Projects, hi-fi, ham radio, computers, CB, SWL

electronics today

APRIL 1979 INTERNATIONAL

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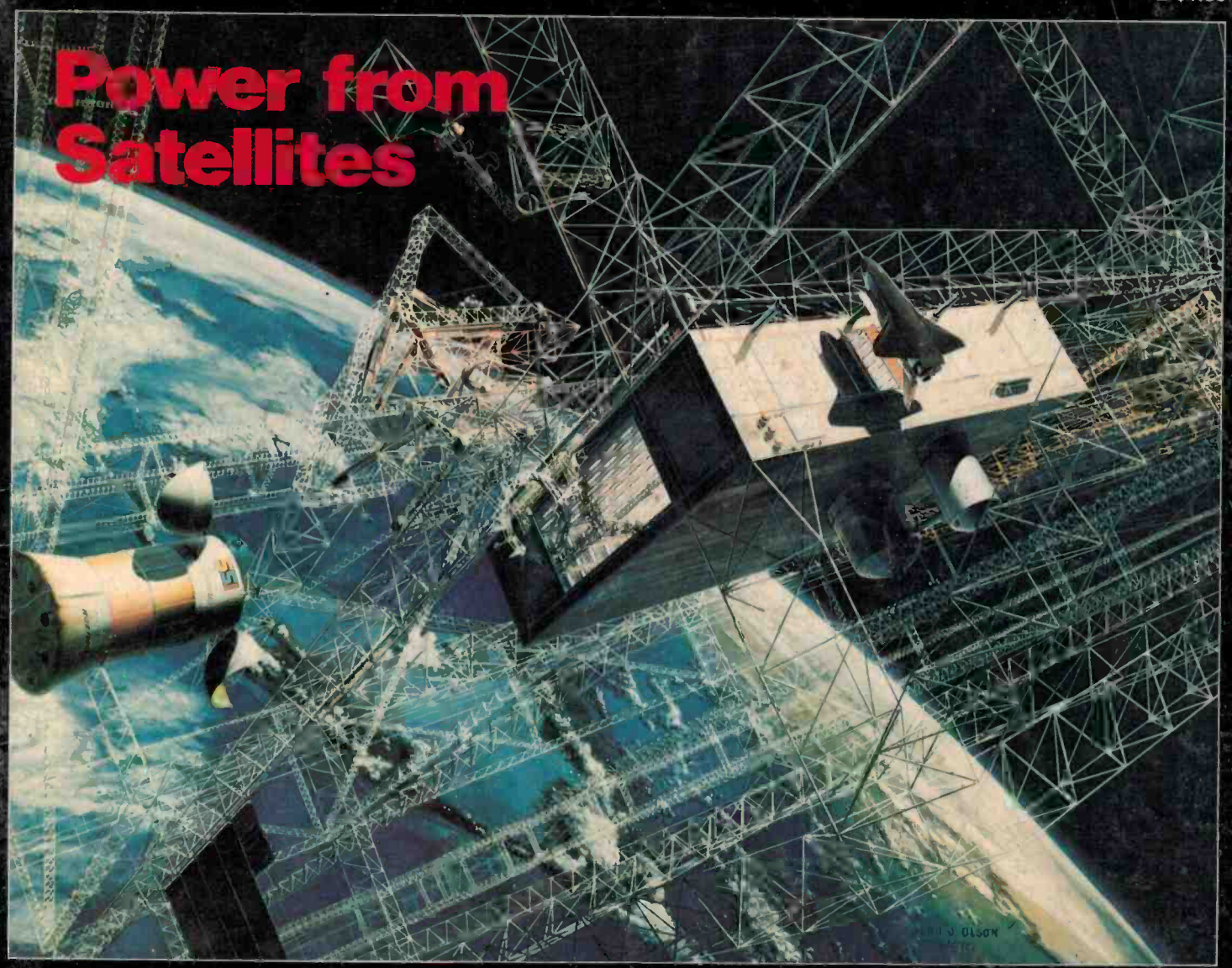

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Video cassette recorders

Battery condition indicator

FT-7 amateur rig reviewed

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Unlike any other!

Sansui's Pure Power G-7500 DC stereo receiver is unlike any other because of the exceptional musical quality of the reproduced signal. To achieve such quality, Sansui engineers went beyond conventional specs to annihilate TIM — transient intermodulation distortion.

TIM ordinarily occurs with the complex, pulsive signals that are typical of the actual music you enjoy hearing. Proof that Sansui has virtually eliminated such distortion is the super-high 60V/μsec. slew rate and very fast 1.4μsec. rise time. We believe that no other amplifier, let alone receiver — at any price, can match such performance.

Radically reduced TIM is only one benefit from Sansui's original DC circuitry. Eliminating capacitors in the NF loop and inputs and outputs is another vital step towards pure power for pure sound. An extraordinary frequency range — from DC (zero Hz) to 200,000 Hz — assures the cleanest and clearest sounds you've ever heard.

New standards. New features. A full 90 RMS watts per channel with low 0.025% T.H.D. Sansui's unique DC configuration means pure power for pure music. The same outstanding basics can be enjoyed in our other Pure Power receivers:

G-5500 (60 watts 0.03% T.H.D.)
G-4500 (40 watts 0.1% T.H.D.)
G-3500 (26 watts 0.1% T.H.D.)

For receivers that deliver the best, come to Sansui.

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G-7500

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AUSTRALIAN OWNED AND PRODUCED

April 1979, Vol. 9, No. 4.

electronics today INTERNATIONAL

Cover: Artist's impression of a 'Powersat' under construction. Huge satellites, assembled in space, are seriously proposed as a future means of delivering solar energy to power-hungry Earth. Fascinating feature article begins on page 10.

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PROJECTS

FEATURES

NEWS & INFORMATION

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IMPORTED BY CHLORIDE Chloride Batteries Australia Limited

now the most complete range available in Australia

News Digest

The Allsop head cleaner. A felt pad, driven by the take-up spindle, wipes across the heads as the cassette is 'played'.

A Long Felt Want

Like so many *really* clever ideas, this one's *remarkably* simple.

You want to clean a cassette head, right? The access is limited by the cassette mechanism. The ideal cleaning medium is a felt pad soaked in a solvent.

One possibility is to go for a set of tools, complete with mirrors on long handles, to enable you to play at dentist inside your tape recorder. This is fine if you happen to have been trained as a dentist. Most people find that using such an arrangement is a pain in the . . . er . . . mouth.

Another approach is to use a 'head-cleaning' cassette. These contain a length of abrasive tape which slowly grinds the muck off. Unfortunately, it doesn't clean the pinch wheel and roller. The effect it has on the head itself is also questioned by those who believe that any sort of abrasive shouldn't go within less than a metre of a tape head. The tape doesn't carry any solvent and doesn't absorb the dirt – it just grinds it off.

Ideally, what's required is a dummy cassette with a felt pad, driven by the machine, that you insert – press the button and let the machine do the rest. That's just what CPI (Aust) have just released here.

A cam in the cassette is driven by the take-up reel and moves a felt pad on an arm back and forth across the head. As a bonus, a second pad is held against the capstan and pinch wheel to clean *them* as well.

A bottle of cleaning solution comes with the cassette so that the pads can be soaked before use. This helps remove grease.

The whole thing is very effective and is bound to make an impact on the Australian market. It's available from *CPI (Aust.) Pty. Ltd., PO Box 264, Double Bay, Sydney 2018*

Skylab's Fall

When the 85-tonne 'Skylab' space workshop de-orbits (as NASA so poetically puts it), about 25 tonnes of high-technology space garbage will fall in an area covering 12% of the Earth's surface.

This will consist of 400 to 500 pieces, each travelling at speeds up to 100 m/s. It will include the film vault and airlock shroud – weighing two tonnes each – which are both designed to come down *intact*. We calculate that each will have a kinetic energy equivalent to 50 kg of TNT! NASA reckon the chances of a one-tenth tonne piece falling into an inhabited area as one in forty.

Admittedly, there's nothing we can do about it – but why wasn't all this thought of when the thing went up? NASA seem to be playing the whole thing down (for obvious reasons). The figures released for one-tenth tonne objects is all very well but what's the smallest size which could damage property? 50 kg?, 10kg? The chances of smaller bits hitting inhabited areas must be greater. Even at forty to one, any bookmaker will tell you that longer odds have come off in the past.

