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JUNE 1978

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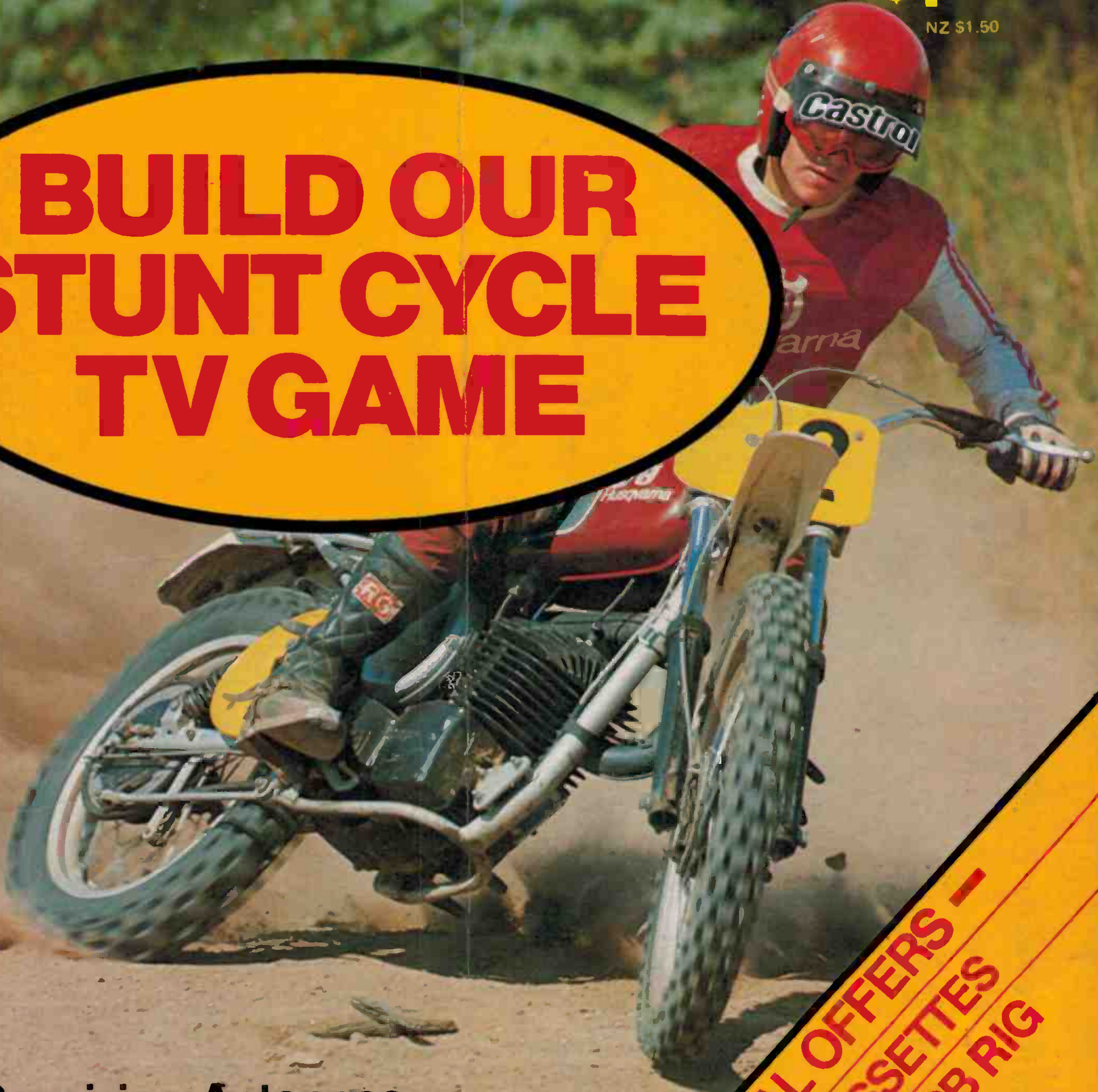

BUILD OUR STUNT CYCLE TV GAME

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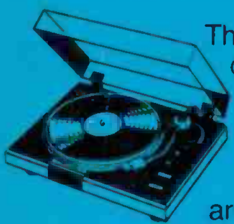
What's the real advantage of owning matching stereo components?

Matched stereo components are not simply components that are designed to look alike. Instead they are matched to deliver the right kind of balanced performance that will bring out their very best musicality under all conditions of use. The real advantage of owning matched stereo components is the way they work together in the areas of critical performance, such as input/output power levels, distortion and signal to noise ratio. The way they deliver what we at JVC like to call The Musical Truth.

The Musical Truth is something special in sound. It's an indication that your records sound as good in your listening room as they did when they were cut in the studio, or your tapes just as good as the original sound or music you recorded. Only superior components . . . matched to handle the fine nuances of music can create pure Hi-Fi entertainment for your enjoyment. That's why if you're serious about music, you'll want matched components . . . just like these JVC units we've pictured here.



The JL-A40 direct-drive turntable is a beauty in its own way, what with automatic operation for arm cut/shut-off, a beautifully realistic price, low 0.03% wow/flutter & high 70 dB S/N ratio.

The KD-S200 II stereo cassette tape deck matches the best-selling JVC knobless receiver line. You can stack it with the receiver, co-ordinate the design of your system, operate everything from the front. It features a wide 30-16,000Hz (chrome, typical) frequency response and a high 56 dB S/N ratio.

The JR-S300 II FM/AM stereo receiver gives you dependable power output (50W RMS per channel, THD 0.1%), advanced tuner circuitry (usable sensitivity 10.8dBf) and the unique JVC five tone-zone S.E.A. Graphic Equalizer.

JVC Hi-Fi Components beautifully matched for your entertainment!

Balanced performance!

For details on all JVC Hi-Fi Equipment, write to: JVC Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033

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WT78/1

AUSTRALIAN OWNED AND PRODUCED

June 1978, Vol.8 No.5

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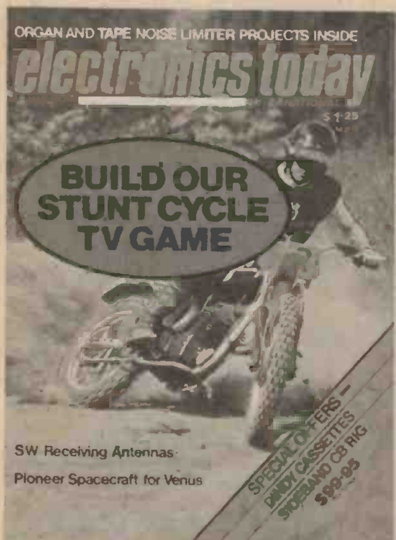

This month we feature a TV game which we hope will follow in the successful footsteps of the ETI 804 Selectagame. The Stunt Cycle game is great fun, but not as dangerous as our cover shot, which was taken by Ray Ryan.

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PROJECTS

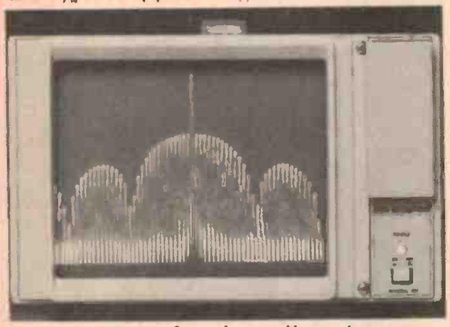
FEATURES

NEWS & INFORMATION

News Digest

Higher Brightness X-Y Display
Tektronix 624 Display Monitor offers a brightness of 130 cd/m^2 (40 fl) for easy viewing in room ambient light. A 12 mil spot size assures crisp, detailed displays, and this spot size is held over a wide range of brightness levels. The 100 x 120 mm viewing area matches well with the standard formats of available instrument cameras and films.

The 624 is suited to applications in medical diagnostic equipment, electronic instrumentation, mechanical measurements, and military;aerospace systems. A specific example of a medical application is the A-scan display in an ultrasound system. Electronic instrumentation applications include displays for spectrum analyzers and logic analyzers. In mechanical measurements, display of a vibration signature is a typical application.



A number of options allow the user to fit the 624 to his specific application. An internal graticule is a no-cost option. Electronic options include a time base, a remote program connector for x, y, and z functions; full differential inputs for x, y, and z axes; an extended gain range (X5); TTL blanking; and 50 ohm inputs. Operation from unregulated dc power (+17 V to +26 V and -17 V to -26V) is available for OEM applications where this is preferable to the standard ac supply. P4, P7 and P11 phosphors can be chosen rather than the standard P31 at no additional cost.

Voice Operated Computer
Interstate Electronic Corp (Anaheim, Calif) has developed a practical, voice-operated 'intelligent' terminal for entering data into computers in commercial and industrial applications.

The unit enables operators to speak directly to computers, in familiar English, via microphones or ordinary telephones. In some cases, such as verifying telephone-entered data, the computer talks back, repeating the words and figures spoken to it or asking for clarification. The system operates with a single operator station vocabulary of up to 900 words, or a 250 word vocabulary for each of four channels, or stations, plugged into the same processor, permitting source data to be entered in the terminology associated with the operator's task. The system may be expanded to handle up to four input stations, provided with a voice synthesizer audio response unit, and accommodate a number of optional features for computer interfacing, I/O peripherals and mass storage. Single or multiplexed 4-channel ASCII interfaces allow completely interactive operation with virtually any modern computer or information processing system.

Anti-skid Braking
Hitachi and Nissan have jointly developed a Doppler radar anti-skid braking system which permits efficient braking control for a wide variety of vehicles on all kinds of road surfaces. The system, tested in a production sedan, prevents the rear wheels from locking by comparing the ground speed measured by radar during braking with rear wheel speed, obtaining the slip ratio of the wheels, and controlling the ratio via hydraulic brake fluid pressure modulation.

Communicating via Neutrinos
Communications via neutrino beams are currently being studied by US Naval Research Laboratory scientists.

The transmitter is a high-energy proton accelerator, no details are currently available of proposed receiver techniques.

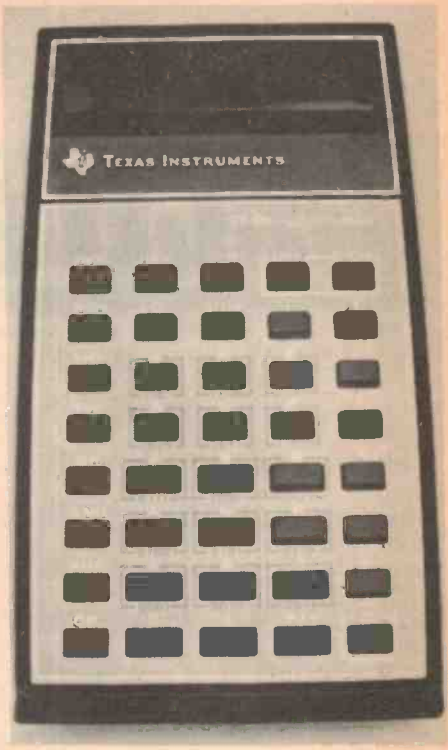
Advantages of such are technique are that neutrinos have no (known) detrimental effects and are not affected at all by weather or sunspot activity.

FM Indicator
Visible indication of the FM station and programme tuned is made possible by a small display developed by Philips Research Labs (Eindhoven) in co-operation with the Dutch Broadcasting Corp. It facilitates tuning to FM stations.

The display reacts to a code which is transmitted with the single FM signal and is characteristic of the station. The introduction of the Station Programme Identification device will depend on international acceptance and on the co-operation of broadcasting authorities.

ESP — An Electromagnetic Effect
Stanford Research Institute are currently testing the hypothesis that telepathic information is transmitted — consciously or otherwise — by extremely-low frequency electro-magnetic waves, modulated in such a manner as to reduct the inherently poor signal/noise ratio.

The Institute is actively carrying out a series of tests using double-walled copper-screened Faraday cages.



TI Programmer
Several years ago, Texas Instruments released a calculator specifically for computer programmers, but it was not a popular product, and was withdrawn after a fairly short time. However, in the intervening time, a tremendous number of computers have been built, most of them hobby computers, and so TI have rereleased the calculator.

The TI Programmer is unique in that it can calculate in decimal, hexidecimal or octal number systems, perform conversions between the different bases and do some other interesting tricks. In the octal and hexidecimal modes, the calculator can perform right and left shifts, calculate 1's and 2's complements, as well as the logical functions AND, OR and XOR.

We have been using the TI Programmer for several days while working on software, and have found it an invaluable aid.

The TI Programmer costs $53, and is available from Emona, PO Box K21, Haymarket, NSW 2000, who supplied our review sample.

Volatile Credit Cards
Honeywell are experimenting with a microprocessor based credit card. Apparently the chip is packaged using a variation of Honeywell's existing film-carrier micropackaging process.

The idea is that the 'cards' would store the holder's bank balance and record each transaction obviating the present need to check the card user's current balance with a central office or computer.

Sony's New Betamax Home Video

Sony recently announced that the PAL model of their Betamax home video recording unit, (SL-8000) will be marketed shortly in Australia.

The Betamax connects to any existing colour television set, and enables television programmes in monochrome or colour to be video-recorded and played back at any desired time. By connecting a video camera users can produce their own video programmes. The unit's built-in timer can be set so that any desired television programme can be automatically recorded. While viewing a TV programme on one channel, another programme can be simultaneously recorded via the TV tuner contained in the Betamax unit.

The unit will of course also handle prerecorded tapes.

Video-cassettes are marketed in length from 30 minutes to 3¼ hours and will be offered the same time that the SL-8000 is placed on the market:

L-125 for 30 minutes
L-250 for 1 hour 5 minutes
L-500 for 2 hours 10 minutes
L-750 for 3 hours 15 minutes

Braille Arithmetic Teaching Unit

An RMIT student has developed a small machine which will enable blind children to undertake arithmetic problems and know immediately whether their answers are correct or incorrect.

The Braille Arithmetic Teaching Unit is a system which comprises a Perkins Braille typewriter interfaced with an electronic arithmetic checking device. Mechanical keys operate circuits connected to the electronic processing unit which checks the student's work. The student hears two tones through headphones. One tone indicates his answer is correct, the other tells him he is wrong.

The visual display unit displays a record of the number of correct and incorrect answers. It is designed so that in a classroom situation, a sighted teacher can tell at a glance which pupils are having difficulty, and can assist them immediately.

Frank Wrobel, a final-year Bachelor of Engineering (Electronics) student, began the project over a year ago. It is one of several which are being undertaken by students in RMIT's Department of Communication and Electronic Engineering in the area of medical electronics. The projects are supervised by MrJohn Podolak, lecturer in Communication and Electronic Engineering, who has been involved with medical electronics projects in the Department for some years. Application for a provisional patent has been made.

For further information, please contact:
Mr John Podolak,
Department of Communcation & Electronic Engineering, RMIT.

Compact, Low-cost Electronic Piano

A recently developed metal-oxide semiconductor microcircuit a simulates the sound and touch of hammer action instruments, enabling a compact electronic piano to be made at a fraction of the price of a conventional instrument.

The AY-1-1320 chip incorporates circuitry which senses the key velocity as the pianist strikes each note, adjusts the output volume accordingly and produces a note which dies away in a similar manner to a hammer action instrument. Loud pedal operation can also be simulated. The sound can be adjusted to simulate a honky-tonk piano, harpsicord or clavicord.

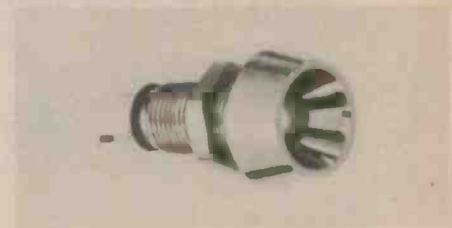
The electronic piano chip incorporates 12 separate envelope generation circuits, four octave tones and semitones. Thus a five octave instrument would require no more than five 40-pin dual-in-line devices of this kind.

Output from each keying circuit is a square wave of the required fundamental frequency. This is shaped by external voicing circuits to produce a piano like tone. The characteristics of the external voicing circuits are defined by the facturer and his skill in specifying them determines the eventual sound produced by the electronic piano.

A complete kit of 18 ICs (five of the above, 12 dividers, one master tone generator) is now available ex-stock from General Electronic Services, 99 Alexander Street, Crow's Nest, NSW 2065.

Sloan LED Lamps

C & K of Australia in association with Sloan AG. of Switzerland have arranged to import a range of high quality light emitting diode indicator lamp assemblies.



The indicators offer two basic sizes (both requiring a 6.35 mm mounting hole) in three popular colours, red, green and amber. Lights designated types 133 and 233 provide a panel viewing diameter of 8 mm and 11 mm respectively and are available ex stock, Sydney. The panel style also matches the range of C & K switch panel dress nuts, thus providing uniformity of instrument panel presentation.

For further information contact:–
C & K Electronics, Office 2, 6 McFarlane Street, Merrylands, 2160. Tel. 682 3144.

Cryogenic Computers

When some materials are cooled to near absolute zero they become superconductors – they have virtually no resistance.

IBM has been experimenting with this technique (known as cryogenics) for nearly ten years using what are known as Josephson junctions. The company has now successfully assembled arrays of such junctions into complex computer circuits. The devices are hundreds of times faster than existing computer devices but do of course need complex and expensive cooling arrangements.

Japanese Experimental Broadcast Satellite

A high-power 678 kg experimental television broadcast satellite was launched from Cape Canaveral (in April) by NASA for the National Space Development Agency of Japan (NASDA). The satellite will provide high quality experimental colour television reception in remote and in urban areas of the Japanese mainland and offshore islands. Known as the "BSE" (Broadcast Satellite Experimental), it was built for NASDA by the Space Division of the General Electric Co under contract to the Tokyo Shibaura Electric Co. (Toshiba).

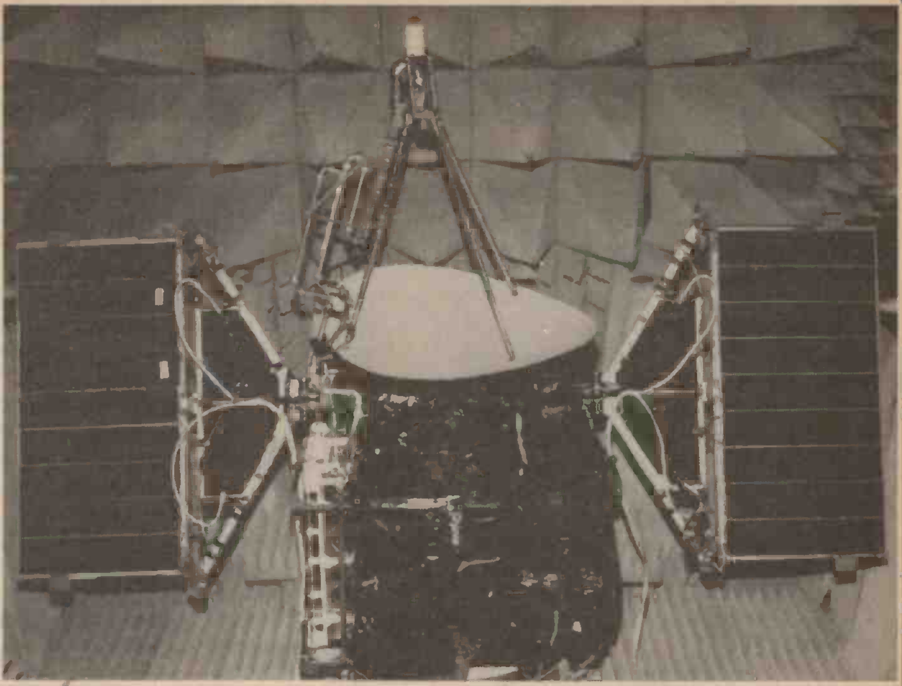
The BSE satellite will receive television and voice signals on 14.0 to 14.5 GHz and will relay them back using frequencies in the 11.7 to 12.2 GHz band. Parabolic antennae as small as 1m in diameter will be used with relatively inexpensive ground station receivers, whilst many signal strength measurements will be made both on the Japanese mainland, offshore islands etc.

The primary objective is the provision of two channel high quality colour television signals over the whole of Japan and the Japanese islands. About two percent of the Japanese population (mostly those living in remote islands or in mountain districts) are not in an area where they can obtain satisfactory reception from the existing transmitters. It is expected that the BSE satellite will provide an effective and cost efficient means of providing reception in remote areas or in regions screened by mountains.

This experimental broadcast satellite is probably the first of many high powered satellites which will be able to provide first class reception in most regions of the world. The basic design of the high power BSE satellite can be readily adapted to provide both expanded telephone, television and data services as well as to deliver education and health care.

The BSE satellite represents a trend towards higher power broadcast satellites using three-axis attitude control and larger solar arrays.

Such satellites from their position some 36 000km above the equator can relay television, radio, telephone and business data to small antenna which provide a service to a large city, a small village or even a single private house in a remote area. The impact on education and on health care may be very great in the developing areas, since a single teacher will be able to instruct many students in widely scattered locations, whilst a medical diagnosis system can be used in conjunction with the development of widespread nurse-practitioner programmes where routine medical services are rendered by nurses with advanced training by satellite transmissions. A single physician can supervise the medical progress of a number of widely scattered communities.



Pocket Typewriter

An extremely ingenious pocket calculator sized typewriter has recently been developed by an American engineer currently living in London.

Unlike conventional machines the unit has only five keys — one for each finger of the user's hand. Letters and numbers are produced by pressing combinations of the five keys using an easily remembered code. The inventor claims that the code can be mastered in about half an hour and that anyone can learn to use the machine as quickly as they would a normal typewriter in about three days.

The desired text is displayed on an electronic readout in a similar fashion to a calculator. The typed material is stored in a memory within the machine and is eventually 'played-out' by connecting the unit to a conventional electronic typewriter. At present the machine can store the equivalent of eight or so foolscap pages of type but the inventor is apparently developing a very much larger store.

Measuring the Power in Lightning

A recording-tape lightning detector has been developed to measure the current in lightning strikes. Developed by NASA Kennedy Space Center (Florida), the simple passive device monitors lightning strikes and records their peak current. It requires no external equipment, power, or human attention.

The monitor consists of a 1300mm length of magnetic tape doubled over a plastic strip within a plastic tube. An 8kHz sine-wave signal is prerecorded on the tape. The tube is mounted perpendicularly to an exposed conductor such as a guy wire.

When lightning strikes the conductor, the lightning current creates a magnetic field which erases part of the prerecorded signal on the tape. The amount of erasure is proportional to the magnetic field and therefore to the current.

To determine the magnitude of a lightning strike, a user removes the tape from the tube and plays it on a tape machine. The period of time that the tape is silent (erased) is proportional to the lightning current. Current as high as 17 000 amps on a single guy wire has been measured with the device.

Ultra-thin TV.

A prototype monochrome TV set a mere 30 mm deep has been developed by Sharp Electronics. The picture is produced on a flat electroluminescent screen approximately 150 mm across. Work is also progressing on a colour version — using the same basic principles.

Analogue to Digital Speech Chip

Britain's Post Office Research Dept has developed a chip which converts analogue speech signals to digital form on a single line.

The new device will speed the introduction of digital switching in local exchanges. At present complex digital-to-analogue decoders used in pulse code modulation systems must be shared among 24 to 30 channels.

THE LOUDSPEAKER WITH A TOUGH ACT TO FOLLOW: JBL's NEW L40.

For the past 2½ years, we've been making a two-way bookshelf loudspeaker called the L26. The critics loved it. The dealers loved it. The customers loved it. 250,000 times to be exact.

The smart thing to do would've been to just keep cranking out those L26's for the next hundred years. Never change a winner, right? Not if you're JBL.

Meet JBL's brand new L40. It's one of the best two-way loudspeakers you can buy. Here's why:

The L40 has tremendous power handling capability. Don't let its size fool you. It'll play right up there with loudspeakers twice its size.

Every sound is clean and clear. Listen to the snap of a rimshot, the crash of a cymbal. Pure. Accurate. Perfectly defined. (If you'd like the technical information on the L40, write us and we'll send you an engineering staff report. Nothing fancy except the specs.)

Go listen to the L40. And ask for it by its first name: JBL. You'll be getting the same craftsmanship, the same components, the same sound heard in the very top recording studios in the world.

If you've been thinking about getting into high performance high fidelity, we know a great place to start: JBL's new L40. It's a whole lot of JBL for not a whole lot of money.

Ranked by the number of Top Fifty albums they produced last year, seven of the ten leading recording studios in the world used JBL to record or mix their music. They used our sound to make theirs.

Source: Recording Institute of America.

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HARMAN AUSTRALIA PTY. LTD., 271 Harbord Road, BROOKVALE, N.S.W. 2100. Telephone 939 2922

JBL

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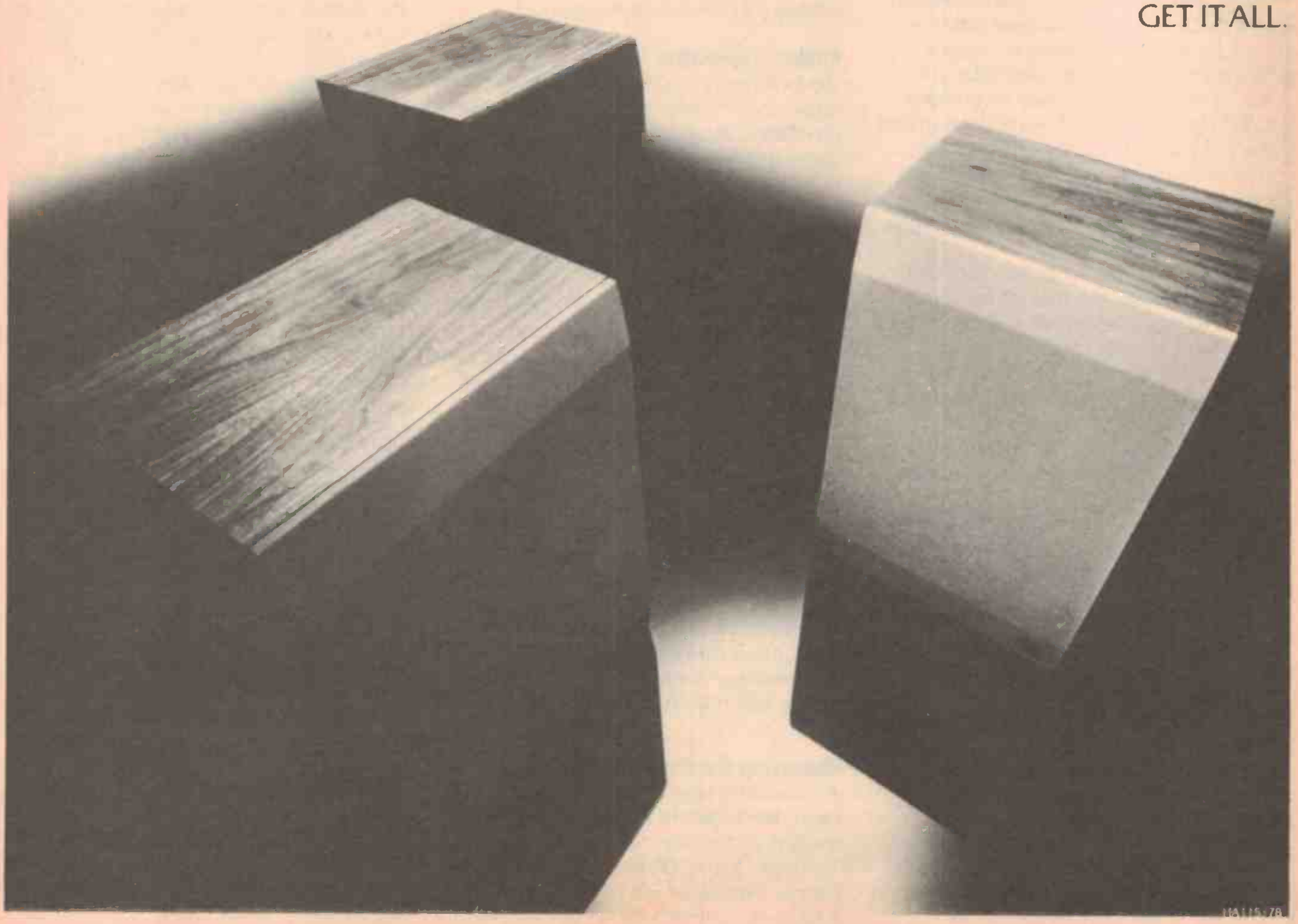


New Trio Portable Oscilloscope

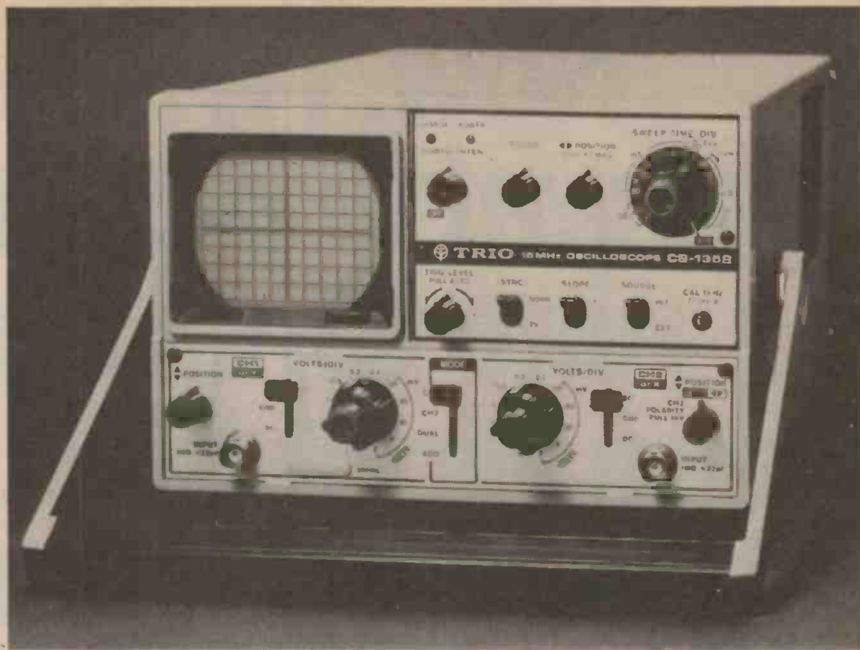
Parameters has announced the availability of a completely new portable dual-trace oscilloscope from Trio.

The CS1352 has been specifically developed for field use in TV and computer service situations where freedom from a mains supply is an important consideration. The scope has a three-way supply system – ac mains (recharging), 12 Vdc or internal rechargeable cells giving over 2 hours continuous operation. Full 15 MHz 3 dB bandwidth is offered on both channels with a sensitivity of 2 mV/division plus a triggered sweep system.

Performance compares very favourably with the well established CS1560A mains operated 15 MHz scope. Screen size, however, is 75 mm with an extremely stable display achieved by the use of dc-to-dc converters in the power supplies. These ensure constant deflection sensitivity and sweep rates over extended periods of time.

Lissajous figures can be displayed at full sensitivity, together with add and subtract signals on both channels. A trace rotation feature enables accurate alignment of traces with the graticule facilitating measurements.

Full information is available from Parameters or any stocking distributor.



Trackball CRT Control

The Librascope trackball is a manually operated direct digital input for control of CRT graphic displays where its primary use is adding new data.

Experience has shown that data entry is easier with the trackball than with any other type of interactive control device.

Potential applications include fast and accurate positioning of plotters, cranes, numerical manual control of machine tool operations, two-axes proportional remote controls for steel mill equipment, high speed marine targets, and as an improved manual control for other applications.

Details from British Merchandising, 49-51 York St, Sydney 2000.

New Displays

To satisfy the demands of a new and fast growing market for video and data display units, Philips Electronic Components & Materials have introduced a range of small cathode ray tubes and deflection components for use in computer terminals, word processors and text editors, closed-circuit TV surveillance and patient monitoring equipment.

The new cathode ray tubes are available with a choice of three different phosphors and can be supplied with an optional anti-reflective bonded face-plate. Circuit designers are given full support with a comprehensive range of wound components which include deflection yokes, line output transformers (flyback), linearity controls, and line driver transformers.

For further information please contact *Philips Electronic Components & Materials, 67 Mars Road, Lane Cove.*

New Philips Distributors

Philips Electronic Components & Materials are pleased to announce the appointment of Cema Electronics Pty. Ltd. and Soanar Electronics Pty. Ltd. as major distributors for their range of Philips and Signetics IC's and semiconductors, effective as of July 1, 1978.

These companies are well established electronic component suppliers throughout Australia and it is expected that the new arrangement will broaden the penetration of Philips and signetics Solid State Products in the market place.

Cema and Soanar will both carry a comprehensive stock holding of the Philips and Signetics IC and semiconductor range.

In making the announcement, Philips Division General Manager, Mr. Fred Catts said he welcomed the new arrangement and looked forward to a successful relationship with both Cema and Soanar.

ETI/Unitrex Calculator Contest

Okay, all you smart guys (and girls) out there! So the April contest was too easy, huh? Just about everyone got the correct answer – that the cards should be in the order 8: A: 3: K: 7: Q: 4: J: 6: 10: 2: 9: 5: for them to be played out in the correct order. For his efforts, J. Nasrallah of Gladstone Park, Vic, wins a Unitrex calculator.

But since it was *so* easy, we're gonna put you through it all again, this time with a full pack. The idea is the same as in the April contest: imagine you have a pack of cards, face down, in your hand. Remove the top card and slide it into the bottom position. Next move the new top card to the bottom. Third step is to remove the next top card and turn it face up beside you. Now repeat the process, moving two cards to the bottom of the pack and turning one over; two cards to the bottom, one over; and so on, until all the cards have been played out.

The question is: in what order would the cards have to be originally for them to be played out in the order Ace Hearts, Ace Diamonds, Ace Clubs, Ace Spades, King Hearts, King Diamonds, King Clubs, King Spades, etc., down to 2 Spades?

Seal an empty envelope, write your answer on the back of it, with your name and address, and send it to: Unitrex Calculator Contest (June), ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011. The closing date is 14th July.

More News Digest on p. 104.

Now. Two 3-way 40 watt speakers with nine tonal choices

Save about $50 per hour while you assemble them

Even if you didn't know them by number, you probably heard about the Philips AD12K12 MK11 Speaker Kits.

Because they are now a no.1 best-seller.

And here is the compact AD8K30, 8" 3-way compact system, with fine electronic and acoustic components (1" domed tweeters, 5" mid-range, super 8" bass drivers). Brilliant clean sound, with a frequency response closely following the ideal Bruel & Kjaer curve for hi-fi equipment measured in an actual listening room, using the "Third Octave Pink Noise Method".

Plus 9 combination tonal choices to adjust to the acoustics of your own listening-room.

You can assemble the AD8K30's in about two hours. You will get a professional result and save about $100 per pair over a comparable system.
Phone or send coupon now for full details of this and all our kits.

PHILIPS ELECTRONIC COMPONENTS AND MATERIALS
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Please send me full details and brochures on your loud speaker kits and a list of retailers who stock them.

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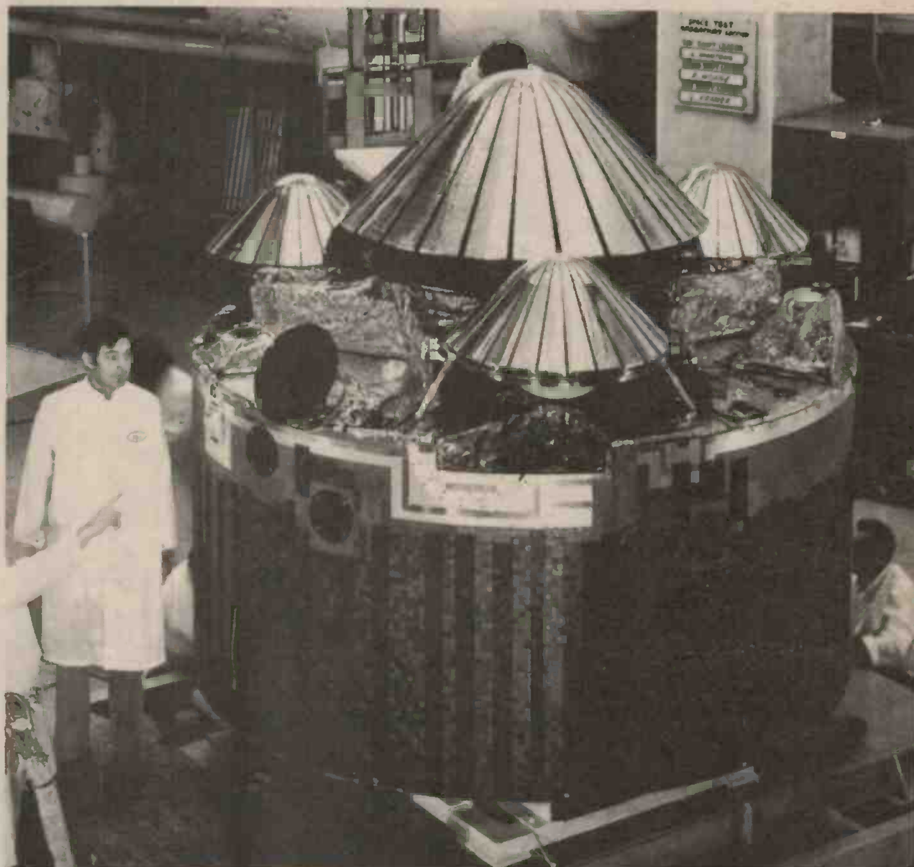
Pioneer Spacecraft prepares for Venus voyage

New probes will reveal much about the atmosphere of Venus. By Brian Dance

ABOUT THE MIDDLE of this year two 'Pioneer' spacecraft will be sent to the planet Venus and should arrive there early in December 1978. One of these probes, known as the 'Orbiter', will circle the planet for at least one Venusian year. It will collect data on the upper atmosphere of the planet (including field strengths and the types of particle present) and will also record events occurring on a global scale on or around the planet over a fairly long period of time.

The other spacecraft will consist of a transporting vehicle, known as a 'Bus', which will convey one large probe and three small probes to Venus. All five parts of this spacecraft will enter the Venusian atmosphere at widely separated points and will transmit data back to earth. The four probes will fall to the surface of the planet and should provide much information about the lower atmosphere at four widely separated points.

Although Venus is our closest planetary neighbour, it is always covered in very thick cloud; our knowledge of this planet is therefore very limited, especially as regards its lower atmosphere. The early probes have shown that Venus has a high surface temperature and an atmospheric pressure nearly one hundred times that of the earth, but a great deal of work remains to be carried out. It is expected that the two Pioneer spacecraft will increase our knowledge of this planet by a factor of about ten. They will also greatly increase our knowledge of the solar system and are expected to provide much information which will add to our theories about the origin of the earth.



The Pioneer Venus Multiprobe spacecraft; a thermal test model is shown.

Early probes

Mariner 2 was the first probe to reach the vicinity of Venus; on 14th December 1962 it passed by the planet at a distance of some 35,000 km (22,000 miles). This probe found that the surface temperature of Venus was very high confirming the earlier radio astronomical observations. In 1967 Mariner 5 came nine times nearer the planet (about 3,900 km at its nearest point), whilst in the same year Russia's Venera 4 atmospheric probe came to within 25 km of the planet's surface before being crushed by the dense atmosphere. These two probes showed that the Venusian atmosphere consists of over 95% carbon dioxide with only traces of water vapour. Venera 5 and 6 came to within 20 km of the surface in 1969 and confirmed the earlier results.

In 1970 Venera 7 actually landed on the surface of Venus and found that the temperature was about 750°K (477°C) and the pressure about 95 earth atmospheres. However, the temperature at the tops of the clouds is only about 200°C (−73°C). The earlier probes entered the atmosphere on the side facing away from the sun, but in 1972 Venera 8 landed on the illuminated side of Venus and transmitted data from the surface for almost an hour. It found that the surface composition resembled that of granite and that a significant amount of visible light penetrates through the thick clouds of the planet to reach its surface. This probe also confirmed the earlier findings of Mariner 5 that there is little difference in the surface temperature during Venusian day and night times.

The US space programme concentrated on Mars probes during the period between the years 1967 and 1974, but in 1974 Mariner 10 came to within 5,800 km of the surface of Venus whilst on its way to Mercury.

Pioneer Spacecraft prepares for Venus voyage

This probe took the first closeup pictures of the dense Venusian clouds in ultra-violet radiation and discovered spiralling cirrus-type cloud formations. It also found that Venus is much more nearly round than the earth, that its magnetic field is extremely weak and that it leaves a long plasma trail behind it much like the tail of a comet.

Pioneer

The Pioneer missions were conceived as long ago as 1970 as a result of recommendations made by the Space Science Board of the US National Academy of Sciences who decided that there is a need for relatively low cost orbiter and probe landing systems for Venus investigations. Overall responsibility and control of the mission has been given to the National Aeronautic and Space Administration (NASA) Research Centre at Moffett Field, California.

The Hughes Aircraft Company gained a contract to manufacture both space vehicles for the Pioneer mission in February 1974 after a series of competitions which started in 1972. The scientific instrument payloads were selected in June 1974, thirty instruments being included on the list. The spacecraft will be launched on top of Atlas SLV-3D Centaur D-1AR rockets from Cape Canaveral, Florida. The vehicle tracking, command signal transmission and data reception will be carried out by the established US Deep Space Network stations in California, Spain and Australia.

The Multiprobe Mission

The multiprobe launch is scheduled to take place between 7th and 24th August 1978 which is the launch 'window' for the Venus type I launch. The Bus, the large probe and each of the small probes include payloads of scientific instruments. The Bus will be destroyed by burn-up in the Venusian atmosphere after its two instruments have transmitted data about the atmosphere back to earth. It is, perhaps, somewhat surprising that work on the atmosphere and weather on Venus is expected to teach us more about the weather on earth.

The multiprobe vehicle is a circular, spin-stabilised craft with an array of solar cells around its exterior. The large probe will examine the atmosphere surrounding the planet, measuring the clouds, the atmospheric composition, etc. The three identical small probes will separate and enter the atmosphere some 7000 miles apart, two of them on the dark (night) side. They will collect information on the general circulation of the lower atmosphere.

Structure

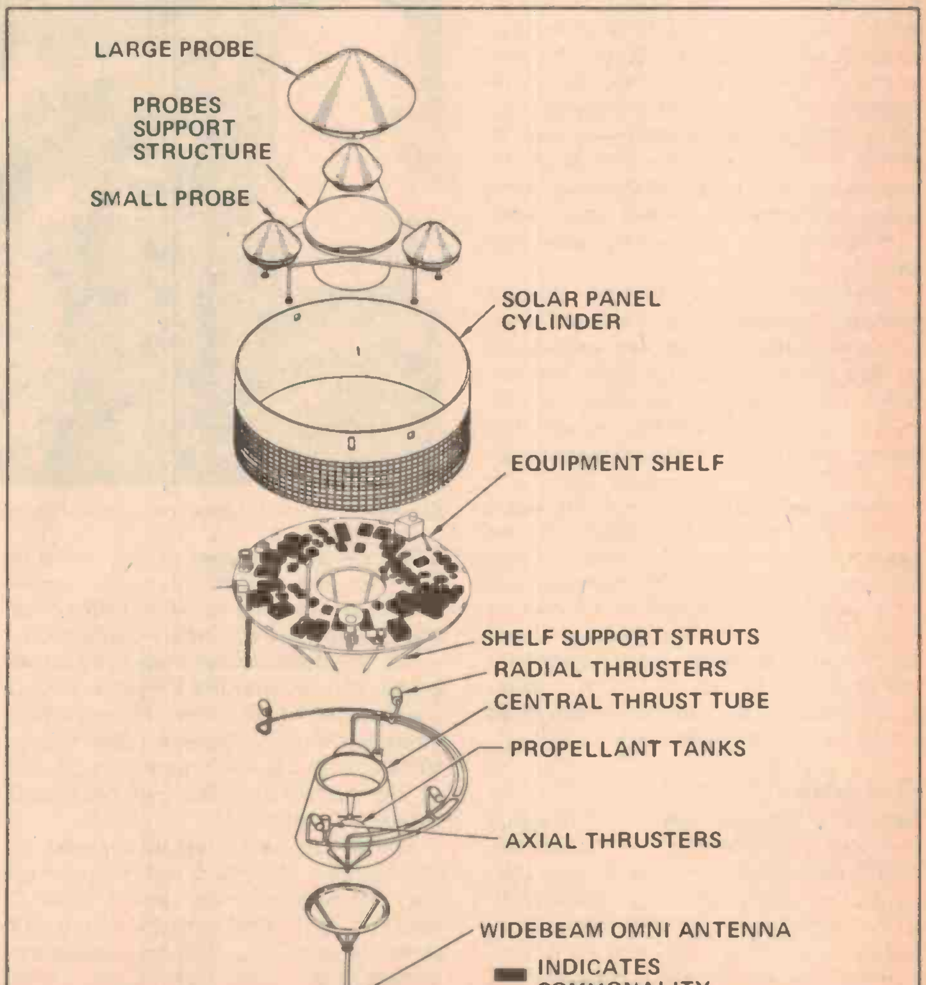
The structure of the multiprobe unit is shown in the exploded view of Fig. 1. The cylindrical solar panel is 2.54 m (100 inches) in diameter and 1.22 m in length. The equipment shelf is 2.47 m in diameter, the electronic units and the scientific instruments being mounted on this shelf.

The large probe is at the centre of the spacecraft on an inverted conical structure, whilst the three small probes are symetrically placed around the main probe. Each probe is fixed by spring loaded clamps which can be released (pyrotechnically) about 20 days before the craft arrives at Venus so that the five sections move independently.

The probe weight, including the interfacing connection with the launching vehicle, is designed to be 920 kg. Great care has been taken in the thermal design of the craft to ensure that the temperature is kept between suitable limits; heaters and thermal blankets are included and appropriate materials with suitable thermal properties are used.

The control system employs a sun sensor and a solid state sensor which can detect the radiation from 24 stars. The vehicle contains two tanks which will be filled with 32 kg of liquid hydrazine propellant. When this liquid is allowed to pass into a chamber containing a suitable catalyst, it decomposes into nitrogen and hydrogen and provides a thrust of about 0.5 kg as a jet for controlling the spacecraft's trajectory,

Fig. 1. An exploded view of the Multiprobe unit



attitude and spin rate.

