes big in little estate agent

Sydney estate agent, Bigge and Little, of Willoughby, have installed video recording and play back equipment so that customers may preview a variety of properties without the hassle of having to inspect them all personally.

Having to inspect, say, 30 or 40 properties is a daunting prospect to a customer in search of a home to suit their tastes and budget.

Property descriptions on an estate agent's books are of necessity brief and that old saw of "a picture is worth a thousand words" prompted the proprietor of Bigge and Little, Graham White, to purchase the video equipment.

They bought a National portable video cassette recorder and portable camera with which they film not just the property inside and out — 'warts and all' — but the locale as well. In this way, customers can get quite a good idea of the properties in which they may be interested — all in the comfort of the agent's office and in much less time than it takes to traipse around them all with a salesman. Customers can inspect those properties of interest they've selected from the video tape.

Bigge and Little are rapidly building up a tape 'library' of the properties on their books.

An added bonus is reduced costs. Bigge and Little have been able to reduce commissions by a third as there is a considerable reduction in vehicle overheads and wasted journeys.

Meanwhile, the video boom is spreading amongst real estate agents. Since getting this story, we have been told of two other Sydney estate agents who have followed Bigge and Little's lead and another in Melbourne. Seems a fascinating phase of real estate salesmanship has been launched . . .

Hailing Halley's comet

This month's feature is concerned, amongst other things, with cometary exploration as Halley's comet will re-appear in our solar system in 1985 and a number of countries are working on proposals to rendezvous a satellite with the comet.

The British Aerospace Dynamics Group (under contract to the European Space Agency) has recently completed a study of the possibility of intercepting Halley's comet using a satellite called GIOTTO.

It has been given this name after the Florentine master Giotto di Bondone who depicted the appearance of this comet in 1301 in his painting **Adoration of the Magi** which he probably completed in 1304 — the earliest known visual impression of this comet.

The three month study undertaken in England assessed the feasibility of a mission using a satellite based upon the highly successful GEOS-1 and -2 design (ETI October 1978). It is intended to intercept the comet with an instrument-laden satellite which will provide data on the chemical composition of the coma region surrounding the nucleus and tail of the comet. A camera will return images of the nucleus and measurements will also be made of its magnetic field. In this work the satellite must pass less than 1000 km from the nucleus of the comet which may be only a few km in diameter.

The time available for observation is only a few hours, so extreme accuracy is required in computing the orbits of the comet and of the satellite. The European Space Agency plans to use the Space Telescope(see ETI, June 1980) to track the comet during its approach to the Sun to provide the data needed to direct the Giotto satellite to the encounter point.

The satellite will carry a solid propellant rocket motor for injection into the orbit to intercept the comet together with a very advanced telecommunications system for the transmission of the data back to earth over a distance of some 160 million km. A shield will protect the satellite from destruction by the particles in the tail of the comet which approach at over 80 km per second.

The cost has been estimated at 50 million pounds, but European scientists, like the Americans, feel that this opportunity for studying a comet at close quarters must not be lost. The project should enable a resolution of items in the nucleus of only a few metres to be obtained and we shall not be able to view this most famous of all comets again for 75 years.

Snakes alight! It's the Starchaser!

A Sydney company is now making a sequence chaser to control four channels of snakelights or other lamps.

Snakelights, popular in discos, are long flexible plastic tubes that look like garden hose till you plug them in. Then they light up with coloured lamps all along their length that can flash on and off in an extraordinary variety of combinations.

The Saturn 4 Starchaser from Sevlen Lighting has an 'autochase' mode that runs snakelights simply as light chasers at speeds varying from one change every seven seconds to thirty changes a second, but for really elaboarate effects the machine should be used in its 'audio level' mode. This modulates the light sequence according to the level of a sound signal and used with the variable speed control gives a wide range of effects with intriguing names like **pumping, whizzing, bouncing and auto-reversing.**

Sevlen also make the snakelights themselves. They come in twelve colours and ten metre lengths that can be connected end to end to make a sinuous chain up to 300 metres long. A continuity link (claimed to be unique) ensures that the whole circuit still functions if one of the lamps fails.

More information from Sevlen Lighting Pty Ltd, 4 Weldon St, Burwood, NSW 2134. (02) 74-8905.

New Mitsubishi VCR

The new Mitsubishi VCR, as featured on page 9 last issue, will be released in Australia shortly through AWA-Thorn.

Last month's item indicated that the machine has been available in other countries since May, but at press time we didn't know when it would be available here. A call from AWA-Thorn just before this issue went to press put us in the picture . . . er, pardon the pun. Enquiries to AWA-Thorn in your capital city.

National all-band radio

The latest consumer radio from National Panasonic will give a standard of resolution previously only attained by professional equipment, according to National.

The RF-9000 has a phase-locked-loop synthesiser and double conversion super heterodyne circuitry which allows tuning in 100Hz steps on the long, medium and short wave bands and 10 kHz steps on the FM band.

For consumer appeal there are facilities like pressbutton tuning — you press keys to light up the desired frequency on a liquid crystal display and the PLL circuit automatically tunes in. Once a station is found it can be stored in memory for instant tuning thereafter. Up to fifteen stations can be preset in this way and sequentially scanned for 1.5 seconds each so listeners can select the one they want. For those who like a bit more personal involvement, there's also a manual tuning facility.

Microcomputer controlled programming allows six different preset schedules, with programme modes like automatic daily, once a week, every day but one, twice a week etc.

Price in this country is anticipated to be around $3500. More details from National Panasonic (Australia)Pty. Ltd., 95-99 Epping Road, North Ryde, NSW 2113.

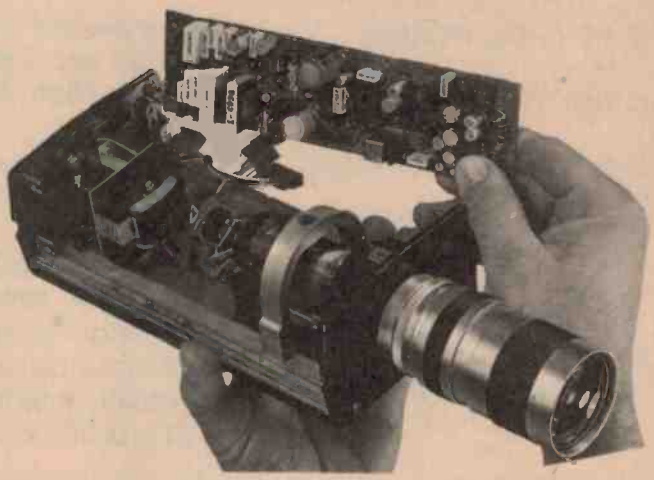
ERRATA

For some perverse reason we've not yet been able to fathom, last month's **Simple House Alarm** project was numbered **ETI-262**. This project number has been used before — in December 1979, for the Simple Intercom.

The actual, originally issued, number that did not get onto the Simple House Alarm project, is **ETI-250**. All kit and component suppliers have been notified. Printed circuit boards for the project are actually numbered ETI-250.

Also, in the **ETI-564 Digital Clock** featured last month, one tiny track came off the pc board artwork, between pin 5 of IC2 and pin 11 of IC3. The clock will work, but gains around four minutes a day without this connection as IC2 will divide by a little less than 3000. The circuit diagram is correct.

Integrated CCTV



All the electronics for a new closed circuit TV camera are on a single printed circuit board.

The Spectar camera from Javelin Electronics achieves this by making use of medium scale integration (MSI) chips. Javelin say this is more efficient and reliable than unproven LSI technology.

The main pc board takes up only one side of the compact (approx. 200 x 110 x 70 mm) camera body, leaving space on the other side for boards incorporating special functions. Options available include Video Line Amp, which increases line output to match cable parameters in remote surveillance work, and an Inserter/Splitter which allows video from two separate sources to appear on the same monitor at the same time.

A standard feature is vertical phasing, which synchronises the signals of all the cameras in a system so that their vertical blanking periods occur simultaneously.

For more details contact Photo-Scan (A/Asia) Pty. Ltd., P.O. Box 588, Potts Point, NSW 2011. Phone (02) 33-0966.

First optical undersea cable

The first submarine telephone cable ever to use optical fibres was laid recently at Loch Fyne in Scotland.

Conditions theree are similar to the North Sea, where it is expected that the first commercial cable of this type will be commissioned.

Optical fibres offer a vastly greater bandwith. This trial system, consisting of a 9.5 km loop, can carry 6000 telephone calls simultaneously, which is already 500 more than the largest conventional undersea cable.

Signal attenuation problems are dramatically reduced. Today's low-loss optical fibres can carry a signal 50 km before it needs to be amplified by a repeater station, whereas conventional cables need to incorporate repeaters every 5 km.

To cope with an expected doubling of international telephone calls every four or five years, the UK Post Office (who organised the Loch Fyne experiment) expect to have commercial optical cables availabe on short and medium routes by 1985 or 1986.

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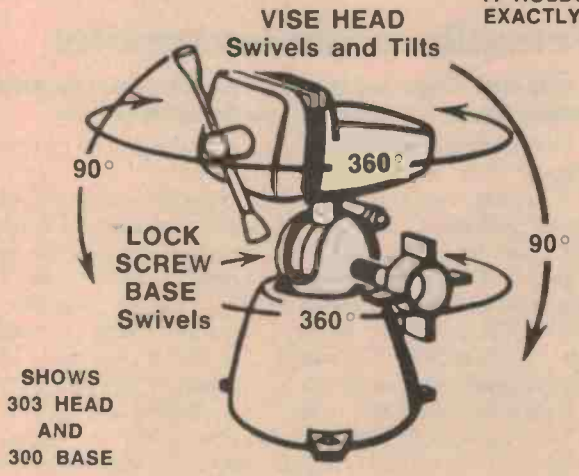
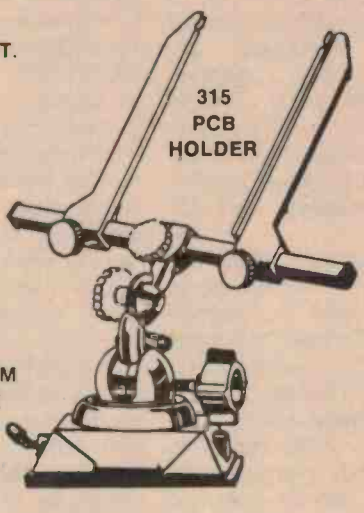
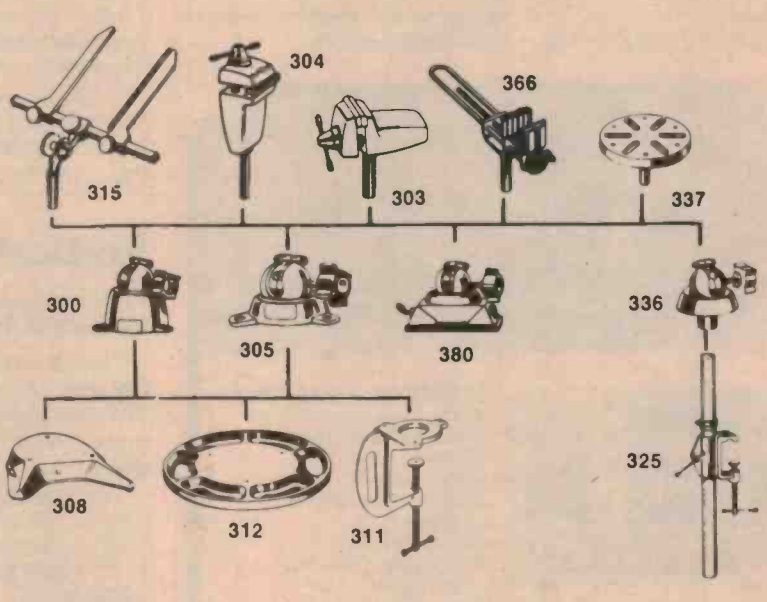




PHASE 1
SELECTION OF HEAD

PHASE 2
SELECTION OF BASE

PHASE 3
SELECTION OF BASE MOUNT



Want more information ... then contact

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Saudi weather watch

An automatic weather and pollution monitoring network planned for Saudi Arabia will use METEOSAT, the European meteorological satellite, to relay data from outstations to a central processing centre.

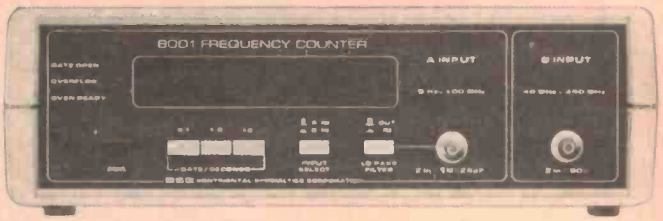
There will be a total of 17 automatic monitoring stations distributed throughout the Kingdom. Seven synoptic weather stations will measure wind velocity, temperature, humidity and pressure of the air, total solar and ground radiation, hours of sunlight and UV radiation.

Six air quality stations will measure all the meteorological parameters and in addition provide data on levels of sulphur dioxide, nitrogen oxides, carbon monoxide and ozone.

Four marine outstations will each have a shore station to gather weather information as well as a remote buoy to measure wave heights and periods and the sea surface temperature.

Information from the outstations will be stored for transmission to METEOSAT on a predetermined time schedule. METEOSAT will also transmit photographs in the visible, infra-red and water vapour spectra to the central processing centre at Jeddah. Additional infrared and visible image data will be collected from the polar orbiting satellite TIROS-N.

The whole programme, which is believed to be the first of its kind in the world, is partly motivated by the Saudi government's desire to assess the environmental impact of their continuing large scale industrialisation plans. The major contractor is Plessey Radar of the UK, who are supplying a total of $4.5 million worth of equipment — everything except the marine stations.



Versatile frequency counter

A 650 MHz frequency counter from CSC has selectable gate times and can be used with an external time base.

The model 6001 benchtop counter has two front-panel BNC inputs, one for signals in the range 5 Hz to 100 MHz and the other for 50 MHz to over 650 MHz. The lower frequency input has a switchable low-pass filter which gives 3 dB per octave roll-off at 50 kHz for audio and ultrasonic measurements.

Gate times of 0.1 sec., 1 sec., or 10 sec. can be chosen, giving resolutions of 10 Hz, 1 Hz and 0.1 Hz respectively.

The internal timebase is a 10 MHz oven-controlled crystal oscillator, which is claimed to be accurate to within one part in two million from 0° C to 50° C, with a normal oven temperature of 55° C. A buffered output from this oscillator is available through a rear panel BNC connector.

Another rear panel connector allows an external timebase to be used instead. If this has a frequency different from 10 MHz, the counter operates in a 'scaling' mode, in which the measured frequency is presented in different units. This enables the counter to be used as a direct indicating digital display in applications such as transducer translation, flow monitoring and tachometry.

The 6001 is mains powered, weighs 1.4 kg and measures 76 × 254 × 178 mm. More details from the distributors, Ampec Engineering Co. Pty. Ltd., 1 Wellington St, Rozelle, NSW 2039. Phone (02) 816-1168.

Vertical axis windmill

An unorthodox design of windmill generator with vertical blades will be tested this month in Rocky Flats, Colorado.

The makers, McDonnell Douglas, have christened it 'Giromill' and expect it to prove more efficient than normal types.

The prototype stands 37.5 metres tall with three blades 12.5 metres long supported by a 17 metre tower. It turns on automatically when the wind speed reaches about 18 km/h and runs free in high winds to prevent damage.

Designed to replace diesel and gas engines in isolated rural communities, the Giromill can be used to drive a generator to provide electricity for 15 homes or it may be geared down to run irrigation pumps for hundreds of acres of farmland. Installation and operating costs are expected to be lower than for horizontal axis mills.

OPAL 1000

The OPAL 1000 is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4Mhz CPU card with 2 RS232c serial and 3x8 bit parallel ports is used in conjunction with the Delta Products Disk Controller. One serial and one parallel (Centronics interface) port have been initialised as printer ports. Memory is provided by a 4 MHz 64k dynamic RAM Board by Measurement Systems and Control. The memory board is fully bank selectable and is designed for upgrading to a multi-user system. Disk drives are 2x8" Shugart SA801R running at double density (480k/drive) and fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks by turning off the AC power to the drives 14 seconds after the last drive select and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch.

The operating system software is CP/M version 2.2 with Delta Product's utilities which include DTEST (for testing drives and floppy disks) and M2 (a comprehensive memory test program). The Delta PROM monitor enables fault finding to be carried out independently of the Disk Drives.

PRICE $4,174.00

The OPAL 1000 can be used as a basis for expansion.

NDK S-4000 Wordprocessing Printer

For all bulk wordprocessing applications where reliability, speed and sustained print quality are of prime importance.

The **NDK S-4000** is supplied with a heavy duty 16 wire head producing single pass high quality 17 x 16 matrix characters at 75 characters/second for wordprocessing quality and 150-200 characters/second for drafts.

Three fonts (dot matrix, wordprocessing and super/subscript) are supplied as standard. The fonts can be intermixed as bold faced, enlarged (5 CPI 17 x 23 matrix), reduced (12 CPI) or normal (10 CPI). Other fonts can be specified by the user. Each dot on the 16 x 16 matrix can be programmed by the Host computer to produce special graphic effects (such as Letterheads and trade marks). John F. Rose Computer Services Pty Ltd will be supplying software to enable the user to specify and print special characters for any row/column position. The special patterns can be printed at the rate of 900 dot columns/second at a resolution of 4.7 dots/mm (120 dots per inch) both horizontally and vertically. Superscripts and subscripts are produced by the superposition method enabling complicated mathmetical formulae to be produced quickly and easily. John F. Rose Computer Services Pty Ltd will supply samples on request.

The following come as **standard** and are **included** in the price shown.

A. Stand.
B. Parallel Interface.
C. Front or rear paper feed.
D. Adjustable tractors.
E. 2 x Form Control Loops & 2 Ribbons.
F. Variable pitch (10 CPI, 11.7 CPI and 5 CPI).
G. Sound proofed contoured casing.
H. Ease of maintenance (only 3 major sub-assemblies).
I. 6 month's warranty.

Installation and servicing can be arranged through STC for any location in Victoria, New South Wales and The Australian Capital Territory. Other locations by negotiation.

Printer.....$3,105.00
Cable (for parallel interface only, see NDK S-2000 for types available).....$50.00
Complete service manual $35.00

SPECIFICATIONS

Printing method:	Dot Matrix impact. Serial printing by 16 wire head.			
Printing direction:	Bi-directional printing with logic seeking and 762 mm/second (max.) space skipping function.			
Character Size, Pitch, Speed and Line Length:				
Character Mode	**Regular Mode**		**Draft Mode**	
(Normal/Enlarged)	**Pica**	**Elite**	**Pica**	**Elite**
Printing Speed (Char/sec)	75/35	90/45	150/75	180/90
Pitch (CPI)	10/5	12/6	10/5	12/6
Line length (char/line)	136/68	163/81	136/68	163/81
Dot density:	4.7 dots per mm.			
Character set:	160 codes (JIS c6220, 8 bit). 2 modes (regular and draft).			
Line Feed:	6 lines per inch or 12 lines per inch. 45 lines/second (slew rate 6 lines per inch). 40 ms max. (single feed).			
V.F.U.:	Optical 2 channel (8 bit punched tape).			
Ink Ribbon:	Underwood spool, nylon fabric ribbon 13mm x 27m or 13mm x 11m.			
Paper:	4" to 15" inches width continuous paper with sprocket holes for tractor feed.			
Copy:	1 original and 5 copies with 34Kg no carbon paper.			
Interface:	8 bit parallel TTL level (Centronics).			
MTBF:	2000 hours.			
Life:	7 years (Head life: 100 million characters plus).			

Prices and specifications subject to change without notice.

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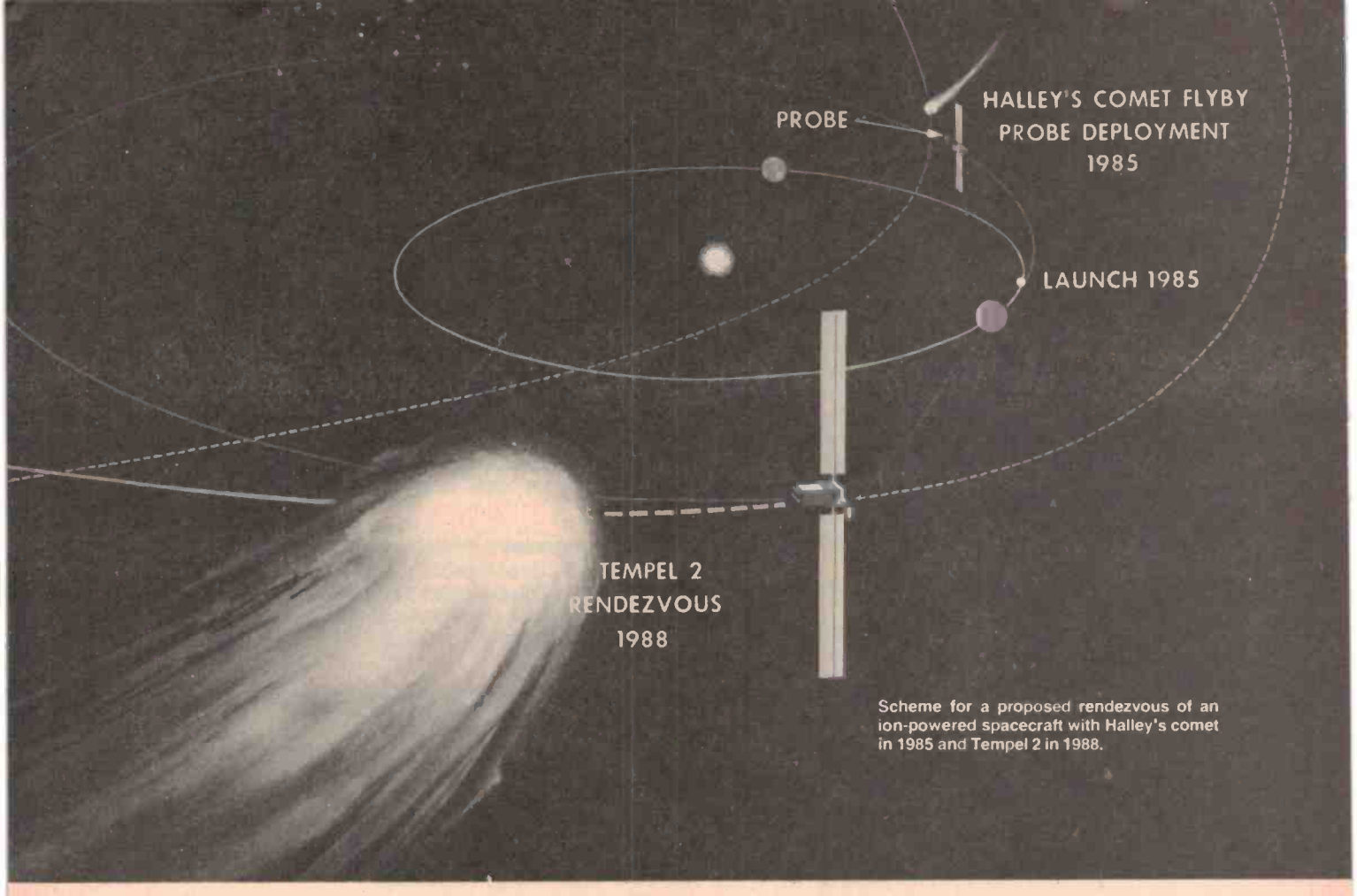
Send $1.00 to join our mailing list and receive our 130 page catalogue.

OPAL ENHANCEMENTS

The Opal 1000 is now available with the Shugart SA 1004 HARD DISK (10 Megabytes, disk is used as drive B), and the AMPEX 5 plus 5 (5 fixed megabytes, 5 removable megabytes — top loading cartridge), using MP/M (for multi-users) a CP/M 2.2 (single user) operating systems by Digital Research. The system can be supplied for any hard disk utilising the 213 interface (Diablo, Pertec, Ampex 16 plus 16 etc.). Send for our catalogue.



Scheme for a proposed rendezvous of an ion-powered spacecraft with Halley's comet in 1985 and Tempel 2 in 1988.

Solar electric propulsion and cometary exploration

This fascinating story tells how the power of the sun may be used with ion drive motors to take our spacecraft to much greater velocities than has yet been possible. Plans have even been made for such craft to chase comets.

Brian Dance

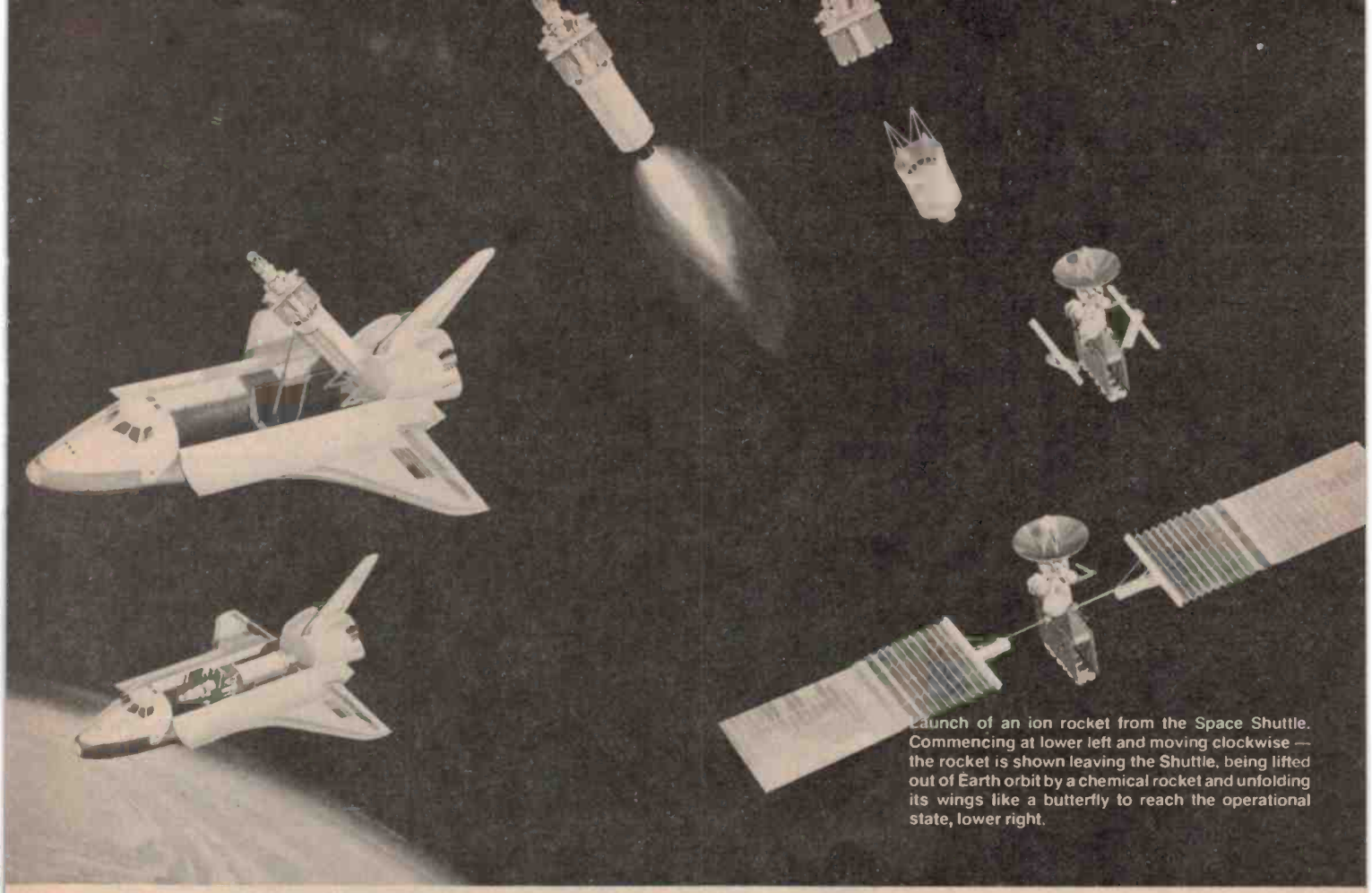
CHEMICAL PROPELLANTS have been used to power the rockets which have placed all our spacecraft into earth orbit, or into deeper space. Most of the rocket fuel is placed in the first stage of the rocket which boosts the second and later stages to a high velocity before the first stage is detached; the second stage boosts the much smaller mass to a higher velocity. After the second stage is exhausted, it too is detached and the third stage is fired so as to increase the velocity of the payload still further.

Unfortunately, the use of successive stages in this way means that a large amount of fuel is used to lift a relatively small payload. The maximum weight of the payload which can be lifted into earth obit is limited, but much more severe limitations occur when one wishes to send a payload into deep space. Multi-stage rockets are required to give a payload an adequate velocity to take it into deep space and the final stage of the rocket can carry only a relatively small payload if the size of the first stage is to be at all reasonable.

Once a rocket is on its way into deep space, its velocity cannot be changed by very large amounts unless it can be directed near to some massive object such as Jupiter. Deep spacecraft carry only a relatively small amount of hydrazine fuel which can be catalytically decomposed into gases which are fed to jets to change the velocity of the craft slightly or to alter its speed of rotation.

Ion drive

Scientists have proposed a new method of propelling spacecraft so that they can continuously accelerate over a long period using the power from the sun. Spacecraft using this method of



Launch of an ion rocket from the Space Shuttle. Commencing at lower left and moving clockwise — the rocket is shown leaving the Shuttle, being lifted out of Earth orbit by a chemical rocket and unfolding its wings like a butterfly to reach the operational state, lower right.

propulsion would still have to be lifted into the vacuum of space above the atmosphere of the earth by a rocket using a chemical propellant, but once there the spacecraft could be accelerated without any further use of chemical fuel. It is intended that spacecraft powered in this way will be able to chase rapidly moving objects, such as comets, and investigate these objects as they fly alongside them.

For this kind of work speeds of around 150 000 to 250 000 km per hour are required. However, the use of ion drive seems very attractive for any missions to Saturn and the other outer planets (especially if heavy payloads are to be carried) and for return journeys to some of the nearer planets, such as Mars.

The basic idea of the ion drive system is that electrical energy of sun light will be used to provide the power required to volatilise mercury and to ionise the atoms of the vapour which will then be accelerated by high voltages to tremendous speeds. The mercury ions will be ejected from the spacecraft at an enormous velocity so that the craft is pushed forward. When chemical propellants are employed, the burnt fuel is ejected from the rocket motors so as to propel the vehicle. The amount of fuel required is very large, since the velocity of emission of the burnt gases, although high, is not nearly so high as designers would wish. In order to give a spacecraft a continuous acceleration over a long period, one would need a tremendous weight of chemical fuel and it is just not practicable to put such a weight in orbit.

The ion motor operates by using a much smaller weight of fuel, but obtains a reasonable thrust by ejecting the ions formed from that fuel at far higher velocities than is possible with the atoms of a normal chemical fuel. Although the force from ion motors is relatively small, the force can operate over very long periods (months or even years) so that the spacecraft velocity is boosted to a very high value over a prolonged period of time. Mercury atoms are used as the fuel for the ion motor, since mercury atoms are relatively heavy and are readily volatilised.

The concept of the ion motor bears a similar relationship to the rocket motor as the latter bears to a gun. In the case of a gun, the gases formed by an explosion of a chemical cartridge push on the bullet or other projectile only for the very short time the projectile is passing down the muzzle. The propellant does not move with the projectile. In the case of rocket motors, the unused fuel moves with the projectile so that the rocket can be accelerated over a much longer period than the time of acceleration of a bullet from a gun. In the ion motor the period of acceleration is extended still further from the few minutes of a typical rocket by a very large factor.

Ion Motors

In the USA a whole team of scientists and engineers are working on ion motors. The study team is headed by people from the Jet Propulsion Laboratory of the California Institute of Technology and includes workers from NASA's Lewis Research Centre, Cleveland, Ohio and the Marshall Space Flight Centre, Huntsville, Alabama. They are working on the integration of light-weight solar arrays and mercury ion engines for a workhorse shuttle spacecraft for the next two decades.

An ion powered spacecraft will be a really impressive sight, since it will have solar panel arms about 150 metres across when fully extended resembling a huge galactic butterfly in space. The solar panels in these arms will be able to develop a power of the order of 100 kW from sun light. The electrical energy from the solar array will be converted by a power conditioning unit into the voltages required to operate the ion motors. ▶

It is planned that each spacecraft will have about ten ion engines of which eight will operate at any time and two will be spares. Each engine will be in the shape of a coffee-can about 28 cm in diameter and about 27 cm in depth. The fuel will be liquid mercury.

The main part of an ion motor is the ionisation chamber in which the mercury atoms are converted into charged ions by collision with electrons. The ions are focused by electric and magnetic fields and delivered to a pair of accelerating electrode grids.

These ions are then expelled from the spacecraft at a very high velocity indeed. An ion motor does not produce any explosion or anything like the white hot gases from a conventional rocket engine. There is merely a steady, flameless violet glowing beam of high energy particles which push the rocket steadily in the opposite direction to their motion.

Early versions of the engines being developed for ion drive were placed in earth orbit as early as 1969 during the Space Electric Rocket Test (SERT) Programme under the direction of the NASA Lewis Research Centre. These experimental engines gave much valuable information on ion drive and were operating for over seven years in space.

Techniques

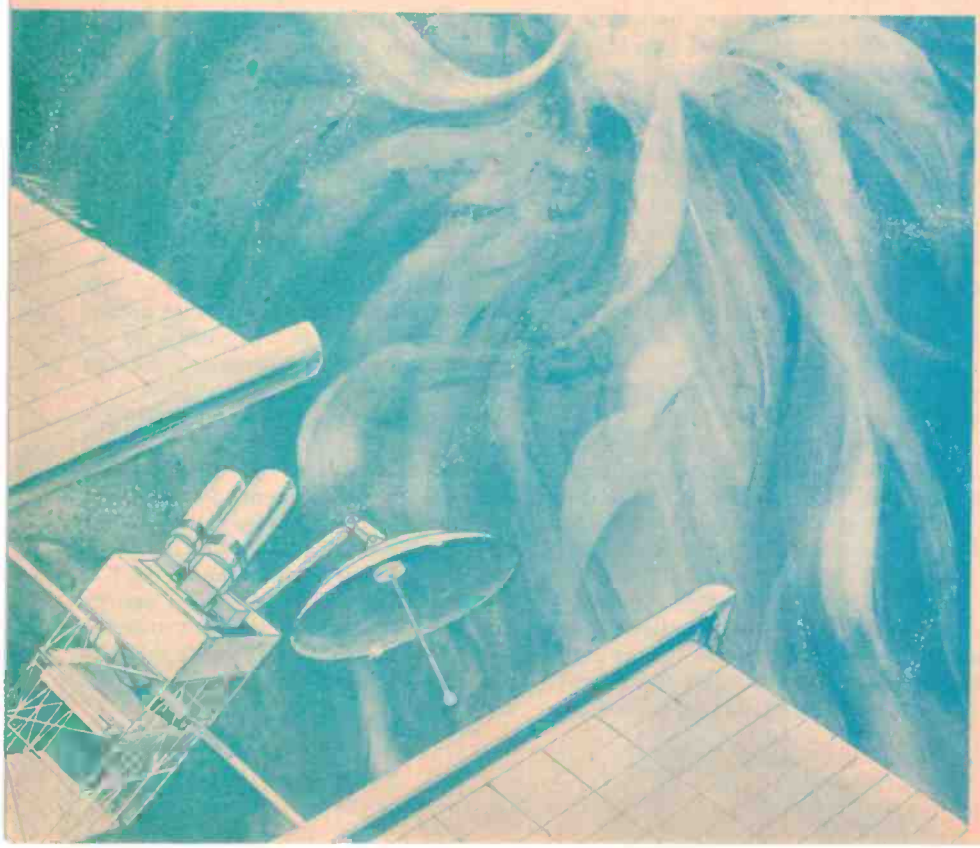
Although electricity-producing solar arrays have been used in most spacecraft for power production, spacecraft using ion drive propulsion will require solar power on a far greater scale than any vehicles launched previously. In order to keep the launch weight to a reasonable value, ultra-light weight solar cells only 50 micrometres in thickness have been developed.

The enormous size of the solar cell arrays required for powering the ion drive motors of a spacecraft makes it essential that these arrays should be folded up into a small space at launch. In the unfolded state they could not possibly be fitted into any launching rocket of a size we may be able to make in the foreseeable future. New methods of stowing deployment for the launching phase have therefore been developed which will enable the spacecraft solar arrays to be deployed in earth orbit almost like roll-down window shades!

Once the system has been lifted into space, probably by the Space Shuttle, the flexible thin blankets of solar cells tightly wrapped around a central core will be unrolled in the ion drive spacecraft to begin to provide the power required. The ion motors will then commence to operate (they are not ignited like a conventional rocket) and the ion powered drive to distant targets will commence.

The ionisation propulsion technique is said to promise fuel economies over ten times better than the conventional chemical rockets of today. Projects which we have only been able to dream about in the past because of the high cost of rocket fuel and rockets are expected to fall easily within the reach of the ion propelled spacecraft.

Artist's conception of an ion-powered craft rendezvous with Halley's comet.



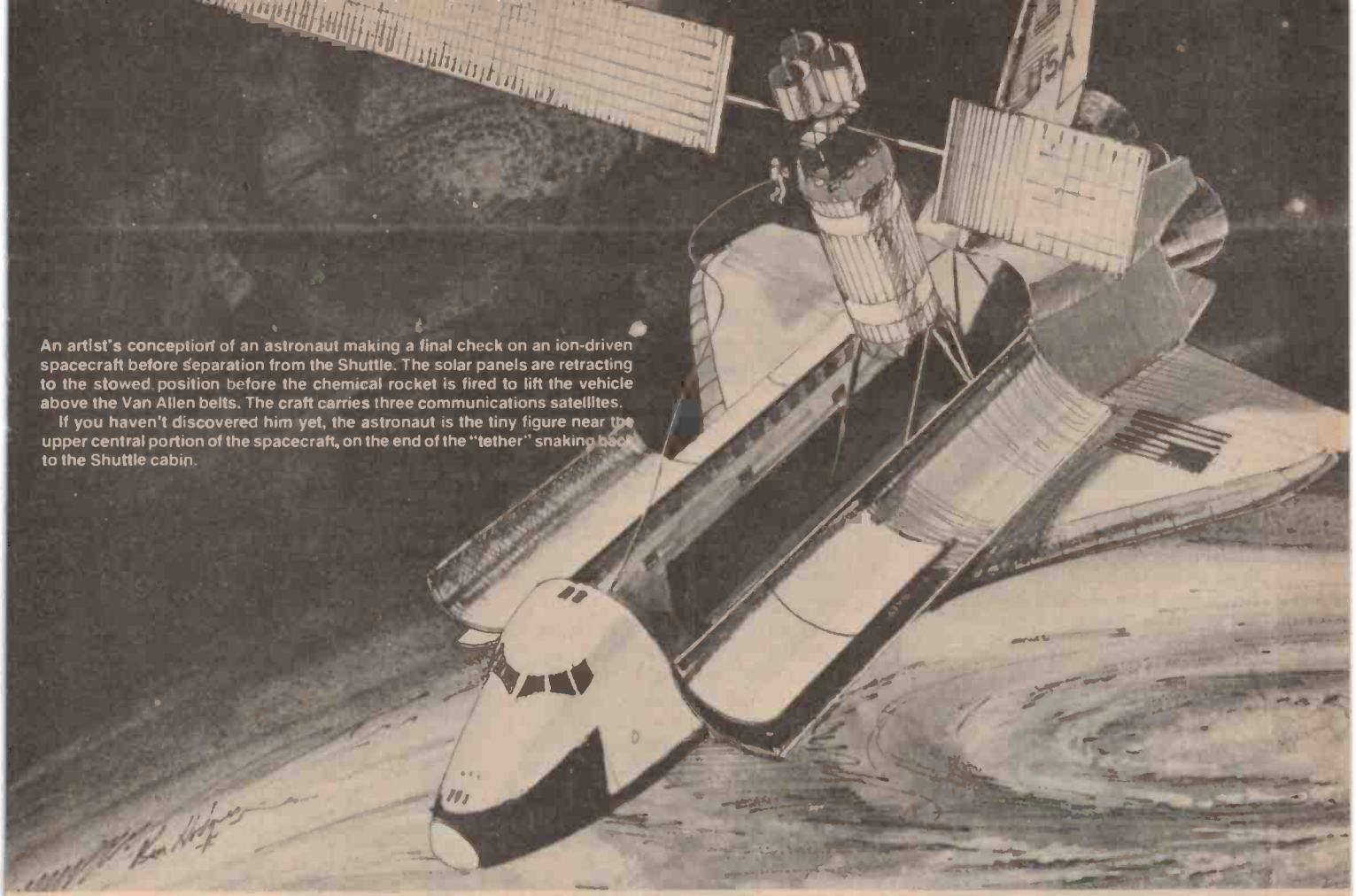
Work on comets

One of the most interesting pieces of work for ion powered spacecraft is the investigation of comets. Some comets travel in elliptical orbits around the Sun with their major axis much greater than their minor axis. When near the Sun, they travel much faster than when in deep space and this inevitably means that such comets spend most of their time in deep space at huge distances away from us. Other comets come into the vicinity of the earth from deep space and then return to deep space, never to return to the vicinity of the earth.

In order to investigate such fast moving objects in the short time they are near to us, very high velocity spacecraft are required. Ion powered spacecraft would seem ideal for this purpose. The comets Encke and Giacobini-Zinner have been considered as possible targets for ion powered spacecraft, but perhaps the most interesting of all comets is the famous Halley's comet which will make its closest approach to the earth in 1986. It visits our region of space only about once every 76 years, so we shall have to wait a long time if we do not take this opportunity of investigating it in 1986.

The object is of particular interest, since it has such a long and interesting history. Halley himself observed it in 1682 and recognised that it was the same object that Kepler had seen in 1607 and Apian in 1531. Halley's comet returned again and was seen by an amateur astronomer, Palitzsch, on Christmas night 1758, reaching its closest approach to the Sun on 12th March 1759. In 1835 it was found by Domouchel and later developed into a brilliant naked eye object with a tail some 25° in length (corresponding to a diameter about fifty times that of the moon!) as seen from the earth. It was again seen in 1910 and formed a magnificent view in the Southern hemisphere. It has been possible to trace this comet back as far as the year 11 BC, the intervals between its returns being from 74 to 79 years, the period depending somewhat on the gravitational influences of objects such as Jupiter and Saturn on the orbit of the comet. It was often considered as a heavenly sign of historical events, one of the most interesting being its appearance in April 1066 when the success of William the Conqueror was attributed to its presence.

Detailed plans have been made to employ an ion drive spacecraft for launch in 1982 to reach the vicinity of



An artist's conception of an astronaut making a final check on an ion-driven spacecraft before separation from the Shuttle. The solar panels are retracting to the stowed position before the chemical rocket is fired to lift the vehicle above the Van Allen belts. The craft carries three communications satellites.

If you haven't discovered him yet, the astronaut is the tiny figure near the upper central portion of the spacecraft, on the end of the "tether" snaking back to the Shuttle cabin.

this comet about three-and-a-half years later. The spacecraft would fly alongside the comet and put a probe with scientific instruments into the nucleus of this famous comet. Scientific data would be returned to the earth by telemetry from a distance of about 93 million miles and the spacecraft would then continue to a rendezvous with the comet Tempel 2 in 1988.

Unfortunately it seems very doubtful whether his magnificently planned project will be carried out. Budgetary considerations in NASA have delayed work on the ion propulsion system and the latter must get into top gear by the end of 1980 if the Halley and Tempel 2 comet encounters are to become a reality.

The latest information from the Jet Propulsion Laboratory is that it is planned to send a spacecraft to Halley's comet using only conventional rocket power. It is intended that a probe will be sent into the comet, but the available power will not be adequate to fly alongside the comet in formation nor to visit the second comet Tempel 2. Although a much less exotic mission than the one planned using ion propulsion it should provide much valuable data on a fascinating and historical object.

It is understood that the Russians, Europeans and Japanese also have plans to send missions to a rendezvous with the Halley comet.

In spite of the disappointment over the almost certain cancellation of the ion drive mission to Halley and Templar 2, ion drive propulsion will come in due course. Over a decade ago solar electrical developmental work by NASA resulted in the choice of ion drive over the solar sail concept for long term, space flight propulsion to distant regions of the solar system when heavy payloads are involved.

Thus it seems we must be very patient for the time being and wait until ion drive can accomplish the huge fascinating tasks awaiting it in the future.

TABLE 1. Typical Data on an Ion Drive System.

Fuel: 500 kg to 1000 kg of liquid mercury (amount depends on the mission).
Engine size: 28 cm diameter by 27 cm deep.
Thrust force, per ion motor: 0.25 Newton.
Total thrust force (eight engines): 2 Newton.
Exhaust ion velocity: 30 to 50 km per second (67 000 to 112 000 miles per hour).
Specific impulse: 3000 to 5000 second.
Solar power generated: 50 to 100 kW.
Proposed solar array plan-form: 8 x 75 metres per solar panel wing.
Approximate average spacecraft acceleration: 86 metres per second per day or 190 miles per hour per day.
Estimated typical spacecraft speeds relative to the earth:
after 100 days of ion thrust 55 000 miles per hour
after 500 days of ion thrust 131 000 miles per hour
after 1000 days of ion thrust 226 000 miles per hour.
Typical initial escape speed: 36 000 miles per hour.

Acknowledgement

The writer would like to express his gratitude to Mr. Don Bane, Public Information Office, Jet Propulsion Laboratory, California Institute of Technology for the information and artwork he has kindly provided for us in this article.

A GUIDE TO FM RADIO

MHz	Station	Music
92.9	ABC FM	Mostly classical with some jazz and folk.
102.5	2MBS	Mostly classical.
103.5	2CBA	Saccharine sounds sprinkled with Christian messages.
104.1	2DAY	Soft rock aimed at the 25-40 age group.
104.9	2MMM	Contemporary rock aimed at the 18-30 age group.
105.7	2JJJ	Way out music and talk similar to 2JJ-AM.
107.5	2SER	Educational and community programs.

When recording video or sound tapes (FM-AM or TV), the performance is largely dependant on the level and quality of the signal being fed into the tuner or video cassette.

You could be plagued with the same bugs, (ghosting-snow-poor sound) that you encounter with TV reception.

Regardless of how much you spend on your video cassette or FM & AM tuner, your equipment will only perform as well as your aerial system will allow.

However, a good antenna installation will rectify these problems and let the tuner or video cassette prove how good they can be.

Project 475

AM Tuner features wide bandwidth and low distortion

Design: Ken Woods
Article: Staff

Now the 'FM boom' has arrived, the AM stations are fighting back with wide bandwidth, good quality sound. This tuner, though simple to build and get going, provides extraordinarily good performance.

WE WERE SURPRISED to learn recently that many of the AM broadcast stations have been transmitting 'full bandwidth' signals for quite some time, it seems they're 'fighting back' at the recent boom in FM with all the new stations coming on to the VHF band.

This tuner has been designed to take advantage of this situation. Broadcast stations are permitted to transmit an audio bandwidth that rolls off at 15 kHz. That means an AM broadcast station will have a nominal bandwidth of 30 kHz. At first glance this seems a little out of kilter as frequency spacing in the 530 - 1650 kHz AM broadcast band is 9 kHz. However, stations serving a particular area are generally allocated frequencies no closer than 54 kHz. Hence, a wideband tuner may be used to exploit the good quality reception possible from stations transmitting 'full bandwidth' programme material.

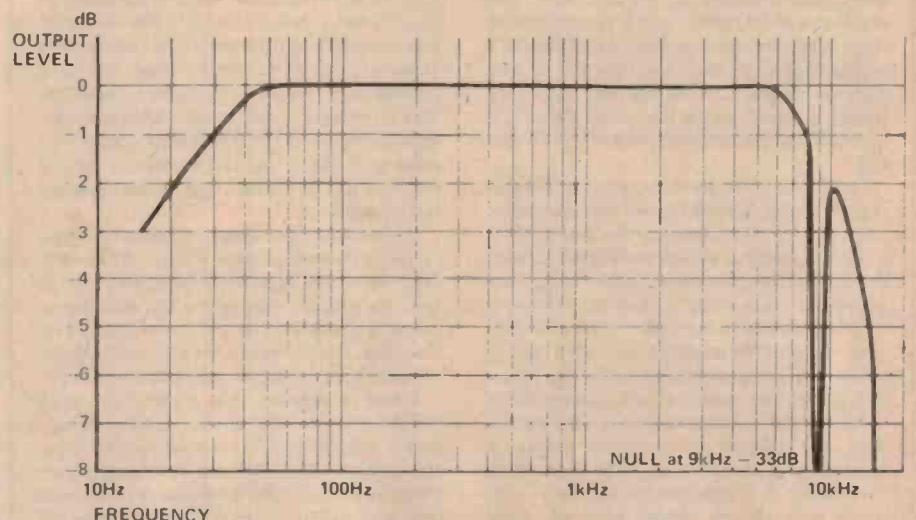
The tuner is housed in a simple, yet attractive, case. A plugpack is used to power the unit.

Design

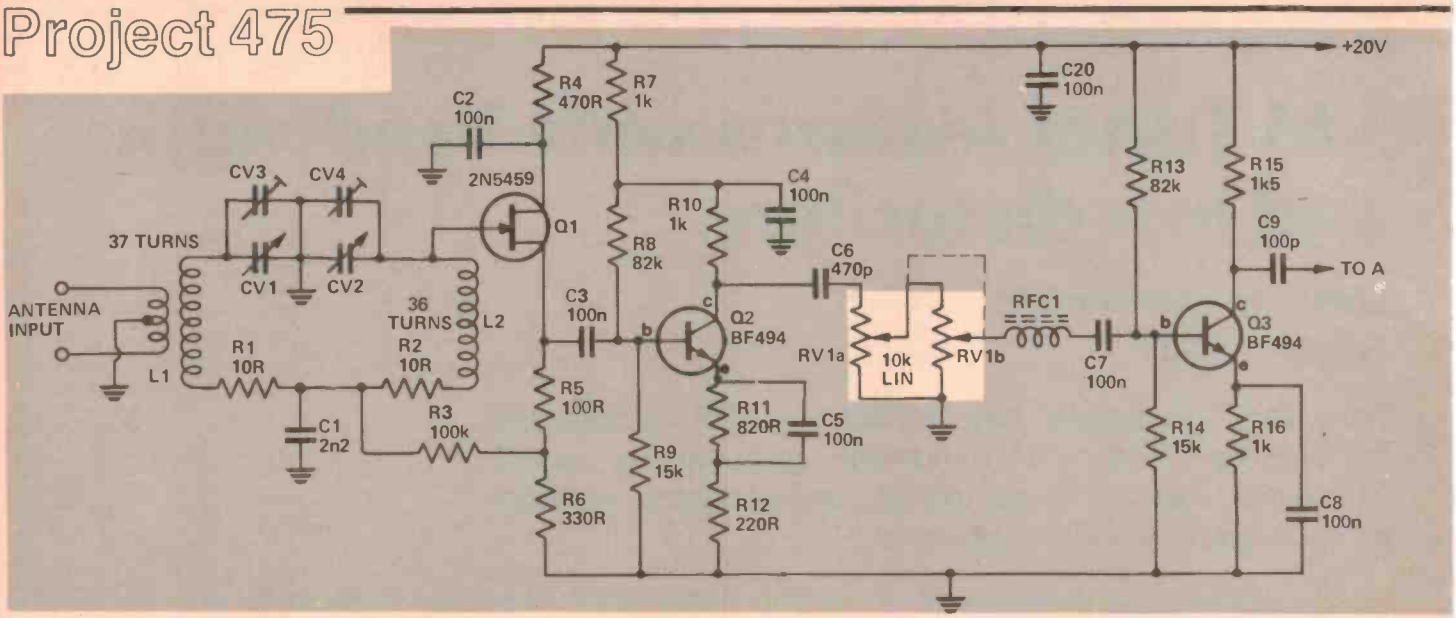
The designer, Ken Woods, has chosen to employ a 'tuned radio frequency' design to achieve low intermodulation distortion, low phase distortion and good transient response. There are only two tuned circuits. The overall selectivity is determined solely at the front end, at the frequency selected. The parameters of the input double-tuned circuit have been arranged to provide the required bandpass selectivity with good attenuation outside the passband, to reduce unwanted noise and interference. This circuit arrangement provides low phase distortion as it has a slowly varying phase change across the pass band and no phase reversals. Transient response of this particular arrangement is also good as there is minimum signal delay from input to output and the Q has been carefully 'tailored' to reduce the 'flywheel effect' of multiple tuned circuits (ringing).

In addition, the circuit has a virtually constant bandwidth characteristic right across its tuning range. It's a little too complex to go into here, but readers looking for a good reference could hardly do better than consult "The Radiotron Designer's Handbook", by F. Langford-Smith, published by AWV-RCA, Chapter 8, section (iii) 'Complex Coupling' (Page 420 in ours, the Fourth Edition).

The tuner has a manual RF gain control and no AGC so that the evil of AGC distortion, prevalent with conventional superhet AM tuners, is eliminated. Actually, rather than varying the gain of one or more of the amplification stages, the RF gain control is an attenuator, ▶



Overall frequency response of the receiver. The response is 3 dB down at 15 Hz and 12 kHz. The whistle filter provides 33 dB of attenuation at 9 kHz and is 3 dB below midband response at just over 8 kHz and just below 10 kHz.



HOW IT WORKS — ETI 475

The tuner employs a TRF design where all the amplification and selectivity is achieved at the actual frequency of reception, prior to the detector.

The required selectivity characteristics are provided by the input tuned circuit which is arranged to tune the whole broadcast band, from 530 kHz to 1650 kHz. Several stages of untuned RF amplification follow the tuned circuit. A low distortion diode detector removes the audio programme information from the selected station's RF carrier and this is fed to a 9 kHz whistle filter — which provides a deep 'notch' to remove interstation heterodynes — followed by an audio output stage.

For best, low noise reception, a balanced antenna input is provided. Antennas are discussed in the text. The two tuned circuits, comprising L1, L2 and the dual-gang tuning capacitor CV1/2, are mutually coupled by C1. Individually, each tuned circuit has quite a high Q by virtue of the totally 'closed' magnetic field provided by the pot core. The reactance of C1, whilst small, is sufficient to overcouple the two tuned circuits, providing a 'double-humped' response (see the accompanying diagram). To remove the 'dip' in the middle of the response, the overall circuit Q is 'damped' by two, low value resistors — R1 and R2.

A FET source follower, Q1, isolates the input tuned circuits from the first RF amplifier stage, Q2. The input impedance to the gate of Q1 is quite high and this avoids loading the coupled tuned circuits which would reduce the Q. Gate bias dc return is via R3, R2 and L2. The source of Q1 is coupled to the base of Q2 via C3. This first stage of RF amplification has a gain of about five and is stabilised by having part of the emitter bias resistance unbypassed (R12).

An RF gain control is placed between the first and second RF amplifier stages. A dual-gang potentiometer, RV1a and RV1b, connected in a cascade configuration, provides very smooth control over the signal level.

The input stage FET has its drain decoupled from the supply rail by R4 and C2 while Q2 has its collector circuit and base bias decoupled by R7 and C4.

The third stage of amplification is provided by Q3 which operates at full gain. To prevent VHF parasitic oscillation in this amplifier, a wideband RF choke, RFC1, has been inserted in series with the input to the base.

A further two stages of amplification follow, before the detector. Transistors Q4 and Q5 are direct-coupled and the collector of Q5 drives the diode detector via C11.

The detector is a voltage-doubling type with degeneration to reduce distortion. In addition, there is negative feedback from the detector to the emitter of Q4 via C12, further reducing distortion. A signal strength meter has been provided as a tuning aid. It measures the dc output level from the detector. Capacitor C14 provides smoothing for the meter, removing any audio signal influence.

RF 'smoothing' from the output of the detector is provided by R24 and C15 forming a low pass filter that passes audio (3 dB down at 28 kHz) but bypasses the RF. The output of this is coupled to the input of the audio output stage via the 9 kHz whistle filter. This is a parallel tuned circuit made up by L3 and C16. This provides a 'notch' in the audio response, attenuating any 9 kHz interstation whistles by more than 30 dB. The coil is constructed in a pot core which ensures high Q and a narrow bandwidth notch.

The audio output stage consists of a Darlington pair emitter follower stage, Q6 and Q7. This has a high impedance input, so as not to load the whistle filter, and a low impedance output suitable to drive the 'tuner' input of an amplifier. The collectors of Q6 and Q7 are decoupled from the supply rail by R29 and C18.

Power is supplied from a plug back, thus removing a possible source of hum pickup, and a voltage-doubler rectifier involving D3, D4, C21 and C22. Extra supply filtering is provided by R31 and C23. A front panel LED power indicator, LED1, is supplied directly from the rectifier output. Switch SW1 is used to turn the tuner on and off.

located between the first and second stages of RF amplification. Its purpose is to allow adjustment of the signal level so that at no time is the detector overloaded.

The detector employed features some signal degeneration, via R23, to reduce distortion and negative feedback to one of the RF amplifier stages to further reduce distortion. The overall distortion

PARTS LIST — ETI 475

Resistors — all ½W, 5%

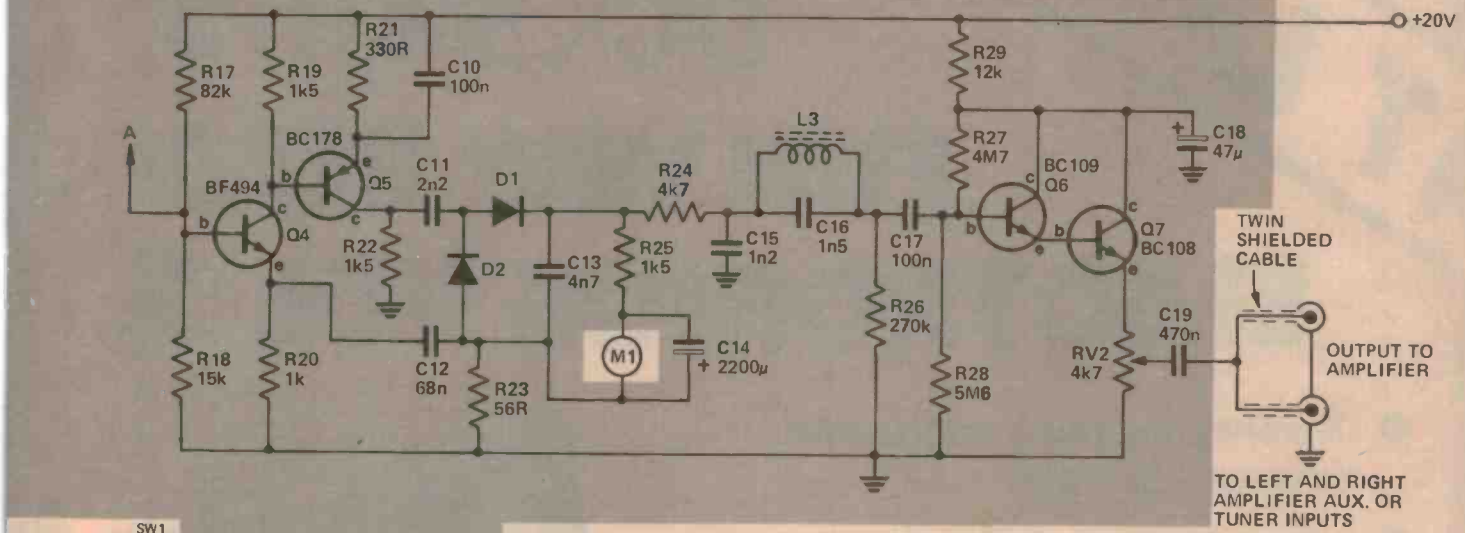
R1,R2	10R
R3	100k
R4	470R
R5	100R
R6,R21	330R
R7,10,16,20	1k
R8,13,17	82k
R9,14,18	15k
R11	820R
R12	220R
R15,19,22,25	1k5
R23	56R
R24	4k7
R26	270k
R27	4M7
R28	5M6
R29	12k
R30	2k2
R31	270R

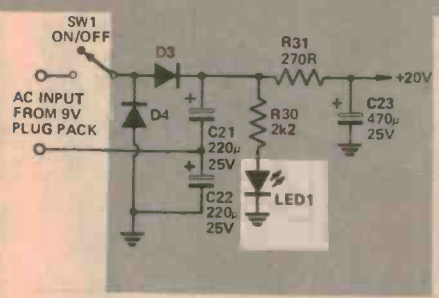
Potentiometers

RV1	10k linear dual pot.
RV2	4k7 flat mounting large trimpot.

Capacitors

C1,C11	2n2 greencap
C2,3,4,5,7, 8,10,17,20	100n greencap
C6	470p ceramic or styroseal
C9	100p ceramic or styroseal
C12	68n greencap
C13	4n7 greencap
C14	2200u/16V electro
C15	1n2 greencap
C16	1n5 see text
C18	47u/25V electro, axial lead type





C19	470n greencap
C21,C22	220u/25V electro
C23	470u/25V electro

Variable Capacitors

CV1,CV2	415p dual gang variable capacitor (Roblyn RMG — 2), see text
CV3,CV4	40p film dielectric trimmer, Philips type 2222 808 01027 (grey case) or similar.
Inductors	see coil winding details

Semiconductors

D1,D2	AA119, OA95, see text
D3,D4	1N4004, A14A or sim.
Q1	2N5459
Q2-Q4	BF494
Q5	BC558, BC178
Q6	BC549, BC109
Q7	BC548, BC108
LED1	red LED, TIL220R or sim.

Miscellaneous

SW1	one pole, two position rotary switch
M1	1 mA meter, University TD48, Minipa MU45 or similar

Planetary dial drive with flange (Watkin Wynne type 4511 DAF or similar); large black knob 40 mm dia., aluminium disc 55 mm dia. for scale plate (see text); two small black knobs; two antenna terminals: one black, one red; two-pin plug and socket for power input; 9V plug pack, Ferguson type PPA9 - 500 or similar; length of twin shielded cable with two RCA plugs on one end; five pc board standoffs, box to suit (see text); ETI-475 pc board.

of this tuner proved to be significantly lower than that of our Wavetek laboratory signal generator, so we are unable to present a reliable distortion measurement. Listening tests confirm the low distortion characteristic of this tuner.

As some interference may be experienced in particular areas from distant stations propagating via the ionosphere (this generally occurs at night), a 9 kHz whistle filter has been incorporated. It provides an attenuation in excess of 30 dB at 9 kHz and the notch bandwidth is about 2 kHz maximum. If you do not experience any difficulties with this sort of interference, the whistle filter may be dispensed with.

A tuning or signal strength meter has been provided and it has several functions:

(a) To provide a positive tuning indication.
(b) To facilitate optimum signal strength control.
(c) To indicate when signal overload occurs.

It's a very handy aid when adjusting antennas or when setting the RF gain control.

Instruments are not absolutely necessary to align the tuner, although a signal generator makes it somewhat quicker.

An inexpensive plug back is used to provide power to the tuner. This has the advantage of removing the transformer from the tuner's chassis, eliminating a possible source of hum.

Construction

The tuner is housed in a chassis made from a 240 x 290 mm sheet of 16 gauge aluminium bent into a U-shape measuring 290 mm wide by 180 mm deep and 80 mm high. The lid was made from a 205 x 455 mm sheet of 16 gauge aluminium. It is bent and mounted so that it overhangs the front panel of the chassis by 10 mm and the rear by 15 mm. This results in quite a neat, professional-looking unit.

The power switch, power LED, signal strength meter, gain control potentiometer and planetary reduction drive are all mounted on the front panel. The antenna terminals and two-pin power input socket are mounted on the rear panel. The output lead passes through a rubber grommet.

Commence by marking out and drilling the holes in the chassis. This is probably best done before bending it up. Mark out accurately, as per the metalwork drawings. The size of hole required for the meter depends on the meter used. The one on our prototype is a Minipa MU-45 type. It fits neatly on the front panel and has a pleasing appearance. However, other types may be used, such as the University type TD48. This is a little smaller than our meter, but will do equally well.

Two lengths of aluminium angle are bolted to each side of the chassis and the lid is secured to these with either bolts (which mate with tapped holes in the angle pieces) or self-tapping screws. The aluminium brackets are cut from a single 320 mm length of 13 mm (½") angle. This is readily obtainable in hardware stores. Mark and drill the lid, then bend it carefully to shape. The aluminium angle pieces are best marked up and drilled using the chassis, and then the lid, as a template.