Meanwhile the Americans are taking the whole thing in their stride as usual. (Well, it's only natural that they should be responsible for what must be the largest lottery in the world). A Washington (DC) company, called Chicken Little Associates, is offering a service (at $US100 a time) to warn people if they happen to be in the path of any of the space junk as it falls with greater and greater predictability onto a mainly unsuspecting public.

NASA think that the Grand Draw for the find-a-piece-of-Skylab-in-*your*-back-yard lottery should be around the end of this year.

VTR Film Suit

Two film studios in the States have filed a copyright infringement suit against Sony over the use of the Betamax video cassette system.

Universal Studios and Disney claim that *no* material can be recorded legally from the TV.

Sony have replied that Universal and Disney should only be involved in alleged infringements of their own material and that most TV programmes have nothing to do with them. They also claim that the studios have used private detectives to talk retail sales staff into recording films from TV for evidence.

Claims and counter-claims will probably be flying across US court-rooms for some time to come. This looks like it's going to be a long one. They may even have to brief Rumpole of the Bailey!

News Digest

Kimberley - award winner

A new transceiver to appear on the Australian market seems certain to capture a large share of the commercial two-way radio sales. The Australian designed and built Kimberley transceiver is probably one of the finest examples of communications engineering we've seen in a long time.

Winner of an Australian design award, the unit has proved popular in Western Australia and is soon to be marketed in the eastern states from a Sydney base.

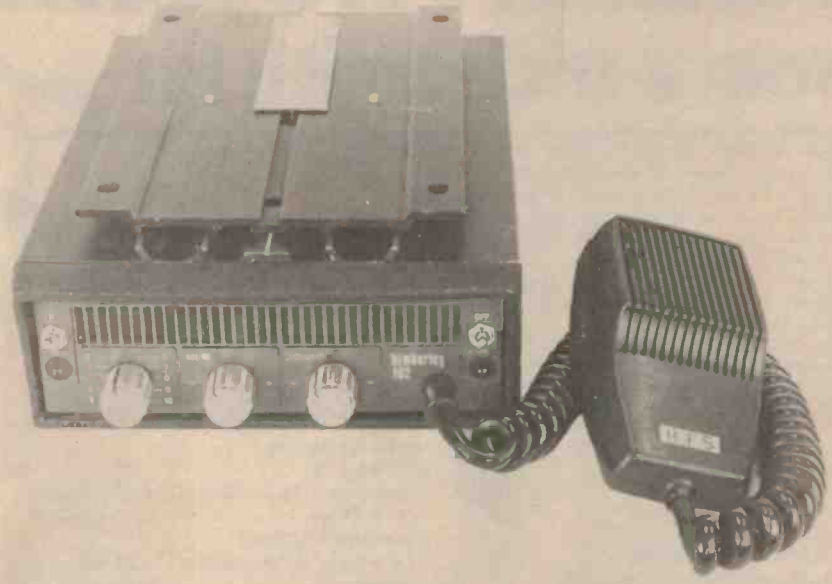
As it's name suggests, the Kimberley transceiver is designed to withstand extremely harsh environmental conditions. The unit is housed in a strong extruded aluminium case with dual speakers for reliability. A ruggedised version is also available which is 'splash proof'. Transceivers installed in ore trucks and other heavy mining vehicles have to withstand being hosed down regularly!

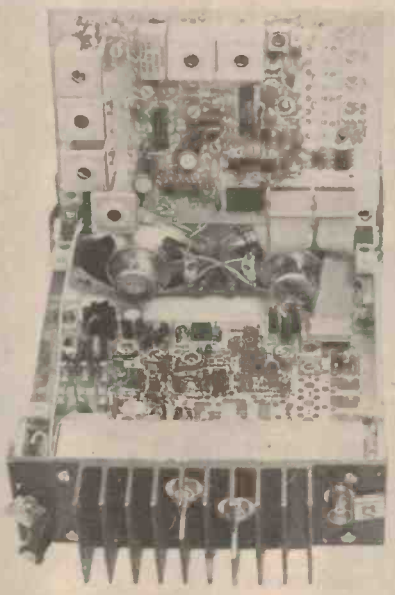
Inside the transceiver all components are readily accessible, the two main pc boards hinging out to reveal the screened power output and driver amplifiers. The double-sided boards are gold plated for reliability and long life.

Performance-wise the Kimberley is everything you'd expect from a modern solid state design. It features up to 20 crystal-locked channels which are available with the options of high or low band operation, repeater and link operation, selective call, remote control, transmit timer, privacy facility, telephone type handset and extension speaker. Power drain on receive is a low 150 mA.

All that aside, a price near $500 (excluding sales tax) for a single channel VHF transceiver makes the Kimberley very attractive indeed. Other products include 25 and 50 watt base stations, remote control units, power supplies and cavity reasonators.

For further information, contact *R F Systems (NSW), PO Box 148, Pennant Hills NSW 2120 (ph (02) 487 3850).*





15 000 More?

Many of our advertisers and readers are puzzled by the apparent contradiction in the audited circulation of this magazine and our nearest Australian competitor.

Electronics Today International was conceived and produced in Australia – commencing in April 1971. It was and still is an Australian product.

Overseas editions followed, and ETI is now published as seperate editions in Australia, Britain, Holland, Germany and Canada. The total world circulation exceeds 150 000 monthly and is increasing.

Agreements with ETI's overseas editions restricts direct sales of the Australian edition to Australia and New Zealand *only*.

Our audited circulation relates solely to sales within Australia plus a quota-restricted 1 500 or so to New Zealand.

Within Australia the sales of ETI are, on average, substantially similar to those of our closest competitor.

Disco Player

DiscoVision is *not* the latest John Travolta extravaganza – it's a video disc system which has just been released by Magnavox/MCA in the US.

Weighing in at about 15 kg and costing around $US700, the set uses a laser to 'read' the discs and individual frames can be played back with random access.

Two hundred titles are available so far, with another hundred to be released at the end of this year. Discs will cost between six and sixteen US dollars each. They come in either 'Standard Play', with 30 min/side or 'Extended Play', with 60 min/side.

The system also has outputs for stereo sound, which can be fed into a normal hi fi system.

Two possibilities which spring to mind are: using the system for high-quality music reproduction and high-density data storage. Any more?

Odd Sods

Brazil has set a limit of $US130 mil/yr on computer imports in order to help its domestic industry. Critics see this as a gamble which may leave the country with too little computing power.

Sperry Co. have sup .ied Atlanta, Georgia with a laser-linked traffic control system. Transceiver heads at each intersection can communicate at up to 2 km, even in heavy fog.

BUILD A PROJECT...
from a Dick Smith kit

CAR STEREO BOOSTER (E.A. January 1979)
Boosts power output of your car cassette or FM stereo radio to 12 watts per channel — gives you home quality sound while you drive. This project is extremely easy to build. The Dick Smith kit contains everything you need — even a special anodised heatsink bracket and front panel decal — plus a specially written step-by-step construction manual.

$29.50 Cat. No. K-3493

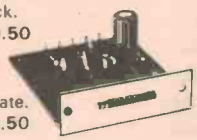
AUDIO AND AMPLIFIERS

PLAYMASTER 40/40 STEREO AMPLIFIER
(E.A. December '76)
Our most popular kit ever. Thousands sold.
Cat. K-3411 .... $129.50

PLAYMASTER TWIN 25 AMPLIFIER
(E.A. May '76)
Similar to above, but less power. A great kit.
Cat. K-3410 ..... $105.00

PLAYMASTER AM/FM TUNER
(E.A. Nov/Dec '76)
Matches Playmaster amplifiers — with in-built digital clock.
Cat. K-3494 .... $159.50

LED LEVEL METER
(E.A. June '76)
Easy to make, fully solid state.
Cat. K-3370 ..... $13.50



ETI480 100W POWER AMP MODULE
(E.T.I. December '76)
100 watts for $25.00? Unreal, man! (mono module).
Cat. K-3442..... $25.00

ETI480PS 50W POWER AMP MODULE
(E.T.I. December '76)
As above, but 50W. Easily extended to 100W.
Cat. K-3440..... $19.50

ETI480PS POWER SUPPLY MODULE
(E.T.I. December '76)
To run either 1 x 100W or 2 x 50W modules.
Cat. K-3438..... $19.50

MUSICOLOR Mk 111 COLOUR ORGAN
(E.A. September '76)
Turns your music into light! Just add the lights.
Cat. K-3140..... $65.00

ETI601 MINI ORGAN
(E.T.I. August '76)
YOU can play your favourite tune in style.
Cat. K-3430 ..... $26.50

LOUDSPEAKER PROTECTOR
(E.A. June '76)
Eliminates turn-on and turn-off surges from most amps.
Cat. K-3425..... $13.50

AMATEUR CB, ETC.