The power for the spacecraft is obtained from the cylindrical array of solar cells which has an area of just over 6 square metres. This provides 228 W when the spacecraft is near the earth, but extra power can be obtained for a limited time from two 7.5A-hr nickel-cadmium batteries. The solar cells and batteries provide a 28v supply; overload protection and undervoltage detection circuits are included in the power supply system.

Command signals are transmitted from the Deep Space Network ground stations to the Bus at 4 bits/second using pulse code modulation or frequency shift keying. The electronic on-board equipment can store command instructions for execution at some later time. Six command output modules on the equipment shelf can distribute 384 pulse commands and 12 quantitative (or analogue) commands to scientific instruments and to the spacecraft units. Commands from the earth stations modulated onto a 2115 MHz carrier wave are received by the spacecraft transponders.

Data for transmission to the ground is convolutionally encoded, assembled into 8 bit words in a 64-word frame and modulated into a data stream. Eight data input modules on the equipment shelf can receive the signals and establish up to 253 data channels with the telemetry processor for transmission to earth.

The data is transmitted on a 2300 MHz beam at a power of 10 or 20 W using one of three antennas and a data rate of between 8 and 2048 bits/second. The antennas comprise two omnidirectional types (forward and aft) to provide spherical coverage at both the transmit and receive frequencies together with a medium gain horn antenna at the aft end of the craft.

The Voyage

The trajectory of the multiprobe vehicle is shown in Fig. 2 at various times after the launching date. The launching vehicle will place the multiprobe spacecraft into an earth parking orbit about 167 km above the earth where it will remain for 18 to 23 minutes before adopting the inter-planetary trajectory shown. The spacecraft will initially be spinning at 5 rpm, but it is expected that contract with the ground station at Canberra will occur within 4 hours from launch and the rate of revolution will then be increased to 15 rpm by a command from the ground.

During the passage of the spacecraft towards Venus, the forward antenna will be employed to communicate with the 26 meter diameter dish aerials of the Deep Space Network. A velocity correct-

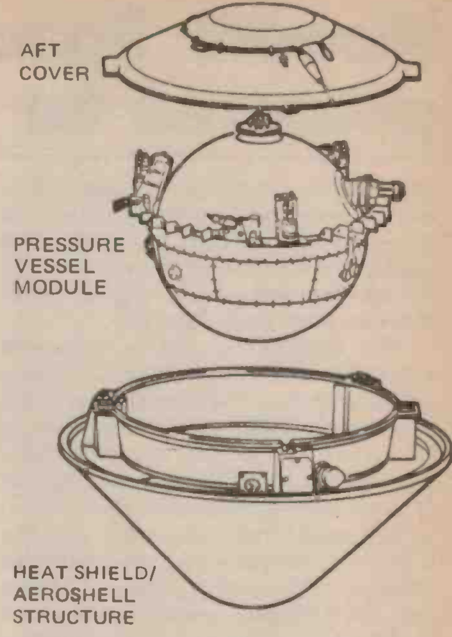


Fig. 4. The large probe with shield and pressure vessel.

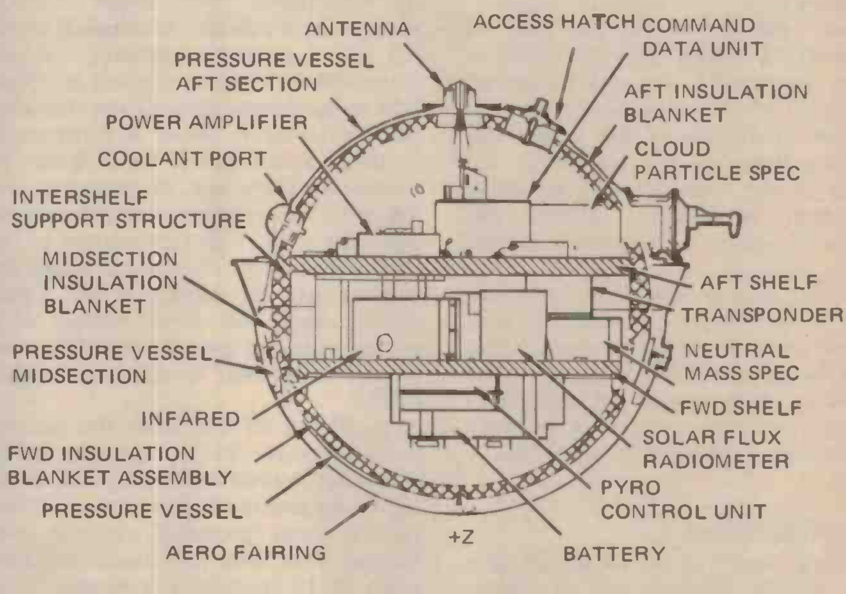


Fig. 5. The interior of the large probe.

Fig. 2. Trajectory of the Multiprobe unit to Venus.

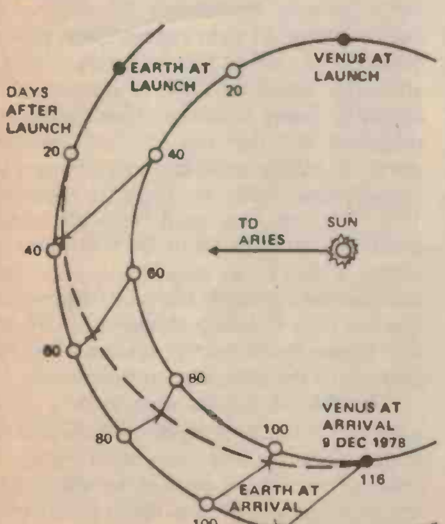
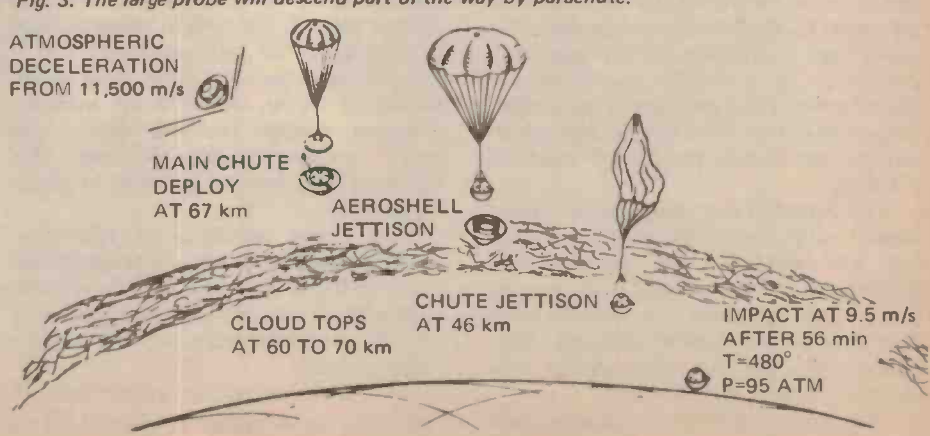


Fig. 3. The large probe will descend part of the way by parachute.



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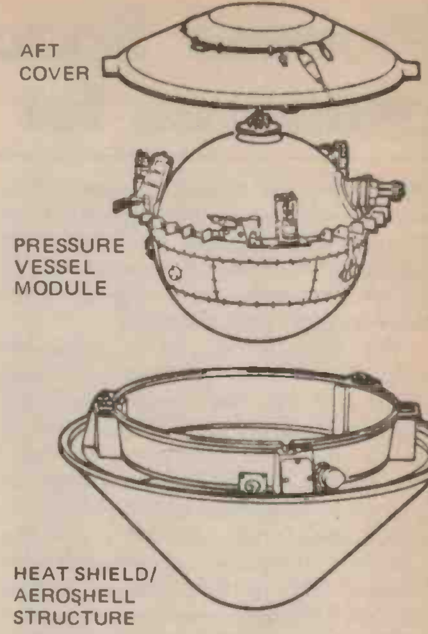

Fig. 4. The large probe with shield and pressure vessel.

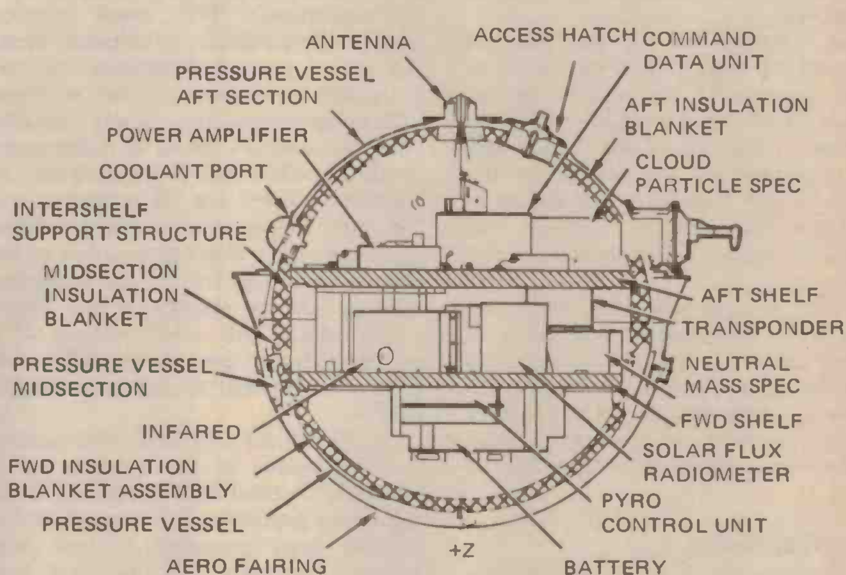

Fig. 5. The interior of the large probe.

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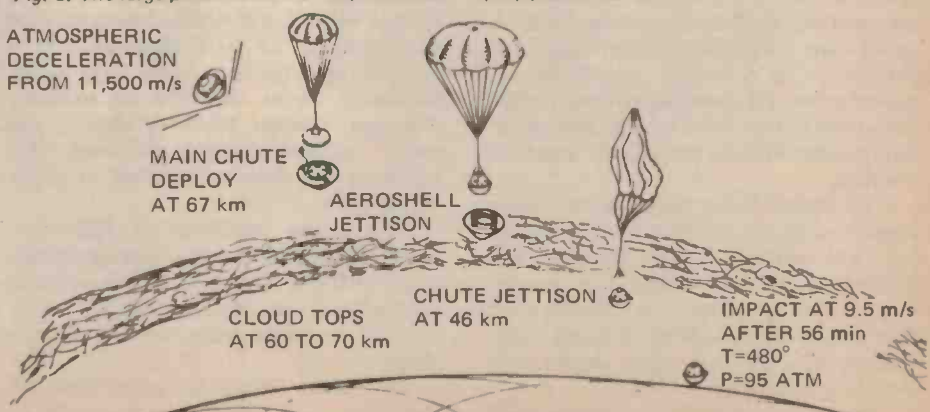
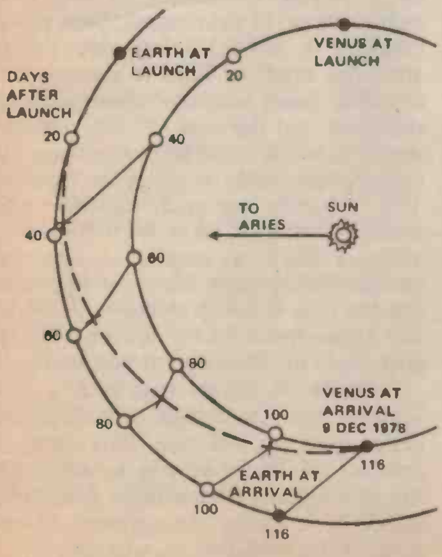


Fig. 2. Trajectory of the Multiprobe unit to Venus.



Pioneer Spacecraft prepares for Venus voyage

ion of up to 12 m/s can be made 5 days after launch and further corrections at 20 days after launch, etc. Command signals for these corrections will be transmitted from one of the huge 64 meter diameter earth station aerials.

The large probe will be separated from the Bus about 24 days before arrival at Venus. The spacecraft axis will then be precessed so that the medium gain horn can be used for earth communication. A velocity correction of 5.1 m/s will be made to achieve the required small probe trajectory and the three small probes will be released about 20 days before reaching Venus. The spin rate will have been previously increased to 48.5 rpm so as to provide a suitable tangential velocity at separation for the small probes to acquire the desired trajectory.

The velocity of the Bus will be corrected 18 days before its arrival at Venus to achieve the desired arrival point and to delay its arrival by 90 minutes so that all of the probes will have impacted on the surface of the planet by the time the Bus arrives in the upper atmosphere. Burn-up will occur at some 120 km above the planet.

All five vehicles will enter the atmosphere in a two hour period and all will be transmitting simultaneously, so the time of entry will be arranged to be one at which two of the Deep Space Network stations can simultaneously receive signals to avoid possible loss of data.

Large Probe Mission

The large probe is to be aimed at a point on the daylight side of Venus, decelerations of up to 400 g being possible at times during entry. As shown in Fig. 3, the large probe parachute opens at a height of 67 km and for the next 18 minutes the probe descends upder the stabilising influence of the parachute to a height of 46 km at which point the parachute is jettisoned. The probe then falls to the surface of the planet over a period of some 38 minutes.

The probe is not required to survive impact with the surface of the planet, but will withstand the pressure and temperature at the surface. This requirement together with the requirement that the probe can withstand the fierce acceleration presents many design problems unique to this mission.

The large probe and its deceleration module shown in Fig. 4 have a total weight of some 316.6 kg. The deceleration module provides thermal protection during atmospheric entry; it consists of a pointed nose cone of 45° angle with a diameter of 1.42 m. The base of the probe is thermally protected by a coated fibreglass aft cover.

The dacron main parachute has a diameter of nearly 5 m and is deployed by a much smaller pilot chute 0.76 m in diameter ejected by a mortar. The pull of the parachute extracts the pressure vessel module from the deceleration module.

Pressure vessel

The interior of the large probe pressure vessel is shown in Fig. 5, together with its instruments. This vessel contains nitrogen at a pressure of between about 0.5 and 2 earth atmospheres, but can withstand an external pressure of about 100 atmospheres. The 73 cm diameter titanium pressure vessel is constructed in three pieces and is about 6 mm in thickness. There are 15 apertures and 7.6 m of sealing are required to prevent gas leaks at the high temperature of the Venusian surface. The thermal insulation ensures that the electronics and instruments inside this vessel ramain at a temperature not greater than 50°C even when the external temperature reaches 480°C.

A 19 cell 40 A-hr silver-zinc battery supplies power to the pressure vessel assembly. A total of 15 magnetic latching relays provide on/off control, whilst parallel fuses provided overload protection. Four solid state amplifiers, each rated at 10 W, feed a cross dipole antenna mounted on the rear of the pressure vessel which sends the data back to earth. A data rate of 128 or 256 bits/sec in a convolutionally encoded format is used, the system being capable of providing 72 data channels and 2 minor frame formats in an 8-bit word, 64 word frame. A 3072 bit memory provides storage facilities during the entry communications blackout; this blackout will have a duration of about 10 seconds.

The entire sequence of 128 commands is predetermined and programmed prior to the multiprobe launch. A timer with a 24.27 day capacity and a stability of ±32 seconds turns on the system prior to entry.

The seven scientific instruments in the large probe weigh a total of 35 kg and require 106 W for their operation. Three of these instruments require inlets for sampling the atmosphere and four require windows for viewing the atmosphere. All of the windows except one are made of sapphire, the exception being the window for the infra-red instrument which is a 13 carat diamond nearly 2 cm in diameter; diamond is the only material able to transmit infra-red in the 10 micron region and to withstand the temperature and pressure at the Venusian surface.

The small probes

The three identical small probes are designed to measure the characteristics of the Venusian atmosphere simultaneously at three widely different locations. They are designed to withstand the high temperature and pressure at the surface of the planet, but need not necessarily withstand the impact with the surface. During entry into the atmosphere at a speed of about 11.6 km/s, a deceleration as great at 565 g may be encountered. The time of descent to the surface will be about 59 minutes.

Each small probe contains a pressure vessel and a deceleration module, as shown in Fig. 6. The total weight is some 97 kg. Unlike the large probe, there is no parachute with each small probe and the deceleration module is not detached during descent. The cone of the deceleration module has a diameter of some 76 cm.

The small probe pressure vessels which contain the electronics and the instruments are designed to operate with an internal atmosphere of xenon at between 0.25 and 2 earth atmospheres pressure. These vessels consist of a two piece titanium shell of about 46 cm diameter (Fig. 7).

The small probes are each powered by a battery containing 20 silver-zinc cells with an 11 A-hr rating. Each probe employs a single, solid state power amplifier rated at 10W rf output; this amplifier feeds a crossed dipole antenna mounted on the rear of the pressure shell. A stable oscillator maintains the S-band downlink frequency to 1 part in 10^9. The data rate used from the small probe to earth is 16 or 64 bits/second, whilst a 3072 bit memory is used for storage during entry blackout and when the bit rate is being changed. A 24.27 day timer turns on the system prior to entry into the Venusian atmosphere.

The 64 bit/second data rate is used initially, but at an altitude of some 30 km above the surface the data rate is reduced to 16 bit/second to allow for the attenuation of the radio frequency signal as it passes through the denser parts of the Venusian atmosphere.

The Orbiter Mission

The main aim of the Orbiter mission is to put 12 scientific instruments in orbit around Venus and to receive information from these instruments. It can be seen from Fig. 8 that the Orbiter spacecraft has much in common with the multiprobe vehicle of Fig. 1, including a rather similar structure. Some of the most noticeable differences are the replacement of the probe structure by a high gain aerial system which can provide communication with the earth at distances of up to 250,000,000 km. A 4.5 m long magnetometer boom is also used in the Orbiter craft.

The size of the Orbiter spacecraft is similar to that of the multiprobe craft. The diameter of the cylinder of solar cells is the same at 2.54 m, but the surface area of the cells is greater, being almost 7.2 m^2. The Orbiter is lighter than the multiprobe unit, being just under 600 kg and only 372 kg in orbit.

Fig. 6. A small probe.

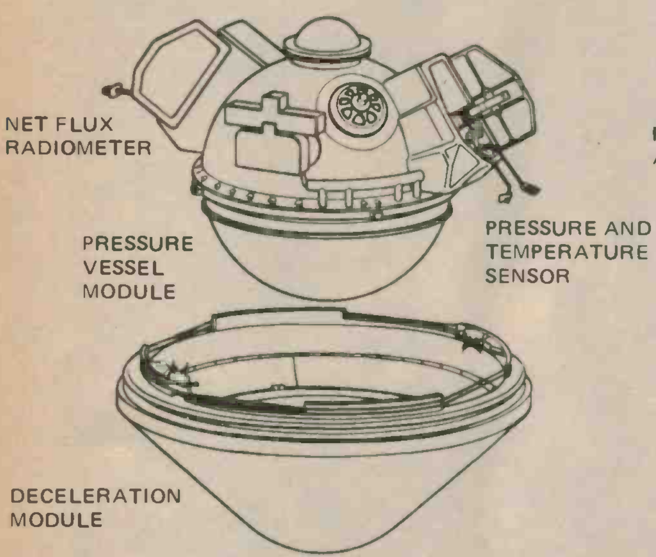


Fig. 7. The interior of a small probe.

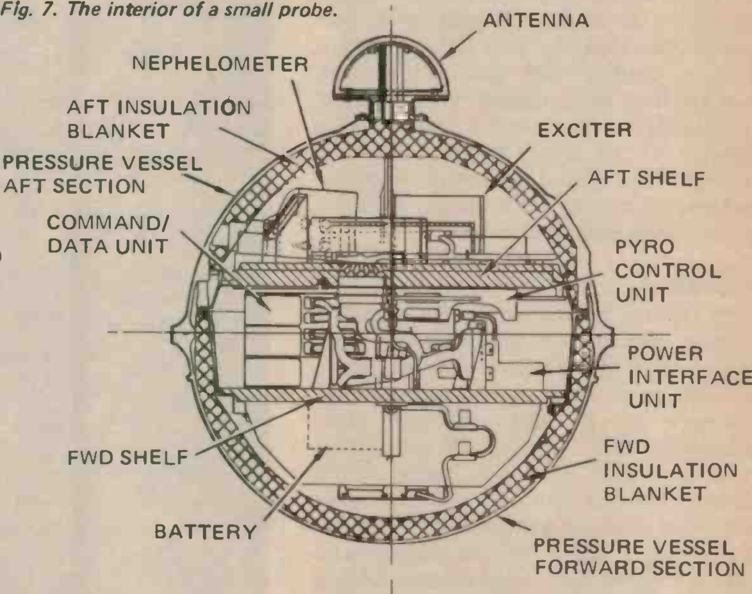
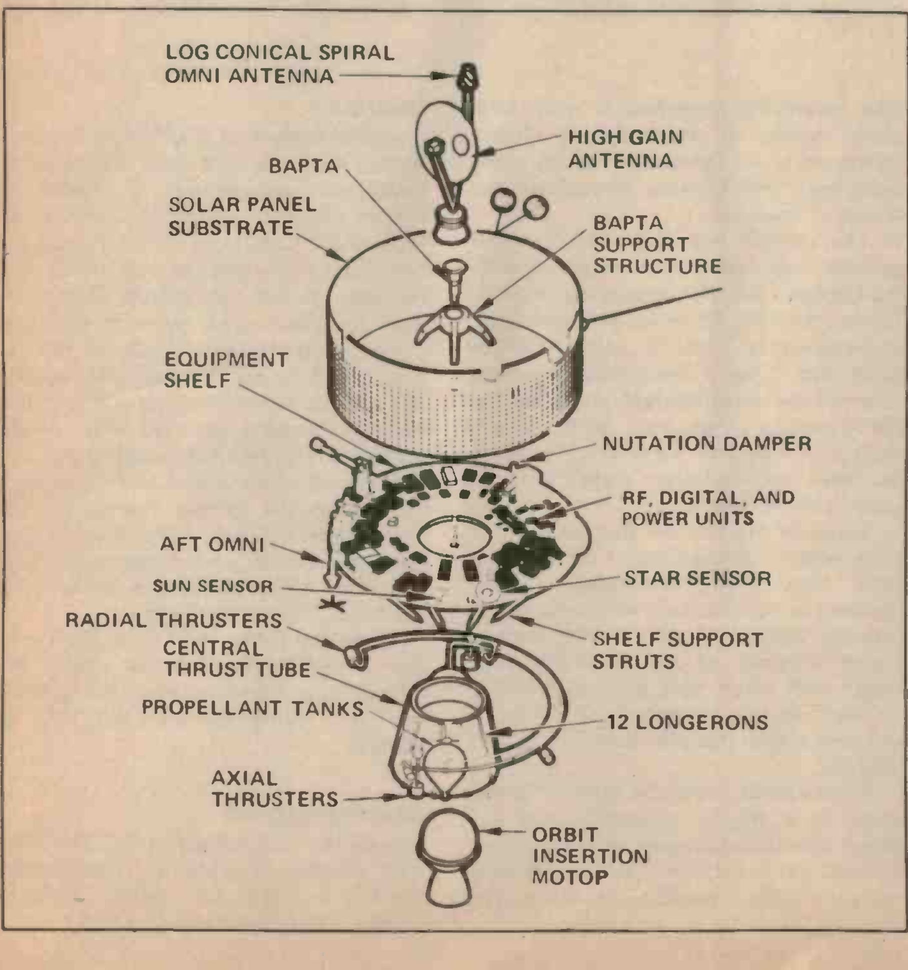


Fig. 8. An exploded view of the Orbiter spacecraft.



The slightly larger solar cell area of the Orbiter provides a little more power than in the case of the multiprobe Bus, this power being about 325 W in Venus orbit. Two 7.5 A-hr nickel cadmium batteries are also incorporated in the Orbiter spacecraft.

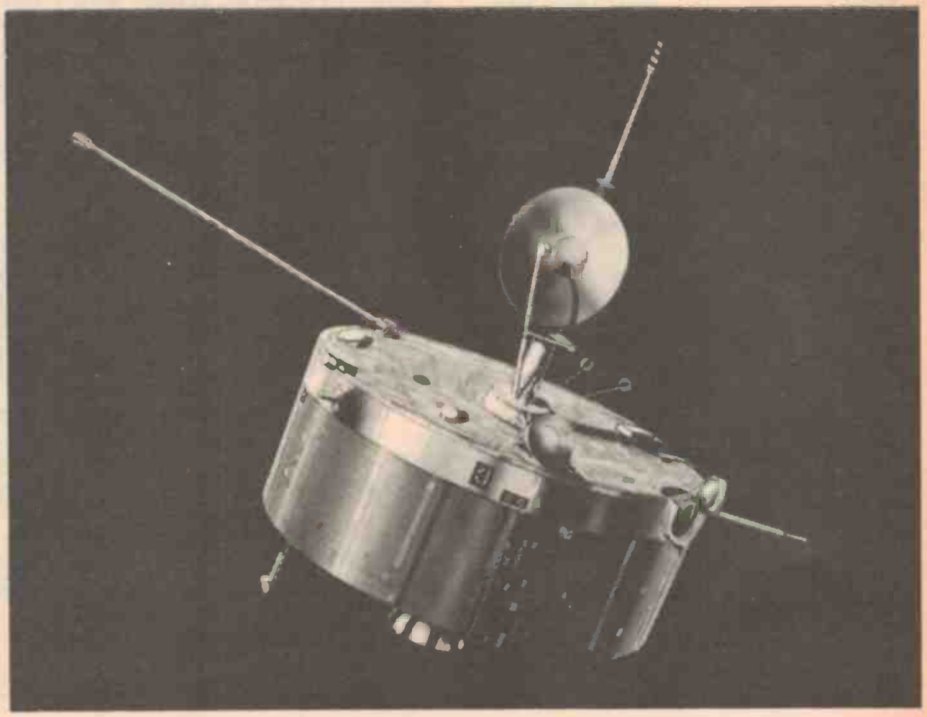
A bearing and power transfer assembly (BAPTA) serves an electrical and mechanical interface between the spinning part of the spacecraft and the despun aerial which must always point towards the earth. As in the case of the multiprobe Bus, 32 kg of liquid hydrazine propellant is carried in two tanks and can drive 7 jets, each with a thrust of about 0.5 kg, for the control of the trajectory, attitude and spin rate.

A solid propellant rocket motor, the Thiokol TEM-604, is to be used to place the Orbiter in Venus orbit. It has a velocity change capability of 1060.6 m/s for the maximum design weight.

The command data will be transmitted to Orbiter at 4 bits/second. Commands can be stored for later execution. Eight data input modules can be used as pick-up points for telemetry and provide up to 253 channels for either immediate transmission to earth or for temporary storage in a 1048 megabit magnetic core storage unit.

Pioneer Spacecraft prepares for Venus voyage

The Orbiter transmitter uses either 10 or 20W of RF power at about 2300 MHz; this is passed to one of four antennas at a rate of between 8 and 2048 bits/second. The Orbiter has a 1.09m despun high gain antenna, a second high gain antenna and a forward omni antenna all mounted on the despun mast. An aft omni antenna together with the forward antenna provides spherical coverage at both the transmit and receive frequencies.



The Orbiter craft. Note the long magnetic probe to measure the magnetic field well away from any interfering field from the craft.

Launch

The Orbiter spacecraft will be launched during the period 20th May to 2nd June 1978 during the type II Venus launch window. It will spend 6 to 18 minutes in an earth parking orbit. Communication should be established with Canberra within 4 hours of the launch and the spin rate will be increased from about 6 to about 15 rpm. The high gain antenna will be despun and the jets calibrated in preparation for the first trajectory correction 5 days after the launch.

The Orbiter craft will carry out experiments during its passage to Venus, these being mainly the measurement of the interplanetary fields and particle densities.

Unlike the type I trajectory of Fig. 2, the type II Orbiter launch initially takes the spacecraft outside the orbit of the earth up to a maximum distance of 161 million km from the sun before turning inwards to meet Venus on 4th December 1978. About two days before reaching Venus, the speed of rotation will be increased to about 30 rpm. Communications will be effected using the forward omni antenna of the spacecraft and the huge 64 meter diameter dishes of the Deep Space Network.

At the point of closest approach to Venus, the orbit insertion motor will be fired so as to place the Orbiter craft in a 24 hour Venus centred orbit. The firing of the motor occurs behind the planet relative to the earth, so the necessary commands are stored in the command memory. The orbit chosen is inclined at 75° to the equator of Venus. The rate of spin will be reduced to 5 rpm and the point of closest approach to 200 km.

The Orbiter mission will nominally have a duration of one Venus day which is 243 earth days. The period will be adjusted to 24 hours so that the point of closest approach to the planet will remain in view of the same earth station.

The scientific experiments will take place mainly at the point of closest approach to the planet, although some equipment will operate throughout the whole of the orbit.

The despun high gain antenna will provide two way communication with the Orbiter craft throughout the mission. During the first 40 orbits an occultation experiment is planned using both X band and S band frequencies radiated towards the earth through the fringe of the Venusian atmosphere as the spacecraft passes behind the planet.The 64 m diameter earth station aerials will be used in this experiment.

Early in the mission the duration of solar eclipses at the Orbiter craft will be little more than 20 minutes, so full operations can be maintained using the internal battery. Later in the mission longer eclipses of up to nearly four hours will occur and this requires the Orbiter to be operated at a much reduced power for the duration of the eclipse.

Observation from the Orbiter spacecraft in a highly elliptical orbit for about one Venusian year should provide us with much information into the way the solar wind interacts with the planet, ect.

Conclusion

A special feature of the Pioneer missions is the relatively low cost for such an ambitious programme. In order to reduce the cost, no experimental prototype craft have been built — only the one multiprobe and the one orbiter will be made, tested and orbited. Economies have also been made by using the same type of components (such as the RF amplifiers) in the Bus, Orbiter and in the probes. Identical command and data handling circuits are used in all of the probes, whilst about 78% of the Bus and Orbiter parts are identical. The cost of developing the probes themselves has been relatively high, since they involve new techniques, whilst special facilities have had to be developed to simulate the hostile Venus atmosphere.

It seems likely that craft similar to the Pioneer type will be useful for relatively economical missions to Mars and for flying through the tails of comets.

Acknowledgement

The writer is indebted to Mr. Del Bowman, Hughes Aircraft Co., Los Angeles, California, USA for detailed information on the Pioneer craft.

SOUND

Nightingale NM1

BRITISH HI-FI equipment in general, and British loudspeakers in particular, have long been regarded as first class. Mark Levinson's state-of-the-art speaker (not our tag in this instance) uses a pair of stacked Quad electrostatics and Decca-Kelly ribbons and one therefore presumes this American company was unable to find the bits and pieces it needed from U.S. domestic manufacturs.

But British excellence is not confined to esoterica. With speakers, particularly, the Poms seem able to design something that works well yet doesn't cost too much. It actually amazes us, with so much good equipment being made in England, that the Japs have managed to make such inroads into the British scene.

A fairly recent British company is Nightingale, whose NM1 loudspeaker seems already to have scored quite a reputation from the U.K. press. The NM1 has recently been joined by a smaller model (the MN2) but this has yet to reach Australia.

We were therefore delighted to have the opportunity of reviewing the NM1's. Our samples were finished in black and wood-effect thermoplastic laminate, the latter being both practical and acoustically desirable — it adds considerable strength to particle board panels.

The NM1 is a straightforward three-way speaker system based on moving coil drive units. The infinite baffle principle is employed for bass loading, using a KEF B139 in a fairly large box-shaped enclosure. Midrange is handled by a 100 mm diaphragm unit, built into an integral sub-enclosure. This unit is similar to the one used in the Gale GS401, made, we believe, by Peerless of Denmark.

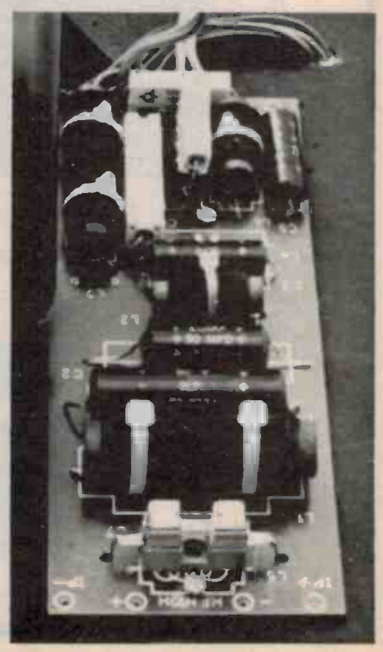
The tweeter is a 25 mm dome type, whose origin we were unable to determine (possibly Leak-Rank?)

Tweeter and midrange unit were mounted on top of the main floor-standing enclosure using small individual baffles, along the lines of the Dahlquist DQ10. Like this American system, the NM1 is a phased array, with the diaphragm surfaces lined up in the vertical plane to reduce the effects (if any) of time-delay distortion. We ourselves are not convinced of the effectiveness of these so-called linear-phase speaker systems, particularly in view of the enormous phase shifts wrought by dividing networks and drive units themselves.

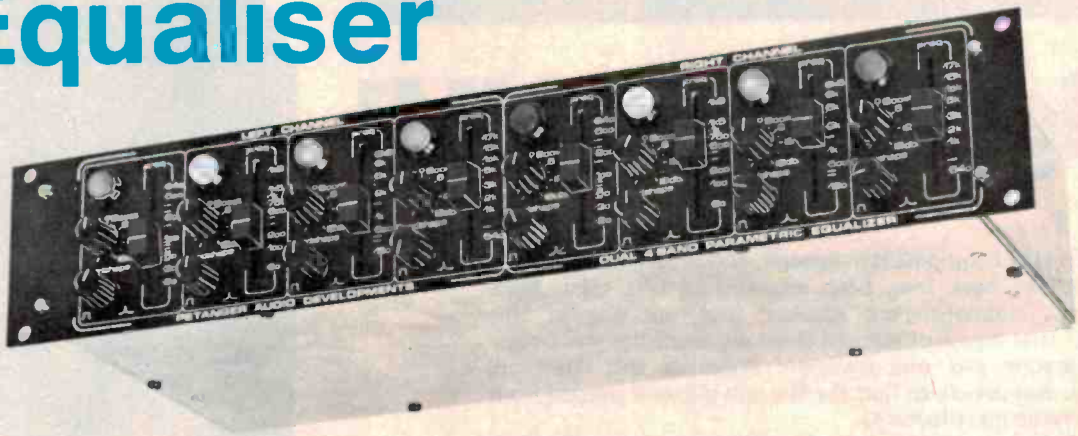
The grilles of our samples were made of reticulated foam and the front panel grille, which was fluted and bore the Nightingale badge, was permanently stuck to its mounting surface. The overall top grille was, however, removeable, revealing upper frequency drive units, dividing network circuit board, and a three-position slider switch for tweeter output level adjustment.

Finish beneath the detachable grills was not particularly good; the circuit boards were very untidy and used bi-polar electrolytic capacitors and ferrite-cored inductors throughout. We'd have expected better quality crossovers than this.

The bass enclosures were not adequately sealed; the wiring routed through each enclosure emerged through a



Petanger Parametric Equaliser

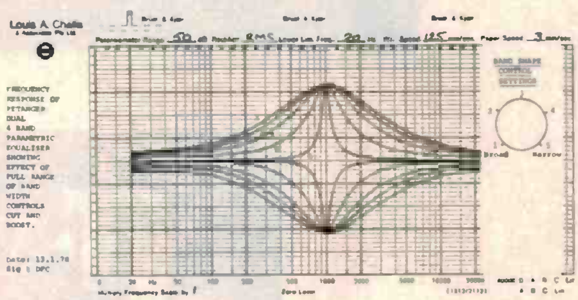


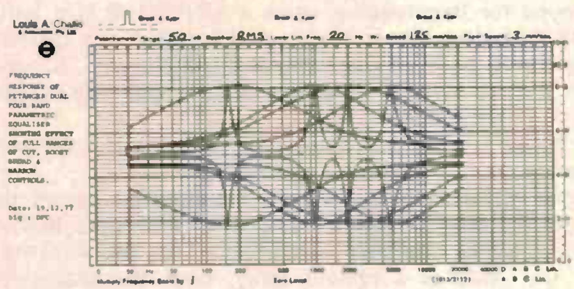
The Petanger Dual 4 band Parametric is a state of the art stereo equalizer consisting of 4 independent filter sections in each channel. Each filter is capable of continuous adjustment of amplitude, frequency and bandwidth.

Petanger Audio Developments Dual 4 Band Parametric Equalizer gives you unprecedented accuracy in equalization — accuracy and simplicity — You can create just about any frequency response curve you can imagine. You no longer have to compromise with tricky narrow band problems such as feedback, ring modes, pilot tones etc.

The large overlap margin even allows easy correction of broad and narrow band problems at the same time.

Typical applications include: ● Feedback control ● Critical E.Q. requirements ● Room correction ● Microphone, instrument and vocal correction ● Noise and hum filter





Actual unretouched frequency sweeps

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small hole near the crossover board and there was considerable leakage here. The front and rear panels both sounded hollow and resonant when tapped with the knuckles indicating insufficient bracing.

Otherwise finish and construction standards seemed good. Our samples were supplied with glider-domes for easy movement, and these were also adjustable for height.

Wiring connections were concealed in a recess in the rear panel of each enclosure, and both DIN and banana type sockets were included.

The samples did not seem excessively sensitive to room position yet sounded less good when placed in corners. Although not designed for mounting on stands, our samples sounded best when raised some 300 mm from the floor. This raised the high frequency drive units to an ideal height just above the ear level of a seated listener.

Performance

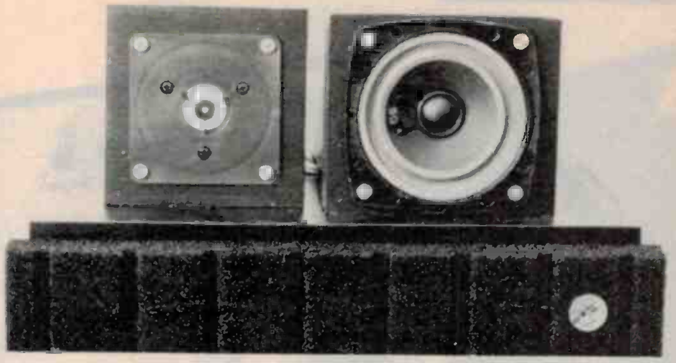
Ancillaries used for our listening tests included a Naim NAC32/NAP250 amplifier, Linn Sondek turntable, Decca International arm and modified Decca Mk 6 cartridge. Our first impressions were of a well extended bass response and a basically neutral, uncoloured tonal quality.

Before long, however, we observed some upper bass prominence which seemed somehow to overpower other parts of the spectrum. This wasn't so much of an overemphasis of the frequencies in question as a lack of definition, stringed instruments, particularly cellos, sounding rather rubbery and soggy.

Midrange was clean and smooth, although not entirely free of vices. Some stridency was noted on vocals, particularly females. The effect was also evident on massed strings such as violins.

Treble was nicely balanced yet seemed very slightly veiled, although considerable variations of balance was achieved using the level switch. No instructions or performance details were supplied with our samples, but we'd guess the changes made by the level control were substantial – in the order of 2-3 dB.

Pin-point stereo images were obtained, the samples having been supplied as mirror-image pairs. According to the directives on each enclosure, the NM1's should be used with the tweeters outermost. We found, however, that best results were obtained with the tweeters innermost, this giving an equally wide sound stage but improving the depth aspect.



Even so, image depth and perspective was not particularly good. In this respect, the samples sounded rather shallow and flat, as a consequence, we feel, of the less-than-adequate dynamic performance. The samples did not provide very good transient impact and whilst not apparently lacking in attack, they did, nevertheless, fail to react with sufficient real punch for our liking. Matters improved when the samples were driven to fairly high levels, but here a harsh midrange edginess became audible from time to time, indicating the presence of unwanted distortion components.

Conclusion

Retail price for a pair of NM1's is about $1,300. For this sort of money there are several appealling competitors, all with their own faults and shortcomings. Overall, it's hard to say whether the NM1's would be a better or worse choice – it depends very much on whether you like and require an extended bass response, which the NM1's undeniably have, or whether you prefer a more restricted response with better definition as would be obtained, for example, from Gales or the new locally-made Otoscan 1's. We do understand, however, that certain modifications have been made to the NM1's since our samples left the factory and so it may be worth while to check out later samples when they arrive in Australia. Judging from the present samples, the NM1's are competitive but against the rivals do not seem to be outstanding.

SAMPLES SUPPLIED BY M.R.ACOUSTICS P.O. Box 110, Albion, Brisbane 4010

NEUTRIK AUDIO TRACER

OVER the last few years many dogmas in the fields of electronics and electro-acoustics have been shaken or destroyed. Not the least are those relating to size, capability, performance and cost of equipment required for performing spectral analysis – for in the last year the cost of various "real time" analysis equipment has taken a tumble. Hence it's now when somebody has released an audio level recording system following the same concept – a neat little package which may do to electro-acoustics what the HP35 did to computing.

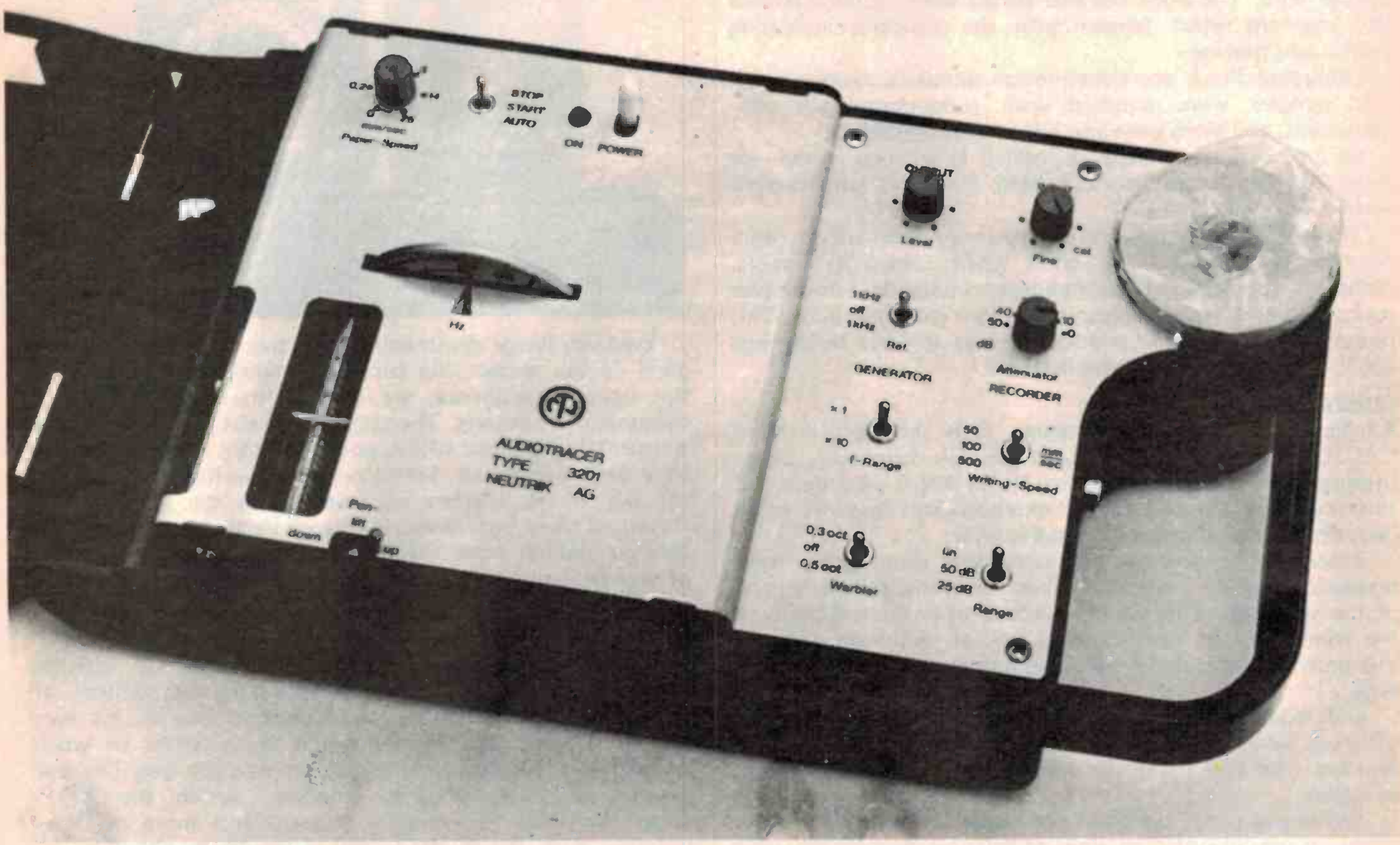
When the local representative placed the Neutrik Audio Tracer on my desk with the comment "I think this may interest interest you" he was right. The unit is so deceptively small that I thought it was a small cassette recorder. Nevertheless it fulfills the more important functions of a synchronised beat frequency oscillator, a level recorder and a measuring amplifier with associated microphone system. Equally importantly it has been put into a package small enough to fit into a technician's toolbox.

Neutrik was founded by Mr. Weingartener, the ex-chief of AKG. He desired to manufacture a range of electronic equipment radically different from that currently available but nevertheless based on sound engineering concepts.

Three basic sections

The Audio Tracer contains three basic sections.

Firstly there's a signal generator with a power amplifier output stage, which is basically a voltage controlled oscillator. This generates sine waves in the frequency ranges 20 Hz to 20 kHz and 200 Hz to 200 kHz. This oscillator has an FM modulator which produces a warble tone (either one-third or one-half octave band width) as required. This function can be very useful and allows the determination of mean frequency



response for electro-acoustic systems in the presence of standing waves or reflective components from a room in which the system may be located.