At this stage, the chassis and lid could be sprayed matt black inside and out, or anodised — if you're willing to go to that expense. ▶

AT LAST!

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DICK SMITH ELECTRONICS

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COIL DETAILS ETI-475

L1

Primary: two turns wound bifilar with thin plastic insulated hookup wire (wound last).
Secondary: 37 turns pile wound, 34 SWG enamelled wire (wound first).

L2

36 turns, 34 SWG enamelled wire.
L1 and L2 are wound on Philips P18/11 pot core assemblies, 3D3 material, ue = 68, with adjusters.

Philips part numbers

Pot core	4322/022/24450
Adjuster	4322/021/32170
Former	4322/021/30270
Washer	1811/HWI
Clip	1811/HPC

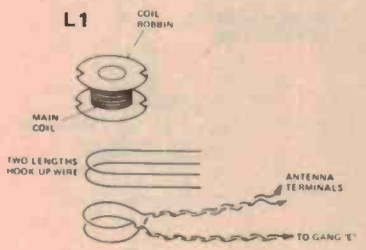
L3

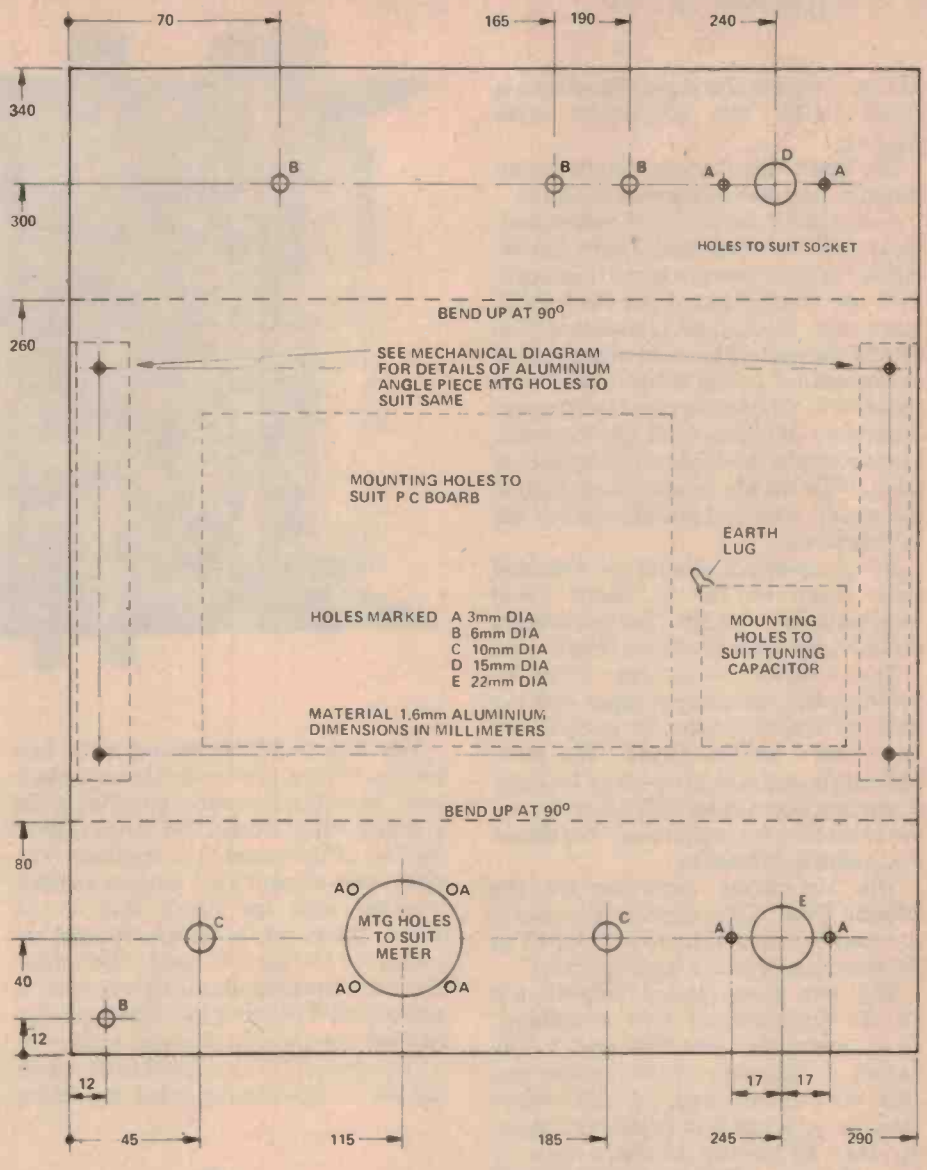
540 turns, 34SWG enamelled wire.
L3 is wound on Philips P26/16 pot core assemblies, 3B7 material ue = 220, with an adjuster.

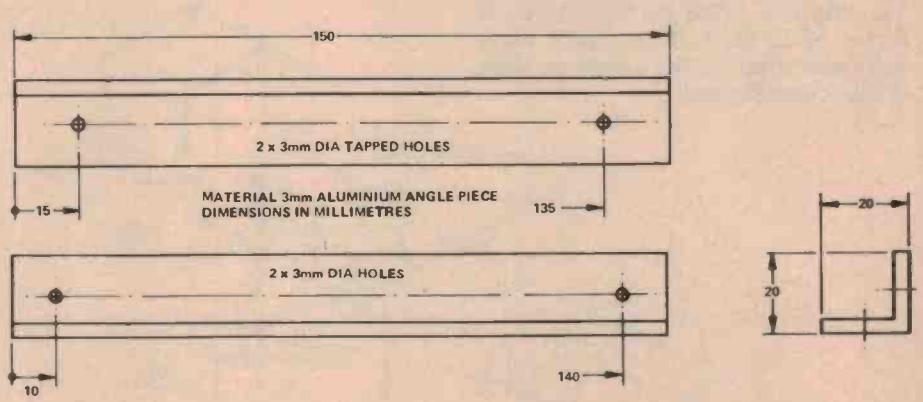
Philips part numbers

Pot core	4322/022/28080
Adjuster	4322/021/30810
Former	4322/021/30330
Clip	2616/HPC

No washer is used with the large pot core.







When the chassis is completely prepared, the major components can be mounted on it. The planetary drive should be mounted first. It is best to mount it on adjustable standoff pillars, as shown in the photographs, to allow the position of the dial flange to be adjusted. This should protrude from the front panel about one or two millimetres.

The dial was made up from a disc of 18 gauge aluminium (though 16 gauge or even a thinner gauge would be OK. The local stations were marked on the dial with white rub-down lettering (such as Letraset or Geotype). This disc is attached to the planetary dial flange by two screws supplied with the dial drive. The complete assembly is shown in the exploded-view diagram.

Since it will probably be difficult for most readers to cut a clean circle from aluminium, without the facilities of a machine shop, we have reproduced a suitable dial from which a Scotchcal copy may be made. If you use the metal Scotchcal, you can leave the backing paper on it and attach that as your dial.

The tuning knob on the prototype is a little special. It consists of a large diameter knob with a turned-up aluminium 'cup' pushed over it (the inside diameter forms a snug fit to the knob). We'll leave the knob to your ingenuity. A large knob is recommended as it provides smooth control of the tuning, a good grip and enhances the appearance.

The next step is to mount the tuning gang. It is very important that no strain is placed on the planetary drive from the shaft of the tuning gang. Careful, correct alignment will ensure this. The tuning capacitor is mounted on small standoff nuts and the shaft is carefully aligned, using washers or something ▶

similar, to pack the standoffs so that it mates with the planetary drive properly.

The rest of the chassis-mounted components may now be secured in place.

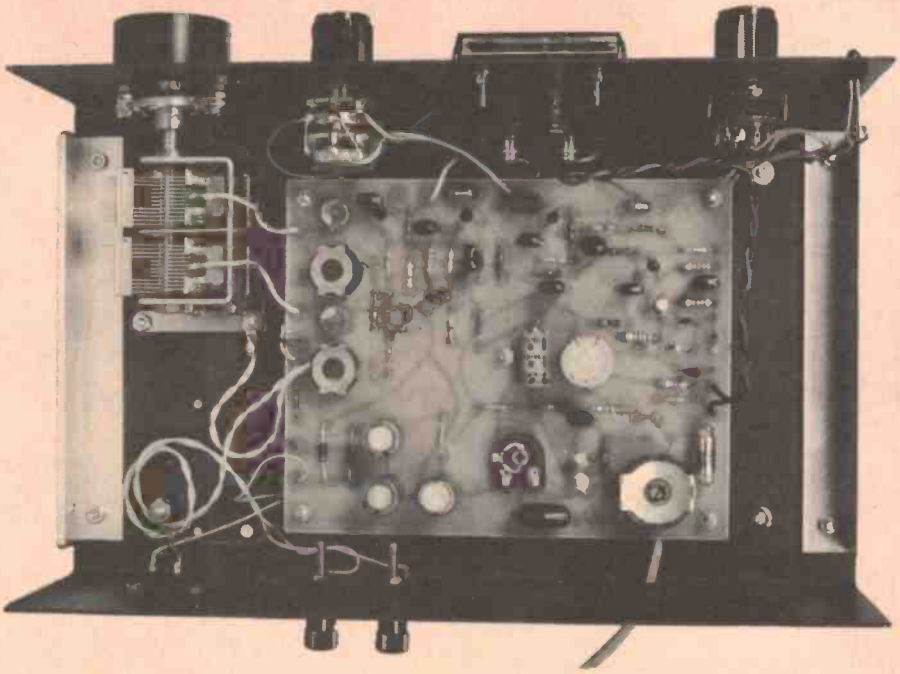
Assembling the pc board comes next. Mount all the components with the exception of the three pot cores. Take care with the orientation of the electrolytic capacitors, diodes and transistors. The BF494 transistors have an unusual lead configuration — the emitter lead is in the centre. When soldering the trimmer capacitors in place, don't use too much heat or strain the leads while soldering them. This avoids possible distortion of the plastic case and problems when adjusting them.

All components should be mounted right down on the pc board using minimum lead length. The transistors should have leads no longer than 5 mm.

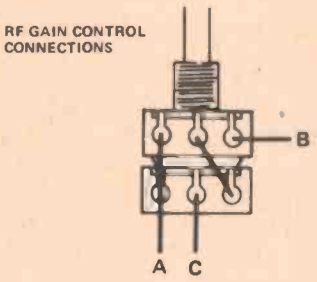
The detector diodes can either be gold-bonded germanium types like the AA119s recommended, or germanium types such as the OA47. The gold-bonded diodes will give lower detector distortion but may be difficult to obtain. We tried both types and could not detect any audible difference.

The resonating capacitor for the whistle filter, C16, should be either a styroseal or mica type to avoid drift in the tuning as this is a high-Q circuit.

The two input tuned circuits use 18 mm diameter pot core assemblies. Each assembly contains two ferrite halves, an adjustor, former, washer and clip. When assembled, the clip solders into the pc board and holds everything together. L1 has two windings while L2 has only one. Wind the secondary (37 turns) of L1 first. This should leave sufficient room on the former so wind the link over the top.



The link is bifilar wound with two lengths of thin, plastic insulated hookup wire. With the two wires parallel, wind a single turn around the former, over the top of the secondary winding. The start lead of one wire is then twisted together with the finish lead of the other. These two leads are twisted together for 150 mm or so and will connect to the antenna terminals after the coil is assembled. The other two leads are also twisted together, for 100 mm or so, and will be joined and soldered to an earth lug under the tuning gang mounting bolt adjacent to the coil locations on the pc board.



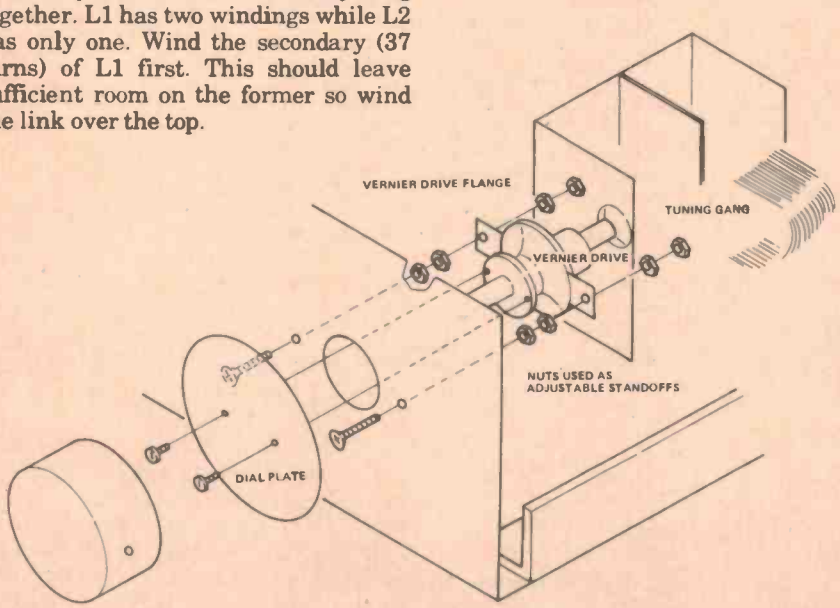
The accompanying exploded diagram should make the assembly of this link winding clear.

Arrange the wires so that all the link wires come out one side of the bobbin and the secondary wires come out the other.

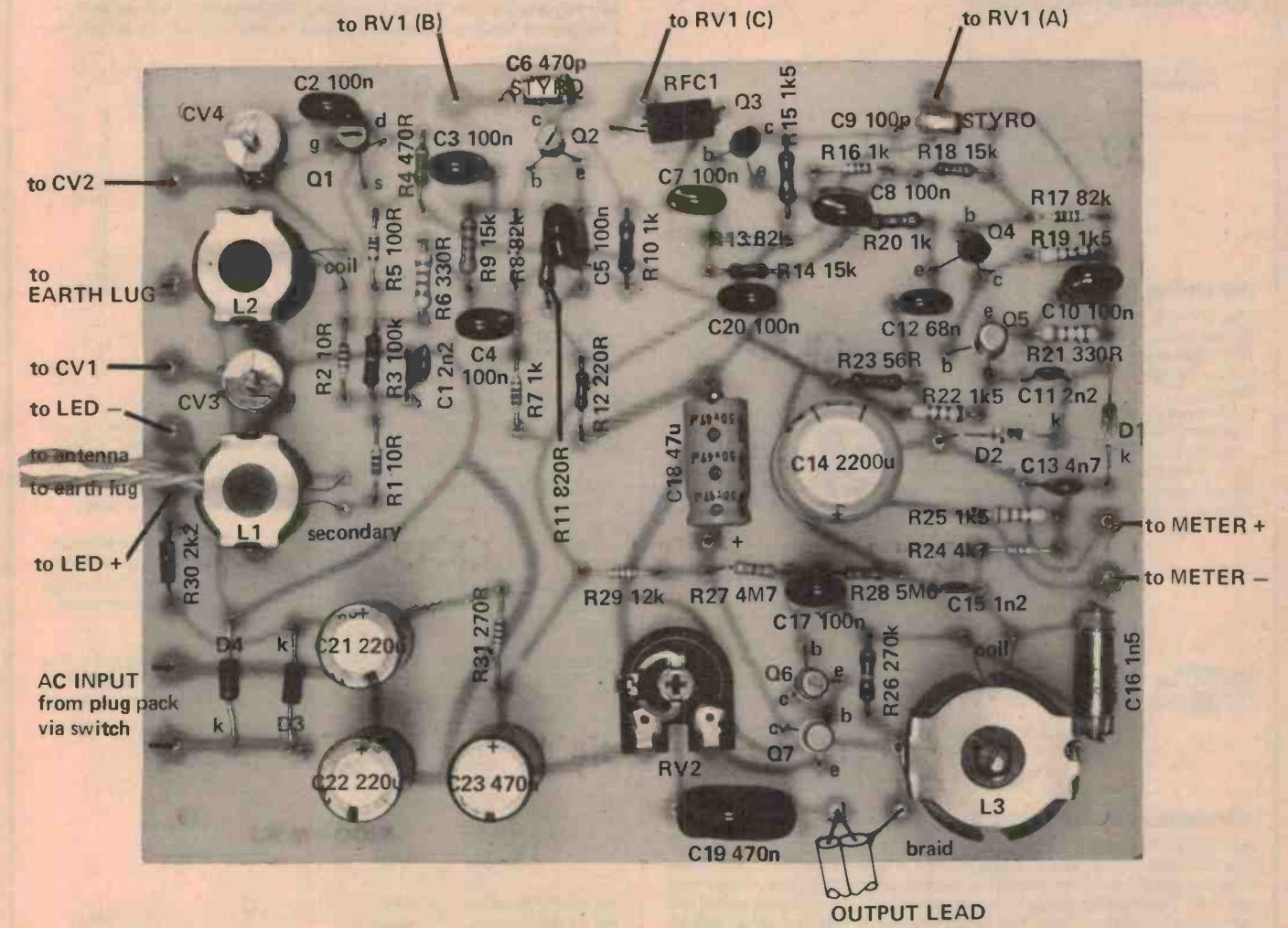
Assemble the two ferrite pot core halves over the former, place the washer on top of the assembly and slip on the clip. The washer ensures an even pressure is transmitted from the clip to the ferrite assembly and should always be used with these small pot cores. Insert the adjuster carefully into the centre hole of the core using a small aligning tool. Take care as it cuts its own thread in the nylon insert and any forcing can damage this.

Solder the complete assembly into the pc board (before everything falls apart!) orienting the assembly with the link connections facing the edge of the board and the secondary connections toward the centre.

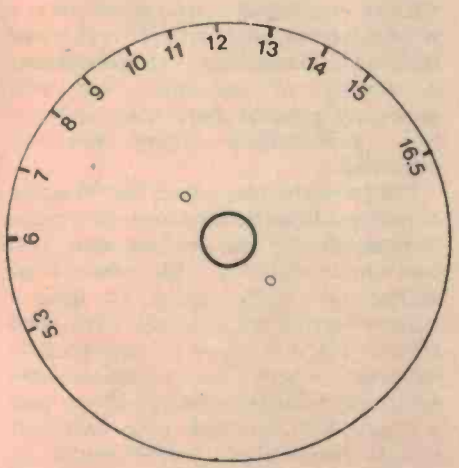
The second front end pot core, L2, is assembled in a similar way but note



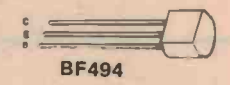
EXPLODED DIAGRAM OF VERNIER DRIVE AND DIAL ASSEMBLY

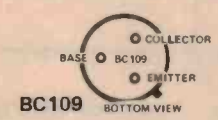


NOTE: Space problems prevent us publishing the pc board pattern this month. A good quality photostat may be obtained by sending a large, stamped-addressed envelope to 'AM Tuner PCB' c/o the magazine. We will endeavour to publish the pc board next month.



Full-size reproduction (negative) of the dial.





BC109

that it has no link.

The whistle filter, L3, uses a 26 mm diameter pot core which is assembled in a similar fashion to the other two except that it does not require a washer under the clip. Wind the wire on the bobbin as detailed in the accompanying box. The wire should almost fill the former, so be careful to wind it firmly, laying the turns neatly on the bobbin.

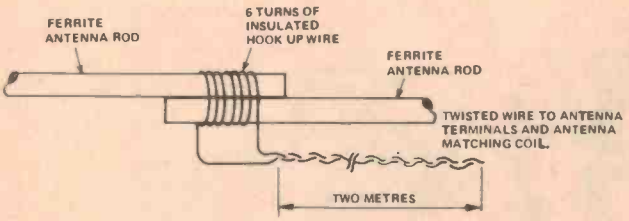
Tuning up

Turn the unit on and connect it to your stereo amp. Turn trimpot RV2 on the pc board fully clockwise. Connect an antenna and turn the RF gain control fully clockwise. Set the two trimmer capacitors at mid range (you can see the plates), and the ferrite adjusters in L1 and L2 at half depth. Tune over the range and you should hear some stations. Select a station at the high frequency end of the range. By adjusting the two trimmers in turn, and the tuning capacitor, bring the station to its correct position on the dial. This requires a little juggling with the three adjustments. Next, find a station at the low frequency end of the dial and repeat the procedure, this time tuning in the station using the two ferrite pot core adjusters and the tuning capacitor. You now have the receiver roughly aligned.

Repeat the process but this time you can set the dial to where a station should be located on the dial (according to the markings) and tune the two trimmers for maximum signal on the meter. Repeat for a low frequency station, adjusting the pot cores.

Repeat once more, just to make sure, ▶

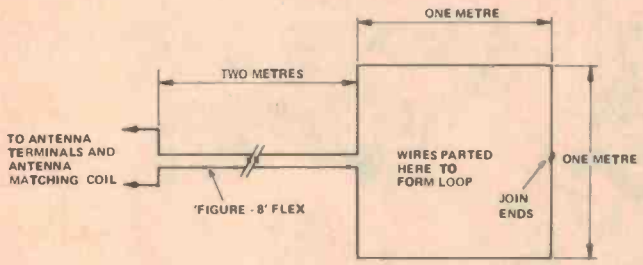
SUGGESTED ANTENNAS



For strong signal areas

This antenna is constructed of two 13 mm diameter ferrite rods. We suggest Neosid types, of F8 material, 12.7 mm diameter by 100 mm long. Most ferrite rods intended for broadcast band 'loopstick' antenna applications will probably suffice though, as construction is not all that critical; performance may vary though.

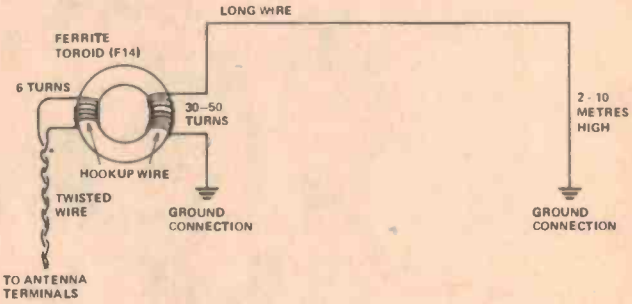
Six turns of hookup wire are wound firmly around the two rods and twisted leads two metres long connect to the tuner's antenna terminals. The two ferrite rods may be extended as illustrated or pushed together so that they overlap over more of their length. As shown, the antenna provides maximum sensitivity and least directivity. The rods should be oriented for best reception for the station or stations of interest.



For medium to weak signal areas

A loop antenna can provide very good results where signals are not too strong. The loop illustrated is made by taking a length of 'figure-8' flex, parting the wires over a length of two metres, joining the free ends and forming a loop of one metre per side. The feedline should be about two metres long. It can be longer but performance may deteriorate. The plane of the loop should be oriented towards the transmitters for best results.

A larger loop may be constructed to improve pickup. Note that a rectangular loop may also be used, if more convenient. Experimentation will indicate which arrangement provides satisfactory results. A matching coil, as shown, may improve results.



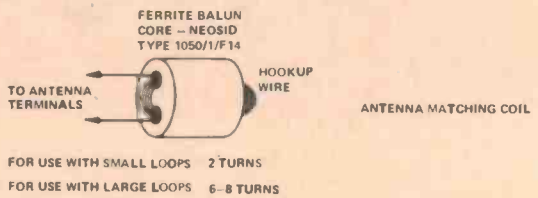
For weak signal areas

If you live in a weak signal area, or want to 'chase the DX', this antenna should provide good results. Run a long, straight wire as high above the ground as you can reasonably manage and as long as will fit in your property (but less than 5 km !). Connect the furthest end to a ground stake. The opposite end connects to the primary of a 'matching' transformer wound on a ferrite toroid. The illustration shows the main details.

The toroid should be of a material having an initial permeability of about 200 to 300, t least, and an A_L factor of around 100 to 150. A Neosid toroid of F14 material, 25.4 mm outside diameter, 19.05 mm inside diameter and 9.5 mm high should do nicely. It's not too critical, and some experimentation may be in order.

Note

The impedance of the antenna will have some effect on the tuning of L1. This may necessitate minor re-alignment of the adjuster in L1 if you change antennas or change the position of the antenna. Check the alignment at the low frequency end of the band.



and you should notice that all the stations are in their correct positions on the dial. If you change antennas you may need to make a slight re-adjustment to L1.

The whistle filter can be adjusted by tuning across the dial until you find a 9 kHz whistle between two stations. Wind the ferrite adjuster on L3 in until the tone disappears. If no whistles are found, wind the adjuster all the way out.

An alternative method is to use a signal generator with external AM modulation. Set the modulation to 9 kHz, at about 80%, and tune in the signal. Use the ferrite adjuster on L3 to null the audio from the speaker.

Always use proper adjusting tools (these are available from most suppliers) to avoid breaking the adjusters or affecting their correct operation. The pot core adjusters are delicate and should be treated with kindness. Overzealously screwing them in and out will almost certainly result in permanent damage.

This fairly simple alignment technique yielded an overall bandwidth, at the −3 dB points, extending from 15 Hz to 12 kHz. For those readers with a little more perseverance, this can be improved with judicious adjustment of the tuned circuits.

Operation

With the unit aligned you can connect an antenna and enjoy sounds from an AM tuner you never thought possible!

The output level to your stereo amplifier may be set by adjusting RV2, a trimpot on the pc board. The setting will depend on the signal strengths of the different stations at your location and the tuner input sensitivity of your amplifier. It is best set by experiment.

The antenna required will depend, again, on the signal strengths of the various stations at your location. It is a wise move to spend a bit of effort here as it pays off. The accompanying box shows a variety of antennas that will generally provide more than satisfactory performance under different conditions.

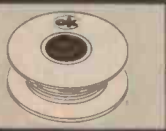
We tried the tuner in different areas of metropolitan Sydney and were quite impressed with the performance. At a location on the north side, where local stations are quite strong, we used a simple ferrite rod antenna with good results. At our offices in the eastern suburbs, where some stations are relatively weak (especially 2JJ) we used a small loop antenna with excellent results. Sound quality is remarkable — you have to hear it to believe it! ●

JUST WRAP™ WIRE WRAPPING TOOL

ok®

WHY CUT? WHY STRIP? WHY SLIT? WHY NOT JUST WRAP?

JW-1-B	BLUE WIRE
JW-1-W	WHITE WIRE
JW-1-Y	YELLOW WIRE
JW-1-R	RED WIRE



JUST WRAP REPLACEMENT ROLLS

R-JW-B	BLUE WIRE	50 ft. Roll
R-JW-W	WHITE WIRE	50 ft. Roll
R-JW-Y	YELLOW WIRE	50 ft. Roll
R-JW-R	RED WIRE	50 ft. Roll

UNWRAP TOOL FOR JUST WRAP

JUW-1	UNWRAPPING TOOL

JUST WRAP KIT

JWK-6	JUST WRAP KIT

"HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

BW-2630	FOR AWG 26-30

Use "C" size NICAD Batteries, not included. Bits not included.

BT-30	BIT FOR AWG 30
BT-2628	BIT FOR AWG 26-28

HOBBY WRAP TOOLS

WSU-30	REGULAR WRAP
WSU-30M	MODIFIED WRAP

XURON CORP.

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Cutters have a new patented shearing action

- Very thin profile
- Low operator fatigue
- Low cost
- Long life

TRI-COLOR DISPENSER

WD-30-TRI	TRI-COLOR DISPENSER
R-30-TRI	REPLACEMENT ROLLS

WIRE DISPENSER

WD-30-B	BLUE WIRE
WD-30-Y	YELLOW WIRE
WD-30-W	WHITE WIRE
WD-30-R	RED WIRE

DISPENSER REPLACEMENT ROLLS

R-30B-0050	30-AWG BLUE 50 FT. ROLL
R-30Y-0050	30-AWG YELLOW 50 FT. ROLL
R-30W-0050	30-AWG WHITE 50 FT. ROLL
R-30R-0050	30-AWG RED 50 FT. ROLL

*KYNAR-PENNWALT

HOOK-UP WIRE

HK-18	18 AWG	25 FT	SOLID CONDUCTOR
HK-20	20 AWG	25 FT	SOLID CONDUCTOR
HK-22	22 AWG	50 FT	SOLID CONDUCTOR
HK-24	24 AWG	50 FT	SOLID CONDUCTOR
HK-26	26 AWG	50 FT	SOLID CONDUCTOR
SHK-18	18 AWG	25 FT	STRANDED CONDUCTOR
SHK-20	20 AWG	25 FT	STRANDED CONDUCTOR
SHK-22	22 AWG	50 FT	STRANDED CONDUCTOR
SHK-24	24 AWG	50 FT	STRANDED CONDUCTOR
SHK-26	26 AWG	50 FT	STRANDED CONDUCTOR

PRB-1 DIGITAL LOGIC PROBE

- DC to > 50 MHZ
- 10 Nsec. pulse response
- 120 K Ω impedance
- Automatic pulse stretching to 50 Msec.
- Automatic resetting memory
- Open circuit detection
- Automatic threshold resetting
- Compatible with all logic families 4-15 VDC
- Range extended to 15-25 VDC with optional PA-1 adapter
- Supply O.V.P. to ± 70 VDC
- No switches/no calibration

PRB-1	DIGITAL LOGIC PROBE

PROTOTYPE BOARD CM-100

TERMINALS: 1,020 TEST POINTS. 188 separate 5 point terminals, plus 2 horizontal bus lines of 40 common test points each.

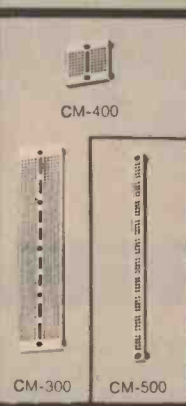
SIZE: 6½" Wide, 5" Long.

CM-100	MODULAR PROTOTYPE BOARD

PROTOTYPE BOARD CM-200

TERMINALS: 630 TEST POINTS. 94 separate 5 point terminals, plus 4 bus lines of 40 common test points each. SIZE: 6" Wide, 3½" Long.

CM-200	MODULAR PROTOTYPE BOARD



PROTOTYPE BOARD CM-300, CM-400

CM-300 and CM-400 have two separated rows of five interconnected contacts each. Each pin of a DIP inserted in the strip will have four additional tie-points per pin to insert connecting wires. They accept leads and components up to .032 in. diameter. Interconnections are readily made with RW-50 Jumper Wire. All contact sockets are on a .100 in. square grid (1¾ in. wide).

CM-300	MODULAR PROTOTYPE BOARD
CM-400	MODULAR PROTOTYPE BOARD

MODULAR BUS STRIP

CM-500 is a bus strip to be used in conjunction with CM-300 and CM-400 for distribution of power and common signed lines. Two separate rows of common terminals, grouped into clusters of five. All contact sockets are on a .100 in. square grid.

CM-500	MODULAR BUS STRIP

DIP IC INSERTION TOOLS WITH PIN STRAIGHTNER

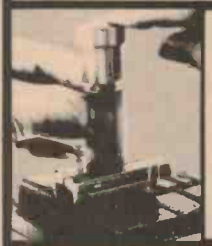
Narrow profile. Pin straightener built into tool. Automatic ejector.

INS-1416	14-16 PIN DIP/IC INSERTER

MOS, CMOS-SAFE

GROUND STRAP NOT INCLUDED

MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER



36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

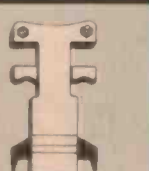
GROUND STRAP NOT INCLUDED

MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL

DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1	EXTRACTOR TOOL



24-40 CMOS-SAFE EXTRACTOR TOOL

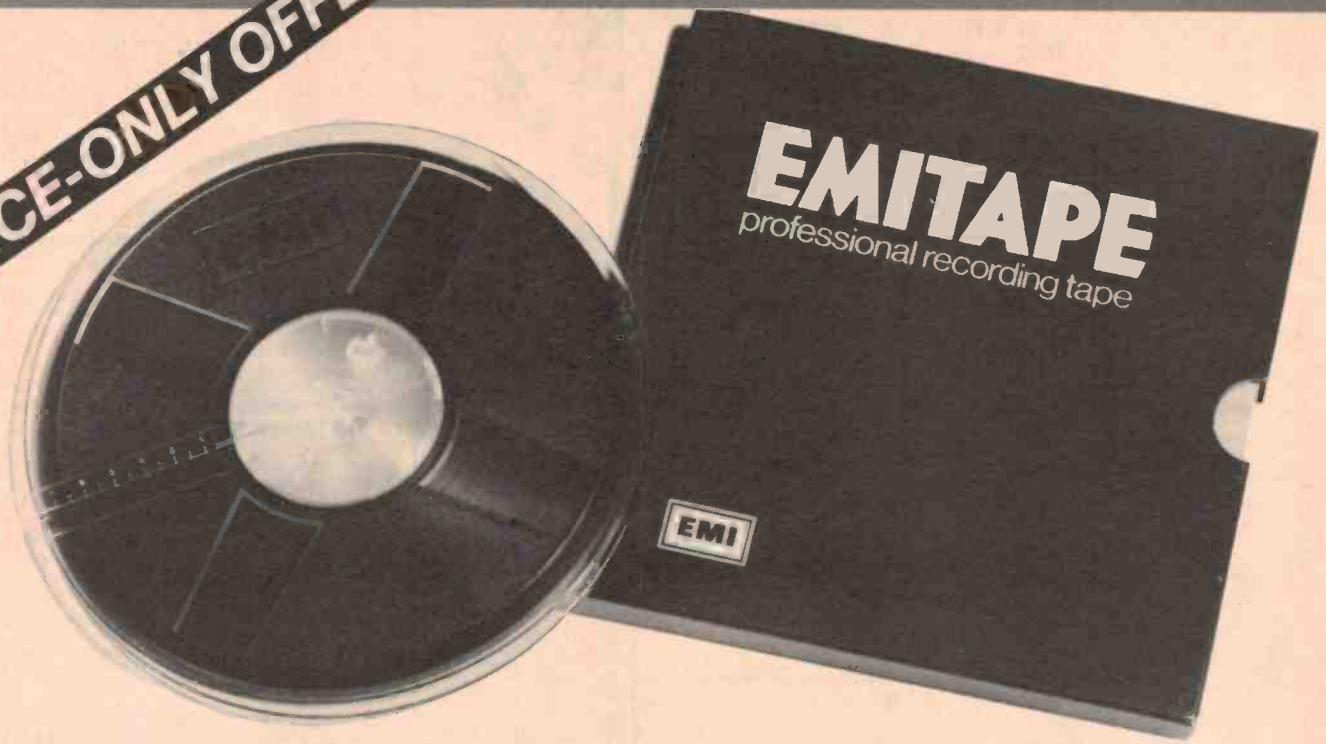
Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2	CMOS SAFE EXTRACTOR TOOL

AMPEC ELECTRONICS PTY. LTD. 1 Wellington Street, Rozelle, 2039. Tel. (02) 818-1166. Available from: NSW David Reid Electronics, 29-6601. Radio Despatch Service, 211-0191. Electronics (Distributors), 636-6052. Martin De Launay, 29-5834. Applied Technology, 487-2711. Vic. Radio Parts, 329-7888. Stewart Electronics, 534-3733. Ellistronics, 602-3282. S. Aust. Protronics, 212-3111. W. Aust. Reserve Electronics, 328-3116.

A ONCE-ONLY OFFER !



SUPERB REEL TO REEL TAPES

Dindy Marketing have a limited quantity of these EMI tapes available, **only for the duration of this offer** (unless sold out before the offer expires) so rush your order now. These tapes will not be offered again as EMI is ceasing production.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to **'EMITAPE OFFER'** *and sent, together with the coupon (or a photostat or clear, handwritten copy of same), to* **Emitape Offer, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.** *We will then process your oder and pass it on to Dindy who will send you the goods. Please allow up to four weeks for delivery.*

Send coupon to:

EMITAPE OFFER

ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011

Quantity ..... 900 x 5/825 ..... $ .....

..... 1800 x 7/825 ..... $ .....

..... 2400 x 10½/816 ..... $ .....

..... 10½" NAB reels ..... $ .....

1 - 9 tapes	$2.50	Packing & delivery: .. $ .....
10 - 29 tapes	$3.50	
30+ tapes	$4.00	TOTAL: $ .....

(Tapes can be mixed for quantity discounts)

Name .....

Address .....

..... Postcode .....

Cheque or money order .....

Or use your Bankcard 4 9 6 _ _ _ _ _ _ _ _ _ _ _ _ Expiry Date .../.../..

Signature .....

EMITAPE 816 MATT BACKED PROFESSIONAL AUDIO TAPE

The advantages of back-coated tapes — such as high spooling speeds and uniform wind under adverse conditions, together with the reduced risk of edge-damage — are already widely recognised. These advantages are frequently obtained, however, at the expense of other, no less important characteristics. The most significant adverse effects are deterioration in amplitude modulation noise, caused by imprint effect from the backing on to the oxide during storage, and a higher degree of head and guide wear.

The development of **EMITAPE 816** has been concentrated on eliminating these disadvantages while combining the benefits of matt backing with the stringent audio performance. **EMITAPE 816** is a standard play professional audio tape, its polyester base having a specially treated back coating.

EMITAPE 816 is not recommended for use on recorders using pressure pads.

AUDIO PERFORMANCE SPECIFICATION
38.1 cm/sec (15in/sec)

REFERENCE BIAS	1 dB over bias at 1 kHz (this condition is that with increase of bias current the 1 kHz output level has fallen by 1 dB from its maximum value).	
1. Sensitivity at	1 kHz	0 dB
	4 kHz	+1.5 dB
	10 kHz	+2.5 dB
	16 kHz	+4 dB
2. Bias current ratio at 1 dB over bias (at a frequency of 1 kHz)		0.87
3. Maximum Output Level for 3% third harmonic distortion at 1 kHz (Ref. 1)		+6 dB
4. Maximum Output Level for saturation at 10 kHz (Ref. 1)		+5.25 dB
7. The ratio of the 1 kHz Maximum Output Level to Bias Noise		74.5 dB full track (6.25 mm tape width)
8. The ratio of the 1 kHz. Maximum Output Level to Bias Noise		66 dB full track (6.25 mm tape width)
9. The ratio of the 1 kHz Maximum Output Level to print first pre-echo after storage for 72 hours at +20° C.		58 dB

Ref. 1 Relative to an RMS flux of 320 nWb/m tape width (32 mMx./mm.) at a frequency of 1 kHz.

Ref. 2 Measured in accordance with the paper by E.G. Trendell entitled "The Measurement and Subjective Assessment of Modulation Noise in Magnetic Recording". Journal of the Audio Engineering Society, December 1969, Volume 17, Number 6.

Tapes available
EMITAPE 825 900ft (274 m) on 5" (133 mm) reels (quantity: 800)
EMITAPE 825 1800ft (549 m) on 7" (178 mm) reels (quantity: 4500)
EMITAPE 816 2400ft (732 m) on 10½" (267 mm) metal reels with NAB hub (quantity: 1100)
Metal Reels — 10½" (267 mm) with NAB hubs; boxed.

Tapes can be mixed for quantity discounts.
These prices are around half what the tapes were selling for originally.

OFFER PRICES	1 - 9	10 - 29	30+
900 x 5, 825 tape	$3.99	$3.69	$2.98
1800 x 7, 825 tape	$6.99	$6.28	$5.88
2400 x 10½, 816 tape	$16.99	$15.27	$13.85

10½" Metal Reel — $9.97, any quantity.

Order now and ensure delivery before Christmas !
Offer closes 13 November

EMITAPE 825. LOW NOISE LONG PLAY PROFESSIONAL AUDIO TAPE

EMITAPE 825 is a low noise long play audio tape which was specially developed for professional studio mastering and broadcasting. This tape has an excellent signal to print ratio and a specially treated coating which gives extremely low head wear and low modulation noise. The wide frequency response obtainable from this tape ensures an excellent high fidelity performance when used in conjunction with any good quality tape recorder.

AUDIO PERFORMANCE SPECIFICATION

	19.05 cm/sec (7½in/sec)	9.53 cm/sec (3¾in/sec)
Recommended Bias	1 dB overbias at 1 kHz (the value of bias used by the majority of professional recording and broadcast engineers)	The value of bias current required to record a 333 Hz signal which when reproduced gives an output level of +3 dB (Ref. 1a) with a third harmonic distortion content of 5%
Frequency Response (when compared with EMI Standard Tape S.4)	Within +/−2 dB from below 31.5 Hz to 16 kHz	Within +/−2 dB from below 31.5 Hz to 16 kHz
Maximum Output Level	+3 dB (for 3% Third Harmonic Distortion at 1 kHz (Ref. 1))	+3 dB (for 5% Third Harmonic Distortion at 333 Hz (Ref. 1a))
Maximum Output Level (for Saturation at 10 kHz)	−1 dB (Ref. 1)	−7 dB (Ref. 1a)
Maximum Output Level (for Saturation at 10 kHz)	−1 dB (Ref. 1)	−7 dB (Ref. 1a)
Signal to Noise Ratio (a) Weighted in accordance with IEC 123A, BS3489-1962 (A Curve) and ASA Standard S1-4-1961 (A curve) using a measuring instrument with the same dynamic characteristic as a Standard Volume Indicator (BS3489- 1962 and ASA Standard C16-5- 1961)	66 dB (Ref. 2)	58 dB (Ref. 2a)
(b) Weighted using a filter and a quasi peak measuring instrument in accordance with DIN45405	57 dB (Ref. 2)	51.5 dB (Ref. 2a)

Ref. 1	Relative to an RMS flux of 320nWb/m tape width (32mMx/mm) at a frequency of 1 kHz.
Ref. 1a	Relative to an RMS flux of 250nWb/m tape width (25mMx/mm) at a frequency of 333 Hz.
Ref. 2	The ratio of the 1 kHz Maximum Output Level to Bias Noise.
Ref. 2a	The ratio of the 333 Hz Maximum Output Level to Bias Noise.
Note	The figures quoted are mean values and subject to manufacturer's tolerances.

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And that's just one of the beauties of being with AGC.

We also offer you an easy Pay-by-the-Month Car Insurance.

And we have a no-claim bonus that reaches 60% in just four years and you do not lose all that bonus for one claim.

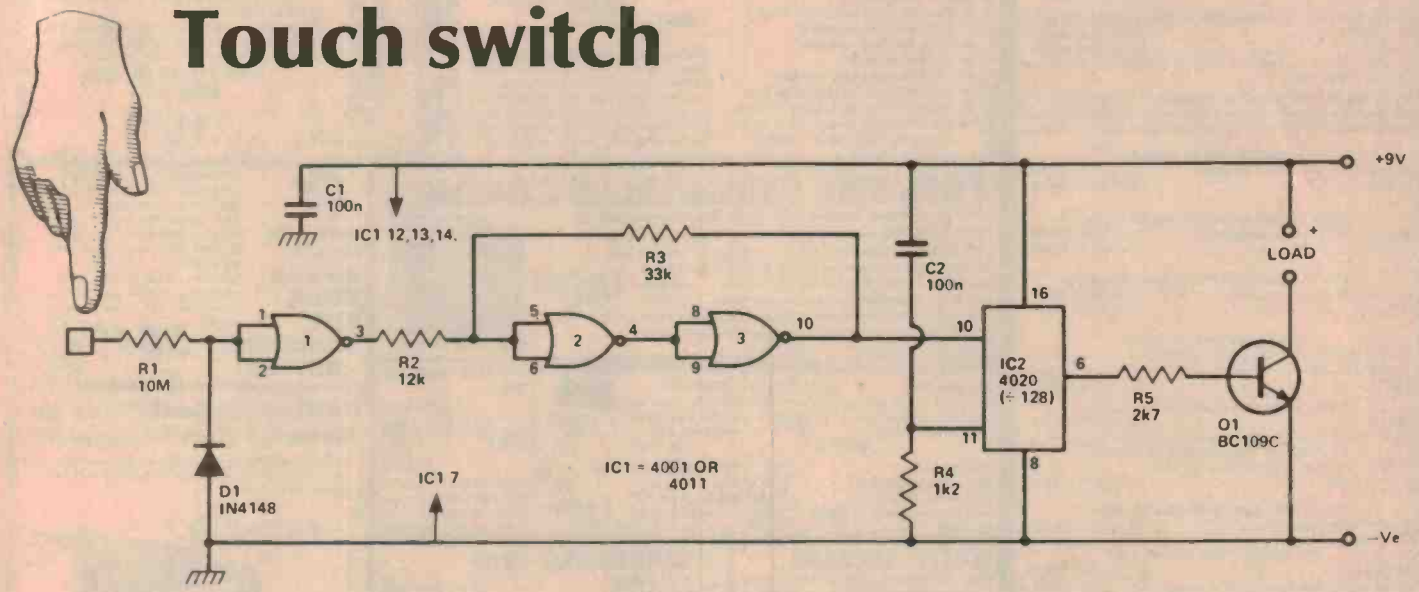
The more you think about it, the more AGC leaves the others behind.

Sydney: Phillip & Hunter Streets.
Melbourne: 31 Spring Street.
Brisbane: Tank Street & North Quay.
Adelaide: 10 Pulteney Street.
Perth: 165 Adelaide Terrace.
Hobart: 161 Collins Street,
and offices throughout Australia.

AGC (Insurances) Limited.
A division of Australian Guarantee Corporation Limited.

AGC991 FCB

Touch switch



THIS TOUCH SWITCH is designed to provide on/off switching for 9 V battery operated equipment having a current consumption of up to 100 mA. It has a single touch contact which is briefly touched in order to change from on to off or vice versa. The circuit is operated by stray pick-up of mains hum which is coupled to the input of Gate 1 (which, like the other three gates employed in the unit, is connected to act as an inverter) via R1 when the input contact is touched.

As IC1 is a CMOS device it has a very high input impedance, and the input signal will be capable of switching the Gate 1 input from one logic state to the other. The input impedance of the circuit is so high that the reverse resistance of D1 is used to tie the input to earth under quiescent conditions, so as to prevent spurious operation. Resistor R1 acts as a low pass filter in conjunction with the input capacitance of the circuit, and this attenuates high frequency noise which may be present on the 50 Hz mains signal.

The output from Gate 1 still contains significant noise products, and also has a rise time which is inadequate to drive the final stage of the circuit. This is overcome by a trigger circuit using Gates 2 and 3. Resistor R3 tends to hold Gate 2 input in the same state as Gate 3 output, resisting any change in logic state caused by Gate 1 output due to the coupling through R2. This resistance to change is termed 'hysteresis'. Resistor R2 has a lower value than R3, and so Gate 1 can operate the trigger circuit if its output signal is of adequate amplitude. The 50 Hz signal will be strong enough, but the noise spikes will not and are thus eliminated from the output of the trigger.

Once the output of the trigger does start to change state, the coupling through R3 provides a triggering action which ensures a rapid change.

IC2 is a 14 stage binary counter and Q1 is driven from the output of the seventh stage via a current limit resistor, R5. The C-R network consisting of C2 and R4 provides a positive reset pulse to the counter at switch on so that the outputs are all low and Q1 is switched off.

The controlled equipment forms the load for Q1 and obviously receives no significant power. If the touch contact is operated, a 50 Hz signal is fed to IC2 and the seventh stage output changes state every 64 pulses. As this output goes high and low the load is switched on and off. In practice the contact is touched just until the unit switches to the desired state (which one tends to do automatically).

The unit consumes only about one microamp in the "off" mode and approximately 3 mA in the "on" state.

A suitable relay may be used as the load, its contacts may then be used to control mains-operated equipment.

SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.

PARTS FOR NEW KITS

If a kit you want to build is not listed, the parts may be available anyway. Check the Dick Smith Catalogue or call in to your nearest Dick Smith store.

ACOUSTIC COUPLER (See EA September)
Complete kit, including metalwork, etc. . . . Cat K-3605 $75.00
Printed Circuit Board only . . . . . Cat H-8380 $4.00

EXPANDED SCALE AUTOMOTIVE VOLTMETER (See ETI Sept.)
Printed Circuit Board . . . . . Cat H-8630 $1.50
LM3914 IC . . . . . Cat Z-6295 $4.25
Choose round or rectangular, large or small LEDs to suit your particular application.

(Above kits are from magazines' forecasts. We will endeavour to have these kits on sale when the magazines are released; however, delays can occur! Please enquire at your nearest Dick Smith Store).

CHASER (See EA August)
Complete kit, including front panel . . . . . Cat K-3145 $69.50
PCB only . . . . . Cat H-8379 $6.95

NASA POWER CHOPPER (See EA August)
Short form kit (All components & PCB) . . . . . Cat K-3325 $16.50
PCB only . . . . . Cat H-8378 $3.00

LEDS AND LADDERS GAME (See EA August)
Complete kit inc. printed panel . . . . . Cat K-3390 $15.75
PCB only . . . . . Cat H-8378 $3.00

LED TACHO (see ETI August)
Short Form Kit (includes PCB components etc. but no case – build it into your dash board). . . . . Cat. K-3240 $24.50

FAST NICAD CHARGER (See ETI August)
PCB only . . . . . Cat H-8627 $3.00
(All other components in this kit are normal stock lines)

GUITAR/PA PREAMP (See ETI August)
Short form kit PCB & components, no transformer or case). . . . . Cat K-3035 $29.50

300 WATT AMPLIFIER (See EA June)
Printed Circuit Board only. . . . . Cat H-8376 $9.95
(Most other components are normal stock lines).

TV CRO ADAPTOR (See EA May)
Complete Kit . . . . . Cat K-3060 $29.95
Printed Circuit board . . . . . Cat H-8375 $3.75

EA'S NEW ACOUSTIC COMPUTER COUPLER:

We've lost count of the number of customers who have asked for this project: well here it is! This acoustic coupler acts like a modem without any physical connection to the phone lines. It uses your standard telephone handset, placed over a small microphone and speaker in the coupler case, and transfers the information from your computer by sound. Hence the name, acoustic coupler. Now you can have your computer talk to another across the street, across the town – even across the country (or further). It is a must for all serious computer users, and we hope to release the kit by the time this magazine is published.

KIT ONLY $75.00
Cat K-3605

SPECIAL OFFER FOR PROJECT BUILDERS

BUY A SHEET OF RED SCOTCHCAL AND WE'LL GIVE YOU A BOTTLE OF DEVELOPER FOR NO EXTRA CHARGE!

Red Scotchcal (H-5692) $8.00
Developer (H-5696) $1.00
YOU PAY: $6.00

Have you found out how easy 'Scotchcal'™ is to use? And how it makes very professional front panels for all your projects?
All you do is make up artwork (with ink, 'Letraset', etc), expose the Scotchcal™ to UV light (eg the sun) and develop it with Scotchcal developer. It's that easy!
We're sure there are many hobbyists who haven't found out about Scotchcal™ yet – so to introduce it to you, we're making a special offer: buy a sheet of Red Scotchcal for the normal price, and we'll throw in a bottle of developer as a bonus!
Each sheet of Scotchcal comes complete with instructions for making your own front panels and labels, easily & quickly!

HERE IT IS: THE NOVA 80

ONLY $399.00
Cat K-3600

You'll find full details of this exciting new computer beginning in the October issue of Electronics Australia. But to whet your appetite, check this out:

- Powerful BASIC interpreter included
- Z-80 based microprocessor
- Up to 48K RAM on-board!
- S-100 compatibility
- Full 63 key keyboard 'on board'
- Both RF and Video outputs 'on board'
- Extremely reliable cassette interface
- All components (except power transformer) 'on board': simple assembly!

We're very excited about this dramatic new breakthrough in home computers. A really professional quality design, with the incredible versatility only S-100 can give you. If you've been putting off buying a home computer, lucky you: now you can build your own at a fraction of the cost of built-up models! (Full, explicit instructions supplied). Check out the Nova 80: you won't be disappointed!

LEDS AND LADDERS GAME (See EA August): New, up-graded circuit is $1 cheaper than it was 4 years ago!!!

One of our most popular kits of the past was the intriguing 'LEDS AND LADDERS' game described in Electronics Australia in 1975. Now EA have come up with a new version of the game which is not only easier to build, it is also easier to play! Can you climb out of the well without being plummeted down again?
And the best news of all: this kit is actually $1.00 cheaper than it was in 1976 – despite four years of inflation! Hurry while this low price lasts!

WAS $16.75 IN 1976
NOW ONLY
$15.75!
Cat K-3390

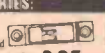
FOIL THE CHRISTMAS CROOKS!

Statistics show most robberies occur around Christmas time. Foil the felon's filching this festive funtime: install a burglar alarm now and be really protected! (Don't put it off: you could be next on their list!)
This outstanding new Dick Smith two sector composite alarm module is made right here in Australia! It features very high reliability – a completely professional quality system for the home handyman to install. Entry and exit times are variable to comply with various state noise pollution laws; system gives positive indication of 'seal' by LEDs. Accepts all types of alarm triggering devices; both normally open and normally closed.

$49.50
Cat L-5055

ALARM ACCESSORIES:

REED SWITCHES: Twin set of magnet and reed switch. Wire them into windows and doors for protection. $1.95 Cat L-5210



PRESSURE MAT Hide under carpets, mat etc. Pressure of person walking sets it off. $14.95 Cat L-5270

HORN SPEAKER: Highly efficient horn plugs into alarm module. Mount under eaves for distant warning. $9.50 Cat C-2705

GLASS BREAKAGE DETECTOR Sticks to glass, responds only to sound of glass actually breaking. Easy to install. $29.50 Cat L5230

PROTECT YOUR CAR, TOO . . .

$49.50
Fully integrated car protection with alarm & horn unit in one. Current sensing system: no external switches. Cat L-5090

MORE OF DICK'S BONZA BULK BUY BARGAINS – BEWDY!

Well, actually it's more of a stuff-up than a bulk buy! We ordered the wrong switch: so we've slaughtered the price just to get rid of them! It's a five position single pole rotary switch, selling for just 55 cents: that's nearly $1.00 under normal price!
Remember, you can use a five position switch as a one, two, three and four position, too: just ignore the other positions!

55¢!
Cat S-3215

WOTTA BARGAIN!

We've just bought a HUGE shipment of these incredibly popular push button telephone dials in – so our cost has dropped. You reap the benefit of Dick's huge bulk buying power!
Simply substitute for any rotary dial. Although these units fit perfectly into standard Aust. phones (no soldering required) current regulations do not allow you to use them for this purpose.
Cat X-1175
NOW: $39.50

$49.50

INCREDIBLE CRO VALUE!

Since this superb CRO was released we've sold hundreds: it offers the hobbyist incredible value for money! A useable response up to 5.5MHz, plus a range of controls which make it easy to drive – you'll wonder how you got along without a CRO for so long! Check it out at your nearest Dick Smith store soon. It's worth it!
Cat Q-1280

ONLY $199.00

NEED A SAFE AC SUPPLY FOR YOUR PROJECTS?

How about 12 volts at 500mA!!!!

$9.50
Most plug-packs give you around 200mA. This one gives 500mA! The reason: it is ALL transformer. You put the rectifiers, capacitors, etc, in the project, and plug in the AC supply. It's a great space saver!
Cat M-9555

ADAPT IT!

This snazzy plug converts banana sockets into a BNC type socket. Suits above CRO, lets you use many more accessories.
$9.50 Cat Q-1281

PROBE IT!

Make your job easier with this versatile probe set. Has 3 position slide switch and 1.5m cable. Complete with all accessories. Great value!
$34.50 Cat Q-1245

NEW! AF & RF WIDEBAND SIGNAL GENERATOR

Here's a great new test instrument for the hobbyist and the professional. It's a wideband AF & RF signal generator, offering sine and square wave capability from 18Hz to 200MHz in 6 ranges (AF is 18Hz to 220kHz; RF is 100kHz to 50MHz on 6 fundamental bands and 50MHz to 200MHz on fundamentals). It is all transistorised, compact and light weight – making it ideal for bench work or for the serviceman's toolbox. 240 volts AC operated.

ALL THIS FOR ONLY $149.50
Cat Q-1305

EVER WONDERED WHERE TO BUY AN AUSSIE FLAG?

$9.95
Cat X-1001

Dick couldn't buy an Aussie flag. So he thought 'I'll cure that problem!' Now Dick sells Aussie flags, so every true blooded, dinky-di Aussie can buy their very own Aussie flag to raise up the flagpole every morning. These are the small economy size, (about 1 metre long). Just imagine: the only house on the street with your own flag!
Special note for Pommies: Buy the flag, cut out the corner and you'll have your own personal size flag to remind you of home!

MAJOR DICK SMITH RE-SELLERS:

Listed below are re-sellers who stock a large proportion of our range. However, we cannot guarantee that they will have any or all of the items, or at the same prices, as those advertised on these pages

ATHERTON, QLD: Tableland Radio Service 2 Jack Street. Phone 912 017
BAIRNSDALE, VIC: Odyssey Electronics 101 Main Street. Phone 525 262
BENDIGO, Vic: Sumner Electronics 95 Mitchell Street. Phone 431 977
BLACKHEATH, NSW: Goodwin Electronics 123 Stellon Street. Phone 878 379
BROKEN HILL, NSW: Crystal TV Rentals 66 Crystal Street. Phone 6897
COFFS HARBOUR, NSW: Coffs Harbour Electronics 3 Coffs Harbour Plaza, Park Ave. Phone 525 684
DARWIN, NT: Kent Electronics 42 Stuart Highway. Phone 816 749
FAIRY MEADOW, NSW: Trilogy Wholesale Elect. 40 Princes Hwy. Phone 831 219
GEELONG, VIC: Electrofix 333 Malop Street. Phone 87 827
GERALDTON, WA: KB Electronics & Marine 361 Main Terrace. Phone 212 178
GOSFORD, NSW: Tomorrow's Electronics & Hi Fi 58 William Street. Phone 247 246
HOBART, TAS: Aero Electronics 123a Bathurst Street. Phone 348 232
KINGSTON, TAS: Kingston Electronics & Records Channel Court. Phone 298 802
LAUNCESTON, TAS: Advanced Electronics 5a The Quadrant. Phone 317 075
LISMORE, NSW: Oecro Electric Cnr Magellan St & Brunner Hwy. Phone 214 137
MACKAY, QLD: Stevens Electronics 42 Victoria Street. Phone 511 723
MARYBOROUGH, QLD: Keller Electronics 218 Adelaide Street. Phone 214 559
MORUYA, NSW: Coastal Electronics 43 Vulcan Street. Phone 742 545
MT GAMBIER, SA: Hutchesson's Communications 5 Elizabeth Street. Phone 256 404
MUSWELLBROOK, NSW: Silicon Chip Electronics Suite 3, 98 Bridge Street. Phone 43 1096
NAMBOUR, QLD: Nambour Electronic Shop Shop 4, Lowen House, Ann St. Phone 411 604
NEWCASTLE, NSW: Elektron 2000 181 Wharf Road. Phone 282 644
NOWRA, NSW: Lyrebird Electronics 50 Berry Street. Phone 25 525
ORANGE, NSW: M&W Electronics 48 McNamara Street. Phone 626 491
ROCKHAMPTON, QLD: Purely Electronics 15 East Street. Phone 21 058
SOUTHPORT, QLD: Amateur's Paradise 121 Nerang Street. Phone 322 644
SURFERS PARADISE, QLD: Viking Electronics 3108 Gold Coast Hwy. Phone 322 644
TAMWORTH, NSW: Sound Components 78 Brisbane Street. Phone 661 363
TOOWOOMBA, QLD: Hunts Electronics 18 Neil Street. Phone 328 544
TRARALGON, VIC: Power'N'Sound 15 Franklin Street. Phone 743 638
VINCENT, QLD: Tropical TV 249 Fulham Road. Phone 791 421
WAGGA, NSW: Wagga Wholesale Electronics 82 Forsyth Street.
WALGETT, NSW: P.J. O'Brien Electronics 82 Wee Wee Street. Phone 243
WINDSOR, NSW: Hawkesbury Electronic Centre 111 George Street. Phone 773 611
WODONGA, VIC: A & M Electronics 78a High Street. Phone 244 508
WHYALLA NORRIE, SA: Mellor Enterprises Shop 2, Forsythe Street. Phone 454 764

BUYING BY MAIL?

ORDER VALUE:	P&P
$5 (min) to $9.99	$1.00
$10.00 to $24.99	$2.00
$25.00 to $49.99	$3.00
$50.00 to $99.99	$4.00
$100 or more	$5.50

NOTE: These charges apply to goods sent by post in Australia only. Large and bulky items cannot be sent by post.
If you prefer, we will despatch your order by Comet Road Freight to anywhere in Australia for only $6.00 – that's below what it costs us! Large and bulky items are normally sent by Comet unless you specify differently (eg by rail or air – you pay freight on delivery.)

DICK SMITH ELECTRONICS

MELBOURNE

399 Lonsdale Street
Ph (03) 67 9834

RICHMOND

656 Bridge Road
Ph (03) 428 1614

BURANDA

166 Logan Road
Ph (07) 391 6233

CHERMSIDE

842 Gympie Road
Ph (07) 59 6255

CANBERRA

96 Gladstone Street
Ph (062) 80 4944

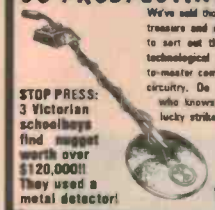
ADELAIDE

60 Wright Street
Ph (08) 212 1962

PERTH

414 William Street
Ph (09) 328 6944

PLANNING SUMMER HOLIDAYS?
GO PROSPECTING . . . ELECTRONICALLY!



STOP PRESS: 3 Victorian schoolboys find nugget worth over $120,000!! They used a metal detector!

We've sold thousands of these . . . this amazing discriminator treasure and metal locator actually uses a microprocessor to sort out the treasure from the trash! This incredible technological breakthrough means that most of the hard-to-master controls are gone: they're replaced by automatic circuitry. Do something different on your next holiday: who knows: you could pay for your trip with your first lucky strike!

$99.00 Cat. X-1065
WAS $125.00!

Cat. B-4525

DON'T KNOW ANYTHING ABOUT PROSPECTING? This book is for you . . . Tells you just about everything you need to know: where to go, what to look for, what to do when you get there . . . It's up-to-date and it's authoritative.

$1.95

BUY NOW AND BEAT THE SUMMER PRICE RISE!

ELECTRONICS FOR YOUR CAR . . .

DON'T LEAVE YOUR LIGHTS ON!

There's nothing more annoying than finding you've left your lights on and . . . flat battery! Solve the problem: fit this light reminder. Gives ten second warning after you turn the ignition off if lights are still on. Easy installation.

$4.50 Cat. A-8509

'INDY' IGNITION

Fit one of these beauties and notice the difference. Keeps your car in tune longer, therefore you save money on fuel! Incredible performer.

$29.95 Cat. A-8530

X & K BAND RADAR DETECTOR

$89.50

Amazing sensitivity. Both the usual X band and the new K band detection, easy installation. Positive warning, both audible and visual. Exclusive to Dick Smith, a must for every conscious driver. Cat A-8504

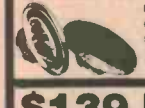
FM AM CASSETTE

Move your car sound into the 80's with this superb FM/AM/Stereo cassette. Fits into normal car dash cut-outs, gives superb performance on radio or tape. Speakers not included. Cat A-6480

$149.00

QUALITY CO-AX SPEAKERS

$39.50 pr



Or a set of dual cone speakers. For the budget conscious who still want their car speakers to sound as good as possible. Easy installation.

$29.90 pr Cat. A-7080

- QUALITY
- PRICE
- VALUE!

That's what you look for in a cassette tape. You can't have value without high quality, or a bargain price. Most often, you have to settle for one or the other. Dick Smith cassettes

		10 OR MORE:	
C60	LOW NOISE	$1.50	C-3350 $1.00
C90	low noise	$2.00	C-3352 $1.20
C90	Extended dynamic range	$2.75	C-3354 $1.90

SPRING INTO SPRING!

To celebrate the arrival of spring, our handy spring pack has been slashed! 1/3 off springs that will last you for all seasons. Just because it's spring!

NOW 1/3 OFF!!! NORMALLY $2.95; FOR 1ST MONTH OF SPRING ONLY $1.95!!!

Cat H-1890

TWO OUTSTANDING AUDIO BARGAINS:

GRAPHIC EQUALIZER WITH LED LEVEL DISPLAYS

Music sound a little dead? Liven it up with a graphic equalizer! This outstanding unit features twin LED VU meters, too! You really won't believe the difference a graphic equalizer can make to your sound system until you try one!

Cat. A-1850

$169.00

DIRECT DRIVE TURNTABLE! UNDER $200.00!!!

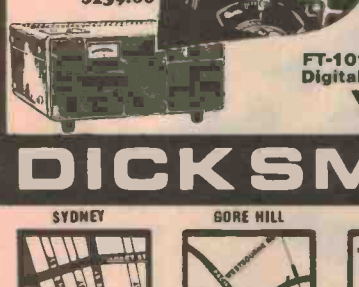
Incredible! A true direct-drive turntable offering outstanding performance, housed in deluxe plinth with clear acrylic cover and complete with a Shure magnetic cartridge — and it is less than $200!!! If you are after the ultimate for your records but have a limited budget, this fits both requirements. Check one out at your nearest Dick Smith store: you won't be disappointed!