VK POWERMATE
(E.A. May '78)
Shortform kit – nb metalwork, mains wiring etc.
Cat. K-3449..... $32.00

CB POWER SUPPLY
13.8 volts at 2A continuous (4A peak). Complete kit.
Cat. K-3448..... $29.50

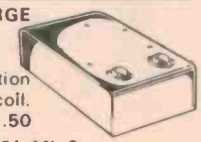
MORSE KEYER
(E.A. April '78)
Perfect Morse code — electronically generated. Including paddle.
Cat. K-3470 ..... $39.50

45 WATT VHF AMPLIFIER
Fibreglass PCB, 13.8V operation. Requires 8 — 12W of drive.
Cat. K-3132..... $29.50

30 WATT 80 METRE AMPLIFIER
Ideal for the novice. 13.8V. Adaptable to 50W output.
Cat. K-3133..... $35.75

MISCELLANEOUS

CAPACITOR DISCHARGE IGNITION
(E.A. July '75)
Save petrol, end ignition troubles. Pre-wound coil.
Cat. K-3280 ..... $27.50



DRILL SPEED CONTROL Mk 2
(E.A. July '76)
Suits 240V 'universal' motors (not electronically switched or controlled types). A must for the home handyman.
Cat. K-3080..... $13.50

HIGH POWER STROBE
(E.T.I. August '71)
A real blast — ideal for parties, discos, etc.
Cat. K-3150 ..... $29.50

TV MASTHEAD AMPLIFIER
(E.T.I. August '71)
Can turn an unwatchable mess into a brilliant picture.
Cat. K-3230..... $32.00

COMPUTERS, ETC.

LOW COST VIDEO DISPLAY UNIT
(E.A. February '78)
Communicate with a computer. Matches above.
Cat. K-3460..... $97.50

VIDEO MODULATOR for use with VDU
(E.A. April '78)
Allows above VDU to be used with any TV set
Cat. K-3462..... $4.50

2650 MINI COMPUTER
(E.A. May '78)
1k of memory — contains ALL parts required.
Cat. K-3447 .... $125.00

ASCII KEYBOARD ENCODER
(E.A. April '78)
Uses our standard keyboard (Cat. X-1180)
Cat. K-3464..... $39.50

CASSETTE INTERFACE
(E.A. April '77)
Use any cassette player to communicate with computer.
Cat. K-3465..... $24.50

SHORTFORM MINISCAMP
(E.A. May '77)
Contains PC board and components only.
Cat. K-3445..... $59.00

TV GAMES

10-GAME VIDEO GAME
(E.A. July '78)
Features 4-way bat control, many combinations of bat sizes, ball speeds, angles, etc.
Cat. K-3491..... $49.50

STUNT MOTORCYCLE GAME
(E.T.I. June '78)
Play 4 different games, motorcross, enduro, drag and stunt. Easy to build!
Cat. K-3474..... $29.50

TEST EQUIPMENT

40MHz DIGITAL FREQUENCY COUNTER
(E.A. August/Sept. '78)
Versatile piece of test gear. Easily upgraded to 200MHz by adding 95H90 Pre-scaler IC.
(Cat. Z-5360 ..... $12.50)
Cat. K-3437 ..... $99.50

NEW MODEL TRANSISTOR TESTER
(E.A. July '78)
Checks most transistors and FETs quickly and easily.
Cat. K-3052..... $19.75

R-L-C BRIDGE
(E.A. March '78)
Ideal project for the beginner or enthusiast.
Cat. K-3468..... $34.50

AUDIO OSCILLATOR
(E.A. June '78)
Outstanding value for a valuable service aid.
Cat. K-3469..... $32.00

MAIL ORDERS: Certainly! Simply send your order to the Dick Smith Mail Order Centre, PO Box 747, Crows Nest NSW 2065. The chart at right shows the post and packing charges you must add to your order. (Order value at left, P&P charge at right).

$5 - $9.99	$1.00
$10 - $24.99	$2.00
$25 - $49.99	$3.00
$50 - $99.99	$4.00
$100 or more	$5.50

NOTE: Prices & stock availability could change between publication deadline & on-sale date due to circumstances beyond our control. Please check with our stores for latest availability & prices.

* SEE OUR DOUBLE PAGE AD FOR FULL LIST OF STORES AND DEALERS

DICK SMITH ELECTRONICS

News Digest

Single-chip Photo Imager

Hitachi has developed a new single-chip colour image pick-up device which promises to make home colour TV cameras as small and cheap as 8 mm movie cameras. The MOS device incorporates a special colour filter on the chip itself.

Hole Magnifier

This useful little device allows pc manufacturers to check on the quality of their plated-through holes. It shows the *inside* of the hole in a nine-segment 360° view with a five times magnification.

Drilling and plating imperfections can thus be quickly and easily spotted at an early stage of production.

The magnifier (called rather succinctly the Model ZPR Hole Inspector) can also be used by people who buy boards to keep an eye on (groan) the quality of what they get.

You never know, someone may even come up with another application for this fascinating little device – like checking lab mice for tooth decay, or ... well, the uses must be endless.

C & K Electronics (Aust.) Pty. Ltd., Office 2, 6 McFarlane St., Merrylands, 2160. PO Box 101 Merrylands (ph 692 3144).

Desoldering Tool

Two new developments have been added to the Royel de-soldering tool.

One is a throw-away solder collection cartridge which sits in the sucker itself and can be changed easily and quickly.

The other is a 'boost' vent which, when the tip is withdrawn from the joint, whisks the molten solder from the bit's interior up into the sucker. This was designed especially for de-soldering small leads where the vacuum-induced airflow is restricted.

These two developments are claimed to overcome the major obstacles to vacuum de-soldering.

Royston Electronics, 22 Firth Street, Doncaster, VIC 3108 (ph 848 3777).

Electronic Agencies

Comings and goings in the Sydney trade – Bill Edge has bought Electronic Agencies from Pre-Pak. As well as the more usual hobbyist components, he will also distribute Philips speakers and kits.

Mr. Edge was the founder of Edge Electrix which once operated from Burwood.

Electronic Agencies are situated at 115-117 Parramatta Road, Concord, 2137 (Ph: 747-6472).