The second function of the Audio Tracer is provided by the level recorder. This is not a frequency selective unit but incorporates pre-calibrated paper which tracks directly with the internal oscillator to duplicate the functions of a B.F.O./level recorder combination. The calibrated paper is similar to the 50 mm paper produced by Bruel & Kjaer and can be almost directly overlaid for direct comparisons. The paper unlike that used by Bruel & Kjaer and General Radio, is marked by a thermal mechanism and is intended to be used with either a 25 dB, 50 dB or linear response range setting which the unit provides.

The start of each section of level recorder chart incorporates a small section for annotation and the green on white paper is complemented well by the dark blue trace produced by the thermal writing system, which uses a ceramic-tipped heater on the end of the galvanometer writing arm system. This produces a smudge free trace which is cleaner than that produced by any of the inking systems we know and gets high marks for practical ingenuity and effectiveness. Although the paper is calibrated between 20 Hz and 20 kHz, the x 10 range setting also makes it directly applicable for 200 Hz and 200 kHz response recording. This is an undoubtedly worthwhile feature for analysing modern amplifiers and filters whose performance may be important at extended frequencies.

The third section of the Audio Tracer is the measuring amplifier. This has a high sensitivity stepped-attenuator input with 5 mV sensitivity on the 50 dB range at minimum scale deflection and 0.3 mV sensitivity on the 25 dB range — both at minimum scale deflection. Input impedance is 20 kΩ so it will match a wide range of loads including buffered outputs from microphones, record players, amplifiers and the like.

In an attempt to provide the widest possible facilities the unit is provided with a calibrated electret microphone. This plugs into one of the two inputs on the side of the unit.

The measuring amplifier section has a 50 dB stepping attenuator with accurate 10 dB steps plus a fine attenuator giving a further nominal 20 dB of attenuation. The unit will also accept a dc input via a separate dc input termination on the input socket. This is capable of handling dc signals with a 360 millivolt for full scale deflection. This input as we discovered, has apoplexy if it is fed with a super-imposed ac signal with frequency components above 10 Hz!

Two other important features of the unit are the RMS characteristics of the rectifier utilised in the level recorder feed back and the motor drive systems, which unlike other level recorders has steplessly variable speed range between zero and 25mm/sec. chart speed — a "feature" which appears to have been incorporated for economy rather than as a technical advantage.

Facilities

The internal or active section of the Audio Tracer is flanked at the left hand end by the mains lead compartment, which is obviously designed for a European plug — not for the Australian three-pin plug, and at the other end by a carrying handle moulded into the plastic case which is shaped at the top to hold a spare roll of chart paper.

The front panel is brushed satin aluminium. Primary level recorder controls are at the left hand side — paper speed, stop /start and auto selection for level recorder operation together with a power on/off switch are at the top of the unit. A calibrated frequency dial, which allows initial setting of the oscillator relative to the paper chart, protrudes through the middle of the unit. The level recorder paper chart and thermal recording system are clearly visible through a cut out in the front panel at the bottom left hand corner.

The frequency calibrated dial of the level recorder oscillator drive interconnection covers approximately 330° of angular travel between the 20 Hz and 30 kHz calibrations. There is a dead band area in between in which it is possible to activate the remote start facility for automatic start/stop control from an external switch. There are eight controls on the right hand side — an output level control covering the range zero to 2.5 W into 4 Ω (although the manufacturer claims a capability of 3 W); a steplessly variable input control covering 20 dB for the measuring amplifier; a reference generator input/output providing a 1 kHz, 10 kHz capability; a 50 dB stepped attenuator for the recorder; a x 1 and x 10 frequency range switch; a level recording writing speed switch for 50, 100 and nominal 500 m/sec. writing speed; an 8m modulation control for one-third octave, centre off and one-half octave deviation; and a level recorder range switch for linear, 50 dB or 25 dB settings.

On the top side panel are two Tuschell type sockets, one being a four-pin socked for an ac input of 20 kΩ in parallel with 50 pF, a dc input for direct dc drive, a ground connection and a 9 V dc supply at 0.5 mV for feeding the electret microphone.

The output has five connections — 10 mV to 1 V line into 50 Ω; a voltage proportional to frequency-out, nominally 10 mV to 10 V; a remote stop/start connection; and an earth.

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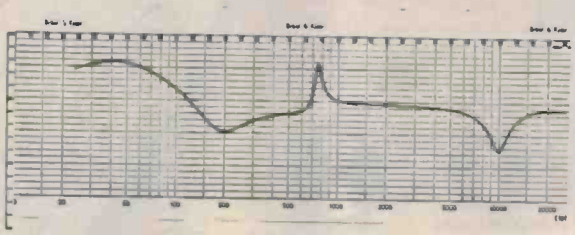
Louis A. Challis & Associates Pty Ltd.

FREQUENCY RESPONSE OF PETANGER DUAL 4 BAND PARAMETRIC EQUALISER WITH BRUEL & KJAER LEVEL RECORDER SYSTEM.

Date: 28.4.78



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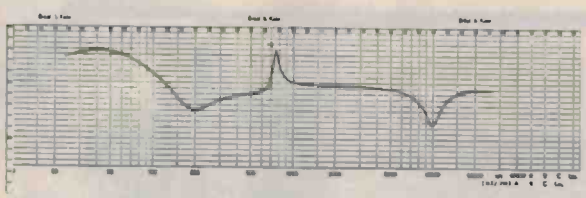

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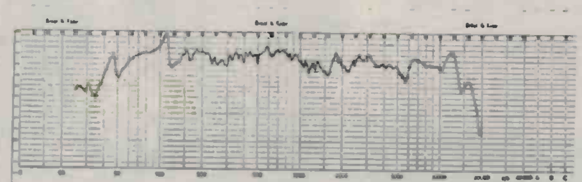
FREQUENCY RESPONSE OF JBL 4311WX CONTROL MONITOR UTILISING BRUEL & KJAER 4133 MICROPHONE.

Date: 28.4.78



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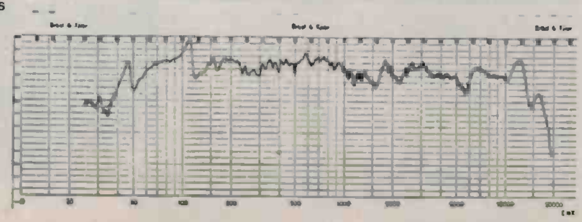


All provide difficult to use because of the lack of normal terminals.

The paper chart is loaded into the unit from the back by a simple slide out mechanism. Paper loading is reasonably easy and with an all up weight of 2.24 kg the unit is extremely compact and light.

Our first thoughts were to doubt the claims made for the unit if only because of the simplicity of construction and the compactness of design. Nevertheless the most important parameters, which included sensitivity figures proved to be accurate.

The input attenuator settings proved to be accurate to within 0.5 dB both on the 50 dB and 25 dB ranges (a fine attenuator setting which proved to have 22 dB range capability and not the 20 as stated), as were the characteristics of the direct dc input although for this we discovered the input controls to be ineffectual.

How it performed

The level recorder characteristics are in some respects unusual. On the 25 dB range the frequency response was −1 dB from 16 Hz to 100 kHz, with a 3 dB point at 7 Hz and 200 kHz. On the 50 dB range the frequency response was −1 dB at 12 Hz and 110 kHz, and −3 dB at 8 Hz and 200 kHz. This was a significantly better performance than we expected. A two-tone test highlighted the linearity of the rms response which proved to be within 0.2 dB of the value expected and apparently only limited by the hysteresis of the recorder.

The recording section has some limitations for the writing speed in one direction of pen movement is different from the other. The 'up' writing response was more in keeping with the impulsive response of a sound level meter, whilst the attenuator or downward response was like a damped filter response with decay rates of 250 m secs. at 500 mm/sec; 900 m secs. at 100 mm/sec; and 1.6 seconds at 50 mm/sec. switch settings. This is a serious limitation for some applications as responses recorded for such measurements as reverberation time and room response determinations would suffer accordingly.

The oscillator output frequencies proved to be quite accurate, the maximum deviation being 2 Hz (or 6%) whichever is the greater across the frequency range 20 Hz to 20 kHz, and likewise 200 Hz to 200 kHz. The 1 kHz reference signal proved to be precisely 1002 Hz.

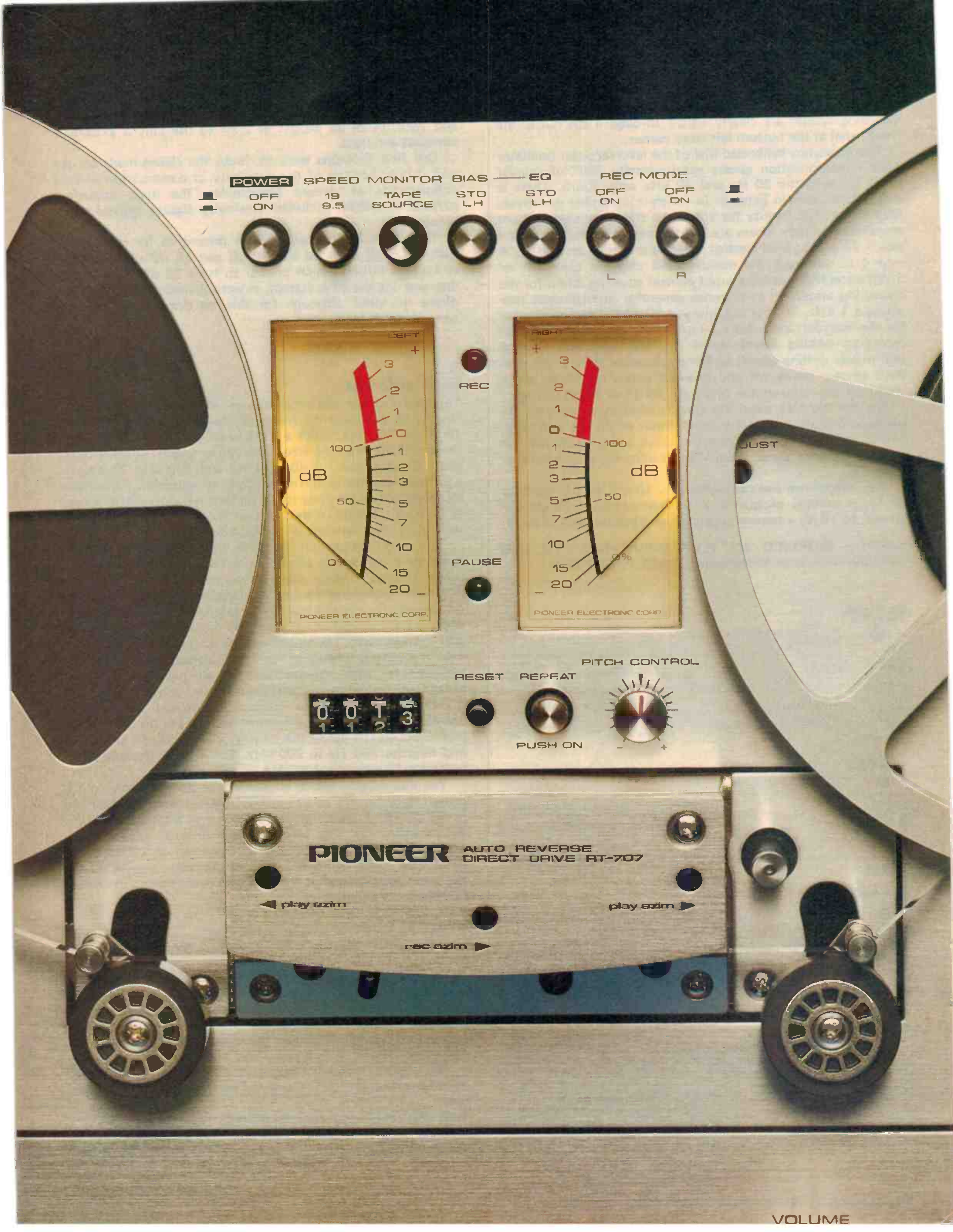
The line output, which is specified as being 10 mV to 1 V proved to be a 2 mV to 195 mV output with a source resistance of 56 Ω. Pin 1 which is supposedly 3 W into 4 Ω provided 2.5 W into 4 Ω. The level recorder linearity proved to be remarkably good with a maximum deviation of 0.3 dB in the range zero to 50 dB, and 0.4 dB in the range zero to 25 dB. Even the linear range of the potentiometer system proved to be reasonably accurate.

Having found that most but not all parameters were within reasonable tolerances we used the Audio Tracer in the same way that we would our own laboratory level recorder, BFO and analyser combinations.

Some limitations became apparent — for example the unit is not provided with a reversing switch thus making it almost impossible to trace the one chart for comparing two different phenomena. In fact, if one makes a mistake it is necessary to go to the end of the chart and start again on the next blank sheet.

The unit, of necessity, has only one colour for recording; the blue colour which is produced by the ceramic hot tipped pen.

The Tuschell type sockets utilised with the unit were not supplied with the mating plugs and thus interconnection for recording and analysis with the exception of the microphone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"Open reel has been closed to new ideas for far too long. The RT-707 proves it."

One glance says it all. From the people who Pioneered the front loading design comes the world's first stackable open reel. The Pioneer RT-707. Suddenly open reel is the same as any other component. Compact and easy to manage. At home on the shelf or racked up leaving bench space clear and uncluttered. Compared with the RT-707, all other open reels are not only bulky and awkward, they're downright old fashioned.

Cosmetics apart, it's also good to know that Pioneer's new ideas are more than skin deep, embracing a whole new open-reel technology. The design is 4-head, 3-motor, 2-speed, with auto-reverse and pitch control. Tape format is quarter-inch, 4-track, 2-channel stereo giving 1½ hours of absolute musical fidelity from 7-inch reels at 19 cm/sec (with auto-reverse). Performance is to professional level with 0.05% WRMS wow/flutter, 58dB signal-to-noise ratio, and a remarkable 20 to 28,000HZ frequency response.

The trend-setting RT-707 exhibits an impressive array of advanced electronic and engineering features. Auto-reverse, for example, not only promises but delivers total fidelity in both tape directions. In addition, you have the added bonus of auto-repeat for endless tape play if you desire. A direct-drive capstan is part of the reason for the improved signal-to-noise ratio at low speed. As in Pioneer turntables, direct drive eliminates the belts and pulleys of other open reels, allowing greater rotational accuracy, less induction hum and heat, with the extra facility of pitch control over ± 6% range.

The RT-707 is the complete open reel package. Hair-triggered pause

button. Precise tape path tolerances. Hard Permalloy record and playback heads. Four different Bias/EQ values. Independent left/right recording controls.

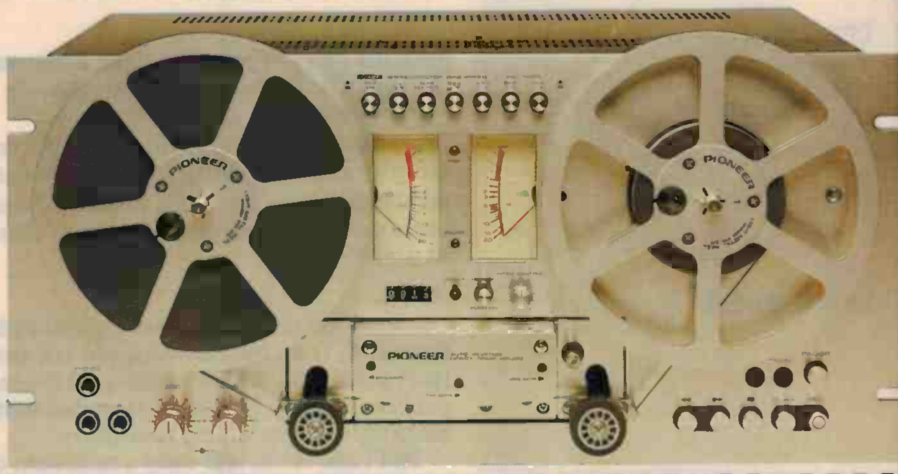
Exclusive Pioneer ICs in recording amps and playback. Mode-to-Mode transport controls without going through Stop. Extremely long-throw VU meters.

All in a compact and revolutionary configuration that heralds the trend in open-reel for the decade to come.

A short specification

Frequency response	20 to 28,000 HZ.
Wow and flutter	No more than 0.05% WRMS
Signal to noise ratio	No more than 58dB.
Channel separation	No more than 50dB.
Distortion	No more than 1%.
Reference tape and speed	Scotch No. 206 at 19cm/sec.

All Pioneer open-reel decks are covered by warranty for one year. Excellent service facilities are available throughout Australia via a network of Pioneer approved outlets.



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- ☐ RT-707 Open Reel Tape Deck.
- ☐ Folders on other components of equivalent compatibility.
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supplied proved to be a little difficult. The 1000 mm/sec. writing speed upwards and differing decay rates downwards made interpretation of dynamic levels complex.

Last but not least the microphone is not all that would be desired and this comes in part from the set back of the electret diaphragm from the front plate of the enclosure and the utilisation of what appears to be a sintered metal protective facing (see level recordings). The lid could not be closed with the Australian-type mains plug supplied with the test unit and although this could be fixed by sawing a groove in the lid a better approach would be to find a more suitable three-pin plug acceptable to the local power authorities.

We compared the response produced by the unit against similar responses produced by our own analysis systems. The response of filters, amplifiers and even record players could be accurately recorded but the lack of comprehensive associated equipment such as special test records and the like makes this task initially more complex than with the more conventional Bruel & Kjaer or General Radio equipment.

We compared the frequency response of our laboratory monitoring system (recorded by the Audio Tracer) against the calibrated microphone system we normally use. This showed that in the frequency region 20 kHz to 20 kHz the electret microphone system provided with our test sample fell short of what the average intending user would reasonably require. This could be overcome by substituting the microphone with a superior one, preferably a fully calibrated laboratory microphone — ideally with matched load requirements (9 V at 0.5 m amp). However we have been assured by the manufacturers that our test microphone was from a pilot run and that production units will be flat within ± 1 dB from 30 Hz to 15 kHz.

The unit was extremely simple to use even taking into account its several obvious limitations which were more obvious to us because of our pre-conditioning with more expensive equipment.

Nevertheless, we believe that most technicians and many engineers would get more than just good mileage (kilometre-age?) out of the facilities provided.

For the person who has never been able to afford a comprehensive level recorder system before the Audio Tracer is hard to beat for its price and the facilities it provides.

At it's recommended retail price of under $2,000 it's excellent value for money.

Louis A Challis.

SOUND BRIEFS

NOW – CLASS H!

Soundcraftsmen have announced a 250 watt (into eight ohms) stereo amplifier incorporating analogue computer circuitry claimed to sense and calculate the voltage level required to cater for the rising or falling output level. The sensing circuitry is outside the feedback loop.

The manufacturers claim that the new 'Class H' amplifier can be produced at lower cost even than conventional Class AB units.

CES '78

Australia's biggest-ever Consumer Electronics Show will open to the public July 13 - 16. Venue is the Sydney Showground.

Public hours are as follows:

Thursday July 13/Friday July 14: 1.00 p.m. – 10.00 p.m.
Saturday July 15/Sunday July 16: 1.00 p.m. – 6.00 p.m.

Admission will be $1.50 for adults. Children under 14 will be admitted free. There's ample parking within the Showground. For further info ring Riddell Exhibitions on (03) 699.1066.

HI-FI & MUSIC

Our sister publication – previously Hi-Fi Review – has changed both name and format. As from the July issue (on sale first week in July) the magazine will be called Hi-Fi and Music. Whilst retaining all the regular features that have made this publication one of the most respected in its field a number of changes have been made to widen its appeal yet further.

Hi-Fi and Music will carry a minimum of five equipment reviews per issue – undertaken by the well-known and respected team of Doug Saunders and Nadine Amadio.

In addition Nadine will be contributing her very readable and authorative special music features.

Don't miss the first new issue of Hi-Fi and Music – out soon.

PRIZE FOR SME

Britain's Design Council has awarded a consumer product award to SME for their new Series III arm. The company's Series I arm was similarly honoured in 1962.

Petanger Address

In our review of the Petanger Parametric Equaliser (April '78) we inadvertently omitted Petanger's address, which is *503 Pittwater Road, Brookvale, NSW 2100. Tel: (02) 938 2372.*

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7409	.38
7410	.35
7411	.35
7413	.63
7414	1.35
7416	.60
7417	.60
7420	.35
7422	.35
7426	.45
7427	.45
7430	.35
7432	.45
7437	.50
7438	.50
7440	.35
7441	1.50
7442	.70
7447	1.25
7448	1.25
7450	.35
7451	.35
7453	.35
7454	.35
7460	.35
7470	.65
7472	.65
7473	.65
7474	.65
7475	.70
7476	.45
7480	1.25
7483	1.25
7485	1.45
7486	.65
7489	1.20
7490	.85
7491	1.00
7492	.85
7493	.85
7494	1.10
7495	.95
74100	2.45
74107	.65
74121	.65
74123	1.10
74132	1.25
74150	1.80
74151	1.10
74153	1.10
74154	1.70
74157	1.10
74160	1.55
74164	1.55
74165	1.55
74173	2.75
74175	1.65
74180	1.35
74192	1.45
74193	1.45
74221	1.50
74367	1.50

SCHOTTKY

74LS00	.32
74LS01	.32
74LS02	.32
74LS03	.32
74LS04	.35
74LS05	.35
74LS08	.32
74LS09	.32
74LS10	.32
74LS11	.32
74LS12	.32
74LS14	1.35
74LS20	.32
74LS21	.32
74LS27	.32
74LS28	.42
74LS30	.32
74LS32	.35
74LS37	.46
74LS38	.46
74LS40	.32
74LS42	1.25
74LS73	1.25
74LS74	.50
74LS75	.70
74LS78	.55
74LS85	1.50
74LS86	.55
74LS90	1.20
74LS92	1.20
74LS93	1.20
74LS95	1.60
74LS109	.55
74LS113	.55
74LS114	.55
74LS138	1.20
74LS151	1.20
74LS154	1.60
74LS157	.90
74LS163	1.25
74LS164	1.35
74LS174	1.00
74LS175	1.00
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.20
74LS196	1.20
74LS221	1.20
74LS253	1.85
74LS279	.65
74LS365	.80
74LS367	.80
74LS368	.80

CMOS

4000	.25
4001	.25
4002	.25
4006	1.40
4007	.35
4008	1.25
4011	.25
4012	.30
4013	.55
4014	1.35
4015	1.20
4016	.50
4017	1.40
4018	1.40
4019	.75
4020	1.60
4021	1.55
4022	1.60
4023	.35
4024	.90
4025	.40
4027	.80
4028	1.25
4029	1.90
4030	.40
4040	1.35
4041	1.25
4042	1.25
4043	1.50
4044	1.50
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4051	1.20
4052	1.20
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4066	1.20
4068	.40
4069	.35
4070	.40
4071	.40
4072	.40
4073	.40
4075	.40
4076	1.85
4077	.40
4078	.40
4081	.40
4082	.40
4510	1.50
4511	1.50
4518	1.50
4520	1.45
4528	1.20
4556	1.20
14553	7.50
14584	1.25
74C00	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	1.90
74C48	2.55
74C73	1.20
74C75	1.20
74C76	1.35
74C90	2.25
74C93	2.25
74C175	1.85
74C192	2.25
27C193	2.25
74C221	2.40
74C905	14.75
74C922	6.50
74C926	11.50

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307	.65
308	1.35
311	1.25
324	1.35
339	1.35
349	2.25
356	1.65
379	6.95
380	2.00
381	2.00
382	2.00
386	1.95
555	.40
556	.85
565	1.95
566	2.50
567	2.65
571	11.95
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7815	1.40
7818	1.40
7824	1.40
7905	2.55
7912	2.55
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MOST of our readers will know Dindy cassettes. Those who don't really should. They are good to the point that Dindy not only offer a 14-day money-back guarantee but also a five year guarantee against faulty workmanship. Now that's faith!

So that their products may become even better known Dindy Marketing are offering their products to our readers at almost absurdly low prices. Like 91 cents for C90s (100 off plus $2.00 delivery). Two types of Dindy cassettes are offered.

DINDY SUPER

Dindy Super is a budget-priced quality ferric oxide cassette. Frequency response is very good from 50 Hz to well beyond 10 kHz and extends usefully beyond 14 kHz. The cassette housing is a properly made screwed type and the mechanism is effectively jam-proof. The Dindy Super cassettes offered are C46, C60 and C90. (Numbers refer to minutes playing time).

DINDY HI-ENERGY

This is a high energy tape which enables higher recording levels and thus a wider dynamic range to be used. The tape's frequency response extends from 50 Hz to 15 kHz and useful output is still available to 17.5 kHz. The tape coating is a very fine ferric oxide.

These cassettes are offered in C46, C60 and C90. The 60 and 90 have an extra six minutes added to eliminate run-out. Maybe they should really be called C66 and C96!

Dindy Offer — Order Form.
Please forward Dindy Cassettes as detailed.

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TOTAL				

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It should be understood that this offer is made by Dindy Marketing. Orders are to be sent to this magazine for checking thence go to Dindy who guarantee to despatch within one week (via Ipec). Do please allow for a total delivery time of three to four weeks. Dindy have 50,000 cassettes held in stock and have arranged to have further supplies within two weeks if required.

OFFER CLOSES AUGUST 31st 1978

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Super	10	20	50	100	250	500	1000
C46	75c	72c	69c	67c	65c	63c	60c
C60	85c	82c	79c	77c	75c	73c	70c
C90	99c	96c	93c	91c	89c	87c	84c

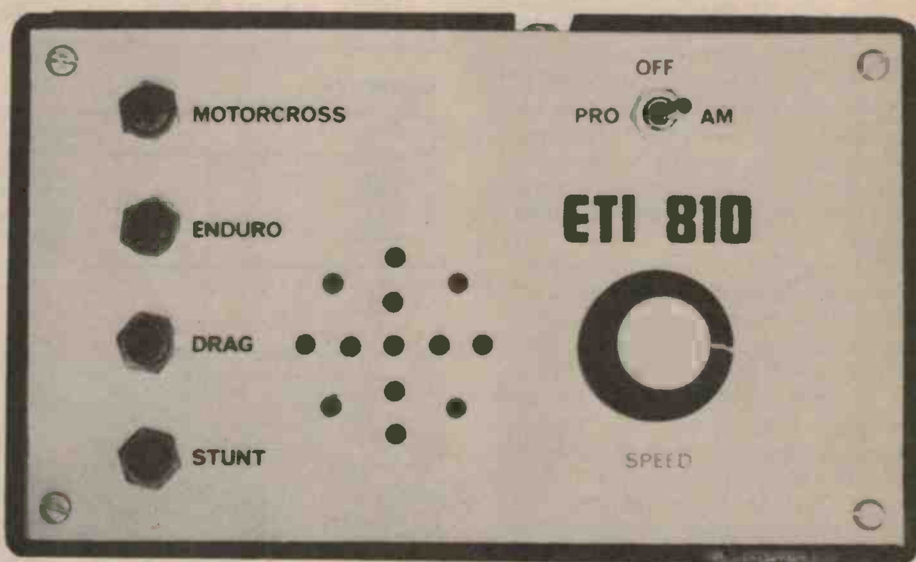
Hi Energy	10	20	50	100	250	500	1000
C46	$1.25	$1.23	$1.20	$1.18	$1.15	$1.13	$1.10
C60	$1.45	$1.43	$1.40	$1.38	$1.35	$1.30	$1.25
C90	$1.65	$1.63	$1.60	$1.58	$1.55	$1.50	$1.45

Minimum quantity — ten of any one size — there's no upper limit! Please include $2.00 for packing and delivery — regardless of quantity.

STUNT CYCLE TV GAME

* simple to build
* no adjustment
* 4 games
* pro – am

Fall off without injury on our latest TV game.



THE ELECTRONIC TV GAME was first conceived in 1966, when Sanders Corporation acquired the first patents on the logic which is used to digitally generate bouncing bats, balls and similar artifacts on a TV screen. However, the first actual TV game appeared in 1972, when Magnavox introduced the Odyssey, which was the precursor of modern TV games. The early games did not display boundaries or score, and were based on lots of TTL IC's.

The next generation of games used some LSI logic, but were still quite complex. They were a great improvement over earlier games in that they displayed boundaries and kept score, thus settling a lot of family disputes! The third generation came about when General Instruments Microelectronics designed the AY-3-8500 games chip, which put virtually the whole logic on one IC. This IC, which was used in the ETI 804 Selectagame, was fortunately produced in versions to suit both American and European/Australian standards, and has led to the development of more sophisticated 'games-on-a-chip', one of which is used in this project.

Finally, the latest generation of TV games are programmable types, few examples of which are available in Australia, and which are, at present, a little outside the scope of a magazine project.

The ETI 810 Stunt Cycle TV Game is rather different from the conventional bat-and-ball type games. Instead, it offers four different types of games involving motorcycles - Drag Race, Motorcross, Stunt Cycle and Enduro.

At the start of each game, the motorbike and rider are stationary at the upper left-hand side of the TV screen. As the player turns the throttle controller, the bike moves across the screen on track 1, with appropriate sound effects.

At the end of track 1, the bike and rider reappear on track 2, and likewise at the end of track 2, the bike appears on track 3. On reaching the end of track 3, the bike will reappear at the beginning of track 1, and the game will reset. There will be no movement until the throttle is reset to a slow speed and then increased.

The Drag Race game involves a straightforward 'race against the clock' from one end of the track to the other. In Drag Race, the bike has 'gears' which must be shifted, by throttling back and then accelerating, to achieve top speed. In the PRO mode, if the bike is accelerated too fast, it will flip over, crash and screech to a halt.

Motorcross involves a race against the clock, this time doing 'wheelies' across obstacles. Hitting an obstacle causes a crash, and in this game, the PRO/AM switch varies the number of obstacles.

If Evel Knievel is your hero, Stunt Cycle will appeal to you - here the idea is to jump a ramp and buses located on track 3, by judging the correct throttle setting. If a jump is successful, the number of buses is increased by one - the initial number is eight. The game is over when the maximum number of crashes has occurred, which is 3 or 7 depending on the position of the PRO/AM switch. The displayed score indicates the number of crashes and the number of buses between the ramps.

Finally, Enduro combines the Motorcross and Stunt Cycle games, with obstacles on tracks 1 and 2 and buses and ramps on track 3. The object of Enduro is to do wheelies over the obstacles and then adjust the throttle to jump the buses. The PRO/AM switch alters the number of obstacles and the number of crashes permitted - this game is quite difficult in the PRO mode.

All the games are accompanied by appropriate sound effects, with engine noises and skidding sounds.

Construction

Start with the assembly of the pc board. With the aid of the component overlay initially fit the resistors in their correct position. Push them flush with the pc board, turn the board over and solder them onto the copper tracks. Cut the leads off close to the solder joint. Now add the capacitors noting that both C3 and C6 are polarized and must be inserted the correct way round. The two transistors can now be soldered in noting that they are different types and also that they must be correctly positioned.

With the IC's it is recommended, although not essential, that sockets be used, for at least the main one. If a Molex type connector is used for IC2 it should be cut into two strips of 14, then inserted in the board and soldered. Then by carefully bending the connector strip over at rightangles and back again, it will break off. Before the IC's can be fitted into either the socket or the pc board, the pins normally need bending in slightly. This can be done by holding the IC by both ends and pressing the pins on the table with a slight rolling action to bend all pins together. Do this with both sides until the pins are at right angles to the body of the IC. This should allow the IC to fit easily.

The modulator can be now fitted and soldered into place. Finally the crystal can be fitted to the pc board.

The front panel should now be assembled with the speaker being glued on with 5 min epoxy cement, in the position shown in the photograph. Solder lengths of tinned copper wire (about 30mm) to each of the terminals of the push buttons, switch and potentiometer. Solder about 50 mm of plastic covered wire to each of the speaker connections.

Double check that all components are on the pc board and are correctly orientated. Now slide the pc board over the wires from the switches until the board is about 30 mm from the front panel. Pull each of the lengths of wire with a pair of pliers to ensure it is straight and not able to shortout on an adjacent wire, solder them all onto the pc board and cut the tails off. The wires from the speaker can now be fitted through the holes provided and soldered.

The plastic box needs a slot cut in the top edge to allow the output socket of the modulator to fit and this should be cut now. Also a hole is needed for the external power socket if required.

The wiring from the board to the external power socket and to the battery pack can now be done. This now completes the unit and as no adjustments are needed it should work on switch on.

Component markings

Resistors

CODE	COLOUR BANDS				VALUE (ohms)
47R	YELLOW	VIOLET	BLACK	GOLD	47
330R	ORANGE	ORANGE	BROWN	GOLD	330
1k	BROWN	BLACK	RED	GOLD	1000
1k2	BROWN	RED	RED	GOLD	1200
2k7	RED	VIOLET	RED	GOLD	2700
10k	BROWN	BLACK	ORANGE	GOLD	10000
12k	BROWN	RED	ORANGE	GOLD	12000
15k	BROWN	GREEN	ORANGE	GOLD	15000
22k	RED	RED	ORANGE	GOLD	22000
100k	BROWN	BLACK	YELLOW	GOLD	100000
4M7	YELLOW	VIOLET	GREEN	GOLD	4700000

Capacitors

CODE	COMMON MARKINGS	VALUE
33p	33 or 33p	33pF
100p	100, 100p or n10	100pF
10n	0.01k or 103k	0.01μF
100n	0.1k or 104k	0.1μF

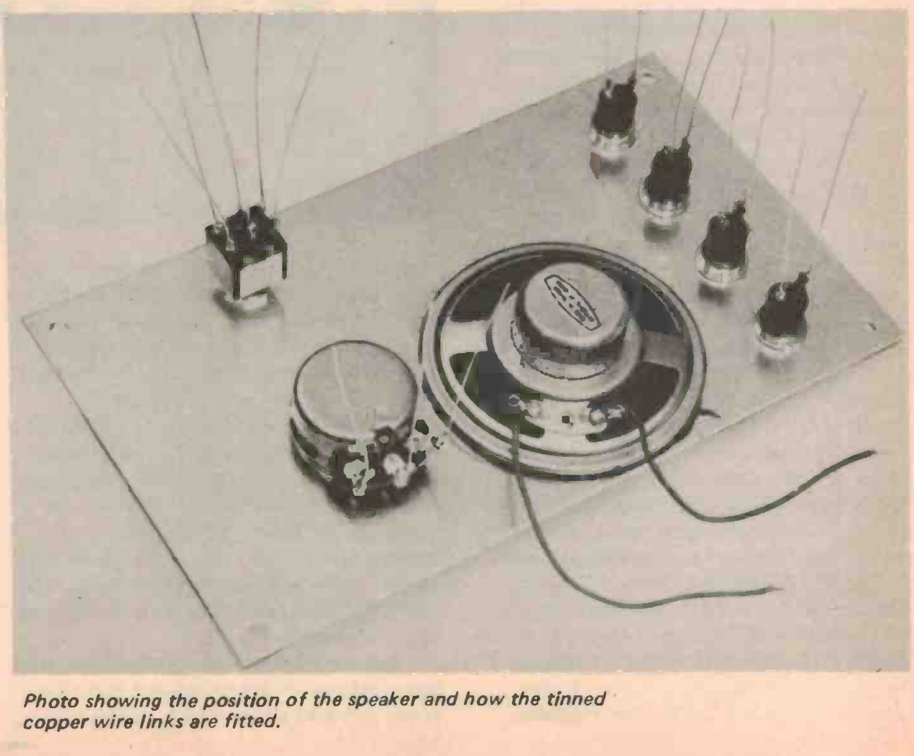


Photo showing the position of the speaker and how the tinned copper wire links are fitted.

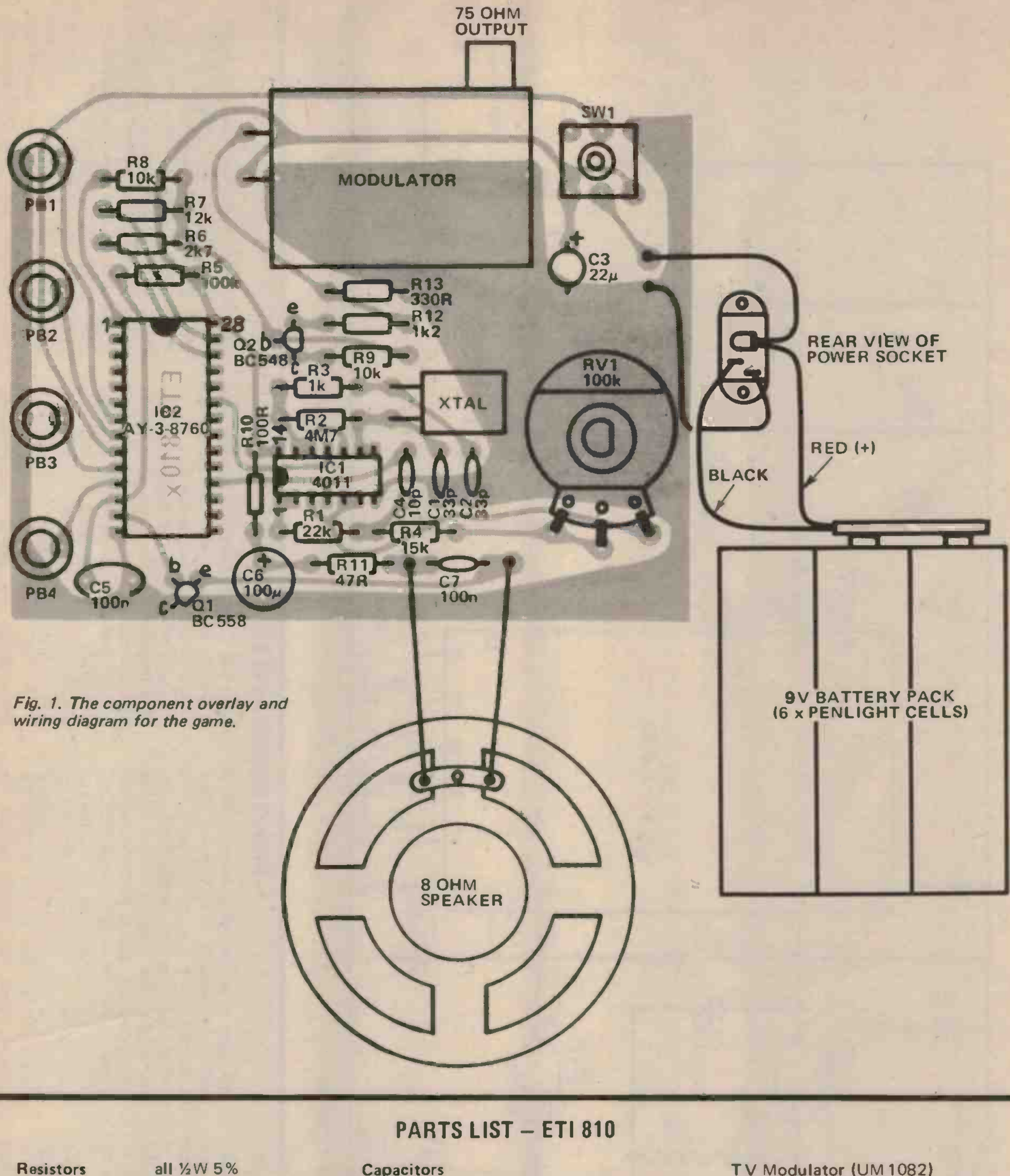


Fig. 1. The component overlay and wiring diagram for the game.

PARTS LIST – ETI 810

Resistors all ½W 5%

R1	22k
R2	4M7
R3	1k
R4	15k
R5	100k
R6	2k7
R7	12k
R8, 9	10k
R10	100R
R11	47R
R12	1k2
R13	330R

Potentiometers

RV1 .... 100k lin rotary

Capacitors

C1, 2	33p ceramic
C3	22µ 16V electro
C4	100p ceramic
C5	100n polyester
C6	100µ 16V electro
C7	10n polyester

Semiconductors

IC1	4011 (CMOS)
IC2	AY–3–8760
Q1	BC558
Q2	BC548

Miscellaneous

PC board ETI 810

TV Modulator (UM 1082)
3.576545 MHz crystal
5 pushbuttons
1 DPDT centre off toggle
8 ohm speaker (55 mm dia.)
28 pin IC socket
plastic box 158 x 96 x 50 mm
six way AA size battery holder
battery clip
length of 75 ohm coax
one 75 ohm plug
one RCA plug
external battery socket

KITS FOR THIS PROJECT WILL BE AVAILABLE THROUGH DICK SMITH ELECTRONICS.

STUNT CYCLE TV GAME

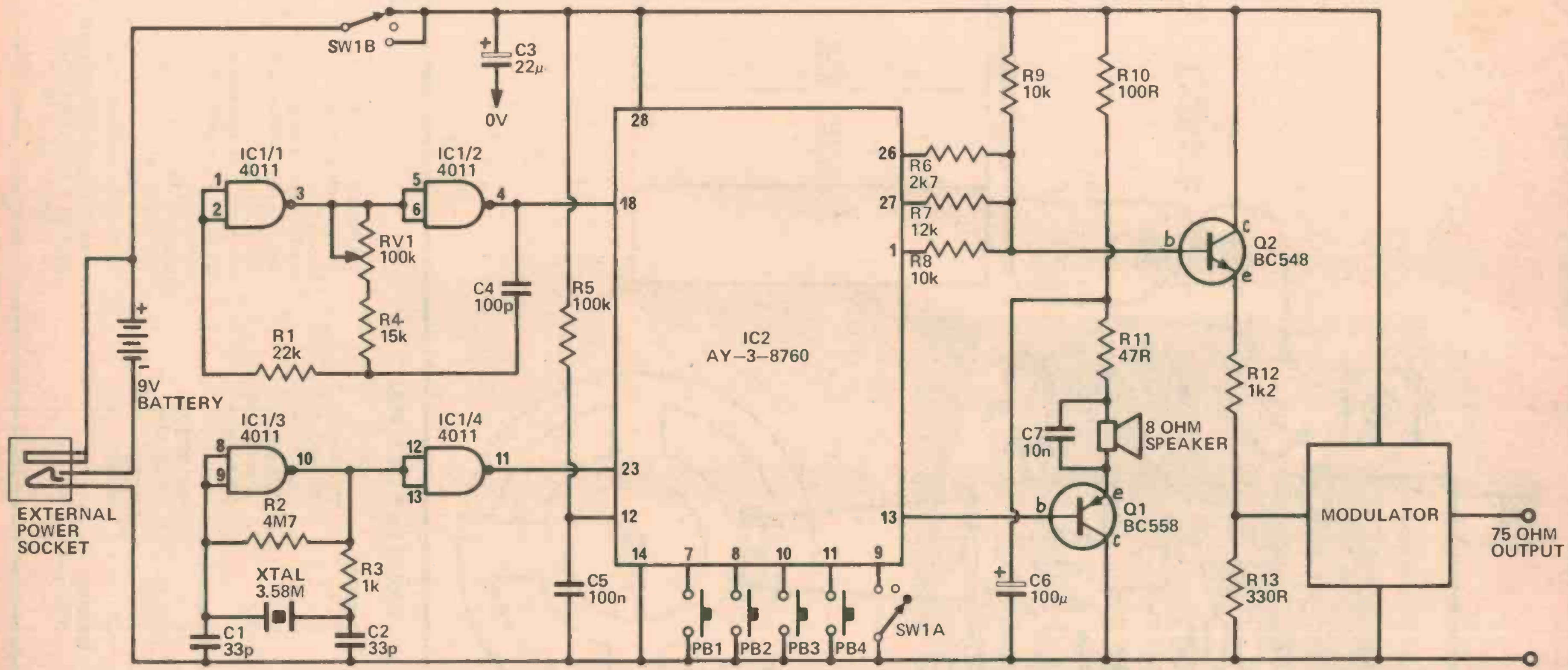


Fig. 2. The circuit diagram of the stunt cycle TV game.

HOW IT WORKS – ETI 810

As this project is going to be built by many beginners we will try to give as complete an explanation of the operation as possible. However, as most of this is done by the main IC and as not much can be said about the internal workings of this IC the explanation will be mainly about the external components.

The IC needs a high frequency clock (3.579545 MHz), to derive all its internal waveforms and the synchronising pulses needed. To eliminate any adjustments we used a crystal oscillator formed by IC1/3. The output of the crystal oscillator is buffered by IC1/4 before driving the main IC.

This gives a square wave output and is used by the main IC to control the speed of the bike.

With this type of oscillator the current in RV1/R4 tries to charge C4 so that the voltage across RV1/R4 will try to fall to 0V. When the output of IC1/2 goes to +9V the junction of R1, R4 and C3 is lifted to +13.5V. As the output of IC1/1 is now 0V, C4 will be charged towards 0V by the current in RV1/R4. However, when the voltage reaches the threshold (4.5V) of IC1/1 the output of IC1/1 goes high, IC1/2 low which pushes the voltage at the junction to -4.5V (i.e., as the voltage at one end main IC. The resistor R5 charges this capacitor in about 10mS and after this period the network has no effect.

Game selection is one simply by four push buttons from the appropriate pins to 0V. Internal 100 k pullup resistors are provided and a latch inside the IC remembers which game has been selected. The selection of PRO or AM modes has to be done with a switch as it has no memory.

We use four outputs in this circuit, these being the sound, synchronising pulses, white information and black information. All these outputs are "open drain" field effect transistors which means that the output is either open cir-

As the horizontal lines are not really horizontal but have a slight slope (1/312.5 of the screen height) the second "frame", which starts halfway through a line, fits between the first set of lines giving a total of 625 lines. A pulse is needed every 20 ms (0.020 sec) to give this synchronisation. These pulses are negative ones and the line sync is 4µs long while the frame sync is 250µs long. The IC gives the combined sync on pin 26. To simplify the design the IC actually gives only 312 lines per frame but the TV set accepts this with no problem.