Cat. A-3078

$199.00

$139 DIGITAL DISPLAY BONUS WITH EVERY YAESU FT-101Z!!

ADD-ON DIGITAL DISPLAY KIT IS ALSO AVAILABLE FOR EXISTING FT-101 CONVERSIONS: Cat D-2861 $139.00



YES! With every FT101Z, we're including a digital frequency display kit, normally worth $139.00, at no extra charge! It's a simple 'drop-in' replacement display, any ham can install it in an hour or so. Full installation instructions are included. You know how good the FT-101Z is: now it is even better: it becomes an FT-101ZD for the same price! Offer is open strictly while current stocks last: be quick for this bargain.

FT-101Z (Cat D-2862): $775.00
Digital Disp. (D-2861): $139.00
YOU PAY: $775.00

COMING SOON!

3 CHANNEL PROPORTIONAL RADIO CONTROL SYSTEM

UNDER $100!!!

Imagine! A three channel, fully digital proportional radio control system under $100!!! Yes, you get the three channel transmitter, receiver, battery holder with on/off switch PLUS three servos, all for the one low price. It's ideal for model planes, boats, cars, etc etc etc — and the frequency can be changed by simply plugging in alternate crystals! Two of the channels even have a 'pre-set' control for trimming, etc. What a beauty!

$99.00 Cat. X-1230

COMPARE SIMILAR MODELS SELLING FOR $150 AND MORE!
DUE IN STOCK SOON*
DELIVERY EXPECTED MID — END SEPTEMBER. WORTH WAITING FOR!

GO-ANYWHERE STEREO CASSETTE WITH AM & FM

Superb quality, superb performance . . . This super sound centre has AM, FM and stereo cassette; goes anywhere (battery, mains or car battery adaptor operation). Yes, you can record 'off-air' if you wish. It has a huge 5 watt output, and you can plug in external speakers for even wider stereo separation if you wish. For full specifications see page 13 of the Dick Smith 1980 catalogue.

$129.95 Cat. A-4020

A GOOD CASE FOR BUILDING PROJECTS

FOR SMALL PROJECTS

Superbly made folded aluminium cases in a variety of sizes; fitted with rubber feet and have ventilation slots. Look really great!

SIZE	CAT	1-9	10 up
102 x 56 x 83	Cat H-2741	$2.75	$2.55
150 x 81 x 103	Cat H-2742	$4.35	$3.95
150 x 78 x 143	Cat H-2743	$4.90	$4.40
184 x 70 x 160	Cat H-2744	$5.45	$5.00

FOR MEDIUM PROJECTS

Here's a bargain! This passivated steel case with vinyl covered lid was selling for almost $11! Suits variety of projects, holes suit 'Musicolor' but add your own dress panel and it suits anything! Size is 250 x 200 x 80mm. Cat H-3160

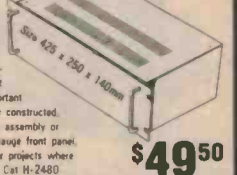
$7.95

FOR LARGE PROJECTS

Or this one: made for the 'Playmaster' amplifiers, size is a whopping 270 x 250 x 80mm. Holes for pots, switches, terminals, etc. Was $12.50 Cat H-3110

$9.95

FOR HUGE PROJECTS



A standard 19" rack-mounting case to suit those really big, important projects. Very sturdily constructed, comes apart for easy assembly or service. Very heavy gauge front panel. A top quality case for projects where quality is important! Cat H-2480

$49.50

BUILD A KIT:

It's simple and it's FUN. Quality Dick Smith kits, complete with instructions to make electronics really enjoyable!

AUDIO MIXER KIT

$49.50

Here's a great kit for the audio buff: a 'universal' mixer designed to do those jobs the others can't — for example, sound on home movies! Professional quality with autofade, tone controls & VU meter. Cat K-3492

MORSE KEYER

For all hams or would-be-hams! This kit includes paddle & all components, inc. case (panel is not marked). Variable speed in correct proportion, inbuilt oscillator. Suits most transceivers. Cat K-3470

$39.50

MORSE CODE TRAINER

$5.90

Easy-to-build Morse Code trainer has code printed on front; battery operated. Key not supplied in kit. Cat K-3472 (battery extra)

BUDGET MORSE KEY AVAILABLE: Cat D-7105; only $1.95. Ideal for trainer.

We're often asked which of the electronics and computer magazines we have available. All of the following are normally stock; however some (especially overseas) magazines are in very limited quantities. Check with your nearest store.

Cat No:	Title	Price:
B-5010	Electronics Australia	$1.60
B-5015	Electronics Today Int.	$1.60
B-5030	Everyday Electronics (UK)	85¢
B-5032	Practical Electronics (UK)	95¢
B-5040	Wireless World (UK)	$2.00
B-5044	Amateur Radio Action (Aust)	$1.30
B-5050	QST (USA)	$2.90
B-5059	Australian Personal Computer	$1.95
B-5061	Byte (USA)	$2.95
B-5062	Micro 80 (Aust)	$2.50
B-5064	80 Microcomputing (USA)	$2.50
B-5065	Kilobaud (USA)	$2.95
B-5068	Creative Computing (USA)	$2.95
B-5071	Popular Electronics (USA)	$1.25
B-5074	Radio Electronics (USA)	$1.65
B-5075	Scientific American (USA)	$2.65
B-5080	Popular Science (USA)	$2.00
B-5090	Elektor (UK/Europe)	$1.50

PLEASE NOTE: Above magazines are not available from our Mail Order Centre.

Dear Customers . . .

Quite often, the products we advertise are so popular they run out within a few days. Or unforseen circumstances might hold up goods so that advertised lines are not in the stores by the time the advert appears. Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, or even locate a shipment that has gone astray.

What we are trying to say is that, if you're about to drive across town to pick up a particular line at a Dick Smith store, why not give the store a ring first (addresses & phone numbers below) . . . just in case! Thanks.

Dick Smith and Staff

FREE CATALOGUE

(Offer expires September 30, 1980)

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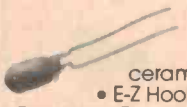

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Expanded-scale LED voltmeter has wide application

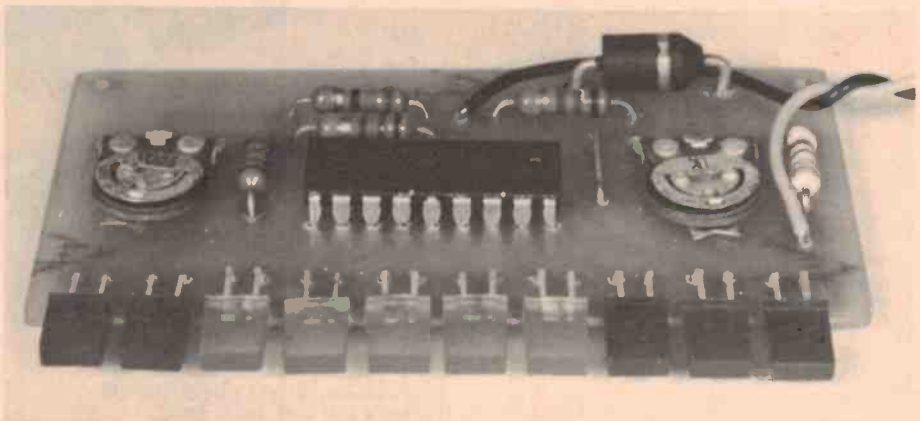
Phil Wait
Simon Campbell

One of the most useful monitors of battery 'condition' is an expanded scale voltmeter. This novel, but nonetheless useful, project should find applications in vehicles, battery chargers etc.

THE 12 V BATTERY, in its many forms, is a pretty well universal source of mobile or portable electric power. There are lead-acid wet cell types, lead-acid gel electrolyte (sealed) types, sealed and vented nickel cadmium types, and so on. They are to be found in cars, trucks, tractors, portable lighting plants, receivers, transceivers, aircraft, electric fences and microwave relay stations — to name but a few areas.

No matter what the application, the occasion arises when you need to reliably determine the battery's condition — its state of charge, or discharge. With wet cell lead-acid types, the specific gravity of the electrolyte is one reliable indicator. However, it gets a bit confusing as the recommended electrolyte can have a different S.G. depending on the intended use. For example, a low duty lead-acid battery intended for lighting applications may have a recommended electrolyte S.G. of 1.210, while a heavy-duty truck or tractor battery may have a recommended electrolyte S.G. of 1.275. Car batteries generally have a recommended S.G. of 1.260. That's all very well for common wet cell batteries, but measuring the electrolyte S.G. of sealed lead-acid or nickel-cadmium batteries is out of the question.

Fortunately, the terminal voltage is also a good indicator of the state of charge or discharge. In general, the terminal voltage of a battery will be at a defined minimum when discharged and rise to a defined maximum when fully charged. Under load, the terminal voltage will vary between these limits, depending on the battery's condition.



The completed voltmeter. LED1 (10.5 V) is on the right and LED10 (15.0 V) is at far left.

Hence, a voltmeter having a scale 'spread' to read between these two extremes is a very good and useful indicator of battery condition. It's a lot less messy and more convenient than wielding a hydrometer to measure specific gravity of the electrolyte!

Let's look at battery characteristics, before we get into the project's circuitry, to get an understanding of what the project can do.

Lead-acid batteries

The fully-charged, no-load terminal voltage of a lead-acid cell is between 2.3-2.4 volts. This drops under load to about 2.0-2.2 volts. When discharged, the cell voltage is typically 1.85 volts. The amp-hour capacity is determined from a 10 hour discharge rate. The current required to discharge the battery to its end-point voltage of 1.85 V/cell is multiplied by this time; e.g: a 40 AH battery will provide four amps for 10 hours before requiring recharge. Note however that the amp-hour capacity varies with the discharge current. The same battery discharged at a rate of 10 amps will not last four hours, on the other hand if it is discharged at 1 amp it will last somewhat longer than 40 hours. The typical discharge characteristics of a (nominal) 12 V battery are shown in Figure 1.

The initial charging current for the fully discharged battery (cell voltage under 2.0 V), should be about 20 amps per 100 amp-hours of capacity (i.e: 8 amps for a 40 AH battery). Once the electrolyte begins to gas rapidly, the terminal voltage will be around 13.8 volts and rising rapidly. At this point, the charging current should be reduced to somewhere between 4-8 amps per 100 AH until charging is complete.

At the end of charging, terminal voltage may rise to about 15.6 volts or

more but this decreases slowly after the charger is removed, the terminal voltage then usually reading around 14.4 volts per cell (see Figure 2.).

NiCad batteries

The no-load terminal voltage of a nickel-cadmium cell is typically 1.3-1.4 volts. This drops to about 1.2 volts under load, and to about 1.1 volts when discharged. As the electrolyte does not change during discharge (as it does in lead-acid batteries), the number of amp-hours obtained from a Nicad battery is much less affected by the discharge rate than are lead-acid batteries (see Figure 3.). Ten individual cells are generally used to obtain 12 V.

A number of charging systems can be used to replenish the charge in NiCad batteries. Constant current chargers are well known and quite common (such as the ETI-578 in the June 1980 issue). Fast charging at a high rate, as illustrated in the ETI-563 Fast Charger, is another method while some commercial manufacturers (Christie Electric Asia, for example) employ the "reflex" technique — the battery is alternately charged and discharged at a high rate over a short period. Increased battery life and extremely rapid charging are the claimed features of this method.

The typical charging characteristics of a single cell are illustrated in Figure 4.

For more details on lead-acid and nickel-cadmium batteries, see "Batteries" in ETI, November 1977.

The voltmeter

This voltmeter uses ten LEDs to provide an 'expanded' voltage scale over the range 10.5 V to 15 V to suit applications with 12 V (nominal) batteries. Heart of the device is an LM3914 LED bargraph driver chip. In this application, we are using it in the 'dot' mode to provide an unambiguous display. The IC has been connected in this circuit such that the first LED (LED1) lights at 10.5 V, the second at 11.0 V and so on at 0.5 V intervals up to 15 V at LED10. Red LEDs have been employed at the extremes of the range to indicate 'problem' conditions. The first three LEDs, covering 10.5 - 11.0 - 11.5 volts, are red to show the discharge condition, while the last two LEDs, covering 14.5 and 15.0 volts, are also red to indicate the overcharge condition. The LEDs covering the 12.0 to 14.0 volts range are all green showing that the battery's within its normal operating voltage range.

An 'idiot' diode (ZD1) and a line fuse protect the instrument in the event of reverse connection or an over-voltage condition. Should the unit be inadvertently wired in reverse polarity, ZD1 will conduct in the forward direction and the line fuse will blow. If a voltage greater than 18 V is applied, which may happen if the unit is installed in a car and a battery terminal comes loose allowing the alternator voltage to rise, then the zener action of ZD1 will cause the line fuse to blow, preventing too high a supply voltage from destroying the unit. ▶

VEHICLE BATTERY FAULTS

Symptom	Probable cause
☆ Voltage falls rapidly to low end of green after engine is switched off.	Battery in poor condition or possibly faulty. Check terminals for good connection.
☆ Battery voltage falls considerably overnight	ditto
☆ Voltage falls rapidly from high end of green to low end if lights switched on with engine off.	ditto
☆ Voltage falls more than about one volt when lights are switched on with engine running at moderate speed	Charging system may be supplying low current. Check alternator slip rings, diodes and regulator adjustment. Check battery terminals.
☆ Voltage rises over 14.5 V (LED9) when engine running	Charging system may be overcharging. Check regulator voltage adjustment.
☆ Voltage never rises to top end of green (LED8).	Charging voltage too low. Adjust regulator voltage.

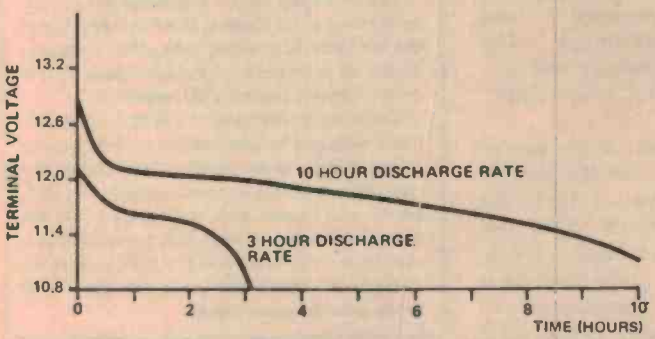


Figure 1. Typical discharge characteristics of a 12 V (nominal) lead-acid battery.

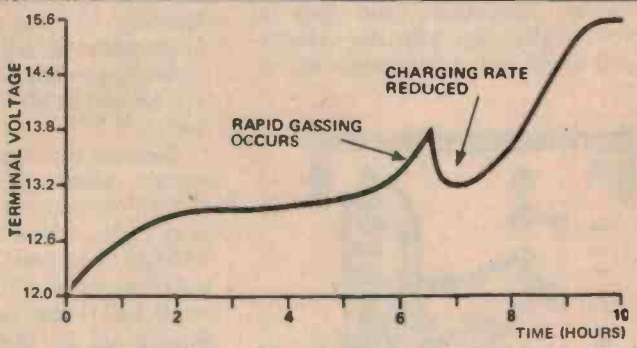


Figure 2. Charging characteristics of a 12 V (nom.) lead-acid battery. The 'kink' in the curve near 6 hrs is explained in the text.

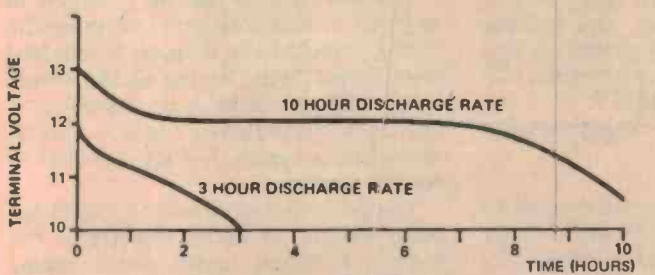


Figure 3. Typical discharge characteristics of a 12 V (nom.) nickel-cadmium battery (usually consisting of 10 cells in series).

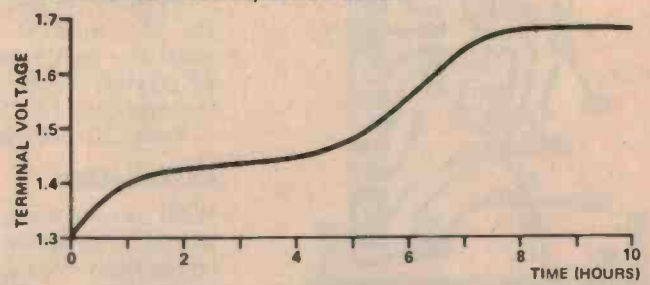


Figure 4. Typical charging characteristics of a single nickel-cadmium cell charged at 1.4 times the discharge rate.

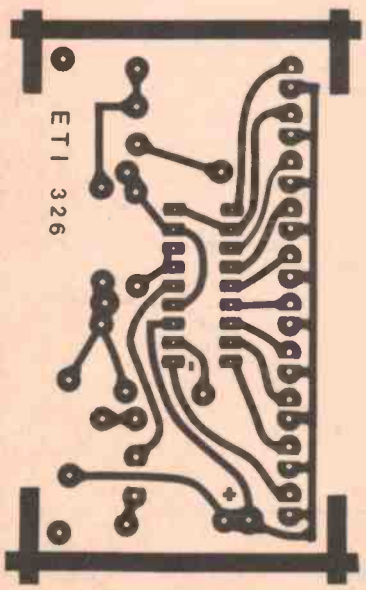
Construction

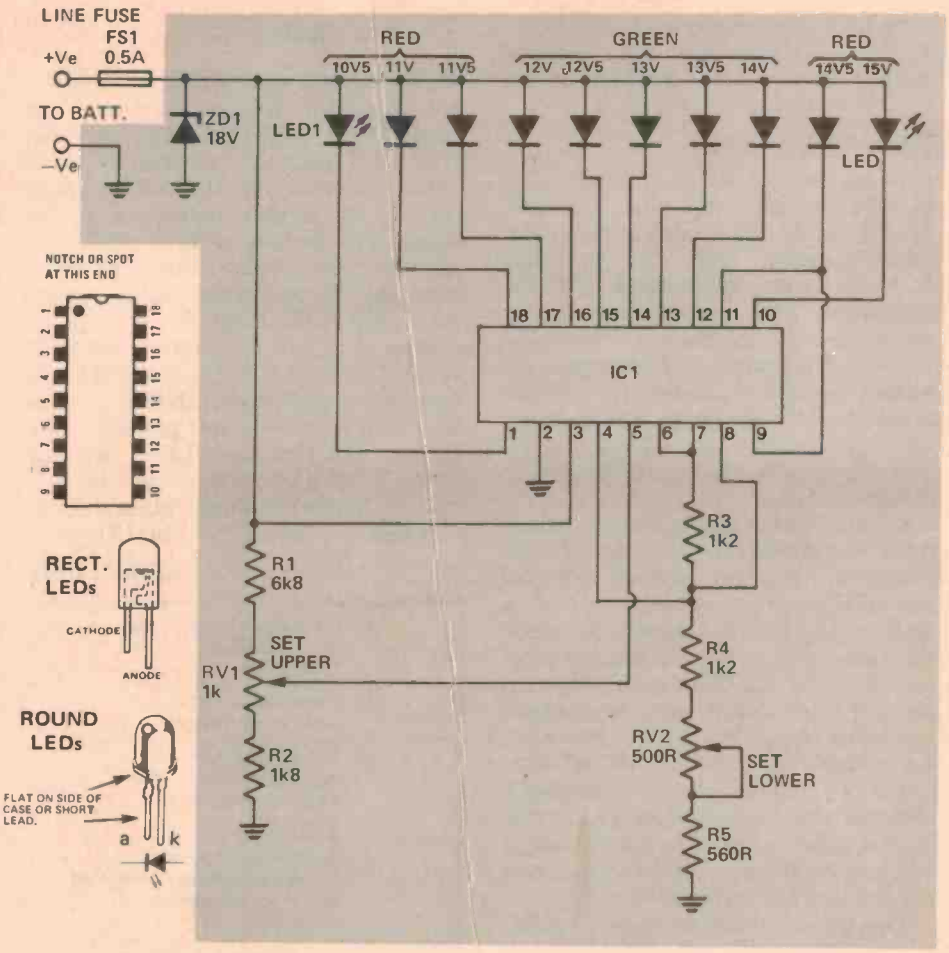
Assembling the project is extraordinarily simple! We recommend you use the printed circuit board — it does make things easier and helps avoid mistakes, although it is not essential.

As with our LED Tacho (ETI-324) we have used rectangular LEDs and mounted them in a row down the front of the pc board. The components may be mounted in any order, but you might find it easier with this project to mount the LEDs first. It is *most important* that they be placed in the board the right way round. About the best way to ensure this is to place them on the table or workbench in front of you with all their leads correctly oriented, just as they would be when mounted in the board. Refer to the overlay and you can't go far wrong. The hard part is getting them all level! Starting at LED1 or LED10 — it doesn't matter which, insert its leads in the board and then bend it over such that it lies flat on the board with the base of the LED flush with the edge of the board. This is clear from the overlay picture. Solder the leads and bend the LED back upright. Insert the next LED carefully positioning it so that it is flush with the first LED and solder its leads. Proceed like this until all the LEDs are in place and then bend the whole row over, parallel to the board.

Note that, although we have used rectangular LEDs, conventional types may also be employed.

If you haven't already done so, the rest of the components may now be mounted. Take care with the orientation of the LM3914 and the zener diode.





Setting the scale limits

To set the scale limits, you will need a variable power supply capable of delivering 15 volts and perhaps a good multimeter or digital voltmeter — the latter is preferable. Whatever you use, you should be able to read it reasonably well to 0.5 V.

Connect the instrument to the power supply (watch polarity), set the supply to 15 V and switch on. Any of the LEDs may light. Adjust RV1 until LED9 just extinguishes and LED10 lights. Next, set the supply to 10.5 V and adjust RV2 until LED1 just lights. Run the power supply up to 11.0 V and check that LED2 lights and LED1 goes out.

As there is some interaction between the two controls, repeat the process until the unit performs properly. The LEDs should light in turn at each 0.5 V interval from 10.5 V to 15.0 V.

Your LED voltmeter is ready for use!

Installation

We'll have to leave this pretty much to you as installation details will depend on the individual application. However, if you plan to mount the unit in a vehicle, here are some general hints.

HOW IT WORKS — ETI 326

The circuit uses an LM3914 LED bargraph driver arranged as an expanded scale voltmeter with a dot display, in which only one of the ten LEDs is lit at any time. If the voltage is below 10 volts none of the LEDs light, if it is above 15 volts the last LED remains lit.

The trimpots RV1 and RV2 set the upper and lower voltages respectively to give a range of 10 to 15 volts in ten steps. Over-voltage and reverse voltage protection is provided by ZD1, an 18 volt zener, and the fuse FS1. If the voltage exceeds 18 volts the zener conducts and blows the fuse, and if the voltage is reversed, the zener acts as a forward-biased diode with the same result.

The instrument can be mounted in any convenient position in or under the dash, provided the display is shielded from direct light. Seeing as the driver only need glance at it occasionally, it may be mounted away from his normal view, but not such that it's an effort to see the display.

The positive supply lead to the instrument should be taken directly to the battery terminal, or the starter motor connection. This is to avoid any voltage drop in the vehicle's wiring from affect-

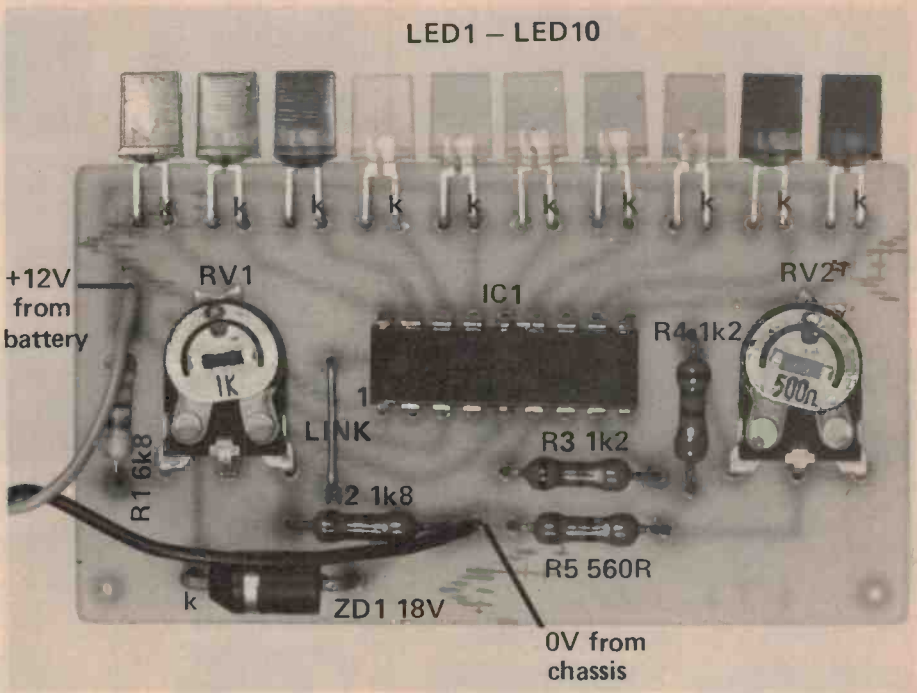
PARTS LIST — ETI 326

Resistors all ¼W, 5%
- R1 ..... 6k8
- R2 ..... 1k8
- R3,R4 ..... 1k2
- R5 ..... 560R

Trimpots
- RV1 ..... 1k min. vert. mounting trimpot.
- RV2 ..... 500 R min. vert. mounting trimpot.

Semiconductors
- ZD1 ..... 18V, 1W zener diode
- LED1-LED3 ..... red LEDs round or rect.
- LED4-LED8 ..... green LEDs round or rect.
- LED9-LED10 ..... red LEDs round or sq.
- IC1 ..... LM3914N

Miscellaneous
ETI-326 pc board; in-line fuse holder with 0.5 A fuse.



ing the reading (such as in the headlight wiring). The chassis connection can be made to the car body under the dash, wherever convenient, or taken to a chassis connection point in the engine bay.

Use in a vehicle

Say you get into your car in the morning. Before you start the engine, the unit will probably register in the upper range of the green portion of the scale. If you left the lights on overnight the battery voltage will most likely be low. If below 11 volts, you'll probably have to push start the car.

Let's assume you've got the car going. As you drive off, the voltage should rise until it reaches the maximum charging voltage — about 14.0 to 14.5 volts. When you reach your destination and switch off the engine the voltage should fall slightly — maybe 0.5 V - 1.0 V, to about 13.0 or 13.5 volts (LED6 or LED7 should light). The accompanying table may be used as a general guide to battery faults. ●

THE LM3914 — HOW IT WORKS

The LM3914 is a highly versatile device designed to sense an analogue input voltage and drive a row of ten outputs, usually LEDs or other indicators, in either a 'dot' or 'bar' graph mode.

The IC contains a ten resistor potential divider. Ten voltage comparators in the chip each have their non-inverting (+) input connected to successive taps on the ten-resistor divider. All the inverting inputs of the comparators are tied together and are driven by the output of a buffer from the input. The buffer has unity overall gain, so that for all intents and purposes the voltage on the inverting inputs of the ten comparators is the same as that on the input pin (pin 5). The outputs of the comparators each go to an individual pin on the IC and are capable of driving an LED or other circuitry.

An internal reference voltage source provides a highly stable 1.2 volts between pins 7 and 8. Since this reference is 'floating', the voltage between pins 7 and 8 always remains at 1.2 volts, irrespective of whether pin 8 is tied to ground or held at some voltage above ground.

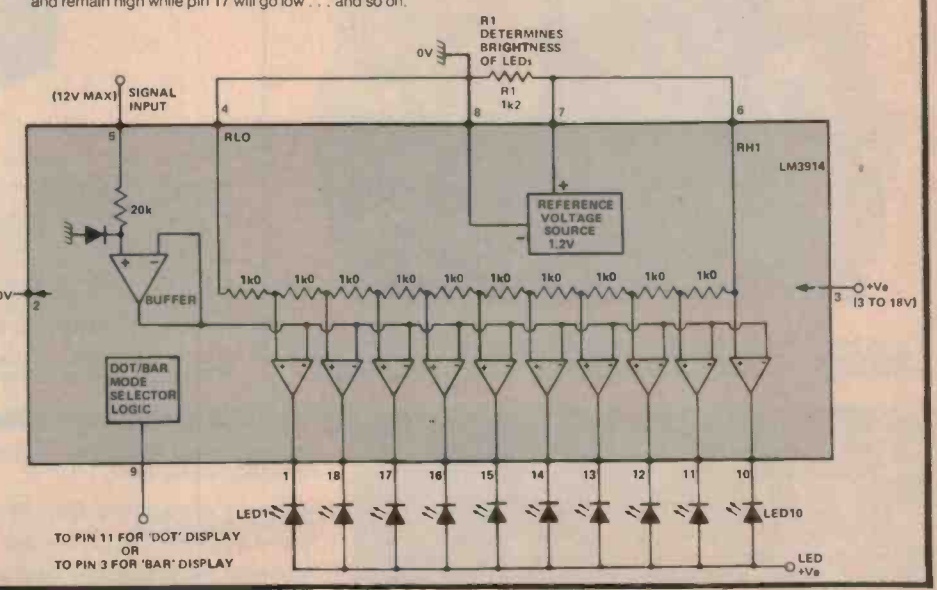
Finally, the IC also contains an internal logic network that can be externally programmed to provide either a 'dot' or 'bar' display from the outputs of the ten voltage comparators. When the dot mode is selected, only one of the ten outputs will be 'active' as the input voltage varies. When the bar mode is selected, each output becomes 'active' in succession as the input voltage increases, and vice versa.

If the reference voltage (1.2 V) is connected across the internal resistive divider, by connecting pin 7 to pin 6 and pin 8 to pin 4, 0.12 volts is applied to the non-inverting input of the lowest voltage comparator, 0.24 V to the next 'up' the divider line, 0.36 V to the next, and so on.

When the input voltage on pin 5 is zero, all the comparator outputs are high. As the input voltage is increased, the buffer output will increase. When it passes 0.12 V, the first comparator in the string (output on pin 1) will switch and its output will go low and remain low. If the input continues to rise, the next comparator will switch over and pin 18 will go low and remain low when the input passes 0.24 V. Pin 17 will go low and remain low when the input passes 0.36 V etc; pin 10 (output of the tenth comparator) will go low and remain low when the input reaches or exceeds 1.2 V. This is what happens when the bar mode is selected. For the dot mode, pin 1 will go low when the input reaches 0.12 V. When the input reaches 0.24 V, pin 1 will go high and remain high and pin 18 will go low. When the input reaches 0.36 V, pin 18 will go high and remain high while pin 17 will go low . . . and so on.

The output currents from the comparators may be programmed by a connecting resistor across the reference supply, between pins 7 and 8. Each comparator output current is approximately ten times the output current of the voltage reference source. This can supply about 3 mA maximum, so the maximum output current from each comparator is 30 mA.

A detailed explanation of the operation and applications of the LM3914 appeared in the March 1980 issue of ETI, page 61.



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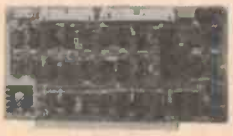

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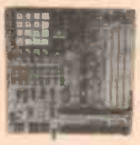

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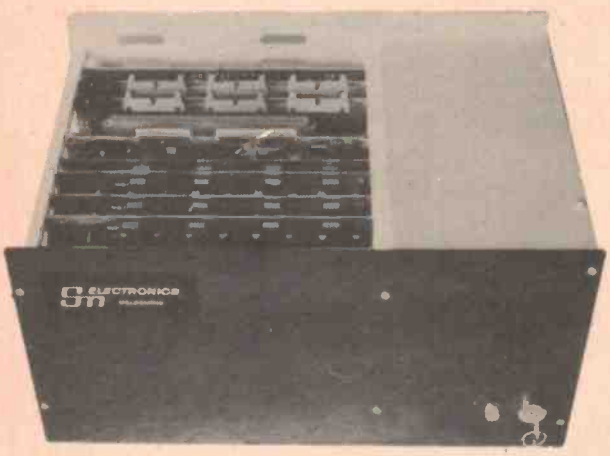

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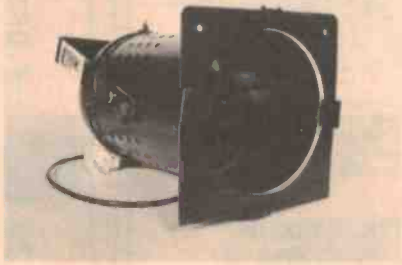

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'Magic candle' is a beaut party novelty

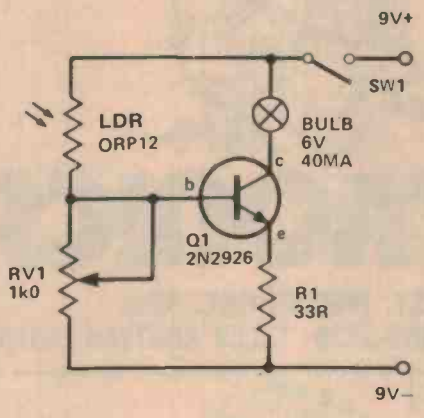
ELECTRONIC PARTY TRICKS are always popular. The majority of people have very little understanding of electronics and even simple tricks can mystify them. This circuit, a 'magic candle', uses only a handful of common components and can be built very quickly. However, as with many projects of this type, the ingenuity in building is probably more important than the circuitry. This however, is left to the reader, though some general tips are given later.

The idea of the magic candle is to demonstrate that light bulbs can be lit by a match or cigarette lighter and then 'snuffed' like a candle. The bulb should be the only item that is actually showing but it is important that the LDR — light dependant resistor — is very close by with the active face pointing at the bulb.

When a match is struck and brought up to the bulb this causes light to fall on the LDR. The resistance of the LDR then falls considerably and since this forms a potential divider with RV1, which is coupled to the base of the transistor, the voltage here rises and causes the transistor to conduct. This causes current to flow through the bulb which in turn lights up.

When the match is withdrawn, the light from the bulb takes over as the source which keeps the resistance of the LDR low and so the transistor will remain on and the bulb will stay alight. If now the bulb is 'snuffed' by breaking the path of light between the bulb and the LDR, the bulb will go out and remain so until the light level once again reaches a sufficient brightness to turn the transistor on.

The use of a 6 V bulb is simply because these types are widely available and cheap and in order to prevent too high a voltage being applied the resistor R1 is connected in the emitter circuit. In the conducting stage there is a small voltage drop across Q1 and about 1.5-2 V will be dropped across the resistor, thus ensuring that the bulb is not overdriven.



Since the circuit will have to operate in widely differing light levels, it is necessary to control the sensitivity of the circuit and this is accomplished by RV1. In high ambient light levels the value of RV1 should be low, this means that the transistor will remain switched off until the light level created by the match goes above this level. In low light levels the value of RV1 will be high.

RV1 can take the form of a miniature preset control which, for normal uses, can probably be left at some level found experimentally for general purpose use. It is not possible to give even an indication of this value as the resistance of light dependant resistors varies considerably with the individual unit.

The current drain of 40 mA is rather heavy for a PP3 battery, though one in good condition will work for a short period. The heavy current drain may be acceptable as the circuit is unlikely to be on for long periods and this battery has the advantage of being small in physical size and cheap.

The on-off switch can take any convenient form, it may even be omitted, the circuit being switched off by removing the battery clips.

As we mentioned before the bulb should be the only thing that observers can see, all the other components being hidden in a small box on which the bulb is mounted. An LDR is about 16 mm in diameter. This can be well disguised since the active surface is rather smaller and in any case not all of it has to be exposed, even a 6 mm diameter hole should be sufficient and this hole should be close to the bulb and pointing at it. It must of course be possible to easily interrupt the light path between the bulb and the LDR in order to 'snuff' the lamp.

SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.

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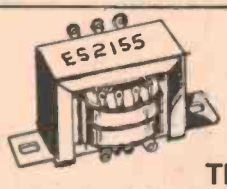

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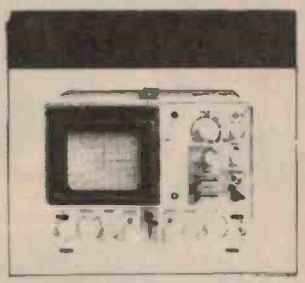

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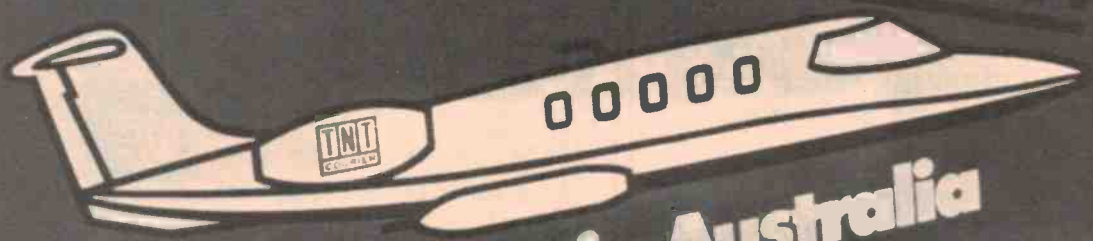

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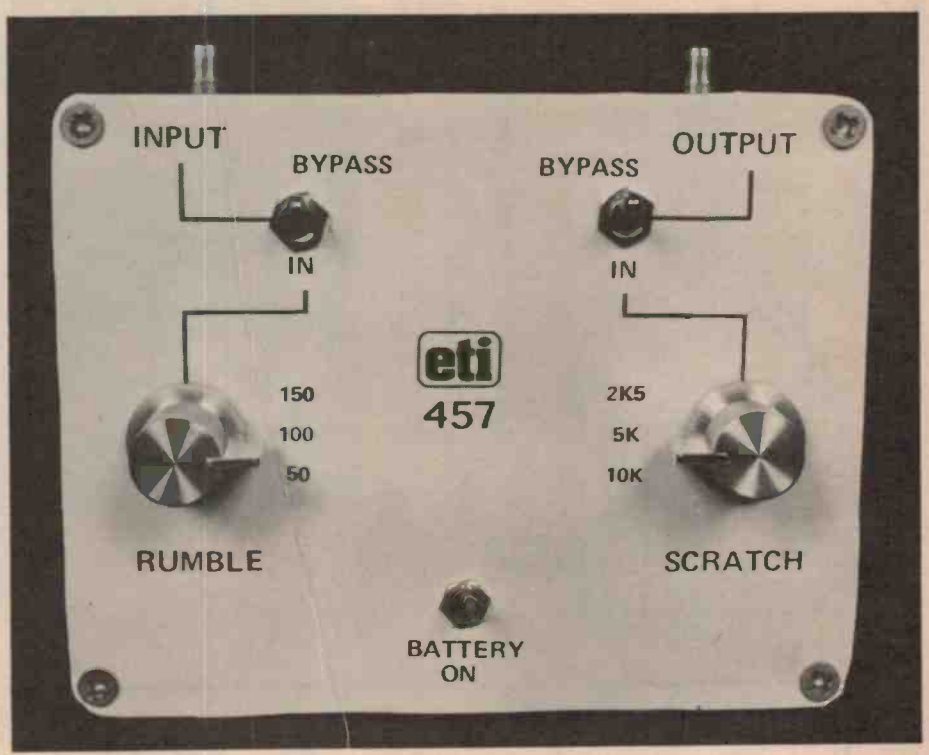
SO YOU SAY you look after your records, but you probably have some that are scratched? Perhaps you lent them to someone who didn't care for them or they might be cherished rarities you picked up in a secondhand shop. Some of the best 'original' recordings are still on 78s especially if you're into jazz, bluegrass, blues or country music. Whatever the cause, clicks, pops and severe surface noise can spoil your listening pleasure, no matter how enthusiastic you are about the artist or the item recorded.

One other source of unwanted sound comes from the turntable in the form of rumble — a low frequency sound which can make your teeth grind in sympathy! If you look at the speaker cone whilst playing a turntable suffering from rumble, you may see it move in and out, although you may not hear anything. This is subsonic rumble and can be detrimental to the performance of the speaker system. The main cause of rumble is a less than perfect turntable transmitting vibration from the motor and bearings to the stylus. Rumble has almost been cured with the introduction of belt drive and good direct-drive turntables but these can suffer from wow and flutter. That's another story, though. Low frequency acoustic feedback from the speakers to the turntable can also occur if the acoustic mounting of the turntable is not up to scratch.

The high frequency surface noise on a recording can be removed with a 'high cut' filter. This will also cut the highs on the recording but on old records this will not be so noticeable. Likewise, low frequency noise can be removed with a 'low cut' filter and again, some of the low frequency information is lost.



It is desirable to only modify enough of the amplifier's frequency response to reduce the problems, therefore we have included switchable cutoff frequencies for each filter. High frequency hiss can usually be removed with the 10 kHz filter while cracks will probably need a lower frequency cutoff.

The unit uses two active filters in series, one a low cut for the rumble filter, the other a high cut for the scratch filter. The filters provide an attenuation of 12 dB per octave at frequencies past the cutoff point and can be switched in and out independently. The unit is battery operated and designed to go between the turntable and the preamplifier on older stereo systems, or between the preamplifier and the main amplifier on modern systems. We have built each channel on a separate pc board to allow the unit to be used for either mono or stereo systems. We have shown only one channel for simplicity. If you wish to build a stereo version you will need to duplicate all components except the switches and batteries, and of course, the box. ▶

Project 457 — scratch & rumble filter

PARTS LIST — ETI 457

Resistors — all ½W, 5%

R1	27k
R2	12k
R3	2k7
R4,R5	15k
R6	220k
R7,R8	4k7
R9	10k
R10	820R

Capacitors

C1,C4	68n greencap
C2,C5	100n greencap
C3,C6,C9	220n greencap
C7,C8,C16	1u tantalum
C10,C13	10n greencap
C11	22n greencap
C12, C15	4n7 greencap
C14	2n2 greencap

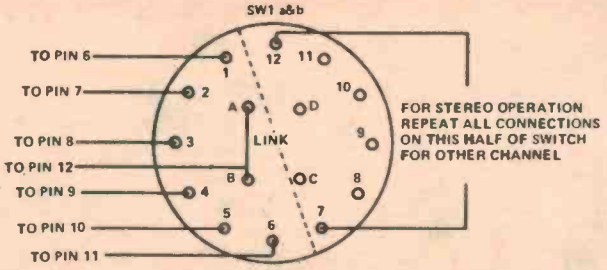
Semiconductors

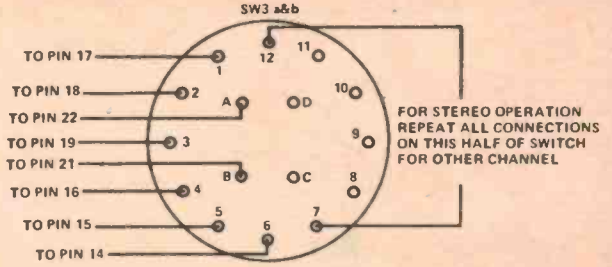
Q1,Q2	BC549, BC109 or sim.
LED1	red LED TIL220R or sim.

Miscellaneous

SW1,SW3	four pole, three-way wafer switches
SW2,SW4,SW5	DPDT miniature toggle switches

ETI-457 pc board; two RCA phono sockets; box to suit (120 mm × 95 mm × 55 mm); knobs; 9V No. 216 battery and battery clip.



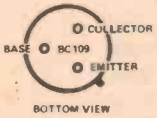


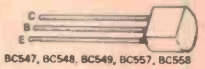
SW1 LOW CUT RANGES

1.	150 Hz
2.	100 Hz
3.	50 Hz

SW3 HIGH CUT RANGES

1.	10 kHz
2.	5 kHz
3.	2.5 kHz





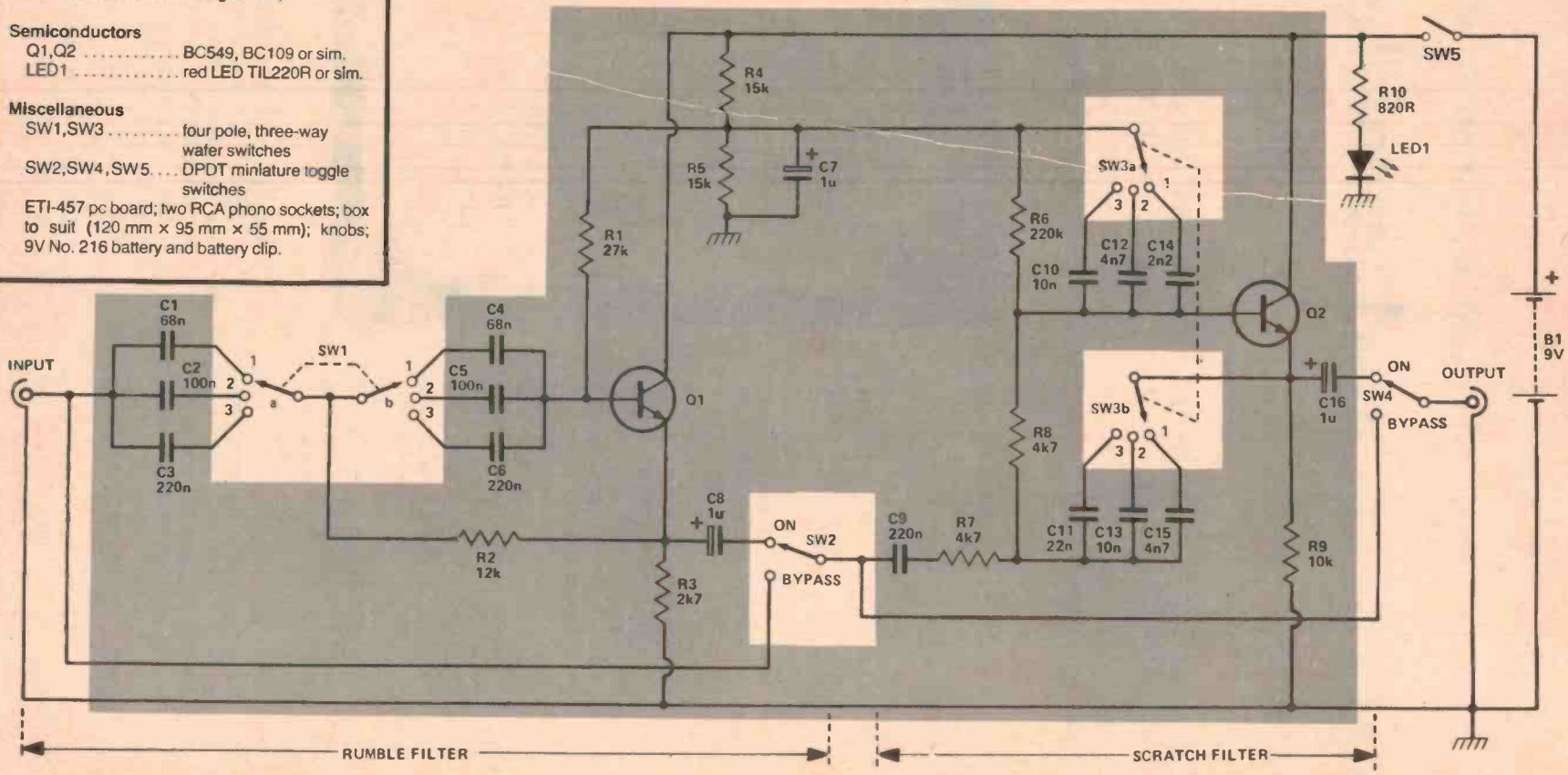


Figure 1 shows the block diagram of the mono version of the scratch and rumble filter. The input signal (from the turntable pick-up) is first fed through a high-pass filter, which rejects unwanted low-frequency rumble signals, and is then fed through a low-pass filter which rejects unwanted high-frequency scratch signals. Each filter can be bypassed via a simple switch if required, so the input signal can be passed through either one, both, or neither of the filters.

Figure 2 shows the circuit (a) and performance graph (b) of a simple single-stage passive high-pass filter. At low frequencies, capacitor C1 presents an impedance that is high relative to R1 so a lot of signal attenuation occurs between the input and output terminals. At high frequencies C1 presents an impedance that is low relative to R1, so negligible signal attenuation occurs between input and output.

The frequency at which the output signal is 3 dB down on the input signal is conventionally known as the BREAK frequency.

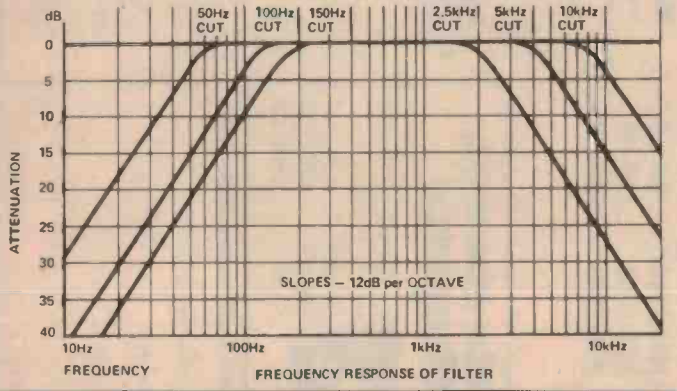
Note in Figure 2(b) that the graph shows a smooth roll-off or slope up to the break frequency point: a single stage filter has a slope or roll off of 6 dB/octave, i.e: the signal output level doubles if the input frequency is doubled.

A number of filter stages can be cascaded to give a roll-off of greater than the basic 6 dB/octave: usually, some kind of electronic buffering or feedback is used between the individual sections of a multi-stage pass filter system.

Figure 3 shows the circuit (a) and performance graph (b) of a two-stage high-pass filter. This design is known as a Butterworth filter, and is the type used as the rumble filter section of our project: it has a sharp break frequency, and gives a slope or roll-off of 12 dB/octave.

The basic high-pass filter of Figure 2 can be made to act as a low-pass type by simply transposing the positions of C1 and R1, as shown in Figure 4. Figure 5 shows the two-stage (second order) Butterworth version of the low-pass filter. This is the design that is used as the scratch filter in our project.

In the complete project (see main diagram) the high-pass or rumble filter is designed around Q1 and R1, R2 and C1 - C6, and the low-pass or scratch filter is designed around Q2 and R6 - R8 and C10 - C15. Resistors R4, R5 and bypass capacitor C7 provide the low-Z bias point for the two transistors. The low-frequency break point of the rumble filter can be varied via three-way switch S1, and the high-frequency break point of the scratch filter can be varied via S3.



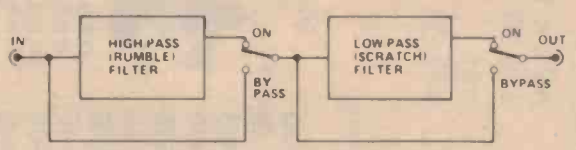


Figure 1. Block diagram, scratch and rumble filter.

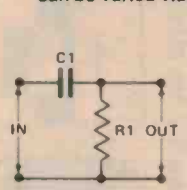


Figure 2 (a). Simple passive high-pass filter.

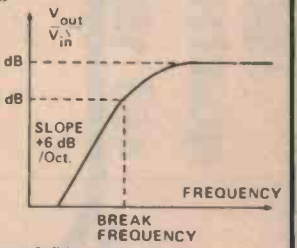


Figure 2 (b). Frequency response.

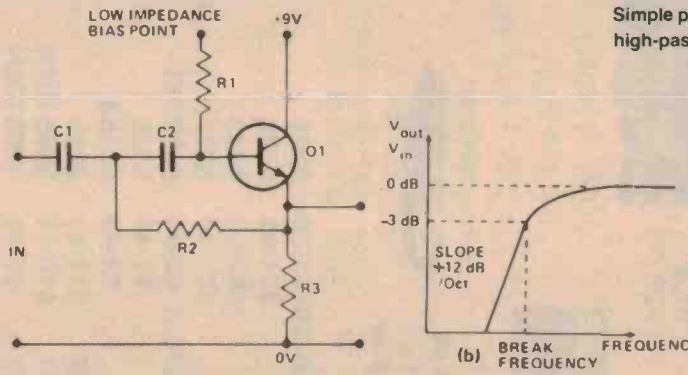


Figure 3 (a). Two-stage active high-pass filter. *Figure 3 (b).* Frequency response.

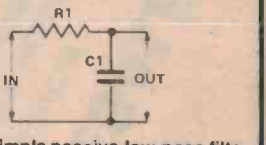


Figure 4 (a). Simple passive low-pass filter.

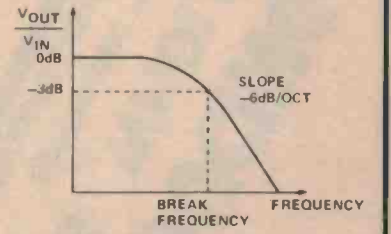


Figure 4 (b). Frequency response.

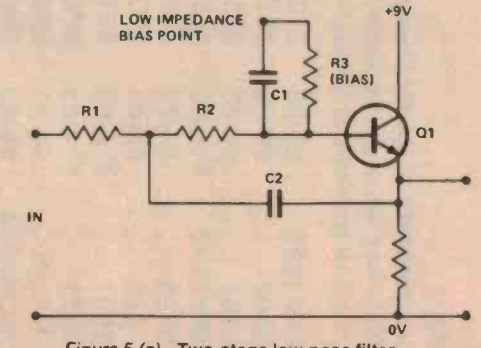


Figure 5 (a). Two-stage low-pass filter.

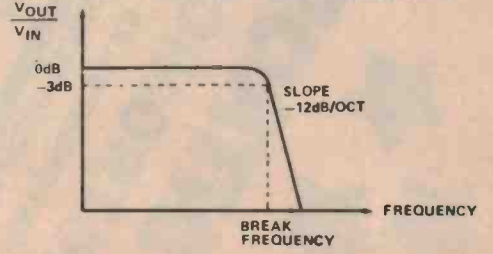
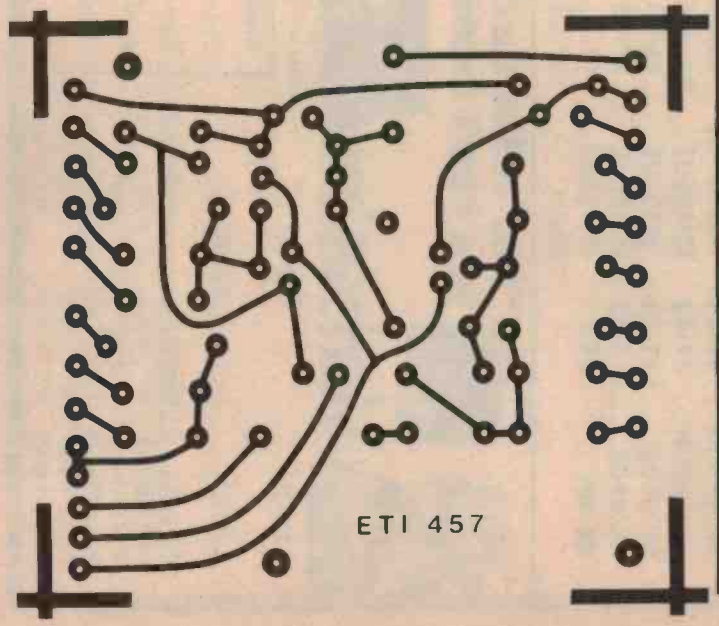


Figure 5 (b). Frequency response.



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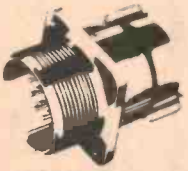

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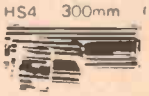

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Construction

This description is confined to the mono version. A stereo version is readily assembled from two pc boards. As the switches are all available with a complete extra set of poles and contacts, these components need not be duplicated in a stereo version. Wiring will follow much the same course as described here.

We built our filter into a diecast box, but you may have something else in mind. A diecast box is very robust and provides generally good shielding, although a steel box would further reduce possible hum pickup.

All the switches are mounted on the lid of the diecast box. The pc board is 'hung' off the rotary switches and supported by tinned copper wire from the switch tags. This makes quite a rigid assembly and ensures short wiring to the switches. For a stereo version, the second channel pc board may be mounted behind the first, wired to the switches in a similar fashion.

The input and output sockets are mounted on one wall of the box and wired to the pc board with shielded cable. The bypass toggle switches are wired with hookup wire.

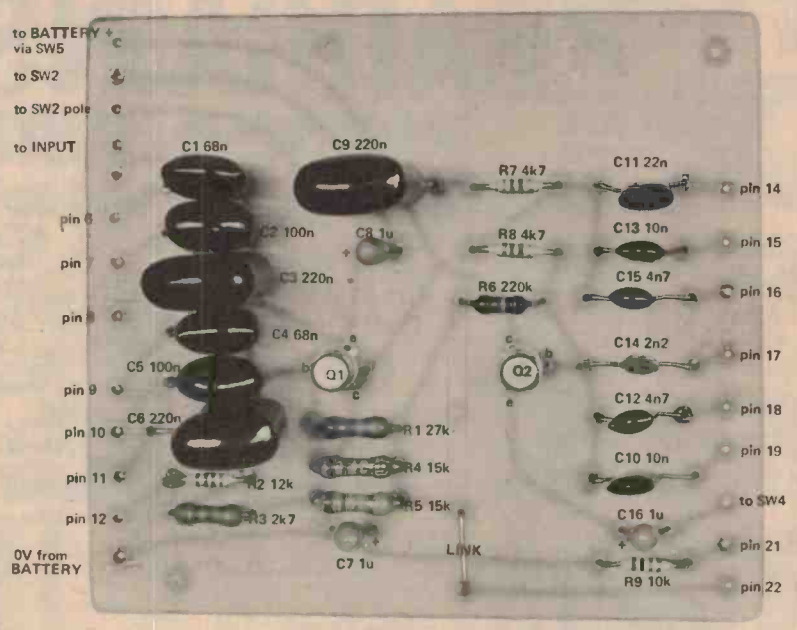
When assembling the pc board, watch out for the polarity of the tantalum capacitors and the orientation of the transistors, otherwise assembly is quite easy. With the components mounted in the board, the next step is to solder 50 mm lengths (longer for the second channel in a stereo version) of tinned copper wire to the lugs on the rotary switches.

Solder suitable lengths of insulated hookup wire to the points on the pc board that lead out to the toggle switches SW2, SW4 and SW5.

Carefully insert the tinned copper wires into their respective holes on the pc board and push the board up the wires to within about 15 mm or so of the switches. Take care not to bend any of the wires. Solder all the wires in place and cut off the excess. If building a stereo version, repeat this, taking care not to get the two channels' switch wiring tangled, pushing the second channel board to within 15 mm of the first.

Wire all the toggle switches input and output leads and you're ready to try it out.

We used a No.216 9 V battery. This is quite sufficient for the mono or stereo versions as current drain is only two milliamps per channel.



Component overlay for the pc board. Note that pin numbers 1 to 5, plus 13 and 20 , are not used. Resistor R10 and the indicator LED1 are mounted off the pc board (we have not used these).

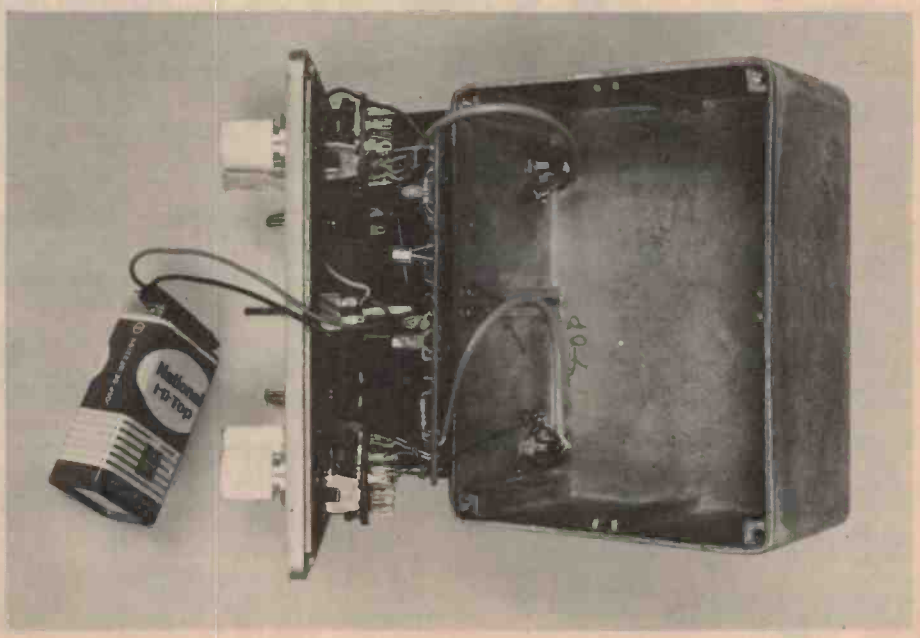
Operation

Operation is quite simple. With the unit's switches set for bypass, put on a record known to suffer from surface noise problems. Switch the unit on and put the scratch filter in circuit. Adjust the rotary switch and note the effect of the different filter frequencies. Do the same for the rumble filter.

A little experimentation should show up the best setting for each recording. It's worthwhile keeping a note of the setting with each record. The Scratch and Rumble filter is also a great aid when making tape recordings of old discs, particularly 78s.

With this unit, those old discs will find a new lease of life! ●

Internal view of the completed project showing the location of the input and output RCA sockets and the pc board 'hung' from the rear of the switches. Note that this is a mono version.



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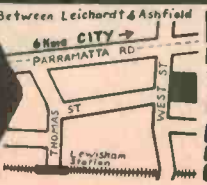

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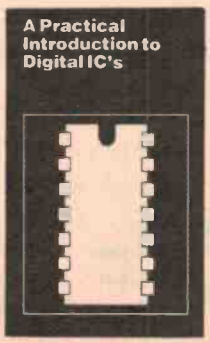

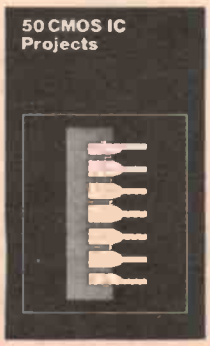

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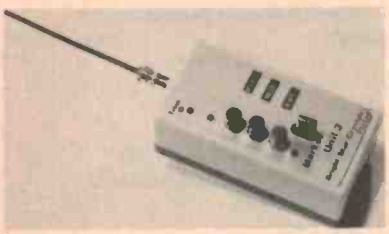

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Lab Notes

Using the 3080 IC

This remarkable IC is quite different to run-of-the-mill op-amps as it has a "control" pin that varies the device's transconductance as the current into this input is varied. These circuits illustrate various ways to use the device — from an original manuscript by UK correspondent, Tim Orr.

THE CA3080 IS KNOWN as an *operational transconductance amplifier* (OTA). This is a type of op-amp, the gain of which can be varied by means of a control current, (I_{ABC}). The device has a differential input, a control input known as the 'amplifier bias input' and a current output. It differs in many respects from conventional op-amps and it is these differences that can be used to realise many useful circuit blocks.

Voltage controlled amplifier

The CA3080 can be used as a gain controlling device. A useful circuit is shown in Figure 1. The input signal is attenuated by R1, R2 such that a 20 mV peak-to-peak signal is applied to the input terminals. If this voltage is much larger, then significant distortion will occur at the output. In fact, this distortion is put to good use in the triangle-to-sinewave converter. (Figure 3, but we're jumping the gun).

The gain of the circuit is controlled by the magnitude of the current I_{ABC}. This current flows into the CA3080 at pin 5, which is held at one diode voltage drop above the −Vcc rail. If you connect pin 5 to 0 V, then this diode will get zapped (and so will the IC!). The maximum value of I_{ABC} permitted is 1 mA and the device is 'linear' over four decades of this current. That is, the gain of the CA 3080 is 'linearly' proportional to the magnitude of the I_{ABC} current over a range of 0.1 uA to 1 mA. Thus, by controlling I_{ABC}, we can control the signal level at the output.

The output is a current output which has to be 'dumped' into a resistive load (R5) to produce a voltage output. The output impedance seen at IC1 pin 6 is 10k (R5), but this is 'unloaded' by the voltage follower (IC2) to produce a low output impedance.

The circuit involving IC3 is a precision voltage-to-current converter and this can be used to generate I_{ABC}. When Vin (control) is positive, it linearly controls the gain of the circuit. When it is negative, I_{ABC} is zero and so the gain is zero.