ETI/Unitrex Calculator Contest

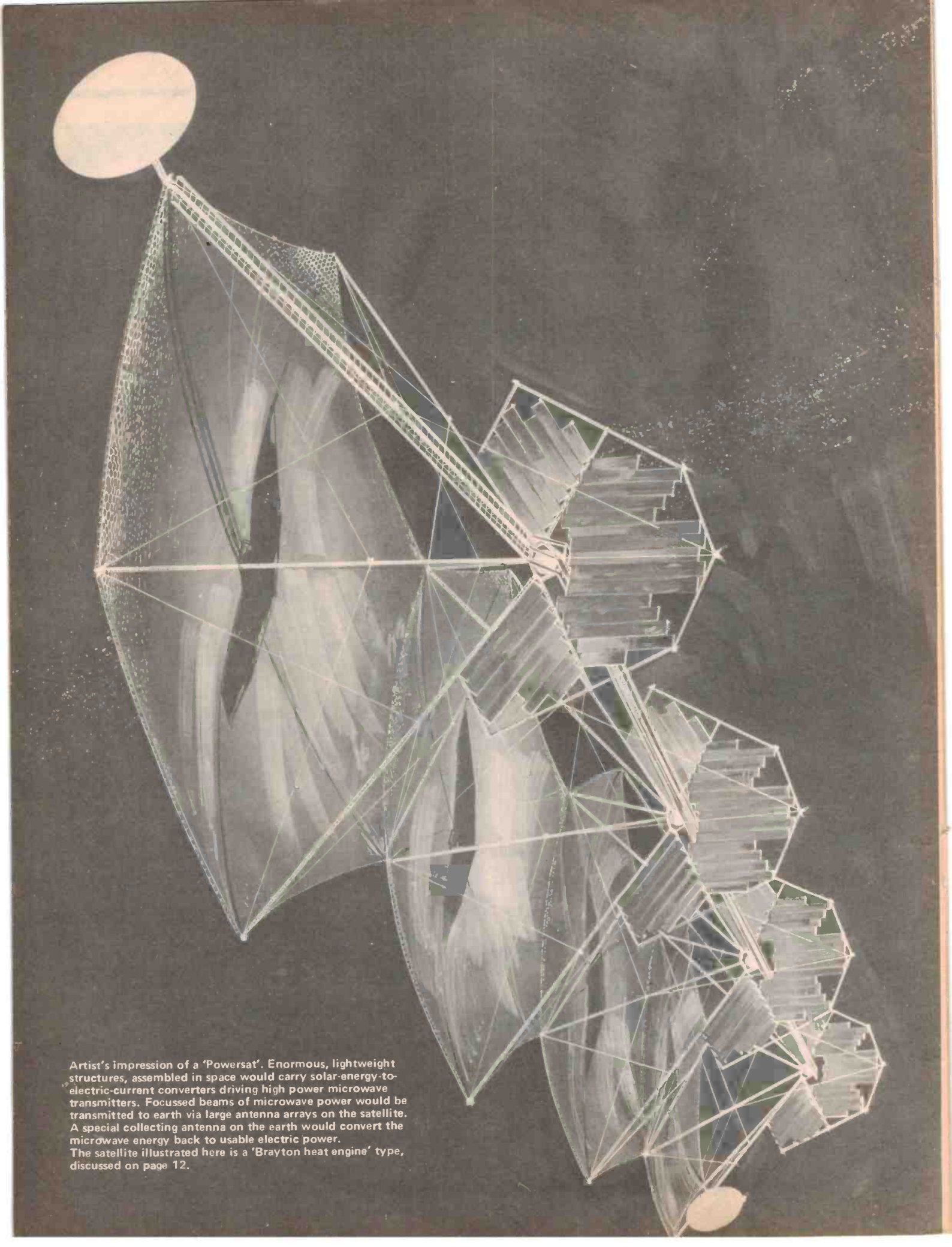
The winner of February's calculator was Mr. Heip of Glandore, SA. He gave one of the two possible answers: RR, CM, DE, RL, IN. The other was CM, RR, DE, RL, IN.

This month's problem concerns a tuna retailer. He has four cans of tuna which weigh 110, 120, 140 and 125 g. He also has a set of scales – but no weights. To make matters worse, his scales have a 10 g bias to one side. What is the minimum number of weighings he needs to find the heaviest tin?

Write your answer, your name and address on the back of an envelope, stamp it and put our name and address on the front: Unitrex Calculator Contest (April), ETI Magazine, 15 Boundary Street, Rushcutters Bay, Sydney 2011. Closing date is May 5th.

Errata

In our February 79 edition, on p.63 in the ETI 557 Reaction Tester project, pin 12 of IC6 is the $\overline{Q}$ output, while pin 13 is the Q output, not as shown in the circuit diagram.



Artist's impression of a 'Powersat'. Enormous, lightweight structures, assembled in space would carry solar-energy-to-electric-current converters driving high power microwave transmitters. Focussed beams of microwave power would be transmitted to earth via large antenna arrays on the satellite. A special collecting antenna on the earth would convert the microwave energy back to usable electric power.
The satellite illustrated here is a 'Brayton heat engine' type, discussed on page 12.

Solar Power Via Satellite

Solar power satellites could provide a real alternative to ground-based solar collector arrays as an infinitely renewable energy source. Brian Dance studies the possibilities.

WORLD-WIDE DEMAND for energy is growing at around 5% per year. Although conventional power stations using fossil fuels (coal and oil) are now backed-up by nuclear power stations, both fossil fuels and our supplies of fissionable isotopes are being depleted. Some action must be taken to provide for our energy requirements during the next centry. fast breeder reactors have been suggested since they generated fissionable fuel, but some people think the associated environmental hazards are unacceptable.

Controlled nuclear fusion produces little radioactive waste and could use readily available hydrogen from the sea. This method is attractive in principle but despite twenty years scientific study has not yet produced useful power.

Solar Satellites

Other sources of power, such as the waves of the sea, geothermal sources, photoelectric converters etc have been suggested but the most ambitious proposal yet made is for a number of huge satellites (often called 'Powersats' or 'Sunsats') to be assembled in space. They would convert the energy of sunlight into electrical energy which would be sent to the earth as a microwave beam. At the receiving station the energy would be converted into power suitable for feeding to our electricity grid.

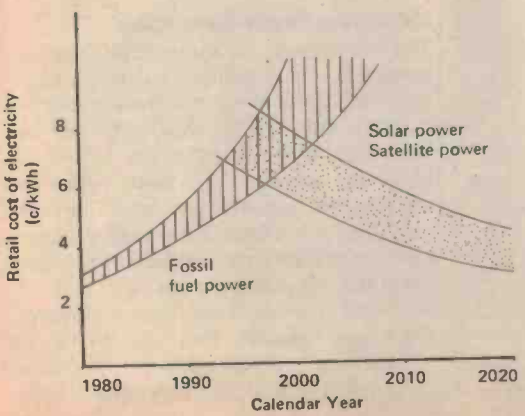
This solar power satellite idea is perhaps the most complex and expensive proposal yet made by our civilization.

US Work

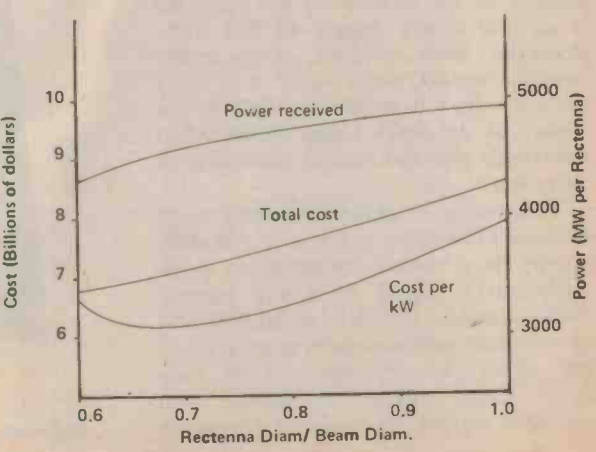
Some immediately obvious difficulties include the problem of converting many megawatts of power into a focussed microwave beam, the possible effects of the beam on people, animals and plants and its effect on the ionosphere and our weather. But the potential benefits are so great that the United States National Aeronautics and Space Administration (NASA) and the US Department of Energy have provisionally allocated 15.6 million dollars for work on the project up to 1980, at which time it will be compared in detail with other possible energy sources. Now a bill is being considered by Congress which would increase the amount by 25 million dollars for the fiscal year beginning in October 1979.

Boeing Aerospace, Varian Associates, the Jet Propulsion Laboratory of California and the Raytheon Company of Waltham, Massachusetts are some of the companies contracted to work on the project.

Although the US Department of Energy actually manage the funds for the Solar Power Satellite project, NASA is deeply involved with the development of new launch vehicles required for putting huge payloads into orbit. NASA has already established a Solar Power Satellite Office.



The graph at left shows how the cost of electricity generated from the burning of fossil fuels (coal, oil) will increase over the next two decades. The cost of solar power derived from the proposed satellites is likely to become an economic alternative within 15 years.
The graph at right indicates how the cost of a solar power satellite system varies depending on the diameter of the receiving antenna (Rectenna) on earth. Optimum cost per kW is obtained from an antenna of about 700 m diameter.



The idea of a solar power satellite was first proposed just over ten years ago by Dr. Peter E. Glaser. His suggestion was not taken very seriously at first, but NASA investigations in 1971/2 showed that it would be a feasible project. At the present time there is enormous interest in the USA in solar power satellites and campaigns are being organised to encourage the Government to proceed with the work with great haste. Peter Glaser leads a group of industrialists known as the "Sunsat Energy Council"; this Washington based Council was formed on solar power satellites. Naturally electronics manufacturers are well represented on this Council (including General Electric, RCA and Westinghouse), since such a project could bring a vast amount of work to the electronics industry.

Current Ideas

The proposals currently being considered are for a number of huge solar power satellites each providing a power level of some 10 000 MW and weighing some 10^8 kg (100,000 tonnes) with an area of about 100 km^2.