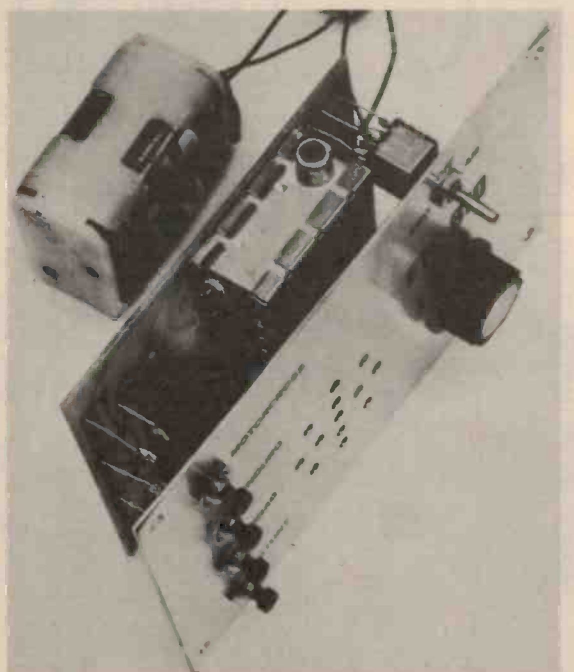
The white information, which means the score, bike and obstacles, consists of

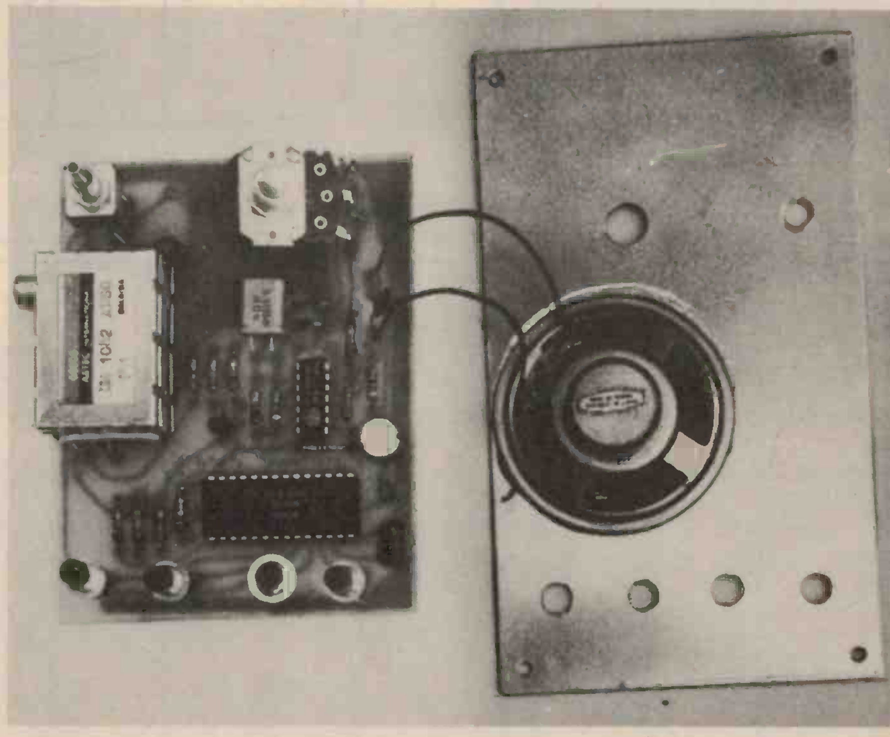
This IC is a digital NAND gate connected as an inverter. If the input voltage (on pin 8, 9), is at 0V then the output (pin 10) will be at +9V. Conversely if the input is at +9V the output will be at 0V – hence the name, inverter. As the input voltage is raised from 0V to +9V the output will initially remain at +9V until the input reaches the "threshold" point, which is about midvoltage, when the output will switch to 0V. The converse applies when the input is dropped from +9V to 0V. There are four sections in this IC all of which are the same with only the pin numbering differing.

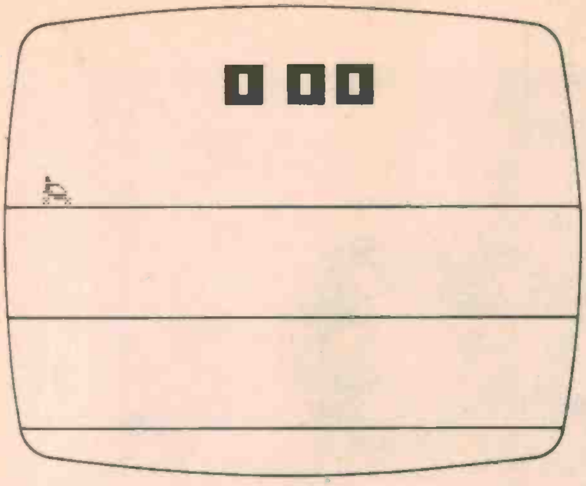
An RC oscillator is formed out of the two remaining sections of IC1 and has a frequency range of 50kHz to 250kHz. of the capacitor changes suddenly by 9V the voltage at the other end must change by a similar amount). The voltage at the junction ow tries to charge to +9V (the output of IC1/1) but when the voltage reaches +4.5V the output of IC1/1 again reverses state as does IC1/2, and the process repeats itself. As the time taken to charge the capacitor depends on the resistance in series, changing RV1 will vary the frequency. Due to IC1 not liking voltages on its input which exceed the supply rails R1 is used to give protection. The IC has protection diodes to each supply rail and hence R1 does carry some current while the junction of R1, R4 and C4 is beyond the supply rails.

On initial switch on C5 holds pin 12 of IC2 low for a short time, resetting the cuit or connected to 0V. With the sound output, we use Q1 to buffer the output (it cannot handle more than about 2mA) and drive the speaker. Resistor R11 limits the current through the speaker and hence the volume, while resistor R10 and capacitor C6 prevent the high current pulses needed for the speaker affecting the rest of the circuit.

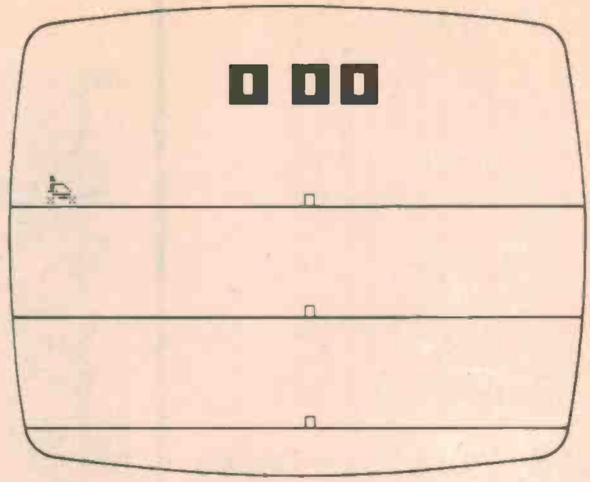
A TV picture is made up by a single beam of electrons hitting a phosphorescent screen which is scanned in horizontal lines with each successive line just under the previous one. By varying the intensity of the beam the brightness of the screen can be varied. With the Australian system each horizontal line takes 64μs (i.e., 0.000064 s) and every 312½ lines the beam reverts back to the top of the screen. positive pulses and is available on pin 27 of the IC. The black information which is the roadway and the ramps for the jump are negative pulses (though not as negative as the sync pulses) and come out on pin 1 of the IC. These outputs are mixed by R6-R9, then buffered by Q2. The voltage at the emitter of Q2 is 0.6V lower than the base, has the same waveshape but has much lower impedance. The output of Q2 is reduced by R12/13 before being fed into the modulator. The output of the modulator is high frequency with the information superimposed on it, and is tuned in by the TV set as a normal program.



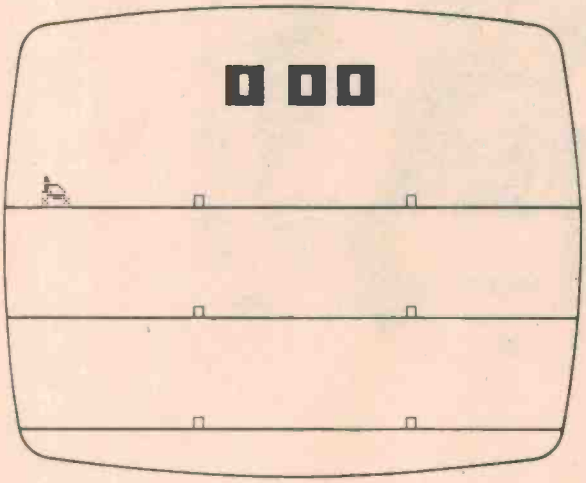




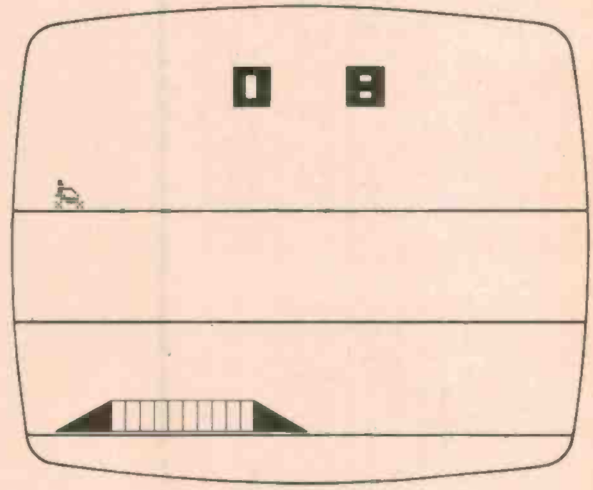
DRAG RACE



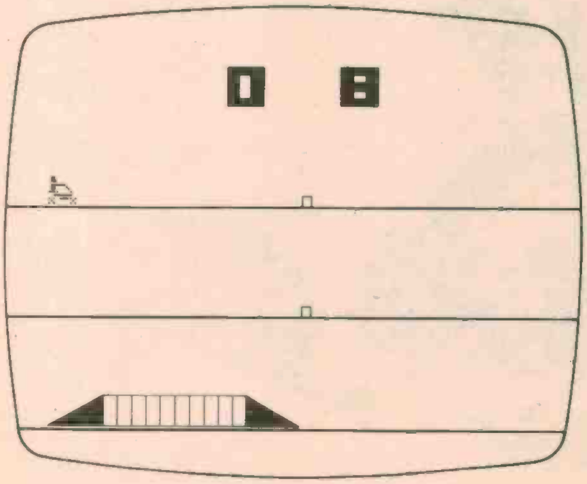
MOTORCROSS (EASY)



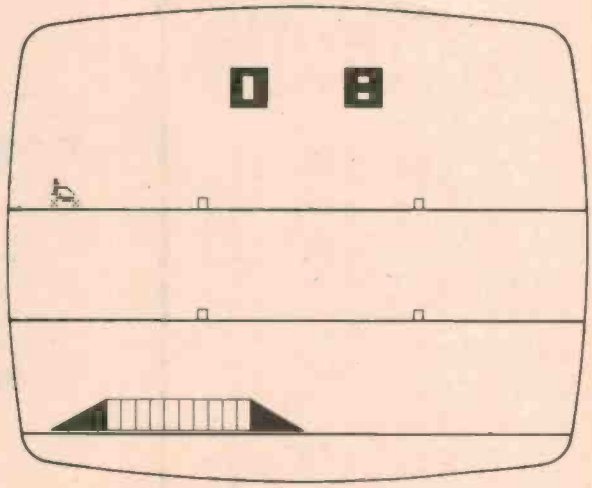
MOTORCROSS (HARD)



STUNT CYCLE



ENDURO (EASY)



ENDURO (HARD)

Drag Race

The object of this game is to reach the end of track 3 in the shortest time. The three-digit score is automatically reset as the rider first begins to move on track 1 and the score is incremented until the game is over. The score appears centered on the screen above track 1, and the score remains until the start of the next game.

Drag Race requires a speed shifting to achieve the lowest time scores. As the throttle speed is increased and the rider begins to move, the bike object is in speed one and moves at a set rate across the screen. The only way to accelerate the bike's motion is to return the throttle to a 'slow' position and then turn to a 'fast' position. This shifting prodedure will move the bike into speed 2 and the object will go across the screen at a faster rate. Another 'shift' will allow speed 3.

A PRO/AM option switch is provided to select a difficulty factor. In the hard mode, a crash occurs if the player trys to increase the throttle speed too rapidly. A crash will flip the bike and rider upside down and the sound will be a high-pitch screech. At the end of the crash, the bike and rider are reinitialized on track 1 and the score reset. In the easy mode, no crash is allowed.

Enduro

This game is similar to Stunt Cycle with the addition of obstacles on track 1 and track 2. The object of Enduro is to do a wheelie over each obstacle and then adjust the throttle for the correct speed to jump the buses on track 3. The PRO/AM option switch selects 2 obstacles per track and allows 3 errors per game in the hard mode, and 1 obstacle per track and 7 errors per game in the easy mode. Errors are caused by accelerating too rapidly, not in wheelie position over the obstacles, insufficient speed to clear the buses, or landing too far past the back ramp after the jump. The score records the number of errors and the number of buses displayed the same as in the game of Stunt Cycle.

Motorcross

As the throttle speed is increased, the bike and rider move across track 1 at a rate determined by the throttle controller setting. Motorcross has no speed shifting. Located on each of the three tracks are obstacles. The easy/hard option switch selects the number of obstacles per track. The easy mode has one obstacle per track and the hard mode has two obstacles per track.

The object of this game is to traverse the three tracks in the shortest time, doing a wheelie over each obstacle. The score counters record the run time in the same manner as the Drag game.

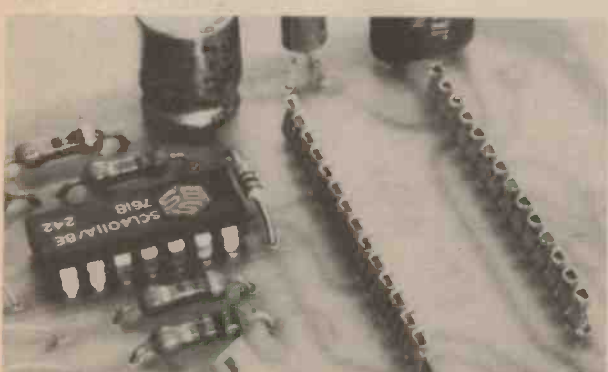
In Motorcross, the crash is not caused by accelerating too rapidly. The crash is caused by not doing a wheelie over an obstacle. In the wheelie position, the bike will have the front wheel lifted off the track. A crash into an obstacle will flip the bike upside down and produce the screech sound. The score is reset at the end of the crash.

Stunt Cycle

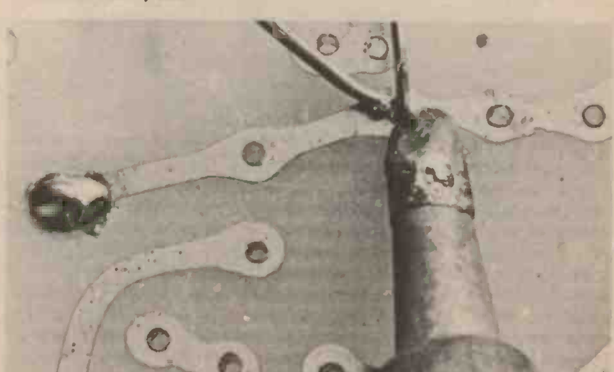
The object of this game is to control the throttle speed to properly jump the ramp and buses located on track 3. The game begins with 8 buses and with each successful jump over the ramp and buses, an additional bus appears. The game is over when the maximum number of errors has been reached, which is 3 or 7 errors depending on the position of the PRO/AM switch. The game is then started by reselecting the Stunt Cycle game input. Errors are caused by accelerating too rapidly, insufficient speed to clear the buses, or landing too far past the back ramp after the jump. The bike and rider flip upside down and a screeching sound indicates an error. The score records the number of errors in the first digit and the number of displayed buses in the next digits.

Initially fit the molex pins in while still linked together by the connector.

Bend the connector bar over evenly being careful not to distort the pins.



When the connector bar is bent back to vertical it should break off leaving the pins separated.



When soldering the components apply the iron to the junction of the lead and the track, then feed the solder Into the junction. Do not carry the solder to the joint on the tip of the iron!

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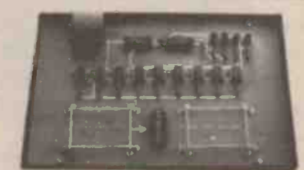
PAPER TAPE READER



Manual operation, self-contained in case 160 x 110 x 50. Flat cable interface to I/O port. Handshake logic, Status LEDS, Data and software supplied. Simple to use on all systems 8080, 6800 etc.
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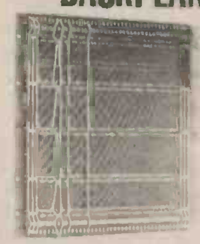
BACKPLANE BOARDS



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8" x 8" 6800 board with wide centres — $26.50.
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SINGLE STEP CONTROL for 8080
Push button single step mode. Auto step low speed (Variable speed) mode, Interrupt facilty. Run mode LED, will suit other systems, works off wait, & ready, lines. Panel mount. **KIT PRICE $23.00.**

All Boards double sided with ground plane.

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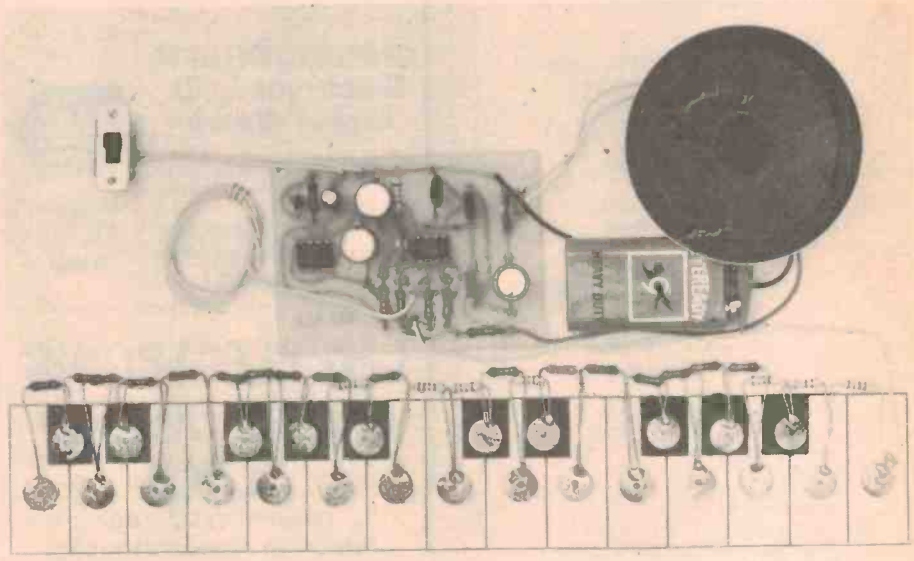
10 Stafford Court, Doncaster East, 3109.
Box 19, Doncaster East, 3109. (03) 842-3950.

Project 072

TWO-OCTAVE ORGAN

Although cheap and simple to build, this monophonic electronic organ is tunable, covers a full two octave range, and has an adjustable tremolo control.



HERE'S A PROJECT where you can well and truly utilise your ingenuity!

A monophonic organ is limited in its scope simply in that only one note can be played at a time – that is you cannot play chords. In practice this is not as big a limitation as it might seem and a monophonic organ of this type will provide a great deal of pleasure and amusement for youngsters and older people who quickly find how easy it is to play.

The organ covers the range from C (262 Hz) to C (1047 Hz), with 12 notes per octave (that is it includes sharps and flats).

The frequency (pitch) of each note is determined by an associated resistor in the chain R8 through R31. We have made some minor compromises in that we have used standard readily available resistor values nearest to those actually required to obtain the exact pitch for each note. The pitch errors are quite small but if you need the pitch to be *exact* all you need to do is to wire additional resistors in series or parallel with the appropriate chain resistor until the exact pitch of that note is obtained.

The overall pitch is adjusted by potentiometer RV1 and the volume by potentiometer RV2. Tremulo may be switched in or out by switch SW1. The depth of tremulo may be altered by changing resistor R2.

As shown in our main circuit drawing and component overlays the circuit includes two output transistors (Q1 and Q2) and a loudspeaker. This enables the unit to be totally self-contained. Nevertheless it has been so designed that you can run it directly into our own basic amplifier (ETI 061) and loudspeaker (ETI 088) or in to any other suitable amplifier or hi-fi system. If you wish to use an external system as suggested above simply leave out Q1 and Q2, change C6 to 1.0 μF, and increase RV2 to 10 k. The positive end of C6 should be connected directly to pin 3 of IC2 and the input to the amplifier or hi-fi system taken from the point on RV2 which is currently wired to the speaker.

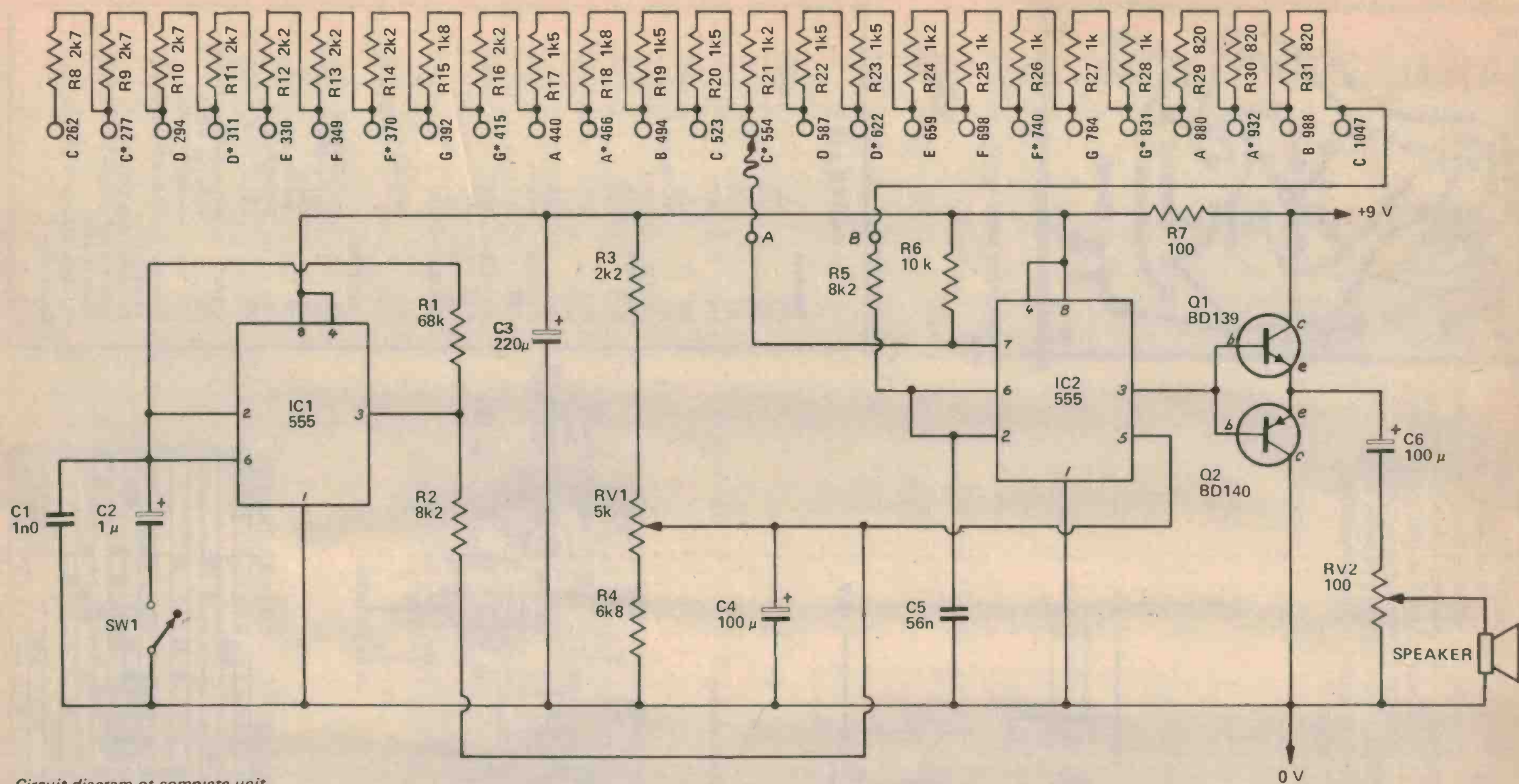
Construction

The organ consists of two main assemblies, plus a battery or other nine volt power supply, and a loudspeaker.

Main board construction is quite straightforward – the usual precautions must be taken to ensure critical components are inserted the right way round and do check for solder bridges, particularly if you are using the Veroboard method of construction.

The second assembly is the keyboard. Here you have unlimited potential for modification. We have shown what we believe to be the cheapest possible construction – 25 pins stuck into a piece of heavy cardboard! But if you want to, you can build up a far more elaborate affair using proper metal or woodworking techniques.

The requirements for the keyboard are very basic. You need to arrange some way by which one common wire may be caused to touch any one of a series of contacts. Our prototype shows a very basic way indeed. We have a series of drawing pins stuck into a piece of heavy cardboard with a keyboard pattern drawn on. The common wire is connected to a sharp probe and you simply touch the drawing pin heads with this probe. If this basic method is used a suitable probe can be made by Aralditing a needle into the end of an old ball point pen. Note that the probe handle must be insulated to prevent 50 Hz mains voltage included in one's body modulating the pitch. A more elaborate way would be for each key to be sprung in such a fashion that when depressed it touched a common strip running right along the front of the keyboard. If you have the facilities for so doing, yet another way is to etch a keyboard on a strip of pc board material.



Circuit diagram of complete unit.

HOW IT WORKS

Firstly consider IC2. This is a 555 oscillator circuit which oscillates at a frequency determined by whatever resistor in the chain R8 to R31 is selected. These resistors have been selected to give the closest possible approximation to the standard spacing between notes. These resistors may be padded or others added in series if an exact scale is required.

The output of IC2 is approximately a square wave. This is buffered by Q1 and Q2 before driving the loudspeaker. The control circuitry is decoupled by R7/C3 from the nine volt supply to prevent load fluctuations varying pitch. Potentiometer RV1 adjusts the overall frequency of the circuit thus acting as a pitch control.

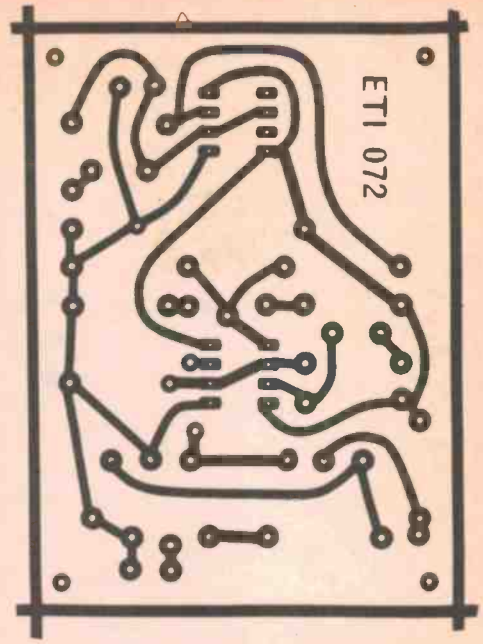
Tremulo is generated by IC1. This IC oscillates at either 5 Hz or 5 kHz depending on the position of SW1. When switched to the 5 Hz position the output is applied to pin 5 of IC2 thus modulating the output of that IC. Capacitor C4 'kills' the output when IC1 is switched to the 5 kHz position. The reason for this apparent anomaly is that it is desirable for the tremulo oscillator to be running at all times – whether tremulo is switched in or not – to eliminate the minor change in overall pitch otherwise caused by the load of IC1 being switched on ,or off.

When completed, the chain of resistors should be soldered in place. Do make sure you have good sound soldered joints as the failure of any one joint in this chain will prevent the organ from operating.

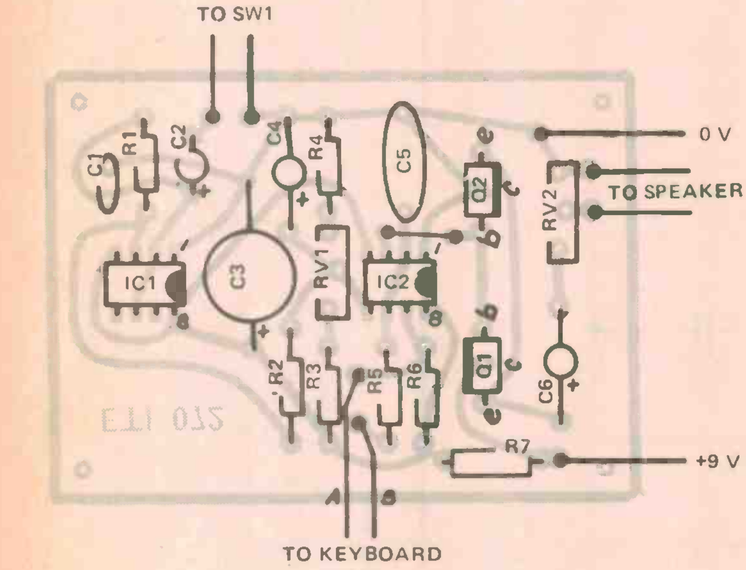
Finally connect the two assemblies together, connect up a battery and away you go!

Some refinements may be made — as with other projects in this series it is possible to delete the trim potentiometers currently shown located on the circuit board, replacing these with larger rotary potentiometers located remotely.

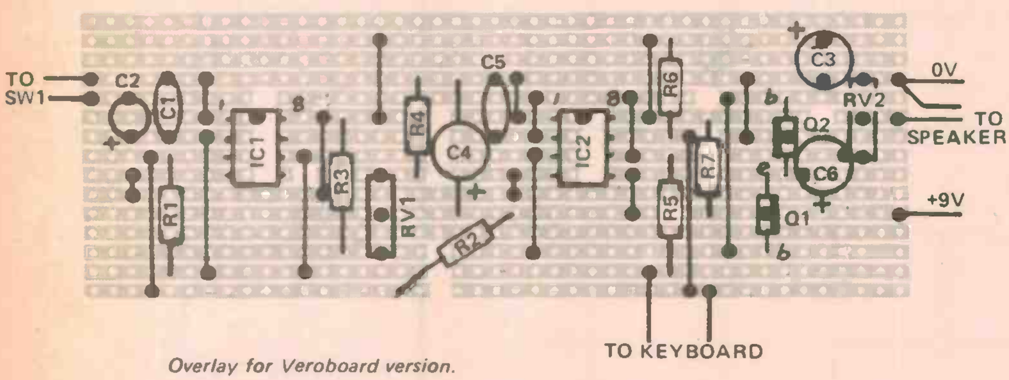
Resistor R2 may be changed to vary the depth of tremulo or replaced by a potentiometer (10 k in series with a 3k3 resistor) to allow immediate adjustment.



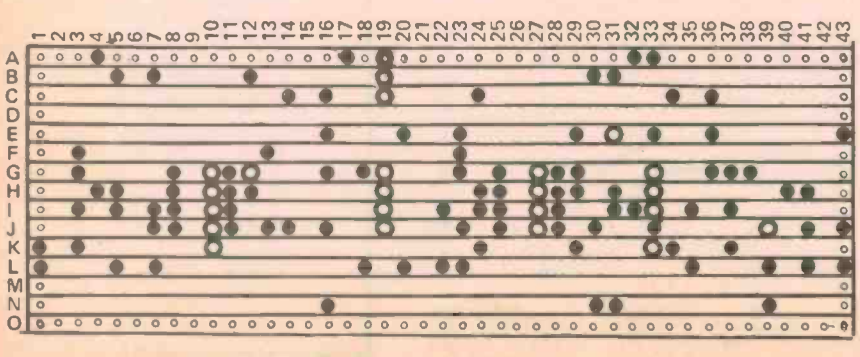
Printed circuit board layout — shown here full size.



Component overlay for printed circuit board version.



Overlay for Veroboard version.



Drilling details for Veroboard.

PARTS LIST

Resistors		
R1	68k	½ W 5%
R2	8k2	" "
R3	2k2	" "
R4	6k8	" "
R5	8k2	" "
R6	10k	" "
R7	100 ohms	" "
R8-R11	2k7	" "
R12-R14	2k2	" "
R15	1k8	" "
R16	2k2	" "
R17	1k5	" "
R18	1k8	" "
R19-R20	1k5	" "
R21	1k2	" "
R22-R23	1k5	" "
R24	1k2	" "
R25-R28	1k	" "
R29-R31	820	" "
RV1	Trimpot 5k	
RV2	" 100 ohm	
Capacitors		
C1	1n0 polyester	
C2	1 uF electrolytic 16 V	
C3	220 uF " "	
C4	100 uF " "	
C5	56 n polyester	
C6	100 uF 16 V electrolytic	
IC1/IC2	integrated circuits 555	
Q1	transistor BD139	
Q2	transistor BD140	

Printed circuit board ETI 072 or Veroboard
SW1 single pole switch
Nine volt battery and clip
Small speaker
Kit available from Dick Smith Electronics.

SUPER SPECIALS

BD 139 — 50c ea.
BD 140 — 50c ea.
BC 547/8/9 — 15c ea.

MJ2955 — 90c.
2N3055 — 85c.
T03 Mounting Kits — 5c ea.

CANNON CONNECTORS

XLP-3-11	$2.30
XLP-3-12c	$3.25
XLP-3-31	$3.25
XLP-3-32	$3.00
XLR-LNE-11c	$3.05
XLR-LNE-32	$4.30

Weller cordless soldering iron kit, model WC100DKW — includes batteries, solder, 4 interchangeable tips, battery charger and instructions for only $29.50.

TTL

7400	.28
7401	.28
7402	.28
7403	.28
7404	.37
7405	.37
7406	.50
7407	.50
7408	.34
7409	.34
7410	.30
7411	.37
7413	.54
7414	1.03
7416	.60
7417	.60
7420	.30
7422	.30
7426	.45
7427	.45
7430	.30
7432	.43
7437	.50
7438	.50
7440	.30
7441	1.50
7442	.70
7447	1.25
7448	1.25
7450	.35
7451	.35
7453	.35
7454	.30
7460	.35
7470	.65
7472	.45
7473	.60
7474	.65
7475	.65
7476	.45
7480	1.25
7483	1.25
7485	1.45
7486	.65
7489	1.20
7490	.75
7491	1.00
7492	.75
7493	.75
7494	1.10
7495	.95
74100	2.45
74107	.65
74121	.60
74123	1.10
74132	1.25
74150	1.80
74151	1.10
74153	1.10
74154	1.70
74157	1.10
74160	1.55
74164	1.55
74165	1.55
74173	2.75
74175	1.65
74180	1.35
74192	1.40
74193	1.40
74221	1.50
74367	1.40

74LS

74LS00	.30
74LS01	.30
74LS02	.30
74LS03	.30
74LS04	.35
74LS05	.35
74LS08	.30
74LS09	.30
74LS10	.30
74LS11	.30
74LS12	.30
74LS14	1.20
74LS20	.30
74LS21	.30
74LS27	.30
74LS28	.40
74LS30	.30
74LS32	.33
74LS37	.45
74LS38	.45
74LS40	.30
74LS42	1.20
74LS73	1.20
74LS74	.50
74LS75	.70
74LS78	.50
74LS85	1.50
74LS86	.50
74LS90	1.20
74LS92	1.20
74LS93	1.20
74LS95	1.50
74LS109	.50
74LS113	.55
74LS114	.55
74LS138	1.20
74LS151	1.20
74LS154	1.60
74LS157	.90
74LS163	1.20
74LS164	1.30
74LS174	1.00
74LS175	1.00
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.20
74LS196	1.20
74LS221	1.20
74LS253	1.85
74LS279	.65
74LS365	.80
74LS367	.80
74LS368	.80

CMOS

4000	.25
4001	.25
4002	.25
4006	1.40
4007	.25
4008	1.25
4011	.25
4012	.25
4013	.55
4014	1.35
4015	1.20
4016	.50
4017	1.40
4018	1.40
4019	.75
4020	1.60
4021	1.40
4022	1.60
4023	.25
4024	.90
4025	.40
4027	.80
4028	1.25
4029	1.90
4030	.40
4040	1.30
4041	1.25
4042	1.25
4043	1.50
4044	1.50
4046	1.95
4049	.60
4050	.60
4051	1.20
4052	1.20
4053	1.20
4060	2.65
4066	1.00
4068	.40
4069	.35
4070	.40
4071	.40
4072	.40
4073	.40
4074	.40
4076	1.85
4077	.40
4078	.40
4081	.40
4082	.40
4510	1.50
4511	1.50
4518	1.50
4520	1.45
4528	1.20
4555	1.20
14553	7.50
14584	1.25
74C00	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	1.90
74C48	2.55
74C73	1.20
74C75	1.20
74C76	1.35
74C90	2.25
74C93	2.25
74C175	1.85
74C192	2.25
74C193	2.25

LINEAR

301	.40
307	.65
308	1.35
311	.85
324	1.35
339	.90
349	2.25
356	1.65
380	2.00
381	2.00
382	2.00
386	1.95
555	.35
556	.85
565	1.95
566	2.50
567	2.65
709	.75
723(VR)	.55
741	.35
747	1.25
3900	.90
3909	1.25

VOLTAGE REGS.

309	2.25
317	3.50
323	8.25
325	2.60
723	.55
7805	1.40
7806	1.40
7808	1.40
7812	1.40
7815	1.40
7818	1.40
7824	1.40
7905	2.25
7912	2.25
7915	2.25
78L05	.50
78L12	.50
78L15	.50
79L05	.85
79L12	.85
79L15	.85

OPTO

FND507 C/A	1.70
FND 357C/C	1.40
FND 500C/C	1.50
Red LED	.22
Green LED	.35
Yellow LED	.35

DIODES

IN4148	6c — 5c/100
IN4004	9c
IN5625 5A 400V	45c

I.C. SOCKETS

8 PIN DIL	.25
14 PIN DIL	.30
16 PIN DIL	.33

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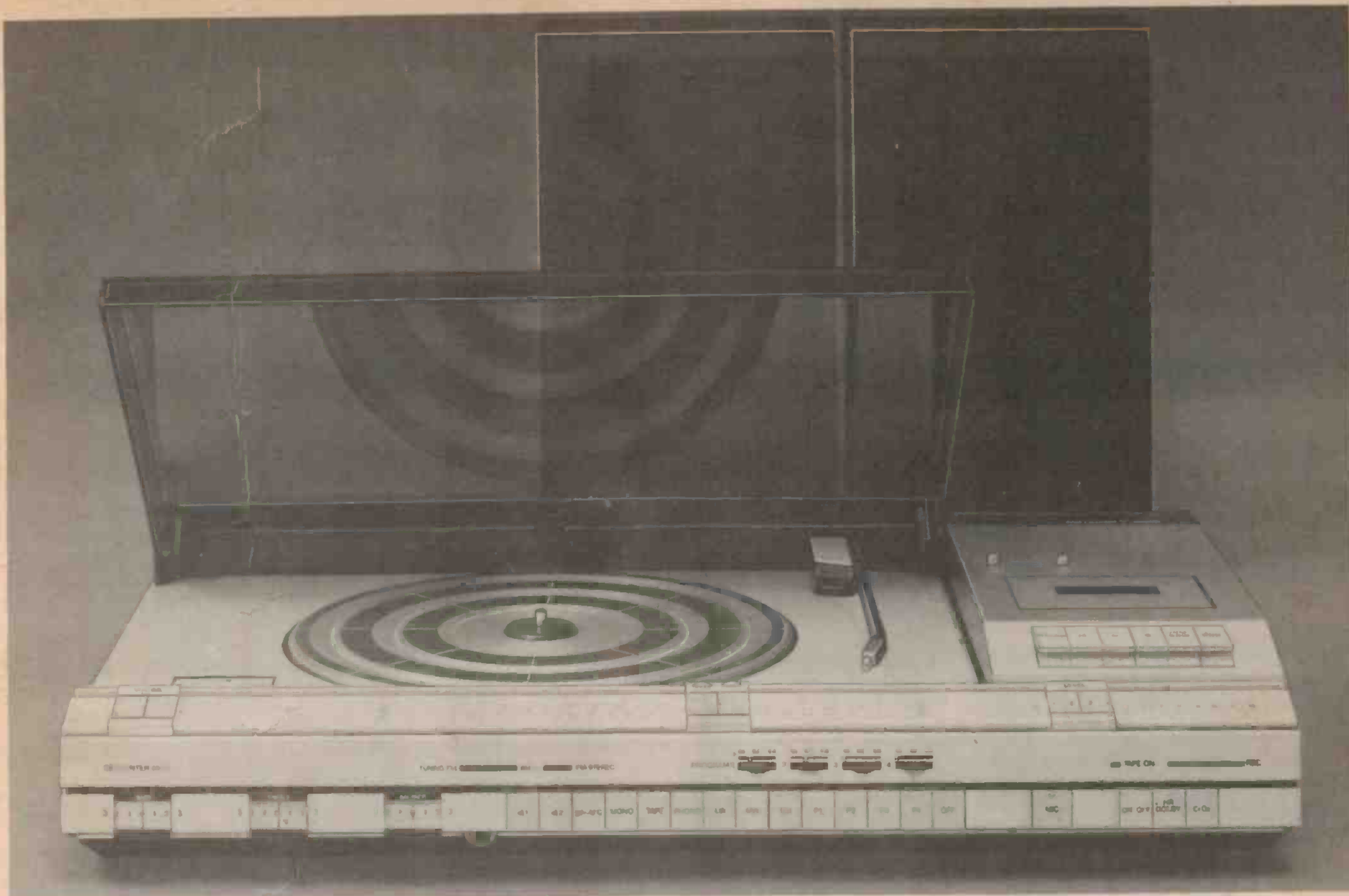


An impossible announcement from B&O

Bang & Olufsen's first 3-in-1, the Beocenter 4600 differs greatly from all other combination sound systems — so greatly, that it is impossible to tell you here, all the joys of owning one. However, before you come to see the 4600 you should be armed with a few facts:

The Tuner-Amplifier

The amplifier is conservatively rated at 2 x 25 watts and it shares the same advanced design concept as the Bang & Olufsen flagship — the Beomaster 4400.

It features AM and FM radio plus connections for several pairs of speakers.

The Gramophone

The turntable's Electronic Servo-Drive ensures correct speed and reliability. Fully automatic single button operation plus a patented suspension system makes the turntable simple to use and isolates it from external vibrations.

The Cassette

The cassette deck naturally includes a Dolby noise reduction system and the fidelity is such that you will not hear any difference between what you record, from record or radio, and what you play back.

The Combination Beocenter 4600

Bang & Olufsen's new 3-in-1 is not like any other — where most are built to sell as cheaply as possible, the Beocenter 4600 is built to **sound** as good as possible.

In other words each part of the Beocenter 4600 has been chosen to pay the highest compliment to the rest of the system — and not just to save a few dollars.

To mention *all* the advantages of owning three-Bang-&-Olufsen-products-in- one, in this small advertisement is clearly an impossibility.

An impossibility which you can, however, overcome by hearing Beocenter 4600 at your nearest B & O specialist.

Bang & Olufsen

simply the best

Victoria: Danish Hi-Fi, Shop 9, Southern Cross Hotel, Melbourne. Tel. 63 8930. Danish Hi-Fi, 698 Burke Road, Camberwell. Tel. 82 4839. Danish Hi-Fi, Cnr. Beach & Olsen Streets, Frankston. **New South Wales:** Deeva Hi-Fi, 326 Pacific Highway, Crows Nest. Tel. 439 3999. **Queensland:** Brisbane Agencies Audio Centre, 72 Wickham Street, Fortitude Valley. Tel. 221 9944. **Western Australia:** Danish Hi-Fi, 256 Stirling Highway (in the Rolly Tasker Building), Claremont. Tel. 384 2852. **South Australia:** Ernsmiths, 50 King William Street, Adelaide. Tel. 51 6351. **Tasmania:** Bel Canto, 138 Liverpool Street, Hobart. Tel. 34 2008.

BO1127

TAPE NOISE LIMITER

Cut down tape hiss by adding this unit to your cassette recorder.

DESPITE the small size, the performance obtainable from a cassette tape in a good recording deck is quite remarkable. In fact the latest top quality decks are so good that it is difficult to tell the difference between the recording and the original sound.

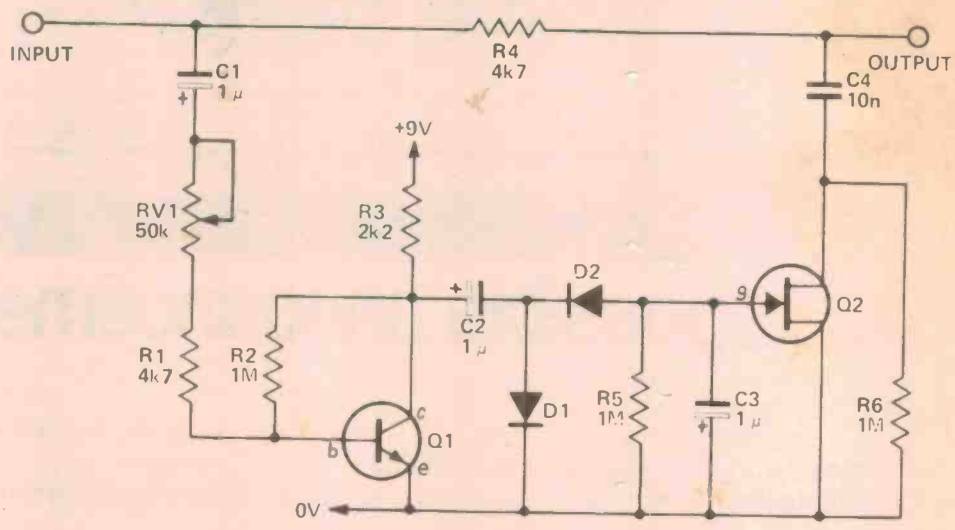
Unfortunately this is not true of the cheaper units — in which 'tape hiss' can be very prominent. Tape hiss is caused by random irregularities in a tape's surface coating. The effect is common to all tapes but some are marginally worse than others.

The annoying characteristic of tape hiss delayed the acceptance of cassette tape recorders in hi-fi systems for some years — until the advent of the Dolby system which was primarily developed as a cure for the phenomenon.