This type of circuit is known by several names. It is a *voltage controlled amplifier*, (VCA), or an *amplitude modulator*, or a *two quadrant multiplier*.

One problem that occurs with the CA3080 is that of the 'input offset voltage'. This is a small voltage diffe-

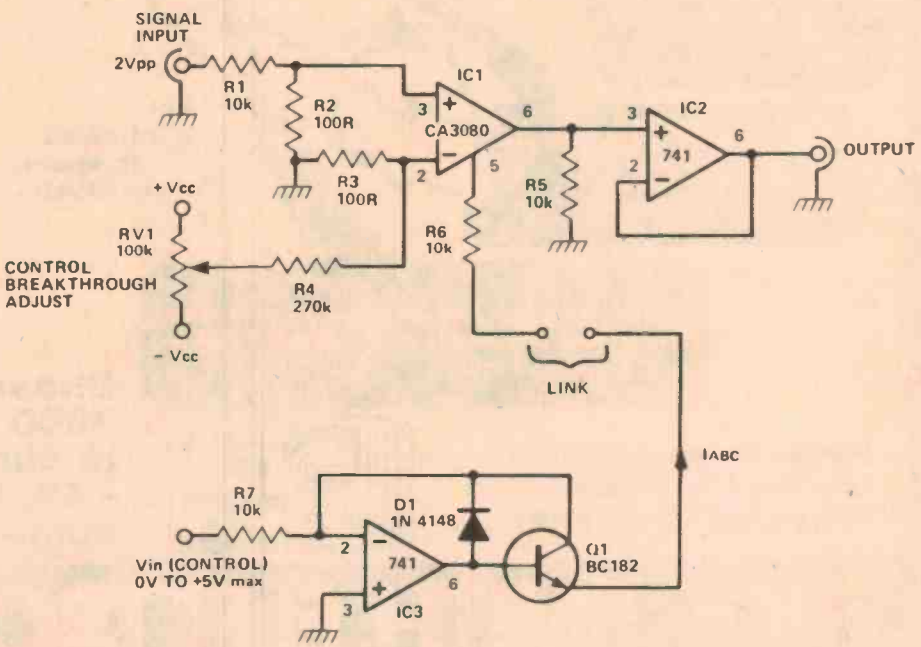


Figure 1. A voltage controlled amplifier. Gain is varied by varying RV1. You can modulate a signal passing through the amplifier by joining the 'link' and applying a modulating signal to the input of IC3 (at R7). This sort of circuit is also known as a 'two quadrant multiplier'.

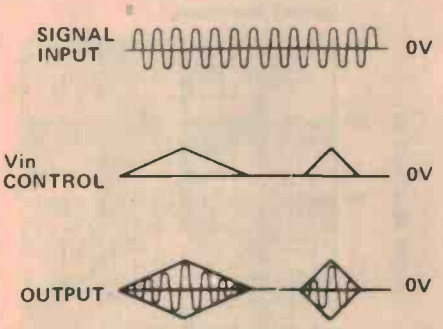


Figure 2. Illustrating the operation of the voltage controlled amplifier shown in Figure 1.

rence, or 'offset', between its input terminals. When there is no signal input and the control input is varied, a voltage similar to the control input will appear at the output. By adjusting RV1 it is possible to null out most of this control breakthrough.

The effect of modulating Vin (control) is illustrated in Figure 2.

Triangle to sinewave converter

By overloading the input of a CA3080 it is possible to produce a 'sinusoidal' transfer function. That is, if a triangle waveform of the correct magnitude is applied to the CA3080 input, the output will be distorted in such a way as to produce a sinewave approximation.

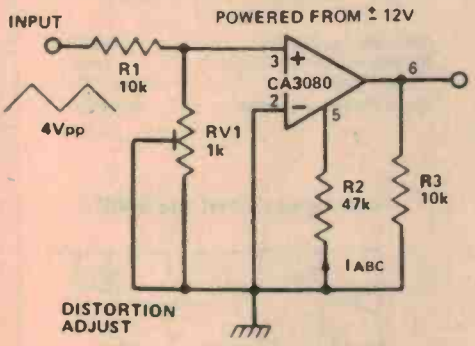


Figure 3. This circuit will convert a triangle wave to a sinewave with a resultant distortion of around 1.8%.

In the circuit shown (Figure 3), RV1 is adjusted so that the output waveform resembles a sinewave. I tested this circuit using an automatic distortion analyser and found the sinewave distortion to be only 1.8%, mostly third harmonic distortion which, for such a simple arrangement, seems very reasonable indeed. This could be used to produce a sinewave output from a triangle/square wave oscillator.

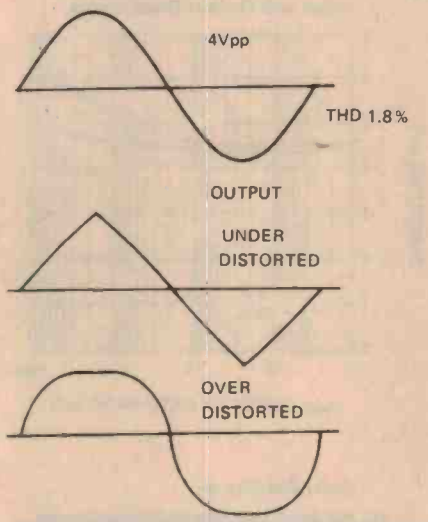


Figure 4. The output of the Figure 3 circuit should be adjusted (by RV1) to produce the waveform shown at top.

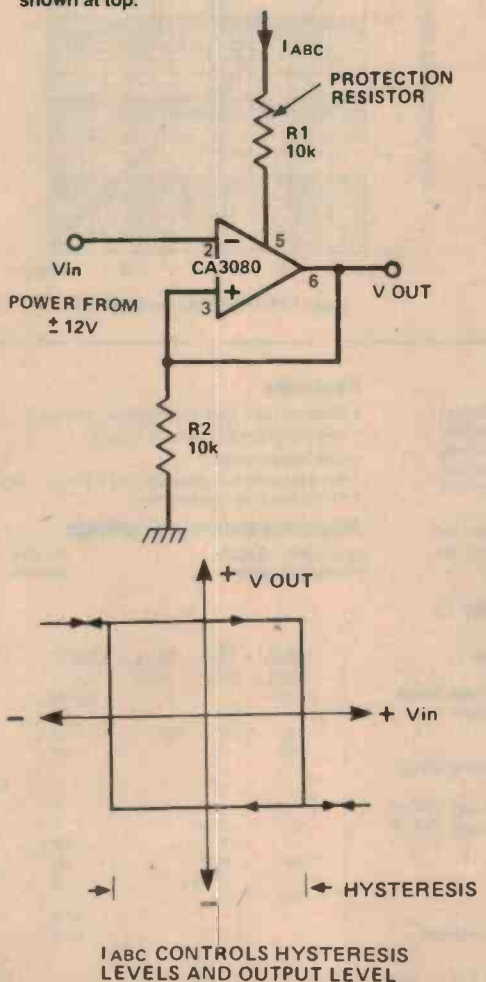


Figure 6. This sort of Schmitt trigger is not only simple but you can specify the hysteresis levels as well!

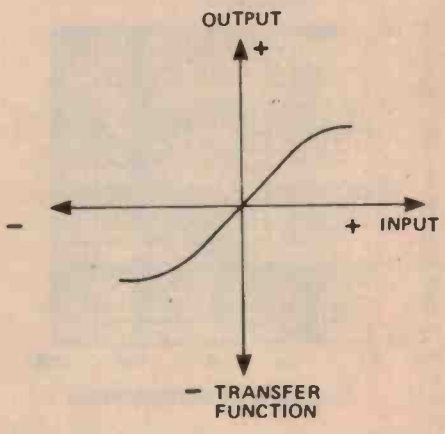


Figure 5. Transfer function of the Figure 3 circuit.

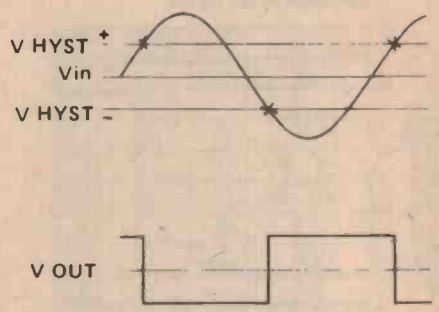


Figure 7. How the Schmitt trigger of Figure 6 works.

The result of varying RV1 is illustrated in Figure 4 and the transfer function of the circuit is shown in Figure 5.

Schmitt trigger

Most Schmitt trigger circuits prove to be very complicated when it comes to calculating the hysteresis levels. However, by using the CA3080 these calculations are rendered trivial, plus there is the added bonus of fast operation. The hysteresis levels are calculated from the simple equation,

$V_{HYST} = +/- (I_{ABC} \times R2)$

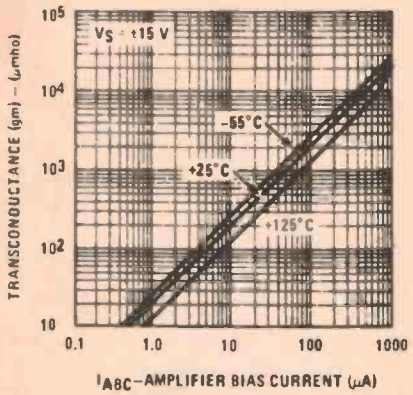
The output squarewave level is in fact equal in magnitude to the hysteresis levels. The circuit operation is as follows (referring to Figure 7):

Imagine the output voltage is high. The output voltage will then be equal to ($R2 \times I_{ABC}$) which we will call + V_{HYST}. If V_{IN} becomes more positive than + V_{HYST}, the output will start to move in a negative direction, which will increase the voltage between the input terminals which will further accelerate the speed of the output movement. This ▶

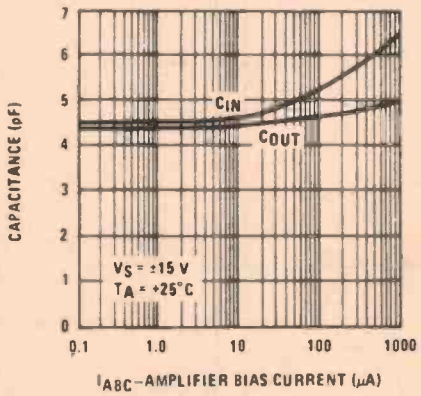
Lab Notes

SELECTED DATA ON THE 3080

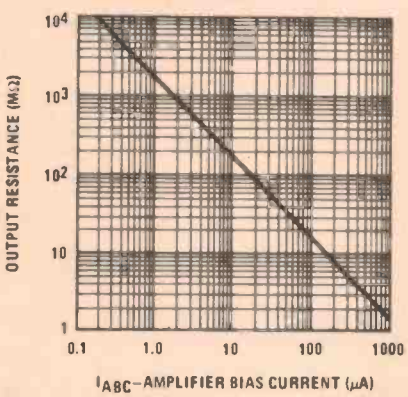
Transconductance



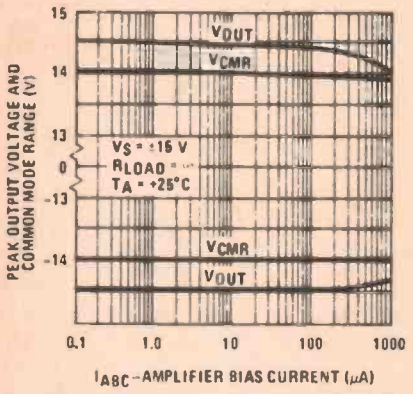
Input and Output Capacitance



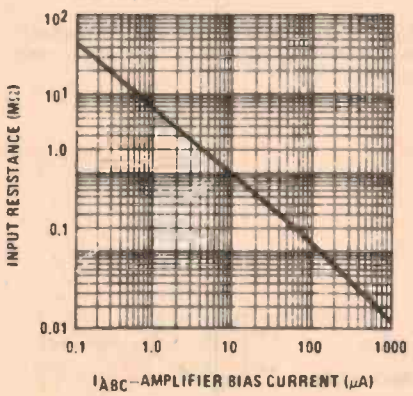
Output Resistance



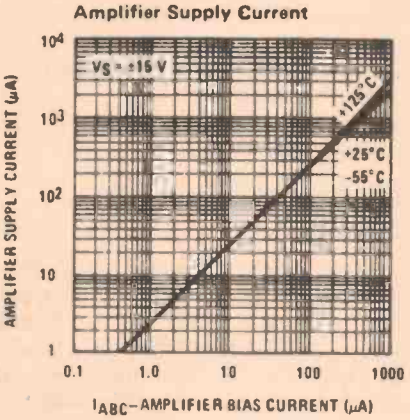
Peak Output Voltage and Common Mode Range



Input Resistance



Amplifier Supply Current



General description

The 3080 is a programmable transconductance block intended to fulfil a wide variety of variable gain applications. The 3080 has differential inputs and high impedance push-pull outputs. The device has high input impedance and its transconductance (gm) is directly proportional to the amplifier bias current (I_{ABC}).

High slew rate together with programmable gain make the 3080 an ideal choice for variable gain applications such as sample and hold, multiplexing, filtering, and multiplying.

Features

- Slew rate (unity gain compensated): 50 V/us
- Fully adjustable gain: 0 to gm R_L limit
- Extended gm linearity
- Flexible supply voltage range: +/−2 V to +/−18 V
- Adjustable power consumption

Absolute maximum ratings

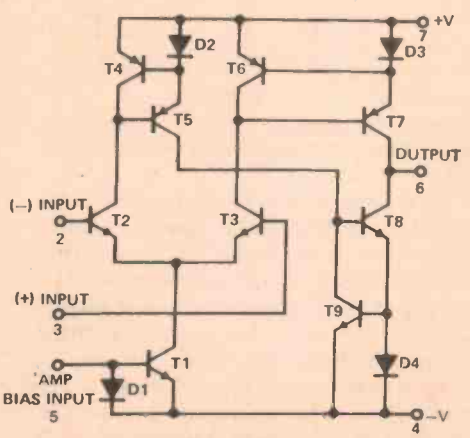
Supply Voltage 3080	+/−18 V
Power Dissipation	250 mW
Differential Input Voltage	+/−5 V
Amplifier Bias Current (I_{ABC})	2 mA
DC Input Voltage	$+/-V_S$ to $-V_S$
Output Short Circuit Duration	Indefinite

Electrical characteristics, 3080 (Note 1).

Parameter	Conditions	Min.	Typ.	Max.	Units
Forward Transconductance (gm)	Over Specified Temp. Range	6700	9600	13000	umho
		5400			umho
Peak Output Current	R_L = 0, I_{ABC} = 5uA		5		uA
	R_L = 0	350	500	650	uA
	R_L = 0	300			uA
	Over Specified Temp.Range				
Peak Output Voltage					
Positive	R_L = ,5uA I_{ABC} 500uA	+12	+14.2		V
Negative	R_L = ,5uA I_{ABC} 500uA	−12	−14.4		V
Amplifier Supply Current			1.1		mA
Common Mode Rejection Ratio		80	110		dB
Common Mode Range		+/−12	+/−14		V
Input Resistance		10	26		k
Open Loop Bandwidth			2		MHz
Slew Rate	Unity Gain Compensated		50		V/us

Note 1: These specifications apply for V_S = +/−15 V and T_A = 25°C, amplifier bias current (I_{ABC}) = 500uA, unless otherwise specified.

Internal circuit of the 3080



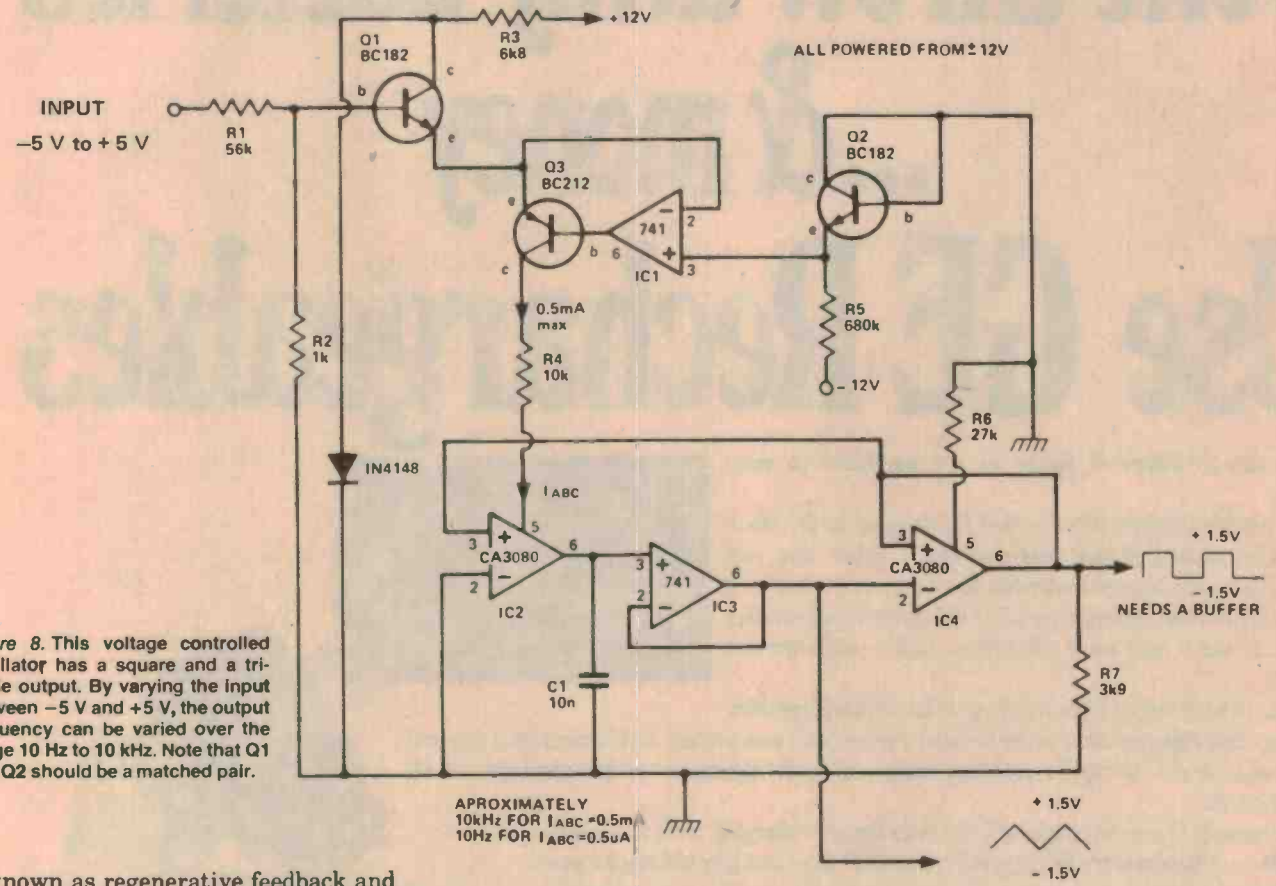


Figure 8. This voltage controlled oscillator has a square and a triangle output. By varying the input between –5 V and +5 V, the output frequency can be varied over the range 10 Hz to 10 kHz. Note that Q1 and Q2 should be a matched pair.

is known as regenerative feedback and is responsible for the Schmitt trigger action. The output snaps into a negative state at a voltage equal to $-(R2 \times I_{ABC})$ which is designated as $-V_{HYST}$. Only when V_{IN} becomes more negative than $-V_{HYST}$ will the output change back to the $+V_{HYST}$ state.

The Schmitt trigger is a very useful building block for detecting two discrete voltage levels and finds many uses in circuit designs.

Voltage controlled oscillator

By using two CA3080s and some 741 op-amps it is possible to make an oscillator, the frequency of which is voltage controllable. This unit finds many applications in the fields of electronic music production and test equipment.

The circuit (Figure 8) has been given a logarithmic control law, that is, the frequency of operation doubles for every volt increase in the control voltage. This makes it ideal for musical applications where linear control voltages need to be converted into musical intervals (which are logarithmically spaced) and also for audio testing where frequencies are generally measured as logarithmic functions.

One CA3080, IC2, is an integrator. The I_{ABC} current that drives this IC is used to either charge or discharge C1. This produces triangular waveforms which are buffered by IC3, which then drives the Schmitt trigger IC4. The hysteresis levels for this device are fixed at +/–1.5 V, being determined by R6 and R7.

The output of the Schmitt trigger is fed back in such a way as to control the direction of motion of the integrator's output. If the Schmitt output is high, then the integrator will ramp upwards and vice versa.

Imagine that the integrator is ramping *upwards*. When the integrator's output reaches the *upper* hysteresis level, the Schmitt will flip into its *low* state, and the integrator will start to ramp downwards. When it reaches the *low* hysteresis level the Schmitt will flip back into its *high* state. Thus the integrator ramps up and down in between the two hysteresis levels.

The speed at which it does this, and hence the oscillating frequency, is determined by the value of I_{ABC} for IC2. The larger the current, the faster the capacitor is charged and discharged.

Two outputs are produced, a triangle wave (buffered) from IC3 and a squarewave (unbuffered) from IC4. If the squarewave output is loaded, then the oscillation frequency will change so a buffer is advisable. ▶

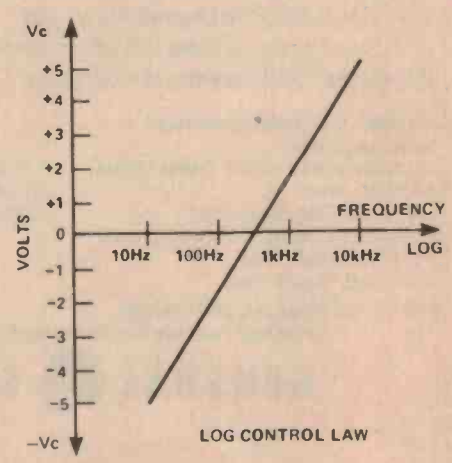


Figure 9. Voltage versus frequency characteristic of the Figure 9 circuit.

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Lab Notes

The log. law generator is composed of Q1, 2, 3 and IC1. Transistors Q1 and Q2 should be matched so that their base emitter voltages (Vbe) are the same for the same emitter current, (50uA). Matching these devices to within 5 mV is satisfactory, although unmatched pairs could be used. When matching transistors, take care not to touch them with your fingers. This will heat them up and produce erroneous measurements.

Transistor Q2 is used to produce a reference voltage of about −0.6 V, which is connected to IC1 pin 3. This op-amp and Q3 is used to keep the emitter of Q1 at the same voltage of −0.6 V. The input control voltage is attenuated by R1, R2 such that a +1 V increase at the input produces a change of only +18 mV at the base of Q1. However, the emitter of Q1 is fixed at −0.6 V, so the current through Q1 doubles. (It is a property of transistors that the collector current doubles for every 18 mV increase in Vbe).

The emitter current of Q1 flows through Q3 and into IC2, thus controlling the oscillator frequency. It is possible to get a control range of over 1000 to 1 using this circuit. With the values shown, operation from 10 Hz to 10 kHz is achieved. Reducing C1 to 1n will increase the maximum frequency to 100 kHz, although the waveform quality may be somewhat degraded.

Changing C1 to 1uF (non-polarised) will give a minimum frequency of 0.1 Hz.

Fast comparator

The high slew rate of the CA3080 makes it an excellent fast voltage comparator and a circuit is shown in Figure 10. When pin 2 of IC1 is more positive than Vref, the output of IC1 goes negative and vice versa. Vref can be moved around so that the point at which the output changes can be varied. As long as the input sinewave level is quite large (1 V say) then the output can be made to move at very fast rates indeed. However, care must be taken to avoid overloading the inputs. If the differential input voltage exceeds 5 V, then the input stage breaks down and may cause an undesired output to occur.

One use of a fast comparator is in a *tone burst generator*. A circuit is shown in Figure 11. This device produces bursts of sinewaves, the burst starting and finishing on axis crossings of the sinusoid. The CA3080 is configured here as a voltage comparator, used to detect these axis crossings and to produce a square wave output which then drives a binary divider (IC3). The divider produces a 'divide by sixteen' output which is high for eight sinewave cycles and then low for the next eight. This signal is then used to gate ON and OFF the sinewave.

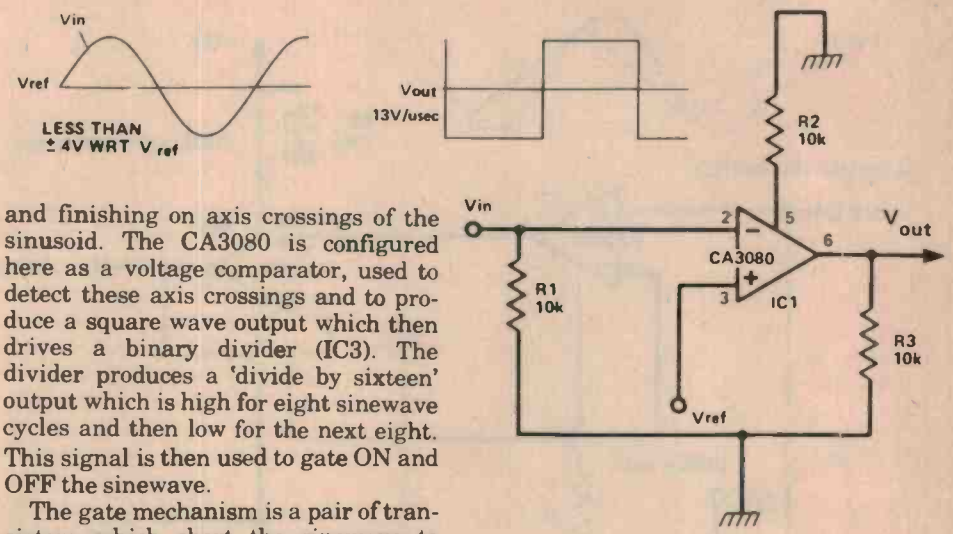

Figure 10. Example of a fast comparator.

The gate mechanism is a pair of transistors which short the sinewave to ground when the divider output is high and let it pass when the divider output is low. The resulting output is a toneburst.

However, if the comparator is not ▶

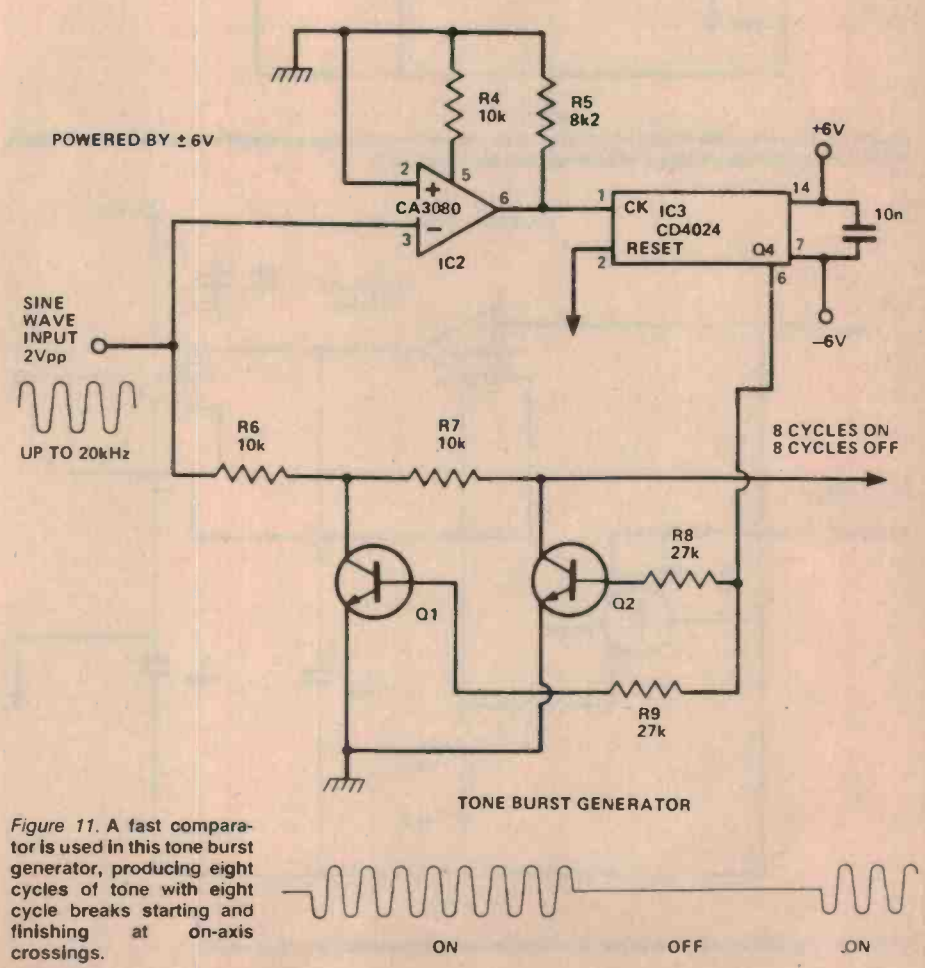

Figure 11. A fast comparator is used in this tone burst generator, producing eight cycles of tone with eight cycle breaks starting and finishing at on-axis crossings.

Lab Notes

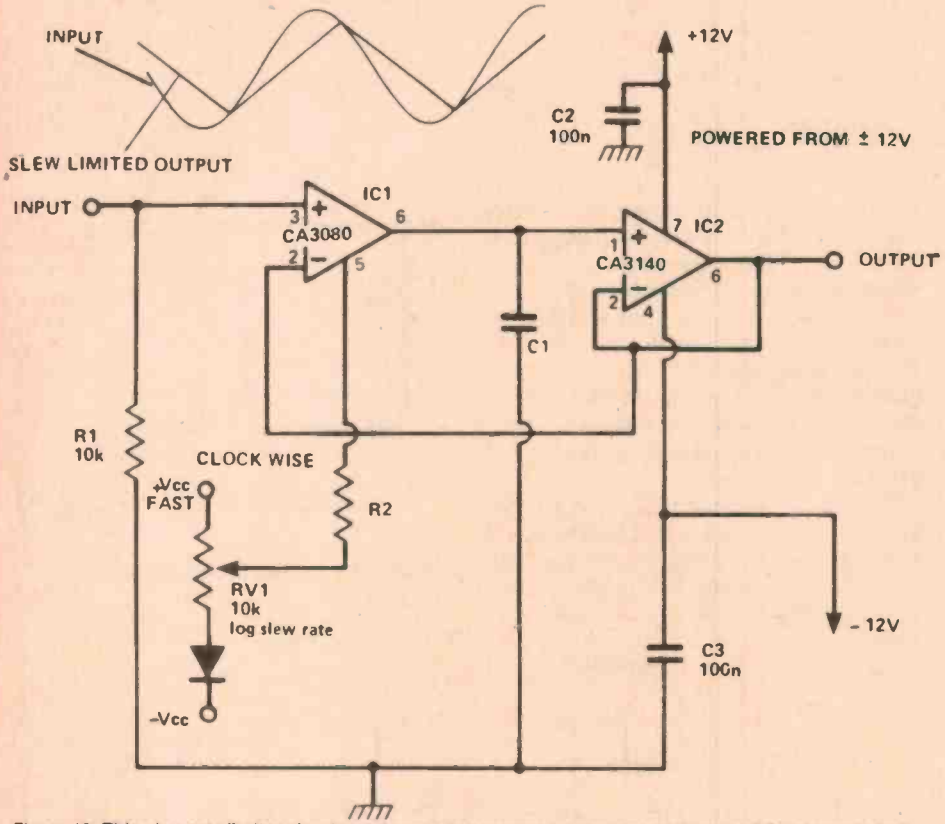

Figure 12. This slew rate limiter circuit produces a linear ramp on signals which exceed the slew rate limit, the output amplitude stopping when it reaches the signal level.

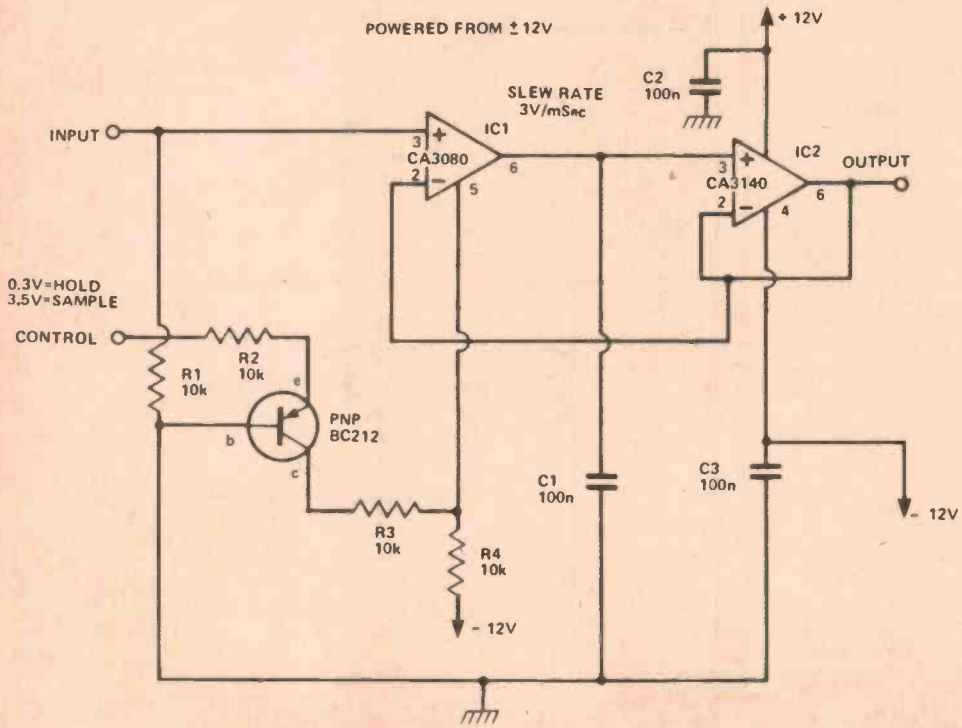

Figure 13. A typical application of the slew rate limiter is this sample and hold circuit.

very fast then there will be a delay in generating the gate and so the tone burst will not start or finish on axis crossings.

Using the circuit shown, operation up to 20 kHz is obtainable.

Slew limiter

The current output of a CA3080 can be used to produce a controlled slew limiter. By connecting the output current to a capacitor, the output voltage cannot move faster than a rate given by

$$\text{Slew Rate} = \frac{I_{ABC}}{C1} \text{ Volts per sec.}$$

Note that I_{ABC} determines the slew rate and as I_{ABC} is a variable then so is the slew rate.

A suitable circuit is shown in Figure 12. The output voltage is buffered by a voltage follower, IC2. This is a MOSFET op-amp which has a very high input impedance, which is necessary to minimise the loading on C1.

When an input signal is applied to IC1 the output tries to move towards this voltage but its speed is limited by the slew rate. Thus, the output produces a linear ramp which stops when it reaches the input signal level.

Sample and hold

A typical application of the slew limiter circuit is in a *sample and hold* circuit. The circuit in Figure 13 could be termed an analogue memory. When the control voltage is high, the circuit will 'remember' or 'hold' the input voltage level present at the time. The result is shown in Figure 14. ▶

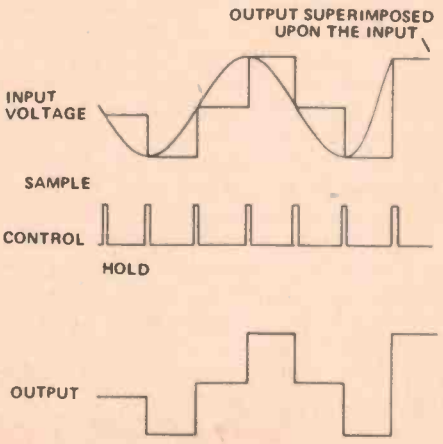

Figure 14. Illustrating the operation of the sample and hold circuit of Figure 13.

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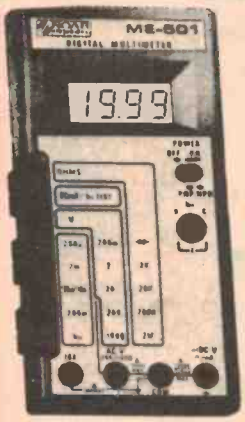

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Lab Notes

In this circuit, I_{ABC} is either hard ON (sample) or completely OFF (hold). In the sample mode, the output voltage quickly adjusts itself so that it equals the input voltage. This enables a short sample period to be used.

In the HOLD mode, I_{ABC} is zero and so the voltage on C1 should remain fixed.

Such circuits are used in music synthesizers (to remember the pitch), in analogue-to-digital converters and many other applications.

A multiplier/modulator

The CA3080 is basically a two-quadrant multiplier, that is, it has two inputs, one of which can accept bipolar signals (positive and negative going) — the inverting or the non-inverting input — the other can only accept a unipolar signal — the control input, pin 5.

Whilst a two-quadrant multiplier is very useful in a wide variety of applications, a four-quadrant multiplier has extra advantages. For example, apart from amplitude modulation, it can perform frequency doubling and ring modulation. See Figure 16. Now, a four-quadrant multiplier has two inputs, both of which can accept bipolar signals. An example of a four-quadrant multiplier is a frequency converter in a radio receiver. The familiar diode ring mixer is another example of a four-quadrant multiplier.

The circuit in Figure 15 is fairly similar to that of the two-quadrant multiplier shown in Figure 1. This circuit has several important differences.

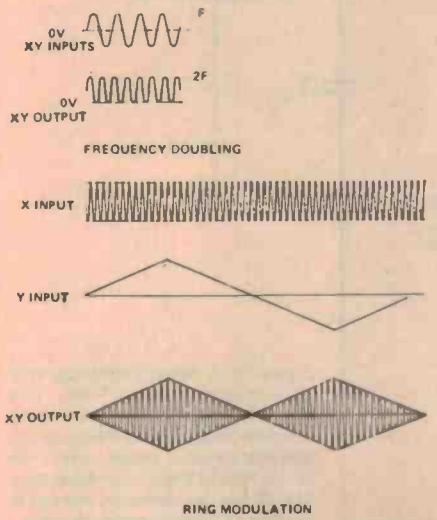


Figure 16. Illustrating the various operations of the four quadrant multiplier of Figure 15.

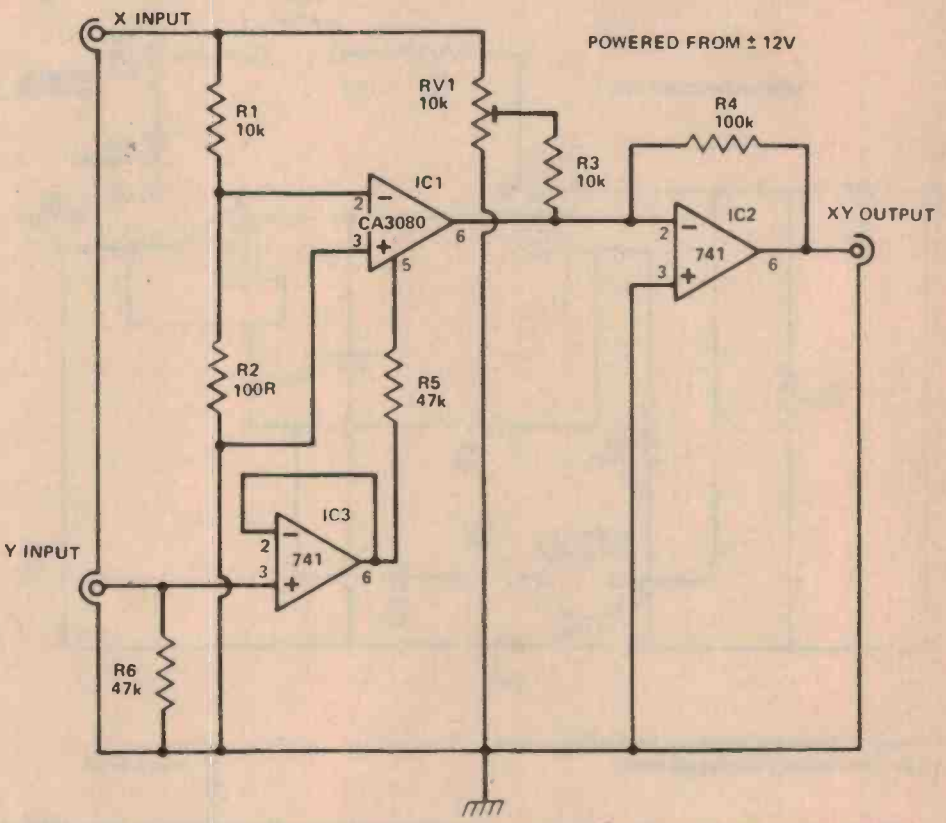


Figure 15. This multiplier/modulator can be used to produce a 'Dalek' voice when working as a ring modulator. It can also be used as a frequency doubler.

A 741 op-amp, IC3, is used to generate I_{ABC} in such a way that its input, the 'Y' input, can go both positive and negative. Thus, the Y input is bipolar.

When Y is at zero volts (no input) and there is a signal on the X input the desired output (X x Y) should be zero. This is achieved by adjusting RV1 so that the signal via IC1 (this is inverted) is exactly cancelled out by that via R3. Now, when Y is increased positively, a non-inverted value of X is produced at the output and, when Y is increased negatively, an inverted value of X is produced. When Y is zero, so is the output. This is known sometimes as ring modulation.

If a speech signal is connected to the X input and an audio oscillator to the Y input, the resulting sound is that of a 'Dalek'.

Also, if a sinewave is connected to both the X and Y inputs, the XY product is a sinewave of twice the frequency. This is known as a frequency doubler, but it will only work with sinewaves.

For more theoretical information on four-quadrant multipliers, especially the variable transconductance type, see "Operational Amplifiers" (second edition), by G.B. Clayton, published by Newnes-Butterworths and available in Australia through Butterworths, 586 Pacific Highway, Chatswood NSW 2067. (02)412-3444.

Single pole filter/wah wah

The guitar 'wah wah' effects unit employs a filter which can be manually 'swept' across the middle of the audio frequency range, generally from around 500 Hz to 5 kHz or so, producing the peculiar 'wah wah' sound.

A single pole, voltage-controlled, low pass filter can be constructed using a CA3080 as a current-controlled resistor. The circuit is showh in Figure 17.

A simple, low pass RC filter configuration is employed, the controllable 'R' is the CA3080 and the 'C' is C1. Varying I_{ABC} varies the amount of current drive to C1. This circuit configuration would normally be a slew limiter, except that the signal level to the input of the CA3080 is kept deliberately low (R1 and R2 form a 100:1 attenuator) so that the IC operates in its linear mode. This enables it to look like a variable resistor. ▶

Lab Notes

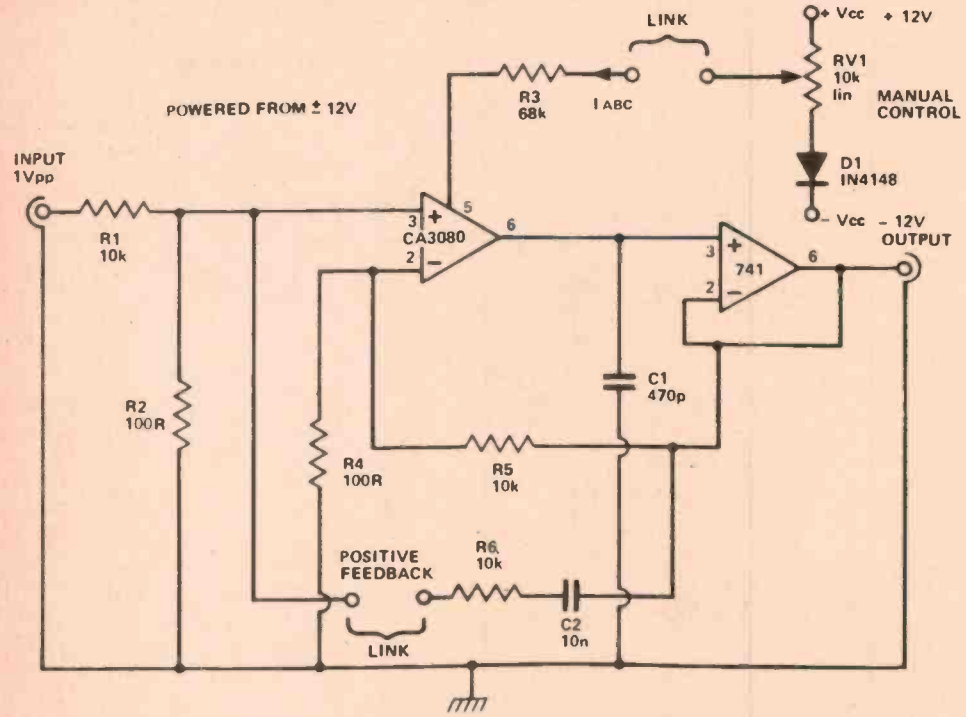


Figure 17. A guitar wah-wah unit can be made with a swept frequency single pole filter.

When this resistor is varied, the break frequency of the filter also varies.

By applying some positive feedback around the filter (R6, C2) it is possible to produce a peaky filter response. The peak actually increases with frequency, producing the wah wah effect.

The circuit as shown can be swept from about 400 Hz at the lower extreme to about 4 kHz at the upper extreme. See Figure 18.

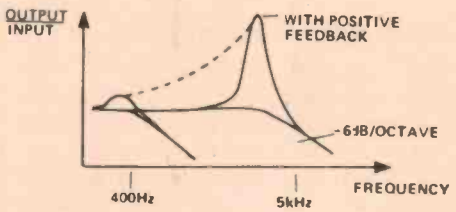


Figure 18. How the single pole filter affects the frequency response of the signal passed through the wah wah unit.

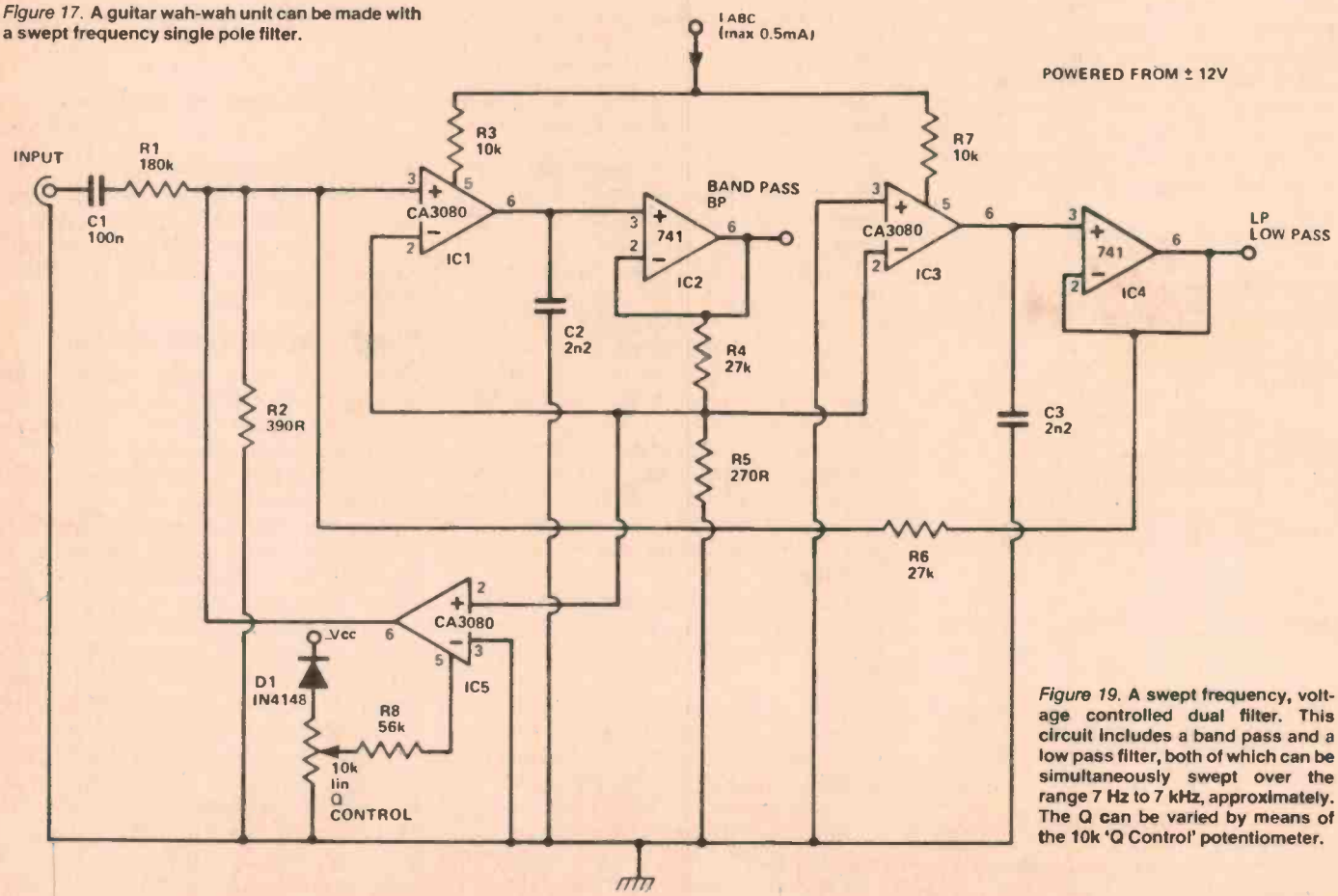
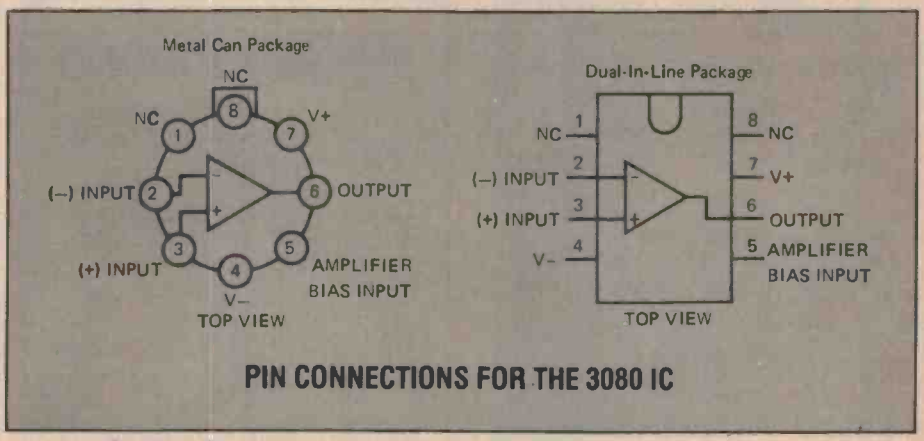


Figure 19. A swept frequency, voltage controlled dual filter. This circuit includes a band pass and a low pass filter, both of which can be simultaneously swept over the range 7 Hz to 7 kHz, approximately. The Q can be varied by means of the 10k 'Q Control' potentiometer.

Voltage controlled filter

A standard dual integrator filter can be constructed using a few CA3080s. By varying I_{ABC}, the resonant frequency can be swept over a 1000 to 1 range. IC1 and IC3 are two current-controlled integrators. IC2 and IC4 are voltage followers which serve to buffer the high impedance outputs of the integrators. A third CA3080 (C5) is used to control the Q factor of the filter. Q factors as high as 50 can be obtained. The resonant frequency of the filter is linearly proportional to I_{ABC} and hence this unit is very useful in electronic music production.

There are two outputs, a low pass and a band pass response. Minimum frequency is around 7 Hz to 10 Hz, upper frequency is around 7 kHz or so. Changing C2 and C3 will alter the upper and lower frequency limits. ●



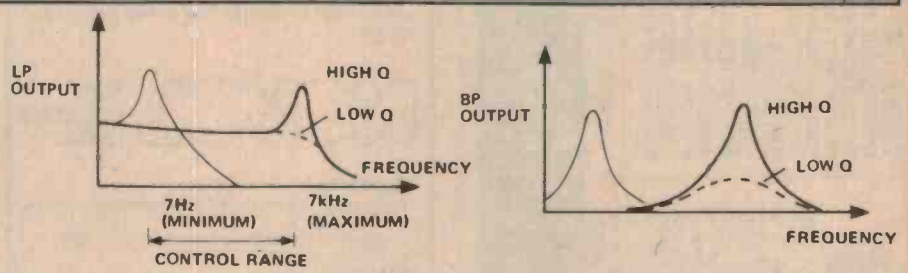


Figure 20. **Illustrating the operation of the filters in the Figure 19 circuit.**

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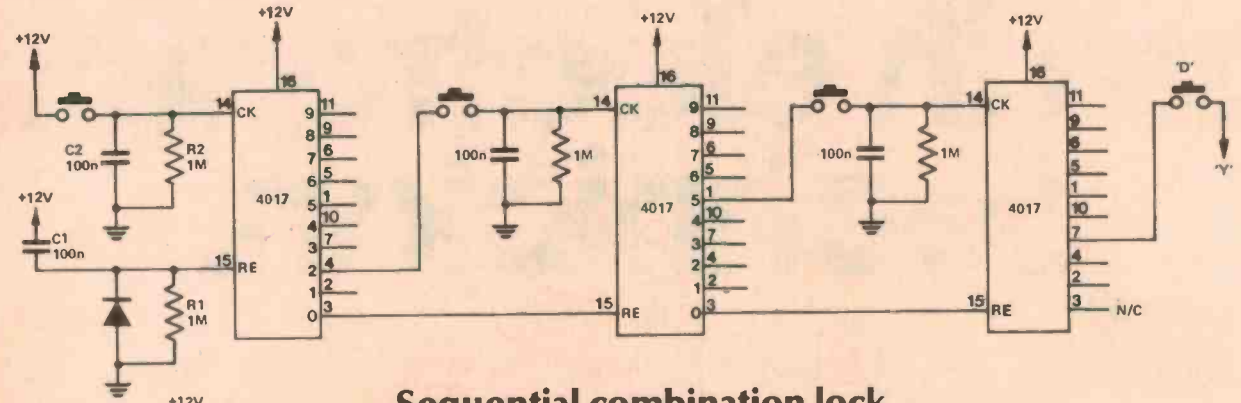
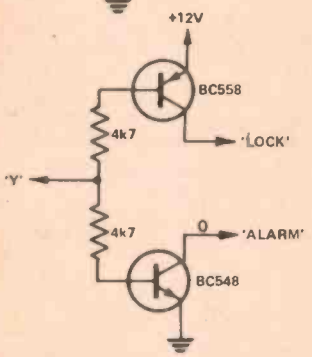
Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.





Sequential combination lock

Another combination lock, this one from **Ronald Mellor of Peakhurst, NSW.** To operate the lock, the buttons must be pressed the right number of times and in the right order. If the 'D' button is pressed ahead of time the alarm sounds.

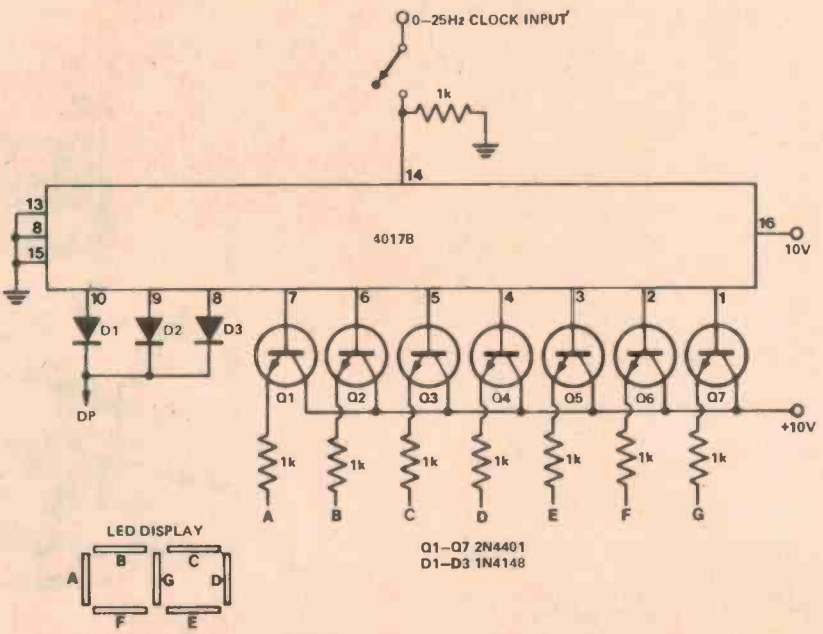
Here, the combination is 2, 5, 3, 1. The odds against pressing the right number first up are 17 496 to 1, not good odds for a potential thief!

Three 4017 decade dividers are used to count the combination which can be easily changed by simply changing the output pin of each divider. The network R1 and C1 ensures all counters reset at switch-on, while R2 and C2 are for debouncing.

The output transistors both remain conducting in the quiescent state. A '0' or '1' signal on the 'Y' line will turn Q1 or Q2 off respectively, giving either an unlock or alarm signal.

Electronic casino

This is a game of chance which can be played by up to seven players. The decimal point has three connections which gives the house a three out of ten chance of taking all bets. The clock is set at a frequency which gives a rapidly flickering display. When a player holds down a key for a few seconds and releases it the display stops and a number or point is displayed. The odds are on the point. Submitted by **Keith Bennet and Peter White of Burwood, Victoria.**



Royce

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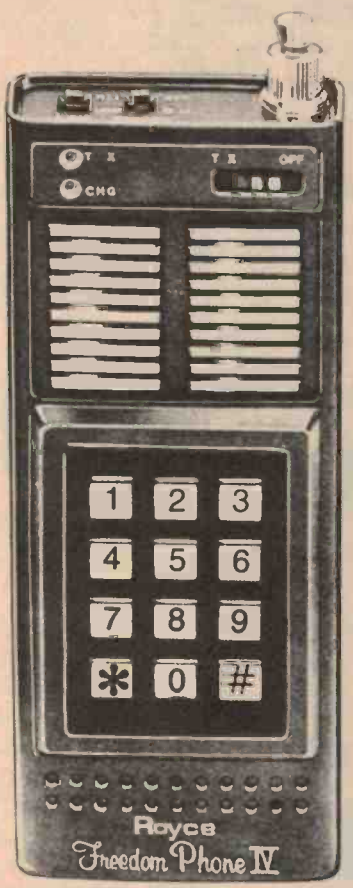

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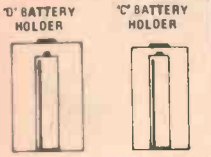

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DATAMAN – An exciting learning aid by T.I. to teach your child maths $25.00
The Popular TI30 CALCULATOR – Students can use this calculator right up to Higher School Certificate.
..... ONLY $26.95
THE LITTLE PROFESSOR Electronic learning aid for children 5 years and up (maths) $19.95
THE FAMOUS TI59 PROGRAMMABLE CALCULATOR Years ahead of its time ... similar to a computer in that you can write your own programmes, etc.
..... $299.00

PHILIPS SPEAKERS

WOOFERS
200mm(8") (AD8066/W8 or AD80652/W8)
woofer, 40W.RMS., 8ohm, freq. response 35Hz to 7kHz $29.50
250mm(10") (AD10100/W8) Woofer
40W.RMS., 8ohm, freq. response 40Hz to 5kHz $57.50
300mm(12") (AD12100/W8) Woofer
40W.RMS., 8ohm, freq. response 30Hz to 1.2 kHz $57.50
300mm(12")(AD12250/W8) Woofer
100W.RMS., 8ohm, frequency response 40Hz to 2kHz $86.95

MIDRANGE SPEAKERS

157mm(7") (AD70601/W8) Low Midrange or Woofer
30W.RMS., 8ohm, frequency response 40Hz to 3kHz $22.95
125mm(5") (AD5060/S08) Midrange
40W.RMS with recommended crossover, 8ohm, frequency response 180Hz to 10kHz $23.50
50mm(2") (AD0210/S08) Midrange
50W.RMS with recommended crossover, 8ohm, frequency response 500Hz to 5kHz $34.75
50mm(2") (AD02160/S08) Midrange
80W.RMS., with recommended crossover, 8ohm, frequency response 500Hz to 10kHz $35.50

CROSSOVER NETWORKS

ET14000/1 4 WAY CROSSOVER NETWORK (Kit Form)
Crossover points: 150Hz, 750Hz, 3kHz. 100W. RMS (designed by ETI) 8ohm. Size: 330mm x 246mm ..... $170 pair

ET14000/2 3 WAY CROSSOVER NETWORK (Kit form)
Crossover points: 700Hz and 3kHz. 100W. RMS (designed by ETI) 8ohm. Size: 210mm x 130mm ..... $91 pair

ADF500/4500/8 3 WAY CROSSOVER NETWORK (Completely assembled)
Crossover points: 500Hz and 4500Hz. 40W. RMS (Philips design). 8ohm. Size: 105mm x 100mm ..... $41 pair

TWEETERS

25mm(1") (AD0162/T8) Tweeter
40W.RMS with correct crossover, 8ohm, frequency response 1600Hz to 20kHz $13.95

25mm(1") (AD01610/T8) Tweeter
100W.RMS with correct crossover, 8ohm, frequency response 2kHz to 22kHz. $16.95

10 WATTS RMS PER CHANNEL AMPLIFIER FOR ONLY $24.50
(less metalwork, knobs, power transformer) ... A FANTASTIC BUY ... Limited stocks.
(See EA August '79 for review). This amp is suitable for crystal ceramic cartridge input. Can be driven from magnetic cartridge with simple addition of special preamp kit ... $8.50 ... preamp can be powered direct from rail voltage of amp (diagram provided).
Transformer (specially wound for this amp) ... only $9.50

300 WATT AMPLIFIER KIT
"The BRUTE" – develops 300 watts into 4 ohms, 200 watts into 8 ohms.

COMPLETE KIT FOR ETI486 300 Watt AMPLIFIER MODULE (less heatsink and power transformer), exactly as described in ETI Feb '80, including predrilled heatsink bracket, all nuts, bolts, silicon grease etc
..... ONLY $63.50 per module.

HEATSINK FOR "THE BRUTE"
This can be done in two ways as mentioned by ETI, i.e., you can make your own out of aluminium (which is not as easy as it looks and is very critical), or you can buy the **Philips 65D8C Heatsink for $29.50**
(N.B. This is the only commercial heatsink available in Australia that is recommended).

HEATSINK BRACKETS FOR POWER TRANSISTORS FOR 300 WATT AMP (Pre-drilled)
Could be used wherever four T03 case power transistors have to be clamped to a heatsink (also takes 4 x TO220 case transistor) ..... $5.00 pr.

All parts for ETI466 are available separately: ETI466 printed board $7.00; MJ15003 and MJ15004 transistors $5.00 ea; 2500 uf/80V Caps $3.90 ea; .1 ohm 5W Resistors 65c ea; 62 volt zener $1.00

PC-100C THERMAL PRINTER, PLOTTER – For use with T158/59. See your program at every step. Plot data and print out headings.
..... $284.00

POWER TRANSFORMER to suit "Brute"
Specially designed high power transformer ... 240V a.c. primary; Secondary: 2 x 47V @ 3A, 2 x 15V @ ¾A (96 x 114 x 110mm) $32.50

..... $32.50

FAN is also available (which runs directly off 94V a.c. secondary of power transformer $29.90

CASES suitable for 300 watt Amp or wherever a large case is required:–

RACK MOUNTING ETI4000 CASE
Beautifully designed (supplied in flat pack), satin anodised 1.6mm aluminium front and back panels, with surfaces suitable for screen printing etc. Top and bottom panels of hard wearing black "marviplate" with 1.0mm steel base. Side panels 3.0mm satin anodised aluminium with chrome handles.
Four aluminium extrusions are used to hold the top, bottom, front and back panels in position.
Size: 134mm(h) x 419mm(w) x 280mm (d) $55.00

WOODEN SIDED ETI4000 CASE
Exactly the same size and same materials as used in ETI4000 rack mounting case, except side panels are made of teak wood (13mm) for a really superb looking case.
..... ONLY $45.00

300 WATTS!

WHEN YOU START A JOB, YOU SHOULD FINISH IT ...
and that is exactly what we have done with the new ...
ELECTRONICS AUSTRALIA 300WATT PLAYMASTER AMPLIFIER ... We have dressed it up and put it into a beautiful case and ask us why it is not selling for $600 like similar commercial amps ... but no ... from just $220.00 (with wooden sided 4000 case) this magnificent 300 WATT POWER AMPLIFIER can be sitting in your lounge room and you'll also be able to say "I built it".