In order to place such an amount of material in orbit, it has been estimated that one would require a few launchings per day of huge Space Shuttle type vehicles over a period of a year or so. Boeing Aerospace are studying the possible effects of such launchings on the environment which will far outweigh the flights of Concorde. Launch and recovery problems may be considerable and the choice of rocket fuel may be limited by considerations of the resultant atmospheric pollution.

A solar power satellite would operate in geosynchronous orbit: this means orbiting at a rate calculated to keep the satellite apparently stationary above a point on the earth's surface. The receiving station would always be in a direct line-of-sight from such a satellite which could supply microwave energy for over 99% of its operational life. The other part of the time is spent with the satellite in the shadow of the earth, so it cannot supply power at this time. However, such eclipses of a power satellite would occur only for short periods when it is late at night in the region of the earth being served when electricity demand would normally be quite low.

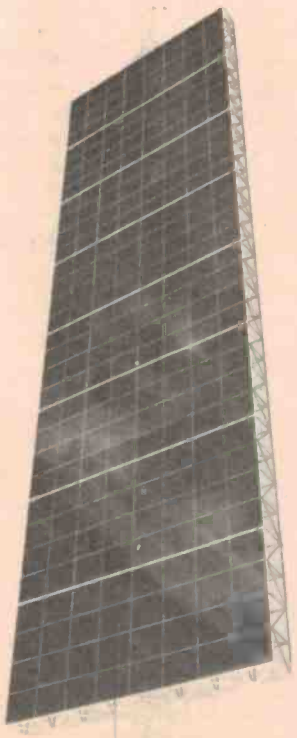
A satellite in geosynchronous orbit receives at least six times as much solar energy as a similar collector on earth (although a figure of nearly twenty times is more typical). A 10,000 MW solar power satellite could supply all of the electricity requirements of New York City. About forty-five such satellites would be required to match the present electrical generating capacity of the USA. Smaller satellites providing outputs down to 2500 MW could be economical propositions for some areas.

If it is decided to proceed with the construction of one or more solar power satellites, hundreds or even thousands of people will be working in space on the project.

Energy Conversion Systems

A number of forms of energy conversion have been studied for possible use in a power satellite, but two basic forms seem to be currently in favour. In the photovoltaic type of satellite, an array of perhaps 14×10^9 solar cells would be employed with a total area of about 24.8 km in length by 5.2 km in width (129 km^2). These cells would convert the energy radiated from the sun into a direct current.

Another possible system is known as the Brayton heat engine satellite; it would employ a series of four huge parabolic-dish reflectors, each about 5.6 km in diameter and similar to the reflectors used with conventional microwave aerials. The whole satellite would stretch some 23.7 km across space. The parabolic reflectors would collect the energy from the sun and would direct it into a 'solar furnace'. Each reflector would consist of thousands of steerable, extremely thin plastic reflectors which would direct the energy into a dome-like cavity absorber or solar furnace located near each dish.



Solar-cell power arrays may be inefficient

Helium gas operating in a closed loop could be heated in the solar furnace cavity so that it passes through gas turbines and would then flow through a space radiator where the heat from the gas would be passed to the radiator for dispersion into space. The space radiator could employ a liquid metal loop with a helium/liquid metal heat exchanger. A liquid alkali metal, such as potassium, would suffer little contamination in space. The gas turbines would drive a dynamo. As there would be no gravitational force in the region, the turbo-generators could be entirely supported by gas bearings.

Power satellites using other types of conversion are possible. The possibility of using thermionic electricity does not seem to be in the running at the moment owing to low efficiency, waste heat rejection and the cost of the materials.

Both the photovoltaic and heat engine systems seem to be possible, although each has its own advantages and disadvantages. In both systems the electricity produced would be beamed to the earth as microwaves. The Boeing study concluded that the weight of either type of satellite would be of the same order, namely 80,000 to 110,000 metric tonnes for a 10,000 MW satellite.

Although the photovoltaic system is less complex, the currently available solar cells are expensive to produce and are believed to be less efficient than thermal cycle engines. In addition, Brayton heat engines have already been operated very successfully on the earth using 7 m diameter reflectors to generate large amounts of electrical energy.

At the present time it seems that a photovoltaic system using silicon cells is most in favour. Unfortunately they are subject to radiation degradation, but this can be corrected by suitable annealing. It seems likely that silicon solar cells which have spent much time in the region of the Van Allen radiation belt would require re-annealing before use in their geosynchronous orbit.

Microwave Power Generation

The conversion of some 10,000 MW of power fed in as a direct current into the required 2.45 GHz microwave beam is no easy task. Varian Associates are basing their plans on the use of 70 kW klystrons cooled by heat pipes for microwave power generation in the satellite. It has been estimated that each satellite transmitter would employ some 250,000 70 kW-klystons in its 1 km diameter transmitting array. However, Raytheon favour the use of 5 kW "amplitron" devices which are crossed field amplifiers of the magnetron type.

The power transmitter design is largely dictated by the fact that it has been decided to limit the maximum power intensity in the ionosphere to 230 W/m^2 (23 mW/cm^2), since this is the best estimate of the limit below which localised heating of the ionosphere by the power beam can not exceed the heating occasionally produced by natural effects. Incidentally, the fraction of the complete atmosphere heated by the combined power beams of even a large number of solar power satellites will be extremely small.

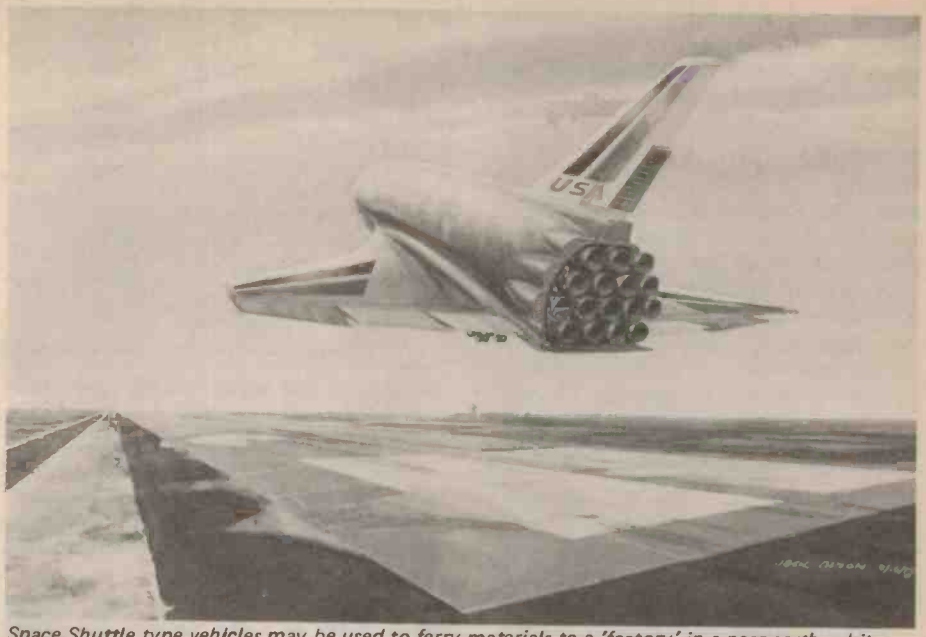
The Microwave Beam

It is intended that the microwave power beam from the satellite used to convey energy to earth would use a frequency of 2.45 GHz and would be focused on an array of receiving aerials on the earth over an elliptical area of some 12 km by 8 km in size. The receiving area would resemble a chain link fence mounted in stripes high enough above the ground to allow agriculture and animal grazing beneath the aerials.

It has been suggested by Ralph Chernoff of the Jet Propulsion Laboratory that a phased array of aerials on a satellite of a diameter of about 1 km could produce a suitable beam to the earth. Large phased transmitter arrays are required in order to produce a narrow beam which can be accurately directed. There may be two transmitters per satellite.

At the receiving station the microwave beam would be converted into direct current. A grid interface converter would then change this current into a high voltage alternating current of the mains frequency used in that region. It is probable that part of the power would be used to electrolyse water at the receiver site so as to generate the oxygen and hydrogen required for liquefaction for use as rocket fuel.