The Dolby system is often misunderstood -- *it only works if the cassette tape itself has been recorded using the Dolby process* — and few commercially produced tapes are. Unless the tape cassette says specifically that it is Dolby processed then it's not! You can of course record your own tapes using Dolby if you own a Dolby machine.

To overcome this limitation a number of cassette recorders are fitted with noise reduction circuitry which reduces the level of hiss on non-Dolby recordings. Most of these noise reducing circuits work by progressively reducing all high frequency signals when the output level falls below a preset minimum. Above that minimum level all sounds are allowed through because tape hiss cannot be heard once the sound level is substantially louder than the hiss. This effect is called 'acoustic masking'.

The circuit described in this project is a simple but very effective unit which may be used with any cassette recorder which is connected to a hi-fi system.



The unit should preferably be connected between the cassette recorder and the amplifier input — using short lengths of screened cable and suitable connecting plugs. If you really know what you're doing it may be actually built into the tape recorder or amplifier. Alternatively it may be connected between the pre-amplifier and power amplifier on those units which are so separated (note that many apparently integral amplifiers still have 'pre-amp out' and 'power-amp in' connectors on the rear panel. These connectors are normally bridged by 'U' shaped links— which should be removed to enable this unit to be plugged in).

CONSTRUCTION

As with most projects in this series you can use either Veroboard or the special printed circuit board shown here.

Take the usual precautions about inserting components the right way round — taking particular care with the field effect transistor Q2. Note that the cathode lead of the diodes (shown as a horizontal bar on the circuit diagram) will be identified on the component by a black band or similar marking.

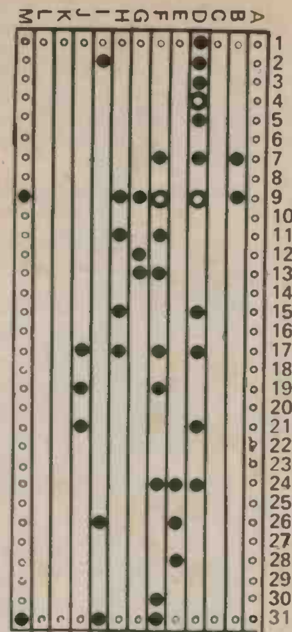
Unless the leads between this unit and the tape deck and amplifier are very short it is advisable to connect it via screened cable. Note that the 0V line shown on the circuit is also the 'earthy' side of the input/output connections.

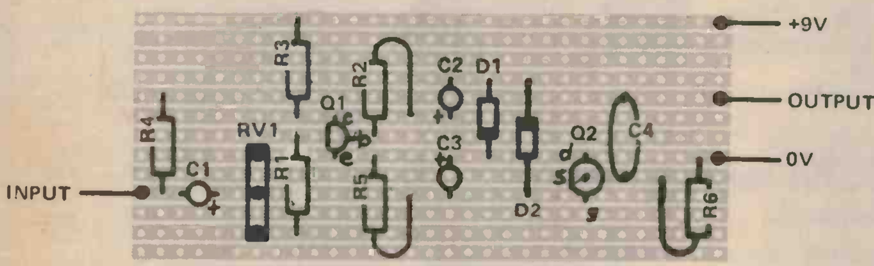
To set up the unit simply choose a recording with a longish quiet passage and then adjust RV1 for the best compromise between tape hiss reduction and minimum loss of high frequency programme content.

NOTE: If you listen only to hard rock — where there aren't any quiet passages — then this unit will be of little value to you. Its main effect is to reduce annoying tape hiss during otherwise quiet programme material.

SPECIFICATION

Input level –	up to 2 Vrms
Min level for flat response –	about 10 mV
Input impedance	depends on Q1 gain but >4.7 k
Output impedance	impedance driving the input + 4.7 k
Output impedance of drive device	– preferably 600 ohms.



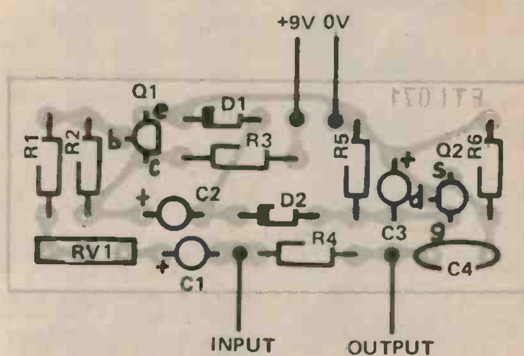


Component layout of Veroboard version.

PARTS LIST
ETI 071

R1	Resistor	4k7 0.5 W	5%
R2	"	1M "	"
R3	"	2k2 "	"
R4	"	4k7 "	"
R5,R6	"	1M "	"
RV1	Potentiometer 50 k trimpot		
C1-C3	Capacitor	1 uF 25 V	
C4	"	10 n polyester	
Q1	Transistor	BC548	
Q2	"	2N5459	
D1-D2	Diode	1N914	

Nine volt battery and clip
Veroboard or pc board ETI 071.



Component layout of printed circuit board version.

Note difference in order of source(s) and drain (d) of Q2 in the Veroboard version and pc board version of this project. This is in fact correct as the source and drain of this transistor are interchangeable in this circuit.

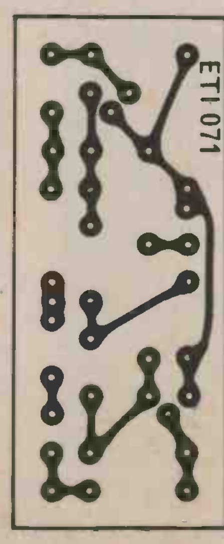
HOW IT WORKS

The circuit passes all frequencies (without attenuation) if the incoming signal is above a set minimum level. Signals below the preset minimum are progressively attenuated from 1 kHz upwards. The maximum attenuation of about 10 dB is applied at approx 10 kHz.

Resistor R4 and capacitor C4 form a filter in which Q2 is used as a variable resistor with the degree of resistance dependant on gate voltage. Thus, if the input voltage is at or near 0V then Q2 appears as a low resistance and C4 is in circuit. If on the other hand the input signal is higher than (say) four volts negative, Q2 has a very high resistance and C4 is effectively out of circuit.

The voltage applied to the gate of Q2 is that derived from Q1 – after rectification by D1 and D2. Transistor Q1 amplifies the input signal and with RV1 in minimum position, input signals above 10 mV or so will cause Q2 to be off.

Increasing RV1 raises the level below which high cut will occur. The change from full to zero cut occurs over a range of approx 5 dB input level change.



Foil pattern for pc board – shown full size.

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104-106 King Street Newtown Sydney Australia P.O. Box 317 Newtown, N.S.W. 2042.
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Height	99 mm	89 mm	98 mm	88 mm	88 mm	88 mm
Diameter	218 mm	216 mm	216 mm	180 mm	180 mm	180 mm
Depth	130 mm	130 mm	130 mm	124 mm	124 mm	124 mm
CR cut out radius	90 mm	90 mm	92 mm	72 mm	72 mm	72 mm
MR mounting hole radius	102 mm	102 mm	102 mm	83 mm	83 mm	83 mm
Magnet Type	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic
Colour	Black	Black	Black	Black	Black	Black
Resonance	35Hz ± 5Hz	45Hz ± 5Hz	45Hz ± 5Hz	45Hz ± 5Hz	45Hz ± 5Hz	45Hz ± 5Hz
Response	25Hz — 3000Hz	35Hz — 700Hz	35Hz — 15000Hz	35Hz — 15000Hz	35Hz — 7000Hz	35Hz — 8000Hz
Power*	25W RMS	15W RMS	15W RMS	15W RMS	15W RMS	25W RMS
Impedence	8 ohms	8 ohms	8 ohms	8 ohms	8 ohms	8 ohms
Voice Coil Dia.	1¼"	1"	1"	1"	1"	1"
Flux Density	1.0 Tesla	1.0 Tesla	1.0 Tesla	1.0 Tesla	1.0 Tesla	1.0 Tesla
Total Flux	484u Webbers	420u Webbers	420u Webbers	420u Webbers	420u Webbers	420u Webbers
Magnet Mass	525 gsm	525 gsm	322 gsm	322 gms	322 gms	322 gms
Price	$15.80	$11.90	$12.45	$11.95	$11.45	$12.40

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NEWS

Infinite UC1800

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As a trainer, in the completely packaged configuration, (nothing else to buy) it offers schools and industrial training departments a reliable, safe and attractive 4 pound package of computer power which takes the user from basics to hands-on use.

The UC1800 can be used as a training device, microprocessor application demonstrator/evaluator, for household and hobby use, small industrial computer, process control, laboratory automation, traffic control and data communication.

Some of the outstanding features are: it is completely self-contained, low cost, complete documentation, expandable by means of S-100 bus, plug in module design, completely assembled and tested with 170 hour burn-in prior to delivery.

DATA AIDS, of 100a West Street, Crows Nest, NSW 2065, will be selling the UC1800 direct to users at $525.00 complete.

Graphics Board

A new graphics board from Vector Graphic, Inc., is compatible with the S100 bus and offers either digital output or 16-level grey-scale mode.

The board uses DMA to access an external 8K RAM, and will produce digital graphic displays of 256 horizontal by 240 vertical elements or grey-scale displays of 128 horizontal by 120 vertical elements. Further information from Vector Graphic agents in Australia or Vector Graphic, 790 Hampshire Road, Westlake Village, Calif. 91361.

EPROM Board

Semcon Microcomputer announce the availability of their new 16K EPROM board. The board carries up to 16 2708's which can be addressed as either 8K or 16K of memory, and is compatible with the Motorola EXORciser bus. The board is fully buffered and decoded, and carries a small wire-wrap area. The price is $135 (without any 2708's) and further details are available from Semcon Microcomputers, 1 Chilvers Road, Thornleigh.

Low Cost EPROM Programmer

A new programmer from Microcontrol, PO Box 361, Broadway, 2007, programs and reads 8K, 16K and 32K EPROMs. Interfaces to computer or microcomputer internal buses.

Programming and reading sequences are supervised by the computer through execution of a short Control Program which must be loaded into the computer prior to programming unless it is stored permanently in a PROM.

A block of data from the computer memory of any length from one byte to full EPROM capacity is then programmed into the EPROM and verified for errors. In the real mode, a block of EPROM data is transferred into the computer memory.

The Control Program parameters include: EPROM type, first address of the data block in computer memory, first and last EPROM address to be programmed or read, and program/read mode.

The programmer 12 interfacing lines are TTL compatible - 1 TTL load each. 4 of the computer I/O parts are used as output latches and 8 as output latches when programming or as inputs when reading.

The programming waveforms conform to EPROM manufacturers' specifications.

An external +30V/80mA regulated or +35-60V/80mA unregulated power supply is required in the programming mode and +/- 5V, + 12V or only + 5V for the latest generation of EPROMs.

The programmer is available as a 4.5 inch x 6.5 inch PCB mating with 22 x 2 0.156 inch edge connector. A special very low insertion force test socket is used for EPROMs. For reliable operation the switching transistors are greatly underrated and the high programming voltage is short circuit protected.

COMPUTER CLUB DIRECTORY

Sydney: Microcomputer Enthusiasts Group, P.O. Box 3, St. Leonards, 2065. Meets at WIA Hall, 14 Atchison St., St. Leonards on the 1st and 3rd Mondays of the month.

Melbourne: Microcomputer Club of Melbourne, meets at the Model Railways Hall, opposite Glen Iris Railway Station on the third Saturday of the month at 2 p.m.

Canberra: MICSIG, P.O. Box 118, Mawson, ACT 2607 or contact Peter Harris on 72 2237. Meets at Building 9 of CCAE, 2nd Tuesday of month at 7.30 p.m.

Newcastle: contact Peter Moylan, Dept. of Electrical Engineering, University of Newcastle, NSW 2308. (049) 68–5256 (work), (049) 52–3267 (home).

Brisbane: contact Norman Wilson, VK4NP, P.O. Box 81, Albion, Queensland, 4010. Tel. 262 1351.

New England: New England Computer Club, c/- Union, University of New England, Armidale, NSW 2351. (New club; not restricted to students)

Auckland: Auckland Computer Club, P.O. Box 27206, Auckland, N.Z.

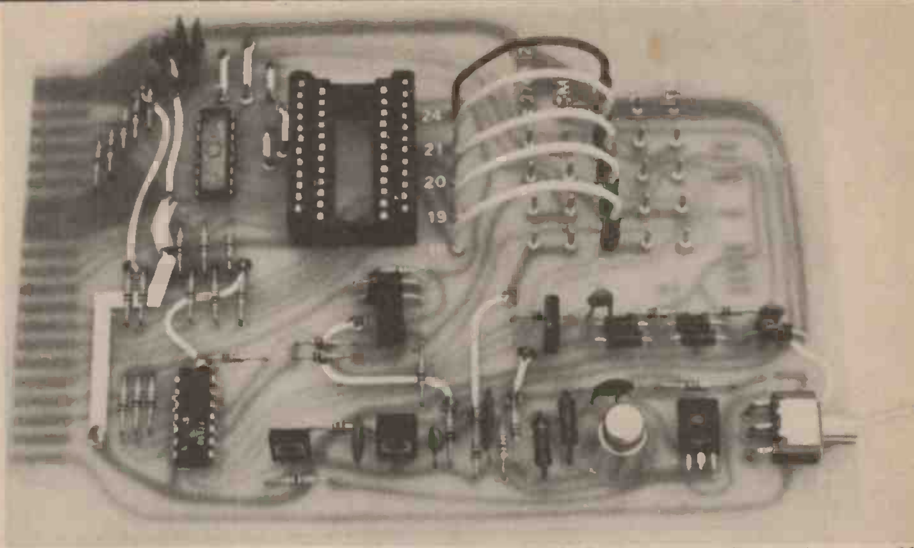
Computer clubs are an excellent way of meeting people with the same interests and discovering the kind of problems they've encountered in getting systems 'on the air'. In addition, some clubs run hardware and software courses, and may own some equipment for the use of members. Try one – you'll like it!

If your club is not listed here, please drop us a line, and we'll list you. The same applies if you are interested in starting a club in your area. Also, if established clubs know their programme of forthcoming events, we can publicise them.

Compucolor II

A new personal computer system from Compucolor Corp, of PO Box 569, Norcross, Ga. 30091, includes an eight-colour CRT, keyboard, and up to 16K of ROM. The CPU is an 8080A, and the system also includes 4K of user RAM and 4K of screen refresh RAM. The system also features an integral minidisk drive allowing use of the Disk BASIC 8001 language, which has 27 statement types with 18 maths functions, 9 string functions and 11 disk commands.

The display accommodates 64 characters in 64 lines and is expandable to 32 lines and graphics of 128 by 128, including vector-generating software. The Compucolor II is priced from US$1,395 to US$1,995.



The Microcontrol EPROM Programmer is discussed on page 49.

16 BITS OR BUST?

THE FIRST MICROPROCESSOR to be made by the Intel Corporation, the 4004, was a four-bit device; that is, the data words it manipulated were four bits long. This is good for doing decimal arithmetic in a BCD (binary coded decimal) format as is used in calculators, but not really very good for handling alphanumeric information in codes like ASCII, which are seven bits long.

Traditionally, computers have operated with pure binary representations of numbers, using a variety of word lengths from the 12-bit PDP-8 to large machines with a 66-bit word. Longer word lengths have several advantages. Firstly, longer words permit greater precision in the handling of numbers, or the representation of larger numbers. For example, the use of a four-bit word permits representation of 16 different values (0-15), a 16-bit word allows any of 65,536 values and a 32-bit word allows integers from 0 to 4,294,967,296.

Secondly, and this is probably more important, the longer word allows greater complexity of instructions. In order to run its instruction set, the 4004 had to piece together its instruction requiring two memory accesses with a consequent penalty on speed. The eight-bit microprocessors can have up to 256 different instructions using eight-bit instructions, although in practice, not all these possible opcodes are used. In the 8080, for example, only 244 of the opcodes are used.

In the Z-80, the instruction set encompasses over 256 different opcodes, although it is an eight-bit microprocessor, by using one of the twelve opcodes not used by the 8080 as the first byte of a two-byte instruction. For example, in the 8080, the opcode 'CB' is undefined, but if a Z-80 encounters a 'CB' instruction it will then look at the following byte as part of the instruction and decode it as a rotate/shift or bit manipulation instruction. The opcode 'CB A1' would be decoded as an instruction to reset bit 4 of the C register.

This process can be, and has been, extended further. For example, the four-byte Z-80 opcode 'DD CB d AE' will reset bit 5 of the memory location pointed to (indexed) by (IX + d). This is not the most efficient way of doing things, but is forced by the Z-80's software compatibility with the 8080. The execution of this instruction requires 6 machine cycles or 23 states, most of which are taken up with loading the instruction into the processor and decoding it.

The answer — longer word length and a wider data/instruction bus.

Upward Moves

There was a move in industry, a couple of years ago, from four bit microprocessors to eight bit ones, and now we are about to see a move from eight bits to sixteen. The reasons for this are several.

The first microprocessors were mainly used as replacements for moderately complex random logic, particularly sequential logic as found in (say) traffic light controllers or applications involving simple arithmetic or counting. In these applications, speed is not critical, and control programs are short so that software can be written by hand. Longer programs which require the use of an assembler could only be tackled by companies who could run a cross-assembler program on their own minicomputer or who had access to a time-share system.

There is a fundamental law of the Universe, related to Murphy's Law, which states that work expands to fill the time available, and this law holds true for microprocessors as well as people. Initially, micros were used as straightforward random logic replacements, and so were somewhat underutilised. It didn't take long for engineers to realise that other functions could be added to a basic product to increase its value without increasing its cost, simply by using the microprocessor's spare capacity. For instance, the traffic light controller could be made to count passing cars. However, with a four-bit processor (as with an eight-bit processor) there is a limit to the amount of extra work one can load on it - only the limit is lower for a four-bit machine than an eight-bit.

Then, along came the 8080, preceded by the 8008. Engineers discovered that the eight-bit processor had a 'nicer' instruction set, so that software was easier to write. In addition, just about all of the eight-bit processors are fast enough and powerful enough to run their own assemblers, editors and even high level languages. Since, for small production quantities, development costs are a major part of the unit cost, the much lower cost of software development with eight-bit processors is very significant. This means that eight-bit micros can be used for one-off applications which

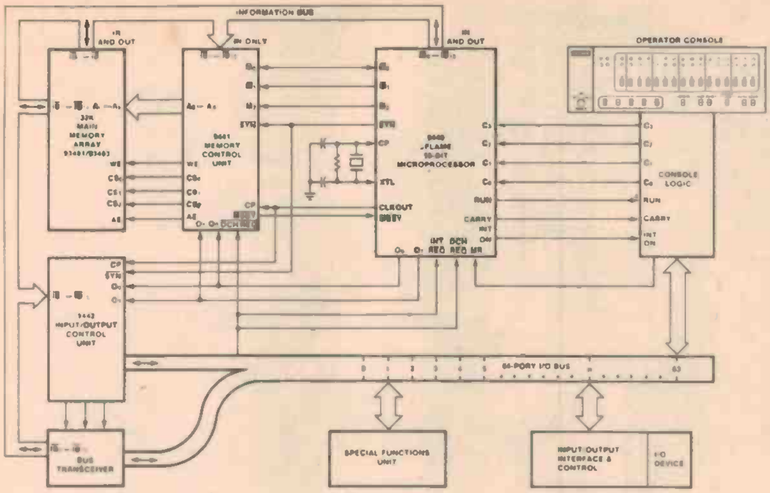


Fig. 1. A typical 9440 system. Note that the 9440 is designed to support a full front panel.

previously were not economically feasible.

With recent increases in the speed of microprocessors, designers now have increased 'headroom' for the addition of features to their products. For these reasons, the four-bit microprocessor is hardly being used for new designs in comparison with the eight-bit types.

Also for similar reasons, the eight-bit microprocessor will, to some extent at least, go the way of the four.

Coming Attractions

A new type of microprocessor is emerging, to fulfil a new range of applications. The new 16-bit devices are designed to replace minicomputers which are in 'overkill' situations, i.e. sledgehammers cracking walnuts, so to speak. In particular, many of the 16-bit microprocessors will not be sold as chips but as single board computers, similar in concept, if not in power, to the Intel SBC80 range.

Let's look at what's going to be available in the coming months. Six major manufacturers are touting 16-bit processors — Texas Instruments, Fairchild, Motorola, National, Intel and Zilog. TI and National were amongst the first away, with their TMS 9900 and PACE devices. TMS 9900 was discussed in our January 1978 issue, and although two years old has made disappointing progress. Only when TI introduced the 9980, a version with 8-bit data bus, and a series of 9900-based boards did the 9900 family of processors begin to take off.

Fairchild's latest product, the 9440, is an extremely interesting device indeed, and is probably the most powerful single-chip processor on the market today. The 9440 is manufactured using Fairchild's Isoplanar Integrated Injection Logic, a bipolar technology that allows a 12 MHz clock rate. This means that, with a 10 MHz clock, the add time is 1.5 μs, while an ISZ (Increment and Skip on Zero) Indirect instruction takes 7.5 μs. That is fast!

Another interesting point about the 9440 is the fact that it executes the instruction set of the Data General NOVA line of minicomputers. Data General are not overly enthusiastic about this, and are in fact suing Fairchild. Nevertheless, 9440's are being delivered to customers, and Data General cannot stop electrons flowing, so they seem to have been presented with somewhat of a fait accomplis.

The NOVA instruction set is a very powerful one, with multifunction instructions for efficient memory usage and eight addressing modes. There is a total of 2192 different instructions, some of which, it must be admitted, are of dubious value.

Fig. 2 shows the construction of a typical arithmetic/logic instruction for the 9440. The first two two-bit fields of the instruction specify the source and destination operands - there are four 16-bit general purpose registers, AC0-AC3, as well as four 16-bit special registers: the scratch register, bus register, instruction register and program counter.

The next three-bit field indicates the function, or instruction type. These are fairly obvious in operation and similar to 8-bit microprocessors.

The next two bits indicate whether the result is to be shifted or the two bytes which make up a word swapped over. Bits 10 and 11 direct the operation of the carry bit, which can be set, reset, complemented or left unchanged. Finally, after any shifts have been executed, the 9440 checks the shifted word and the new carry bit for zero or non-zero results. According to the skip code, the 9440 may skip the next instruction.

It can be seen that these instructions can be extremely powerful, equalling up to three or more instructions on an eight-bit microprocessor. This is one of the strengths of the 16-bit microprocessor - the programmer's ability to 'mix and match' instructions to suit his requirements.

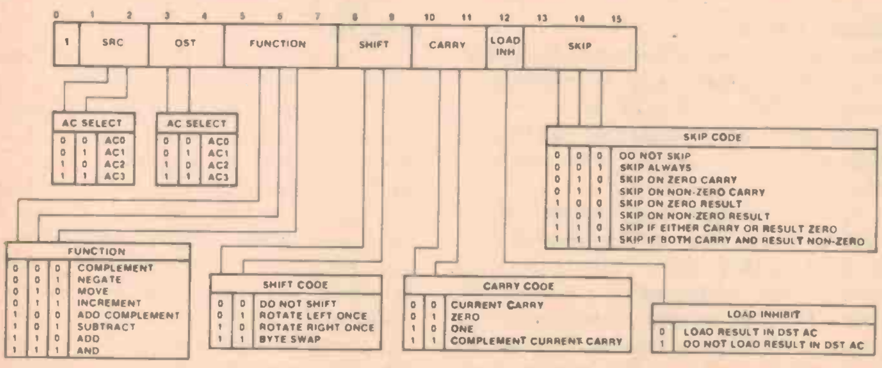


Fig. 2. Breakdown of a 9440 arithmetic/logic instruction.

Addressing Modes

Another powerful feature possible with a 16-bit processor is indirect addressing. The 9440, although it has a 16-bit word, only uses 15 bits to address its maximum 32K words of memory. The remaining bit, the most significant bit, is used to provide indirect addressing. If bit 5 of a memory reference instruction is set, the computed value is itself the address where the processor will find the address it requires.

If the MSB of the word read from the indirectly addressed location is '1', then bits 1-15 point to a location in memory where the next level of indirect address resides. This process can continue indefinitely, as long as the MSB

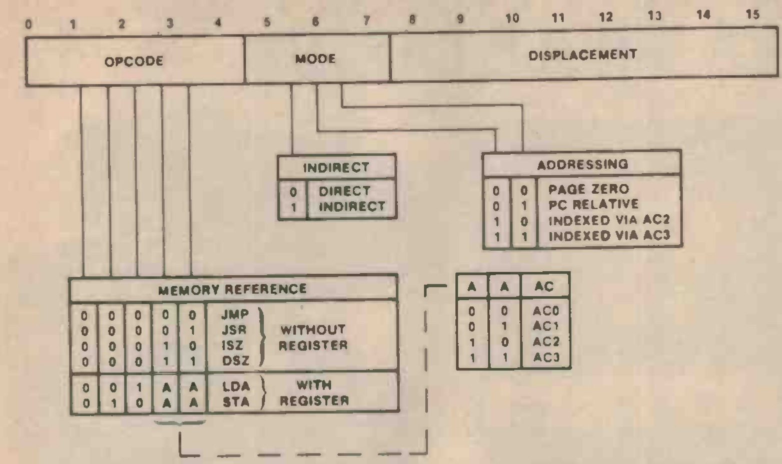


Fig. 3. A 9440 memory reference instruction breaks down in a similar way to the arithmetic/logic instructions.

of each word read from memory is '1'.

The 9440 possesses four types of addressing. One is absolute addressing of page zero, i.e. the first 256 memory locations; the other three are relative addressing where an eight-bit displacement (part of the instruction) is treated as a signed number and added to a 15-bit base address in an index register, either AC2, AC3 or the PC. Each type may be either direct or indirect, giving a total of eight modes. Relative addressing using AC2 or AC3 is useful for table searches, while program-counter-relative addressing is used for jumping to nearby locations when a relocatable program is executed.

When locations octal 20 through 27 are indirectly addressed, the auto-increment feature takes over and the contents of the selected location are first incremented and the new value is treated as the new address, which can be either direct or indirect. Locations octal 30 through 37 are used as auto-decrement locations in a similar fashion.

The only problem associated with the use of a fast processor like the 9440 for the hobbyist is the cost of fast enough memory to go with it. Fairchild are supplying 100 ns bipolar dynamic RAMs and a Memory Control Unit to match the 9440. The Memory Control Unit is necessary because the 9440 puts both addresses and data on a single 16-bit Information Bus (to save pins) and these signals must be de-multiplexed. The MCU also provides a refresh address counter and a 7-bit address multiplexer.

There seems to be no shortage of software for the 9440. The FIRE-1 software package supplied with the 9440 evaluation kit (US$750) includes diagnostic routines, bootstrap, binary loader and an interactive assembler, debugger and editor. Also available is a symbolic debugger, text editor and FIRE-BASIC, which is a commercially-oriented BASIC interpreter. Coming soon are a macroassembler, disk operating system, a storage module operating system and a FORTRAN compiler.

Intel 8086

Intel are now sampling the 8086, a new 16-bit microprocessor, which is unique in that it executes the full set of 8085 8-bit instructions as well as a new set of 16-bit instructions. It can perform 16-bit arithmetic, signal 8- and 16-bit arithmetic, including multiply and divide, and bit manipulation. Amongst its mini-computer-like capabilities, it can handle re-entrant code, position-independent code, dynamically relocatable programs, and can address up to 1 megabyte of memory directly.

The internal architecture of the 8086 is of interest, as it uses two register files which have different functions. A general register file is dedicated to arithmetic and logic functions, and contains four 16-bit general data registers (which can also be addressed as 8-bit registers), two 16-bit memory base pointer registers and two 16-bit index registers. This bank of registers can be accessed by the data manipulation instructions; in addition, certain addressing modes imply specific registers. The relocation register file contains the program counter and four 16-bit segment registers which, in use, are effectively left-shifted four bits to indicate the starting address of four different memory segments which can each be up to 64K bytes in length. The combination of the segment registers with other registers allows the construction of addresses up to 20 bits long, allowing an address space of 1 Mbyte.

The 8086 CPU splits into two parts: the bus interface unit and the execution unit. The execution unit is the general register file, flags and ALU, and operates basically independently of the bus interface unit, which contains the relocation register file. An important function of the bus interface unit is maintaining an optimised 6-byte fetch-ahead instruction queue, thus keeping the memory buses occupied regardless of the activities of the execution unit. Most of the time, the instruction queue is full, though when the processor executes a jump, the queue will have to be refilled.

The 8086 has some other interesting features for error detection, interrupt handling and multiprocessing systems. It will be available in two versions, running at 5 MHz and 8 MHz, neither of which will be cheap, initially at least. But then, you get what you pay for.

Z-8000

Further details are slowly coming our way about the Zilog Z-8000, which is claimed to out-perform Digital Equipment Corp.'s PDP 11/45 minicomputer. Unlike the 8086, the Z-8000 has not been designed with 8080 or Z-80 compatibility in mind, and despite earlier rumours, the architecture is not slanted towards a particular high-level language.

Two versions of the Z-8000 will be available. A 40 pin type can address up to 64 Kbytes in each of six address spaces: a program storage area, data storage area and a stack area, each of which can operate in a normal or system mode. The 48-pin version uses a similar scheme to the 8086 to build 24-bit addresses, and through its extra eight pins can address up to 8 Mbytes, or, if the six address spaces are used, up to 48 megabytes! This is probably more than most hobbyists are ever likely to need!

The Z-8000, although a 16-bit machine, can also handle 32-bit words, BCD digits, and strings. The 16-bit registers in the CPU can (with one exception) be used as index registers, and the first eight can be used as sixteen eight-bit registers. Although designed to run at 4 MHz clock speed, so memory will not be expensive, it is claimed that because of its architecture, it runs five to ten times faster than eight bit types, including the Z80A.

Looking at these upcoming designs, it seems as though 16-bit microprocessors have a lot to offer the computer hobbyist and small business user. It will be interesting to see how these processors start to appear in systems - whether the S100 bus is adapted or whether new, more specialised bus structures appear.

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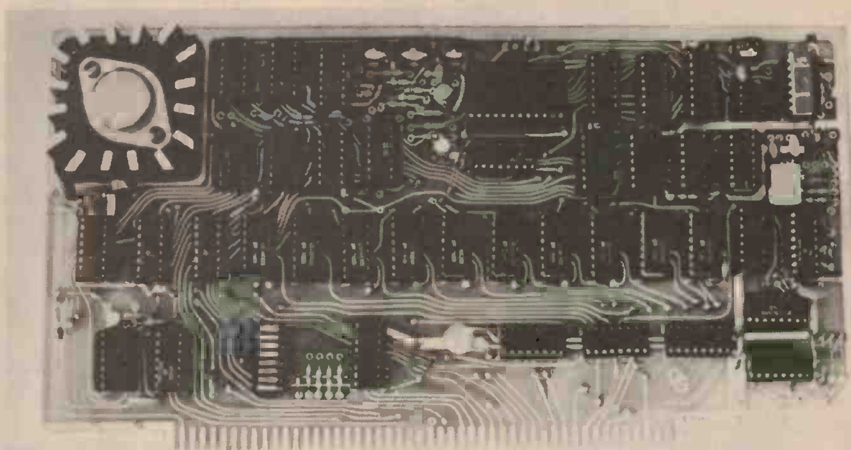
S100 VDU

David Griffiths explains how to fault-find on the VDU, and discusses software.



Although it would be possible to assemble this project and have it work first off, the number of components and solder joints and the tendencies of Mr Murphy (and his famous law) make it quite probable that something won't be right, unless you are extra careful. So with this in mind we have outlined a logical procedure for debugging the VDU.

The first check is one that applies to all projects: a thorough inspection of the board and soldering, looking for bridged tracks or dry joints. Included in this inspection should be a check of the orientation of all components, especially IC's and tantalum capacitors, and the values of all discrete components.

Having ascertained that nothing looks amiss with the board the next step is to look at it at a more technical level. First check the voltage supplies to the board, the input to the voltage regulator (IC42) should have between +8V and +10V on it depending on your power supply and there should be about +16V on the bottom end of R26 (Zener dropper).

An easy place to check these two supplies after regulation and the −3V supply, which is generated on board, is on the pins of the character generator ROM (IC4). Pin 1 is (or should be) −3V, pin 2 is +5V, pin 3 is +12V.

Having checked the voltage supplies, the easy part is over and oscilloscope is almost mandatory from here on in. If you do not have a CRO think seriously about where you can acquire access to one.

With the aid of the CRO, the first thing to look for is output from the 12 MHz Master Oscillator (IC9). Pin 2 of IC9 should carry a 12 MHz square wave with an amplitude of at least 3.5V, which will probably look somewhat sinusoidal unless you have a wide bandwith CRO. If this output is missing check around the oscillator discrete components and the supply pins of IC9.

At this point we are assuming that no output at all is being obtained. If you already have a display of some sort you can skip various bits of this material as you think appropriate.

Sync Pulse Generator

Next check for output from the Sync Pulse Generator. Pin 4 of IC41a should have a waveform like fig. 1 (negative going 5 µs pulse every 64 µs) and pin 12 should have a waveform like fig. 2 (negative going 300 µs pulse every 20 ms). If either of these waveforms is not present check the outputs and inputs of the dual monostable that is generating them. Note that actual voltage levels are extremely important in this area of the circuit as MOS chips are interfacing with LS TTL chips. In the prototype one MOS chip was encountered that would not sink its specified output current and hence the TTL chip being driven did not recognize a logic 0 (below 0.8 V).

A 2 MHz signal should be seen at pin 8 of IC40 (divide by six stage from the Master Osc.) then 15,625 kHz (period 64 μs) should be on pin 4 IC39. IC38 pin 12 should be 31,250 kHz and pin 14 should be 50 Hz (20 ms period).

If any output is not present check the input of the chip concerned, then if this is correct suspect the chip; but don't overlook the possibility of something else holding a short on its output. An easy way of checking for a short is to bend the output pin up (if sockets are used) and measure it completely open circuit.

Before speaking too harshly about any chip remember to check its supply voltage (and earth) and check that it is plugged in the right way round!

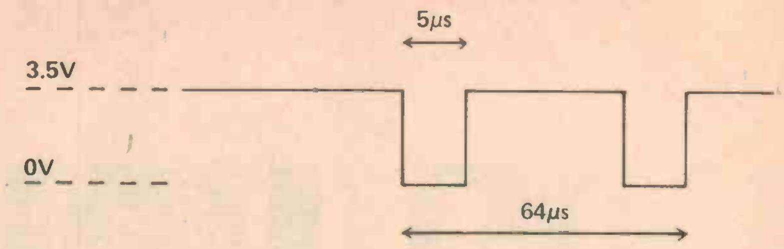


Fig. 1. Waveform at pin 1 of IC41.

Note: logic 'I' voltage could be between 3 volts and 5 volts

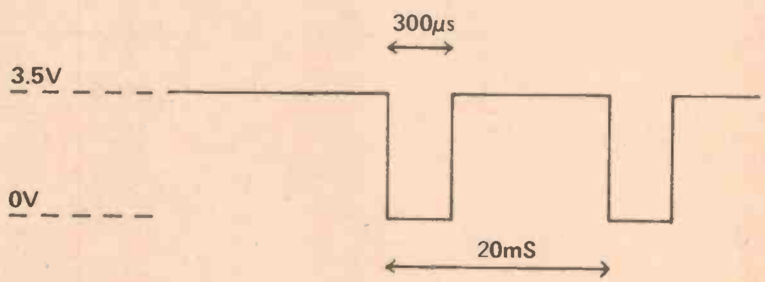


Fig. 2. Waveform at pin 12 of IC41.

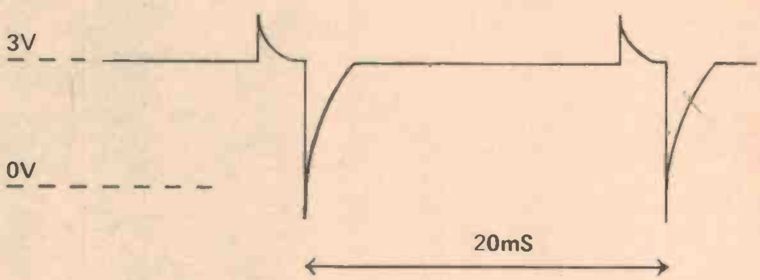


Fig. 3. This waveform should be seen on the reset input of IC2A (pin 2).

Positioning Monostables

The vertical and horizontal positioning monostables (IC3a & IC3b) are triggered by the leading edge of Vertical and Horizontal sync respectively. The output of each of these monos should look like the input with the pulse width being dependent on the associated trimpot. The horizontal positioning mono is held reset when the End Of Page (EOP) flip flop is set, so if you are getting the correct output from the Horizontal positioning mono you can skip the next paragraph.

The Q output of the Vertical positioning mono is differentiated by R3, R4, & C1 to give a negative going pulse on the reset input of the EOP flip flop. (IC2a, pin 2). This pulse should look like fig. 3. If this flip flop is not resetting check the discrete components in the differentiator. If the EOP flip flop is being reset correctly then the Horizontal positioning mono has no excuse for not working.

The End Of Line (EOL) flip flops (IC1b, IC2b) are reset by a differentiator similar to the one just described above (R1, R2, C2). The wave form on pin 6 of IC's 1b & 2b should be like fig. 4. The EOL ff's hold the entire counter chain when set, so it is necessary to obtain the correct output from both EOL ff's before venturing any further.

Counter Chain

The first counter is the one which counts the bits across each character (IC13, 7490). This counter is wired to reset to zero when it reaches a count of nine and is inhibitted from counting (by the EOL ff) by having a reset nine (pin 6) held on it, which takes priority over reset zero. This counter is clocked at 12 MHz and the QD output (fig. 5) on pin 11 is used to load the shift register, clock the next counter (IC12) and clock the flipflops (IC18A and IC18B).

Remember that you will see gaps in the counter waveforms as they are inhibitted from counting for about 13 μs at the end of each line and also during the vertical blanking period for about 1 ms.

On the outputs of IC12 you should see a normal binary count, counting once for each character (each pulse from QD of IC13). This count should also be seen on the QB and QC outputs of IC11. The first (QA) and last (QD) flipflops in IC11 are not used.

As the QC output of IC11 goes low, (after the 64th pulse into IC12) it will set the first EOL ff (IC2B). (Check that the link, LK1, between IC11 and IC2B is installed). One character width later, the second EOL ff (IC1B) will set as the QC output of the first counter goes low.

The Row of Character counter (IC15, 7493) counts once every time IC2B sets, so on the Q outputs of IC15 you should see a binary count once every line (64 μs).

Line of Screen Counter

IC10 is another 4 bit binary counter that counts which line of characters is being produced. It is clocked when IC15 reaches a count of 12 (via IC16/3).

Having ascertained that all the counters are working, the next thing to check is that the count is reaching the RAMs via the address multiplexers. The simplest way to do this is by a look at each address pin of the end RAM (IC31) (pins 1,2,4,5,6,7,8,14,15,16) ensuring that there is a waveform on each pin without worrying what the waveform looks like. Before doing this, however, check the select pin of any of the three multiplexers (IC19, 20, 21 – pin 1), which should all be logic zero. If they are not, the board is being addressed and a check around the board address decoding is required (see below).

Bus Interface

Before looking at the video gating, SR and ROM, it may be desirable to check the interfacing to the bus so that known patterns of characters can be written into the RAM.

Firstly, write '00' Hex to the first location using your processor's monitor program and then read it back. Repeat this process with some other characters, or better still, write a simple program to write, then read, all 256 bit patterns to all locations in the first 1 K of the VDU. If the memory tests all right (i.e. what gets written also gets read) then you can skip the next section. Remember when checking the second K of memory that only the lowest order two bits are stored.

Select an address for the board, e.g. F000 – F7FF, (not F800 – FFFF) and put the processor in a loop reading from the first address of the VDU (e.g. F000). The output of the address decoder (IC34) should be normally high with a pulse going low every 20 μs or so in a typical system. The link connected to pin 7 of IC34 should be connected to earth.

Pin 12 of IC 33 should look almost identical to the previous waveform. If the program is now altered to read from the last location of the VDU, e.g. F7FF, the same waveform should be seen on IC33 pin 8. Change the program to write repeatedly to the first location and you should see a similar waveform on IC33 pin 6.

fig. 4.

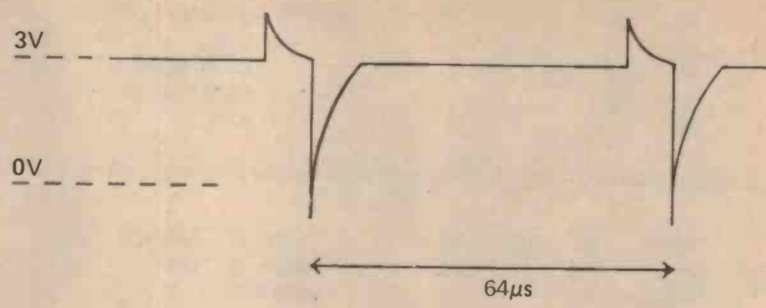


Fig. 4. The waveform on pin 6 of IC's 1B and 2B.

Now fill the screen with an assortment of characters, by writing an incrementing count to each location; for example '00' in F000, '01' in F001, '02' in F002, etc.

Note: this can be done by altering the MOV M,A to a MOV M,L (75H) in the 8080/Z80 page clear routine.

If you put this pattern right through the second K of memory as well, every second character will flash and every second pair will be graphics.

The waveforms around the ROM and shift register are constantly changing, making it virtually impossible to trigger an oscilloscope, but this doesn't matter as the actual waveforms are not important. As long as a changing waveform with suitable amplitude (3.5 – 4 V) is seen on all appropriate pins then all is well.

All the address pins to the ROM should fall into this category. Check pins 4, 8, 9, 11, 12, 15, 16 of IC4. If any pin is found to be held either high or low or if the amplitude is less than 3 V then look for shorts around this pin.

Continue checking all inputs and outputs of the multiplexers (IC's 14, 5, 6) and the inputs of the SR (IC7). On the output of the SR (pin 9) you should see a waveform that begins to resemble a video signal, i.e. a constantly changing waveform with gaps at horizontal and vertical blanking rates.

Inverse Video

The digital information is inverted by IC17 to create black on white characters. If any problems exist in this area check around the D flipflop (IC18A).

The output from the BOW inverter (IC17 pin 8) has the blanking added to it by the diode OR gate (negative logic) from the second EOL ff IC1B. The output is also forced to black at this point by the transistor whenever the processor accesses the VDU. If this point (IC16 pin 12) is being held low, lift the diode to IC1B and the collector of the transistor in turn to isolate the cause.

Flashing

The signal is forced to black whenever a flashing character is being accessed but not displayed by IC16/2. If there is no output or a character cannot be selected as flashing, check that the 555 (IC8) is producing a 2 Hz square wave on pin 3 and that all signals around the D flipflop appear normal.

Video and Sync Combiner

The only thing that stands between this point and a genuine composite video signal is a handful of discrete components.

A composite video signal is nominally 1 V peak to peak (i.e. from the bottom of sync to the top of white level) and syncs comprise only about 0.3 V of this overall 1 V. It is possible to wind the output level up to about 4 V using the 'video level' trimpot if your monitor needs this much drive.

Conclusion

The approach outlined above is really just a logical approach to faultfinding any digital circuit; start at one end and work to the other until a chip is found that is not producing the correct output for the given input. Normally it is not necessary to go through the entire circuit in this fashion as an educated guess can put the fault in a particular part of the circuit.

Remember, every minute of care taken in assembly is worth hours of debugging. Good luck and good hunting.

```
CE  F0  00        LDX F000
86  20            LDA A  20
A7  00     LOOP:  STA A  X
31                INX
8C  F8  00        CPX F800
26  F8            BNE LOOP
39                RTS
```

Fig. 5. 6800 screen clear routine. This is not located at any particular address.

```
B000  21  00  F0   LXI H  'F000'
B003  3E  20       MVI A  '20'
B005  77           MOV M,A
B006  23           INX H
B007  7C           MOV A,H
B008  FE  F8       CPI  'F8'
B00A  C2  03  B0   JNZ B003
B00D  C9           RET
```

Fig. 6. 8080/Z80 screen clear routine, shown assembled to start at B000.

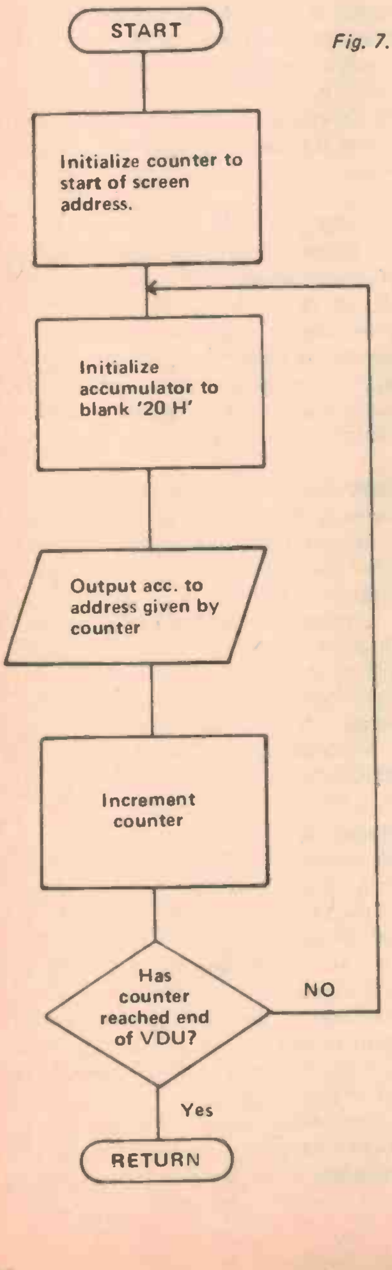


Fig. 7. Flow chart for the screen clear routine.