But if you want to build this amp in stages because you have some things you'd like to change, or you have some parts in the workshop or elsewhere ... or you don't like laying out your money in one lump sum, then we have the whole thing available in a number of sections.
... **COMPLETE KIT (including 300W module, power supply, speaker protector, chassis pack, fan & wooden sided case: $220.00 (with wooden sided case [4000]) $230** ..... (with ETI4000 metal rack mounting case)

CHASSIS & HARDWARE PACK FOR 300WATT P/M (EA July 80) (Less Case & Fan).

If you have made the amp module, the speaker protector and wish to put them all into a case with the power supply, then you'll need this pack to finish every thing off. It includes LED, binding posts, switch, extra resistors and capacitors, wire, front label, nuts, bolts and spacers.
..... ONLY $9.95

CASE: The ideal case for this amp is the rack mounting ETI4000 Case for $55.00 or wooden sided ETI4000 Case for $45.00 (shown elsewhere in this ad.)

MATT BLACK SPRAY ... 125gm can $2.50

P/M 300WATT LOUDSPEAKER PROTECTOR KIT (EA July 80)
For an amplifier of such enormous power output this "loudspeaker protector" is mandatory if you don't want your loudspeakers destroyed and it only costs $12.95
(includes PC board and all components)

AUDIO CROSSOVER CHOKES
Top quality, air-cored, high powered, low DC resistance crossover chokes.
Following many requests from our customers we now have these chokes so that you can design your own cross overs.
0.5 millihenries $7.00
1.0 millihenries $7.00
2.5 millihenries $7.50

POWER TRANSFORMER to suit Playmaster 300 Watt Amplifier $32.50

POWER SUPPLY TO SUIT 300WATT PLAYMASTER AMPLIFIER
INCLUDES TRANSFORMER & all necessary components to make up power supply kit complete.
..... $52.95

SPRITE FAN (4") 240V ac.
Recommended by EA for this project
..... ONLY $29.50

PLAYMASTER 300WATT AMPLIFIER module kit (EA June '80).
The full technical know-how of the 'Electronics Australia' staff has been put into designing this superb project.
The 300 Watt Amplifier Module Kit includes heatsink, thermal cut-out, nuts, bolts, silicon grease, micas, solder ... all you need is a soldering iron, screwdriver, a pair of cutters, drill ... and Stanley knife ... and it's a good idea to have a trusty multimeter ... (we have them from $9.50!)
..... MODULE KIT ... $75.00

WHAT ELSE DO WE CARRY?

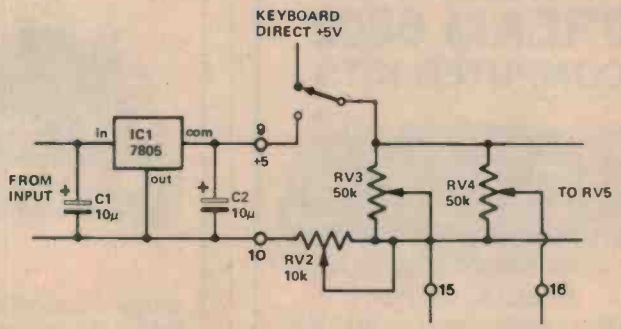
All electronic hardware (boxes, veroboard, PC board, etc.), tools, wire, cable, semiconductors, valves, Hi Fi, Kits, PA Equipment, Microphones, Speakers, Car Radios, Car Tape Players, Car Audio Accessories, intercoms, books, transformers, Resistors, Capacitors, heatsinks, coils, TV aerials and accessories, CB accessories and meters.

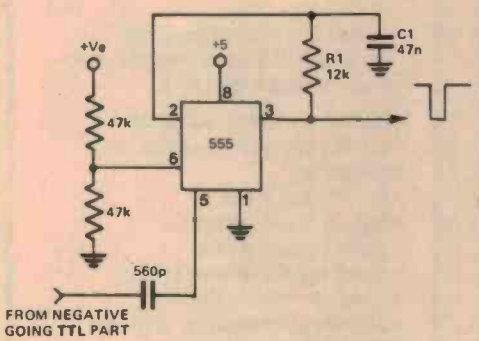
Ideas for Experimenters

Keyboard tracking for the ETI sequencer

Val Starr of Canberra, ACT, has made a small modification to our sequencer to allow it to track up or down in key with the keyboard, giving a very noticeable effect on short runs of four notes or so. This effect is used extensively on modern pop recordings.

The +5V line is broken between IC1 and RV3 and fed to a switch. The +5V supply can then be taken from the regulator as before, or from the keyboard for tracking.



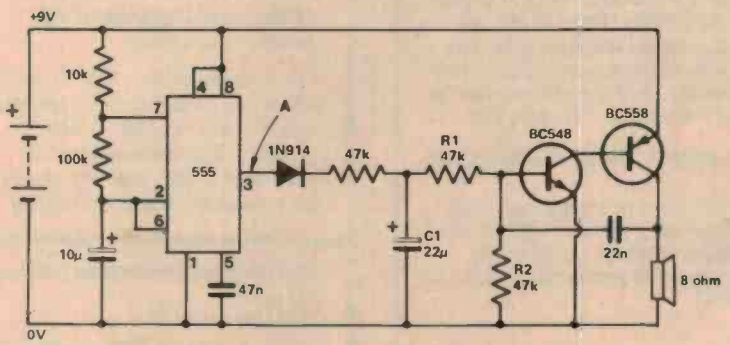


The 555 upside down !

Normally, a 555 is used with negative triggering for a positive output pulse but it doesn't have to be this way, as pointed out by **J.L. Elkhorne of Chigwell, Tasmania.** An inverted scheme can also be used, giving positive triggering and a negative-going output.

The lurk is to use the upper comparator in a different way by biasing the threshold port, pin 6, at half supply and using the control voltage port, pin 5, as the trigger input.

The pulse length is determined by the time constant of R1 and C1, the larger either value, the longer the pulse.



Siren circuit

This circuit simulates the sound of an American police car. Just the thing to stimulate a child's ebbing enthusiasm for an expensive Christmas present!

The 555 timer is used as a very low frequency oscillator giving regular charges to the 22u capacitor, C1. The capacitor discharges through R1 and R2 until the next pulse comes from the 555.

The changing voltage on the base of the first transistor changes the frequency of the oscillator, rising quickly in frequency and falling slowly.

Flashing LEDs can be added with a current limiting resistor at the point marked 'A'. Submitted by **David Brighton of Huonville, Tasmania.**

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 USERS CLUB

Monthly newsletter featuring programmes, hardware and tips. The first issue is September and costs $4.00. A free issue is sent to those who submit programmes that are accepted for publication. Interstate members welcome. Send cheque or money order to:

NSW 6800 Users Group, 27 Georgina Ave, Kelraville, NSW, 2500.

DREAM 6802
COMPUTER KITS

SPECIAL OFFER

All orders received this month will receive a Software Manual at no extra charge. The prices shown have not changed since 1979, are limited to current stock, so be quick. Send the coupon or place a phone C.O.D. order.

DREAM 6802 KIT $149 incl. cabinet and keyboard. **1 Amp Power Supply Kit $29. 3 Amp P.S. Kit $45. R.F. Modulator $3.** The Dream 6802 is the ideal way to "get into" computing. By building it yourself, you learn more and save money at the same time. It is one of the most popular projects ever published by Electronics Australia, and has been chosen by a number of Technical Colleges as the basis for courses.

- Top quality keyboard and components
- Tinted perspex display case
- Pre-tinned fibreglass P.C. board has a component overlay for easy assembly
- Service is available at a nominal charge.
- The 1 Amp Power Supply can supply the Dream only, while the 3 Amp unit has more than enough capacity to supply the expansion board as well.
- The R.F. Modulator allows the computer to be connected to the aerial socket of your TV.
- Money back guarantee. Examine the kit for 7 days (without removing the I.C.'s from their packaging) and if not satisfied return it for a full refund.

EXPANSION BOARD KIT $99.50

Available early October.

Provides extra memory and control functions to enable your Dream to interface with outside equipment, keyboards, etc. Comes complete with fibreglass P.C.B. (Dream-sized), 3K RAM and 1xPIA with sockets, select logic, tri-state buffers, plugs and ribbon cable, and instructions. In addition it also has provision for an Eprom and an extra PIA with full buffering. Designed to fit neatly inside the display case. Phone for details of Sydney counter sales.

Cut out or copy coupon.

- ☐ Dream 6802 kit ..... $149.00 ea.
- ☐ 1 Amp P.S. kit ..... $29.00 ea.
- ☐ 3 Amp P.S. kit ..... $45.00 ea.
- ☐ Expansion Kit ..... $99.50 ea.
- ☐ R.F. modulator ..... $3.00 ea.

Post and packaging $2.50
C.O.D. (optional) ..... ($2.00)
Total .....

Name .....

Address .....

Postcode ..... Phone No. .....

Signature .....

This order is subject to a 7 day money back gtee.

J.R. COMPONENTS

P.O. BOX 128, EASTWOOD, NSW 2122. Phone: (02) 85-3385.

ATTENTION CONNOISSEURS OF HI-FI

Woodland Audio introduces a Turntable Base that effectively improves the performance of the renowned Connoisseur BD1 Turntable Kit.

Advantages of selecting the Woodland Audio Turntable Base:

- Helps eliminate Feedback
- Produces a tight, clean, and detailed sound
- Enhances stereo image and separation
- Increases Dynamic range
- Is aesthetic in appearance

The Woodland Audio Turntable Base can be installed in minutes as a replacement for your present base or as an excellent choice of base for a new Connoisseur BD1 Kit.

The base is manufactured from high density materials and laminates to ensure a rigid, no-compromise turntable platform that successfully dampens vibration. It has been designed for the audiophile who requires maximum musical satisfaction from the BD1 Kit.

The Woodland Audio Turntable Base is available in three tasteful veneered finishes either direct from the manufacturer or in Brisbane from Stereo Supplies, Roma STreet, City.

Pictured above is the Woodland Audio Turntable Base with the Connoisseur BD1 Kit, Grace G707 Tonearm, EEI MC 555 Moving Coil Cartridge and Micro Shock Absorbing Feet.

TO BUY DIRECT FROM THE MANUFACTURER:

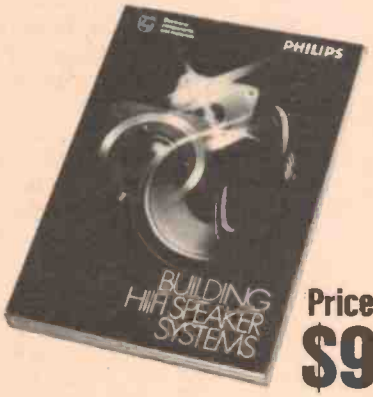
- simply select the required veneer finish.
  ☐ Knotty Pine ☐ Teak ☐ Matt Black
- send details of tonearm to be used
- enclose cheque or postal order for $96 (add $5 freight)

MAIL TO:

Woodland Audio
50 Sherbrooke Road,
Acacia Ridge, 4110,
Brisbane.

TRADE ENQUIRIES WELCOME

The definitive book on speaker enclosure design and construction.



Price: $9.*

Since its first publication in 1969 "Building Hi-Fi Speaker Systems" has become a classic in its field.

And now, in a completely updated seventh edition, this book contains chapters on:

- the nature of sound
- high fidelity and realism
- power considerations
- loudspeaker & enclosure theory
- crossover network theory
- listening room acoustics and room placement of loudspeakers

And it includes constructional details of 19 new enclosure designs which can be built using Philips quality speakers.

All this in plain language for the non-technical layman.

This book is a definite must for anyone who wants a superior sound system at less cost and, at $9.00*, you have nothing to lose, and a new fund of knowledge to gain, even if you have no plans to get into home construction.

Philips Electronic Components and Materials
P.O. Box 50
LANE COVE, N.S.W. 2066

Please send me a list of Philips dealers where I may purchase this book and further information on Philips loudspeakers.

*suggested retail price only

NAME _____
Please Print
ADDRESS _____
_____ STATE _____ P'CODE _____

Electronic Components and Materials

PHILIPS

ETI

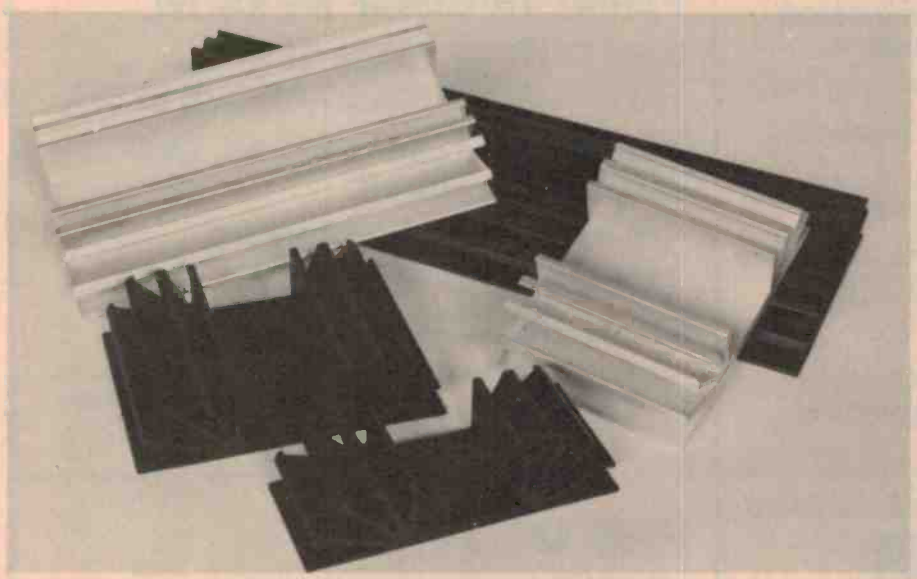
AHEARN EL27

Shoparound

The 3080 IC

This useful little chip, featured in Lab Notes this month, is made by RCA and National Semiconductors. You'll find it labelled CA3080 (from RCA) and LM3080 (from NS). It is available in both metal can and DIL packages. Either make or package is suitable for the circuits suggested in Lab Notes. To the best of our knowledge, at time of going to press, the following firms sell the 3080: In Melbourne — Ellistronics and Radio Parts in the city, Rod Irving in Northcote, Semis Unlimited (mail order only) and Tasman Electronics in Coburg. In Sydney — Radio Despatch Service in the city and Electronic (distributors) in Pendle Hill.

No trouble should be experienced finding parts for the Scratch and Rumble Filter or the LED Voltmeter.



This heatsink, made locally by Rod Irving Electronics, is available in a variety of lengths, both anodised and unanodised. It measures 105 mm wide overall and the centre section is 35 mm wide by 5 mm thick. There are five fins on each side and a 220 mm length (anodised) has a thermal rating around 1°C/watt in free air. See Rod Irving Electronics, 425 High Street, Northcote Vic. 3070. (03)489-8131.

AM Tuner

The tuned circuits in the AM tuner are designed to give a constant bandwidth across the tuning range, the correct 'Q' for the desired bandwidth and good rejection of adjacent stations. The pot cores cannot be substituted with ones of a different size, material, or 'ue' value. Philips have agreed to make stocks available ahead of time so supplies should be obtainable by the time this issue goes on sale.

The dual tuning gang and vernier drive are available from most suppliers (except Dick Smith who doesn't stock the tuning gang or pot cores). Alternatively, both are available from Watkin Wynne, 32 Falcon Street, Crows Nest NSW 2065. Make sure your vernier drive has a flange with tapped holes to mount the dial plate.

If you don't want to build your own box many suitable ones are available. Try something from the Horwood range, which are common and inexpensive.

Project price estimates

This information is published as a guide and a variety of factors may affect the actual price of a project, whether obtained as separate components or as a kit.

ETI-475 AM Tuner	$65 - $80 (depending on case)
ETI-326 LED Voltmeter	$10 - $13
ETI-457 Scratch and Rumble Filter	$25 - $30 (stereo version)

THE INCREDIBLE A.E.D. S100 Terminal

THE UN-SERIAL

MORE FEATURES! MORE SPEED! MORE SALUBRIOUS THAN ANY SERIAL TERMINAL WE KNOW.

CAN OUTPERFORM SERIAL TERMINALS PRICED ABOVE $2300.

YET ONLY $1350 + SALES TAX FULLY INCLUSIVE.

'CP/M' PATCH SOFTWARE AVAILABLE FROM A.E.D.

THE TERMINAL YOU DESERVE!

This memory mapped terminal can be configured to have the intelligence of top serial terminals such as Hazeltine, Lear Siegler, Soroc 'etc' without eye strain and sludgy slow speed.

STANDARD ARE ALL THE FEATURES YOU WOULD LIKE BUT WERE AFRAID TO ASK THE PRICE OF.

- WIDE, 16 MHz BANDWIDTH.
- 160 x 96 GRAPHICS FOR BUSINESS AND TREND ANALYSIS, CURVES, BAR CHARTS ETC.
- HALF TONE, UNDERLINE, BLINKING, STRIKE THRU, REVERSED VIDEO, BLANK OUT, OR ANY COMBINATION OF THE SCREEN AT ONCE.
- SHARP, GREEN PHOSPHOR SCREEN.
- CONTRAST ENHANCING FILTER.
- SUPERB, SCULPTURED WORD PROCESSING KEYBOARD.
- STRONG WELL ENGINEERED HOUSING SCULPTURED FROM SOLID TIMBER AND METAL.

ALSO WE CAN PROVIDE 256 x 256 OR 512 x 256 HIGH RESOLUTION GRAPHICS AS AN OPTION.

WE ARE NOW GAINING A NAME FOR OUR 8" DISK SYSTEM FOR

SORCERER

- 8" IBM SINGLE AND DOUBLE DENSITY.
- 600K BYTES PER DISK — ALMOST TWICE AS MUCH AS QUAD DENSITY 5" SYSTEMS.
- MORE SPEED AND DATA RELIABILITY THAN 5".
- CP/M PROVIDED FULLY INTEGRATED WITH THE SYSTEM.
- CAN READ AND WRITE SINGLE DENSITY AS WELL AS 256, 512 OR 1,024 BYTE DOUBLE DENSITY FULLY TRANSPARENT TO THE USER.
- PRICED GENERALLY LESS THAN MICROPOLIS 5".
- INCLUDES SHUGART DRIVE(S), CABINETS, CABLE AND CONTROLLER + CP/M DISK OPERATING SYSTEM.

PRICED FROM $1285.20+ SALES TAX

DESIGNED BY GEORGE MORROW, THE GUY MOST INSTRUMENTAL IN WRITING THE IEEE SPEC FOR S100

SEE US FOR:

- SYDNEY'S BEST VALUE IN STATIC RAM BY GEORGE MORROW.
- VIDEO CARDS, I/O CARDS ETC.
- PROTOTYPING BOARDS, SOCKETS WIRE WRAP "SLIT AND WRAP".
- DRIVE CABINETS FOR YOUR REMEX, SHUGART OR SIEMENS DRIVES.
- KEYBOARDS AND ENCLOSURES.
- S100 CABINETS.
- COMPUTER FURNITURE.
- VIDEO MONITORS "WIDE BAND WITH GREEN PHOSPHOR".

IN FACT, ALL YOUR S100 NEEDS.

ACOUSTIC ELECTRONIC DEVELOPMENTS PTY LTD

MICROCOMPUTER PRODUCTS

123 Military Road, Guildford, NSW 2161. Phone (02) 632-6301 (02) 632-4966. Telex AA25958.

LETTERS

Dear Sir,

For some reason best known to themselves, Riddell Exhibitions did not send me an invitation to this year's fifth Consumer Electronic Show (whatever happened to Intelect '80?) in Sydney, so I didn't know when the trade sessions were scheduled. Curiously, July ETI's lavish guide to the CES was crammed with information about everything except when the damned thing was on. By the time I got around to calling Riddells in Melbourne, the trade sessions were over so I had to front up with the great unwashed, pay my $2, and honestly, it really wasn't worth it.

In fact, I fail to see the point of having the show at all. Indeed, if the average exhibitor annot rustle up a little more energy, enthusiasm and imagination than was evident this year I wonder why they bother. (ETI naturally excepted!). Flair would be going too far!

My impression is that important exhibitors *are* staying away (maybe in favour of the specialised hi-fi and computer shows?). No doubt the organisers will say space bookings were a record, but they have gone way down-market with Sanyo predicably dominant and half-a-dozen side shows selling funny telephones and computerised handwriting analyses and biorhythm charts. For heaven's sake!

My impression *may* be distorted by the boredom which quickly set in after half-an-hour of seeing nothing that's not on display in any large regional shopping centre.

It happens that this year, apart from my professional interest, I am in the market for a hi-fi system. Where were Technics? Where were Sharp? RetraVision had a Sharp display with four women demonstrating microwave ovens and one beleaguered male managing everything else. No, he didn't have any literature on calculators (heavy Sharp sales campaign currently), the kids pinch it all. Optonica? Forget it! In fact, there was virtually no literature available anywhere. No one manning the JBL stand. Bose were solely into car stereo. The supposedly informative descriptions on the Marantz display bore no relation to the systems displayed beside them!

I did unglaze my eyes momentarily to glance at Pioneer's laser video disc display. Although the monitor picture quality was only slightly worse than the receiver in an average country motel, it was nonetheless highly educational, being the first time I've ever seen what looked like multipath transmission from closed circuit TV!

John J. Howard
Aust. Film & Television School

Well, John . . . if you pick up your (I expect) dog-eared copy of the July ETI, turn to page 67 and read the first paragraph of the "lavish guide", you will find the dates of the (now passed) Consumer Electronics Show. Unfortunately, at time of going to press, we could not inform readers of trade times or general exhibition hours — we didn't know them! Newspaper and radio advertising prior to, and during, the C.E. Show gave the information. Still, our omission didn't help.

As for the great unwashed . . . they didn't come onto the ETI stand!

Getting back to the point, viz: having the show, it seems the raison dè être is:-

(a) To launch new products
(b) Generate sales prospects and
(c) hopefully, stimulate sales

The Show also serves to put companys' names 'on the map'.

*The fifth C.E. Show (***Incorporating** *Interlect '80 — which was to be the show's 'new' name) was broadened to include any product which "plugged into a three-pin outlet or ran off batteries". Hence the proliferation of 'white goods' and other domestic products. For someone 'in the business', your view is probably close to being saturated. For the "great unwashed", exposure is probably considerably less. Certainly, attendance was massively up on last year. This year's Saturday/Sunday attendance exceeded last year's* **total** *attendance by a wide margin.*

From the sound of it, you missed a personal guided tour of the Marantz stand by the Penthouse Pet. She was probably on the Bose stand while you were at Marantz's, and on the Marantz stand . . . etc. Bose had a speaker demonstration room and ran audio-visual sessions. Perhaps you thought it was their back room? You seem to have missed Philips' and JVC's video disc demos, too.

Ah, well. Next year you can pack a picnic lunch and yodel out to Yennora . . .

Full report on the fifth C.E. Show from master show reporter and journalist extraordinaire, Dennis Lingane, next issue.

Roger Harrison Editor

Australia's first under $300 COMPUTER...

$295
INCL. ZX80 BASIC MANUAL

Remember — *all prices shown include sales tax, postage and packing.*
N.B. Your Sinclair ZX80 may qualify as a business expense.

sinclair ZX80 -British made.

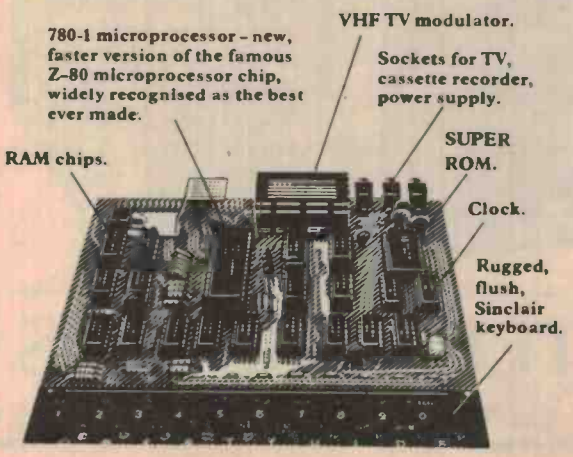
Until now, building your own computer could cost you around $600 — and still leave you with only a bare board for your trouble. The Sinclair ZX80 changes all that. For just $295 you get everything you need including leads for direct connection to your own cassette recorder and television. The ZX80 really is a complete, powerful full-facility computer matching or surpassing other personal computers costing much more. The ZX80 is programmed in BASIC and you could use it for anything from chess to running a power station.

Two unique and valuable components of the Sinclair ZX80: the Sinclair BASIC interpreter and the Sinclair teach-yourself BASIC manual. **The unique Sinclair BASIC interpreter:** offers remarkable programming advantages — unique 'one touch' key word entry. The ZX80 eliminates a great deal of tiresome typing, Key words (RUN, PRINT, LIST etc) have their own single key-entry. Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately, preventing entry of long and complicated programs with faults only to discover them when you run.

Excellent string handling capability — takes up to 26 string variables of any length. All strings can undergo all rational tests (e.g. comparison). The ZX80 also has string input to request a line of text; strings do not need to be dimensioned. Up to 26 single dimension arrays. FOR/NEXT loops nested up to 26. Variable names of any length. BASIC language also handles full Boolean arithmatic, conditional expressions, etc.

Exceptionally powerful edit facilities, allows modification of existing program lines. Randomise function, useful for games and secret codes. Timer under program control. PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine. **High resolution graphics** with 22 standard graphic symbols. **The Sinclair teach-yourself-BASIC manual 96 page book free** with every kit.

Fewer chips, compact design, volume production means MORE POWER FOR YOUR DOLLAR! The ZX80 owes its low price to its remarkable design; the whole system is packed onto fewer, newer more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer because the ZX80's brilliant design packs the RAM so much more tightly. (Key words occupy just a single byte). You can add to the memory via the expansion port, giving a maximum potential of 16K.



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308 High St., Kew 3101. Vic. Tel. 861 6224.

Quantity	Item	Item Price	Total
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price incl. ZX80 BASIC manuale excl. mains adaptor.	$295.00	
	Mains Adaptor(s) (600Ma at 9V DC nominal unregulated).	$ 9.50	
	Memory Expansion Board(s) takes up to 3K bytes.	$ 28.50	
	RAM Memory chips — standard 1K bytes capacity.	$ 10.00	
	Sinclair ZX80 Manual(s) free with every ZX80 computer.	$ 15.00	
I enclose cheque/Bankcard/ Diners Club/Amex		TOTAL	

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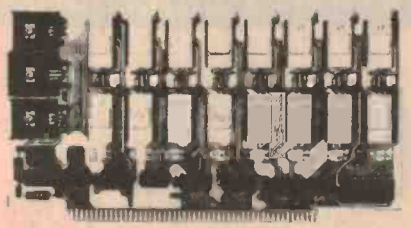
S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS



$89.50 KIT

FIRST TIME OFFERED! BLANK PC BOARD - $39

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

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8K LOW POWER RAM KIT-S 100 BUSS

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21L02 (450 NS RAMS!)

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

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ALL ASSEMBLED BOARDS ARE TESTED AT 4MHZ.

Blank PC Board w/Documentation **$44**

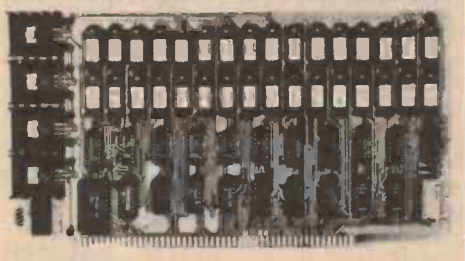
Low Profile Socket Set..13.50

Support IC's (TTL & Regulators) **$13**

Bypass CAP's (Disc & Tantalums) **$7**

16K STATIC RAM KIT-S 100 BUSS

KIT $249
A&T $279



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA **$49**

LOW PROFILE SOCKET SET **$19**

SUPPORT IC'S & CAPS **$27**

ASSEMBLED & TESTED-**ADD $30**

OUR #1 SELLING RAM BOARD!

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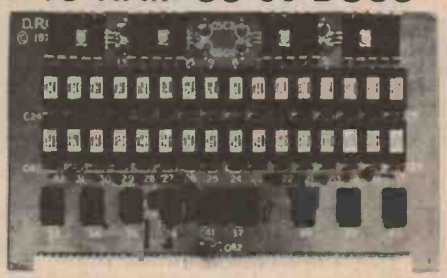
FULLY STATIC AT DYNAMIC PRICES



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $30

KIT FEATURES:
1. Addressable on 16K Boundaries
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3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers
5. All Parts and Sockets Included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD— **$39** COMPLETE SOCKET SET— **$19**
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ITOH Model 8300 PRINTER. $770 plus 15% sales tax.

This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.
A bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4½ to 9½ inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/ programmable tab positions, top of form and bottom of form for complete formatting capabilities.

RITRON 8 SLOT MOTHERBOARD: KIT $65.90 inc. tax.
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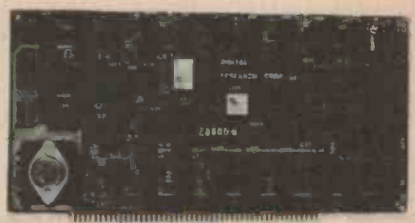
Write for list of other power supplies. Tax free prices also available.

S-100 Z80 CPU CARD

Perfect for OEM's

$199.00 Wired & Tested

4 MHZ



ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a TRUE S-100 Z80 CPU at a genuinely bargain price!

BRAND NEW!

FEATURES:
★ 2 or 4 MHZ Operation. ★ Generates MWRITE, so no front panel required.
★ Jump on reset capability. ★ 8080 Signals emulated for S-100 compatability
★ Top Quality PCB. Silk Screened. Solder Masked. Gold Plated Contact Fingers

JUST WRAP KIT - JWK-6 $39.50

● 50ft ea. blue, white, red, yellow wire ● Just Wrap Tool ● Unwrap Tool

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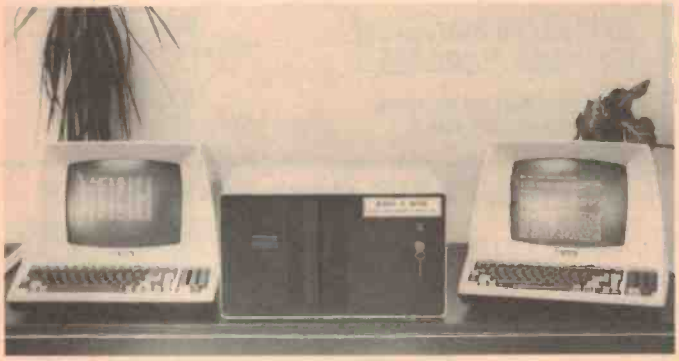
10M hard disk is first for new microcomputer



The new Opal microcomputer system, just released here by John F. Rose Computer Services, is believed to be the first S-100 microcomputer to incorporate an SA 1004 10M hard disk by Shugart.

Manufactured by NNC Electronics of Huntington Beach, California, the Opal employs a Z80 microprocessor and features an 8-slot S-100 system.

The CPU card is by Delta Products and runs at 4 MHz. It incorporates two RS232c serial ports and three fully buffered 8-bit parallel interface ports.

The unit comes fitted with a 4 MHz 64K dynamic RAM board, by Measurement Systems and Control, fully bank selectable and designed for upgrading to a multi-user system.

In addition, you get one 8" (uh, 203 mm) Shugart floppy disk drive of 240K capacity with a Delta Products Disk Controller and CPM version 2.2 operating system. Price ? — only $7700 !

You can order single or multi-user configurations. For multi-user use, the Opal comes with 128K of RAM plus MPM set up for two users. You get two serial ports set up for two users and one of the parallel ports for a printer. All for $9345 plus the inevitable sales tax (if applicable).

John F. Rose is also releasing an Ampex "5 + 5" top-loading hard disk cartridge system. (Five megabytes fixed and five removable). This, together with MPM and CPM software, hard disk controller S100 interface and timber desk top case — fully set up for any Opal system — is expected to cost around $8500.

While we're at it, John F. Rose also has available an SMD hard disk controller capable of handling up to 600M on line!

We were fortunate to see a first-shipment Opal demonstrated by NNC Electronics' "big chief", Alexander 'Sandy' Watson, just before going to press. File management was impressively fast and it can sure play a mean game of 'Adventure'.

Further details from John F. Rose Computer Services, 33-35 Atchison St, St. Leonards NSW 2065. (02)439-1220.

Light pen for System-80

A new low cost light pen designed for use with the popular System-80 microcomputer has been released by Dick Smith Electronics along with suitable software.

Designated Cat. No. X-3645, the new light pen replaces an earlier imported product sold under the same number which had become unavailable. The new pen is being locally assembled and is also being sold separately from the software. This has enabled a drastic price reduction: the pen itself, sold with instruction brochure, now sells for only $95.

Two demonstration software programs are available on cassette tape as a separate product. One program is a 'naughts and crosses' game, while the other provides a sample 'menu selection' routine. The two come together on cassette as Cat. No. X-3647, which sells for $11.95. So the X-3645 light pen and X-3647 software cassette can both be purchased for a total of $21.90 — a saving of no less than $7.60 compared with the earlier product. The light pen is compatible with the TRS-80 Level II, also.

DSE is also offering SKETCH-80 which can be used with the new light pen to 'sketch' diagrams, patterns and other graphics directly on the System-80 video screen. Designated Cat. No. X-3646, SKETCH-80 comes on a tape cassette with accompanying instruction booklet and sells for $17.95.

The new light pen and accompanying software products are available from Dick Smith Electronics branches in each state.

Beehive Burroughs emulator

Datatel has released a new microprocessor-based communications terminal by Beehive International, the Micro 4400.

The Beehive Micro 4400 does not require a controller as it emulates Burroughs' TD 700/800 series terminals and enhances Beehive's DM series product line array of smart terminals.

For custom OEMs, the Micro 4400 features the ability to support special protocols conforming to particular applications and offers variation of known protocols.

Features include: large displayable character set, upper/lower case, numeric keypad, printer interface, detachable keyboard, scrolling, background printer operation, line drawing capability, and program attention/programmable function keys.

Another outstanding feature claimed for the unit is its unique printer control capabilities. The Micro 4400 supports both serial and parallel interfaces, as well as local and communications printers on a concurrent basis.

In a polled environment the printer address may be shared or independent of the terminal group address.

The basic Micro 4400 is supplied with 16K of RAM which may be expanded to 32K. The RAM is used for display (up to 120 lines accessed by scrolling), I/O printer data and 16 user-definable function keys.

The hardware has been specifically designed to allow extensive checking by the self test diagnostic and thus provides the operator with a high level of confidence in the terminal.

For further information, contact: Datatel Pty Ltd, 3 Raglan Street, South Melbourne Vic 3205. (03) 690-4000.

Tasmanian societies

The Darth Amateur Computer Society writes to tell us that their name has been changed to the Tasmanian Electronic and Microcomputer Oriented Society (or TEMOS). Only the name has changed, everything else is the same.

Unfortunately, last time we mentioned this group we misprinted their address. The correct address is 4, Melinga Place, Taroona, Tas. 7006. Sorry!

And we've just heard about the **Small Computer Users Group**, which meets on the first Tuesday of each month at 7.30 pm at the Computer Centre, Elizabeth Matriculation College, North Hobart. Anyone interested should phone Steve on 23-2211 or write to P.O. Box 474, Sandy Bay, Tas. 7005.

Zilog offers 6 MHz Z8000

A faster version of the advanced Z8000 16-bit microprocessor circuit has been announced by Zilog which will run at a clock rate of 6MHz, a 50 percent improvement over the 4MHz rate of the earlier version.

The 6 MHz Z8000 is available in two package types for different applications. The segmented Z8001A, in a 48-pin dual-in-line package, permits the user to address up to eight megabytes of memory for highly memory-intensive applications. The non-segmented 40-pin Z8002A allows addressing of 64 kilobytes of memory for less memory-intensive uses.

When used with Zilog's Z8010 Memory Management Unit, the Z8001A can offer high performance and a memory addressing range of up to 48 megabytes.

According to Janak Pathak, the Z8000 product marketing manager, the 6 MHz Z8002A is ideally suited for use in high-speed controllers; the Z8001A has applications in the design of new systems requiring higher system throughput, such as distributed processing systems.

The Z8001A is priced at $21.25 and the Z8002A at $187.50 each in quantities at 10-99. Both devices, which comes in ceramic dual-in-line packages, will be available in sample quantities in the third quarter of 1980, and in small production quantities by the fourth quarter.

For further information please contact Zilog Australia Products; Sydney (02) 438-4533, Melbourne (03) 656-1420, Brisbane (07) 36-3396 and Perth (09) 272-6611.

Single board video terminal

With everything but the CRT and the power supply packed in, the KTM-2 from Synertek provides a complete video terminal on a 406 x 172 mm board.

The new terminal board offers a 54-keyboard 24 x 40 (Model KTM-2) or 24 x 80 (Model BTM-2/80) character display generation with full ASCII upper and lower case characters and descenders, and 128 graphics characters.

In addition, the board does scrolling and reverse and performs full cursor control as well. To do all this, the KTM-2 uses two microprocessors, instead of a CRT controller chip.

Two RS232-compatible serial ports operate from 110 to 9600 baud. If TTL serial levels are required, all the board needs is a 5 V supply capable of delivering from 1 A.

Other standard board features include switch-selectable 50 Hz or 60 Hz operation, composite video or discrete video outputs, display scrolling, absolute or relative cursor addressing interface/no-interface, and operating models by characters, line or page. Also local editing with character insert/delete, line insert/delete, erase screen/line, transmit page/line, truncate/not-truncate at end of line, four levels of character intensity, auxilliary RS232 port for printer interface etc.

The BTM-2 can readily be customized for any application just by changing the program ROMs. Both the character set and the key functions can be altered since the basic 54-key matrix is simply scanned by one of the microprocessors and the key functions are defined by the software.

According to distributors Royel Micro Systems, the combination of high capacity and low cost puts the KTM-2 well out in front of most well known terminal units.

Literature is available from Royel Micro Systems, 27 Normaby Road, Notting Hill Vic 3168. (03) 543-5122.

WHY IS THIS AUSTRALIA'S FASTEST SELLING COMPUTER?*

*OVER 900 SOLD IN 12 WEEKS!!!

Simple. It is far and away the best value computer available in Australia

We admit it: Australia's fastest selling computer **was** the TRS-80. Was. It has now been well and truly beaten by the remarkable System 80 from Dick Smith Electronics. It has TRS-80 compatible level II BASIC **as standard**. So the huge software range which has been written for the TRS-80 is compatible! Not only that, it has S-100 bus expansion capability: so the huge range of S-100 hardware will be useable on the System 80!

- **Level II compatible BASIC as standard**
  (Tandy charge extra for level II)
- **Industry standard S-100 bus expansion**
  (They use their own non-standard system)
- **RF output: uses any TV set as a monitor**
  (You have to buy a true video monitor with theirs)
- **Two motor controlled cassette interfaces**
  (Theirs only has one)
- **Inbuilt cassette deck (no inter-connections necessary)**
  (Their cassette deck is completely separate)
- **Inbuilt power supply (no inter-connections)**
  (Tandy power supply must be connected up)
- **AND THE BEST PART OF ALL: IT IS MUCH CHEAPER THAN THE TANDY EQUIVALENT!**

Send for our FREE Computer Comparison Chart

DICK SMITH SYSTEM 80

4K RAM WITH LEVEL II BASIC $670.00
Cat X-4003

16K RAM WITH LEVEL II BASIC $750.00
Cat X-4005

Terms available to approved applicants

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	30 Grose Street,	PARRAMATTA	Ph 683 1133
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	842 Gympie Road,	CHERMSIDE.	Ph 59 6255
ACT	96 Gladstone Street,	FYSHWICK.	Ph 80 4944
SA	60 Wright Street,	ADELAIDE.	Ph 212 1962
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EPROMS make excellent loggers

Erasable PROMs have proved very successful and reliable for unattended data logging in remote areas.

Their most successful application so far is in automatic rainfall recorders, which used to present a tricky problem.

Because rain comes only rarely in the outback, continuous chart recorders are impracticable — they would generate vast amounts of blank paper or magnetic tape during the long dry spells. But a sampling recorder could easily miss the typically brief periods of intense rainfall — and still waste a lot of paper.

The DRF77 rainfall recorder, developed by Measuring and Control Equipment (MACE) for the Sydney Water Board, neatly solved the problem by using an EPROM to record the instant when a water collecting cup fills with an inch of water and tilts, closing a contact.

A quartz crystal oscillator updates a 16-bit register every minute or two minutes. When the tilting cup contact closes, the contents of this register are programmed into a 2716 or 2732 EPROM. The EPROMs are contained in modules that plug directly into the recorder and the same plug can be used to match the module to a computer or graphic plotter. Once read, the EPROMs can be easily bared for erasure and covered for re-use.

The units only draw significant power when they are actually recording an event so only a small power supply is needed — a 12 volt 900 milliamphour battery which can be recharged by solar cells. They will run completely unattended until either the EPROM has stored 4095 events or the timing register overflows, which happens after 45 days with one minute resolution, or 91 days with the two minute timing interval.

DFR77s have been in operation for around three years now and over a hundred instruments are in the field. MACE also use EPROMs for recording analogue quantities such as river levels. They are now updating their system to use the latest 64K EPROMs and a low power multichannel microprocessor version is under development.

More information from Measuring and Control Equipment Co. Pty. Ltd., 24 Chester St, Epping, NSW 2121. (02) 86-4060.

Wizard matrix printer

The NDK S4000 dot matrix printer, recently released by John F. Rose Computer Services, can print subscripts, superscripts and scientific or mathematical symbols.

Featuring a 16-wire head, this machine can handle most paper widths, variable size characters, user-defineable characters and overprinting. The distributors claim the S400 has 2000 hours mean time before failure and you can obtain one for $3105 (plus S/T), complete with six month warranty.

See John F. Rose Computer Services, 33-35 Atchison St, St. Leonards NSW 2065. (02)439-1220.

Getting down to BASICs

Have you always wanted to know about BASIC but were afraid to ask? Banish embarrassing ignorance with one (or more) of four books reviewed here by Elaine Ray.

Introduction to BASIC — A Structured Approach
Chris R. Siragusa

A good book for beginners. Mr Siragusa assumes no previous knowledge of the subject, only an interest in computers and a knowledge of High School algebra. He begins with a resume of the history of computer science and advances step by step to the final chapter on debugging techniques. The book is well designed, with excellent graphics, flowcharts and structural programming information.

Business BASIC
Robert V. Bent and George C. Sethoris

This is great for the first time business user with no previous computer or programming experience. There's a brief look at hardware and software, leading on to exercises in problem solving and the first program. Small business users who have ingested the contents of this book will be able to converse on much more equal terms with slick salesmen and white-coated experts.

BASIC Stephen C. Lawlor

A really comprehensive guide to the subject that should answer every question you're likely to ask. The instructions and flowcharts are clear and the examples are realistic and credible. The glossary is first rate — every piece of computer jargon you're likely to come across is listed with a concise definition.

Applied BASIC programming
Roy Ageloff and Richard Mojena

This is best described as an in-depth course for those who already have a little knowledge of the subject. Topics covered include the impact of the computer, computer systems and perhaps the most delightful chapter of all, 'Before You Leap'.

If you want to know more about any of these books, you can write to Michael Smith, manager of the Wadsworth Publishing Company (A'Asia), P.O. Box 278, Artamon, NSW. Or phone (02)439-8781.

WOW! SOUND EFFECTS FROM YOUR SYSTEM 80!

(Also suitable for TRS-80 Level 11)

SOUND OFF!

Yes! At last there is an add-on sound effects generator for your System 80 or TRS-80 level II computer. It will give you exciting music synthesis and sound effects facilities that you haven't had before!

Add another exciting dimension to your computer with this superb system.

Here's what you get:

- **A battery powered amplifier unit which connects to the 16K System 80 or TRS-80 computer via the normal external cassette recorder cable.**

  A software cassette, which tells the computer how to manipulate its cassette interface. On one side of the cassette is a sound effects demonstration program; on the other a 'patch' program, designed so that the user can combine sound effects with almost any other BASIC programs!

- **Plus a very comprehensive 8 page user's manual to tell you what is going on, and how to change the system to suit your particular requirements.**

'SOUND-OFF' PACKAGE:

Includes amplifier module, software cassette and very comprehensive user manual:

ONLY $19.50

Cat X-3648

Hurry! Limited stocks available at present!

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GREAT NEWS for System 80 and TRS-80 owners . . .

We can now offer the lowest cost light pen EVER!

Due to the incredible popularity of these light pens we're now getting them assembled locally – you reap the benefit of lower production costs!

So now you can give your System 80 or TRS-80 Level II an 'eye', for even less than before . . .

- **Uses external cassette recorder as a preamplifier**
- **Comes complete with full instruction details, how to get your programs to use the pen, etc.**
- **Save time! Uses matching software cassettes, also available:**

Demo Cassette: Has noughts and crosses game, sample 'Menu' program. Cat X-3647 **$11.95**

SKETCH 80: Lets you use the light pen to 'sketch' on the screen! You can also save 'sketches' in memory. Cat X-3646 **$17.95**

Cat X-3645 **$9.95!!!**

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	656 Bridge Road,	RICHMOND.	Ph 428 1614
QLD	166 Logan Road,	BURANDA.	Ph 391 6233
	842 Gympie Road,	CHERMSIDE.	Ph 59 6255
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Print-out

Printer interface for System-80

A low cost parallel printer interface for the System-80 microcomputer has been announced by Dick Smith Electronics. The interface plugs directly into the expansion connector on the rear of the basic System-80 machine and provides all of the interfacing logic necessary to drive a Centronics-type parallel printer.

It is intended specifically for low-end applications, where the full facilities of the System-80's S-100 Expansion Interface are not required, nor its cost justified.

The new interface is designated as Cat. No. X-4012, and sells for $89.50. It comes complete with instructions and a printer interconnection cable, terminated in the standard 57N-36 connector used with most printers having a Centronics-type parallel input.

For those without a suitable printer, Dick Smith Electronics also offers the X-3255 dot-matrix printer, a compact 125 character/second model priced at $970.00.

No special software is required in order to use the X-4012 interface and a printer with the System-80 computer, as the machine's inbuilt Level-II Microsoft BASIC interpreter already provides the necessary LLIST command and LPRINT statement.

The X-4012 Printer Interface is available from Dick Smith Electronics branches in each state.

Mod. for BASIC ROMPAC

There is now a better way available to write programs for the Exidy Sorcerer with a new "extended" version of the Exidy BASIC ROMPAC.

The new BASIC comprises a hardware modification to an existing ROMPAC and the exchange of two ROM chips.

The language becomes considerably more powerful with the addition of full line editing and block deleting functions along with a fully selective renumber function. This allows the complete restructuring of a program without destroying its integrity.

Programs can be instantly recovered after a reset (remember the program you lost after that mains spike ?). In addition, most of the known bugs of the original have been fixed, according to Software Source, the firm marketing the mod.

Software Source, of P.O. Box 364 Edgecliff NSW, call it "Basic Mod 1.01" and market it on an exchange basis as a fully-assembled and tested unit, or as a two-chip hardware kit with instructions.

Interface for System-80 has floppy disk controller & I/O ports

An Expansion Interface unit for the popular System-80 microcomputer has been announced by Dick Smith Electronics.

The interface plugs directly into the expansion connector on the rear of the basic System-80 machine, and provides all of the interfacing necessary to provide the machine with up to four mini-communication busses as well as two vacant S-100 sockets which allow the system to be expanded even further.

Designated as Cat. No. X-4010, the new expansion unit sells for $575.00. This includes an inbuilt power supply and all required interconnection cables.

Basically, the expansion unit consists of a three-slot S-100 card cage, motherboard and power supply in an enclosure which matches the case of the System-80 computer. Along with these comes a single, large S-100 card, providing a complete floppy disk controller along with the interfacing required for the S-100 buss, a Centronics-type parallel printer port and a bidirectional RS232C serial port.

The floppy disk controller uses one of the latest LSI dedicated controller chips and is capable of controlling up to four standard single-density 14 cm (5-1/4in) drives. The X-3230 drives sold by DSE for $379 each (less power supply) are suitable, and four of these drives will provide the System-80 with more than 800K of storage capacity. Power supplies capable of powering up to two of the X-3230 drives are available (Cat. No.X-3234) for $60 each.

A software disc operating system (DOS) specifically designed to suit the System 80 will be available shortly, although a number of the currently available DOS packages will run on it quite satisfactorily.

The parallel printer port on the new expansion unit has all floppy disk drives, a Centronics-type parallel printer and communication facilities using an RS-232C asynchronous serial I/O port.

The unit also provides full interfacing to the standard S-100 logic necessary to drive a standard Centronics-type printer, while the printer cable supplied is terminated in standard 57X-36 connector. It is thus eminently suitable for use with the 125 character/second dot matrix printer sold by DSE, the X-3255.

The RS232C serial I/O port provided by the unit may be set by DIP switches to any of 10 standard and crystal-derived baud rates between 110 and 2400 baud. It may also be set for any standard data format (number of data bits, number of stop bits, parity etc). The port is also provided with all standard "handshaking" logic.

A unique and added feature of the expansion unit is that if the user has a serial printer (such as a surplus teleprinter), this may be used in place of a parallel printer of BASIC listings and printing using the standard LLIST and LPRINT commands. This is achieved merely by setting two further DIP switches — a very handy facility not found on comparable systems, according to Dick Smith.

An obvious use for the spare S-100 card slots in the new expansion unit is for expansion of the System-80's RAM memory capacity. Suitable memory expansion cards will be available shortly, offering either 16K or 32K bytes of extra memory. This will allow the System-80 to be expanded to a fully-blown system with 48K of RAM.

The X-4010 System-80 Expansion Unit will be available shortly from Dick Smith Electronics branches in each state.

HARDWARE & SOFTWARE

From DICK SMITH

PROFESSIONAL DAISY WHEEL PRINTER FOR WORD PROCESSOR SYSTEMS

This superb unit is a self-contained printer with in-built asynchronous serial interface conforming to the established RS-232C standard. It prints on business stationery up to 380mm wide at the rate of 45-65 characters per second – three times faster than golf-ball typewriters. Top quality office systems printer that is below competition prices. . .

$3,390.00 Cat. X-3260

EXIDY S-100 BUS EXPANSION UNIT

The way to go if you want extra versatility from your Sorcerer.

$575 Cat. X-3010

● Allows up to 6 plug-in cards ● Connects directly to Sorcerer's 50-way expansion socket via supplied cable ● All S-100 lines fully buffered ● Separate 2.000MHz crystal clock provided for S-100 cards which cannot use the Ø1 and Ø2 clock signals derived from the Sorcerer's 2.106MHz clock ● Provision for mounting up to six 25 pin "D" connectors for additional I/O ports, etc.

THE SORCERER

Cat. X-3001 *SORCERER*

Cat. X-1196 *MONITOR*

The Sorcerer is the expandable Z-80 based microcomputer that allows you to add peripherals to take it from basic computing through to advanced office business systems.

● 16K RAM expandable to 48K (on board) ● Serial I/O and Parallel I/O ● S-100 BUS compatible ● Cassette I/O for two recorders at speeds of 300 or 1200 baud ● Video I/O – 1920 characters full screen ● Full ASCII 128 characters (64 defined characters and 64 undefined characters) ● Graphic resolution 122,880 pixels ● Includes 8K BASIC plug-in ROM PAC™ in MICROSOFT™ ● Dimensions 490 x 330 x 100mm ● Weight 6 kilograms.

(Ask for our FREE comparison chart between the Sorcerer and other well known computer brands).

Dust cover to suit Cat. X-3005 *$5.95*

$1,395.00

LIGHT PEN FOR SYSTEM 80

Cat. X-3645

$9.95

Fantastic light pen for use with your TRS-80 or System 80 computer. Uses your cassette player as a preamp. Complete with plug & battery snap. Use with program tapes below.

ALSO FOR TRS-80

NOUGHTS & CROSSES

Just insert this program cassette into your computer cassette player and enjoy playing the game with your light pen.

Cat. X-3647 ***$11.95***

MICROPOLIS™ QUAD DENSITY DISC DRIVE

The Micropolis mod 2 drive with controller enables you to store 315,000 bytes on just 1 disc. By adding the mod 2 add-on drive (up to 3) you can obtain up to a maximum of 1.26 Megabytes! Complete with all software to enable you to be up and running in a very short time.

Model 1043/mod 2 with controller.

Cat. X-3205 ***$1,350***

Model 1023/mod 2 add-on

Cat. X-3208 ***$750***

VIDEO MONITOR

This is a superb 30cm black and white video monitor that can be used on AC and DC. Simple connection to your computer. Features jitter free and distortion free characters. Can be used with most computers on the market.

Cat. X-1196 **$149.50**

WORD PROCESSOR PAC

Remove the plug-in BASIC PAC™ and replace it with the powerful WORD PROCESSOR PAC™ and you will have the basis of an office computer system.

Features: ● Automatic text wrap ● Automatic checking of drastic commands ● Powerful search function ● Auto commands ● Macro programming – all this plus extensive user instructions.

Cat. X-3085 **$275.00**

SOFTWARE FOR SYSTEM 80

and also the TRS-80

TIME TREK

Hunt the Klingons through space and fight an intergalactic war. Has nine levels of play. (4K level I and II).

Cat. X-3650 ..... ***$17.95***

STIMULATING SIMULATIONS

10 games on one cassette from monster chase to nautical navigation and lost treasure. (4K level I and II).

Cat. X-3652 ..... ***$17.95***

ELECTRIC PAINTBRUSH

Create dazzling real time graphics. Commands let you draw lines, turn corners, change white to black, repeat previous steps or call other programs. (4K level I and II).

Cat. X-3654 ..... ***$17.95***

BLOCKADE

Many variations whereby you and your opponent try and make each other collide with a wall. (4K level I and II).

Cat. X-3659 ..... ***$17.95***

BRIDGE CHALLENGER

Practice and improve your game of Bridge. (16K level II).

Cat. X-3656 ..... ***$17.95***

MICRO CHESS

The computer is programmed to beat you at chess and you are trying to beat it - absorbing & educational.

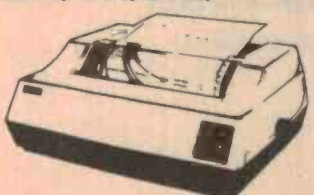
Cat. X-3658 ..... ***$22.50***

SIMUTEK 1

Contains 5 games that would normally cost $19.50 each! Great fun for all the family and friends. (4K level I and II).

Cat. X-3685 ..... ***$17.95***

C.ITOH BRAND DOT MATRIX PRINTER



The model 8300P dot matrix printer is a no-nonsense unit that can churn out the full 96 character ASCII at a brisk 125 characters per second on standard fan-fold paper. Character spacing of 80, 40 or 132 columns which are software selectable. A quality unit that costs less than $1,000!!

Cat. X-3255 **$970.00**

DYNAMIC EXPANSION KITS

These are top quality ICs that can expand your basic 16K Sorcerer to 32K or even 48K (expands the 8K to 16K etc). They can also be used with the TRS-80 level I and II and the Apple II computers to expand their on-board RAM. Superb value and complete with installation instructions.

SAVE $30.50 **NOW $79** Cat. X-1186

SOFTWARE FOR YOUR SORCERER

MARTIAN INVADERS

Similar to the very popular 'Space Invaders' you find in amusement parlors.

Cat. X-3626 ..... ***$17.95***

NIKE II

Fight off bombing attacks with your missiles and protect the city from heavy casualties.

Cat. X-3627 ..... ***$14.95***

TANK TRAP

Render the marauding tank harmless but watch out for slow drying cement and unarmed citizens!!!!

Cat. X-3628 ..... ***$14.95***

JABEL COMPUTER MAINS FILTER

Having trouble with memory crashes? Then the answer is the Jabel Mains Filter – it will remove those annoying spikes from the 240V mains and thereby protect your memory!

Cat. M-9850 ..... ***$75.00***

C10 COMPUTER CASSETTE

Dick Smith special grade cassette tape with 5 minutes per side and 38K capacity per side.

Cat. X-3500 ..... ***$1.95***

SKETCH 80

For the System 80 and TRS-80

A program tape that allows you to sketch on your VDU - the light pen becomes a real writing tool!! SEE LIGHT PEN ABOVE

Cat. X-3646 ..... ***$17.95***

NEW NEW NEW

DUE IN SHORTLY

COGNIVOX™

VOICE INPUT & OUTPUT FOR THE SORCERER

★ Recognizes up to 16 words.
★ 16 word voice response vocabulary
★ Easy two pass training
★ Up to 98% recognition accuracy
★ Generates music & sound effects
★ Excellent software support
★ Connects directly to Sorcerer

Cat. X-3150 ..... ***$199***

FAMOUS 'BLUE BOARD' PLUG-IN CARD MODULES FOR THE S-100 BUS. . .

And now for the famous 'Blue Boards' from SSM in the US of A. Three boards available for your S-100 unit in ready built form or as kits with comprehensive instructions.

2 PARALLEL & 2 SERIAL I/O BOARDS

Built unit Cat. X-3300 ***$250.00***

Kit form Cat. X-3301 ***$190.00***

MUSIC SYNTHESISER BOARD

Built unit Cat. X-3305 ***$310.00***

Kit form Cat. X-3306 ***$250.00***

8K & 16K PROGRAMMER & 4K/8K EPROM BOARD

Built unit Cat. X-3310 ***$250.00***

Kit form Cat. X-3311 ***$190.00***

SORCERER BOOKS

A new series of books containing programs that will make your Sorcerer even more versatile!

Small Business	Cat. B-6110	***$49.95***
Educational & Scientific	Cat. B-6112	***$37.95***
Fun & Games No. 1	Cat. B-6114	***$17.95***
Fun & Games No. 2	Cat. B-6116	***$17.95***
Home & Economics	Cat. B-6118	***$27.95***

Fantastic value for anyone with a Sorcerer

SEE THE OTHER DICK SMITH ADVERTISEMENTS IN THIS PUBLICATION FOR STORE ADDRESSES AND PHONE NUMBERS

WIN A DICK SMITH SYSTEM-80 COMPUTER !

Two — yes, two ! — Dick Smith System-80 computers to win. You can win one for yourself or one for your school by entering this simple contest.

The Dick Smith System-80 has the following features:

- **Level II compatible BASIC standard**
- **Industry standard S100 buss expansion**
- **RF output: you can use any standard TV set as a monitor**
- **Two motor-controlled cassette interfaces**
- **In-built cassette (no inter-connections)**
- **In-built power supply**

The unit comes with 4K of random access memory (RAM) which can be expanded to 16K on board. The Dick Smith System-80 sells for $615. A range of peripherals are available, including S100 buss expansion unit, light pen, printer and monitor. Peripherals do not come with the prize.

Here's an excellent chance to obtain a System-80 for nothing ! ! !

This contest is jointly sponsored by ETI and Dick Smith Electronics — who have generously donated the prizes.

You can specity whether you want to win one for yourself or for your school by ticking the appropriate box on the entry form.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand page of the contest. You must put your name and address where indicated on each entry form and tick one of the boxes showing whether you want the prize for yourself or your school.

NOTE: Please read contest rules carefully, especially if sending in multiple entries.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Dick Smith Electronics, Modern Magazines (Holdings) Ltd, K.G. Murray Ltd, Australian Consolidated Press, Wilkes Pty Ltd and/or associated companies.

Entries should be addressed to ETI System-80 Contest, Electronics Today International, 15 Boundary St, Rushcutters Bay NSW 2011.

Closing date for the contest is 31 October 1980. Entries received within seven days of that date will be accepted if postmarked prior to and including 31 October 1980.

The contest will be judged by the Managing Editor of ETI whose decision will be final. No correspondence can be entered into regarding their decisions.

In the event of one or more tied results occuring in the multi-choice questions amongst entrants, the finalists' entries will be judged on the written answer to the last question.

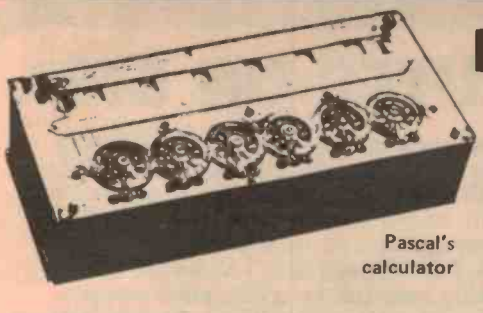
Winners will be advised by telegrams the same day the results are declared. The names of the winners, together with the winning answers will be published in the next possible issue of ETI.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the right hand page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in States where local laws prohibit entries.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

ENTRY FORM



Pascal's calculator

Pascal is generally credited with inventing the first digital adding and subtracting machine. It was based on number wheels linked by pin gearing and most of the wheels had ten divisions for decimal reckoning. The two wheels on the right hand side were different — one had twenty and the other had twelve divisions. Why? (Five points)

- To cater for sous and derniers ☐
- One was for shillings and one for pence ☐
- The builders made a mistake ☐
- So that hire charges for the machine could be calculated ☐
- The 'twelve wheel' handled months and the 'twenty wheel' was two 'tens' doubled up to save space ☐

The first universal automatic calculator was conceived in 1833 by Charles Babbage, who worked on the design until his death in 1871. It had all the main features of today's electronic computers — memory, control, arithmetic unit and input/output. How much data was the memory designed to hold? (Five points)

Babbage

- 100 words of fifty digits ☐
- 500 words of fifty digits ☐
- 1000 words of ten digits ☐
- 1000 words of fifty digits ☐
- 10 000 words of five digits ☐

Inspired by Babbage's ideas, a Swedish printer built a 'difference engine' which was displayed in London in 1854. This machine had four differences, calculated to the fourteenth digit and could print out its own tables. What was its inventor's name? (Five points)

- Pehr Scheutz ☐
- Georg Gutenberg ☐
- Hally Aller ☐
- Peter Ibsen ☐

In 1947 Eckert and Mauchly designed a 'Universal Automatic Computer' UNIVAC). Apart from their operating principles and intent, UNIVAC and Hollerith's tabulating machine of 1889 had something in common in their original application. What was it? (Ten points)

.....

.....

In 1948 the British inventor M.V.Wilkes built EDSAC, the Electronic Delay Storage Automatic Calculator, which had an unusual method of storing data. What was this method? (Five points)

- Ultrasonics, using tanks full of liquid ☐
- Multiple cathode ray tubes and cameras ☐
- Mercury tilt switches ☐
- Morse code on gramophone records ☐
- 100 000 Post Office type 3000 relays ☐
- None of the above ☐

Unlike several competing systems the Dick Smith System 80 is S-100 buss compatible. What is the S-100 buss? (Five points)

- An internationally agreed system of interconnections enabling units such as computers, disk controllers, speech synthesisers etc. to be readily interfaced ☐
- A minimum packaging size agreed in 1976 ☐
- A means of stabilising mains voltage ☐
- None of the above ☐

Dick Smith's System 80 is built around which microprocessor chip? (Five points)

- 8080 ☐
- Z80 ☐
- 6280 ☐
- 2650 ☐

Does the System 80 have an inbuilt cassette recorder for data storage? (Five points)

- Yes ☐
- No ☐
- Maybe ☐
- None of the above ☐

Please write not more than fifty words explaining why you (or your school) would like to win a Dick Smith System-80 computer.

.....

.....

.....

.....

.....

I want to win a Dick Smith System-80 for (tick one box only)

☐ myself
☐ my school

Name .....

Address .....

.....

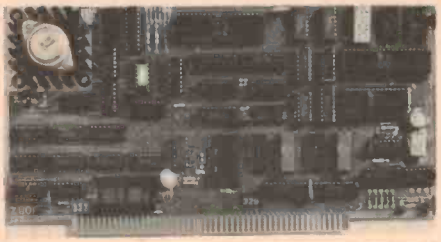
..... Postcode ....

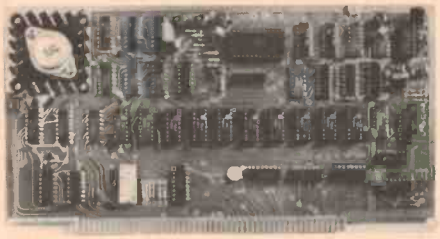
I have read the Contest Rules and agree to abide by their conditions.

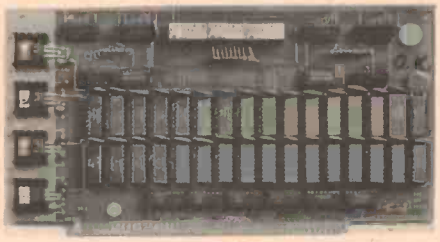
Signed .....

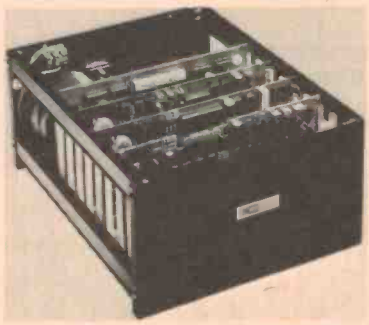
Date .....