Earthbound experiments at the Jet Propulsion Laboratory have used a conventional communications receiver operating at 2.45 GHz as a beam source to direct power onto a tower at a distance of over 1.6 km. A receiving antenna was mounted on the tower; it consisted of a phased array of dipoles with each dipole connected to a diode rectifier and smoothing capacitor, the output being connected to a direct current load. An efficiency of 82.5% was obtained at a level of over 30 kW, the efficiency being defined as the direct current power delivered divided by the rf power transmitted. These experiments, which were performed a few years ago, almost abolished any doubts about the feasibility of obtaining high efficiency power transfer through the use of a microwave beam.



Space Shuttle type vehicles may be used to ferry materials to a 'factory' in a near earth orbit constructing a power satellite, the completed structure being moved later to a geosynchronous orbit.

A solar power satellite receiving station could also use a suitable array of dipoles and diode rectifiers; such a system is often referred to as a 'rectenna' or 'rectifying antenna'.

Accurate direction of the power beam from the satellite is essential for optimum efficiency. An error of only 1 second of arc in the direction of the beam will produce an error of about 174 m at the ground from a satellite in a geosynchronous orbit at 36,000 km above the earth.

A "retrodirective" technique is employed in which a signal transmitted from the ground station is used to measure and correct for any mechanical inaccuracies in the transmitting antenna. It is desirable that the wavefront emitted from the 1 km diameter transmitting antenna should be planar to within ±3 mm (±10° phase error) for optimum efficiency. It is probably impossible to obtain such mechanical perfection, but the phase front can be electronically controlled by distributing a reference phase synchronisation signal to all of the sub-arrays from a common source on the antenna and comparing this signal with the signal transmitted from the ground.

Rectenna costs have been found to be a major factor in the overall cost of transmitting the power from the satellite to the grid. Owing to the shape of the beam intensity pattern on the ground, one can reduce the size of the antenna array somewhat in order to reduce the cost per kW collected. In other words, the outer parts of the beam contain so relatively little energy that one cannot collect it economically. The graph on the right (page 11) shows a definite minimum in the cost per kW of the collected power for various rectenna dimensions.

Assembly Location

Boeing Aerospace have studied the possibility of assembling the parts of the solar power satellite in low earth orbit and then using the power available from the satellite itself to provide electric propulsion into a geosynchronous orbit. The main advantage of an assembly in low earth orbit is the reduction in rocket fuel requirements from 2.1 tons per ton delivered to a geosynchronous orbit to a mere 0.25 tons per ton. This greatly reduces the cost of launching the solar power satellites.

However, there are quite a number of disadvantages of assembly in low earth orbit, some of which are not easy to quantify. Boeing Aerospace feel the main disadvantage of low earth orbit assembly is the relatively long time (about 6 months) required for moving the satellite assembly from low earth orbit into geosynchronous orbit. This delay represents interest chargeable on the cost of the satellite assembly, etc. and interest charges on such enormous amounts of money cannot be ignored. Nevertheless Boeing feel that the reduction in the rocket fuel costs make assembly in low earth orbit the best technique.

Other problems associated with assembly in low earth orbit include the radiation damage of the solar power satellite components and solar cells during the relatively long time they remain in the Van Allen radiation belts, the problem of converting the assembled satellite into an electrically propelled unit, the risk of collisions with man-made objects in the low earth orbit and

during the relatively slow spiralling passage from low earth to geosynchronous orbit, the upper atmosphere drag affecting the construction work.

Hazards

The proposed 10,000 MW beam directed onto the receiving antenna should produce an intensity of some 230 W/m^2 (23 mW/cm^2) at the centre of the rectenna and about 10 W/m^2 at the edge of the ellipse. It is rather surprising that the 230 W/m^2 level corresponds to about the level of natural radiation incident upon the ionosphere. Investigations have been made into techniques for reducing the amount of radiation in the side lobes by some 45 dB so that the intensity outside most of the main rectenna area is seldom more than 0.1 W/m^2. Offshore rectennas have been proposed for use in areas of high population density.

It is claimed that birds and aeroplane passengers would be able to pass directly through the main beam without any harm, owing to the low beam intensity. Presumably aeroplane passengers would be fairly well screened from microwave radiation anyway by the metal body of the craft. Peter Glaser has commented: 'I have made a standing offer to provide the wine and salad to anyone who promises to eat that duck that flies through the beam – cooked or not!'

Biological tests are to be conducted to ascertain if a microwave beam of 230 W/m^2 produces any effect on birds and flying insects at the 2.45 GHz frequency. Similar tests will be performed at 10 W/m^2 on plants and animals. One wonders whether biological tests at much higher intensities have yet been performed.

Perhaps it is rather remarkable that the rectenna arrays will be suitably elevated to permit frost-free farming or other re-use of the land area. The field strength below the rectenna should be less than the currently recommended maximum US exposure level of 0.1 W/m^2.

Experiments are planned to test the effect of very high power microwave beams from the huge Arecibo antenna on the ionosphere. These experiments will be carried out with the express purpose of checking that the solar power satellite beam will not produce any deleterious environmental effects.

Heavy Lift Vehicles

The cost of the launch vehicles for placing heavy parts in low earth orbit ready for assembly forms one of the major items of a solar power satellite budget. The Boeing study assumed that a new launcher known as the 'Heavy Lift Vehicle' will be developed which should be able to put material into earth orbit for a cost of about 20 dollars per kg. Without such a heavy lift vehicle, the whole solar power satellite project would become economically impossible. The enormous fall in the cost of putting material into earth orbit is well illustrated by the table above.

Rocket type	Time	Dollars/kgm	Typical load
Vanguard	late 1950's	1.1×10^6	9 to 14 kg
Thor	1960's	22×10^3	450 kg
Saturn	early 1970's	1.4×10^3	110,000 kg
Space Shuttle	1980's	330	
Heavy Lift Vehicle	?	20–30	500,000 kg

Approximate cost of lifting material into earth orbit at various times.

The heavy lift vehicle could either have wings like the Shuttle (in which case it could land on the ground like an aeroplane even without using any of its motors) or alternatively it could be a vehicle without wings rather like the Saturn rocket which would have to return to earth by splashing down in the sea. It seems likely that the type of vehicle without wings will be favoured for heavy loads according to current ideas. The Boeing report shows a Saturn type vehicle 72.98 m in height and 32.68 m in diameter at its base.

The European Outlook

The energy requirements of Europe have been studied by the OECD and it is felt that about fifteen 10 000 MW solar power satellites could supply all of Europe's requirements for 1980. (The total number required for the world has been estimated as about sixty-nine.) The total *developmental* cost (not including operation) of a solar power satellite has been estimated as being of the same order as the total investment already made in North Sea oil by European nations.

The problems in Europe associated with a solar power satellite programme are not identical with those in the USA, largely owing to the different population densities. In the highly industrialised regions of Europe (where power consumption and population densities are greatest), there is normally little land to spare for the huge rectenna arrays together with any surrounding safety areas which may be desirable. The low electrical power demand in rural areas and the high cost of conveying power over large distances may render it uneconomic to place rectenna arrays in these rural areas, so some compromise must be sought in choosing the optimum regions for the siting of rectennas.

It is, perhaps, quite amazing that the USA has set a limit of 10 mW/cm^2 as the maximum safe exposure of people to microwave radiation, whereas the upper limit in the USSR is one thousand times smaller, namely 0.01 mW/cm^2. It is certainly true that exposure to intense, non-ionising radiation at radio frequencies can produce internal heating of biological tissue and this can produce damage if the heat cannot escape rapidly enough for a reasonable equilibrium temperature to be obtained. However, scientists are not yet certain whether other adverse effects than those due to mere heating are also present when personnel are exposed to intense microwave beams. In Western Europe the US standards are applied in radar stations, etc., but it would seem to be highly desirable that the biological effects of microwaves be more intensively investigated so that various countries no longer have a factor of one thousand differences in their safety standards.

International Enterprise

Work on solar power satellites is one of those major technological enterprises which should stimulate international participation and co-operation. The microwave beams can be received in all countries with latitudes between about 65°N and 65°S without any great loss of efficiency. The beam is virtually unaffected by even the heavy rain clouds so often found over many parts of the earth.

One may feel that the use of solar power satellites would not be an economical proposition in countries where the population density is not very high. However, one should remember that once a number of solar power satellites have been placed in geosynchronous orbit, the cost of placing any other such satellites in orbit will be much reduced.