Software

As with all peripherals it is necessary to have some driver software that knows what the peripheral wants. In this case it is necessary to keep a counter in software of where the next character is to be written and to do decoding for any control functions that it is desired to implement. The normal way this driver would be used is to call it as a subroutine every time it is desired to output a character with the character to be output being passed in a particular register. The driver then looks at the character to determine if it is a control character (such as carriage control, or backspace etc) and if it isn't then it is placed on the screen at the cursor position and the cursor is moved on one place. Since the cursor is something written by the software you can select a variety of cursor symbols. The most useful being to use a black on white character, so when the cursor is sitting over a blank (as it usually is) then it appears as a white block, and when it is backspaced over characters, it is still possible to read the character.

Of course this driver is the normal method of outputting characters, simply operating as a 'glass Teletype' with no programming complications. If you wish to use any of the other facilities of the VDU you simply don't call this driver and access the VDU directly as memory.

A program written for some special application, such as a Radio Teletype (RTTY) substitute can use multiple cursors simply by keeping several counters of output position. Thus one area of the screen could be reserved for incoming messages while another area is outgoing message preparation area with maybe a line at the top of the page giving log information, like callsign, name, and location of station being worked.

The first part of the driver software, which it becomes immediately obvious is necessary, is a screen clear routine, as the VDU displays chaotic conglomeration of characters and graphics when it is first powered up. This routine is very simple as all it needs to do is write blanks all over the screen and set the flashing and graphic bits for each character to zero. The ASCII code for a blank is 20H and the flashing and graphic bits are the two least significant bits, so if the program writes '20H' 1024 times to make the screen blank and then continues to write '20H' another 1024 times to eliminate any graphics or flashing characters then our object has been achieved. The program to do this can be written in a lot less space than it takes to describe it, see the flowchart in figure 7.

The listings given are not minimized completely but are written to agree with the flowchart for clarity. As you can see all the programs refer to the start of the VDU as 'F000H', this is where I have located the VDU in my system so that it is up near the top of memory and out of the way of program space. It is not advisable to put the VDU at 'F800', the very top of memory, as the processor's bus will usually 'float high' when tri-stated and hence attempt to write to the VDU and blank the screen. If the choice of 'F000H' doesn't conflict with your existing memory map I recommend you use this address to facilitate any software interchange.

Software beyond this is best left to the individual constructor, as everyone has different requirements. It is not difficult to write the simple routines necessary to update the cursor and write characters onto the screen, but there are so many processors in use at present that it is of little value to give them for one particular processor. We are, however considering the possibilities of expansion of the 8080 Octal monitor published in our December 1977 issue and when (and if!) we get it all running we shall no doubt publish it.

In the meantime, we are interested in hearing from readers who have written software compatible with the 640 VDU and will consider publishing software in a section similar to Ideas for Experimenters (for payment, of course!). Reader feedback is invaluable and we would like to hear of your experiences, perhaps for publication to aid other readers.

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zener	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25

SOCKETS/BRIDGES

8-pin	pcb .20	ww	.35
14-pin	pcb .20	ww	.40
16-pin	pcb .20	ww	.40
18-pin	pcb .25	ww	.75
22-pin	pcb .35	ww	.95
24-pin	pcb .35	ww	.95
28-pin	pcb .45	ww	1.25
40-pin	pcb .50	ww	1.25

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2 Amp Bridge		100-prv	.95
25 Amp Bridge		200-prv	1.95

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2N2907	PNP	.15
2N3906	PNP (Plastic - Unmarked)	.10
2N3904	NPN (Plastic - Unmarked)	.10
2N3054	NPN	.35
2N3055	NPN 15A 60v	.50
T1P125	PNP Darlington	.35
LED Green, Red, Clear, Yellow		.15
D.L.747	7 seg 5/8" High com-anode	1.95
MAN72	7 seg com-anode (Red)	1.25
MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74A	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

C MOS

4000	.15
4001	.15
4002	.20
4004	3.95
4006	.95
4007	.20
4008	.75
4009	.35
4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
4021	.75
4022	.75
4023	.20
4024	.75
4025	.20
4026	1.95
4027	.35
4028	.75
4030	.35
4033	1.50
4034	2.45
4035	.75
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
MC 14419	4.85
4511	.95
74C151	1.90

– T T L –

7400	.10
7401	.15
7402	.15
7403	.15
7404	.10
7405	.25
7406	.25
7407	.55
7408	.15
7409	.15
7410	.15
7411	.25
7412	.25
7413	.25
7414	.75
7416	.25
7417	.40
7420	.15
7426	.25
7427	.25
7430	.15
7432	.20
7437	.20
7438	.20
7440	.20
7441	1.15
7442	.45
7443	.45
7444	.45
7445	.65
7446	.70
7447	.70
7448	.50
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.40
7473	.25
7474	.30
7475	.35
7476	.40
7480	.55
7481	.75
7483	.75
7485	.55
7486	.25
7489	1.05
7490	.45
7491	.70
7492	.45
7493	.35
7494	.75
7495	.60
7496	.80
74100	1.15
74107	.25
74121	.35
74122	.55
74123	.35
74125	.45
74126	.35
74132	.75
74141	.90
74150	.85
74151	.65
74153	.75
74154	.95
74156	.70
74157	.65
74161	.55
74163	.85
74164	.60
74165	1.10
74166	1.25
74175	.80
74176	.85
74180	.55
74181	2.25
74182	.75
74190	1.25
74191	.95
74192	.75
74193	.85
74194	.95
74195	.95
74196	.95
74197	.95
74198	1.45
74221	1.00
74367	.75
75108A	.35
75491	.50
75492	.50
74H00	.15
74H01	.20
74H04	.20
74H05	.20
74H08	.35
74H10	.35
74H11	.25
74H15	.45
74H20	.25
74H21	.25
74H22	.40
74H30	.20
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.20
74H72	.35
74H101	.75
74H103	.55
74H106	.95
74L00	.25
74L02	.20
74L03	.25
74L04	.30
74L10	.20
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.85
74S00	.35
74S02	.35
74S03	.25
74S04	.25
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.25
74S40	.20
74S50	.20
74S51	.25
74S64	.15
74S74	.35
74S112	.60
74S114	.65
74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.20
74LS01	.20
74LS02	.20
74LS04	.20
74LS05	.25
74LS08	.25
74LS09	.25
74LS10	.25
74LS11	.25
74LS20	.20
74LS21	.25
74LS22	.25
74LS32	.25
74LS37	.25
74LS38	.35
74LS40	.30
74LS42	.65
74LS51	.35
74LS74	.35
74LS86	.35
74LS90	.55
74LS93	.55
74LS107	.40
74LS123	1.00
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LM320T12	1.65
LM320T15	1.65
LM324N	1.25
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LM340T15	.95
LM340T18	.95
LM340T24	.95
LM340K12	1.25
LM340K15	1.25
LM340K18	1.25
LM340K24	1.25
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LM711	.45
LM723	.40
LM725N	2.50
LM739	1.50
LM741 (8-14)	.25
LM747	1.10
LM1307	1.25
LM1458	.65
LM3900	.50
LM75451	.65
NE555	.35
NE556	.85
NE565	.95
NE566	1.25
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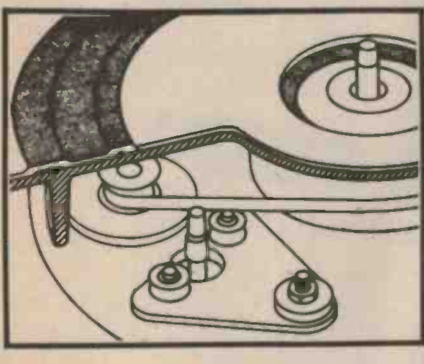

In essence the 830 may be seen as a belt-drive unit but with an idler wheel drive which automatically aids the drive belt whilst running up to speed and also during the inward and outward movement of the pick-up arm. In addition the mechanism ensures that the drive belt is slackened off whenever the turntable is switched off thus preventing belt stretching unevenly. The result of all this is extraordinary smoothness reflected in a wow and flutter figure of 0.08 percent. Rumble is down to 44 dB and signal noise 64 dB.
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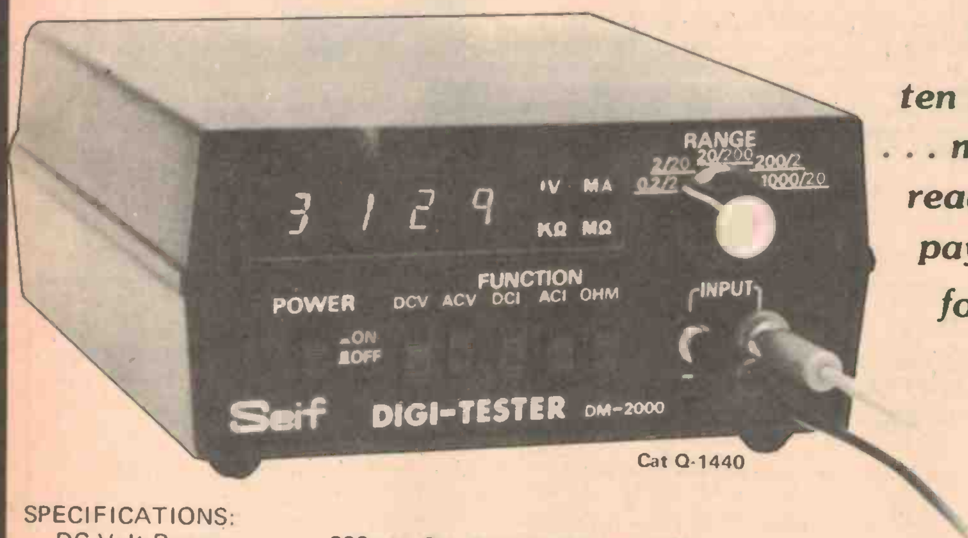

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We get many enquiries from readers wanting to know where they can get kits for the projects we publish. The list below indicates the suppliers we know about and the kits they do.

Any companies who want to be included in this list should phone LES BELL on 33-4282.

Key to companies:

- **A** Applied Technology Pty. Ltd. 109 - 111 Hunter St, Hornsby. 2077. NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW. (see Ads. for address).
- **E** All Electric Components (formerly ED & E Sales), 118 Lonsdale Street, Melbourne, Victoria, 3000.
- **J** Jaycar Pty. Ltd. 405 Sussex St., Sydney 2000.
- **L** Delsound Pty. 1 Wickham Terrace. Queensland.
- **M** Mode Electronics. PO Box 365, Mascot 2020.
- **N** Nebula Electronics Pty. Ltd. 15 – 19 Boundary St., Rushcutters Bay 2011. NSW.
- **P** Pre-Pac Electronics. 718 Parramatta Rd., Croydon NSW 2132.
- **T** Townsville Electronics Centre. 281E Charters Towers Rd, Rising Sun Arcade, Hermit Park. 4812

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ETI 072	2-Octave Organ	DS
ETI 081	Tachometer	E

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ETI 105	Lab Power Supply	E
ETI 107	Widerange Voltmeter	E
ETI 108	Decade Resistance Box	ES
ETI 109	Digital Frequency Meter	E
ETI 111	IC Power Supply	ES
ETI 112	Audio Attenuator	ES
ETI 113	7-Input Thermocouple Meter	P,E
ETI 116	Impedance Meter	ES
ETI 117	Digital Voltmeter	E,AS
ETI 118	Simple Frequency Counter	E,AS
ETI 119	5V Switching Regulator supply	ETS
ETI 120	Logic Probe	L,ES
ETI 121	Logic Pulser	L,ES
ETI 122	Logic Tester	ES
ETI 123	CMOS Tester	ES
ETI 124	Tone Burst Generator	ES
ETI 128	Audio Millivoltmeter	L,ES
ETI 129	RF Signal Generator	L,ES
ETI 130	Temperature Meter	E
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	NSE
ETI 133	Phase Meter	E
ETI 134	True RMS Voltmeter	E

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ETI 218	Monophonic Organ	ET
ETI 219	Siren	ET
ETI 220	Siren	ET
ETI 222	Transistor Tester	ETS
ETI 234	Simple Intercom	T
ETI 236	Code Practice Oscillator	E
ETI 239	Breakdown Beacon	E
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ETI 302	Tacho Dwell	ET
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ETI 313	Car Alarm	E,DT
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ETI 317	Rev. Monitor	E

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ETI 413	x 200 Watt Bridge Amp	S E
ETI 414	Master Mixer	E,J
ETI 416	25 Watt Amplifier	E
ETI 417	Amp Overload Indicator	E
ETI 419	Guitar Amp Pre-Amp	P,E,DT
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	S L,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
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ETI 427	Graphic Equaliser	S L,E,J
ETI 429	Simple Stereo Amplifier	E
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ETI 435	Crossover Amp	J
ETI 438	Audio Level Meter	L,ES
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,ES
ETI 443	Compressor-Expander	E,J
ETI 444	Five Watt Stereo	ES
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ETI 446	Audio Limiter	J
ETI 447	Phaser	E,J
ETI 449	Balanced Mic Preamp	JE
ETI 480	50 W, 100 W Power Amp	A
ETI 480P	Power Supply	DAT
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ETI 534	Calculator Stopwatch	A,D
ETI 539	Touch Switch	E
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ETI 704	Crosshatch/Dot Generator	L,A,D,ES
ETI 706	Marker Generator	ES
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 709	RF Attenuator	E
ETI 710	2 metre Booster	C,E
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ETI 711C	Double Relay Remote Control	AE
ETI 711R	Receiver	AE
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Device	# of Op Amps	Internal Compensation	Offset Voltage Null	Pin-out Equivalents
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TL081	1	Yes	Yes	μA741; LF13741; CA3140; LF355
TL082	2	Yes	No	LM358; MC1458; RC4558
TL083	2	Yes	Yes	μA747
TL084	4	Yes	No	LM324

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Designing Oscillators

One of the problems in electronics is stopping amplifiers from oscillating, another problem is getting oscillators to oscillate . . . Tim Orr explains.

AN OSCILLATOR is basically an amplifer with positive feedback applied around it. The feedback must be ac coupled otherwise a dc latch up condition would occur. Having got some sort of oscillation, one of two things can happen. The oscillation can build up in amplitude until clipping occurs due to the power supply voltage levels: at this point a stable, but truncated waveform will be generated. Alternatively if the gain of the amplifier is too low the oscillation will die away.

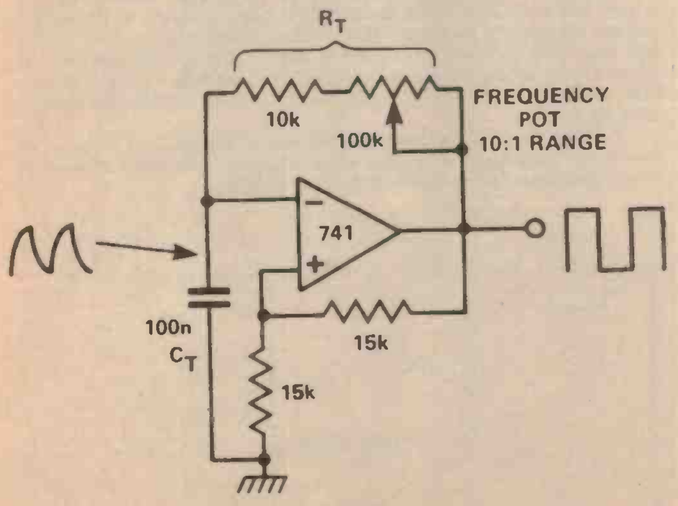
To produce a pure sinusoidal oscillation the level of the signal in the system must be accurately controlled. There must be some amplitude limiting or automatic gain control such that when the peak signal level tries to exceed a reference voltage, the amplifier's gain is reduced. This is in fact what limiting does. To maintain stable oscillation, the overall gain of the system must be exactly unity. Any less and oscillations will never start. If the gain is more than unity, oscillations will occur, but amplitude limiting will cause gross distortion.

A very common method for stabilising oscillations, which is often used in Wein bridge oscillators, is to employ a very sensitive thermistor as an automatic gain control device. However, the thermal time constant of this component often produces an annoying amplitude bounce which occurs when changing to a new frequency.

Other methods are diode limiters (which tend to cause large amounts of distortion) and FET AGC circuits. The latter method can be used to generate super low distortion sinusoids by allowing the system gain to stabilise over tens of seconds.

The oscillation frequency is mainly determined by the feedback around the amplifier. By making the feedback reactive, the phase of the feedback will vary as a function of frequency. Oscillations can only occur when the feedback is positive and thus the phase response of the feedback will determine the frequency of oscillation, assuming that the overall gain at this frequency is at least unity. By varying the phase response of the feedback, the oscillation frequency may be altered.

An oscillator should be thought of as being a circuit which continuously generates a waveform, no matter what the shape of the waveform, There are very many circuit techniques for generating these signals which range from relaxation oscillators to piece-wise approximations using square waves. This article shows many such techniques.

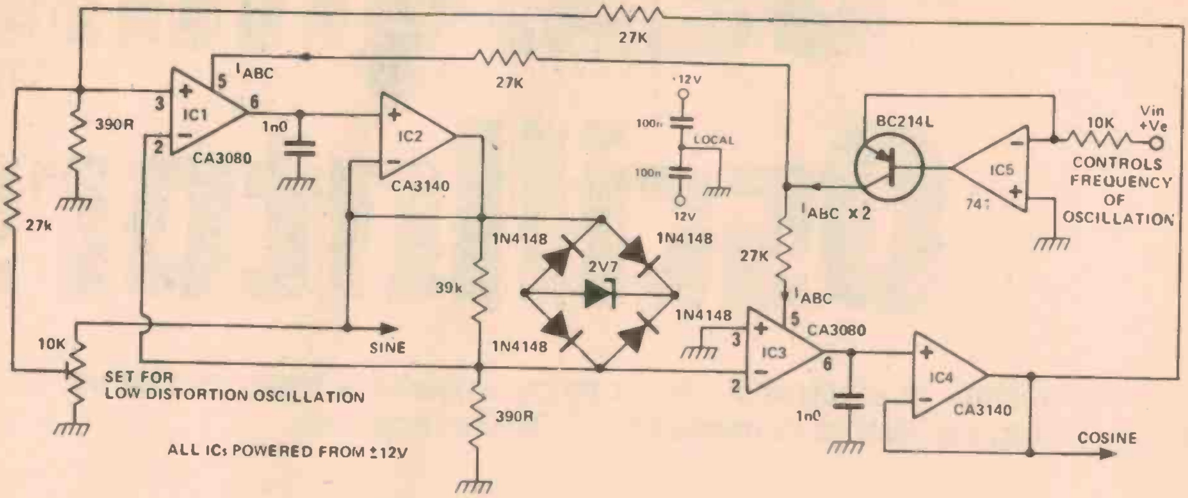


Manually Controlled Oscillator

In this circuit there are two feedback paths around an op-amp. One is positive dc feedback which forms a Schmitt trigger, the other is a CR timing network.

Imagine that the output voltage is +10V. The voltage at the non-inverting terminal is +15V. The voltage at the non-inverting terminal is +15V. The voltage at the inverting terminal is rising voltage with a time constant of C_TR_T. When this voltage exceeds +15V, the op amp's output will go low and the Schmitt trigger action will make it snap into its negative state. Now the output is −10V and the voltage at the inverting terminal falls with the same time constant as before. By changing this time constant with a variable resistor a variable frequency oscillation may be produced.

Oscillators



Dual Integrator Quadrature VCO

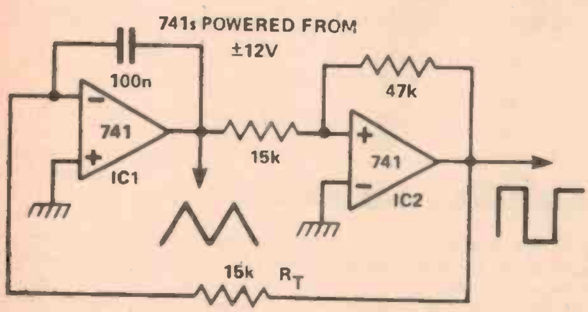
This is a sinusoidal oscillator which uses frequency dependent feedback and zener diode amplitude limiting. IC1,2,3&4 form a dual integrator circuit which is an analogue model of a second order differential equation! There is some positive feedback around IC1,2 which is analogous to having a zero damping factor in the equation. This means that the oscillations will build up. The positive feedback is controlled by the 10 k preset. IC1,3, are integrators and IC2 and IC4 are voltage followers with high input impedance. The phase shift produced by an integrator is 90° so there is no overall feedback around the loop (IC1 is non-inverting, IC2 inverts). Thus we have all the conditions for oscillation, and in fact oscillations will occur when the preset is adjusted to give the correct phase shift around the IC1,2 stage.

Amplitude limiting is produced by the 2V7 zener inside the diode bridge. By placing it inside the bridge the same diode is used for both positive and negative signals and the limiting is symmetrical. The integrators are two quadrant multipliers (CA3080s), so the gain of the loop can be controlled by the current I_{ABC}. In the solution of this second order differential equation, the gain of the loop is proportional to the resonant frequency. Thus, by varying I_{ABC} or rather by varying V_{IN}, the frequency of oscillation may be altered.

As the integrators produce a 90° phase shift, the two sinusoid outputs are in phase quadrature, i.e. one is a sinewave, the other a cosine wave. The cosine output is lower in distortion than the sinewave, because the amplitude limiting (and hence the distortion) is producted at the IC1,2 stage.

The second stage (IC3,4) acts as a filter and hence produces a purer sinusoid. Using this circuit a 1000 to 1 continuous frequency sweep can be obtained. However, the inaccuracies in the CA3080's will cause some amplitude variations and it may be necessary to set the positive feedback a bit high (and hence attract more distortion), to maintain stable amplitude limiting over the sweep range. This circuit is an oscillating filter and if you turn down the positive feedback and inject a small signal through a 100 k resistor into IC1 pin 3, a bandpass and low pass response is obtained from the sine and cosine outputs respectively.

Simple Triangle Square Wave Oscillator



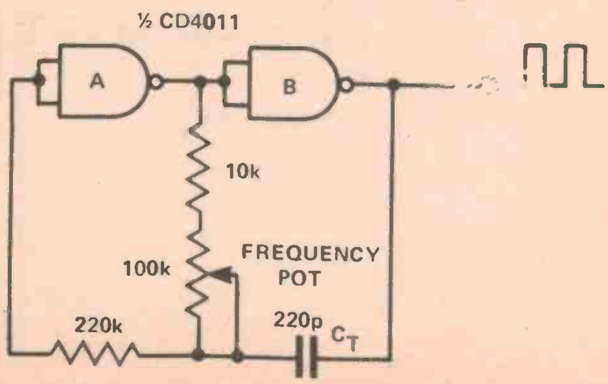
This circuit generates simultaneously a triangle and a square waveform. The triangle could be 'bent' by a diode function generator to produce a sinewave. The circuit is always self starting and has no latch up problems. IC1 is an integrator with a slew rate determined by C_T and R_T and IC2 is a Schmitt trigger. The output of IC1 ramps up and down between the hysteresis levels of the Schmitt, the output of which drives the integrator.

By making R_T variable it is possible to alter the operating frequency over 100 to 1 range. Three resistors, one capacitor and a dual op amp is all that is needed to make a versatile triangle squarewave oscillator with a possible frequency range of 0.1Hz to 100kHz.

CMOS Oscillator

Two CMOS gates can be used to produce a simple oscillator. Imagine that output B is high. Then the input to A is also high due to it being coupled via the capacitor C_T to output B. Thus output A is low, input B is low and output B is high, which is as we would expect. However, capacitor C_T is being discharged via the 100 k pot and 10 k resistor to a logic 0. When this voltage reaches the crossover point for A, output A goes high, and thus output B goes low. Now the capacitor is charged up to a logic 1. Thus the process repeats itself.

Varying the 100 k pot changes the discharge rate of C_T and hence the frequency. A square wave output is generated. The maximum frequency using CMOS is limited to 2 MHz.

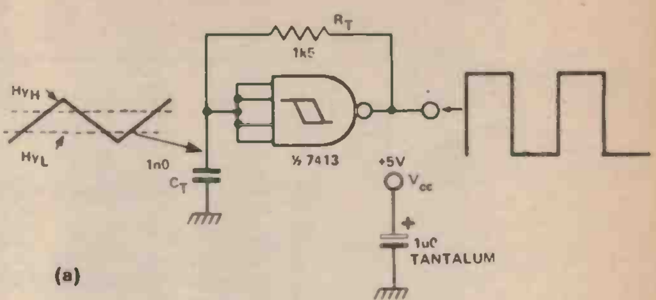


TTL Oscillator

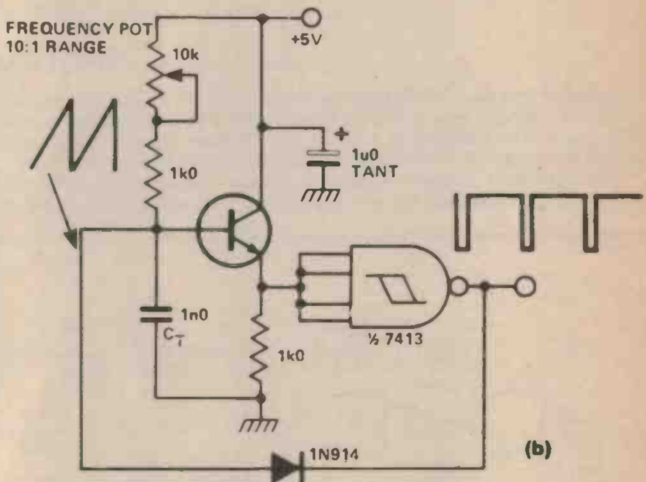
A simple relaxation oscillator can be made using a TTL Schmitt trigger. The circuit 'a' is the most simple version that can be produced. Imagine that the output is high. Capacitor C_T is charged up via R_T. when the upper hysteresis level (Hyh) is reached, the output goes low. CT is now discharged until the low hysteresis level (Hyl) is reached whereupon the output goes high. Thus the oscillator generates a square wave, with an uneven mark to space ratio, due to the output current requirements of the 7413. The frequency can be set at any value up to several megahertz by varying C_T and R_T. C_T can be an electrolytic by R_T must not be more than about 1k5 or it will not be able to pull down the Schmitt trigger inputs. (If you use a CMOS Schmitt this does not apply). The output is a nice fast squarewave capable of directly driving several TTL loads.

One problem to be encountered is frequency jitter. When the input is very near to a hysteresis level, noise in the system may cause the oscillator to prematurely trigger, thus making that period slightly shorter and producing a noise induced frequency jitter. Also using two Schmitt triggers from the same IC is sure to cause interaction and thus jitter. To reduce power supply noise effects the IC should be decoupled with a 1 uF tantulum capacitor actually at the V_{cc} and GND pins of the package.

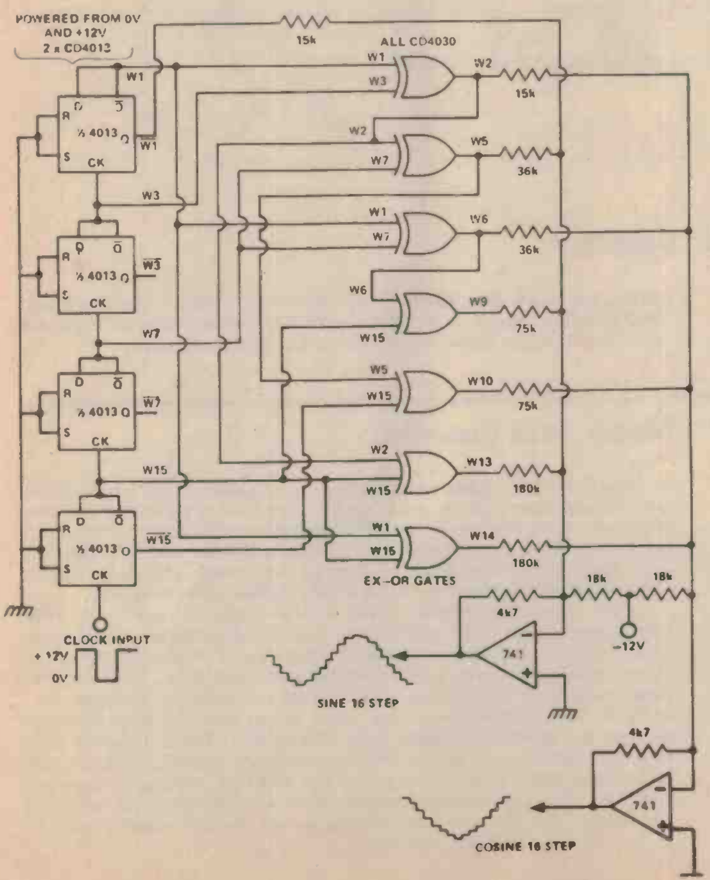
Diagram 'b' shows the same oscillator, but with a 10 to 1 manual control of frequency. The timing capacitor is charged up by the 10 k pot and the 1 k resistor. This voltage is then buffered by the emitter follower and fed to the Schmitt trigger. When the upper hysteresis level is reached the output of the Schmitt goes low and the capacitor is rapidly discharged via the diode until the lower level is reached. The process then repeats itself. As the discharge period is so fast, it can be as short as a few hundred nano seconds, the period can be thought of as being determined by the charging time, which is controlled by the 10 k pot.



(a)



(b)



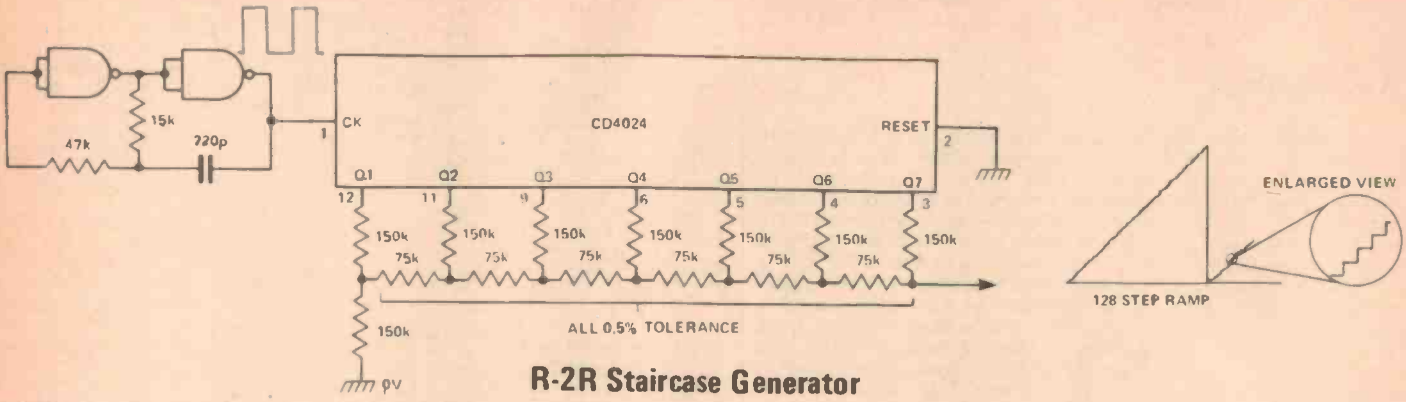
Walsh Function Generator

The mathematician, Fourier, said that any repeating waveform coulb be made up out of harmonic components. These components are sinusoids which are integrally related to the fundamental period of the waveform in question. This is a convenient conceptual approach, but as a way of practically synthesising waveforms it is not on. You would have to generate a whole series of harmonically related sinewaves which might prove a little difficult. However, a man called Walsh said that you could do the same thing as Fourier, but with square waves. So, instead of using sinusoidal Fourier sets, we can use square wave Walsh functions to synthesise waveforms.

There are various techniques for calculating the Walsh function co-efficients for generating particular waveforms but these are beyond the scope of an article such as this. The diagram shows the circuit for generating a sine and cosine waveforms using 16 steps. Walsh functions are orthogonal functions, just as sine and cosine are orthogonal, and so the generation of these two waveforms is relatively simple using this technique. The 4013 dividers and the exclusive OR gates generate the Walsh functions, which in turn are converted into analogue waveforms by use of the correctly weighted resistor networks. Note that you only need four resistors to generate 16 step sinewave approximation.

The resultant outputs can be easily filtered by fixed or tracking filters to produce pure sinusoids. The output frequency is 1/16th of the input clock frequency. The clock can be stopped and the outputs will remain fixed, try that with analogue techniques!

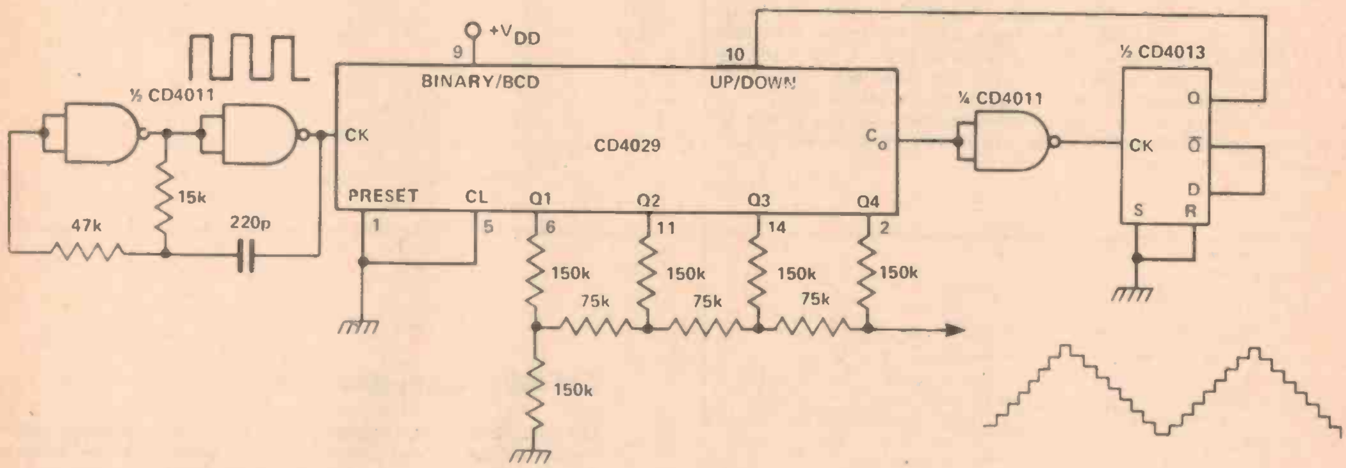
Oscillators



R-2R Staircase Generator

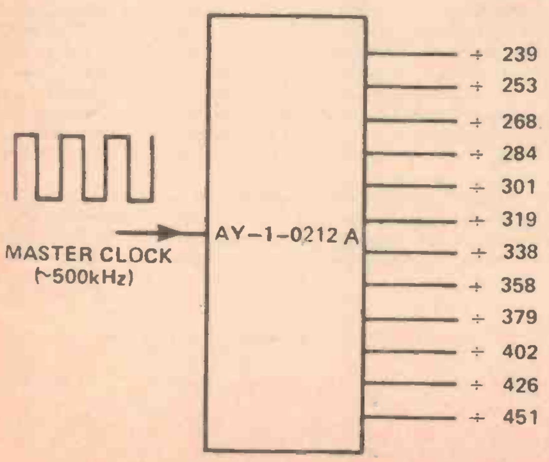
Waveforms can be constructed by building them up out of separate elements. In this case a linear ramp waveform is generated out of 128 steps. The CD4024 is a seven stage binary counter. It is being driven from a CMOS clock oscillator similar to that already described.

The Q1 to 7 outputs divide this clock frequency by 2,4,8,16, 32,64and 128 respectively and the divided outputs are then fed into an R,2R ladder network. This is in fact a Digital to Analogue Converter (DAC) and as the counter is merely counting up, the converter will generate a linearly rising waveform made out of 128 steps. When the counter overflows, the ramp waveform resets and the process repeats itself.



R-2R Triangle Generator

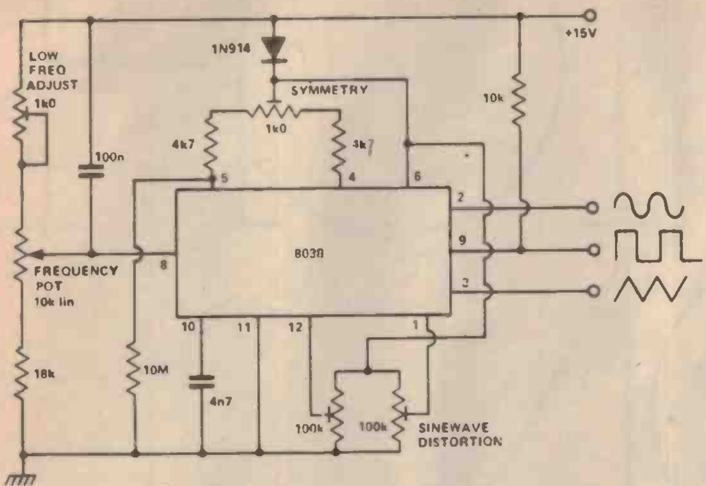
This circuit is similar to the previous except an up down counter is included. A clock signal is applied to the 4029 counter. When it has counted 16 clocks a Carry signal is generated. This clocks a D type flip-flop (4013), which changes state and reverses the up down mode of the 4029. Thus the circuit counts up, down up, etc. The counting is converted via an R,2R ladder into an analogue output, a triangle waveform made up out of several steps.



Master Tone Generator

If you have ever made an electric organ, piano or string machine you would have had to produce the top twelve notes for the top octave by some means or other. Some organs use 12 master oscillators which would be tuned to the top twelve semitones on the keyboard. This gives a nice free phase quality to the sound. The notes in the octabes below are made by using binary dividers and filtering.

Very expensive organs would use an oscillator per note. This allows every note to be individually tuned and produces a very good sound quality. However, there is an easy way of producing the semitones and this is with a master tone generator chip. This is a pre-programmed divider having one input and twelve or thirteen outputs. A high frequency master clock is put into the chip which is divided by numbers ranging from 239 to 451. These divisions produce the semitone outputs. Thus, by using one master oscillator and one master tone generator a lot of the work of making an organ is removed. It is possible to produce more accurate intervals using 12 oscillators, but the speed and efficiency of the chip usually wins in the lower price end of the market.



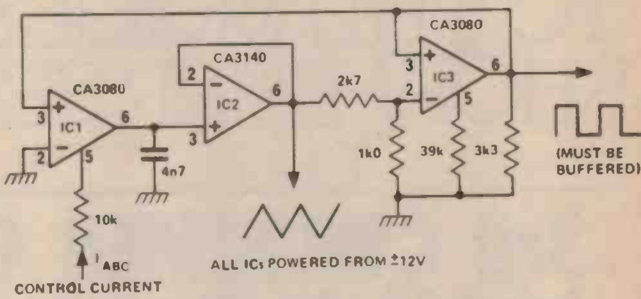
8038 Function Generator

There are several ICs available which perform some sort of oscillator function. One such is the Intersil 8038 which is a VCO with sine, triangle and squarewave outputs. The basic oscillator is a triangle squarewave device with a function generator to produce the sinewave. The frequency is voltage controllable but is not a linear function. The triangle symmetry and hence sinewave distortion are adjustable with a preset but change when the frequency is altered. Operation up to 1 MHz is possible.

Triangle Squarewave ICO Using CA3080's

This circuit is very similar to that of the simple triangle/square oscillator, except that the operating frequency is controlled by a current IABC. (ICO stands for current controlled oscillator, as opposed to VCO, voltage controlled oscillator). Using this circuit, a sweep range of 10,000 to 1 is possible (for IABC 500 uA to 50 nA).

The CA3080 is a two quadrant multiplier and the CA3140 is a MOS FET op-amp. IC1 is used as an integrator. IC2 is a high input impedance voltage follower and IC3 is a Schmitt trigger. The CA3080 has a current output which in the case of IC1 is used to charge up a capacitor. The voltage on this capacitor is buffered by the CA3140 and fed into the Schmitt IC3. The CA3080 (IC3) forms a very fast Schmitt trigger but as it has a current output, it cannot be loaded in any way without affecting the operating frequency. The output of the Schmitt is used to make the integrator inverting or non-inverting. Thus the operation is as follows. The integrator ramps upward until the positive hysteresis level is reached. The Schmitt flips over, the integrator then ramps downwards until the negative hysteresis level is reached. The Schmitt flips back and the process is repeated.

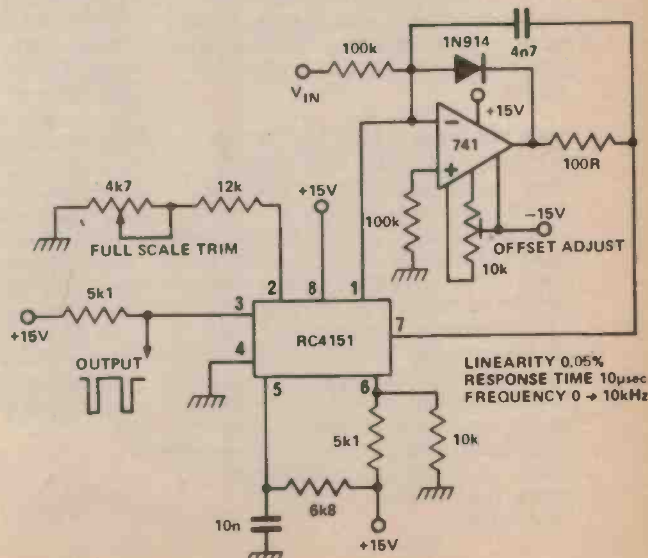


The ramp rate is determined by the size of the current I_{ABC} is linearly proportional to the oscillation frequency. At very low currents the triangle wave form may become very asymmetrical. This is due to current mirror mismatches inside IC1 and this device may have to be specially selected for continuous symmetry.

Precision Voltage Controlled Oscillator

The RC 4151 is a precision voltage to frequency converter. It generates a pulse train output which is linearly proportional to the input voltage. The linearity for the circuit shown is 0.05%. The IC compares the input voltage with an internally generated one. It dumps controlled pulses of charge into a parallel RC network and compares this generated voltage with the input. If the Input is greater it puts more pulses of charge into the RC network until the two are balanced. To get a larger sustained voltage in the RC netword the frequency of the pulses must be increased. Thus the frequency of the pulses generated is made to be proportional to the input voltage.

The input is a pulse waveform and is intended to drive some sort of counting system, the chip being used as simple analogue to digital converter. It can also be used as a frequency to voltage converter. A maximum frequency of 10 kHz has to be observed.



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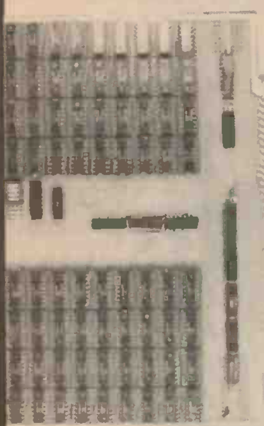

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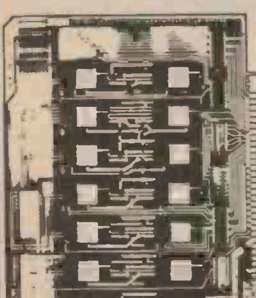

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DIGITAL ELECTRONICS BY EXPERIMENT pt 4

IN THIS PART of the course we shall look into sequential logic using the 7400 IC as a building block.

Set the IC up on the board to make a circuit using two of the logic gates as shown in Fig. 1. The gate with its output taken to the LED should have its spare input marked R, while the spare input to the other gate should be marked S.

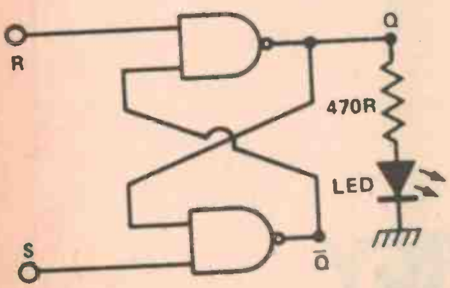


Fig. 1 Cross-coupled NAND gates forming an R-S flip-flop.

This circuit is a flip-flop, as you may have guessed from the cross-coupling of inputs and outputs. Complete the table shown in Fig. 2, and note that the output for R = 1, S = 1 is *not* the same in each case.

Sequential Logic

The R-S flip-flop, as this is called, is an example of a sequential logic circuit, in which the output depends on the *sequence* of signals at the input — in other words, the state of the output depends on the previous signals as well as the present ones. Strictly speaking this circuit is more of a *latch*, a circuit which temporarily stores an output while both inputs are high. Note that in normal use, we want two outputs Q and $\overline{Q}$ to be complementary ($\overline{Q}$ is always the inverse of Q) so that the input R = 0, S = 0 must not be used, since this gives Q = $\overline{Q}$ = 1.

In logic circuits, clocked flip-flops are much more common. A clocked flip-flop changes state only when a timing, or clock pulse is received. This is done by combining the flip-flop action with gating so that the signal inputs have no effect until the gating (clock) pulse arrives.

One type of clocked flip-flop is the D-type, and a typical truth table is shown in Fig. 3. In this type of circuit the signal (0 or 1) which is present at

R	S	Q
0	1	
1	1	
1	0	
1	1	

Fig. 2. Part truth for R-S flip-flop. When you complete the table, taking readings from your blob-board circuit, be sure to work through each state in sequence.

the D (for Data) terminal is transferred to the output at the clock pulse, and remains unchanged until the data changes *and* the clock pulse arrives.

Clocked Flip-Flop

The type of flip-flop chosen for this board is the J-K flip-flop. This is a more versatile device which combines clocking with gating to achieve a wide range of actions. On the type we have chosen, the SN7476, the action is the type known as "Master-Slave", which means that the input signals are accepted on the leading edge of the clock pluse, but the outputs do not change until the trailing edge comes along. This avoids problems which would occur if outputs were connected back to the inputs, as we shall see later.

The J-K flip-flop has five inputs and two outputs. The inputs are labelled J, K, Clock, Set and Reset (the Reset is sometimes called clear, and the Set terminal is sometimes called preset). The outputs are Q and $\overline{Q}$, with $\overline{Q}$ always the inverse of Q. We shall check the action of the J-K flip-flop using signals generated on the board.

From previous work you should have available one section of the 7414 connected as a low speed oscillator. This provides an ideal slow clock pulse, and you should already have an LED connected to the output of the 7414 to monitor this pulse.