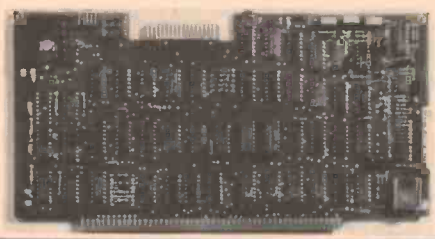
Z80 BUDGET HOME COMPUTER ON S100.











Want to get started in home computing? Then the DGZ80 is an ideal product. Designed by David Griffiths and described in ETI. November 1979, the DGZ80/ETI680 is a powerful single board computer. Because its built on the S100 bus you can add other boards to build virtually any system you require. An ideal system for beginners is the DGZ80, DG640, keyboard, T.V. set and power supply and this can be readily expanded by adding more memory, I/O devices, printer, floppy discs as you need them. Because it is Australian designed and supported, you have full technical backing and of course, the vast library of Z80 software is available world-wide.

DGZ80 – CPU

A single board Z80 based CPU features on board PIO (dual 8 bit I/O), CTC (4 channel counter/timer), power on jump, provision for 2K ROM on board, 1K RAM (expandable to 2K). Sockets for all IC's, top quality solder masked PCB and comprehensive owners manual.

DGZ80 kit $199.25. ($175. tax exempt).
Assembled $240.00. ($215. tax exempt).
DGOS 2K Monitor for DG640 programmed 2516 with listing – $40.00.

DG640. VDU.

Described in ETI March 1978 the DG640 features 16 lines of 64 characters, upper and lower case with "chunky" graphics, crystal locked self contained T.V. scan circuits, top quality solder masked PCB with sockets for all IC's and comprehensive owners manual.

DG640 kit $149.50. ($130. tax exempt).
assembled and tested $159.50. ($140. tax exempt).

TCT 16K S100 STATIC RAM.

The TCT 16K S100 RAM is Australian designed and supported features 4 independ ently addressable 4K blocks, 2114 low cost static RAMS, directly compatible with DGZ80, DG640. Supplied with sockets for all IC's, top quality solder masked PCB, owners manual and full service backup.

TCT 16K kit less RAMS $100.00 ($95. tax exempt).
kit with 16 K RAMS $269.00 ($245. tax exempt).
Assembled & tested $299.00 ($275. tax exempt).

CARD CAGE/MOTHER BOARD.

Designed to exacting specifications the JC100 mother board is a plated through PCB with 9 slots and provision for active termination on all lines. A ground plane on the upper (socket) side ensures reliable operation at all speeds. The JC200 card cage is anodized aluminium and is supplied in kit form with all card guides, predrilled supports and all hardware. Provision has been made to fit a power supply if required.

JC100 mother board $49.50.
JC200 card cage $49.50.
S100 Transformer. 8v @ 10A, 16v-0-16v 2A $25.50.

CLARE C70/MGP KEYBOARD.

Ideal for a most professional system the Clare C70 keyboard is the ideal choice. Outputs are available for fully decoded ASCII parallel or serial.

C70/MGP Keyboard $165.00 tax paid. ($150. tax exempt).

MICROPOLIS 1043 DISC CONTROLLER.

If you need DISCS this is the ideal solution. Just plug in the 1043 controller board and connect the disc unit. Package includes QUAD DENSITY DRIVE, POWER SUPPLY, CONTROLLER, CONNECTING CABLES, SOFTWARE PACKAGE (in DOS, RES and 24K MICROSOFT BASIC).

1043/DISC PACKAGE. $1350.00 tax paid.

Z80 SOFTWARE.

MICROWORLD Z80 BASIC.

At last a powerful extended basic to use with the DGZ80 and 640 VDU. Requires 16K of memory at 0000 features floating point accuracy to 62 digits, full graphics, complete error messages and powerful edit function to correct errors. Of course, it has regular features such as GOTO, IF . . . THEN . . . ELSE, IN, OUT, PRINT, PEEK, POKE, etc. etc.

MICROWORLD Z80 basic Cassette with manual $32.50.
(if purchased with DGZ80 kit Special price $15.00).

GAMES TAPE (1.)

Play TARGET, TREK on your DG640. Based on the original games by PROCESSOR TECHNOLOGY, these are sure fine ways of entertaining your friends for hours!

Z80 GAMES TAPE 1. Cassette. $14.75.

ETI 681 PCG.

As described in ETI June, 1980, this PROGRAMMABLE CHARACTER GENERAT-OR will enable you to produce fine graphics with your DG640 VDU. Kit is supplied with all components, 2 joysticks, top quality PCB, owners manual and sample software.

ETI 680 PCG kit. $140.00.

APPLIED TECHNOLOGY PTY. LTD.

MAIL ORDERS TO:
P.O. Box 311, Hornsby 2077

Please add $2.00 per order towards cost of post and packing.

OFFICE/SHOWROOM:
1a Pattison Avenue, Waitara 2077

Hours: 9-5 Monday to Saturday.
Telephone: 487-2711.

computer users —

FANTASTIC OFFER ON FLOPPY DISKS

ETI READER OFFER

SPECIAL PRICES	10-19	20-49	50-99	100+
133 mm (SS, SD)	$4.95	$4.39	$3.99	$3.29
200 mm (SS, SD)	$5.95	$4.86	$4.25	$3.95

Both sizes can be mixed to qualify for the quantity discount.

Packing and delivery

10-19	$1.50
20-49	$2.00
50-99	$2.50
100+	$3.00

Floppy disks are the highly convenient magnetic media used for mass storage with minicomputer systems. Dindy Marketing (Aust.) Pty Ltd has made available a quantity of 133 mm (5") diskettes and 200 mm (8") floppy disks for ETI readers at special prices. These single-sided, single-density disks are manufactured in the USA and are identical to those marketed here by two large well-known electronics retailers.

Each precision coated disk is enclosed in a PVC jacket with a protective liner. This material has low frictional properties and resists mechanical shock and heat. Minute foreign particles are absorbed by the liner, leaving the disk 'clean' for optimum recording performance. The disk itself consists of oriented polyester coated with a uniquely formulated gamma-ferric oxide, encapsulated in a wear resistant binder providing minimum friction with maximum durability. The smooth, polished surface results in low head and pad wear and gives long performance life.

All stages of manufacture of these disks are carried out in environmentally 'clean' rooms and each stage is continuously monitored to ensure accuracy in accordance with rigid industry standards. Before being consumer packed, the specially coated material is tested for signal levels, modulation and resolution, and the disk certified free of errors.

NOTE: *Offer closes 13 November*

Money back guarantee: Dindy offer to refund the purchase price in full if you are not completely satisfied and provided you return the goods within 14 days of receipt.

Mail this coupon now and ensure delivery of your order before Christmas. Make out your cheque or money order to 'Dindy Disk Offer', don't forget to include post and delivery charges.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to 'DINDY DISK OFFER' and sent, together with the coupon (or a photostat or clear, hand-written copy of same), to Disk Offer, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy who will send you the goods. Please allow up to four weeks for delivery.

Send coupon to:
Dindy Disk Offer
ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011

Please supply:

Quantity ..... 133 mm ..... $.....

..... 200 mm ..... $.....

Packing and delivery: ..... $.....

TOTAL: $.....

(Disks may be mixed for quantity discounts)

Name .....

Address .....

..... Postcode .....

Cheque or money order .....

Or use your Bankcard 4 9 6 [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Expiry Date ... / ... / ...

Signature .....

Zenith gets it all together with the new Z-89 three in one desk top computer.

The All-In-One Computer brings you all the power and built-in peripherals needed for any business computing task—all in one compact, desk-top cabinet.

C.P.U. The popular Z-80 microprocessor gives you abundant computer power. Features include 48K of user RAM, and two serial I/O ports complete with standard RS-232 interfacing for printers and modems.

V.D.U. All terminal functions are controlled by a separate Z-80 microprocessor for significantly increased throughput. It never shares processor power with the computer as do most desk top computers. A crisp, clear video image reduces eye strain and an excellent keyboard layout and touch make data entry fast and easy.

Disk Storage. A builit-in 5¼" floppy disk unit gives instant loading and fast access. An optional **Z-87 dual disk unit** in a separate housing provides an additional 200K bytes for enhanced merging, sorting and copying capabilities.

Software. HDOS operating systems software includes BASIC interpreter, 2-pass absolute assembler and a powerful text editor. The popular CP/M™ operating system runs on the **Z-89** allowing the system to be programmed in microsoft BASIC, FORTRAN, COBOL and others. Application software available includes word processing.

C.P.U. + V.D.U. + DISK = Z-89

For further information contact WARBURTON FRANKI at any of the following locations.

WARBURTON FRANKI

• ADELAIDE (08) 356-7333 • BRISBANE (07) 52-7255 • HOBART (002) 28-0321
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• AUCKLAND N.Z. (09) 77-0924 • WELLINGTON N.Z. (04) 69-8272

WF 211/80

Improvements to the AIM65 cassette interface

The Rockwell AIM65 is a popular and powerful 'naked micro' that has found its way into many hobby and professional spheres. If you have had difficulty with the cassette interface, this note will be of interest.

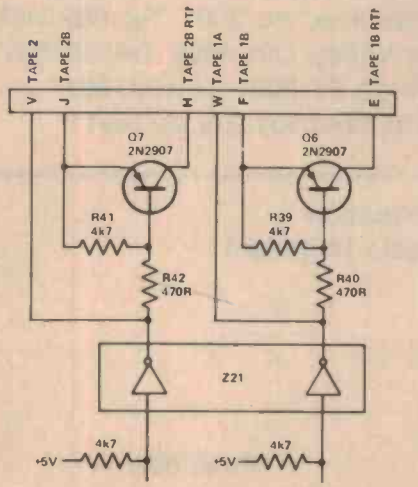
A. Bendeli H.M.P. Stock CSIRO Division of Applied Physics, Sydney NSW.

THIS NOTE may be of assistance to readers concerned with the use of the versatile AIM65 microcomputer system.

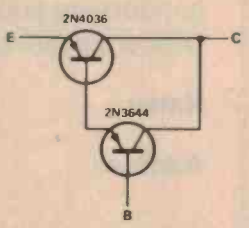
We have encountered some difficulty in interfacing the AIM65 to a "Realistic" (Tandy) CTR80 cassette recorder, in that, despite apparently normal recording signals, it was not possible to read back a short tape written by the AIM65 on the recorder. The problem was traced to the inability of the AIM65 cassette interface to switch the recorder reliably via the *remote* connection. The motor either would not start, or would start and then slow to a stop after about 10 seconds, then advancing sluggishly, or not at all. The fault was apparent on both *remote* channels.

The starting and running currents of the motor of the CTR80 are of the order of 900 mA and 150 mA, respectively. The gain of the 2N2907 switching transistor in the *remote* control of the AIM65 is insufficient for saturation to occur for the motor starting current. The motor supply voltage then appears across the 2N2907, which finally overheats. As a result, the motor is sluggish and eventually stalls.

We have removed the 2N2907 and replaced it with a Darlington pair constructed from a 2N3644 and a 2N4036. The 2N3644 has sufficient gain to drive the 2N4036 into saturation, while the motor starting current as well as the stall current are within the continuous rating of the 2N4036.



MANUFACTURER'S CIRCUIT



SUGGESTED MODIFICATION

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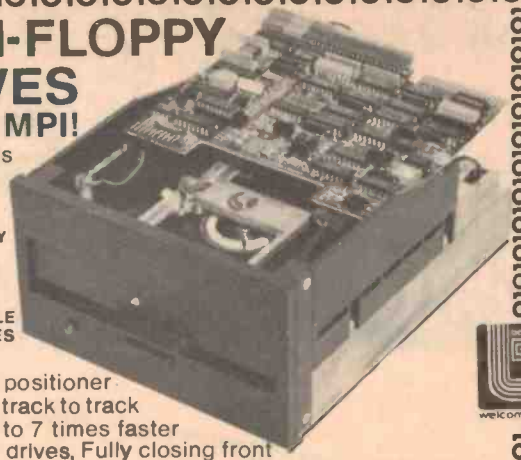
MINI-FLOPPY DRIVES FROM MPI!



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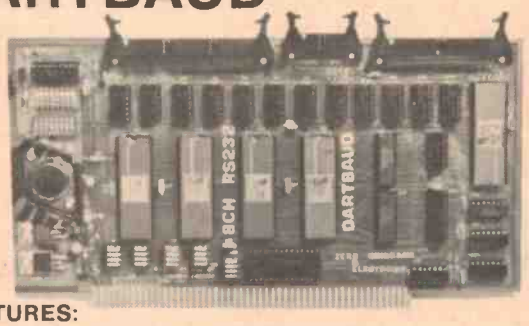

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SPECIFICATION:

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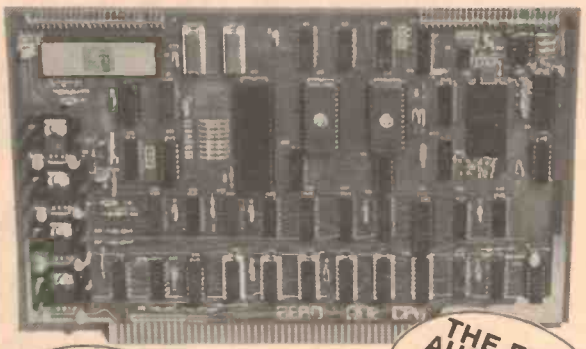

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Please note that 200ns memories are required for VDU 4MHZ operation at $6.00 extra or 10 x 21L02-2 for $26.00 separately.

Z80 CPU CARD
FEATURES —
- Comes with full assembly instructions and card documents.
- Power on jump for automatic execution of monitor program on startup.
- Front panel-less operation allowed by on board 2k monitor which is too good to explain here; 19 commands all unique abbreviations allowed.
- Full S100 DMA Capabilities.
- Sockets supplied for all major devices.
- Clock speed, 2MHZ Standard, 4MHZ Option.
- 1/0 Z80 P10 2 x 8 bit programmable parallel 1/0.
- RAM 256 Bytes scratch pad (Monitor).
- Onboard 2100 baud Tarbell Cassette Interface (Software Controlled) with cassette recorder remote motor control Test Cassette supplied with CPU Kit contains set up procedures for cassette interface as well as software to allow the cassette interface to read and dump 300 baud CUTS (Kansas City) format.
- Keyboard input direct onto card in parallel ASCII.
- Monitor performs all functions to drive ET1640 VDU as an ASCII terminal. Entry points for cursor control etc.
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COMMUNICATIONS

Can hams still contribute to communications art & science?

The answer is, emphatically — yes! Two well-known US amateurs, Doug DeMaw and Wes Hayward have had widespread influence on receiver design, according to a report in a recent issue of the US 'Electronics' magazine.

Doug DeMaw, techical department manager at ARRL headquarters, organised a session at the prestigious Electro 80 conference on "Recent Developments in Communications Receiver Design".

Neither man is a 'professional' in the field and the session's presence on the programme was considered to be as much a tribute to DeMaw and Hayward as to the timeliness of its subject.

The two hams' work has persuaded RF engineers to re-examine the design philosophy and circuits required to construct receivers for both amateur and professional applications. Commercial design goals now aim for high dynamic range and selectivity and low noise floor within an acceptable price. It took DeMaw and Hayward two years to be admitted to Electro 80, which is generally for industry professionals.

Chip Margelli, assistant Vice President of the US operation of the well known amateur equipment manufacturer Yaesu-Musen, commented that the type of progress pioneered by Demaw and Hayward was 'inevitable'.

DeMaw and Hayward, apart from developing state of the art receivers and publishing articles on the subject in QST, wrote a series on Solid State Design for the Radio Amateur which has been published as a book. Bill Sabin, engineer at Rockwell's Collins Radio Division, acknowledged the educational contribution of this book, 'It's recommended reading for Collins' junior engineers. He also said that, on occasion they have picked up some ideas from the work of DeMaw and Hayward.

Their book, published by the ARRL, is considered a 'landmark' text for those interested in actually building high performance equipment, as it contains practical information that is not found elsewhere in sources available to the professional or nonprofessional.

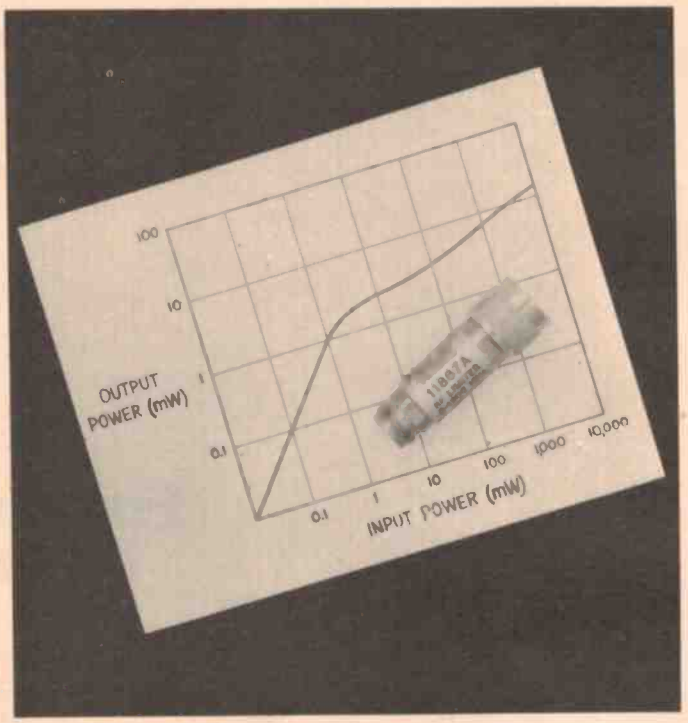
No mistake about it, hams can **still** make a significant contribution to the art and science of communications.

Europe-Japan on 50 MHz!

The first two-way contact on the 50 MHz band between amateurs in Japan and Europe is believed to have taken place on April 10 at 0012 GMT.

Gibraltar station ZB2BL worked JA1BK in Japan with propagation over the 'long path' across South America. The great-circle distance is around 27 200 km, 17 000 miles. The opening lasted about 30 minutes in which time ZB2BL worked a number of Japanese stations.

Propagation was undoubtedly supported by the northern 'equatorial F-layer anomaly' being sufficiently dense to support 50 MHz propagation over a wide geographical extent.



Broadband overload protection for RF instruments

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One of the limiter's most attractive performance characteristics, is that it does not constrict the dynamic range of sensitive instrumentation.

When the limiter is used ahead of the HP 8554B RF Spectrum Analyser, for example, the analyser's 70 dB distortion-free dynamic range is preserved for input signals below -40 dBm. The HP 11867A limiter is priced at $248.

Further information from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph Street, Blackburn, Victoria 3130. (03) 89-6351.

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FC902 Antenna Tuner (with WARC freq.)	D-2855	$224	$24	$13.77	18
Memory Unit for FT-901	D-2858	$139.50	$15.50	$8.53	18
FT-101Z HF Transceiver	D-2862	$775	$85	$23.19	48
FT-7B HF Mobile Transceiver	D-2868	$599	$59	$18.15	48
FT-707 Solid State HF transceiver	D-2869	$735	$75	$22.19	48
FT107M 'The Ultimate' HF rig	D-2871	$1278	$138	$38.32	48
FC-107 Antenna Coupler	D-2873	$196	$26	$11.70	18
FC-707 Antenna Coupler	D-2875	$157.50	$17.50	$9.64	18
FT-625 6 metre all mode transceiver	D-2886	$695	$75	$20.84	48
FT-207R 2 metre microprocessor hand held	D-2888	$358	$38	$17.52	24
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ETI

shortwave loggings

Where are Moscow's transmitters?

Even the most casual of shortwave listeners would have tuned in to Radio Moscow's broadcasts at some time.

Radio Moscow, the overseas broadcasting service, has studios located in the USSR capital city, and broadcasts in a myriad of languages, using hundreds of high powered shortwave transmitters.

Radio Moscow operates a 24 hour service in English also, known as the World Service, which is beamed to all parts of the world at peak listening times. For example, the World Service is beamed to Australia between 2000 and 1300 every day, on frequencies ranging from the 31 metre right through to the 13 metre band.

Although all programmes from Radio Moscow emanate from studios at Moscow, the transmitter you are tuned to is just as likely to be located at the Far East City of Vladivostok, or at the city of Dushanbe near the border with Afghanistan.

Radio Moscow uses transmitters located throughout the entire USSR to broadcast their programmes world-wide. The size of the Soviet Union's territory enables Moscow to use transmitters at a location which will favour propagation to a particular target area. So Moscow can use transmitters in the Far East, at say Vladivostok or at Nikolayevsk, to beam programmes to Asia in our local evenings, when reception via transmitters in the western USSR may be unreliable in Asia.

Radio Moscow registers frequencies, together with sites, with the high frequency coordination body of the International Telecommunications Union (ITU) in Geneva, know as the International Frequency Registration Board (FRB). Unfortunately, the Soviet bureaucracy and sheer enormity of Radio Moscow operations means the sites listed with IFRB for many frequencies are inaccurate.

Experienced DXers have discovered that they can hear broadcasts listed for sites which just could not propagate into their area. To hear a transmission on the 31 metre band in Melbourne, for example, at 0300, with a listed transmitter site of Vladivostok would clearly indicate that the transmitter was NOT located at Vladivostok at all but within the European part of the Soviet Union. The all daylight path from Vladivostok to Melbourne at 0300 would make reception of a 31 metre channel impossible.

DXers therefore have often made DXing the USSR their specialty. Publications are now available for DXers covering USSR broadcasting, compiled by DXers who have become very proficient in working out the sites used for Radio Moscow broadcasts.

One such publication is "UHN" — the USSR High Frequency Broadcast Newsletter, published by experienced US DXer Roger Legge. Roger regularly lists Radio Moscow frequencies, with the IFRB registered site or site placed by Radio Moscow on QSL cards, and then the ACTUAL site, worked out by monitoring.

To show how Radio Moscow "listed" transmitter sites can be off-beam, a recent UHN showed that an often-listed Radio Moscow transmitter site,Frunze, located in Central Asia in the Kirgiz republic, has no towers of any kind of 200 feet in height. This strongly suggests Radio Moscow has NO transmitters located at Frunze at all! Some DXers may find this frustrating, while DXers of the Soviet scene find it fascinating.

Anyone interested in DXing the USSR could do worse than to enquire about receiving UHN via subscription. Write to Roger Legge, Box 232, McLean, VA 22101, USA, for details of subscription rates.

Angola at its best

Reception of stations in Angola is now at its peak, and these conditions should continue through to the end of September.

Interest in DXing Angola is quite high due to the relatively large number of shortwave stations in this former Portuguese colony in west Africa.

The main station is located in Luanda, the capital, and announces as "Radio Nacional de Angola". Best reception is currently on 4820 and on 9535 during our mornings up to sign-off at 2359. The 60 metre outlet of 4820 is best prior to 2230, then begins to fade as the amount of daylight on the Angola to Australia path increases.

Meanwhile, the 31 metre outlet, 9535, tends to be best from 2230 up to close down, due to more powerful European and international stations leaving the frequency.

Best heard of the regional stations currently is Emissora Provincial do Moxico at Luena in Moxico province. This station uses the out of band outlet of 5192, and so has interference free signals up to sign off at 2300. Reception usually peaks at about 2200, when the station relays the news from Luanda.

At present, the Angolan regional stations do not seem to be set up to answer reception reports. Should you wish to attempt to verify these stations, then it might be best to listen for the relays of Luanda programmes over the regionals, such as often occurs at 2200, and report reception to Luanda. The Luanda station presently will verify reports from DXers with a letter in English, although you may need to be patient and wait a few months for your reply.

Spanish guide available

DXers interested in reporting to the myriad of Latin American stations will gain great assistance from a new guide now available which sets out how to write a reception report in Spanish, the main language of Latin America.

This "Spanish Reporting Guide" provides optional phrases in Spanish (together with explanations of their English meaning) which could be used to write a reception report to a Latin American station which does not answer reports written in English.

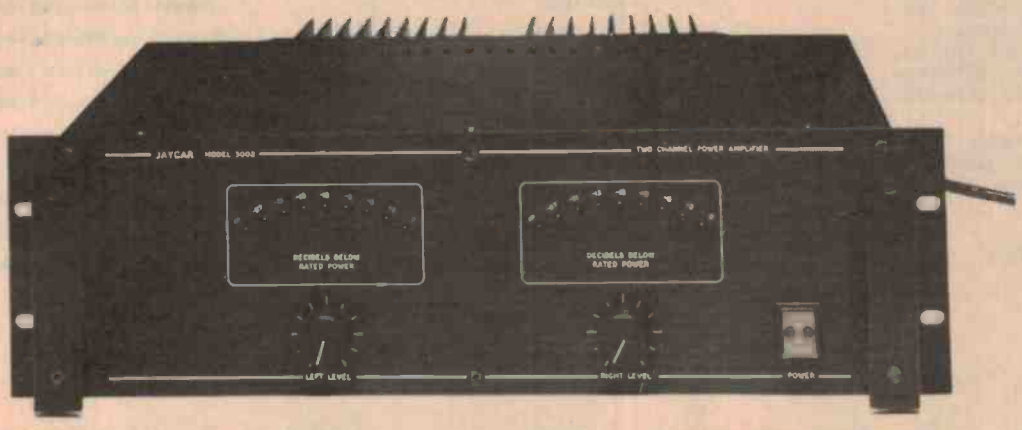
With reception of Latin American stations continuing to be good, especially on the 49 and 60 metre bands during our evenings here in eastern Australia, the "Spanish Reporting Guide" will be of great use to the keen DXer wishing to better his QSL tally from reports to the exotic Latin American stations.

The guide covers 20 pages and includes an outline of the broadcasting scene in Latin America. You can obtain a copy for $2 from the address in this column.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert to Australian Eastern Standard Time, add 10 hours (11 hours for Daylight Saving Time). To convert to Central Time, add 9.5 hours and for Western Time add 8 hours. All frequencies are in kHz.

Shortwave Loggings is 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 — PO Box 79, Narrabeen NSW 2101, for a 30c stamp.

MODEL 3002 — 2 CHANNEL POWER AMPLIFIER



COMPLETE KIT ONLY $452.00 including tax. Freight extra. Attractive quantity prices also available.

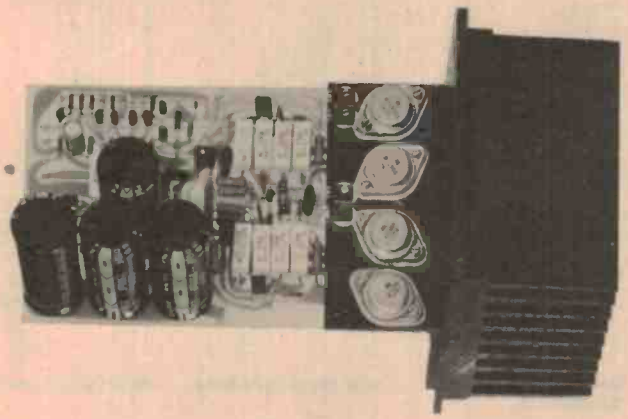
FEATURES

- 300 Watts per channel.
- Massive rear mounted heatsinks.
- Multiple speaker protection circuits.
- Peak output power meters.
- Constructed to withstand the tortures of 'On the road' use.
- Standard 19" rack mounting.
- Separate power supplies for each channel.
- Dual RCA input sockets to allow bridging to other amplifiers.
- Equally suited to Hi Fi use or P.A./Disco situations.

BRIEF SPECIFICATIONS

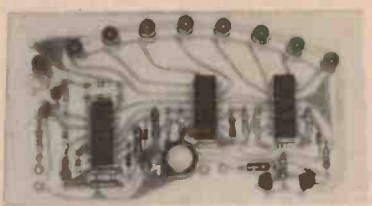
Output Power — 300 watts/channel into 8 ohms.
200 watts/channel into 4 ohms.
Frequency Response — 20Hz to 20kHz ±0.5dB.
Hum and Noise — 105dB below rated output.
Harmonic Distortion — Less than 0.05% to 80 watts.
Less than 0.15% at rated power.
Input Sensitivity — 1.0 volts for rated output.
Dimensions — 482mm x 133mm x 340mm.
Weight — 20 kgs.

3002P.A. 300 WATT POWER AMP MODULE



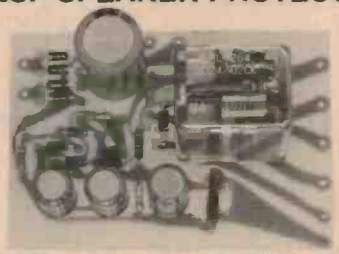
The same amplifier module as used in the complete amplifier. The 3002P.A. is based on the ETI 466 amplifier but with a redesigned P.C. board and much improved heatsink bracket. The module is designed to mount vertically in a 5¼" rack box. Complete kit includes P.C. board, all components and anodised heatsink bracket.
COMPLETE KIT ONLY $70.00 plus freight.
Heatsink — Philips 65D pre-drilled and tapped, and anodised black — $32.50 plus freight.
Ferguson PF-4363 transformer $38.00 plus freight.

3002P.M. POWER LEVEL METER



The 3002P.M. can be used to indicate power output of any amplifier from 5 watts to 300 watts. Several component changes converts the module from a power meter to a VU meter.
COMPLETE KIT ONLY $18.00 per pair.

3002SP SPEAKER PROTECTOR



The 3002SP can be connected to any amplifier output to provide a turn on delay to eliminate thumps and full protection a turn on delay to eliminate thumps and full protection against D.C. voltages on the output of the amplifier. One module will protect two channels.
COMPLETE KIT ONLY $13.00 each.

jaycar PTY LTD

380 SUSSEX STREET, SYDNEY, NSW
P.O. BOX K39, HAYMARKET 2000
TEL: (02) 211-5077

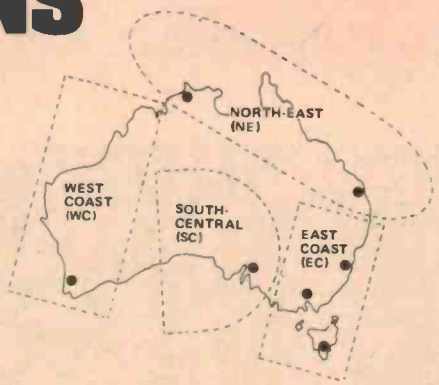
PREDICTIONS

OCTOBER 1980

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.

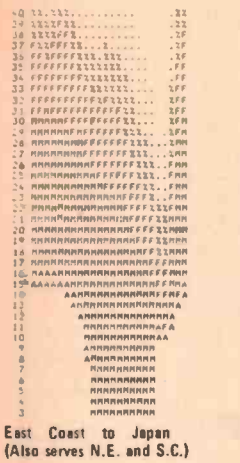
F . . . . . path open at least 90% of days in month.

B . . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

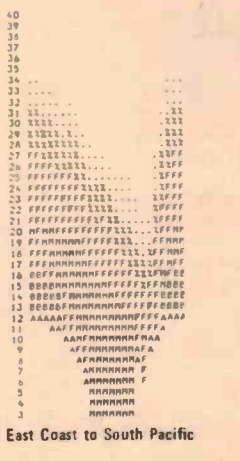
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

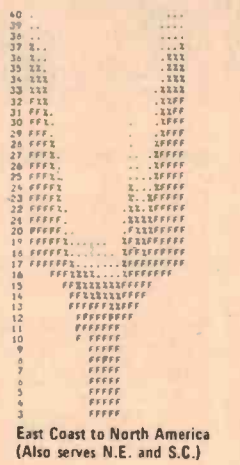
A . . . . . High absorption indicated. Expect weak signals.



East Coast to Japan (Also serves N.E. and S.C.)

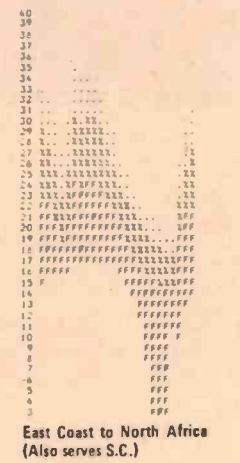


East Coast to South Pacific

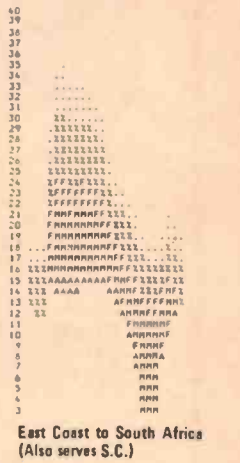


East Coast to North America (Also serves N.E. and S.C.)

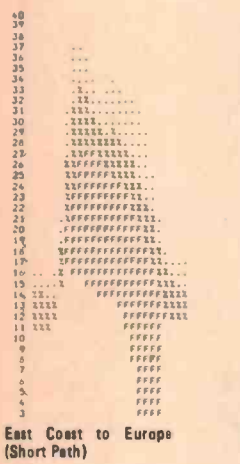
East Coast to South America (Also serves S.C.)



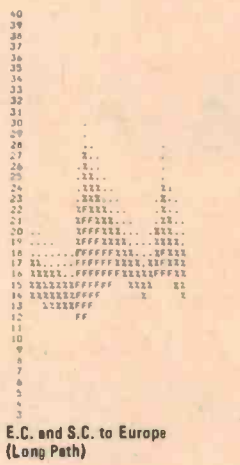
East Coast to North Africa (Also serves S.C.)



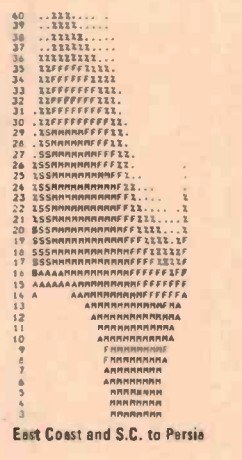
East Coast to South Africa (Also serves S.C.)



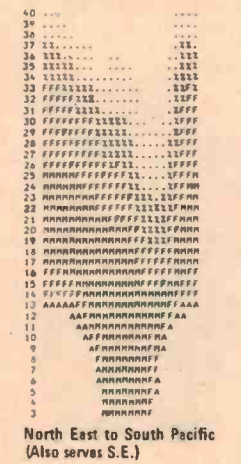
East Coast to Europe (Short Path)



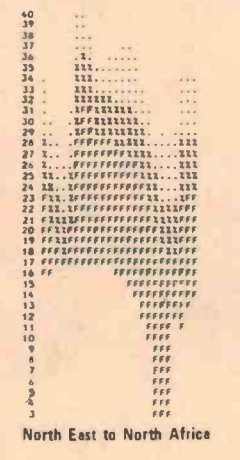
E.C. and S.C. to Europe (Long Path)



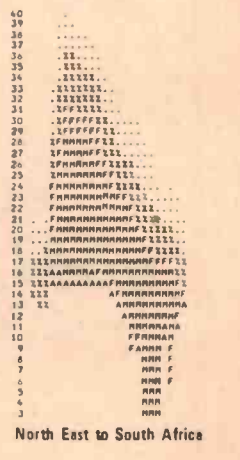
East Coast and S.C. to Persia



North East to South Pacific (Also serves S.E.)

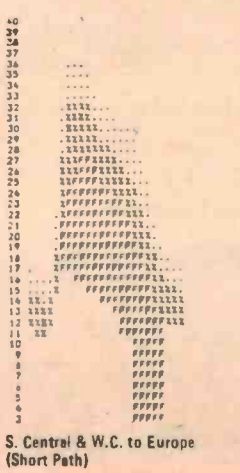


North East to North Africa

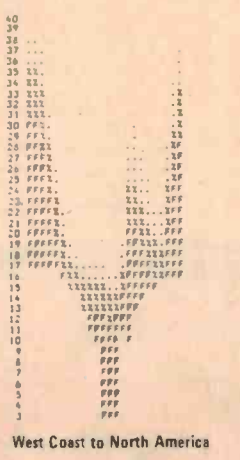


North East to South Africa

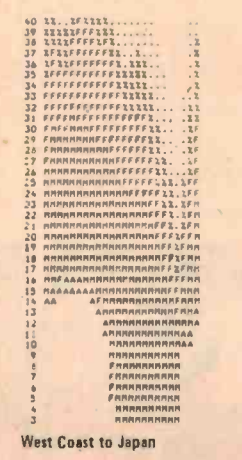
North East to Europe (Short Path)



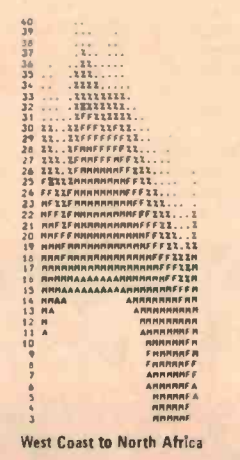
S. Central & W.C. to Europe (Short Path)



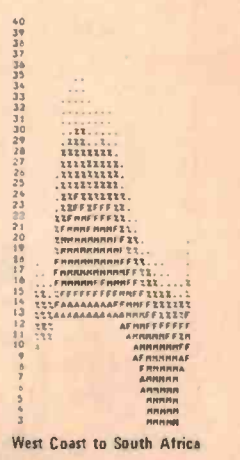
West Coast to North America



West Coast to Japan



West Coast to North Africa



West Coast to South Africa

SPECIAL OFFER

A SUPERB DIRECT-DRIVE TURNTABLE . . . SANYO TP929

NOW AT A PRICE YOU CAN AFFORD . USUALLY $279

NOW $189

(LIMITED STOCKS ONLY)

- Semi automatic
- 2 speed
- 120 pole synchronous motor
- 0.03 percent wow and flutter (WRMS)
- 1 second warm-up
- built-in stroboscope
- 1 kilogram platter
- cartridge included
- 2 years warranty

PHILIPS LOUDSPEAKERS

PROFESSIONALLY DESIGNED SPEAKER KITS

If you are in the market for a $2000 set of speakers with only a few hundred dollars in your pocket, we could have just what you want. The ETI 4000 Series Speakers — using Philips Drivers — compare very favourably with speakers costing twice to three times as much. If you are on a really tight budget you could consider the Philips AD12K12 kit — a 70 watts r.m.s. per channel 12" 3-way system — which you assemble completely in about 2 hours. A steal at under $300 per pair. You can buy all components with or without boxes, any way you like. We have both the ETI 4000-I and II on display, as well as other Philips Kits. Come in for an audition, or write for further information.

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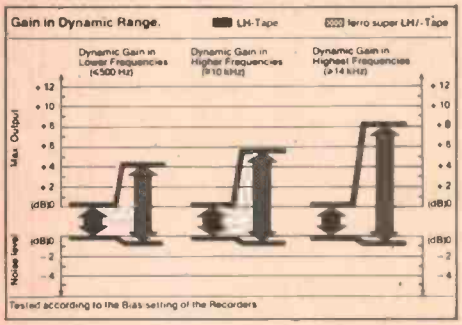
The new BASF high precision cassette. An unbeatable case for buying The Green One.

Dubbed The Green One for ease of identification, the new BASF ferro super LH I displays high precision and performance throughout.



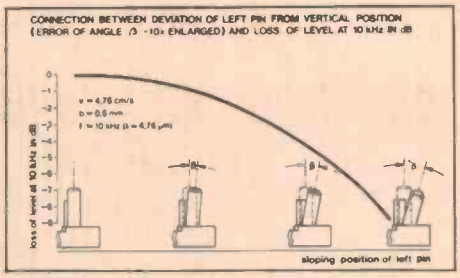
In the mechanics of the cassette, BASF has achieved new standards of azimuth precision, taking full advantage of the outstanding LH I quality.

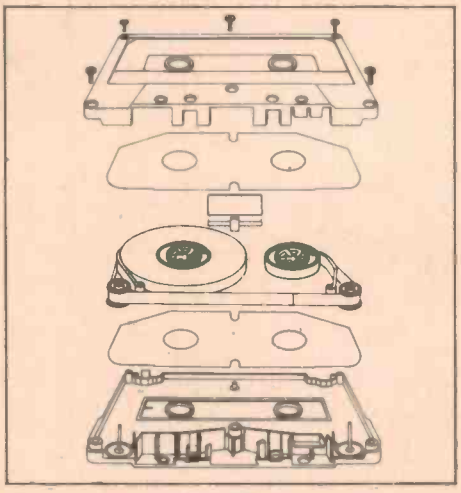
A dense coating of super-fine ferric oxide particles has produced a mirror-finish tape with extremely strong magnetic direction preference.

The end result – true Hi-Fi in the normal bias position I (Ironoxide or Fe 120 µs EQ). Plus higher volume levels with minimised distortion.

One common cassette fault. Deviation in vertical position of the pins diminishes high-frequency output, which results in loss of sound brilliancy. Minimum tolerances ensure that no fault can occur with the new BASF ferro super LH I.

In the tough, screw-together polystyrene, precision moulded shell, slip sheets eliminate tape edge damage. A mu-metal shield blocks stray magnetic fields. A felt pressure pad on a phosphor bronze spring ensures precise head contact on any deck. Flanged roller guides on lubricated stainless steel pins provide precise tape feed and azimuth alignment.





The patented BASF Security Mechanism (SM) prevents scrambling of tape and guides the tape smoothly within the cassette. A large strong window gives clear visibility to the best BASF ferro super I tape yet.

So spend a little more, and get more for your money.

Go for The Green One. Step up to Hi-Fi precision.

BASF

Quality across the range.

FCB/SPASM/BAS/40R

"I have always wanted a really good loudspeaker system."

Today the cost of excellent turntables, cartridges, tape decks and amplifiers has fallen to the point where the average family man can afford equipment of a quality and performance-level that was impossible ten years ago.

But good loudspeakers have remained extremely expensive and, in most domestic hi-fi systems, the rest of the equipment can dramatically outperform the speaker.

Philips have set out to correct this imbalance.

In co-operation with Philips Elcoma Division, a leading Electronics magazine has developed the ETI 4000/1 speaker system.

The ETI 4000/1 is available in kit form which means you save money by assembling it yourself.

A total kit, including:

- 8 loudspeaker drivers (4 per box)
- 22 element crossover networks
- pre-assembled boxes.

For around $798.00 per pair. ($300.00 less, if you build your own boxes)!

The ETI 4000/1 is comparable to systems selling for twice the price.

See your Philips dealer today or send for complete details including a free reprint of the original construction article. Further information on Philips loudspeakers; a list of Philips dealers and a free 4-speed stroboscope card for checking the speed accuracy of your turntable.

Philips Electronic Components and Materials
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LANE COVE, N.S.W. 2066
Please send me complete information on the ETI 4000/1 loudspeaker system plus my free 4-speed stroboscope card and further information on loudspeakers.

NAME _____
Please Print

ADDRESS _____

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ETI

PHILIPS

Electronic Components and Materials

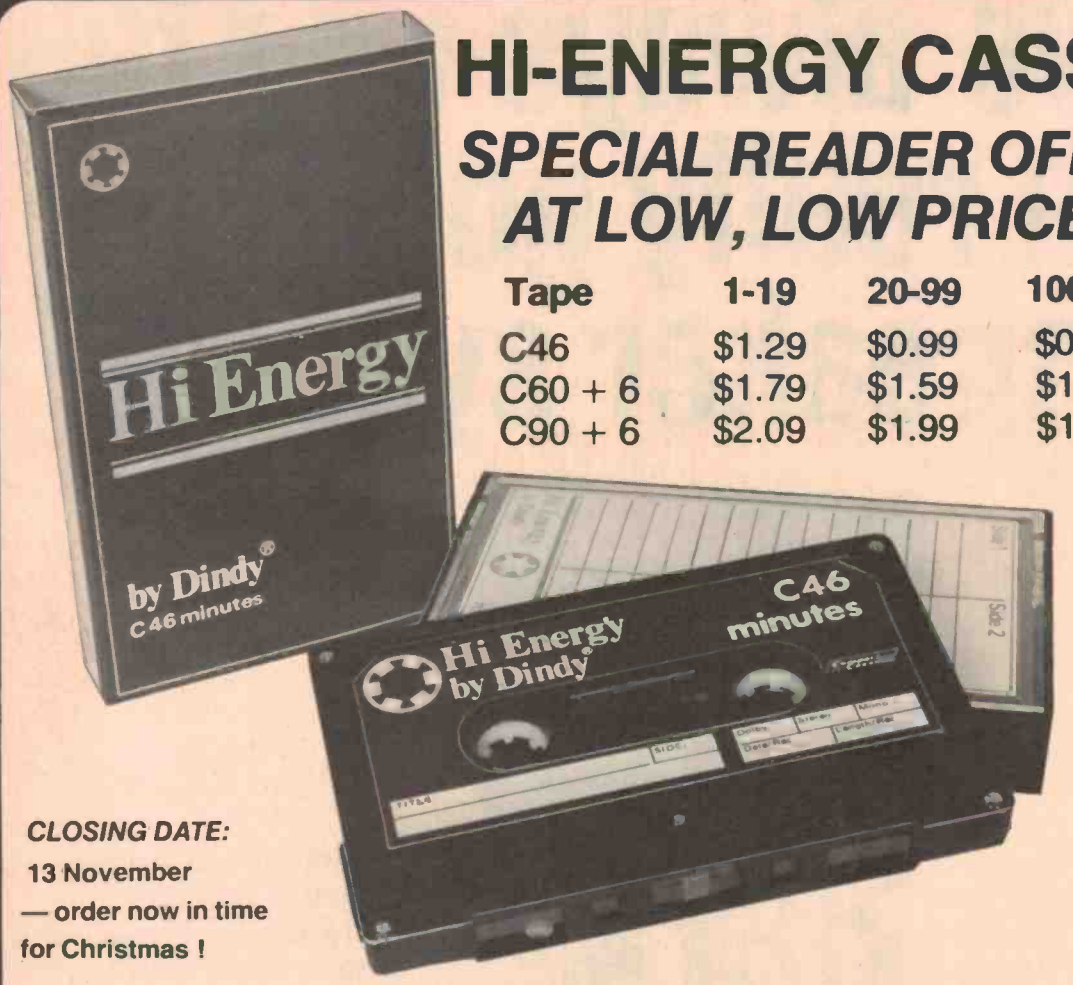
PHILIPS

AHEARN EL 30

HI-ENERGY CASSETTES

SPECIAL READER OFFER AT LOW, LOW PRICES

Tape	1-19	20-99	100 +
C46	$1.29	$0.99	$0.86
C60 + 6	$1.79	$1.59	$1.39
C90 + 6	$2.09	$1.99	$1.79



CLOSING DATE:
13 November
— order now in time for Christmas !

BONUS:
For orders over $60.00 we will include a can of Tape Head Clean Spray valued at $2.25.

Dindy Hi-Energy Cassettes

- **low noise/high output**
- **Cassette case screwed together, not glued**
- **Five year unconditional replacement guarantee**
- **Bonus taping time on C60 and C90**

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and this publication is acting as a clearing house only. Cheques or money orders should be made payable to **'Dindy Cassette Offer'**, *and sent to* **ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011**. *We will then process your order and pass it on to Dindy, who will send you the goods. Please allow up to four weeks for delivery.*

Dindy Cassette Offer

Please supply: Quantity ..... C46 ..... $ .....
..... C60 ..... $ .....
..... C90 ..... $ .....
Packing & delivery — under 99: $2.50
over 100: $4.00 $ .....
(Tapes may be mixed for discount) TOTAL: .....

NAME .....

ADDRESS .....

..... Postcode .....

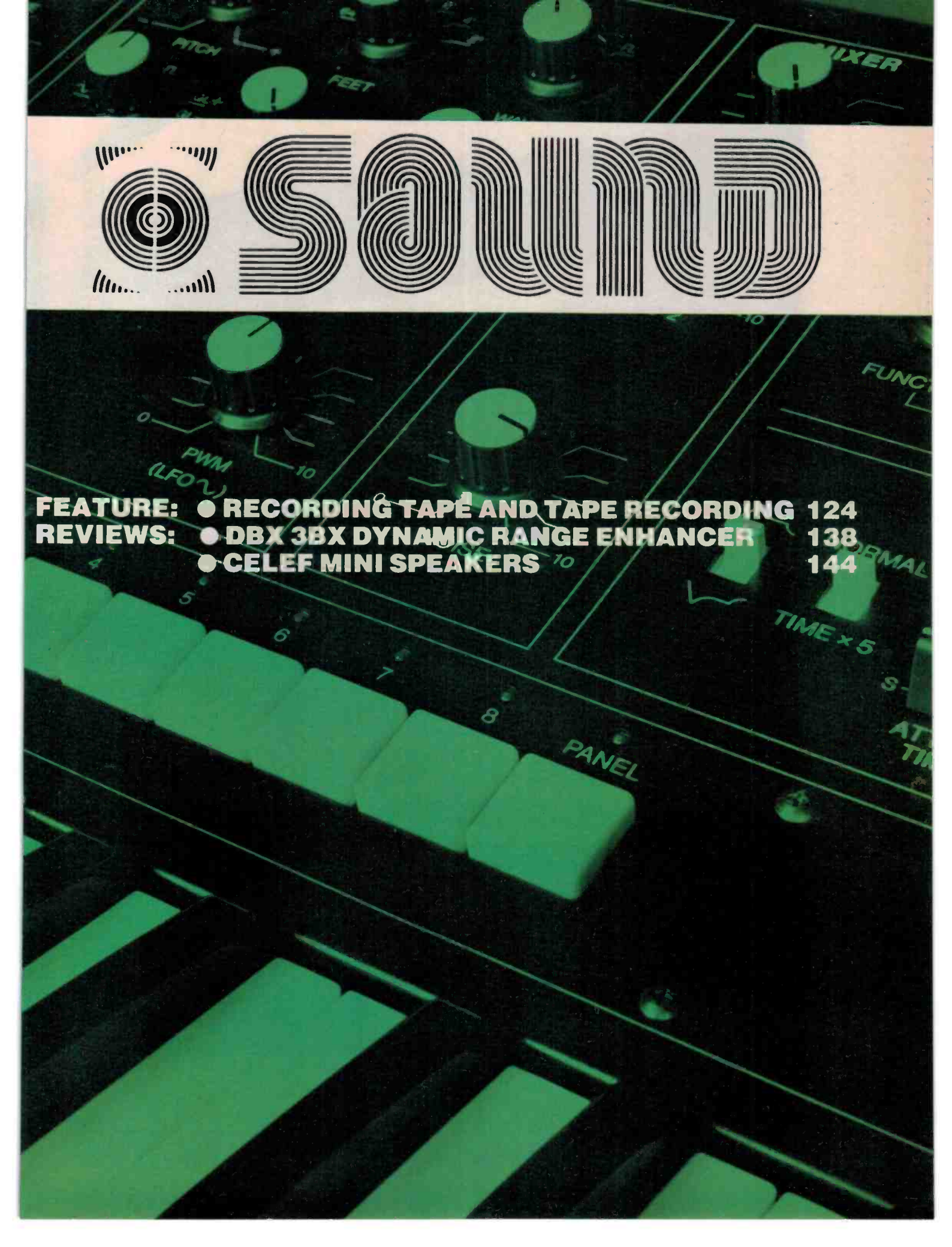
Cheque or money order .....

Or use your Bankcard 4 9 6 [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Expiry Date .../.../...

Signature .....

CHARACTERISTICS

DINDY 'HI-ENERGY' — NORMAL Eq: 3180us + 120us Bias: Normal				
Physical Properties	**Unit**	**C60**	**C90**	**C120**
Base Material				Tensilized Polyester
Width	mm	3.81	3.81	3.81
Length	m	90	135	180
Base Thickness	um	11.5	7.5	6.0
Coating Thickness	um	3.8	3.8	3.0
Total Thickness	um	15.3	11.3	9.0
Colour		Brown	Brown	Brown
Magnetic Properties				
Coercivity (Hc)	Oe	320	320	320
Retentivity (Br)	Gauss	1100	1100	1100
Max. Inductance Bm	Gauss	1350	1350	1350
Squareness	Ratio	0.82	0.82	0.82
Electro-magnetic properties				
Bias Setting at 6.3 kHz	dB+	+4.0	+4.0	+4.0
Relative Sensitivity (333 Hz)	dB	+3.5	+3.5	+3.5
Variation of Sensitivity	dB	+/−1.0	+/−1.0	+/−1.0
MOL 333 Hz/3% THD	dB	+4.0	+4.0	+4.0
10 kHz/3% THD	dB	−9.0	−9.0	−9.0
Signal/noise ratio (NAB)	dB	58	58	58
Signal/noise ratio (MOL/NAB)	db	64.5	64.5	64.5
Print through	dB	−59	−59	−59
Third Harmonic Distortion				
250 nwb/m	%	0.8	0.8	0.8
160 nwb/m	%	0.2	0.2	0.2


sound
FEATURE: ● RECORDING TAPE AND TAPE RECORDING 124
REVIEWS: ● DBX 3BX DYNAMIC RANGE ENHANCER 138
● CELEF MINI SPEAKERS 144

A dream come true
demands music
as true as the dream
– Nakamichi

For further information contact Convoy International Pty Ltd 4 Dowling Street Woolloomooloo NSW 2011
Telephone (02) 3582088

For those who appreciate simple virtuosity

The 480 Series

With the 480 Series, Nakamichi again offers a more affordable cassette recorder – a deck that is simpler to operate, but that sacrifices neither Nakamichi sound nor Nakamichi excellence. The secret is simple. The Asymmetrical, Diffused-Resonance Transport – shared by all models and closely akin to that of the highly acclaimed 582 – is a 3-motor, dual-capstan drive so unique in its simplicity and elegance that it can be manufactured with virtually zero defects. Each 480 Series deck is factory calibrated to yield optimum performance with three types of tape – ferric, chrome-equivalent and metal. Use products of equivalent quality, and you can experience Nakamichi sound and Nakamichi specifications – response to 20 kHz – in *your* home.

Nakamichi

480

The 2-Head Model 480 – fully metal-compatible thanks to our special, narrow-gap, Sendust R/P head and exclusive Direct-Flux erase head. Wide-range, peak responding meters, professional sliding record-level controls, Dolby, and defeatable MPX filter, of course! Even an optional remote control.

482

Step up to the 482, a 3-Head deck utilizing Nakamichi's exclusive "Crystalloy" cores and "Discrete-Head" technology. For those who demand "off-tape monitoring", the 482 incorporates two complete sets of electronics and Double-Dolby so you can hear exactly what *has* been recorded *as* it is being recorded.

For further information contact Convoy International Pty Ltd 4 Dowling Street Woolloomooloo NSW 2011 Telephone (02) 3582088

Minimise infidelity — keep your body in good shape!

BASF have paid as much attention to the body of their latest audio cassette as they have to the tape itself.

This is important because distortion of the case, poor location of the pins and shafts, wobbly guide rollers and slack pressure pads can all prevent the tape from passing the record and replay heads at the correct height and angle.

Even a small variation in azimuth (the angle between the direction of tape travel and the direction of alignment of the head) can cause a noticeable degradation of the replay response, especially at high frequencies. For example, an error of only 12 minutes of arc will cause the output to be down 3 dB at 10 kHz.

It's also very important that the tape head height is right — that is, the recorded track on the tape should not overlap the head gap which is reading it.

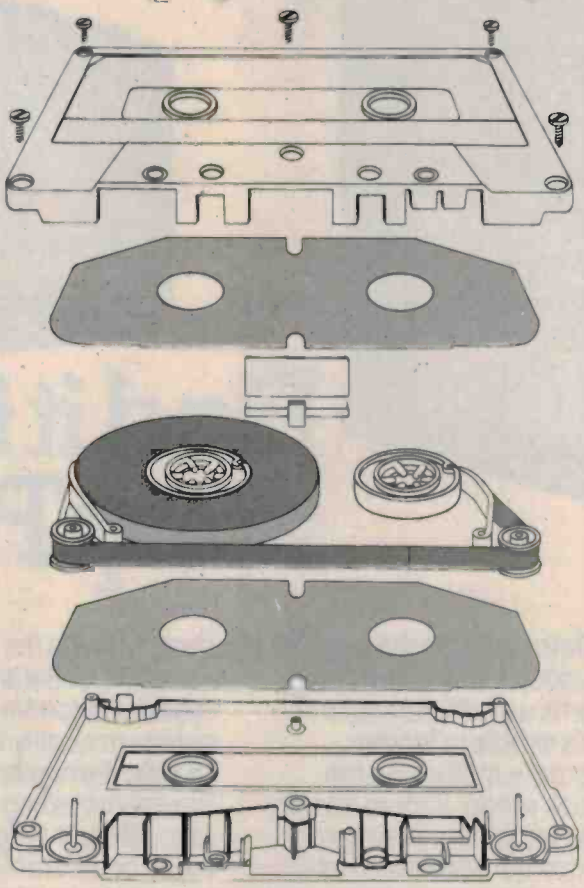
BASF's new Ferro Super LH 1 is a normal bias 1 and 120 us equalisation tape contained in a precision moulded, high impact, thermally stable plastic case, the two halves of which are screwed together, not welded or pinned.

The quality of the housing means (according to BASF) that the pins will not 'dip' and introduce azimuth distortion. BASF say tests of the cassette on every type of cassette have shown a distinct reduction in wow, flutter and intensity variations.

The tape coating contains a finely particled "maghemite" variety of iron oxide which gives a noise figure up to 2 dB lower than standard LH tapes. A new production process allows a higher density of oxide particles than before and a much better alignment of the particles in the magnetic preferred direction. The surface is said to be particularly smooth and slippery (which is kind to heads), abrasion-proof and mechanically strong.

So confident are BASF that the construction of the Ferro Super LH 1 cassette is reliable that they guarantee to replace one without question if it should ever fail for any reason.

More details from BASF Australia Ltd, 55 Flemington Road, North Melbourne, Vic 3051. (03) 329-9555.

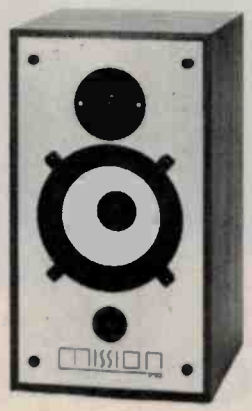


Double launch by Mission

Two new compact two way loudspeaker systems have recently been introduced by UK manufacturer Mission.

Both are ported designs standing about half a metre high and both accept an amplifier signal power range of 15 to 80 watts per channel.

The 710 MK II speakers have a 210 mm polypropylene woofer and a 25 mm ferrofluid tweeter, while the less expensive 700 models have a paper cone woofer and a smaller (19 mm) soft dome tweeter.



Phono matching aids

Berkshire Audio have brought out a handheld capacitance meter to simplify matching phono cartridges to preamps.

Serious degradation of frequency and transient response can result from presenting the wrong reactance to a cartridge and to make things difficult, almost every model of cartridge prefers a different capacitance.

The model CCM is a pocket-sized battery-operated instrument that measures the total capacitance (including cable capacitance) between the cartridge and the preamp. Its range is from zero to 1000 pf (In) with an accuracy of 5% and it is claimed to be the only instrument of its kind that can measure the input capacitance of a preamp without regard to input resistance.

From the same manufacturer comes the Match-Maker, a switchable adaptor that plugs into the preamp phono input and accepts the phono cables. Up to 18 different loading conditions can be selected — capacitance in 50 pf steps from 50 pf to 350 pf and resistance from 22k to 100k. The unit includes a filter to eliminate interference from extraneous RF sources.

More details on both these items can be obtained from the distributors, M. R. Acoustics, P.O. Box 165, Annerley, Brisbane, QLD 4103.

Somewhere on this 3 hour cassette a brilliant goal was scored.

Find it in seconds with Sony 'Picture Search'.

Sony Betamax C7 solves one of home video's more frustrating problems with 'Picture Search'. Now it's simple to locate programme material in the playback mode. Picture Search plays in forward or reverse at 11 times normal speed with all the action on the screen. That means 3 hours of recorded programme can be reviewed in just 16 minutes. Now you can find that last minute goal without playing extra time. But then, Picture Search is just part of the magic Betamax C7.

A choice of viewing speeds.
From 3 x normal speed to single frame advance, or variable slow motion, that's the viewing versatility of Betamax C7. Sony's superior U-loading system ensures optimum quality in every mode.

14 day, 4 programme timer.
Pre-set recording times for up to four different programmes on the same or different channels up to two weeks in advance. Betamax C7 also features a cordless infra-red remote control unit which puts all major functions including 'Picture Search' in the palm of your hand.

Sony leads in home video.
1 million Betamax recorders and 20 million tapes have already been sold. With Sony Betamax C7, you enjoy all the benefits of Sony research and leadership.

Sony Betamax C7

SONY

There are two different Betamax units available, the C7E and the C7EC. For areas which require channels 3/4/5/5A, please specify C7EC. Your television should also have a UHF tuner.

AP3467

Noiseless discs?

Specially encoded discs with very low noise and wide dynamic range are to arrive in Australia very soon.

The discs are encoded by the dbx type 11 noise reduction system, which dbx claim gives up to 30 dB of noise reduction (compared to about 10 dB achieved by the Dolby process).

This is said to completely suppress surface noises. turntable rumble and groove echo.

A special dbx decoder has to be used when playing the discs and there are two different styles of these. Model 21 is a stralghtforward disc and tape decoder which can only be used to replay dbx encoded discs and tapes. It is expected to retail at a little under $200.

Or you can go for one of the dbx noise reduction units which have been around for some time. As well as dbx decoding, these can also be used as dynamic range expanders and noise reducers for normal discs and tapes.

More information from Electro-Voice Australia Pty Ltd, 174 Taren Point Road, Taren Point, NSW 2229. (02) 525-8588.

Freon-cooled amp heads new Sanyo series

Sanyo's latest power amplifier doesn't use conventional heatsinks to cool the output transistors.

Instead, the temperature is kept down by using a heat pipe — a closed tube of freon with one end in good thermal contact with the transistors, terminating in a set of radiating fins at the other end.

As the transistors' temperature rises the freon begins to evaporate and migrate away along the tube, cooling as it does — until it eventually condenses and runs back as a liquid again. In this way the transistors' temperature is maintained close to the boiling point of freon, because increasing the power dissipated increases the **amount** of freon evaporated, not its temperature.

This unusual method of heat dissipation is a feature of the Plus P55 stereo power amplifier, which is part of the Sanyo Plus series of receivers, tape decks, turntables and other items which has just been released. In all there are 13 units in the series.

Like all the Plus series amplifiers the Plus P55 amp has a moving coil cartridge preamp stage built in. Power output is 100 watts RMS per channel and total harmonic distortion is specified as a respectable 0.009%. Phono input sensitivity is 97 dB with moving magnet cartridges and 70 dB with moving coil types according to Sanyo.

In the same series is the Plus D62 cassette deck, which is compatible with metal tapes and incorporates Sanyo's Automatic Music Select System. A "Super D" noise reduction system, which is a separate unit, is claimed to improve considerably on Dolby techniques and increase dynamic range by as much as 40 dB.

Other items of interest are a receiver which is said to have THD of 0.03% or less and FM sensitivity of 10.8 dBf and the Plus T55 AM/FM tuner, which has quartz locked tuning, digital frequency readout and a twelve station memory.

Fast setting cassette deck

The Pioneer CT-F1250 cassette deck can be manually adjusted for correct bias, level and equalisation in about twenty seconds, the makers claim.

That's with a bit of practice, but the technique doesn't sound too hard to master. First you load the cassette and put the deck into Record, then you set a mode switch to Bias.

This sends to the record head a 2 kHz signal superimposed on a bias frequency that you vary until two arrowhead indicators light up. Without stopping the tape you then change mode to Level and make a similar adjustment until indicators light and finally you do the same thing in the EQ mode.

The CT-F1250 is a three head, two motor machine with quartz controlled direct drive and a tape transport mechanism that keeps wow and flutter down to 0.03% WRMS.

It retails for a little under $700 but the same manual tuning facility is also available on the lower priced CT-F950, CT-F750 and CT-F650 decks. Only the CT-F1250 will accept metal tapes though.

Base for Connoisseurs

A small Brisbane company are making a base specially designed for the famous Connoisseur BD1 turntable kit.

The unsophisticated BD1 has been appreciated for years for its high performance and the new base from Woodland Audio is claimed to make it sound even better.