One must not forget the disadvantages of establishing a world-wide solar power satellite system. Such a system would inevitably cause interruption of communications on the 2.45 GHz frequency. However, the enormous power radiated from a power satellite would result in considerable interference not only in the 2.45 GHz band, but also in a relative-

ly wide frequency band around this region and in frequencies which are harmonics of 2.45 GHz. Apart from this problem, increased radio frequency noise is likely to be produced by the microwave energy absorbed by the ionosphere which results in a raised electron temperature in this region. There would also be interruptions in the radio frequency communications links with aeroplanes or satellites whilst they cross the microwave beams from the power satellites, but doubtless other frequencies or laser beams could be used to overcome this problem.

It seems likely that the equivalent of 1000 or more Saturn V launches would be needed to place one solar power satellite into geosynchronous orbit. The total mass sent into space in a project of this type would easily exceed an astounding 10^6 tonnes/year!

It has even been advocated (by the *L-5 Society, 1620 N. Park Av., Tucson, Arizona, 85719)* that the materials already in space should be used to make most of a solar power satellite in order to minimise transport costs.

Other Requirements

A maintenance vehicle would be needed to maintain and re-supply solar power satellites in geosynchronous orbits — possibly a couple of journeys to each satellite per year. If many solar satellites were in use, a maintenance base in geosynchronous orbit would be justified — especially as it could be used to maintain communications satellites and other non-power craft.

During the construction phase of a solar power satellite (either in low earth orbit or in a geosynchronous orbit) living accomodation must be provided in space for the workers. As the cost of human labour in space will be exceedingly high, intensive studies are in progress to promote the automatic assembly of large structures in space.

Microwaves from Iceland?

The Icelandic Government are currently looking into the possibility of marketing electrical energy generated from their abundant geothermal sources. This energy would be converted into microwaves and distributed to the industrial nations by satellite. A consultant with Rockwell International, Dr. Krafft Ehriche, proposed this idea in 1969, but objections to its development include the high incidence of earthquakes in Iceland and the fact that the country cannot itself pay for the developmental work involved.

In order to develop this system, Iceland would require a primary energy power plant, a transmitter array system, a power relay satellite and distributed receiving plants. A transmitter power of 3,000 MW is proposed with a possible expansion to 7,000 MW. Perhaps it is rather amazing that the use of underground nuclear explosions has been suggested for increasing the amount of hot rock for steam production.

A transmission frequency of 2.4 GHz is planned with phase shifters to maintain beam coherence in the event of thermal stresses or minor earth perturbations. More than 67 million antenna elements would be required extending over a 65 km^2 area. The satellite would be positioned over the equator directly south of Iceland in geosynchronous orbit. It would have a surface area of 1.5 to 4 km^2 consisting of finely polished surfaces which would act as passive reflectors of the microwave energy. The transmitted beam would be only 16.4° above the horizon, but the satellite could relay energy to Western Europe, Africa, nearly all of South America and the Eastern coast of the United States. Rectenna systems of some 25 km^2 area located near industrial centres would receive the power. An end-to-end transmission efficiency of between 51% and 67% has been predicted.

Artists impression of a 'Rectenna' used to receive and convert the microwave energy, from the power satellite, to usable electric power.

Conclusions

The need for a non-depletable energy source for the next century is undisputed. Many scientists believe that if the necessary funds are made available quickly, energy could be provided by solar power satellites by about the mid-1990's. The estimated cost of solar satellite produced power is 1700 dollars /kW as against 1400 dollars/kW for power from conventional nuclear power generators. However, the effective cost of satellite generated power will decrease with time, since solar satellites require no fuel and relatively little maintenance. In addition, the cost of fossil fuels will doubtless continue to rise as sources are depleted. The trend of rising fuels costs and falling solar satellite power costs is illustrated in the graph, but obviously all cost estimates are subject to wide variations.

The possibility of power transfer over large distances by satellite is well illustrated by the Iceland geothermal power example. However, one of the objections to power satellites is that of security. If a nation relies on solar power satellites for a major part of its energy, how could its factories operate if its power satellites were destroyed in a war? At the present time the main objection to the speeding up of the solar power satellite programme seems to be environmental health and safety considerations together with the problems associated with rocket launching and recovery operations and the enormous cost of the complete project.

The construction, in space, of equipment the size of a city is quite beyond our present experience. It is not, however, so very far beyond the present state of our art as to be a practical impossibility. No new technological developments are required — only an expansion of current technologies. First of all we must break through the psychological barrier which has convinced us that it is virtually impossible to put a satellite the size of a city and the weight of a battleship into orbit.

If *you* had perhaps 1,000,000 million dollars to spend, would you choose to use it on a multi-solar satellite power project, relief for the underdeveloped countries, cancer work or perhaps some other project? Sooner or later decisions of this type must be made about the solar power satellite work. It seems likely that many vital decisions will be made in the USA when the results of the 1980 status report requested by NASA and the US Department of Energy are known.

The author is indebted to Mr. William A. Rice of Boeing Aerospace, Seattle, for the information and photographs which he has kindly provided for this publication.

Why most other record cleaners are victims of their own design.

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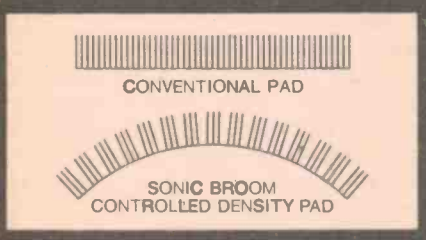
Look at almost every record cleaning brush on the market. You'll see a pad completely covered with closely packed fibers sticking out, intended to trap surface debris as they rub across the record surface.

Now look at the new Audio-Technica Sonic Broom cleaner. Lots of closely-packed fibers alright, but we skip a whole row, every fourth row. Which may make a funny looking pad, but a superior cleaner.



There are several reasons for our effectiveness: By skipping every fourth row, the Sonic Broom pad gets deeper into each groove without excessive pressure on the record surface. If we had more tufts—like most of the others—the Sonic Broom fibers might do a great job of cleaning the surface *between* the grooves, but never get to the very bottom where foreign matter can build up and destroy good sound.

Our varied tuft spacing also permits dislodged particles to migrate further from the tips of the cleaner fibers during cleaning. Without those gaps, the loosened particles would stay right at the ends of the fibers where they are easily redeposited somewhere else on the record. And you want to *remove* dust...not just move it around.

The differences don't stop with our fibers. The shape of the Sonic Broom pad has been carefully designed to make it easy to hold, easy to use correctly. The curve insures that just the right amount of cleaning area is in contact with the record at any time for maximum effectiveness. And the rigid backing, unlike soft pads, helps insure that the fibers don't simply collapse under pressure but are directed deep into every groove.

And how well does the Sonic Broom system clean, once the fibers reach the bottom of the groove? Very well indeed, since each tiny fiber is so small (about 6 microns or 0.00025" in diameter) that dozens can work side-by-side, contacting the entire groove wall surface. Even the smallest dust particles can't escape the repeated brushings.

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SOUND

with Wally Parsons

MOST READERS, I'm sure, are aware of the importance of wide bandwidth, and of flat response. Modifying frequency response by boosting or attenuating certain frequencies produces a change in tonal character, but often the results are quite different from what is expected. Thus a high frequency boost might add harshness rather than brightness to the sound, or reducing the midrange can produce boominess, rather than spaciousness. And yet, large changes in response in some areas of the spectrum may produce only slight variations in overall sound or in the tonality of certain instruments. This can be quite perplexing and frustrating when setting up a multi-way speaker system, for example, and finding that no matter how the different drivers are balanced, it never really sounds right, so that vocal recordings may have just the right amount of presence (although still lacking that elusive quality of "realism"), and orchestral music becomes brittle, and lacking in fullness.

What You Hear

An examination of the audio frequency spectrum, the musical scale, and auditory response reveals greater complexities than commonly believed.

The human auditory system is responsive to frequencies between about 20 Hz and 15kHz, sometimes higher in young persons, and deteriorating with age, assuming the system to be in healthy condition. Acuity tends to be greatest around 200 Hz to 5 kHz. The musical scale, as represented on a standard 88 key piano extends from 27.5 Hz for a bottom "A" to 4180 for a top "C". Above this we find high harmonics (including some speech articulation sounds) and high transient sounds. The most active region for instrumental music tends to be from about 110Hz (A_2) to 880 Hz (A^1), a range of three octaves. The human voice also is placed in this range extending downward to about 80 Hz for a Basso up to just over 1 kHz for a Soprano. Obviously, what happens in this three-octave band is of considerable importance.