Double Flip-Flops

The connection diagram of the 7476 is shown in Fig. 5. From this you will see that the 7476 contains two J-K flip-flops which are completely independent. For the first series of practical exercises we shall use only one half.

Solder connections from pin 13 of the 7476 to earth, and from pin 5 to the +5 V line. Now solder an insulated wire connection from the clock oscillator output to pin 1 of the 7476, so that flip-flop number 1 is activated.

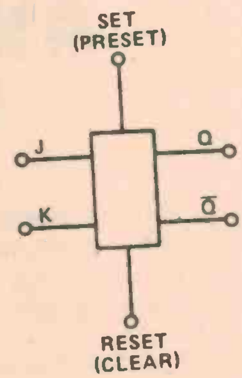


Fig. 4. J-K flip-flop symbol.

Connect pins 4 and 16 to earth so that J = 0 and K = 0, and connect switches so that the reset pin (pin 3) and the set pin (pin 2) can be connected momentarily to earth as needed. The circuit is now as Fig. 6, and the board appears as shown in Fig. 7.

Now connect a resistor from pin 15 (Q) to a spare pad, and an LED from the spare pad to earth. This LED will

D SIGNAL	Q BEFORE CLOCK	Q AFTER CLOCK
0	0	0
0	1	0
1	0	1
1	1	1

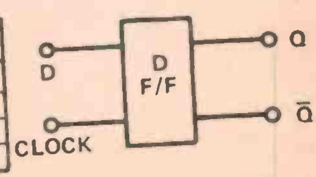


Fig. 3. D-type flip-flop and truth table. Note that, unlike the R-S flip-flop, changes take place only when the clock pulse arrives.

indicate the state of the Q output from the flip-flop.

Switch on, and look at the LED. Using the SET switch, set the output to give logic 1. (This happens when the SET switch is returned to 0, whatever the clock pulse is doing at the time.) When the switch is changed back again, does the output change at once? Or when a clock pulse arrives?

These changes and others which follow may be easier to observe if the clock pulse is very slow, and a 1 000 μF, or greater, capacitor may be used in the oscillator circuit. Later, a "debounced" switch will be used.

Complete this sequential truth table, in which Q_{n-1} is the value of Q just before the clock pulse arrives, and Q_n is the value of Q just after the end of the clock pulse (the 1 to 0 change). Can you decide when the change, if any, occurs? Is it on the leading or the trailing edge of the clock pulse?

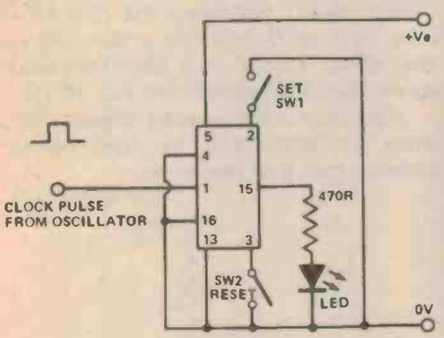


Fig. 6. Circuit for checking J-K action, see text for details.

Now switch off, and disconnect one end of the link between K pin (pin 16) and earth, so allowing K to float to 1. Now we have J = 0 and K = 1. Switch on and observe the output. Change the output by using a switch (which one will you use, SET or RESET?). Does the clock pulse affect the output after the switch has been returned to normal?

Switch off again and reverse the connections so that J = 1 and K = 0, and repeat your readings. Enter all the readings on the sequential truth table of Fig. 8.

From these exercises you will have found that the action of the J-K flip-flop can be controlled by the J and K inputs, which act to force the output to either 1 or 0 when the clock pulse arrives. The SET and RESET pins act independently of the clock, making the output go to 0 or 1, and holding it there until the reset or set voltage rises to 1 again, when the next clock pulse will cause whatever output is forced by the J and K voltages.

Toggling

With the power off, disconnect the

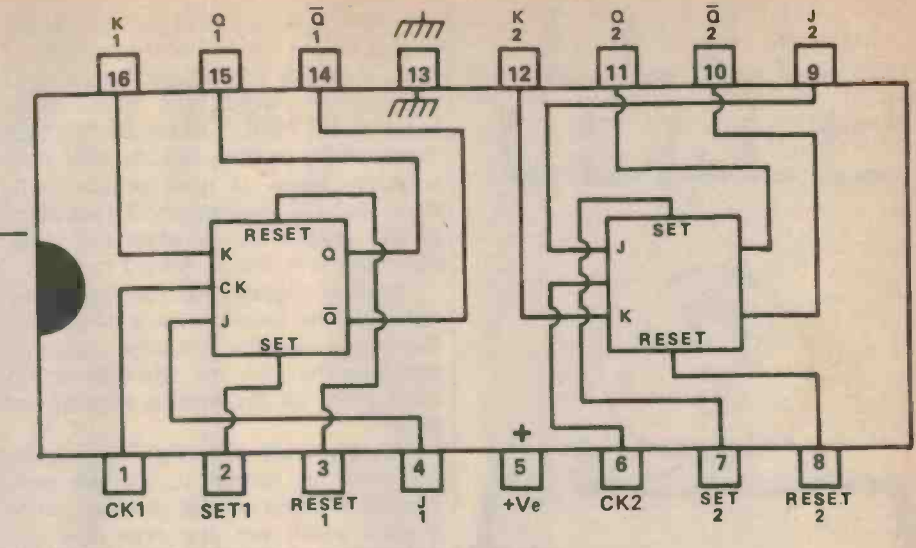
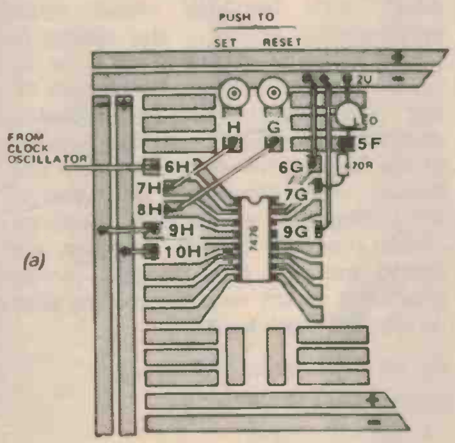


Fig. 5. Pinout of the SN7476 dual master-slave J-K flip-flop.

wires from both J (pin 4) and K (pin 16). Switch on again, and observe both the output and the clock LEDs. Now complete the truth table of Fig. 8 (c). In this arrangement the J-K flip-flop is acting as a divide-by-two stage, for there is one complete output pulse for each two complete input pulses — we say that the flip-flop is *toggling*. At any time during this action, the output may be forced to 1 or 0 by the action of the SET or RESET pins, but it will revert to the toggling action when the SET or RESET is released.



(a)

J=0
K=0

Q_{n-1}	On
0	
1	

(b)

Q_{n-1} – STATE OF Q (0 OR 1) BEFORE CLOCK PULSE

On – STATE OF Q (0 OR 1) AFTER CLOCK PULSE

Fig. 7. (a) The layout on the board, with the LED in position.
(b) Form of part truth table.

J=0
K=1

Q_{n-1}	Qn
0	
1	

J=1
K=0

Q_{n-1}	Qn
0	
1	

J=1
K=1

Q_{n-1}	Qn
0	
1	

Fig. 8. Remaining truth tables for J-K action.

Try applying a clock pulse obtained from a switch, as in Fig. 9 (a). Wire the switch to the board and replace the connection between the 7414 clock generator and the flip-flop with a connection from the switch output on the flip-flop clock input. Turn on the 5 V supply, and use the switch as a slow clock generator. You will probably find that the output is erratic, sometimes seeming not to change the output when the switch is operated.

This is caused by switch contact bounce.

Switch Debouncing

With power off, rewire the switch with a resistor and a capacitor to one of the spare sections of the 7414, as shown in Fig. 9 (b). This is a simple de-bouncing circuit.

Solder a resistor and an LED to the output of the 7414 in the usual way to show the state of the clock pulse, and connect the output also to the clock input of the 7476. You should find that the action is perfect, and the very slow clocking which is now possible will show that the changes which take place at the output do so when the clock pulse goes low, that is, from 1 to 0.

Note that other flip-flop types may not have the same sequence of actions. Some, for example, are edge triggered, meaning that all the flip-flop action takes place on the leading edge of the clock.

When you are using flip-flop circuits, you must be careful to use the same type of flip-flop as that specified, since circuits which suit one type may not suit another. In particular, the 7476 "Master-Slave" type of flip-flop has a particularly complex action.

In essence, the action is that on the leading edge of the clock, the information which is present (1 or 0) at the J and K inputs is stored and once the clock pulse has reached its 1 value, these inputs are locked out, meaning that changes in J and K will now have no effect. At the trailing edge of the clock pulse, the flip-flop action takes place to change the output. The reason for this construction is that several types of circuits, some of which we shall build in this series, use feedback connections between the output of the flip-flop and its J or K inputs.

If all the action of the flip-flop happened at the leading edge of the clock, such feedback would cause indeterminate action — any change in Q would cause a change in J or K, which might cancel the effect on Q, and the flip-flop would probably oscillate at the high frequency. Because of the Master-Slave action, this does not happen — the changes in Q happen at the trailing edge of the clock pulse, by which time the J and K inputs are locked out and their voltages cannot affect the action until the leading edge of the next clock pulse.

Investigation

You should already have one section of the 7414 set up as a high frequency oscillator with earphones, or similar, to detect the output note. What is the effect of leading the output of the 7414 oscillator to the clock terminal of the 7476 with J = 1 and K = 1? Listen to the output wave from Q and compare it with the signal from the oscillator.

Can you now design an "octave" oscillator? This circuit will use a single oscillator, but its output will be alternately at oscillator frequency, then at half oscillator frequency (one musical octave below) according to the input to the gate. The gate input could then be obtained from another slow oscillator.

Finally, Fig. 10 (a) shows the complete truth table for the 7476. Fig. 10 (b) shows a changes truth table, in which the settings of J and K to produce certain changes (or non-changes) are listed. In the last table, X means "don't care", signifying that the value may be 1 or 0, and the action will be the same. Check that this last table agrees with the full table of Fig. 10 (a).

You may want to copy these tables, since we shall refer to them several times in Part 5 of this series.

To be continued.

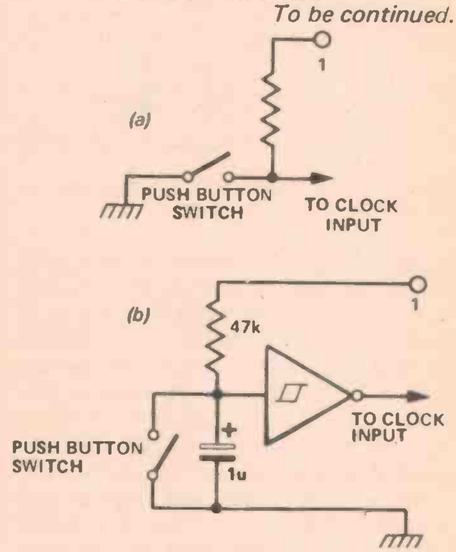


Fig. 9. (a) Using a push-button-switch as a clock pulse supply.
(b) A debounced switch circuit.

Fig. 10. Truth table for J-K flip-flop
(a) Complete truth table

J–K FLIP–FLOP

INPUTS		OUTPUT	OUTPUT
J	K	Q BEFORE CLOCK	Q AFTER CLOCK
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

(b) Shortened truth table for changes only.

J	K	Q_{n-1}	Qn
0	X	0	0
1	X	0	1
X	1	1	0
X	0	1	1

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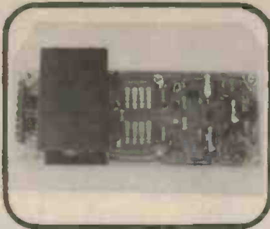

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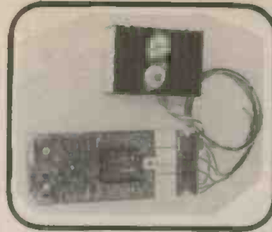

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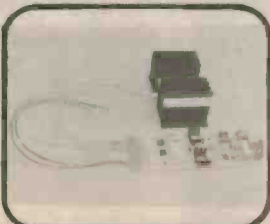

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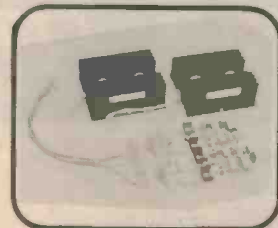

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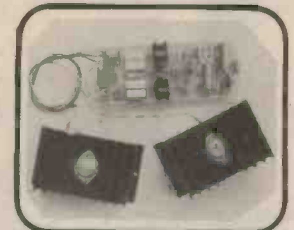

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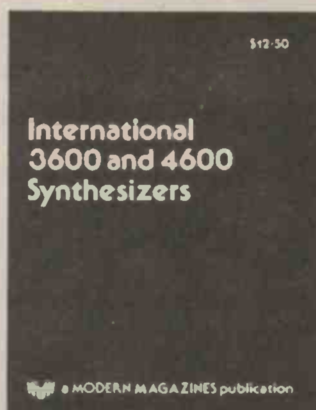

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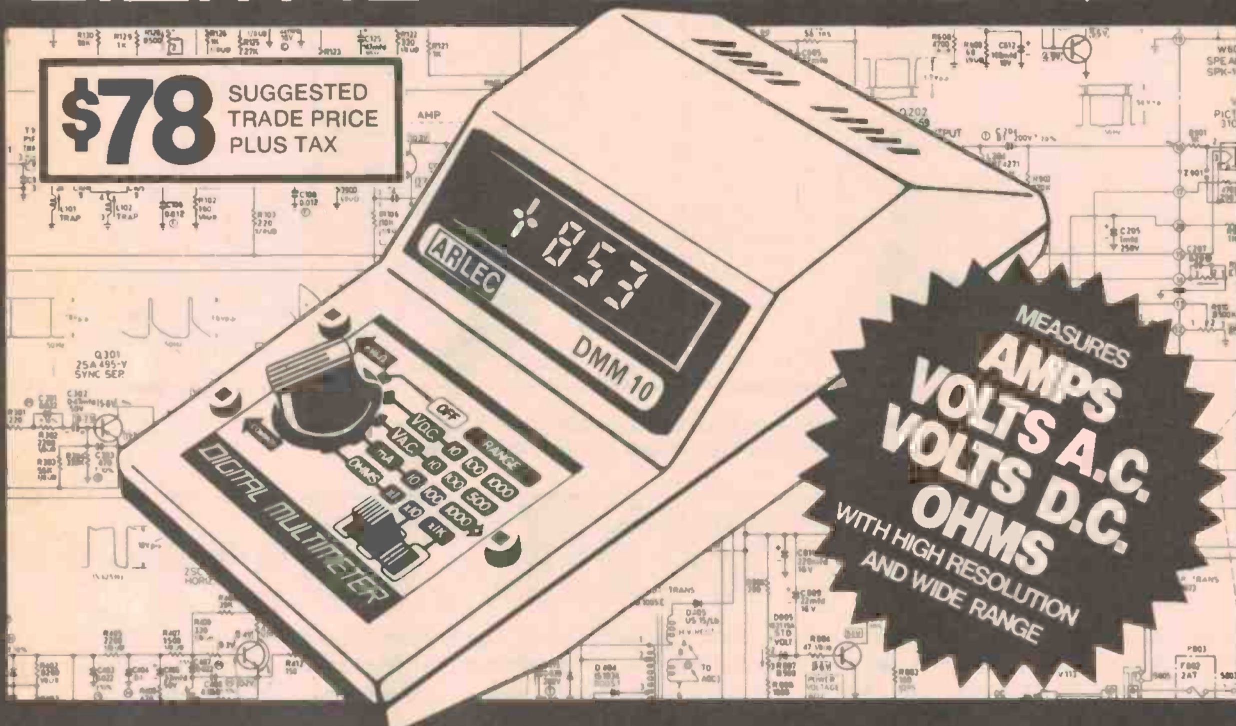

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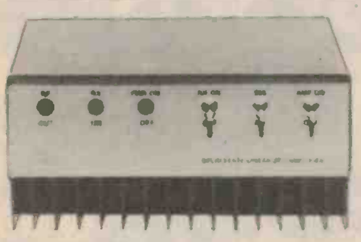

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SALES OF GOOD QUALITY 'general coverage' receivers with tuning ranges that cover the HF spectrum from 3 MHz to 30 MHz have boomed in recent years, bringing about an upsurge of interest in shortwave listening.

The price of receivers with good 'slow' tuning rates, dial readout to 5 kHz or better, excellent sensitivity and selectivity as well as good stability has decreased to the point where many enthusiasts can afford a 'communications quality' receiver.

Examples are the Yaesu FRG-7, the Drake SSR-1 and the Barlow-Wadley XCR-30 — all of which use the Wadley-Loop frequency selection system which provides coverage of any 1 MHz band between 500 kHz and 30 MHz.

However, judging from the letters received from readers of Electronics Today, there remains a problem with antennas to suit such wide frequency coverage.

The Long Wire

No discussion or description of wide coverage receiving antennas is complete without mention of the ubiquitous 'long wire'. The time-honoured long wire is simply what is says — any 'random' length of wire that it is possible to erect in a given space.

Theoretically it is 'long' when its length is one wavelength or more at the lowest frequency of interest. The other way of looking at it is that the wire you erect is no longer 'long' below that frequency where it is one wavelength long.

No matter, modern receivers are sufficiently sensitive that they only need a whisker of an antenna to pull in plenty of stations at good strength. It's for the weak ones that you need the big antennas.

A typical long wire installation is illustrated in figure 1. The actual height and length depend entirely on your circumstances. A piece of 50 mm by 100 mm oregon is painted (the new external wood paints such as 'Timbercolour' etc are very good) and bolted to a fence post or other support, as far from your receiver installation as you can reasonably manage it. A pulley, obtainable at almost any hardware store, is fixed to the top and a loop of good quality hemp rope threaded through it, before erection.

An egg or strain insulator is attached to one end of the antenna which is also tied. The other end of the antenna is erected near the receiver installation. An insulator is also attached at this end and the lead-in taken down from it to the receiver installation. The antenna is then supported from this end by tying it off to a chimney, as illustrated, or to a screw-eye in the barge-board of the house. Having one end of the antenna higher than the other is of little consequence. It'll still work!

The lead-in should be taken in such that it clears the house guttering and may be fed through a ventilator opening or over a window sill — whatever is convenient. Avoid running it for any distance clammped to a wall or parallel to metal guttering, pipes or wiring. The more direct, the better.

Once your long wire is up, you're ready to go! The end of the lead-in can simply be attached directly to the antenna terminal of your receiver or it can be connected to your receiver via an 'antenna tuner' — more on that subject later though.

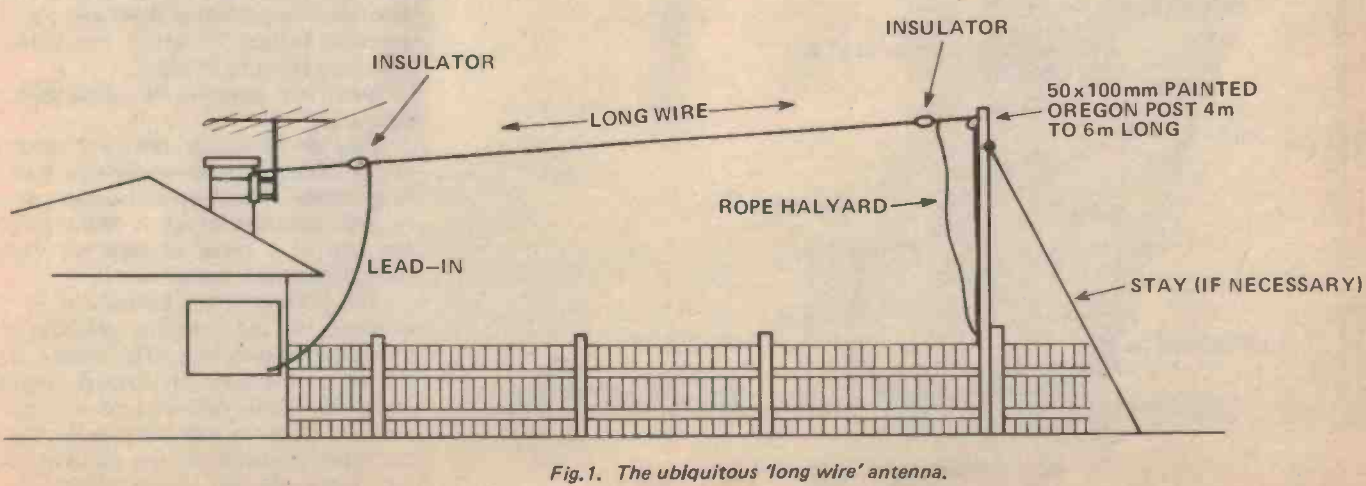


Fig.1. The ubiquitous 'long wire' antenna.

Shortwave Receiving Antennas

Inverted-Vee

A wideband "inverted-vee" style of antenna is illustrated in figure 2. This works extremely well across the range from about 5 MHz up to 30 MHz and uses ordinary TV ribbon for a feedline. However, a balun or an antenna tuner is necessary. A balun is simple but an antenna tuner will give better results.

Good signals will be picked up by this antenna right down to 2 MHz, but at these low frequencies, there's no substitute for size and different antennas, designed to operate in these regions, usually provide better performance.

Beggers can't be choosers though, in many circumstances!

Construction is quite simple. Again, a 4m or 6m length of 50 x 100 mm oregon, painted, is erected against a suitable support — shown here as the side of a house. A fence or garage is just as good.

If you can attach a length of aluminium pipe to a chimney mount or to your house gable — well and good. Just get the centre up as high as you reasonably can.

Each leg of the inverted-vee should be six metres long. However, they can be shorter — whatever you can fit, but the performance at low frequencies suffers.

The TV ribbon is connected where the opposite legs of the antenna join at the apex. Support the ribbon with standard screw-in TV ribbon insulator standoffs. These are obtainable from many electronic component suppliers, such as Davred and Dick Smiths.

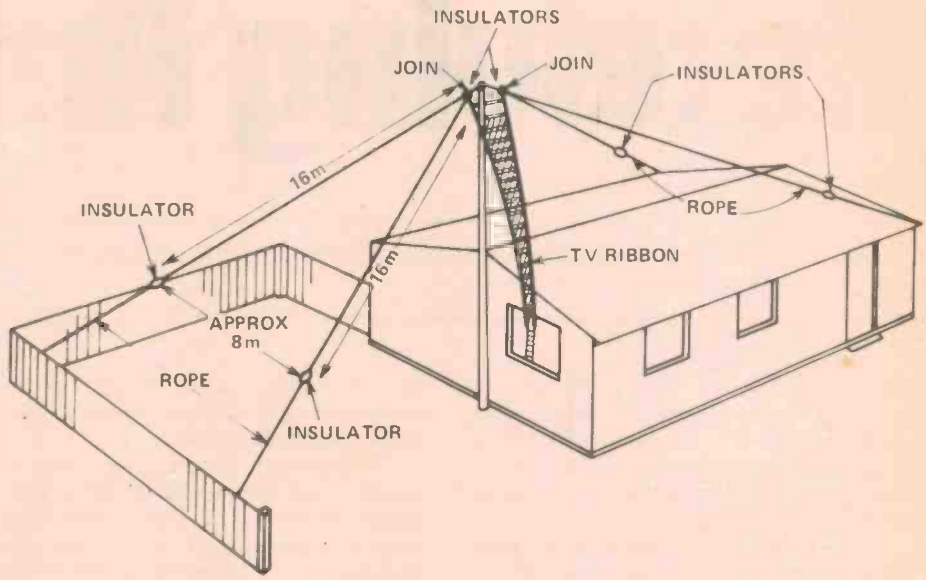


Fig.2. The 'inverted-vee' antenna. This is a wideband version.

Each leg should be individually tensioned with the rope strainers indicated in figure 2. Large screw-eyes, obtainable from most hardware stores, screwed into the supports as illustrated serve as excellent anchor points and allow the rope to be tightened using an appropriate slip knot (a round turn and two half-hitches is excellent).

Balun and antenna tuner construction, whichever you choose, to suit the inverted-vee antenna are described later.

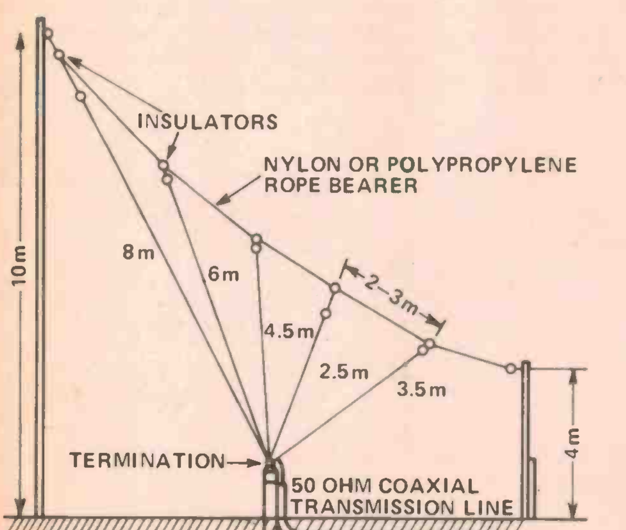


Fig.3. A broadband version of the HF groundplane antenna.

Vertical

The familiar groundplane antenna, much used in commercial VHF two-way communications systems as base-station antennas, becomes somewhat cumbersome at the frequencies that interest hams and shortwave listeners, although they are manageable above 14 MHz.

Loaded verticals, short verticals and other forms of the vertical antenna are popular for a variety of reasons, one good one being they have a low impedance, unbalanced feedpoint which suits most receivers on the market today.

If the *actual* ground is utilised as the ground plane for a HF groundplane antenna, a series of vertical elements can be connected in parallel at the feedpoint to provide a wideband vertical antenna system — which can give an excellent account of itself.

Such an antenna is illustrated in figure 3.

Five elements, of different lengths, are arranged in a fan supported from a rope bearer. They are all brought down to a termination which is supported on the top of a piece of pipe which has been driven into the ground.

The joining of the bottom of all the elements at the terminal provides the feedpoint connection. The centre conductor of the 50 ohm coaxial feedline (such as RG58) connects to this point and the outer conductor, or braid, of the coax connects to the earth via the pipe supporting the termination.

Details of the termination are shown in figure 4. The use of a coax socket is recommended as it is a simple matter to waterproof a coax connector, however, an alternative method is indicated.

Waterproofing of the coax plug and cable will see that it has a long useful life. Use Silastic or some other sealing and waterproofing compound. Silastic is excellent as it sets to plastic consistency and is easily removed at a later time if necessary.

The antenna dimensions indicated in figure 3 need not be strictly adhered to — some latitude is possible.

Construction is easy if you follow this procedure: lay out the bearer rope first. Insert the insulator ties at intervals of two to three metres as indicated. Attach the insulators that go at the top of each element to these points on the bearer rope using short lengths of rope or wire. These will have to be subsequently adjusted, so don't tie the insulators on in a permanent fashion yet.

Next, lay out all the elements, using the lengths as a guide and allow at least one metre at the termination end of each wire so that they can be individually tightened from the termination end when the antenna is erected.

Hoist the bearer rope into position and adjust the termination ends of the elements so that they come together with the termination insulator about 300 mm above the ground.

Drive the pipe into the ground below this point. Finish everything off as illustrated in figure 4. If using a coax socket for the coax connection, mount it on a small aluminium or galvanised steel plate which is mounted to the pipe via a long bolt passed through the pipe, as illustrated.

If you wish, the coax may be buried. However, it is advisable to pass it through some flexible plastic conduit and bury the whole assembly. This will prevent damage to the cable (from enthusiastic or ignorant gardeners, dogs, small brothers etc) as well as reducing the ingress of moisture.

If you want the ultimate in performance, a series of ground wires can be buried about 200 - 300 mm below the soil surface radiating out from the pipe for a distance of six to ten metres. They should all be connected together at the centre and bonded to the pipe.

However, keeping the area surrounding the pipe well-watered should satisfy most requirements.

Biconical Monopole

Yes I know it sounds funny — looks funny too, (except to the died-in-the-wool enthusiast!) but this antenna really performs as is attested by the fact that many professional and military receiving installations throughout the world use them.

The biconical antenna is mentioned in all the classic textbooks — so I won't go into it here. Suffice to say that it will readily cover a 4:1 bandwidth and has a low impedance, unbalanced feed. Low frequency performance is reduced of course but it still works sufficiently well to provide reasonable signals well below the low frequency design limit.

A biconical monopole suitable for home-construction (for the enthusiastic!) is illustrated in figure 5. A central pole has two cross-arms located low down around which is passed a length of rope. Twelve wires run from the top termination to the bottom termination, all wires being connected together at the termination points. The four wires which pass over the ends of the cross-arms are arranged to act as guys so that the whole assembly is self-supporting.

The most practical height for the central pole is about six metres, although if you can manage something higher, so much the better. The cross-arms are located about 40% of the pole height above the ground. Each cross-arm is about 40% of the pole height long.

Dimensions are given in figure 6 for a biconical monopole that will cover the 7 to 30 MHz range.

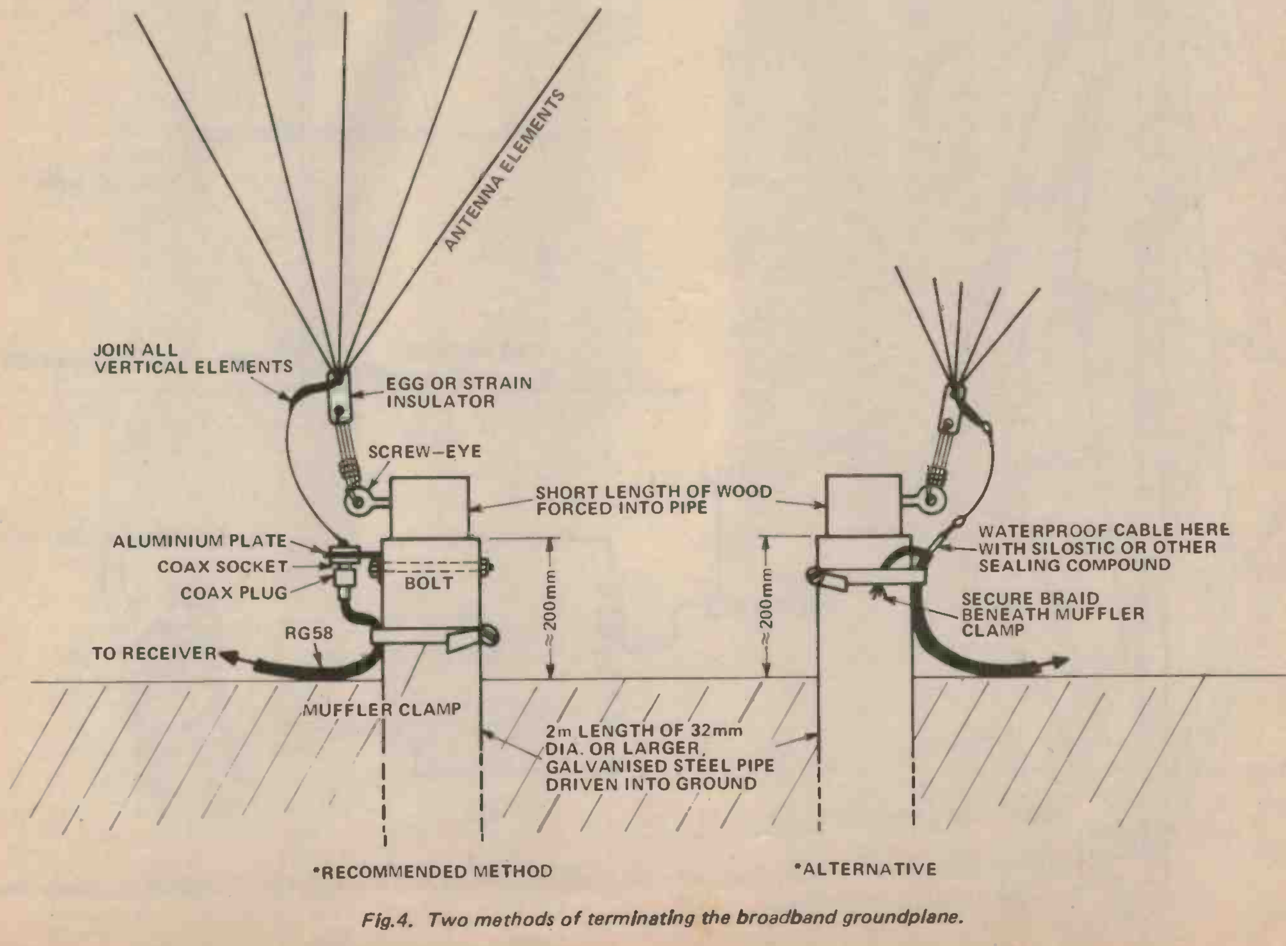


Fig.4. Two methods of terminating the broadband groundplane.

Shortwave Receiving Antennas

Specific construction details are left up to the individual constructor. However, the following points should be noted.

All the wires should be insulated from the pole and cross-arms. Wooden cross-arms are recommended (paint them though). Nylon or polypropylene rope is recommended to go around between the ends of the cross arms to support the eight wires not used as the guys. Simply tie them with short lengths of wire to the rope to secure them, after tensioning.

All the wires should be joined together at the top and bottom terminations. The bottom termination is the feedpoint. An arrangement similar to that in figure 4 should be used to connect the coax feedline. A good ground stake should be used, or better still a ground radial system, as previously described.

Antenna Tuners

Two basic types are really all that is necessary for most SWL applications: the unbalanced type for long-wire antennas and the balanced type for balanced-to-unbalanced conversion as well as tuning the antenna-feedline system.

Circuit and construction details for a long wire antenna system are illustrated in figure 7. The coil L1 consists of a length of "air-wound" coil stock – such as supplied by William Willis & Co. or Dick Smith.

A portion of every second turn is depressed, using the blade of a small screwdriver and moderate pressure, so that the remaining turns stand proud and allow a standard small crocodile clip to be attached, forming a tapping point on the coil.

The tuning capacitor, C1, can be anything suitable, providing it has a maximum capacitance greater than 200 pF. A broadcast tuning gang, such as one of the Roblan RMG series, would be suitable – these generally have a maximum capacitance of about 350

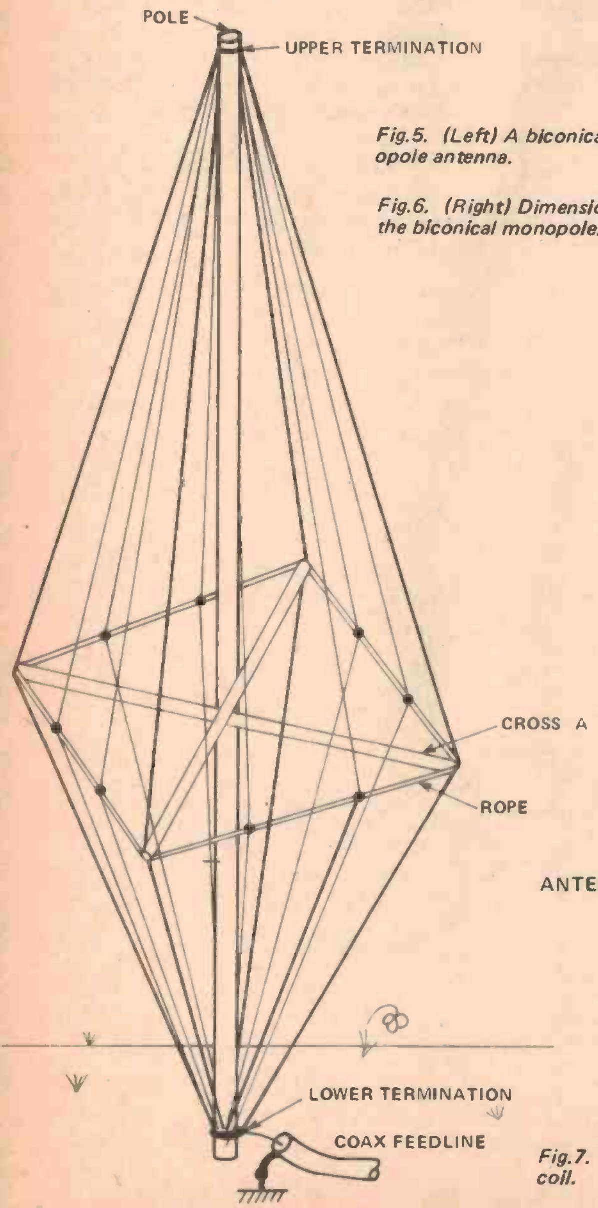
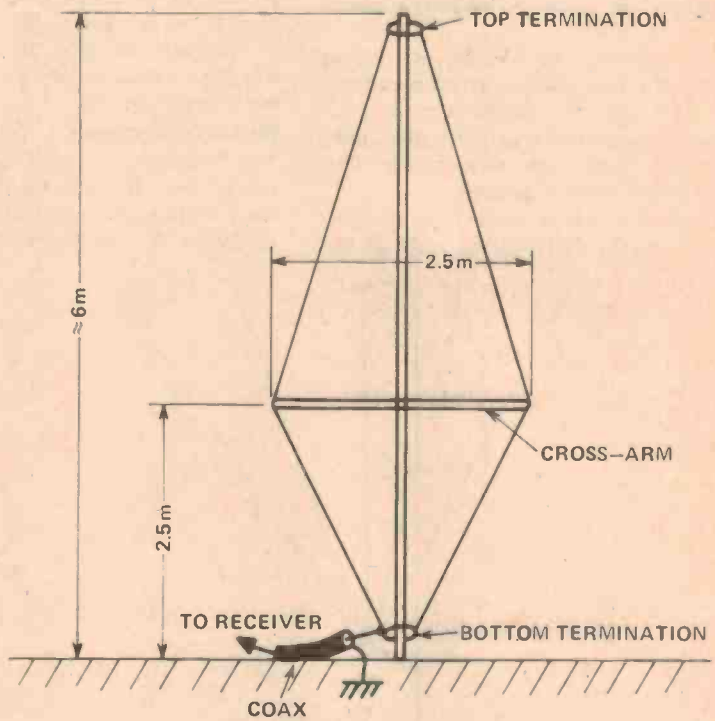


Fig.5. (Left) A biconical monopole antenna.

Fig.6. (Right) Dimensions for the biconical monopole.



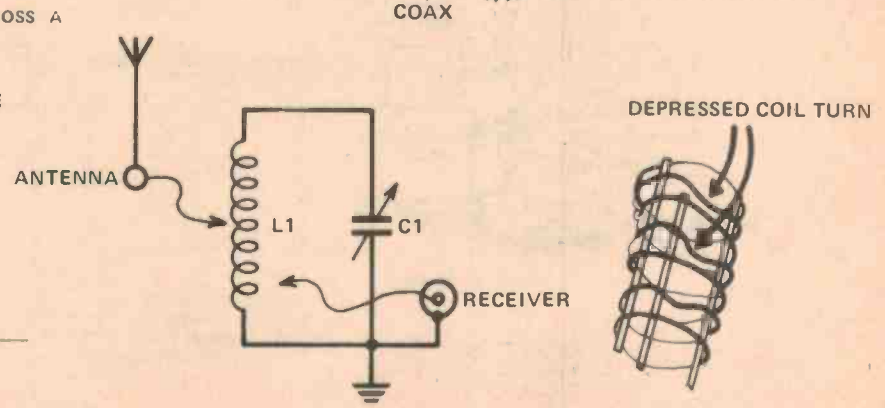


Fig.7. (a) Circuit of an antenna tuner for a long wire antenna. (b) Method of constructing the coil.

to 450 pF.

The receiver tap is generally best at a point only several turns from the grounded end of the coil. Tune in a signal near or in the frequency band of interest and commence with the antenna tapped about ¼ to 1/3 the way up the coil from the grounded end. Tune C1 for maximum signal strength.

Move the tap higher and retune for maximum signal. If it increases, you're headed in the right direction. If it decreases, move the tap the other way.

A balanced tuner is illustrated in figure 8. Coil taps are made in the same fashion as illustrated in figure 7. The tuning capacitor is a double-gang broadcast type, which must have identical gangs. This item can be salvaged from old valve-type mantle radios, or bought in electronic disposals stores. Some component suppliers stock such items also.

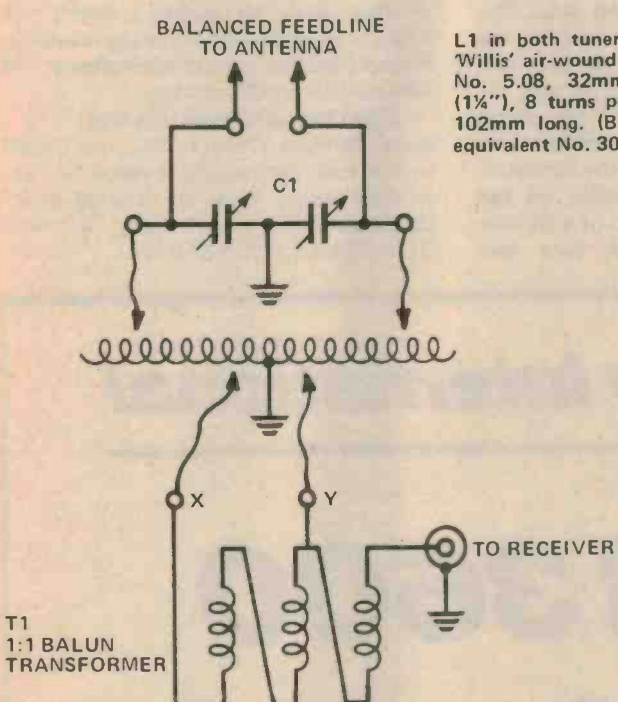
Balun

The balun, T1, is a wideband type and is constructed as follows: A dual-hole ferrite core such as the Philips 4322-020-3150 or the Neosid 1050/2/F29 is required.

Take three 180 mm lengths of light gauge hookup wire or 26 gauge enamelled copper wire and twist them together at about two twists per 10 mm. Wind three turns of the twisted strands through the holes of the core as illustrated in figure 9. Identify and mark the three separate wires. Having done this, connect them as shown in figure 10. Use a small tagstrip or terminal block to support the joints.

When using the tuner, taps are made symmetrically about the centre-tap of the coil, L1.

The antenna tuners can be constructed in any suitable metal or plastic box. However, if using a metal box, choose one of such a size that the air-wound coil stock can be mounted at least its own diameter away from any side.



L1 in both tuners is a 'Willis' air-wound inductor No. 5.08, 32mm dia. (1¼"), 8 turns per inch, 102mm long. (B & W equivalent No. 3018).

Fig.8. A balanced antenna tuner.

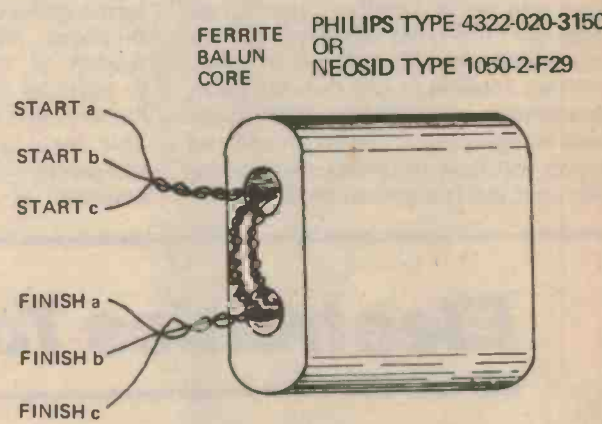


Fig.9. Construction of the 1:1 balun transformer.

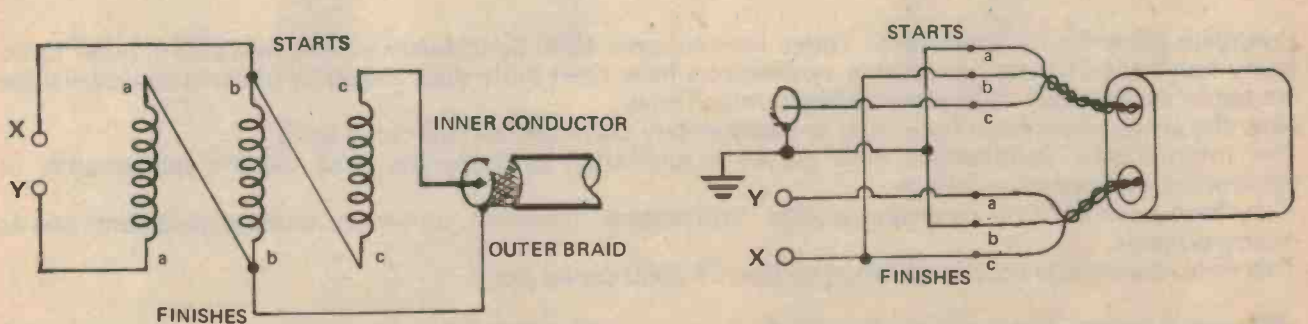


Fig.10. (a) and (b) Connections for 1:1 wideband balun transformer.

Shortwave Receiving Antennas

Insulator Hints

The antennas described call for the use of insulators at various critical points to insulate the antenna elements from any support or tension rope.

There are two types generally available, the 'egg' insulator and the 'strain' insulator — both illustrated in figure 11. Using them is very simple. However, the rope or antenna wire must be firmly secured where it ties on to the insulator.

Where heavy, standard wire is used, simply wrapping the wire around itself a number of times is usually sufficient. If flexible hookup wire, such as 7/0026 or 10/010 PVC covered, is used then it will have to be knotted to be properly secured. Usually a number of half-hitches following several turns through the insulator eye are sufficient.

Nylon and propylene rope, while cheap and water repellent, deteriorate under the ultra-violet light from the sun and weaken considerably with time. Frequent inspection will indicate when replacement is necessary. Both types creep considerably under strain and the tension will have to be adjusted periodically, but this is only a small chore.