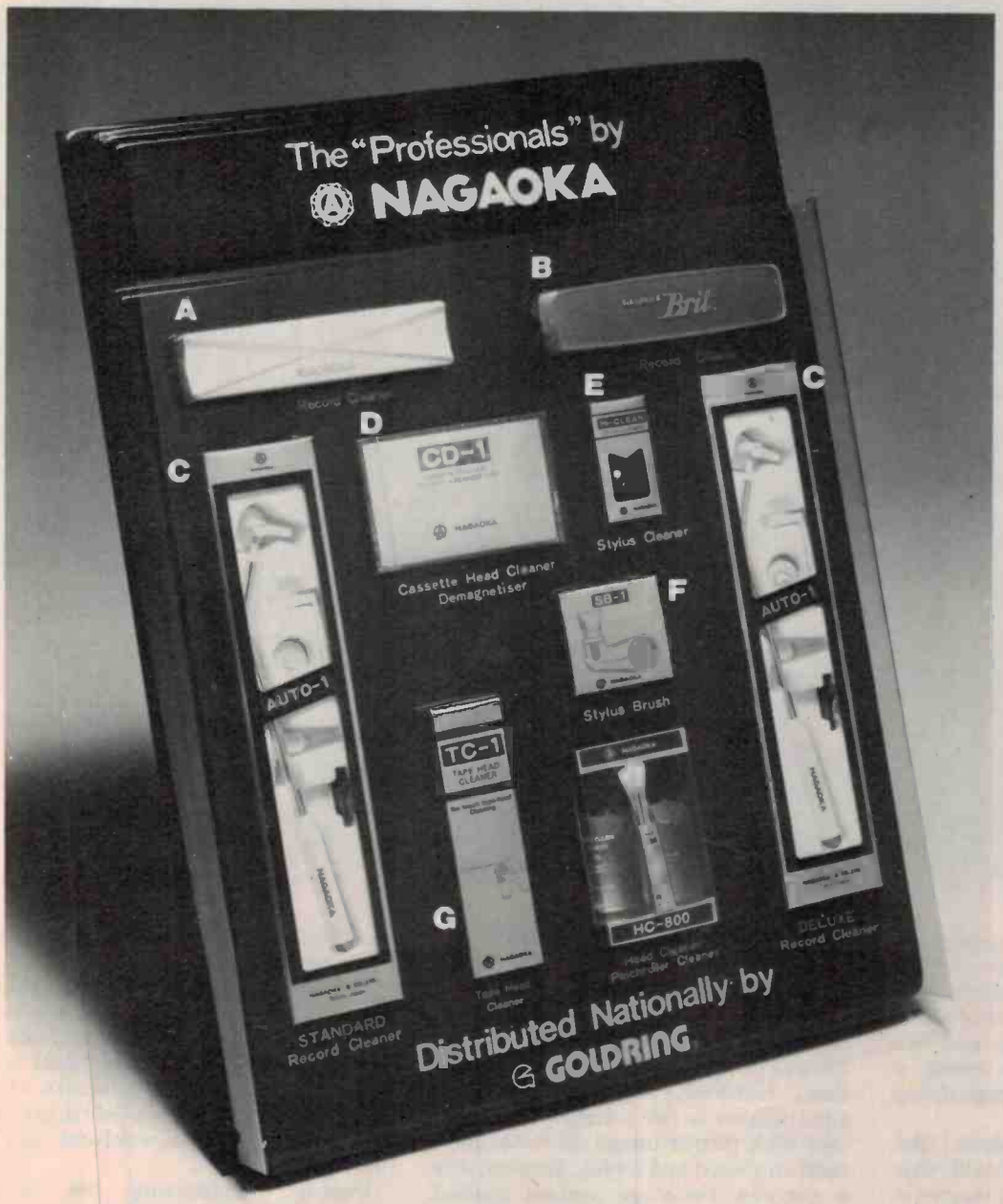
Made from a new high density resin-bonded material with lead damping panels, this base is said to cut down on acoustic feedback, improve stereo image and separation and increase dynamic range. It looks good too.

It comes predrilled to suit most tone arms and has a recommended retail price of $96. More details from Woodland Audio, P.O. Box 307, Rocklea, Brisbane, QLD 4110.

CASSETTE and RECORD CARE by the PROFESSIONALS...

NAGAOKA

Look for this display when you next need cassette or record care products. The items shown are the cream of cassette and record care accessories and are a must for everyone who cares about their equipment.



(a) CEIL:
A velvet type dry cleaner for records.

(b) BRIT:
A velvet type moist cleaner for records.

(c) AUTO-1:
Standard and delux tracking record cleaners — provides gentle cleaning action whilst playing records.

(d) CD-1:
Cassette head cleaner and demagnetiser, simply place in cassette player for easy one step cleaning and demagnetising.

(e) HI-CLEAN:
Fluid styles cleaner and brush.

(f) SB-1:
Stylus cleaning brush.

(g) TC-1:
Pressure pack tape head cleaning spray with extension for cleaning inaccessible areas.

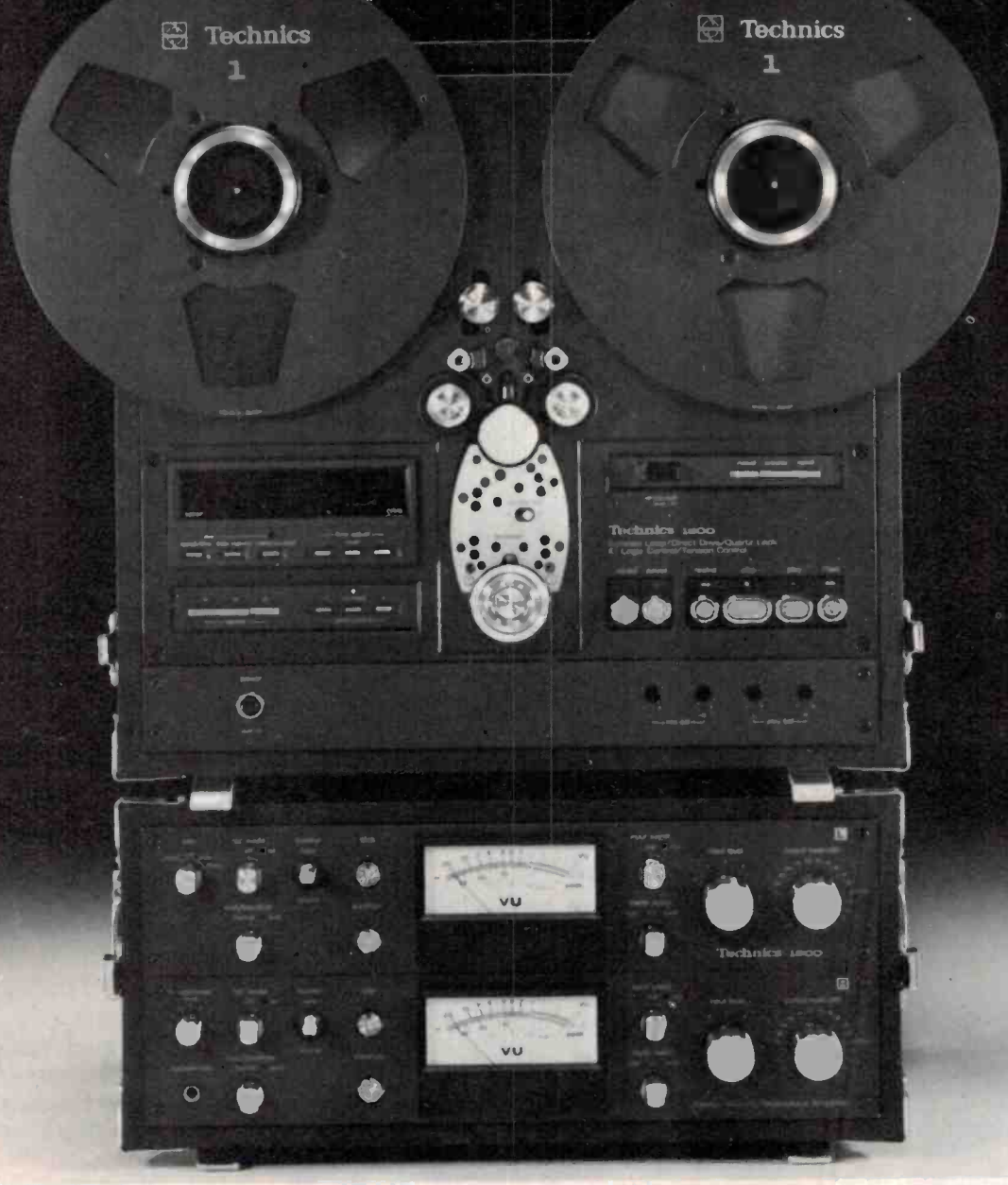
(h) HC-800:
Tape head and pinch roller cleaning kit, includes cotton swabs for effective cleaning.

Nagaoka products are distributed throughout Australia exclusively by Goldring Audio Industries.

GOLDRING®

Recording tape and tape recording

If you're a newcomer to the popular pastime of tape recording and reproduction, here's a complete rundown on the technicalities



John Gardner

ALL HI-FI reproduction is dependent on the storage of information and its retrieval when required. Information stored on a gramophone record is in the form of a modulated groove, and the signal waveform is visible under a microscope or a powerful magnifying glass.

With tape recording, however, the signal is stored by a magnetic oxide that carries an invisible, varying magnetic pattern. To record and recover the information a series of energy conversions is necessary: acoustic-to-electric, electric-to-magnetic, and vice versa.

As with the disc system there are losses and technical inadequacies that have to be compensated for by equalisation. However, in tape recording, equalisation is not a single stage process with mirror image characteristics used on record and replay. Instead, it is a complex two-stage process applied partly when recording and partly on playback, to give an overall flat response. Before we discuss this in detail let us consider the nature of tape and of the recorded signal.

Recording tape consists of a thin, pliable base of plastic material, such as mylar or polyester. The base is coated with a magnetic oxide paste about four um thick (one um is one millionth of a metre), the constituents of which are the oxide itself, a binder, a solvent, and a lubricant.

During manufacture the oxide powder, which is in the form of minute needle-shaped particles (or magnetic domains), is given a type of 'grain'. That

is, the particles have a common orientation. For some computer and video systems the grain is vertical — perpendicular to the direction of tape travel — but for conventional sound recording the grain is horizontal (Figure 1).

Aligning the particles in this way allows a more concentrated coating to be applied than would random application. For a given type of oxide and a given tape width, the thickness of the coating determines the maximum output possible from the tape.

The most commonly used oxide is gamma ferric oxide (Fe_2O_3) and, until about 1966, it was the only oxide regularly used in the manufacture of magnetic tape. Later developments were chromium dioxide (CrO_2), ferrichrome — a mixture of ferric and chrome coatings — and cobalt. More recently 'metal' tape formulations have appeared (see July 1979 ETI, p.159).

Early ferric tapes were noisy, had low sensitivity, and poor high frequency response. With improved manufacturing methods the tape was improved immensely and finer oxides, with more regular particle structure, were developed to give lower hiss, higher output levels, and better high frequency response.

Chromium dioxide enjoyed a popular vogue in cassette recording but, while it has a slightly superior high frequency performance at low speeds, it is more prone to distortion than ferric tapes and is now being superseded by ferrichrome. For reel to reel recording at speeds above 95 mm/s there is no advantage to be gained from the use of tapes other than ferric oxide.

Tape magnetisation

When tape is in a so-called demagnetised state the individual particles (domains), although physically aligned, have no common magnetic sense (Figure 2). The domains may be regarded as minute bar magnets, but when these are of random polarity, as with blank tape, the only output produced by the oxide is in the form of noise. To record a signal on the tape it is necessary to modify the distribution of polarity so that a magnetic analogy of the audio signal applied to the machine's input is written along the tape's length.

To store the input signal on tape it must be converted into a form that the tape will recognise and retain. This conversion is carried out by the tape head (Figure 3.), which is effectively a ring-shaped electromagnet. The audio signal, in the form of a varying voltage, is applied to the head winding.

Now, if a current flows through a piece of wire a magnetic field is created around the wire, and if the wire is wound into a coil this field is intensified. If a core, such as soft iron, is inserted into the coil it will become magnetised and remain so until the voltage applied to the coil is removed. A tape head is simply a variation of this idea with the coil curved to bring the two ends (poles) into close proximity.

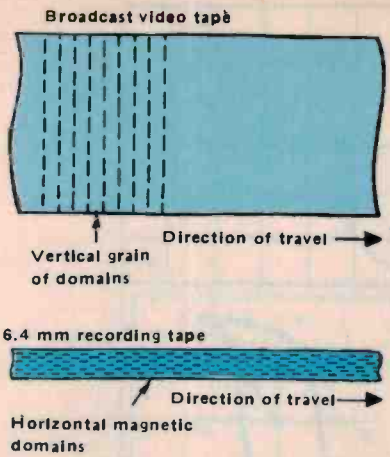


Figure 1. During manufacture the magnetic particles are given a common orientation.

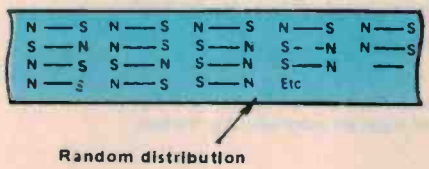


Figure 2. An erased so-called demagnetised tape with a random distribution of domains.

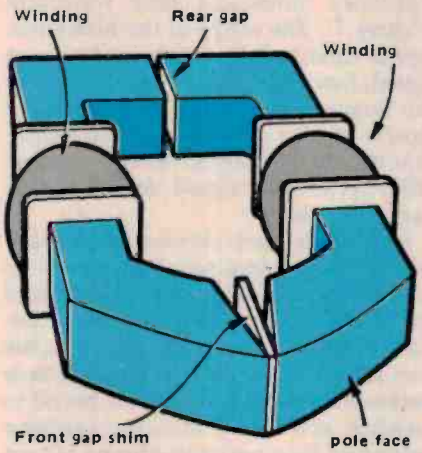


Figure 3. A typical record/replay head.

With a constant voltage applied to the coil, the iron core will have a North and South pole, rather like a horseshoe magnet. If the polarity of the supply voltage is reversed, the two poles will be reversed. If we substitute an audio signal, such as a sinewave, for the constant voltage, the poles will alternate in sympathy with the positive and negative half-cycles of the applied signal.

The strength of the poles at any instant will depend on the voltage of the signal, which in turn depends on the amplitude of the original sound. Because of a shim placed at the front of the head, filling the gap between the pole-pieces, the magnetic flux cannot easily pass from the North to the South pole. In fact, the reluctance of the shim (reluctance is the magnetic analogy of resistance) is so high that it is easier for the flux to complete the magnetic circuit by crossing the air space in front of the shim.

If a tape is passed over this concentrated magnetic flux the magnetic circuit is completed through the tape oxide. The effect of the varying flux on the moving tape is to produce a series of bar magnets along the length of the tape. The stronger the magnetising the greater will be the strength of the bar magnet so formed. The length of a particular magnet depends on the rate at which the applied magnetising force is changing polarity, and on the linear speed of the tape. (For example, at 10 kHz with a tape speed of 190 mm/s, the recorded wavelength takes up 0.019 mm of tape. Wavelength here is tape velocity divided by frequency.)

In the case of a sinewave input — as shown in Figure 4 — a wavelength consists of two bar magnets of equal length. The positive going half-cycle is represented by a North-to-South field, and the negative half-cycle by South-to-North field, although the opposite could equally well be the case.

So far the concept is relatively easy to grasp. An electrical signal is converted to a magnetic form and is effectively 'written' — in the form of a varying magnetic flux — on the tape oxide. It is then retained and at any time the message may be read by the reproducing system. What complicates the matter is that in both recording and ▶

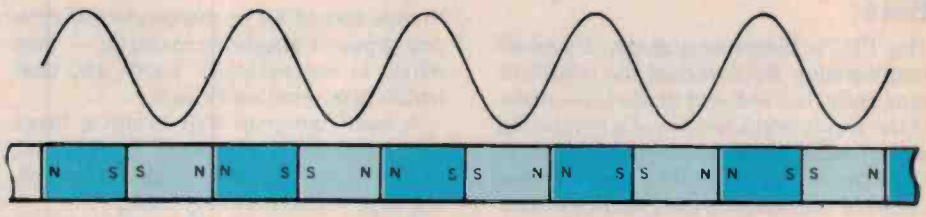


Figure 4. A recorded tape has areas of magnetic polarisation corresponding to the positive and negative half cycles of the applied waveform.

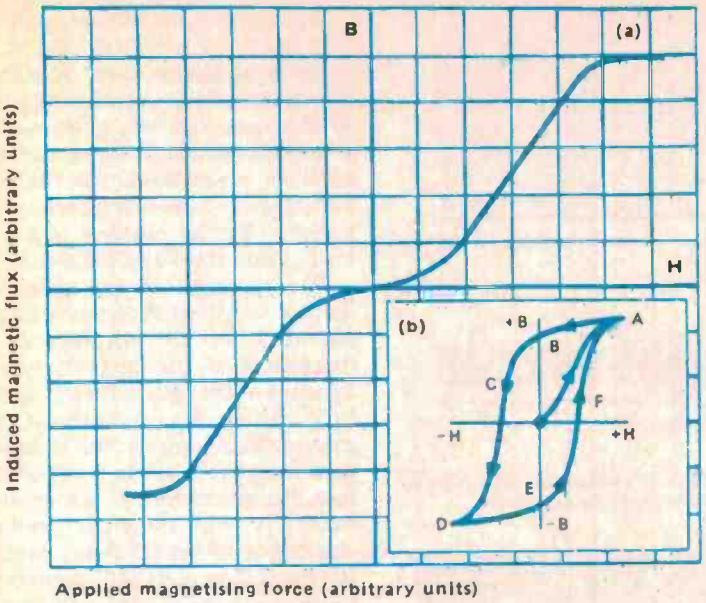


Figure 5. The non-linear tape transfer characteristic (a) is derived from the hysteresis loop (see inset). It is a graph of induced magnetic flux versus applied magnetising force.

replay the transfer from electrical to magnetic, and from magnetic to electrical energy is non-linear.

Transfer

Every tape has what is known as a tape transfer characteristic, which shows the relationship between the applied magnetising force (H) and the resultant tape flux (B). This characteristic will differ from one type of tape coating to another — a typical transfer curve is shown in Figure 5.

The characteristic is derived from a hysteresis loop, which describes the tape flux resulting from the application of one cycle of magnetising force to the oxide. For the sake of simplicity we will ask you to accept the derivation of the hysteresis loop, and from it the tape transfer characteristic (TTC).

The significant thing is the shape of the TTC itself. There is a discontinuity at the origin of the B-H curve, with a nearly linear slope in the central region of the positive and negative sections of the curve. Beyond a given point an increase of applied magnetising force gives no increase in the resultant tape flux: this is the point of tape saturation.

Bias

The TTC is therefore a graph of applied magnetising force versus the resultant magnetic flux induced in the tape oxide. If the input is in the form of a sinusoidal swing either side of the B axis (Figure 6) then the recording will be distorted because of the shape of the characteristic.

To overcome this distortion the input signal must be offset on to the linear part of the TTC. This is done by superimposing the audio signal on a high frequency sinusoidal bias waveform (Figure 7). The shape of the bias envelope is thus a replica of the audio input signal, but this signal is now applied to the linear part of the TTC. One of the objects of bias adjustment is to ensure that the bias voltage gives the required offset of the audio signal on to the linear part of the curve.

Iron oxide and chrome tapes vary widely in their bias requirements — up to 40 per cent more bias being required for chrome tape, which is more consistent than iron and shows little variation between brands. Ferric tape varies considerably from one brand to another, and once a machine has been optimised for a particular brand of tape it is advisable to stick to that brand unless there are compelling technical or economic reasons for doing otherwise. When the recording bias is adjusted it will be found that if too low an offset voltage is used the signal will be distorted: if it is too high, demagnetisation of the high frequencies will occur and the top response will be impaired.

Tape heads

In tape recording we are concerned with two types of magnetic material — that which is magnetically 'hard', and that which is magnetically 'soft'.

A hard material will retain a large proportion of any induced magnetism, which cannot be easily erased. Recording tape is magnetically hard.

A 'soft' material will react quickly to changes in magnetic force, but when that force is removed will retain very little magnetism. This ability to react rapidly to changing magnetic conditions is exactly what is required of a tape head which, consequently, is made from soft material. In this context hardness and softness are magnetic, not physical properties.

Three functions have to be performed by the tape heads, functions that are so individual that, if they are to be performed efficiently, require three independent heads — erase, record, and playback.

For economic reasons manufacturers often combine the functions of two of the heads, and fit machines with an erase head and a dual purpose record/playback head. Apart from the engineering compromises that such an arrangement necessitates, there are also operational disadvantages, the most serious of which is that the tape cannot be monitored during recording.

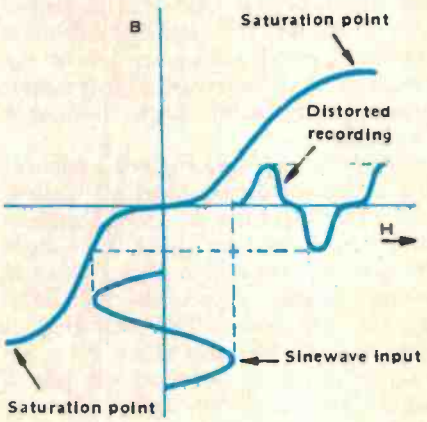


Figure 6. Distorted recording results from non-linear tape transfer characteristic.

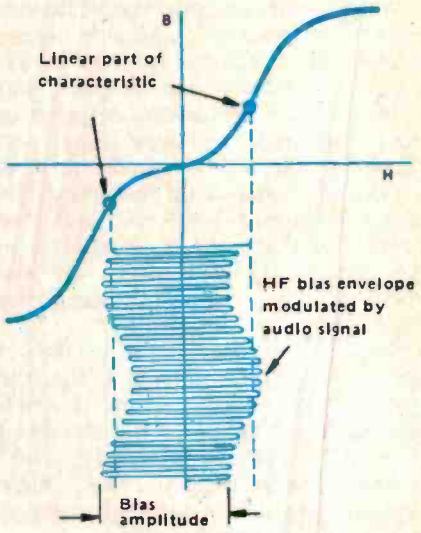
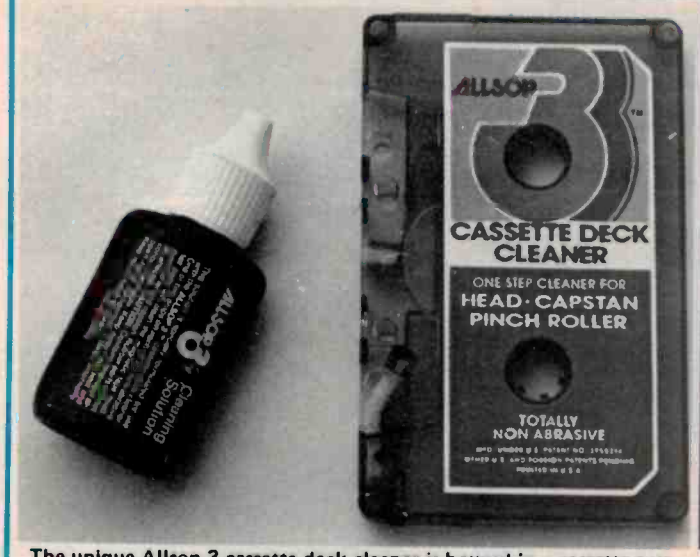


Figure 7. The distortion can be minimised by offsetting the audio signal onto a high frequency bias voltage.



The unique Allsop 3 cassette deck cleaner is housed in a cassette case

The Nagaoka cleaning tape, from Goldring, employs a special tape

Tape Care Products

Cassette cleaners

Users of cassette decks can choose from a wide variety of special cassettes that make head cleaning as simple as playing a tape. But make sure you buy a reputable brand — some cheap head cleaners are abrasive and may damage your heads.

Bib's cleaning cassette contains a non-abrasive textile ribbon and simply wipes off a fluid that is sprayed on prior to use. **TDK** make a cleaning cassette that runs dry and will remove light to moderate dirt accumulations from the heads, capstans and pinch roller. The Nagaoka Cleaning Tape 4, distributed by **Goldring**, has a specially treated polymer tape to clean the heads and two felt pads for wiping the capstan and pinch roller.

Philips sell a kit that includes a cassette with a phial of cleaning fluid — you just put a drop or two of fluid on the textile tape before running it through your machine. For removing stubborn dirt deposits the kit also provides a few cotton buds. **Ralmar** have a number of cleaning cassette outfits ranging from a simple cassette and fluid combination to their deluxe kit which also includes a cutter and splicer for tape editing.

Last but certainly not least is the Allsop 3, available through **Communications Power Inc.**, which contains an oscillating mechanism that rubs felt pads to and fro against all the parts that accumulate grime.

The basic elements of a tape head have already been shown in Figure 3. In the case of the erase and record heads the flux due to the current through the windings induces a varying magnetic flux into the core. In the case of the replay head, the magnetised tape induces a varying flux into the poles, which produce an electromotive force (emf) in the windings, and hence an electrical output.

Of particular importance are the width and alignment of the gap, and the shape of the pole-pieces in contact with the tape. The width and alignment of the gap largely determine the attainable high frequency response, whilst the head contact area affects the low frequency replay response. In order to maintain precise head alignment some manufacturers construct the head block as a single unit with the heads rigidly fixed to a common, machined baseplate.

Erase head

It is a curious feature of the recording process that the bias waveform, which reduces distortion and enables a good recording to be made, also has the characteristics required to erase the tape.

The important factor for erasure is a high enough current to carry the tape into saturation at each reversal of polarity. It is not possible to demagnetise the tape — the particles are always polarised in one direction or another. However, if the distribution of magnetism is completely random, the effect is of a mutual cancellation within the tape, which thus has no external flux.

The object of using a high frequency erase current is that it subjects the individual domains to a large number of reversals of polarity in a short space of time. The tape is moved through a concentrated magnetic field, the effect of which progressively reduces as the tape leaves the head. Therefore the tape is firstly repeatedly saturated at each reversal of polarity as it crosses the head gap. Then the weakening field, as the tape leaves the gap, is unable to reverse all the particles in a given area, and the final polarity a particle adopts is not greatly influenced by the original signal polarity. The tape therefore has a random magnetic distribution and is said to be demagnetised.

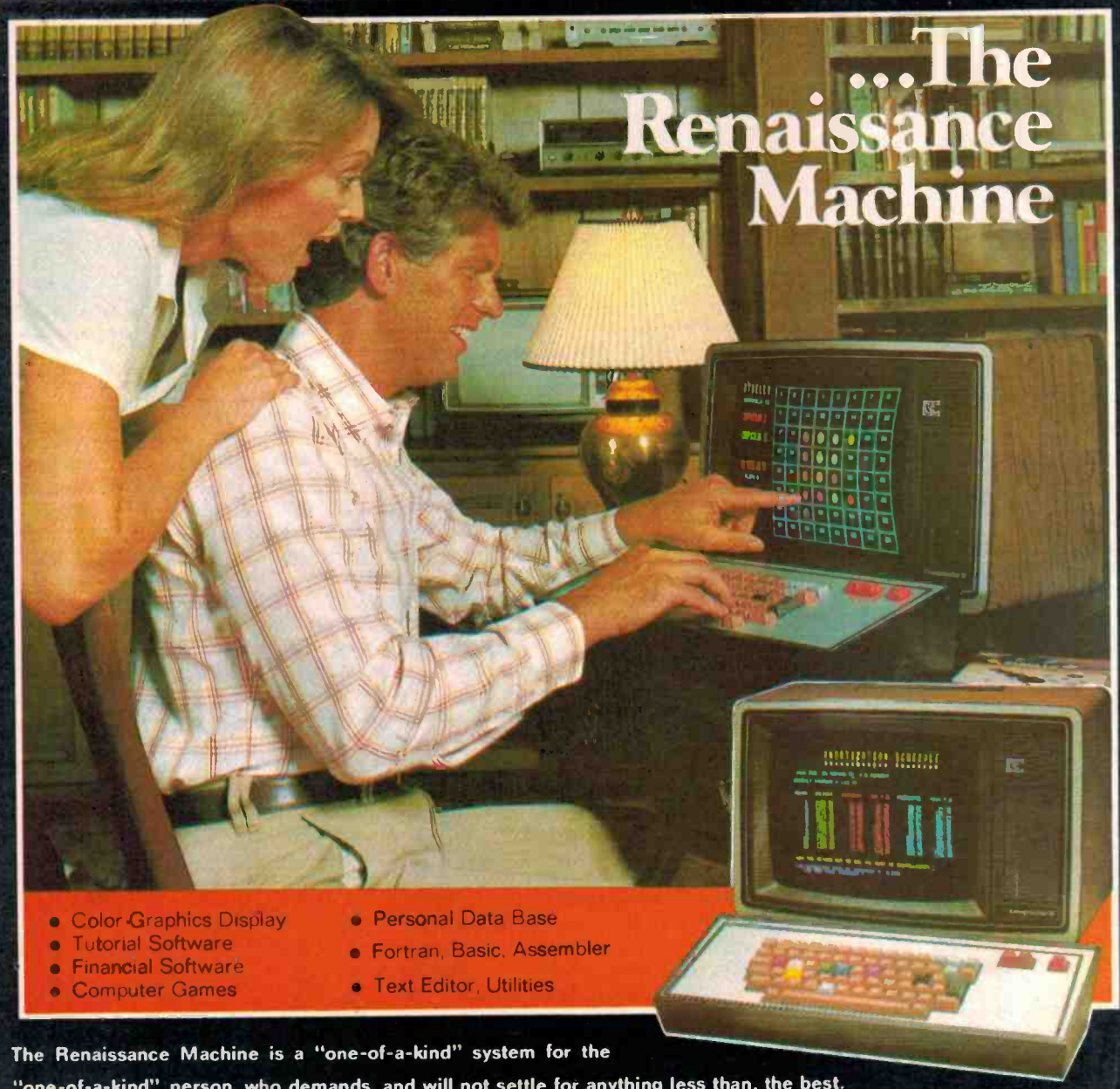
In practice it is possible for some of the particles to partially recover their original magnetic sense. For this reason a second pass over the erase head is often necessary to obtain complete erasure. To increase the depth of erasure many tape recorders are now fitted with double-gapped erase heads that give a similar effect to two passes of the tape across the head. The erase gap may be as much as 20 um, although with a double-gapped head the second gap is usually considerably smaller. The erase frequency must be high enough to produce the rapidly reversing flux and to avoid the generation of spurious beat frequencies (with 19 kHz and 38 kHz signals from stereo tuners). It is usually in the region of 80 to 150 kHz.

Record head

Whereas at the erase head a saturating magnetic force is used to remove any existing signal waveform from the tape, at the record head a bias current of precisely controlled amplitude is mixed with the audio signal to minimise distortion of the audio waveform.

— *to page 131* ▶

Color your thinking with Compucolor 11



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AU-X1

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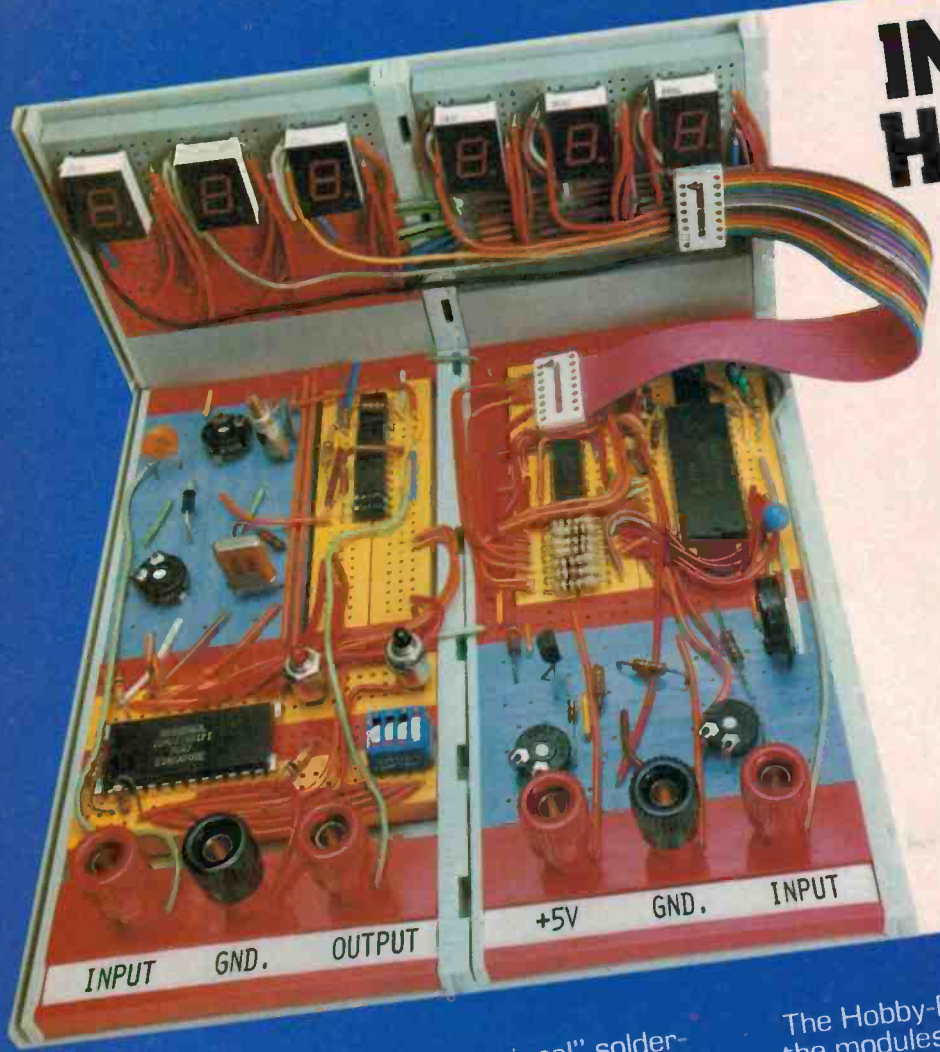

Until now, you had to buy "professional" solderless breadboards for your projects and pay "professional" prices. Now there's Hobby-Blox, a totally new circuit-building system that's not only economically priced but offers many more advantages to the hobbyist.

At the core of the system are two expandable starter packs, one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox modules that fit into a tray and an illustrated project booklet. In addition, the system includes 14 separate component packs you can purchase individually — terminal, distribution and bus strips, speaker panels, binding posts, etc.

The Hobby-Blox system is easy to use because the modules are color-keyed and letter/number indexed. It's time-saving, because they're solderless. It's compatible with DIP's of all sizes and a wide variety of discrete components. And you save money, because the parts can be reused again and again.

How far can you go with the Hobby-Blox system? Take a look at the example above. Then you'll know why we say, "your only limit is your own imagination!"

A P PRODUCTS INCORPORATED
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(216) 354-2101

For a free catalog, contact your local HOBBY-BLOX™ dealer:

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TEL: 570-8122

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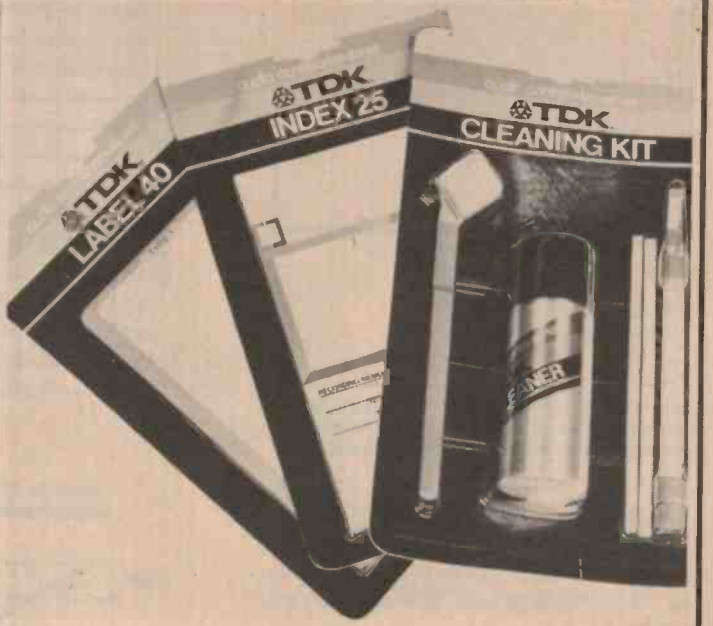
202 Bell Street
Preston, Victoria 3072
TEL: (03) 480-1211

Maxell's head cleaning kit is very comprehensive.



The TDK cleaning kit — simple and inexpensive.

Tape Care Products

Mind your heads!

NOTHING spoils the performance of a tape recorder so much as dirty heads. Even if you're not worried about high fidelity you *must* use something to clean the heads every so often, otherwise your tapes will sound *terrible*.

There's a variety of solvents and tools on the market, some of them simpler to use than others. At the most basic level you can use a cotton bud dipped in meths, but its better to use a specially formulated cleaning fluid such as that made by **Bib**. Or you can spray the heads first with an aerosol solvent, then wipe them off. **Dindy** and **Ralmar** both sell suitable spray cleaners.

Two of the leading cassette makers sell complete head cleaning kits that can be used for both cassette and reel to reel machines. **TDK's** kit has a fluid that you spray onto the end of a cleaning probe. When the probe gets too dirty, you just snip off the end and extend the wick. The kit also includes a little mirror so you can check the heads really are clean.

Maxell's kit comes in a neat plastic box and includes fluid, mirror, straight and angled probes with discardable felt pads and a brush. **Bib**, who specialise in tape and record care products also do a kit of this kind, as do **Tandy**.

Remember, when you clean your heads, not to forget the capstan and pinch roller too. Dirt on these will soon be transferred to the heads and you'll be back where you started.

The record head gap is much smaller than the erase head. It must be small enough to produce a high flux density, but wide enough to allow for a number of changes of polarity of the bias waveform. Depending on the bias frequency, tape speed, and gap dimension, each domain is subjected to around 10 cycles of bias current. Again, the bias results in a polarisation of the magnetic domains but, because of the presence of the audio signal, as the bias field diminishes, so the polarity of the domains is increasingly influenced by this varying signal.

Thus, instead of the tape reverting to a natural state it is magnetised according to the amplitude and frequency of the applied audio signal. This means that the tape is recorded as it is leaving the head gap, and the gap itself is not too critical as far as the audio waveform is concerned. A typical record head gap for a machine running at 95 and 190 mm/s would be six um.

The relationship between the current in the head winding, the permeability of the core, and the flux concentration at the gap is not linear. To overcome this a high reluctance rear gap is used that is analogous to a constant current resistor. The reluctance of the rear shim is so high in comparison with the rest of the magnetic circuit that it swamps any variation in the permeability of the core material, and a virtually linear flux is produced at the front gap. The rear gap is usually about 10 times that of the front.

Replay head

A tape head is a piece of precision engineering. In the case of a replay head the tolerances are so closely defined that there is virtually no margin for error. Even a slight departure from specification can lead to a major loss of performance.

One of the most crucial dimensions is that of the replay head gap. Due to the nature of the head material, the flux coupling with the poles, and the head-to-tape contact area, the effective gap may be as much as twice the physical gap. Because the replay head tolerances are so tight, if a dual purpose head is constructed it will, to all intents and purposes, be a replay head.

The output from the replay head depends on the efficient coupling of the surface induction on the tape with the head and its associated preamplifier. A replay head core has extremely high permeability — several thousand times that of air — so that the tape flux at the point of intimate contact with the head will seek the easy path through the head core.

The changing flux pattern as the tape moves across the scanning head results in an emf in the head windings, a voltage that increases with frequency because it is proportional to the rate of ▶

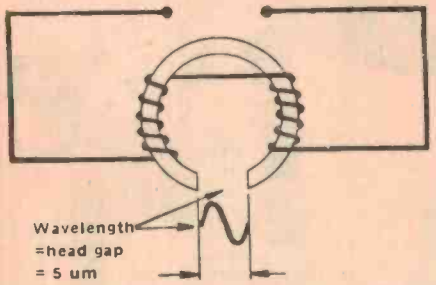


Figure 8. When the recorded wavelength equals the replay head gap there is no flux linkage with the head core and consequently no output.

change of flux. Hence, doubling the frequency will double the output from the head — in other words the output from an ideal head would rise at 6 dB per octave.

In practice a straight line graph is not realised, and the 6 dB per octave slope is only achieved at low and mid frequencies. At the upper end of the audio spectrum a point is reached (Figure 8) where the recorded wavelength is comparable with the effective gap of the replay head. When this point is reached the variation of flux will occur within the gap dimension and consequently there will be no output from the head. The frequency at which this happens is known as the extinction frequency, although the ideal slope does not suddenly fail as the extinction frequency is reached. As shown in Figure 9, it begins to roll off at about half the extinction frequency.

Now we can see the problem in perspective. To achieve a theoretical extinction frequency of 20 kHz at 190 mm/s the effective gap should be 9.5 um, giving a physical gap of about 5 um. The response of the head may not be as good as the theoretical figures given above, but in general the head with the narrower replay gap will have the better high frequency response.

Replay system

We have briefly discussed the principles of the recording and replay processes. Let us now consider how the replay and recording chains are interlinked and equalised so that a flat overall response can be obtained.

We have already referred to the extinction effect, which is a major cause of high frequency loss. In addition to this, when the recorded wavelength is very short the individual poles are in such close proximity that some of the flux fails to emerge from the surface of the tape. Instead, it completes the magnetic circuit through the oxide and so does not

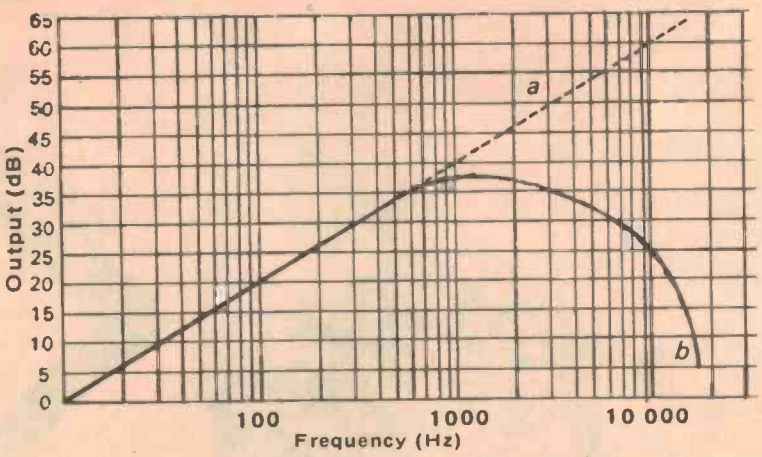


Figure 9. Replay head responses — (a) ideal response and (b) practical response with head losses.

Figure 10. Theoretical response of the replay amplifier.

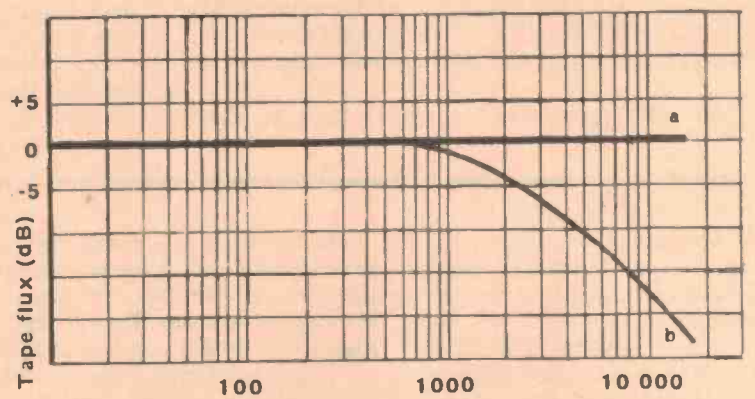


Figure 11. Ideal recorded tape flux (a) and typical tape flux allowing for head and other losses (b).

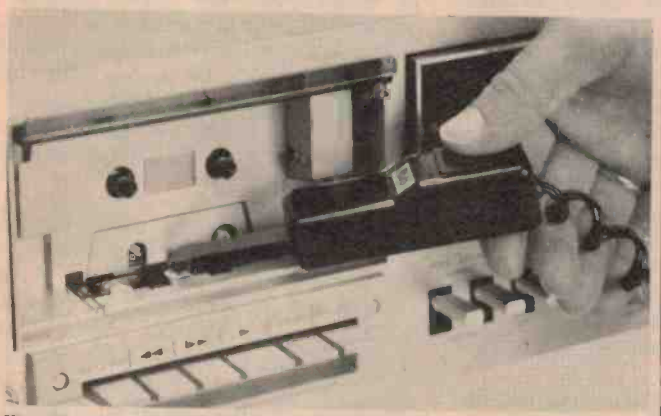
energise the tape head. Other losses are due to imperfect head-to-tape contact, and coupling losses between the head and preamp. At the bass end, where the wavelength is long compared with the head gap, the output may fall at a rate greater than 6 dB per octave as part of the flux path is through the air.

To compensate for the response at the head it is apparent that the replay amplifier must have an initial slope falling at 6 dB per octave, it must flatten out in the mid frequency range and then add a degree of boost at the top end to compensate for the head losses. Figure 10 shows the theoretical response of the replay amp.

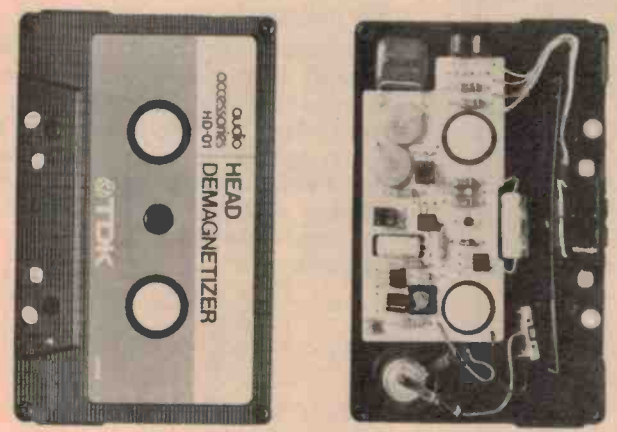
Record system

The signal current is fed through a resistor to the head winding and mixed with the bias waveform. The value of the resistor is such that it is well in excess of any change in impedance of the head (which increases with frequency). The effect is that variations of ▶

Tape Care Products



The Bib demagnetising 'wand'.



TDK's cassette head demagnetiser comes in a cassette housing.

Demagnetisation

To keep them responding as well as they were designed to, tape heads should be demagnetised regularly at intervals of not more than 40 hours use. Head magnetisation is an insidious process that invisibly degrades performance to a surprising extent. Noise levels on recording can rise in the low and mid frequencies by anything up to 7 dB and there can be a loss of playback quality with attenuation up to 1 dB.

Several companies make more or less sophisticated demagnetisers. **Dick Smith** have a mains powered unit for use on reel to reels and a combination cleaning and demagnetising tape for cassette recorders which uses a rotating magnet. **Ralmar** and **Philips** also make cassette cleaner/demagnetiser combos and **Dindy** sell the Ampex cleaner/demagnetiser as well as their own moderately priced mains demagnetiser.

TDK make a battery powered demagnetiser suitable for either reel to reel or cassette players. Its yoke angle can be varied for easy access to the heads and there is no need to withdraw it slowly from the heads because the circuitry produces a decaying alternating magnetic field.

The simplest of all demagnetisers to use are battery powered units completely enclosed in a cassette body. Both **Tandy** and **TDK** make these.

head impedance are minor in comparison with the value of the feed resistor, resulting in a constant current input to the head. Thus, for a signal of given amplitude, the head current is constant regardless of frequency.

In theory this would appear to give a constant level of magnetic induction on the tape oxide. Again the ideal is not realised because of high frequency losses (Figure 11). In the main these are due to partial erasure of the signal by the bias, the falling permeability of the tape with increasing frequency, and poor head-to-tape contact. To compensate for these losses the theoretical response of the record amplifier should be the inverse of Figure 11. In fact it is not quite this simple.

If sufficient pre-emphasis were applied during recording to give constant tape flux with frequency, the tape would saturate at high frequencies. Also, as we have seen, the response of the replay head is not flat, and the response curve of Figure 10 would not produce a flat output from a tape flux that held constant with frequency.

Equalisation

What is required is a two-part compensation process, part of which is applied on recording and part on replay. The result should be a flat response over a given frequency range. However, because the losses vary not only with frequency but also with tape speed, the equalisation must be switched to give the optimum response curve for each tape speed.

Anyone with a turntable expects to be able to replay any gramophone record and to achieve a consistent standard of reproduction. Similarly it should be possible to replay a tape recorded on one machine on any other machine. Without this requirement each designer could equalise for the various losses in any way and, provided the machine had an overall flat response, the customer would be happy — until attempting to replay someone else's tape on that machine!

Obviously a standard is required, but to what does it refer?

It describes the recording characteristic, which is a curve of recorded tape flux level against frequency, and when plotted appears as in Figure 12. Tape flux is measured in nanowebers per metre (nWb/m) of track width, and recording characteristics are commonly referred to in terms of the circuit time-constants that would produce an impedance curve of the same shape.

The problem is to arrive at a recorded tape flux (not frequency response) as per Figure 12, having taken account of the various losses in the recording system. To do this the designer usually begins with the replay system, knowing that if a calibration tape can be replayed accurately, one of the variables is fixed — replay equalisation. A recording amplifier can thus be devised that will produce the tape flux levels shown in Figure 12. If the sums have been done correctly a flat overall (record-replay) response will result.

To summarise this rather complex process: there are losses during the various energy conversions in the record and replay chains. Equalisation circuits are used during record and replay, such that an overall flat response is obtained. Because the losses in the system vary with tape speed, a family of curves is required if a machine has more than one speed.

To ensure that tapes can be interchanged it is essential that a tape recorded on one machine shall be reproduced satisfactorily by another. For this reason specific recording characteristics have been adopted, and provided a machine conforms to the appropriate standard, compatibility will be achieved. ●

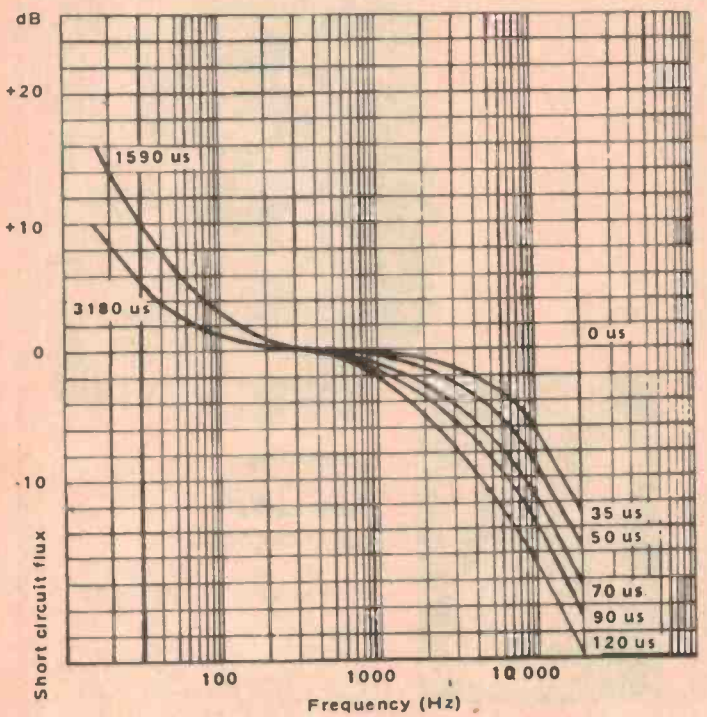


Figure 12. Recording characteristics to BS 1568: 1970.

FIRMS MARKETING TAPE CARE PRODUCTS

Bib Hi-Fi Australia, 43 Birmingham St, Alexandria NSW 2014. (02)667-2750

Communications Power Inc., P.O. Box 246, Double Bay NSW 2028. (02)357-2022

Dick Smith Electronics, P.O. Box 321, North Ryde NSW 2113. (02)888-3200

Dindy Marketing (Aust.), P.O. Box 55, Rushcutters Bay NSW 2011. (02)33-5293

Goldring Audio Industries, 69 Clarence St, Sydney NSW 2000. (02)290-1455

Maxell: Hagemeyer Aust. BV, P.O. Box 307, North Ryde NSW 2113.

Philips Service, 443 Condord Rd, Rhodes NSW 2138, (02)73-0231

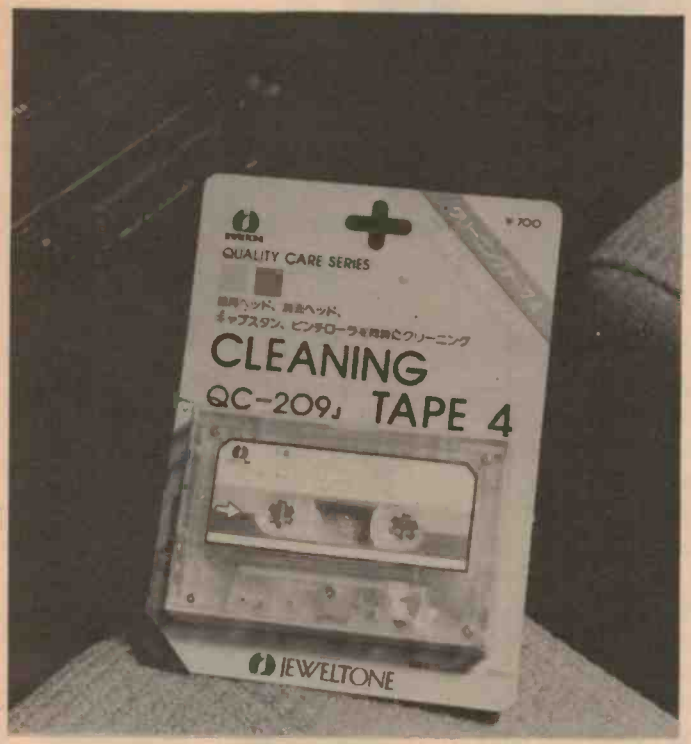
Ralmar Agencies, 23 Atchison St, St. Leonards NSW 2065. (02)439-6566

Tandy Electronics, P.O. Box 229, Rydalmere NSW 2116.

TDK Australia, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088

Special Reader Offer:

Cassette Cleaning Tape



$5.99 + 50¢ post and handling

— that's around $2 less than the recommended retail price

The Nagaoka Cleaning Tape 4 is a unique cassette head cleaner, designed to clean record/playback/erase heads, capstan and pinch rollers in one simple operation. Cleaning Tape 4 is particularly useful in cassette decks, particularly where the heads and rollers are inaccessable for cleaning (in car cassettes, for example). The size of Cleaning Tape 4 is compatible with all cassette units and is as easy to use as any cassette tape. Simply place in cassette unit and press the play button and in about 60 seconds all heads and rollers are cleaned.

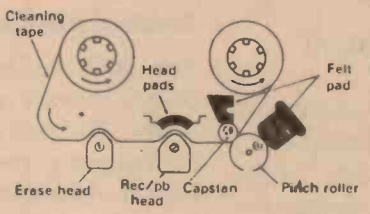
NOTE: This offer is made by Goldring Audio Industries and this publication is acting as a clearing house only. Payment should be made by cheque or money order, made out to **'Cleaning Tape Offer'** and sent together with the order form or accompanying letter to **Cleaning Tape Offer, c/o ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.** We will then process your order and pass it on to Goldring who will send you the goods. Please allow at least four weeks for delivery.

Features

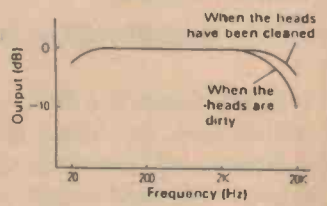
This special cassette can be used to clean the record/playback head, erase head, capstan and pinch roller of your cassette machine all at the same time.

It is ideal for cleaning car stereo cassettes which do not have easy accessibility and cannot be cleaned manually.

How it works



Changes in frequency response caused by dirt on the heads.



The cleaning tape is loaded face up and the cassette machine set to play or record mode from the rewind mode. Cleaning takes about one minute. If the tape is loaded reverse side up, the capstan and pinch roller will not be cleaned.

The action may be repeated if the machine is very dirty.

This cleaning tape cannot be used with dual capstan decks. If the felt pads become very dirty a Repair Pad kit (EX-209) is available to replace them. Cleaning Tape 4 is made by Nagaoka & Co Ltd, Tokyo, Japan.

COUPON

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DX5

double coated Fe-Cr type music tape with improved high and middle frequency characteristics.

Fe-Cr position (EQ=70 μs)

The DX5 Series is a Fe-Cr type double coated tape, for music programs. Its well-balanced characteristics, which extend from low to high frequencies, have been realized by improving the qualities of the middle frequencies, while making full use of DENON's unique magnetic recording tape technology to achieve a reduction of distortion and a widening of the dynamic range. Particularly notable is the adoption of a method which employs an input signal similar to the music signal to measure dynamic distortion, which has been previously overlooked. Thus, as one would expect of a tape for music reproduction, the audible quality has been vastly improved.

Highly reliable and stable tape running curbs output variations and dropouts.

DX3

double coated tape for Normal position emphasizing music recording and playback.

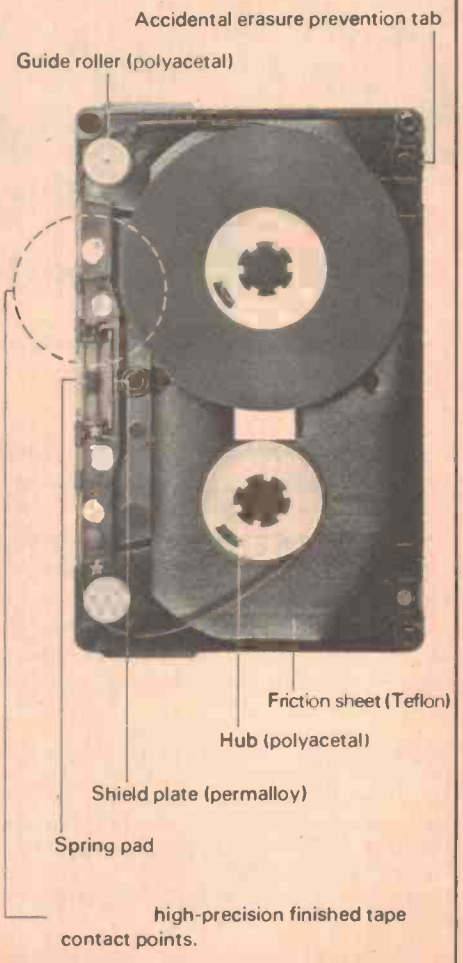
Normal position (EQ=120 μs)

The DX3 Series is a Normal type double coated tape for music programs. Through the adoption of superior magnetic material and the application of experience accumulated in the manufacture of magnetic tape, the dynamic range and the distortion factor—extremely important elements in the recording of music—have been greatly improved. In addition to a reduction in conventional static distortion (third harmonic and intermodulation distortion), serious work has been done on the reduction of dynamic distortion, resulting in the creation of new standards for magnetic recording tapes.

Fully compatible bias curve enables any tape deck to develop its total capabilities.

Reliable tape running stability removes phase differential and output variation.

DENON DX *Series*



The Denon Cassette Tape range has now been expanded to cater for all musical needs, from domestic players to car cassettes to professional applications. For details of the full range available and location of your Denon retailer, please contact:

Hi-Fi Audio Equipment
AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED
554 Parramatta Road, Ashfield, NSW 2131 Phone 797 5757

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CASSETTE CUSTOMISING MADE EASY

NAGAOKA

The Nagaoka Private Library Series of cassette accessories makes it simple for everyone to customise their cassettes to suit themselves. Splice your own tapes, create your own index system — you can even make your own labels with the various kits available.

(a) **TAPE SPLICING KIT:** Everything you need for accurate splicing including precision screwdrivers, scissors, tweezers, blade and screws. EDIT your own tapes or repair breaks in an irreplaceable tape.

(b) **CARD MAKING KIT:** Personalise your cassette collection with this easy to use kit. You can have any picture you like in your cassette case. Enables you to achieve a very professional finish.

(c) **INDEX LABELS & CARDS:** Ideal for developing your own library filing system. Easy identification.

(d) **POCKET WINDER:** Battery operated winder for fast forward and rewind. Excellent for use in cars, for students and dictating machines.

(e) **HAND WINDER:** Manual hand winder for forward and rewind — same size as cassette case.

Nagaoka products are distributed throughout Australia exclusively by Goldring Audio Industries.

GOLDRING®

The dbx 3BX three-band dynamic range enhancer

Louis Challis put it through its paces and found that "... results are outstanding, to say the least."

THE HOTTEST topic in the high fidelity industry at the moment is dynamic range, the difference in sound intensity between the loudest and the softest passages of a piece of music.

Sales of direct cut records, expanded range discs and dynamic range enhancers are booming and the reasons are not hard to find. The dynamic range of a typical orchestral concert in the Sydney Opera House is close to 90 decibels and a recording group in a well designed studio can span nearly 100 decibels.

By contrast, the dynamic range of a well cut conventional LP is less than 65 decibels, whilst a poorly cut LP or conventional pre-recorded cassette may not cover more than 45 to 55 decibels. Local FM broadcasts have a range of around 50 decibels, which is good but not outstanding.

Since most high fidelity systems are capable of reproducing a range lying somewhere between 65 and 85 decibels (and the best can cover 90 to 95), there is obviously a disparity between the records people have been buying and what their equipment can actually reproduce.

Firms like Sheffield Records realised this and released 'direct to disc' records with dynamic ranges of between 65 and 75 decibels. Telarc records, in the USA, achieve ranges approaching 80 decibels on discs such as Tchaikovsky's 1812 Overture (but the cannons will be brutal, perhaps fatal, to your amplifier, your speakers and especially your pickup cartridge).

However, the range of artists represented on such specialist record labels is inevitably limited. If your favourite performers are only recorded by standard techniques or if you simply want to improve the dynamic range of your existing record collection, you'll be pleased to know that there *is* an alternative. It comes in the form of the dynamic range enhancer, of which the dbx 3BX is a particularly good example.

You may be wondering why nobody ever told you this before, but the chances are your local hi-fi outlet either could not get supplies or did not think you wanted to spend the money in any case.

Compression and expansion

Before we describe how the 3BX works, we should look at the background more closely.

The idea of dynamic range alteration is far from new. The dbx corporation and others have been using this concept in the production of standard recordings for many years. Because most magnetic tapes cannot cope with the dynamic ranges that exist in the real world of music, recording companies have been forced to employ some kind of compression to make sure that the musical peaks aren't clipped or otherwise distorted and that the softest sections aren't drowned by noise.

Figure 1 illustrates *linear compression*, in which all levels of sound intensity above a certain threshold are reduced by the same fraction. The threshold is called the *transition level* and the amount by which the levels are decreased is the *compression ratio*. Sound levels below the transition level (0 dB in the diagram) are increased by the same ratio.

Above threshold compression is shown in Figure 2. Low level signals are unaffected but signals above the threshold are severely attenuated.

The reduction of dynamic range imposed by compression can be recovered by means of similar techniques which boost instead of attenuate. Reasonably enough, a device which performs this function is called an *expander*.

The noise reduction circuits used in many tape recorders employ just these principles of compression during recording and expansion during playback. Figure 3 illustrates noise reduction with a linear compression ratio of 2:1 and a corresponding linear *expansion ratio* of 1:2.

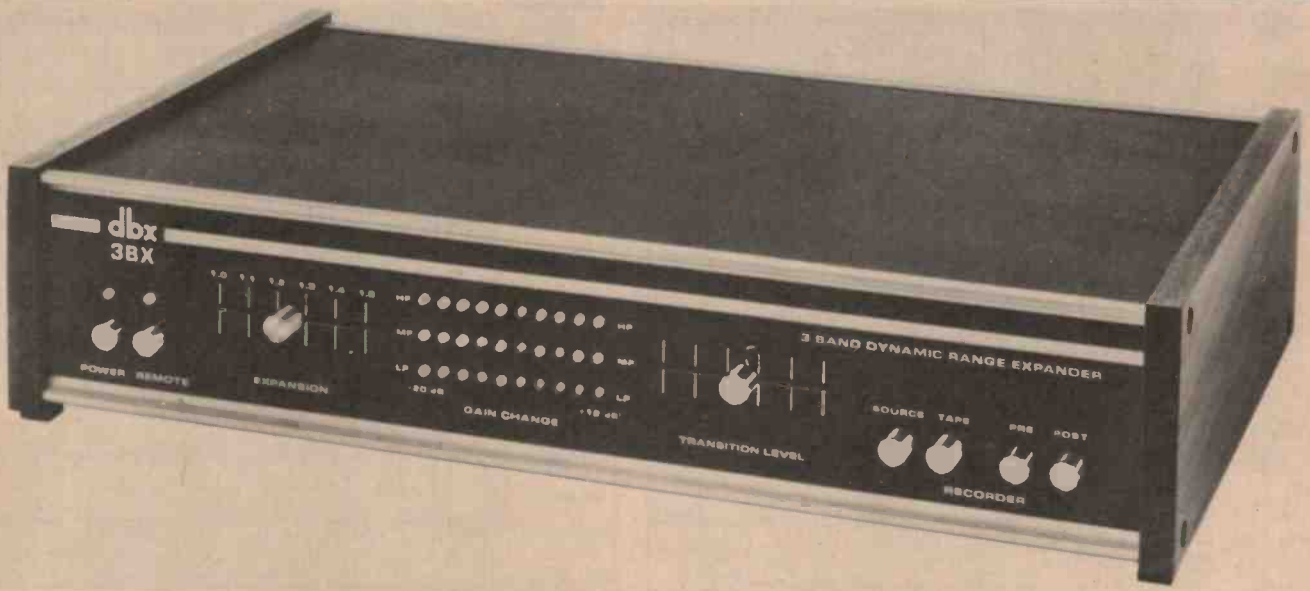
The 3BX is the result of considerable research and development and incorporates several refinements of the expansion concept.