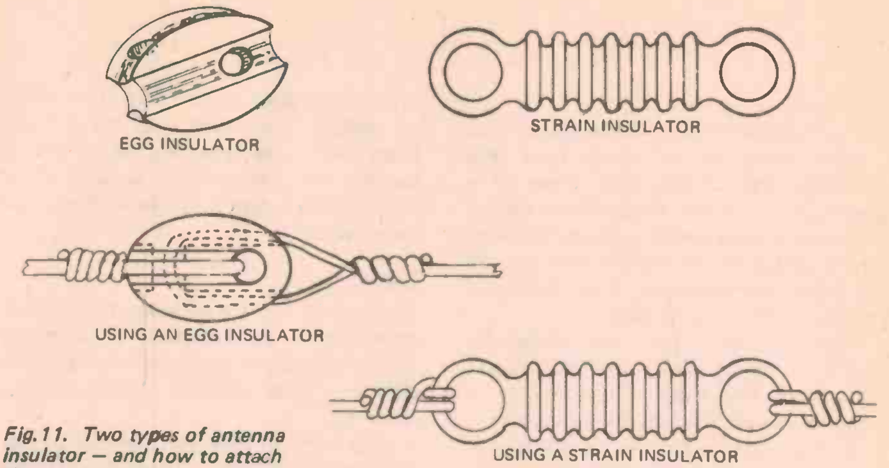


Fig.11. Two types of antenna insulator — and how to attach them.

The insulators illustrated are available in porcelain, nylon and glass. The nylon type egg insulator is usually the least expensive — but they do have one drawback. After some time in use, the tension of the wire causes the nylon to creep or remould itself and the wire literally pulls itself through the insulator. This may cause the insulator to fail completely. It isn't so much of a disaster however as the antenna wire and support rope are looped through one another and the antenna won't fall down — an advantage of the egg insulator. Periodic inspection and replacement will obviate any problems here.

Good luck and good listening!

Note: William Willis & Co., mentioned in the test, can supply a range of "air-wound" coils. They are located at 77 Canterbury Rd., Canterbury, Victoria, 3126. Phone: (03) 836-0707.

SWL COMMUNICATIONS

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC).

Radio Vision's QSL shows the beach at Santa Marta, Colombia.

IN LAST MONTH'S COLUMN, we discussed the peak in tropical band reception from Latin America and Africa which occurs during our winter months. Another feature of reception during winter is signals from Europe on the lower frequency international shortwave bands of 49 and 41 metres, that is 5900-6200 kHz and 7100-7300 kHz respectively, during our daylight hours 0000-0400 GMT.

Throughout most of the year, few signals are audible in these frequency ranges as these bands are well below the absorption limiting frequency. During winter however the picture changes. The Antarctic regions experience constant darkness, and signals from Europe reach Australia during the 0000-0400 GMT period via a route transversing southern America and the south Pacific. Consequently, less daylight on this route results in the absorption limiting frequency dropping below 6 MHz during June and July in our daylight hours. This enables us to hear many of the European stations presenting their programs for North American listeners. A good indicator of whether this reception mode is "open" on any day is the Latin American service of Radio International on 6040 kHz, which should give good reception between 0000-0400 GMT.

Canada

Radio Canada International at Montreal does not broadcast specifically for our part of the world, however its European Service as well as the service for the Americas are both audible in Australia. The current schedule shows English daily for Europe in two segments, at 1900-1930 and at 2000-2030. Frequencies used for both programs are 17820, 15325, 9555, and 5995 kHz, while 11855 is added for the second half-hour. Program highlights include the session for Shortwave listeners called "DX Digest" hosted by the well-known North American DXer Glenn Hauser each Sunday, while Saturday transmissions include Canadian Music Scene. Canada has also introduced a new service. heard Monday to Friday, for the Middle East. Scheduled 0600-0700, this service is in French and English, with English segments aired 0615-0630 and 0645-0700, on 17860 and 15440 kHz.

Latin American News

Radio Vision at Medellin, is currently audible on 6105 kHz, giving fair reception between 1100 and 1215. This station also verifies reception reports with a colourful post card QSL of a Colombian tourist scene.

Radio Nacional at Caracas is well heard from station sign-on at 1000 through until 1100, on 6170 kHz. Later in the evening, reception is spoilt by interference from the Phillippine broadcaster, PBS in Manila, which also uses this channel.

An interesting contrast to most Latin American stations is Radiodifusora Nacional de Colombia at Botoga. This station may be heard on 15335 kHz from about 2200 right through to sign-off at 0500. Programming consists mostly of concerts of classical music, in contrast to most Latin American stations with their fast format of advertisements and popular music recordings.

The Australian Radio DX Club is a non-profit body with headquarters in Melbourne. For further information on shortwave radio, and on the activities of the ARDXC, please write to the General Secretary, PO Box 67, Highett, Vic. 3190, enclosing a 30c. stamp for return postage.

Radio Universidad de Concepcion is a Chilean broadcaster which is often audible on 6136 kHz from 1100 until approximately 1200, mixed with Radio Korea at Seoul also on this channel. Programs consist generally of news and light music.

Afghanistan

The recent political changes in this country only temporarily put Radio Afghanistan's External Services off the air at the end of April. Currently the foreign language programmes from Kabul are scheduled as follows: 1030-1100 Russian, 1100-1130 German, 1130-1200 in English; all these segments aired on 15365 kHz. The Arabic language segment is heard 1000-1030 on 15390 kHz.

Broadcasts From East Europe

Radio Warsaw currently gives good reception on its 31 metre outlet of 9525 kHz with its North American service in English and Polish from 0200 until 0400 GMT. Radio Berlin International may be heard with its service in Spanish for Latin America 0000-0300 GMT on 9535 kHz, followed by the Portuguese service for Brasil at 0300.

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RETAIL OUTLETS

CANBERRA: DAICOM ELECTRONICS, 29 COLBEE COURT, PHILLIP. ACT.

SYDNEY: A to Z Bookshop, 130 Elizabeth Street, Sydney (opposite Mark Foys)

BRISBANE: A to Z Bookshop, 390 George Street, BRISBANE (near McDonnell and Easts)

SWL

Zaire
With the current troubles in this country, it may interest readers to hear a station which is located close to the conflict in southern Zaire. Radio Lubumbashi is occasionally audible on 7205 kHz between 1530 and 1630 GMT, with most programming in the French language. Lubumbashi suffers some interference from Radio Pyongyang on 7203 kHz, but occasionally when that station is silent, the Zaire station gives clear reception.

Somalia
Another station near a centre of conflict is Radio Hargeisa in northern Somalia, close to the disputed Ogaden region of Ethiopia. Radio Hargeisa may be heard with programs in Somali from 1530 on 7120 kHz. At other times, this station relays programs from the capital, Mogadishu.

Lebanon
Radio Lebanon, the Government station in Beirut, has made a frequency change for its daily African service. Lebanon now uses 15440 kHz for this service, beginning at 1830 with French, and presenting English programs at 1930.

New Developments For SBC
The Swiss Broadcasting Corporation in Berne has for the first time begun broadcasts using Single Sideband. These new services are aired on 11780 kHz from 0145 to 0415, and also on 17740 kHz from 1315-1530. Programs are in English, German, Italian and French. In SSB transmissions, the carrier together with one of the Sidebands of a conventional AM signal are eliminated. The main advantage of such signals is gaining the same result (in terms of received signal quality) using considerably less transmitted power.

Italy
Radiotelevisione Italiana, in Rome, currently broadcasts in English to the Far East 220-2225 on 15315, 11905 and 9710 kHz. There is no English service directed specifically for Australia, but this service is easily heard here. Rome also broadcasts twice daily services in Italian for Australian listeners. Firstly between 0830 and 0930 on 21690, 17780, 15230, 11810, and 9575 kHz. The second program may be heard from 2050-2130 on 11905, 9575, and 7290 kHz. All services begin with a news bulletin.

AMATEUR COMMUNICATIONS

Symposium Success
The Future Amateur Communications Technique Symposium, held over the weekend of May 20-21 at the Strata Motor Inn in the Sydney suburb of Cremorne, was voted a great success.

The 75 registrants enthusiastically received the nine papers presented over the weekend apart from enjoying two excellent lunches provided as part of the Symposium package. The Symposium dinner on the Saturday night was attended by 40 people who enjoyed a succession of succulent Chinese dishes in a somewhat confused banquet style. However, a good time was had by all and a goodly number repaired to the organisers' suite on the fifth floor where only the hardy souls lasted until 6am Sunday morning!

A workshop on microprocessors was presented along with workshops on UHF techniques and amateur TV.

The keynote address was given by David Large of the Policy and Planning Division of the P & T Department. His paper was titled "Amateur Radio and Future" and stirred considerable comment and discussion from the audience. This was an important paper and we hope to publish it in ETI in the very near future.

Unfortunately, a projected paper on Pulse Techniques for the Amateur was withdrawn. As it appeared there was some interest amongst registrants on the subject, a paper will be arranged for the next Symposium of this type.

Apart from being enthusiastically received, all papers ran a little over time – not that anybody particularly objected, except for those who had to leave before the end of the final papers of the sessions on each day.

Question sessions following each paper were lively and stimulated further discussion at meal and tea breaks.

Ken McCracken, VK2CAX, gave a stimulating and well-received paper on solar-terrestrial relations imaginatively illustrated with slides, which included some tantalising remarks on the coming sunspot maximum, and the spectacular DX that might (does already!) eventuate.

The papers delivered by Les Jenkins, VK3ZBJ, undoubtedly placed him as star of the show and the array of equipment was most impressive. His paper on UHF antennas was illustrated by an 8mm colour movie, with sound, produced entirely by Les and associates. It described construction and measurement techniques and showed gain and bandwidth measurements made on actual antennas.

A working 25 watt power VFET amplifier for the 2m band was shown to the audience in the paper on Solid State RF Power Amplifiers by Phil Wait VK2ZZQ and Roger Harrison

AMATEUR COMMUNICATIONS

VK2ZTB, possibly the first working model in Australia.

At the closing session on the Sunday evening, it was proposed that a group be formed – The Association of Advanced Amateur Technologists – to organise and conduct symposia, seminars and teach-ins along similar lines to last year's FAMPARC Seminar and the FACT Symposium, amongst other possible aims yet to be decided. All those interested can contact the FACT Symposium organiser, Roger Harrison VK2ZTB in Sydney on (work) 33-4282 ext.28, or Les Jenkins VK3ZBJ in Melbourne on (home) 783-4069, or through P.O. Box 57 Rozelle 2039.

Watch this space for details of the next Symposium.

Copies of the Proceedings of the FACT Symposium are in demand and only a limited number will be printed – all registrants receive a free copy – so if you want to obtain a copy of the Proceedings send an SAE to the FACT Symposium Organiser c/- 14 Atchison Street, Crows Nest, 2065. They will not be cheap, but they will be worth it. Price will be notified.

New QSL Bureau Addresses

The JARL and the RSGB have both changed their QSL bureau addresses in recent months – if you haven't caught up with the scuttlebutt from the DX newsletters, HR Report etc, here they are:

JARL: QSL Bureau: 14-2 Sugamo 1 Chrome, Toshima-Ku, TOKYO 170 JAPAN.

RSGB: QSL Bureau; Mr E.G. Allen, 30 Bodnant Gardens, LONDON, SW20-0WD, UNITED KINGDOM.

New Antenna Relays

Vicom International have recently released two new antenna changeover relays made by Daiwa.

The model CX-2L is suitable for the frequency range 1.8 to 170 MHz and for powers up to 100 watts PEP. The relay requires between 10 and 15 volts to energise it and retails for $45.

The model CX-2H is rated up to 450 MHz and 200 watts PEP and also operates from 10 to 15 volts supply. It retails for $59.

For further information take a walk to Vicom International (do not pass GO, do not collect $200), at their new premises situated in sunny South Melbourne known as 68 Eastern Road.

If you want to let your fingers do the walking, try (03) 699-6700. If you're in Adelaide, call their rep – the steamy Graham Stallard on 43-7981 (Esq.); in Canberra the artful Andrew Davis (not Esq.) on 82-3581, in Hobart Harvey Skeggs on 43-6337 and in Perth the nifty Neil Penfold on 446-3232.

Vale the Uniden 2020

The famous 2020 HF SSB/CW amateur rig, first amateur rig to use PLL synthesizer technology – a forte of Uniden, has ceased production at the Japanese factory of Uniden.

Sold by Henry Radio throughout the USA under their "Tempo" brand name, and in Australia by Vicom the 2020 gained a much-envied reputation.

However, Henrys did not renew orders in January this year and demand from the rest of the world was too small for Uniden to continue manufacture. Uniden, also affected by the CB market slump, has shifted their production facilities to car sound systems and transferred much of its manufacturing facility to Taiwan.

Vicom have large quantities of spare parts and pc boards for the 2020 available and some of these may be discounted over the next few months. Watch for it.

UHF Reversible Wattmeters

A range of 'reversible' wattmeters, suitable for power and VSWR measurements on the popular VHF/UHF amateur bands of 144 MHz, 430 MHz, 576 MHz and 1296 MHz have recently become available from a small Sydney firm, Microwave Developments.

The proprietor, Des Clift VK2AHC, is well-known in UHF/SHF amateur circles and has developed this series of relatively inexpensive instruments to suit amateur applications as the majority of commercially available instruments to suit these frequencies are almost prohibitively expensive for most amateurs.

There are three models to cover the 2m band, 144-148 MHz, each with a power range of 25W, 50W and 75W respectively and designated 2/RWM/25, 2/RWM/50, 2/RWM/75. The 25W model is supplied with BNC connectors, while the other two have series N connectors. Prices are respectively $69.50 for the 2/RWM/25, $72 and $74 for the two higher power instruments.

Three models are also available for the 70cm band, having 10W, 25W and 50W power ranges, respectively designated 4/RWM/10, 4/RWM/25, and 4/RWM/50. Again, the lowest power model is fitted with BNC connectors while the two higher power ones have N series.

Prices for these are the same as the three power ranges for the 2m band.

Only one power range is available for the 576 MHz band, 10 watts (7/RWM/10). This is fitted with N connectors and sells for $75.

Similarly, only one model is available for the 1296 MHz band, the 8/RWM/10, which also measures up to 10 watts, is fitted with N connectors and costs $75.

All the instruments use stripline couplers having around a 30 dB coupling factor and about the same directivity.

A series of dual-band reversible wattmeters are also available for 2m and 70 cm for around $100.

To top it all off, Microwave Developments also have a 70cm VSWR/power meter which consists of a combination direct-reading VSWR meter and a reversible wattmeter. Two models are available, the 70/V/B is fitted with BNC connectors while the 70/V/N has N connectors. They cost $90 and $92 respectively.

Each instrument comes with a small 'user manual' and is guaranteed for six months.

For further information, and other UHF goodies, contact Des Clift at *Microwave Developments, 12 Romford Rd, Frenchs Forest NSW, 2086.* Phone (02) 451-8429.

Microwave Developments have an agent in Adelaide – *Werner Electronics Industries P/L at 28 Gray Street, Kilkenny, S.A. 5009.* Phone (08) 268-2766.

Telex Buys Hy-Gain

Telex Communications Inc. in the US has made a US$7.5 million offer for Hy-Gain's antenna, amateur radio and marine radio divisions.

They have agreed to pay one of Hy-Gain's major creditors, Citibank, for the divisions, which does not include any of the Puerto Rico operations of Hy-Gain. Under the agreement, Telex Communications, a subsidiary of Telex Corp, will pay US$5 million when the plan is approved by US District Court Bankruptcy Judge, David Crawford. They will then pay US$250, 000 each March 31 from 1980 to 1983. If the Hy-Gain operations then earn more than $10 million in the five fiscal years after the acquisition Telex will pay Citibank a further 20 percent of the earnings over that amount, up to a maximum of $1.5(US) million.

Channel Warfare on 27 MHz

A small group of disgruntled (to put it mildly) CBers is waging a war in Sydney using jamming devices that cause havoc on the 27 MHz band at night.

The devices use modified walkie-talkies that have a light-sensitive switch fitted which activates the jammer at dusk and turns it off at dawn. They are generally found 'planted' up a large tree and have a crude but effective groundplane antenna attached and are powered by a series of 6V lantern batteries.

A variable tone modulates the transmitter making the channel it occupies virtually useless for CBers within a considerable radius.

As the signal is extremely strong over quite an area, the adjacent channel rejection of many rigs cannot cope and the jammer can be heard across quite a few channels. This has spurred numerous CBers into somewhat rash 'vigilante' action, resulting in an attack on an innocent radio amateur in the Greystanes area in late April who had the misfortune to live in the vicinity of the location of one of the jammers.

The antennas of Bruce Pinkerton, VK2BPP, were severely damaged and his cables cut by members of a group of 40 or more irate CBers who mistakenly accused him of operating the device in their ignorance of the real situation.

The jammer was eventually located some 300 to 400 metres away from Bruce's house, but as the signal was strong in his street, cruising CBers attempting to find the jammer jumped to the wrong conclusion when they spotted Bruce's prominent 18AVT and VHF/UHF antennas. One CBer has been charged with trespass as a result of the incident. However, a threatening letter, signed by 35 CBers was passed under Bruce Pinkerton's door, and his address and phone number were widely broadcast on 27 MHz with the malicious purpose of having him harassed. The threatening, abusive and obscene phone calls did not cease, even weeks later and Bruce has been forced to sell his house and move.

This incident gained wide publicity in the press, on radio and television.

However, if that weren't disgraceful enough, more jammers have been hidden at various locations (usually at weekends – they last for some days before the batteries give out) and the latest to be located, at Springwood in the Blue Mountains, was found to be booby-trapped with several detonators. A detonator can blind, blow off a hand or otherwise seriously maim a person if exploded in close proximity – which is the clear intention of the person(s) planting the devices.

What is CB radio coming to that it should come to this?

The number of bad incidents, together with increasing 'vigilante' activity of various forms, is very clearly undermining what tattered image there may be left of what was once touted as " . . . a service of great benefit to the community".

Log Speech Processor

Communications Power Inc have recently released in Australia a logarithmic speech processor, the TP-1.

Unlike most speech processors which provide 'hard' compression, a log speech processor has a 'softer' characteristic which is markedly different to the sounding audio provided by conventional compressors.

Average speech power is boosted by a factor of three or four, resulting in a penetrating signal on channel that does not splatter all over the band – as commonly happens with the conventional hard compressors which are difficult to adjust correctly.

The CPI TP-1 processor features a front-panel mic socket, a large panel meter which facilitates precise level adjustment to prevent overmodulation and a "no-hassle, no-solder" hookup that requires no alterations to your transceiver. An internal patch-panel makes for easy, push-pin connection to any four-conductor mic cable wiring configuration and no soldering is required.

Contact CPI at *P.O. Box 246 Double Bay, 2028* (02) 36-3703 for further details.

Cobra Returns

The Cobra brand name has not been seen on the CB market for over 12 months. However, Pye Industries are poised for a quick strike onto the market with a range of four P & T approved rigs for Australian CBers.

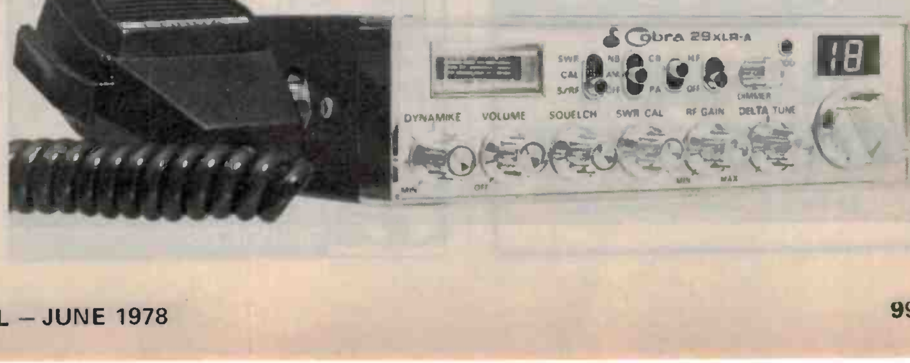
There are three mobiles and one base in the range, all having 18 channel PLL synthesizers and featuring the Cobra 'Dynamike' mike gain control.

All the mobiles have similar styling with chrome knobs, satin finish panel and chrome panel surround. The economy AM only mobile is designated the 77X-A and has a minimum of controls but includes a decent-sized panel meter. Channel number is indicated on the selector knob skirt whereas the other rigs in the range feature digital LED readout. The 77X-A will retail for about $125.

The top-line AM mobile, the 29XLR-A, features a three-function panel meter (S,RF output and SWR) along with a variable delta-tune control, noise blanker and ANL, apart from the standard complement of controls. Retail price of the 29XLR-A will be around $175.

The sideband mobile is the 138XLR-A which features a three-function panel meter also along with a full complement of controls. It will retail for $349 placing definitely at the top end of the mobile CB market.

The 139XLR-A sideband and AM base station features two large panel meters which allows the operator to keep a check on modulation and SWR as well as signal strength and RF output. It is priced at around $465.



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Write for a descriptive brochure and ask for information on study procedures etc. for the novice amateur licence.

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PCB's

ONCE AGAIN, there's a page of blue in the mag, and we've published the PCBs on a page by themselves. We are continuing previous experiments with PCB making directly from the page, and are glad to report that, provisionally at least, the experiment is successful. It is possible to make PCB negatives in Scotchcal 8007 by exposing it directly through the page to UV light. Actinic blue fluorescent bulbs are ideal for this: around 20 minutes exposure at 3-4" will produce a good negative.

We haven't yet tried this process using direct exposure of a negative photo resist; this is a matter for further experimentation.

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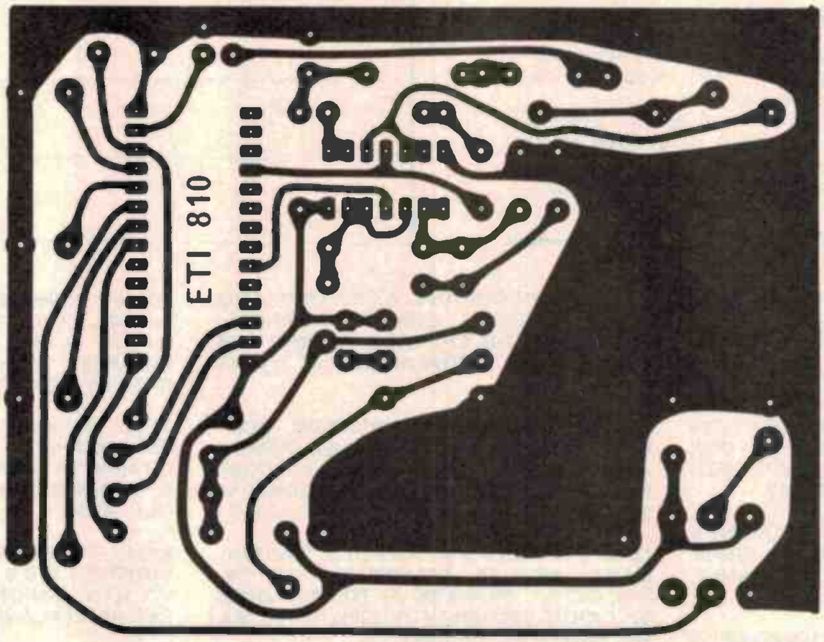


News Digest

New Plessey Micro

Plessey Data Systems have announced a new minicomputer series called the Micro-1, based upon the DEC LSI-11 processor. The Micro-1 is part of the extensive range of add-on products and systems manufactured by Plessey Peripheral Systems Inc. U.S.A., and marketed in Australia by Plessey Data Systems.

Micro-1 has the large and flexible instruction repertoire of Digital Equipment Corporation's PDP-11/35, including more than 400 instructions. It is supported by an impressive set of operating systems and diagnostic software available from DEC.

Whilst designed to include the DEC LSI-11, alternative versions of the Plessey Micro-1 will be available as new processors are developed.

By utilising the Plessey Qbus-'Unibus' converter, facilities traditionally provided for use on the PDP11 range are now available within this package.

The Micro-1 includes LSI/11 microcomputer backplanes, Unibus converter, memories and interfaces, and is housed in an attractive 10.5 inch high chassis providing power supplies, cooling and a control panel.

Bipolar Switches

Philips TDA1028 and TDA1029 bipolar integrated circuits perform the functions of DC controlled audio switches. The TDA1028 behaves as two isolated 2-way, 2-pole switches, and the TDA1029 behaves as a single 4-way, 2-pole switch. Basically, the devices consist of operational amplifiers connected as impedance converters; their overall gain is unity. Control inputs for switching only need a connection to ground.

Intended initially for hi-fi applications, the new circuits can be used for input selection (pick-up, radio a.m./f.m., tape, auxiliary), monitor switch, rumble filter, noise filter, mono/stereo switch, contour, and muting. An unscreened control wire is all that is needed to operate a switch; the end of the wire has to be grounded. This enables controls to be placed where ergonomic considerations dictate. Another important feature is that screened cable does not need to be brought to the front panel. DC control of audio functions enables easy application of remote control to hi-fi equipment; in automobiles, the tape playback unit can be mounted anywhere in the car with simple buttons only on the dashboard.

HEY WHAT'S THIS? A GREAT NEW SHAPE

(No, not me, I'm still your tubby little friend!). It's CB Australia in magazine format.

Let's see what else is different.

All the good stuff is still here — Update — Probe interviews — great technical interviews.

NCRA NEWS! — that's new — eight pages from the NCRA for all affiliated clubs and members.

Rig reviews will be a big feature, also reviews of a whole range of accessories and antennas and there'll be projects — great gear you can build yourself and all the details of how to do it.

Sounds better and better. . CB Oz already has a pretty good reputation for honesty, hard-hitting news reporting and for being the first with the latest CB news (and no ripoff reprints of old articles from US mags).

This new CB Australia looks like a prestige publication to me. I'd say you'll be proud to be seen reading it!

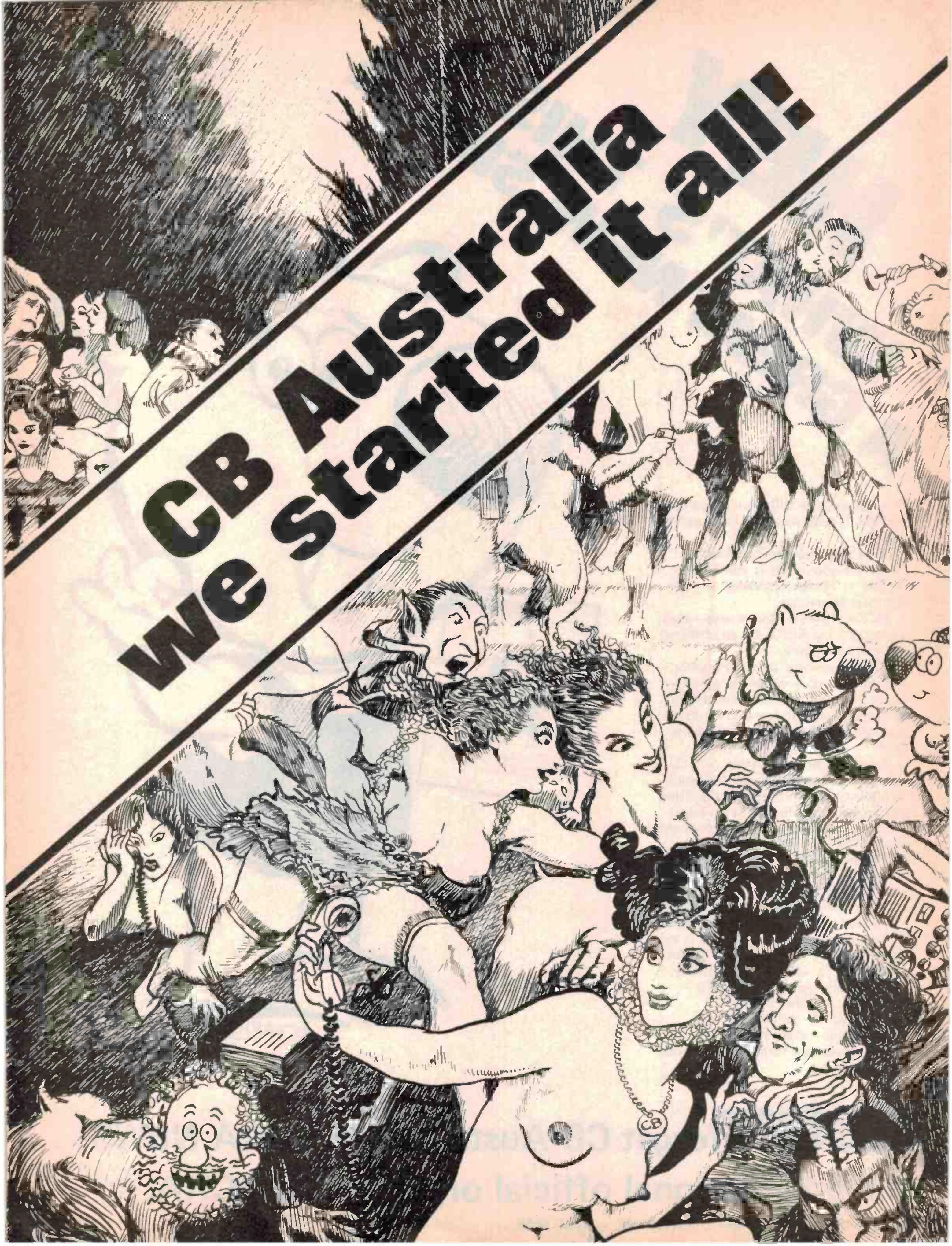
You know CB Oz was *first*. They recognised that CB was going to be big in Australia and they treated it as a serious subject. . I mean, there's a lot of humour in CB Oz but basically they're really serious about CB — that's great, because so am I.

See you in the bright new CB Australia — every month.

First great new-format issue on sale early July.

DON'T forget CB Australia has NCRA NEWS . . .

the only national official organ of the NCRA.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NOTE: This offer can only be obtained by MAIL and not directly from ETI. All units will be sent from Chiba by certified mail. Please allow at least 30 days for delivery. Company purchase orders not accepted.

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predictions

AMATEUR & SWL COMMUNICATIONS

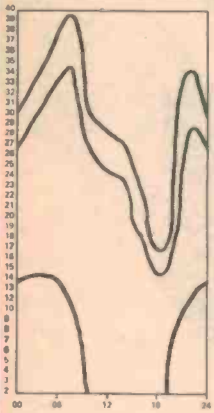
Ionospheric Predictions for the month or July

THESE PREDICTION GRAPHS have been prepared courtesy of Amateur Communications Advancements from predictions supplied by the Ionospheric Prediction Service Division of the Department of Science.

The graphs indicate the maximum usable frequency (MUF) on HF circuits between various centres in Australia and selected points overseas.

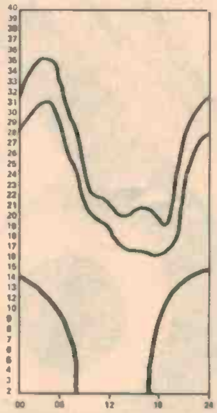
For less than 50% of the days of the month the highest frequencies propagated will be at least as high as the uppermost curve. Between 50% and 90% of the days of the month the MUF will be at least as high as the curve beneath the upper curve. The absorption limiting frequency (ALF), which affects the lowest frequencies that will be propagated, is indicated by the lower curves on the graphs.

Brisbane-Tokyo
Length 7156 KM

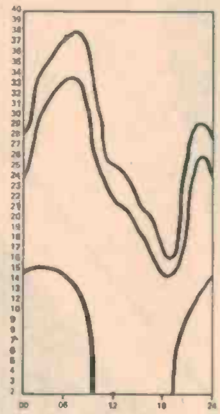


Sydney-Honolulu
Length 8203 KM

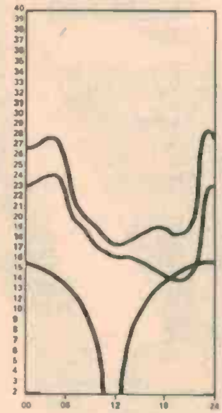
Adel-Honolulu
Length 9206 KM



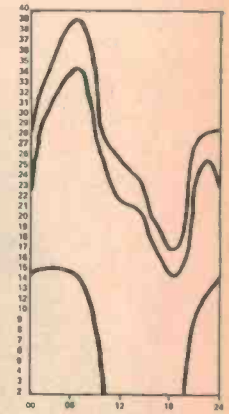
Adelaide-Tokyo
Length 7853 KM



Perth-Ft Collins
Length 16257 KM



Sydney-Tokyo
Length 7822 KM

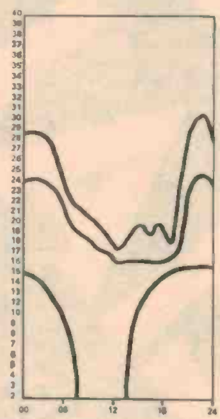


Perth-Tokyo
Length 7922 KM

Perth-Honolulu
Length 10967 KM

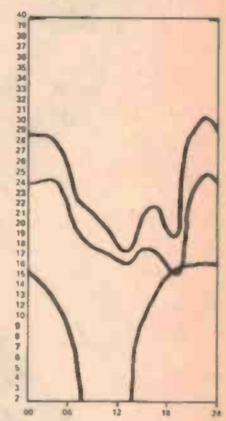
T'ville-Honolulu
Length 7558 KM

Melb-Ft Collins
Length 14143 KM



Melb'ne-Honolulu
Length 8879 KM

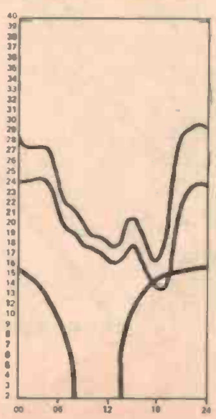
Syd-Ft Collins
Length 13434 KM



Melb'ne-Tokyo
Length 8190 KM

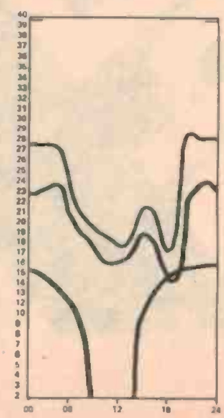
Townsville-Tokyo
Length 6144 KM

Bris-Ft Collins
Length 12902 KM

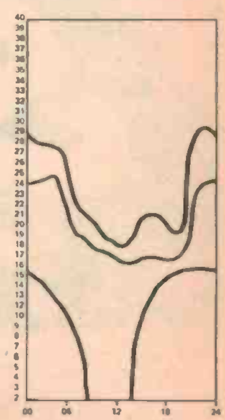


Bris-Honolulu
Length 7610 KM

T'ville-Ft Collins
Length 12873 KM



Adel-Ft Collins
Length 14502 KM

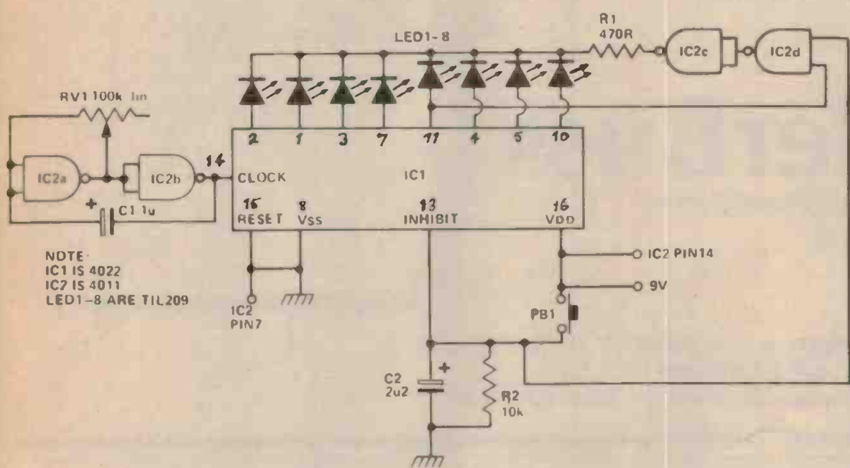


Ideas for experimenters

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.
Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.

Pot Shot

This is a circuit for a game of the shooting gallery variety. IC2a and b form an astable multivibrator clocking IC1 which causes LEDs 1-8 to flash in turn LED 5 is the "target" LED and the object of the game is to depress PBI just as LED 5 comes on. If this is done, the whole display is blanked for a few seconds signifying a hit. Otherwise, the LED which was lit remains lit. When the push button is released, C2 discharges through R2 taking 8 pin 13 low again and the LEDs will start to flash again.

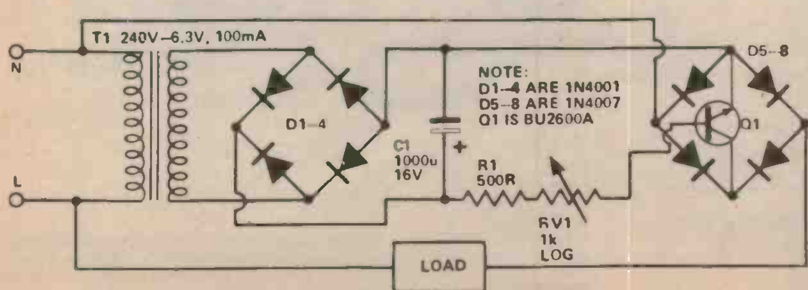


Speed Controller

Some AC motors judder badly at low speeds when controlled by triacs using phase control. This circuit gives very smooth operation with no RFI.

Q1 acts as a 'variable resistor' in the mains supply, with diodes D5-8 ensuring unidirectional current flow through the transistor.

Bias to the transistor is supplied by the mains transformer and controlled by RV1. Q1 must be able to withstand peak mains voltage (–350V).



Ideas for experimenters

Proper Identification for T.V. Game Chip

Many of the T.V. game circuits, whether ready built or as a magazine project, use the popular GI 8500 chip. The standard circuit gives white players, ball and court on a black background. The circuit described below gives a grey background, one white and one black player and a white ball and court. This is aesthetically more pleasing and has the advantage of making the squash game less confusing.

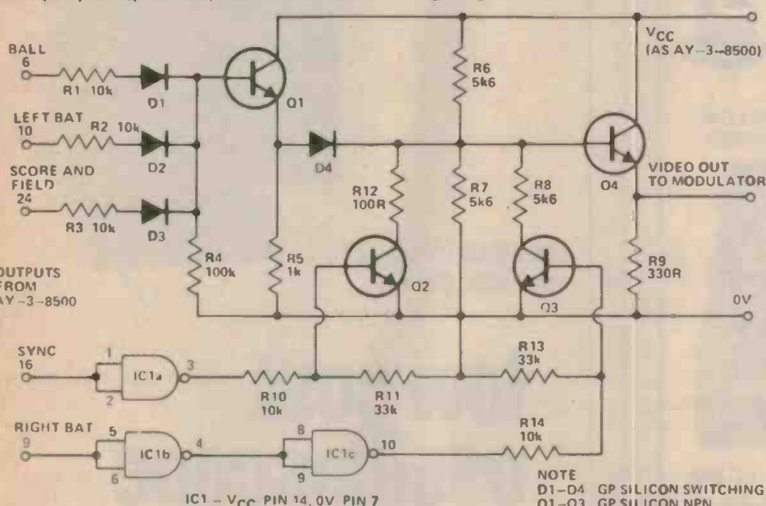
The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

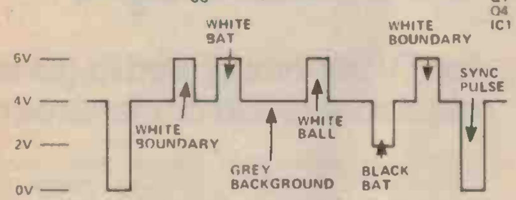
The three signals from the 8500 requiring a white output are Ball (pin 6), left player (pin 10) and the score and field (pin 24), These are "OR'ed" together by Q1 to produce a white level defined by the ratio of R1-R3 and R4. The white level on Q1 takes the output on Q1 to white via diode D4.

The one black signal is the right bat (pin 9). This is buffered by two stages of a CMOS 4011 chip, and turns on Q4. This takes the output to a black voltage defined by R6, R7, R8. If a white and black signal occur together (as happens when the bats cross in squash) the white from Q1 will predominate.

The sync output from pin 16 is inverted and turns on Q3 pulling the output down to sync level, 0V.

With the values shown and a supply of 9V the open circuit output voltages are White 6V, Grey 4V, Black 2V and sync bottom 0V. The output is positive going video.





WAVEFORMS (LINE SCAN)

Moving Coil Cartridge Preamp

Although moving coil cartridges undoubtedly give better reproduction from disc they usually require expensive step up transformers to enable them to be used with conventional RIAA equalisation.

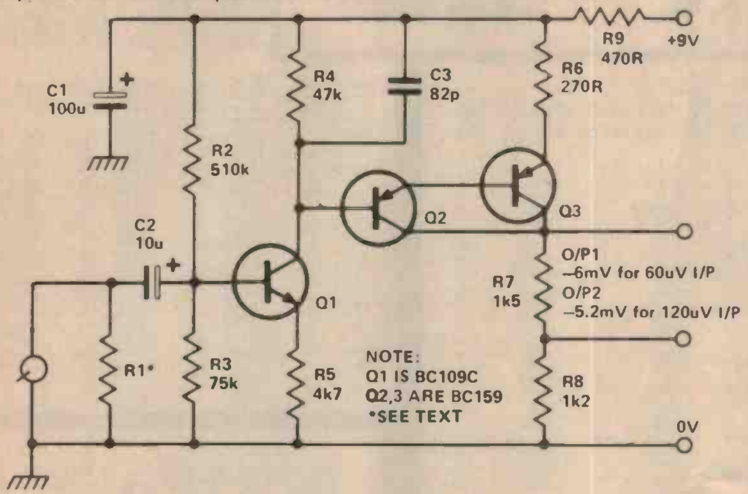
The reason for this is that most cartridges of this type have outputs of 60-150uV and like to 'see' an input impedance between 60-330R.

The circuit shown was developed to cater for a particular cartridge of this type although by modifying the value of one component, R1, it is possible to cater for the complete range of inputs detailed above.

Inputs signals are coupled to the base of Q1 via the isolating capacitor C1. R1 damps the input impedance to the correct value to match the particular cartridge in use. R2 and R3 bias Q1 which is employed in the common emitter mode. Heavy local AC and DC feedback is introduced by R5 and this defines the gain of the stage at 20dB. To minimise noise a BC109C is used here operated with a low collector current, 50uA. The output stage of this amplifier is the darlington pair Q2 and Q3. Output signals being taken from across R7, R8.

Ideas for experimenters

R1 should be determined by experiment but can be initially found by using a 470R preset in the R1 position and adjusting this for optimum sound quality by ear.

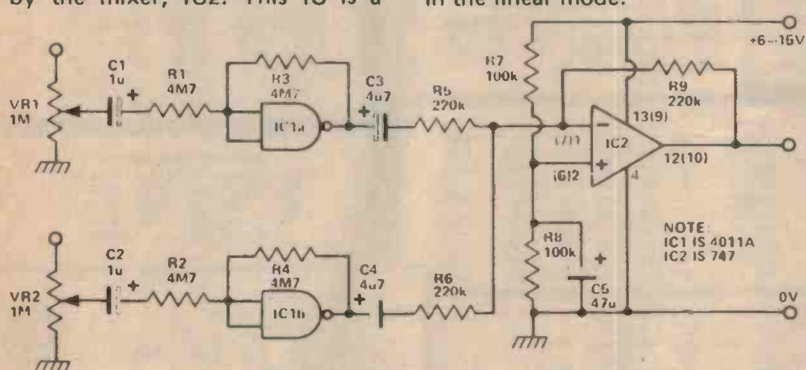


Hybrid Mixer

This circuit shows one channel of a stereo mixer, the other channel being identical. The input signal is applied to the volume controls RV1&2 and from thence to the NAND gates via the blocking capacitors and R1&2. These gates are first used as inverters by strapping both their inputs together, and are biased into the linear region by the feedback resistors, R3&4. In this way the gates act as high impedance, high quality, unity gain amplifiers.

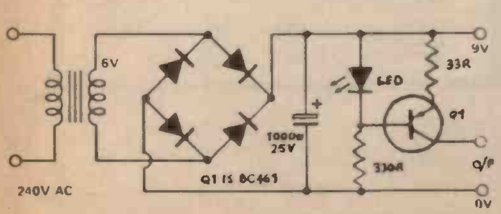
The output from the gates are summed by the mixer, IC2. This IC is a dual op-amp of the same specification as the commoner 741, which could be used instead. As a single power supply is used the non-inverting input must be biased at half the supply voltage. This is done by the potential divider, R7&8, C5 de-couples this point to earth.

The output impedance of this IC when used in the manner described is less than 1 ohm and so can be fed directly into a line socket. This circuit will only work with 'A' series 4011's as the B series contains protection circuitry which will prevent it working in the linear mode.



Constant Current Source

This circuit uses a standard panel mounting LED to provide a constant reference voltage for a transistor in a constant current generator.



The output current I, is given by the equation

$$I = \frac{V_{LED} - V_{BE}}{R_E}$$

When the circuit is not connected to a load, the LED is extinguised, giving a visible indication of when the circuit is operating.

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7405	.19	7446	.81	74107	.37	74175	.95
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7416	.35	7470	.38	74150	.98	74193	.85
7417	.35	7472	.35	74151	.88	74194	1.15
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74LS27	.24	74LS126	.45	74LS193	.88	74LS368	.49
74LS28	.26	74LS132	.71	74LS194	.83	74LS378	.89
74LS30	.21	74LS133	.29	74LS195	.65	74LS390	1.49
74LS32	.25	74LS136	.34	74LS196	.79	74LS393	1.29
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7409	.07	7491	.20
7410	.05	7493	.14
7416	.12	7495	.20
7420	.06	74100	.40
7423	.12	74107	.12
7425	.12	74123	.18
7426	.09	74125	.22
7427	.09	74126	.22
7430	.07	74132	.22
7432	.08	74141	.25
7437	.07	74145	.25
7438	.07	74150	.40
7440	.05	74151	.20
7441	.30	74153	.15
7442	.20	74154	.40
7443	.20	74163	.35
7444	.20	74164	.35
7445	.20	74177	.25
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7448	.30	74182	.25
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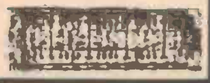

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