Refinements

A simple linear expander looks at the level of the *total* audio signal and expands it all accordingly. In some cases, where the programme has a heavy bass line, this can cause audible 'breathing' as it raises high frequency noise when a loud bass note is detected. For this reason, the 3BX divides the audible spectrum into three bands — low frequency, medium and high — with each band being separately processed.

To optimise response time and prevent overemphasis of transients, the 3BX looks at the total energy content on a 'root-mean-squared' basis. Depending on the expansion ratio selected (which may lie anywhere between 1:1 and 1:1.5), the value of the transition level is set relative to an arbitrary mean. The transition level, which determines when the signal is amplified and when it is attenuated, is the most important factor affecting the characteristics of the sound, but two other parameters are also significant. These are the attack and release times.

Attack time is the time delay between the detection of an input signal level and its expansion. When the signal



level changes back to normal there is a delay before the expander changes its output — this delay is known as the *release time*. In general, attack and release times are independent of each other. The 3BX continuously varies each of them, in response to the overall sound 'envelope'.

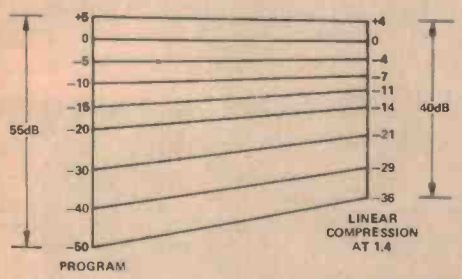


Figure 1. How linear compression reduces the dynamic range of programme material

Layout and controls

The main unit is contained in an attractive black topped box with aluminium trim, wooden ends and photo-anodised front escutcheon which has obviously been designed for the American market. It features numerous controls, lots of flashing lights and plenty of pushbuttons. In addition there's a remote control unit that any knob twiddler will fall in love with.

On the left of the main unit are the power on/off and remote unit in/out pushbuttons, both with their own indicating LEDs, and a slider control for setting the expansion ratio between 1:1 and 1:1.5. In the centre are three rows of light emitting diodes for the high, medium and low frequency bands, with five yellow and five red LEDs in each row. The yellow LEDs cover the range from —20 dB to 0 dB and the red ones span 0 dB to +12 dB. The light emitting diodes thus form a 10 × 3 matrix which gives a graphical indication of what the 3BX is actually doing.

At the right is a slider control for varying the transition level and four pushbuttons for selecting source, tape and pre or post expansion when the unit is used with a tape recorder. At the rear are four sets of input and output circuits, which use coaxial sockets. There is also a 12 pin Jones type socket to accept the plug for the remote control unit. ▶

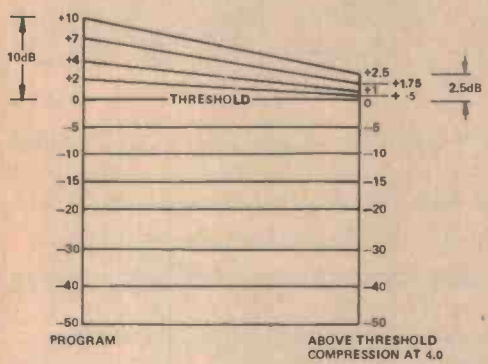


Figure 2. Above the threshold, compression has no effect on low level signals. When the signal exceeds the set threshold, the dynamic range is decreased. This is called 'above threshold compression' and allows higher compression ratios than linear compression.

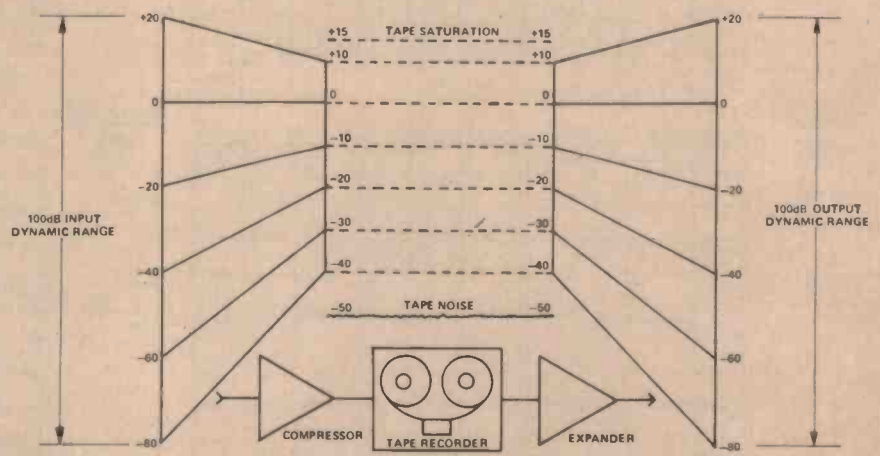


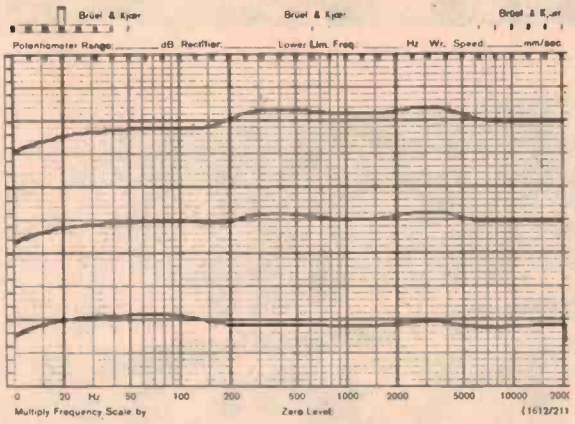
Figure 3. The dbx tape noise reduction system allows low level signals to be recorded well above the tape noise while recording peak signals below tape saturation. Expansion restores dynamic range.

Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.5

Input levels
0, +10, +20dB
re Unity Gain
at 1kHz

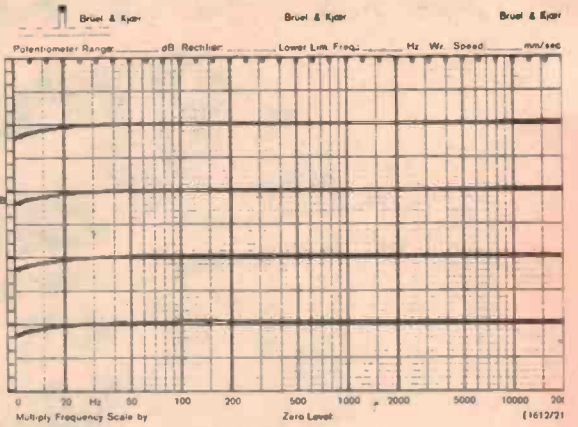


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.0

Input levels
0, +10, +20, +30dB
re Unity Gain
at 1kHz

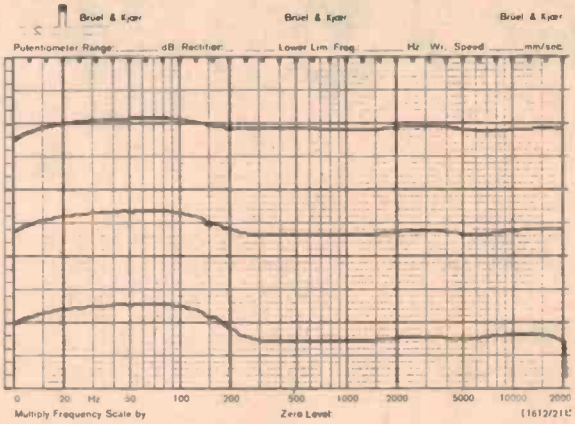


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.5

Input levels
0, -10, -20dB
re Unity Gain
at 1kHz

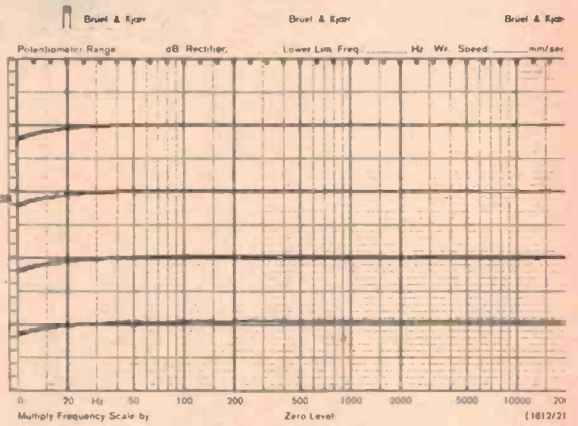


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.0

Input levels
0, -10, -20, -30dB
re Unity Gain
at 1kHz

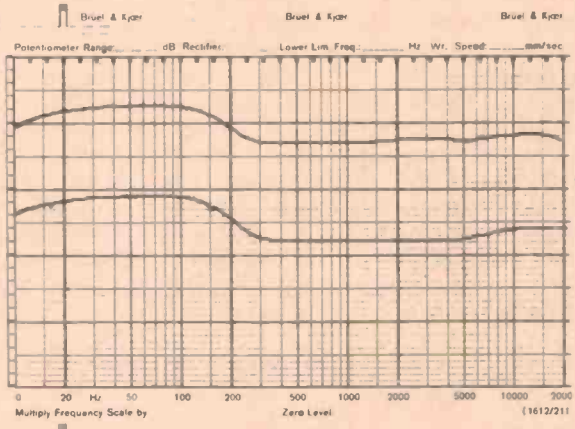


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.5

Input levels
-20, -30dB
re Unity Gain
at 1kHz

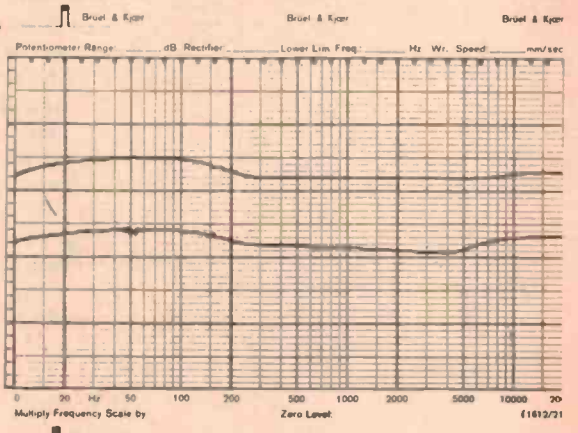


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.3

Input levels
-30, -40 dB
re Unity Gain
at 1kHz

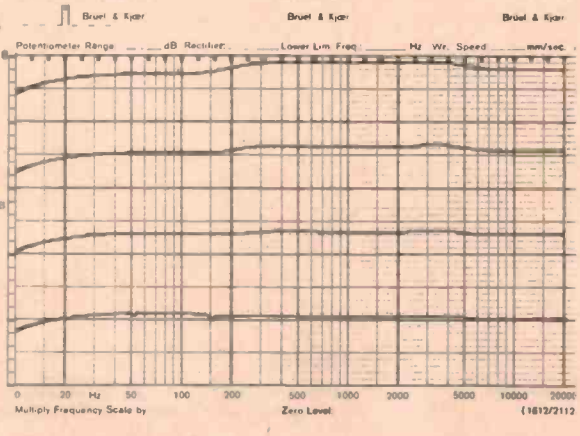


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.3

Input levels
0, +10, +20, +30dB
re Unity Gain
at 1 kHz

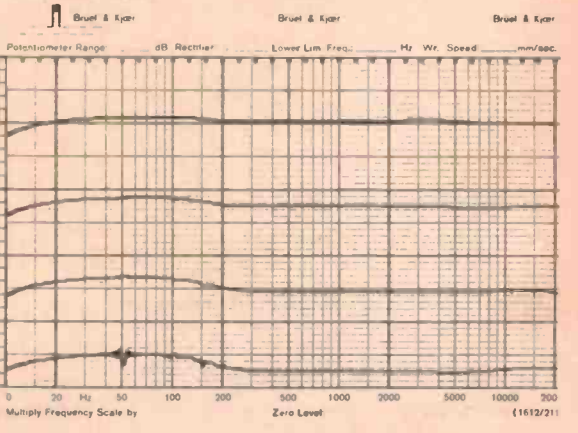


Louis A. Challis & Associates Pty Ltd.

dBx 3BX

Expansion ratio
1 : 1.3

Input levels
0, -10, -20, -30dB
re Unity Gain
at 1kHz



The inside of the main unit contains one printed circuit. This is beautifully laid out, well labelled and more reminiscent of a computer card than a piece of consumer electronics. There are three slave boards for the light emitting diode matrix, a power supply transformer and a power supply module mounted on the rear panel.

Remote control unit

Vaguely similar in appearance to the main unit but much smaller, the remote control unit features a sloped front panel (again with clear anodised lettering on a black background), four slider controls, two switches and a simple matrix of light emitting diodes — three yellow and three red. The yellow lights indicate decreasing gain, the red ones increasing gain and there is one pair for each of the three frequency bands.

As well as replicating the transition level and expansion ratio controls, the remote unit provides a number of additional functions not on the main unit. The first of these is an option to bypass from expansion to unity gain provided the remote control button has been activated on the main unit. Secondly there is a release time control which tailors the reaction time of the midband expansion to suit the type of music. This is normally set to fast for rock music and other types containing impulsive peaks and to slow for symphony music, with intermediate settings for other types.

Behind a panel at the rear are fade controls which allow the output to be slowly attenuated to any extent down to −46 dB over any period from 1 to 10 seconds. Fade-up time to normal can be adjusted from ¼ to 4 seconds. These features are normally used for special effects, when making tape recordings and particularly where the expansion ratio is in the 1:1 setting.

In the same recess is a high frequency transition control that adjusts the 'brightness' of the sound by altering the transition level of the high frequency band relative to the other two when the expansion ratio is set above 1:1.

These rear panel controls are adjusted by the individual user to suit his or her personal tastes, but the specific guidance given for these adjustments in the handbook is very poor and falls short of what either a professional or a serious amateur would call for. Finally, a slider control on the front face can be used to alter the total volume over a range from −20 dB to +6 dB.

On test

The objective testing proved to be particularly interesting, for there really are not too many parameters that one can evaluate, apart from those nominated in the manufacturer's specification. These include expansion dynamic range, transition levels, frequency response, distortion and noise.

Not surprisingly, the electro-acoustic performance lives up to the maker's specifications extremely well. The frequency response at a 1:1 ratio is incredibly flat from 20 Hz to 20 kHz and is only 2 dB down at 10 Hz. This is true at virtually any input level over the 60 dB dynamic range which we selected for its evaluation. At an expansion ratio of 1:1.3 the frequency response was not quite as flat but still fully acceptable, showing peaks of +2 dB midband at +30 dB input level and +2 dB in the low frequency band at −30 dB input level.

Because of the manner in which the equipment is designed one can and should expect a slight nonlinearity in frequency response, partly because of the availability of a preset trimmer for adjusting the relativity of the three bands and particularly as a result of the equipment's inherent feature of selectively expanding the low frequency, mid frequency and high frequency bands.

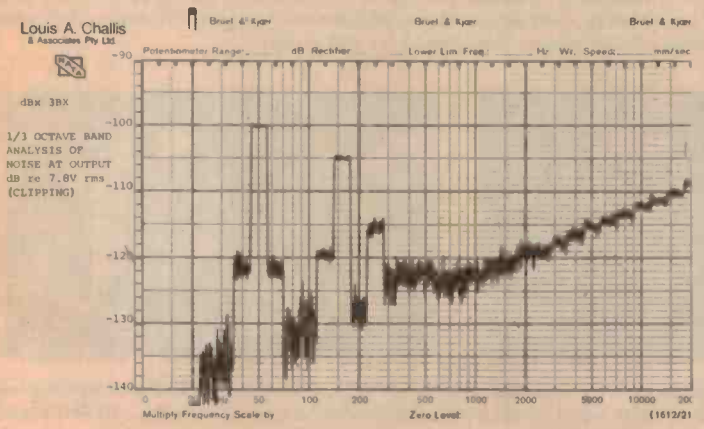
At an expansion ratio of 1:1.5 the nonlinearity in frequency response becomes a little more pronounced and the unit provides a significant bass boost over the frequency region from 10 Hz to 250 Hz with input levels of −20 dB and −30 dB relative to the zero reference level. This does not necessarily detract from the performance of the unit, but as we subsequently found in the subjective testing it does change the timbre or quality of the sound.

The internal noise characteristics of the unit are impeccable and the A-weighted background noise level is −105 dB relative to the 7.8 volts clipping level, which guarantees a fairly spectacular dynamic range capability and virtual inaudibility of background levels under almost any operating conditions. It is interesting that the dominant internal noise frequency components are at 50 Hz, 150 Hz and 250 Hz and are produced by the internal power supply.

The equipment's distortion characteristics are equally impressive, being typically less than 0.13% at 7.8 volt output and even less at lower levels.

The square wave response, while not perfect in shape factor, is controlled to a large extent by the release time set on the remote control panel. Considering the dynamic characteristics of the equipment however, these responses are fully acceptable and generally indicative of a stable transient performance.

The tone burst test results show ▶



dbx 3BX WITH 3BX-R REMOTE CONTROL
3 BAND DYNAMIC RANGE EXPANDER

Other Tests:

THD:	Square wave response	no ringing
	Maximum Output level	7.8V rms
	Noise level	see graph
	Attack and release times	using tone burst generator.

THD at 7.8V output 1:1.5 expansion.

	100Hz	1kHz	6.3kHz
2	-67.6	-59.9	-67.2
3	-61.2	-62.0	-59.9
4	-83.7	-83.0	-82.7
5	-81.0	-84.4	-
THD	0.097%	0.129%	0.110%

clearly how the release time functions in both the fast and slow mode, and it is this parameter above all others which most directly affects the sound quality and the degree of naturalness which the 3BX achieves.

Subjectively

I spent considerable time playing music at home with a wide range of programme content to evaluate the characteristics of the 3BX. It soon became apparent that there is no real benefit to be gained from playing direct cut records through the 3BX except at low expansion ratios.

But with older records, particularly where they are not scratched, the results are outstanding, to say the least. General surface noise is diminished and awareness of the subleties of the original music is unquestionably enhanced.

Regrettably, I became aware of the extent to which I was listening to the equipment rather than the music. At expansion ratios of 1:1.4 and 1.5 this situation was exacerbated and on most of the programme content, especially prerecorded cassettes and older style records, this did detract a little from my listening pleasure.

At reasonable listening levels with a dynamic range in excess of 80 dB, one's choice of amplifier, and most certainly choice of speaker, becomes extremely important. Fortuitously, I chose to use a Sanyo DCX 8000K receiver with a 65 watts per channel capability. This could only just cope with the dynamic range of the system and highlighted the need for a power capability in the range 100 to 200 watts if one insists on using the expansion ratio of 1:1.5.

Equally significantly the faint background noise which this receiver would otherwise have produced was completely removed. On the silent grooves between individual record tracks I could detect no noise at all, even with my ears stuck up against the face of the speakers.

Conclusions

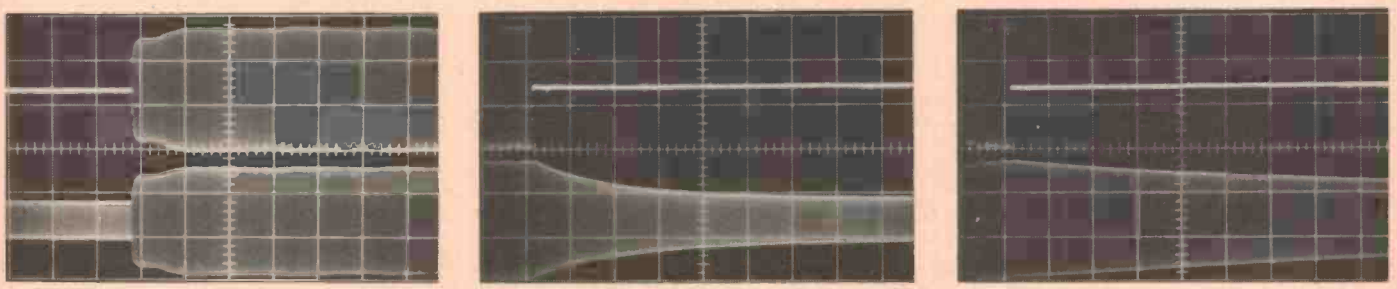
The 3BX basically does everything the manufacturers claim. It can create from any record or tape an output which comes subjectively close to mirroring that from a direct cut disc. However, this cannot occur in the case of scratched records, really bad recordings or dirty records with clicks, pops and other disconcerting features.

The quality of sound that is created is integrally bound up with the fade-up and fade-down rate control settings and with the choice of release times. Whilst I am sure that these can be optimally selected to achieve a greater degree of naturalness, I consider that without more explicit guidance from the makers this is unlikely to be attained in the short term and in some cases may never be achieved.

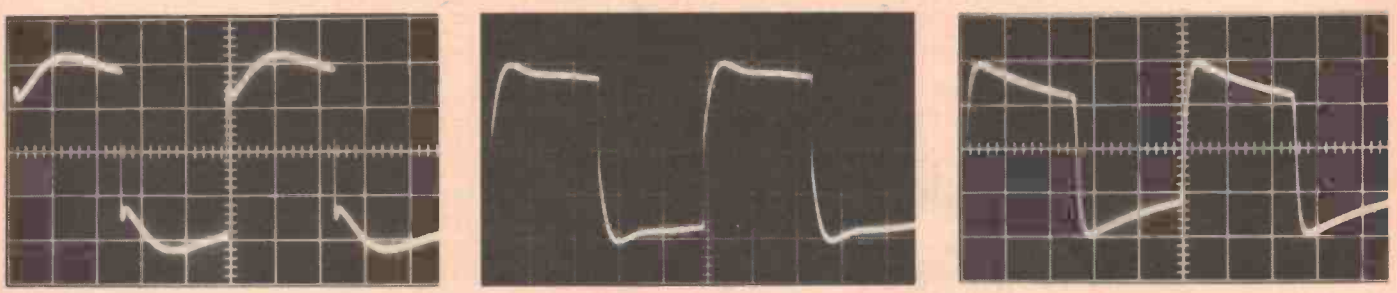
Nevertheless, for those of you who do not want to buy direct cut records the 3BX is unquestionably the most satisfactory way of achieving a comparable characteristic from your existing record collection. ●

THE dbx MODEL 3BX THREE-BAND DYNAMIC RANGE ENHANCER

Dimensions: (main unit) 450 × 95 × 255 mm
weight: 3.19 kg
(remote control) 235 × 98 × 152 mm
weight: 1kg
Price: $1000 rrp
Manufactured by dbx Inc., Massachussetts, USA.



Dynamic characteristics. Expansion ratio — 1 : 1.5; Channel 1 input — 1 kHz tone burst; Channel 1 output is upper trace in each picture; Channel 2 input — 1 kHz steady state sinewave; Channel 2 output is lower trace in each picture. Left picture shows attack time ('scope on 50 ms/div.). Centre picture shows FAST release time ('scope on 200 ms/div.). Right picture shows SLOW release time ('scope on 200 ms/div.).



Square wave response of the dbx 3BX dynamic range enhancer: Expansion ratio — 1 : 1.5; Release time — FAST. Left picture taken with oscilloscope set at 2 ms/div., 100 Hz input. Centre picture has scope set at 0.2 ms/div., 1 kHz input. Right picture taken with 'scope on 20 us/div., 10 kHz input.

The weakest link in your hi-fi system isn't in your system.

You could spend thousands of dollars on your stereo system and still not hear its full musical potential. That's because all hi fi systems, even the most sophisticated, have one weak link — the music source itself.

Dynamic range (the difference between the loudest and quietest music passages) is one of the primary elements that creates the power and excitement of a live performance. Records (even digital and direct-to-disc), pre-recorded tapes and radio broadcasts sound lifeless in comparison because they're missing more than ⅓ of this vital dynamic range. But add a dbx Dynamic Range Expander to any system, large or small, and the missing dynamics are amazingly restored.

dbx offers three state-of-the-art expanders that let every stereo system flex its musical muscles. The 1BX, 2BX, 3BX Dynamic Range Expanders provide as much as a 50% improvement in dynamic range, with the additional benefit of up to 20dB reduction of background noise. Any model will let you enjoy all the music you never heard from your record and tape library.

Don't let the weak link make your investment in a good stereo system worthless. Visit your nearest dbx dealer for a demonstration of the dbx dynamic range expander that best fits your budget. Experience all the emotional impact and realism that was missing from your music. Records, tapes and radio broadcasts never sounded so good.

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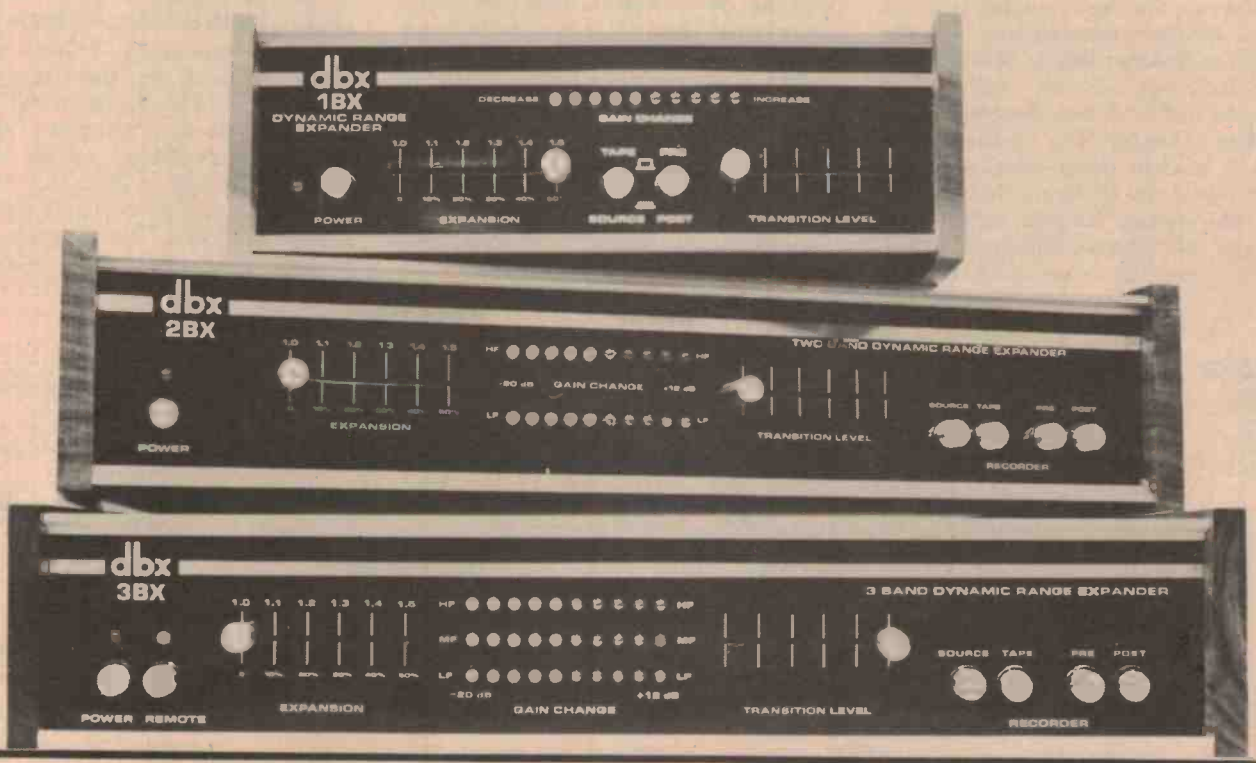


Celef mini professional SM loudspeaker system

Handsome is as handsome does. These smart little speakers did well on the objective tests, less well subjectively.

IT'S OBVIOUS that considerable care has been taken to make these Celef Mini speakers look good and they certainly are attractive units. The enclosures are teak veneered on all sides and the dark brown cloth grille is sensibly fixed to a pineboard frame.

The speaker grille panel is kept in place by plastic captive ball retainers to preserve the neat appearance.

The speaker complement for the 50 litre enclosure consists of a 220 mm low frequency driver with foam surround and a 25 mm diameter Peerless dome tweeter. The woofer has an unusual plastic dress trim surround which takes care of the mechanical fixing of the speaker into the cabinet and provides full edge sealing as well. The magnet assembly is unsophisticated.

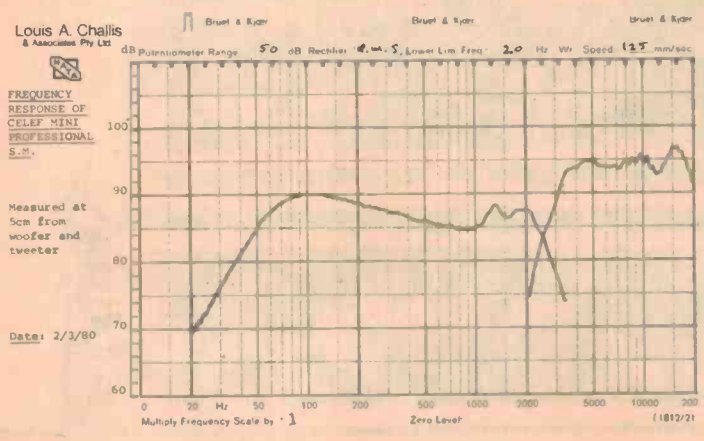
The 15 mm thick pineboard enclosure has been carefully damped internally by the application of a number of layers of bitumen felt stapled at strategic points to minimise resonance. Reticulated urethane foam on all the inner faces provides primary absorption and in addition a layer of bonded acetate forms a roll into which the crossover unit has been inserted. This may not be an original idea but it is nonetheless a very effective way of cutting costs.

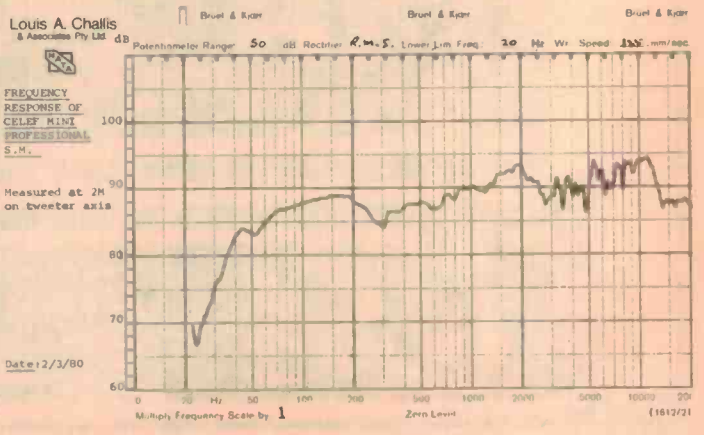
The crossover itself features four inductors (three of them with ferrite cores), five capacitors and three resistors. Speaker leads are connected by means of two universal terminals recessed into the back of the cabinet and the units are specified as requiring stand mountings for best results.

Lab. tests

Considering the size of the enclosure, the frequency response is reasonably good and in this respect the unit does not suffer from having only two drivers. On-axis response extends from 70 Hz to 20 kHz with a dominant tweeter output tending to lift the response in the 2 kHz to 13 kHz region. The low frequency response rolls off smoothly below 50 Hz.

The off-axis response is in general nearly as good, and the crossover frequency of 2.5 kHz has been well chosen to develop the best features of both the low frequency driver and the tweeter. Phase response of the unit is quite reasonable and particularly good from 200 Hz to 20 kHz. The impedance curve is unusual, dropping down to as low as





5.5 ohms at 18 kHz rising as high as 38 ohms at 1 kHz, but these excursions won't really trouble any modern transistorised amplifier.

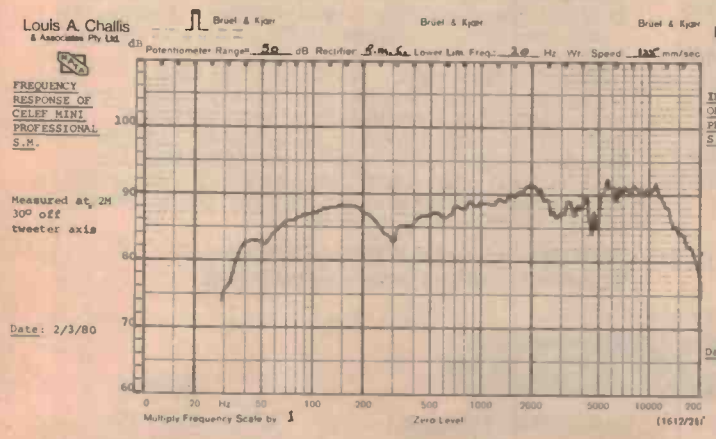
The total harmonic distortion characteristics of the speakers are fairly well controlled at outputs up to 90 dB at 2 metres, but at higher sound levels they rise dramatically for both high and low frequencies. Tone burst responses present a somewhat different picture — at 6.3 kHz and higher frequencies the amount of overshoot and instability did not augur well for the transient performance.

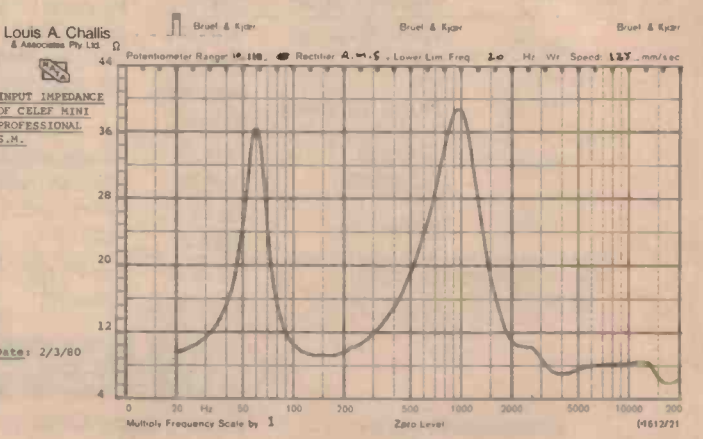
Aural impressions

Our subjective assessment of the speakers proved to be less rewarding than we might have hoped. We made use of a number of our normal records and a few new ones to evaluate a number of specific characteristics.

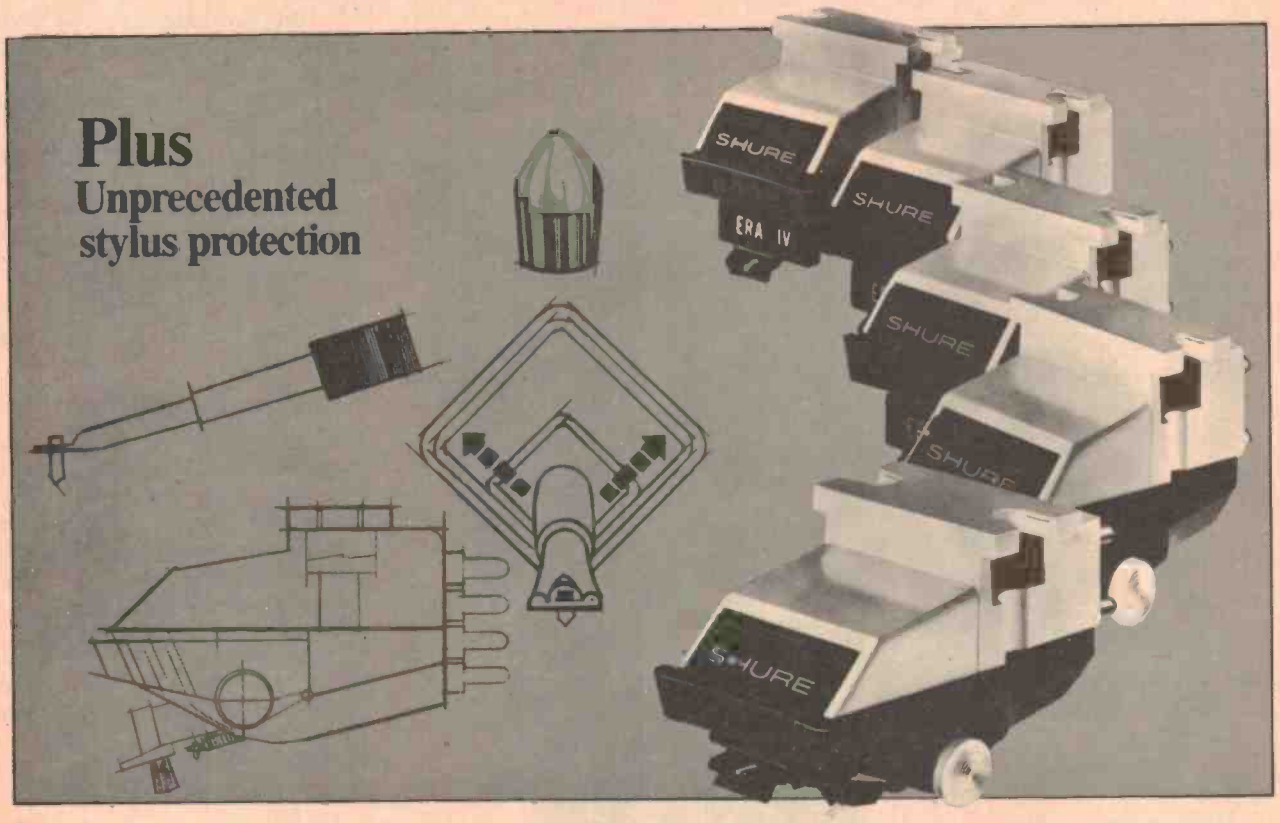
On speech and singing, while the performance was relatively clean, there was nonetheless a distinct colouration which was especially pronounced at higher frequencies. Female voices were particularly affected. At levels above 95 dB at two metres there was a pronounced and audible distortion.

We tried out a new direct cut record from the Tokyo Quintet and found that the speakers had only a desultory response to the bass and tympany passages. A test with Led Zeppelin made it obvious that these speakers don't like rock either. On the other hand, violins and guitars were reproduced excellently. ▶





fact:
five new Shure Cartridges feature the technological breakthroughs of the V15 Type IV



the M97 Era IV Series phono cartridges

Model	Stylus Configuration	Tip Tracking Force	Applications
M97HE	Nude Hyperelliptical	¾ to 1½ grams	Highest fidelity where light tracking forces are essential.
M97ED	Nude Biradial (Elliptical)	¾ to 1½ grams	
M97GD	Nude Spherical	¾ to 1½ grams	
M97EJ	Biradial (Elliptical)	1½ to 3 grams	Where slightly heavier tracking forces are required.
M97B	Spherical	1½ to 3 grams	
78 rpm Stylus for all M97's	Biradial (Elliptical)	1½ to 3 grams	For 78 rpm records.

Shure has written a new chapter in the history of affordable hi-fi by making the space-age technological breakthroughs of the incomparable V15 Type IV available in a *complete line* of high-performance, moderately-priced cartridges: the M97 Era IV Series Phono Cartridges, available with five different interchangeable stylus configurations to fit every system and every budget.

The critically acclaimed V15 Type IV is the cartridge that astonished audiophiles with such vanguard features as the Dynamic Stabilizer—which simultaneously overcomes record-warp caused problems, provides electrostatic neutralization of the record surface, and effectively removes dust and lint from the record—and, the unique telescoped stylus assembly which results in lower effective stylus mass and dramatically improved trackability.

Each of these features . . . and more . . . has been incorporated in the five cartridges in the M97 Series—there is even an M97 cartridge that offers the low distortion Hyperelliptical stylus! What's more, every M97 cartridge features a unique lateral deflection assembly, called the SIDE-GUARD, which responds to side thrusts on the stylus by withdrawing the entire stylus shank and tip safely into the stylus housing before it can bend.

NEW! M97 Series Era IV Phono Cartridges . . .
Five new invitations to the new era in hi-fi.

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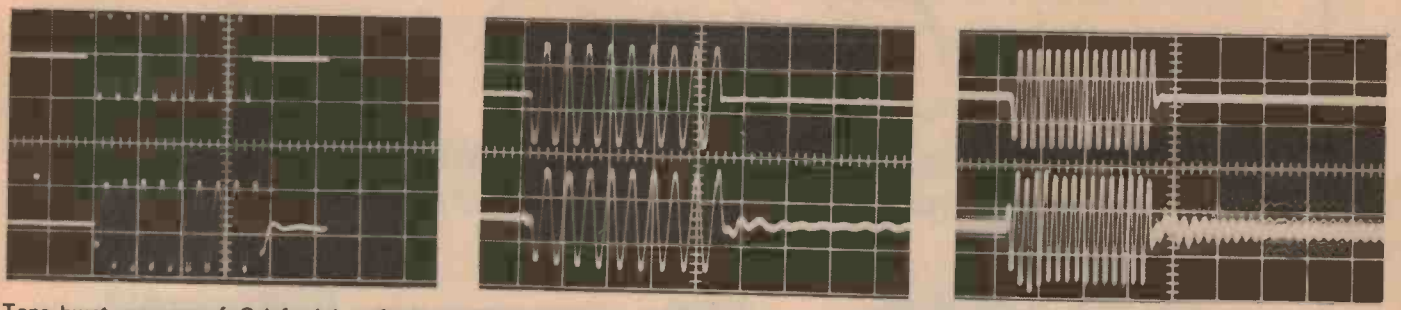
EAST PERTH 6000 W.A.

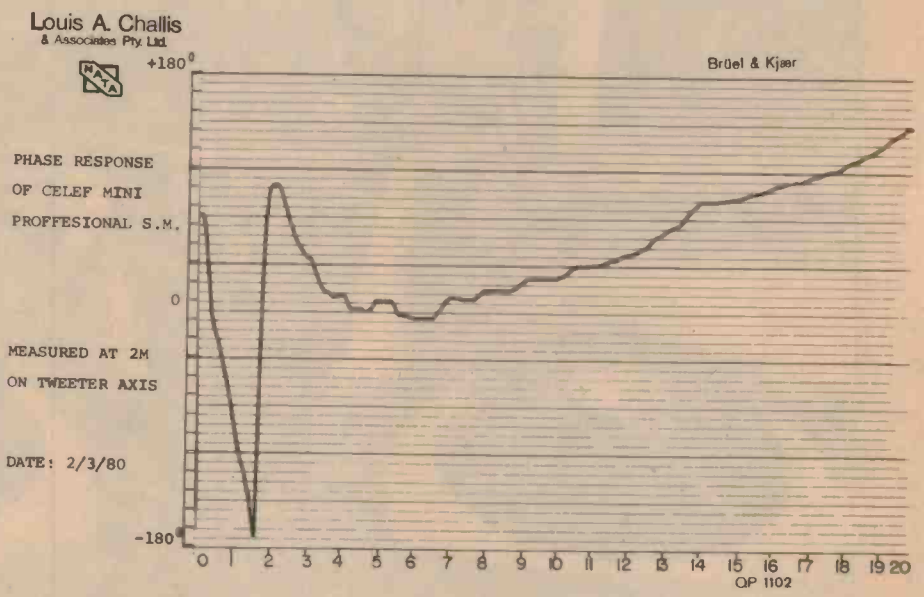


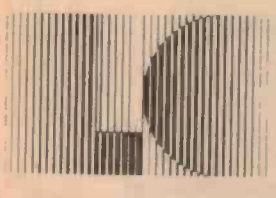
Tone burst response of Celef mini professional SM loudspeakers. Oscillograms taken at 90 dB steady state spl at 2m on axis. Left picture shows 100 Hz burst ('scope on 20 ms/div.). Centre picture shows 1 kHz burst (2 ms/div. on 'scope) and right shows 6.3 kHz burst (0.5 ms/div.).

Our overall impression of these speakers must be related to the manufacturer's description of them. As professional speakers we would rate them as poor; considered as domestic speakers their performance is only just above average. ●

CELEF MINI PROFESSIONAL S.M. LOUDSPEAKER SYSTEM

Dimensions: 585 mm H x 280 mm W x 310 mm D
Weight: 14 kg *Price $740 rrp*
Manufactured by Celef Audio Ltd, United Kingdom.





Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF

CELEF MINI PROFESSIONAL

S.M. LOUDSPEAKER

FREQUENCY RESPONSE: 70Hz to 20kHz

CROSSOVER FREQUENCY: 2.5kHz

SENSITIVITY:
(for 90dB average at 2m) 8.8 VRMS = 9.7 Watts
(nominal into 8Ω)

HARMONIC DISTORTION: (for 90dB at 2m)

	100hz	1kHz	6.3kHz	
2nd	-39.6	-56.6	-46.4	dB
3rd	-48	-51	46	dB
4th	-63.6	-77	-60	dB
5th	-	-75	-	dB
THD	1.1 %	0.32 %	0.7	%

INPUT IMPEDANCE:

100Hz	10 Ω	
1kHz	38 Ω	
6.3kHz	8 Ω	
Minimum at: 17kHz	6 Ω	

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AUDIO

SELL: ETI-471 pre-amp module, wired and tested, $60, with pots and switches $70. Phone Louis before 10.30 a.m. on (03) 481-1209.

SELL: TEAC A4300 auto-reverse RTR tape deck complete with remote control, works well, $350. Phone Pat (02) 759-5080 a.h.

SELL: Trio valve dual tuner amp with SW — old type, will incl 50 Ass. valves, $40. Phone Pat (02) 759-5080 a.h.

WANTED: No.4 key and shaft for Canon-Canola L100S calculator. Phone Pat (02) 759-5080 a.h.

WANTED: Thorens TD124 turntable any condition. Westcott (03) 630-7696 (9 - 4). For STD, give number and hang up, I'll call you. K.W. Westcott, 3 Duke St, Ashburton, Vic 3147.

COMMUNICATIONS

SELL: National Panasonic DR48 radio, New World Reception 10 Band MW, FM, LSB, USB, ANL, digital frequency counter, perfect working $360. Phone Walter Zagora (03) 375-3690.

WANTED: R.1155-N, Ex-R(A)AF Communications Receiver, preferably working but other condition/model acceptable. I have appropriate manual. John Lavender, 3 Raw Place, Farrer, ACT 2609. Phone (062) 86-4029.

FT901DM YAESU HF Transceiver with CW, AM filters, microphone, brand new (unopened carton) $975. Alpha ETO 374AE HF 1-30 MHz linear amplifier made USA; 2 kilowatt dc output power. Manual/auto tune, $2,095. James Goodger (02) 36-7756 or (02) 799-5566. G.P.O. Box 5076, Sydney, NSW 2001.

Kemptronic Base Station 18Ch SSB/AM EC. Built in clock and SWR, covers 27.005 27.225, ant. inc. Suit novice use. $250 o.n.o. Phone (03) 459-0607 a.h. 14 Ferguson St, MacLeod, Vic 3085.

COMPUTERS

SELL: Centronics Microprinter-P1 $458 (TRS-80 owners, this is the same as the "Quick Printer"). R. West, 3/8 Spring Rd, Malvern, Vic 3144. Phone (03) 20-2150.

CASIO FX-502P owners: anyone interested in forming users group to sell/swap programs? Send SAE, suggestions to Clive Conway, 80 Third Ave, Joslin, SA 5070.

TRS-80 L2 s'ware — fantastic games, etc (approx $70 worth) — will swap for light pen, Edit/Ass. prog. or other software. R. McCance, 4 Morris Av, Taroona, Tas 7006.

SELL: Keyboard (encoded), VDU board (EME-1), cursorboard, p/s, case w. connectors/switches. $250 o.n.o. (working). J. Brandwyk, 184 Coromandel Pde, Coromandel Valley, SA 5051. Phone (08) 278-5163.

WANTED: Video cartridges for Fairchild channel F, nos. 1, 4, 5, 9, 11, 12, 14, 15. R. Stuart, 19 Lancaster St, Dianella, WA 6062.

SELL: Centronics P1 Microprinter together with 26 rolls of paper. Printer is similar to Tandy Quick Printer. $500 complete. Bonner, 22 Clontarf St, Seaforth, NSW. (02) 94-6895.

SELL: G.E. 115 V sprocket feed 9 channel paper tape reader, fwd/rev circuit supplied $65. Write C. Hallam, 29 Shaw St, Devonport, Tas 7310.

SELL: 6502 (SYM-1) including 4K RAM 8K BASIC 4K MONITOR housed with power supply. 2 manuals. Application book and 2 MHz 6502 chip. $300. Brian (02) 477-2585.

MUST SELL: EME-1 board, some parts, wires, plans. 2650, all gold sockets etc. almost finished. Sell both $50 or $25 each. Benjamin Simons, 48a Malton Rd, Beecroft, NSW. (02) 848-8141.

TRS-80 LEVEL TWO 16K RAM software, manuals, books, complete system. $850. T.I. Graham (03) 873-3820.

S100 BOARDS: 8K RAMS (2) $120 each. 2-80 CPU $130. Front panel $30. Giles Puckett, 9 Alexandra St, Hunters Hill, NSW 2110. Phone (02) 89-3605 a.h.

SERIAL ASCII terminal $120. ASCII paper tape reader and punch $30 each. Giles Puckett, 9 Alexandra St, Hunters Hill, NSW 2110. Phone (02) 89-3605.

MISCELLANEOUS

DIGITAL VOLTMETER for sale in good working condition, TRIO Model DL703, $89. G. Kingsmill, 45 Jellicoe St, Ivanhoe, Vic 3079. Phone (03) 49-2703 after 6 p.m.

TEKTRONIX OSCILLOSCOPE 465 with DM 44 DMM, hardly used, $3,700 o.n.o. Phone Paolo Colombo, (062) 58-1092.

HELP BUSHIE BEAT BOREDOM! TV game chips wanted, esp. 10-game and tank battle, or completed kits. E. Kepper, Bamaga, Qld 4876.

B.F.O. General Electric made 1928, working, exc. cond. original tubes, original 50p handbook. $100 o.n.o.C. Gordon, 4/177 Power St, Hawthorn, Vic 3122. Phone (03) 819-1287.

WANTED: June '78 and Oct '78 editions of ETI. Also any other back issues of E.A. or ETI. Will pay reasonable price. Phone David (03) 469-3171.

SELL: Original LEAK Point one valve preamp. Electronic Assistance Corp Communications receiver type R-390A/URR plus manual. Blair Lade, P.O. Box 363, Tennant Creek, NT 5760.

WANTED: Liquid crystal display-Epson LD 318 for Unitrex 10 SC calculator. R.J. Hardidge, 17a Glen Shian Lane, Mt. Eliza, Vic 3930. Phone (03) 787-6898 a.h.

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 listed here most of the projects published over the last few years which are either available as kits or can still be made up by shopping around for components. Suppliers listed against a particular project will either stock it as a kit or stock the pc board plus the other components.

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
651 Forest Rd
Bexley NSW

Radio Despatch Service
869 George St
Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four months.

Key to Companies

A Applied Technology Pty Ltd, 1A Pattison Avenue, Waitara, NSW 2077. Ph. (02) 487-2711.

B Bill Edge Electronic Agencies, 115 Parramatta Road, Concord (PO Box 1005, Burwood North 2134). Ph. (02) 747-6472.

C J.R. Components, PO Box 128, Eastwood, NSW 2122. Ph. (02) 85-3976.

D Dick Smith Electronics P/L, Cnr Waterloo & Lane Cove Roads, North Ryde, 2113. Ph. (02) 888-3200.

E All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000. Ph. (03) 662-3506.

F Tasman Electronics, 12 Victoria Street, Coburg, Vic 3058. Ph. (03) 354-5062.

J Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000. Ph. (02) 211-5077.

K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109. Ph. (03) 842-3950.

L Ellistronics, 289 Latrobe Street, Melbourne, Vic 3000. Ph. (03) 602-3282.

M Mode Electronics, PO Box 365, Mascot, NSW 2020. Ph. (02) 666-6324.

N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011. Ph. (02) 33-5850.

O Orbit Electronics, PO Box 7176, Auckland, New Zealand.

P Pre-Pak Electronics, 1A West St, Lewisham, NSW. Ph. (02)569-9797.

R Rod Irving, PO Box 135, Northcote, Vic 3070. Ph. (03) 489-8131.

V Silicon Valley, 23 Chandos Street, St. Leonards, NSW 2065. Ph. (02) 439-4655.

W Willis Electronics, 993 Hay Street, Perth, WA 6000. Ph. (09) 321-7609.

Y Trilogy, 40 Princes Highway, Fairy Meadow, NSW 2519.

Project Electronics

041 Continuity Tester ..... W,R,D,B,Y,L
042 Soil Moisture Indicator ..... R,B
043 Heads or Tails Circuit (Oct 76) . W,R,D,E,A,F,B,Y,L
044 Two Tone Door Bell (Oct 76) . W,R,D,E,O,A,F,B,Y,L
045 500 Second Timer ..... W,D,E,A,B,Y,L
047 Morse Practice Set ..... W,D,O,A,B,Y,L
048 Buzz Board ..... W,D,A,B,Y,L
061 Simple Amplifier (Oct 76) ..... W,R,D,E,A,B,Y,L
062 Simple AM Tuner (Mar 77) ..... W,D,E,B,Y
063 Electronic Bongos ..... R,D,A,B,Y,L
064 Simple Intercom (Nov 76) ..... W,A,
065 Electronic Siren ..... W,R,D,E,O,A,B,Y,L
066 Temperature Alarm (Dec 76) ..... W,D,E,A,B,Y,L
067 Singing Moisture Meter ..... D,B,Y
068 LED Dice Circuit (Oct 76) ..... Y,W,R,D,E,A,B,L
070 Electronic Tie Breaker (Jan 77)
071 Tape Noise Limiter (Jun 78) ..... R,E,F
072 Two-Octave Organ (Jun 78) ..... W,D,B,Y
081 Tachometer (Mar 77) ..... W,E,O
082/
528 Intruder Alarm ..... W,R,E,A
083 Train Controller ..... Y,W,R,E,L
084 Car Alarm ..... W,R,D,E,A,B,Y,L
085 Over-rev Alarm ..... W
086 FM Antenna ..... W
087 Over-LED ..... Y,W,E
088 Hi-Fi Speaker ..... W

Test Equipment

132 Experimenter's Power Supply (Feb 77) ..... E,O
133 Phase Meter (Apr 77) ..... E
134 True RMS Voltmeter (Aug77) ..... E
135 Digital Panel Meter (Oct 77) ..... E
136 Linear Scale Capacitance Meter (Mar 78)
137 Audio Oscillator (May 78) ..... W,D,E
138 Audio Wattmeter (Nov 78) ..... E,B
139 SWR/Power Meter (May 78)
140 1GHz Frequency Meter-timer (Mar 78) C
141 Logic Trigger (Jan 79) ..... E
142 High Current Power Supply (Feb 79) ..... W,E
143 Curve Tracer (Jan 79) ..... W
144 Expanded-scale RMS Voltmeter (Jun 79) ..... E
148 Versatile Logic Test Probe (Jul 79) ..... E,L

Simple Projects

243 Bip Beacon (Apr 77)
244 Alarm Alarm (Feb 77) ..... F
245 White Line Follower (Nov 77) ..... F
246 Rain Alarm (Apr 78) ..... F
248 Simple 12V to 22V Converter (Jul 78) ..... W
249 Electronic Combination Lock (Apr 79) ..... E
252 The Passionmeter (Aug 79)
253 Electronic Grenade (Hot Potato) (May 79)
254 Egg Timer (Jun 79) ..... Y,W

Motorists' Projects

316 Transistor Assisted Ignition (May 77) ..... W,E,O,K
317 Rev. Monitor Counter (Jul 77) ..... E
318 Digital Car Tacho (Jul 78) ..... W,E,K
319 Variwiper MK II (Sep 78) ..... W,E,O
320 Battery Condition Indicator (Apr 79) ..... Y,E,L

Audio Projects

448 Disco Mixer (Nov 76) ..... W
449 Balanced Microphone Amp (Nov 76) .. W,D,E,J,F,Y
450 Bucket Brigade Audio Delay Line (Dec 77) .... W,E
451 Hum Filter (Jul 79) ..... D,E,F

470 60 W Amp Module (May 79) .. Y,W,R,E,F,B,P,L,A,V
471 High Performance Stereo Preamp Control Unit (Jun 79) ..... W,R,E,F,B,P,A,V,L
472 Power Supply — the Series 4000 Stereo Amp (Jul 79) ..... W,R,E,F,B,V,L
473 Series 4000 Moving-coil Cartridge Preamplifier ..... F,J
480 50-100 Watt Amp Modules (Dec 76) ..... W,R,D,E,J,O,Y,L
481 12V 100 Watt Audio Amp (May 77) ..... R,E
481 High Power PA/Guitar Amp (Jun 77) ..... W
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 Equaliser (Jun 77) ..... Y,W,E,J,O
486 Howl-round Stabiliser (Nov 77) ..... J
487 Audio Spectrum Analyser (Feb 78) ..... E
489 Audio Spectrum Analyser 2 (Apr 78) ..... E,J
490 Audio Compressor (Dec 78)
491 Simple Graphic Equaliser (Mar 79) ..... W,E
495 Transmission Line Speakers (Aug 77)

Miscellaneous

546 GSR Monitor (Mar 77) ..... W,E
547 Telephone Bell Extender (Jun 77) ..... E
548 Photographic Strobe (May 77) ..... W,E
549 Induction Balance Metal Detector (May 77) ..... Y,W,D,E,L
550 Digital Dial (Aug 78) ..... E,O
551 Light Chaser (Sep 78) ..... W,E,O
552 LED Pendant (Sep 78)
553 Tape/Slide Synchroniser (Oct 78) ..... E
556 Wind Speed/Direction Indicator (Dec 78)
557 Reaction Timer (Feb 79) ..... E
558 Mast-head Strobe (Feb 79) ..... E
559 Cable Tester (Mar 79)
575 Portable Fluorescent Light Wand for Car, Camping (Aug 79) ..... W
577 General Purpose Power Supply ..... J
581 Dual Power Supply (Jan 77) ..... W,E,Y
582 House Alarm (Jul 77) ..... W,E,O,A,
House Alarm — Installation Instructions (Aug 77) ..... W
583 Marine Gas Alarm (Aug 77) ..... D,E,M
585 Ultrasonic Switch (Sep 77) ..... R,D,E,O,F
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) ..... O,N
591 Up/Down Presettable Counter (Jul 78) ..... D,E
592 Light Show Controller (Aug 78) ..... E
593 Colour Sequencer (Dec 78)
594 Development Timer (Apr 79) ..... E
595 Aquarium Lamp Controller (May 79)

Electronic Music

602 Mini Organ (Aug 76) ..... W,D,E,Y
603 Sequencer (Aug 77) ..... W
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 76) ..... W,E,O,A
631 Keyboard Encoder (Apr 77) ..... W,E,O,A
632 Video Display Unit (Jan 77) ..... E,O
633 TV Sync Generator (Jan 77) ..... E
634 8080 Educational/Prototyping Interface (Jul, Aug 78)
635 Microcomputer Power Supply (Sep 77) ..... O
637 Cuts Cassette Interface (Jun 78) ..... V,E,A
638 Eprom Programmer (Jul 78) ..... W,E
639 Computerised Musical Doorbell (Mar 78) ..... A
640 S100 VDU (Apr, May, Jun 78) ..... W,O,A,V
641 S100 Printer (Sep 78) ..... O
642 16k S100 RAM Card (Feb 79) ..... K
650 STAC Timer (Nov 78) ..... E,L
651 Binary to Hex Number Converter (Jun 79) ..... E
680 Z-80 based CPU (Nov, 79) ..... A

Radio Projects

712 CB Power Supply (Jun 77) ..... W,E
713 Add-on FM Tuner (Sep 77)
714 VHF-Log-Periodic Antenna (Feb, Mar 78)
715 VHF Power Amplifiers (Nov 77)
716 VHF Power Amplifiers (Jan, Feb 78)
717 Crosshatch Generator (May 78) ..... W,D,E,A,Y
718 SW Radio (Oct 78) ..... E
719 RF Field Strength Indicator (Nov 78)
720 2m VMOS Power Amp (Jan 79)
721 Aircraft Band Converter (Mar 79) ..... W,E
722 Antenna for Aircraft Band Converter (May 79)
724 Microwave Oven Leak Detector (Jul 79) ..... D,E,F
725 Simple SSB Generator employs Polyphase Network using Standard Components (Aug 79) . E,L
730 Get Going on Radioteletype (Aug 79) ..... E,L

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) ..... O
810 Stunt Cycle TV Game (Jun 78) ..... D,O
811 TV Tank Game (Oct 78) ..... O
812 Wheel of Fortune (Dec 78)
813 Race Track Game (Jan 79) ..... O
814 The 'Dinky-Die' (Aug 79)

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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 4.30 pm**. In enquiring by telephone about back issues or photostats, please ask for the "Subscriptions Department". **33-4282**

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DREGS

IT WAS PRECISELY 2 am on a warm, late summer's evening. The bushfires had long since petered out and no pall of smoke hung over the harbour, or the horizon, as it had done some weeks past. All slept peacefully that balmy night.

Then, one of them crowed.

Sitting bolt upright in bed, in unison with about 300 other furiously disturbed sleepers, our normally unflappable Managing Editor, Collyn Rivers, uttered a series of vile curses learned as a lad in North Africa. This was followed, about 10 dB lower and in equally intemperate tones, by incantations to the effect that something drastic, final, ultimate and **terminal** had to be done about the infernal Goat Island cockerels!

Goat Island is situated in the middle of glorious Sydney harbour, about 1 km west of The Bridge, just further than a stone's throw from Ball's Head on the north side and Balmain East on the south. Goat Island has a venerable place in Australia's history, and an interesting, if gruesome, past.

Now, legend has it that cockerels crow the dawn. So much for legend. Nobody told the 30 Goat Island roosters. Their habit is to crow on the hour, every hour commencing (on average) about midnight, every night. Even heavy sleepers of placid disposition have been seen to turn into morose, paranoid psychotics with murderous tempers.

Plan A for dealing with the roosters was to obtain a brace of ETI-466 300 watt amp modules and tapes of wolf howls (or some other predator's call) through the Bose 901 speakers Collyn had for review. Certain arrest and arraignment for transgressing NSW's noise laws scotched that plan. Curiously, the Goat Island roosters, being Maritime Services Board employees, do not come under the noise laws' jurisdiction.

Being just over a stone's throw away, lobbing stones on the chookhouse roof was out — assuming its position was known, which it wasn't. Any direct physical method was ruled out as Goat Island is State owned. Some, more subtle — preferably electronic, method had to be devised to remove the offending cockerels, or at least get them to cease and desist. Playing tapes of thunderstorms (using aforementioned pair of ETI-466s, Bose 901s etc) was suggested — fowls seek shelter in violent storms. However, such 'cures' proved worse than the problem, — and then there were the noise laws . . . . . .

Searching through the dim past, and then his old sea chest, Collyn dug out something every boy used to make in 'the olden days' — a model aeroplane powered by a 0.5 cc combustion engine (from Mechanix Illustrated, May 1938). Fitted with the ETI-711 Remote Controller, it could fly suitable 'messages' to the cacaphonic cockerels so close across the water from Collyn's home. Laying a bomb pattern over the island was thought to be wasteful, though. Aha! — build a 'cockerel homing' device to guide the model aircraft to its target! (To be project 901 — watch for it, it's a cunning one).

With this marvellous device aboard, the aircraft, loaded with a miniature torpedo bomb (from War Games Illustrated, June 1956), could be set off at 'first crow', home in on its target and, Kamikaze-like, attenuate the problem in one blow. Being a self-destructive solution, the noise laws seemed to present no problem here.

All was readied. The plane's tank was filled, bomb primed, batteries charged.

Three am. The first crow.

A small engine was heard to sputter into life and then its drone carried out across the slumbering harbour.

Somewhere out in Fairfield, or beyond, in the shadow of the Blue Mountains, another cockerel crowed . . . at 3.02 am.

The little plane banked sharply and headed due west, 90° off course!

One Guiseppe Papadopolous, of Elizabeth Drive, Kemps Creek is still trying to work out who bombed his little corrugated iron chookhouse at 3.15 am one morning in August — and why.

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