The Middle

One assumption which is almost an axiom, especially with respect to loudspeakers, is that the extreme lows and highs are very difficult to reproduce, therefore the midrange can generally be left to take care of itself. Nothing could be further from the truth and the realization of this on the part of the designer has made many an unspectacular looking speaker sound eminently listenable. A typical three-way speaker with cross-overs at 500 Hz and 5 kHz demands that the mid-range unit cover a decade bandwidth, and the woofer a decade or even more, with the cross-over in the middle of the most critical portion of the mid-band.

A prominent rise in the lower part of this band can give rise to a boxy kind of sound, whereas a dip can produce a quantity of thinness. Excessive response in the bottom part of such a midrange unit (that is, just above 500 Hz) produces a muffled and constricted quality, while a broad suck-out may add a certain spactious, or airy quality, which seems better defined, yet actually lacking in detail. If woofer and midrange are not matched in level at the crossover we have the additional phenomenon of hearing abrupt level changes through the musical scale. Indeed, most major differences in sonic character between speakers can be attributed to relatively small differences in this lower midrange, largely due to differences in the compromises made in the relationship between drivers.

A Little Higher

Above the mid-range lies the upper mid-range, sometimes called the lower treble, covering the octave between 2500 Hz and 5000 Hz. Because of the ear's extreme sensitivity in this region, relatively small level changes can have a profound effect on the quality of "presence" or forward placement of voices and individual instruments. Moreover, this octave is predominantly harmonics, especially of the female voice and the upper musical registers, thus the harmonic structure and therefore the tonality of much of the music is profoundly dependent on this region. Too much level here can cause harshness, or brittleness. But if response is ragged we may have a choice of either excessive harshness, or lack of presence, but never "just right".

A Little Lower

Below the midrange lies an octave from about 160 Hz to 320 Hz which forms the upper bass region. This region is especially affected by speaker placement relative to the floor. Too low a placement accentuates response producing boominess, while too high a location results in thin bass. Both qualities contribute to listener fatigue and are particularly common to moderate size speakers of the kind a little too large for a bookshelf and too small for the floor. Also in this region lie the second harmonic of the low male speaking voice and some fundamentals of the tenor and female speaking voice, so anomalies in this region can do some strange things to speech tone.

It may come as a surprise to learn that most bass fundamentals occur in the next octave, that is down to about 80 Hz, the lower limit of the trombone, and the full range of tympani. The double bass has an additional octave to 41.2 Hz and the piano goes down another major sixth to 27.5 Hz. Thus, response which rolls off below 80 Hz will lose little of the bass fundamentals. However, room resonances (both listening room and studio) may appear in this region, and much of the ambience of the performance which is responsible for that feeling of solidity which characterizes a very wide range system. Unfortunately, rumble and other undesirable effects also live down here and the removal of such mud will actually improve the feeling of solidity.

The region just below 100 Hz, as well as the upper bass, also contains many of the fundamentals of the speaking voice, and a boost here will give rise to "chestiness".

Near The Top

Finally, a leap up to the highs, from about 5 kHz up to 20 kHz. Up here we find only the harmonics of tonal instruments, and fundamentals of such percussive instruments as cymbals, castanets, etc. Variations in response in the first octave (5 kHz to 10 kHz) affect brightness, especially around 7.5 kHz, and is most noticeable on strings, high woodwinds, soprano voice and sibilants. Many low compliance pickups begin to lose trackability in this range, which is why it shows up first on sibilants. Also, since it is so close to the commonly used cross-over of 5 kHz, interactions between mid-range and ▶

tweeter drivers, and cross-over design faults influence the reproduction of such signals. Beyond brightness lies stridency and shrillness, but, conversely, harshness can often be controlled by bringing down the response in this region. Some slight boost can also effectively extend the useful range of older recordings and AM (and even some FM) broadcasts.

The final octave, from 10 kHz to 20 kHz is important for the quality of airiness and realism imparted, provided there is actually some signal to reproduce, which is less often than we would like. A rising response here can accentuate noise and irregularities in pick-up performance, while a gradual roll-off, especially in conjunction with the next octave below will often do a remarkable job of reducing noise without severely degrading signal quality.

Play With It

Readers with graphic equalizers might wish to experiment with them, altering the balance of several octaves at once to observe these effects. Similarly, consideration of these effects should prove useful in setting up multi-way speaker systems. In my own experience I've rarely encountered such a speaker which has been set up properly or gave any indication that the user knew what he was doing. Especially common is the practice of cranking up the tweeter in the mistaken belief that in operation it should definitely make its presence known. Or reducing both mid-range and tweeter to bring up the bass. All that happens, of course, is that the sound is boomy and muffled. In fact, if bass and mid-range response are matched and level, the result is actually an *increase* in perceived bass, because by setting up the correct relationship between fundamental and harmonics, the bass instruments become more prominent to the ear-brain system. ●

SOUND BRIEFS

Philips Videodisc on market

Philips have honoured their promise to market their long-awaited optical Videodisc system – before the end of 1978. A small quantity was offered through three stores in Atlanta, Georgia in the very last few days of last year.

The units carried a list price of US$695 (approx A$600). About 200 various records were listed, ranging from US$6.00 half-hour informational recordings (Better Tennis in 30 Minutes) – to US$16 for current feature films. Even a specialty film such as a **full-length 'Mikado' was only US$20.**

Not that many private buyers managed to obtain anything – apparently virtually all units were bought by people from rival manufacturing and marketing companies!

Best is better

The 'best' tape for any given cassette recorder has operating parameters which closely match the bias, equalisation, sensitivity preset by the manufacturer of the recorder in which the cassette is to be used.

These settings vary considerably so it's rare for a cassette recorder to deliver the performance which is inbuilt – unless the manufacturer's recommended cassettes are used.

Recognizing this problem, JVC have introduced their KD-A8 cassette deck which has an **inbuilt microprocessor that optimises bias, equalisation, and** sensitivity for all types of tape formulation.

The microprocessor arranges for a test tone to be recorded onto the cassette – then chooses the best of 15 levels of sensitivity, seven levels of equalisation and no less than 32 levels of bias. It then erases the test tone and winds the cassette back to the start – **all within 25 seconds!** If the cassette is so bad that it's unacceptable the machine flashes an 'error' light.

JVC call the automatic adjusting system 'BEST' (bias, equalisation, sensitivity, total).

Edison update

Toshiba has developed a fixed-head video recorder featuring a cassette with a single reel of endless tape – it's a sort of planar magnetic **equivalent of Edison's cylinder gramophone.**

The 100 metre tape loop has 220 tracks across its surface, it runs at six metres a second providing one hour's playing time. An interesting feature is the use of an inbuilt microprocessor which enables the user to have random access to individual tracks. The prototype takes 20 ms to traverse one track pitch.

According to Toshiba the device is suitable for both consumer and professional applications.

BSR buys DBX

BSR (USA) Ltd has agreed to purchase DBX Inc., manufacturers of top-end consumer, semi-professional and professional audio equipment.

We understand that the sale price was US$8 million, and that whilst DBX will become a BSR subsidiary, the existing management will be retained.

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Electronic products are becoming increasingly sophisticated, and Shawmut engineers work closely with "state of the art" circuit designers to meet and exceed the protective needs of their products.

The Form 101 series of current limiting rectifier fuses protects semiconductor power diodes (rectifiers), thyristors, triacs and other solid state devices against short circuit faults to which they are particularly susceptible because of their intrinsic low overload capability. Short data is listed below.

These Shawmut fuses are available off-the-shelf in a range which can meet your most critical specifications.

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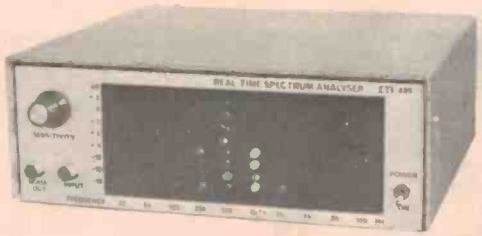

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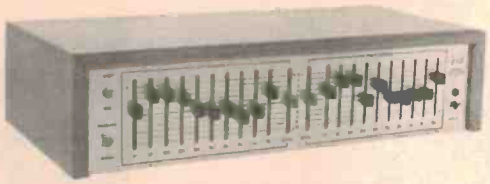

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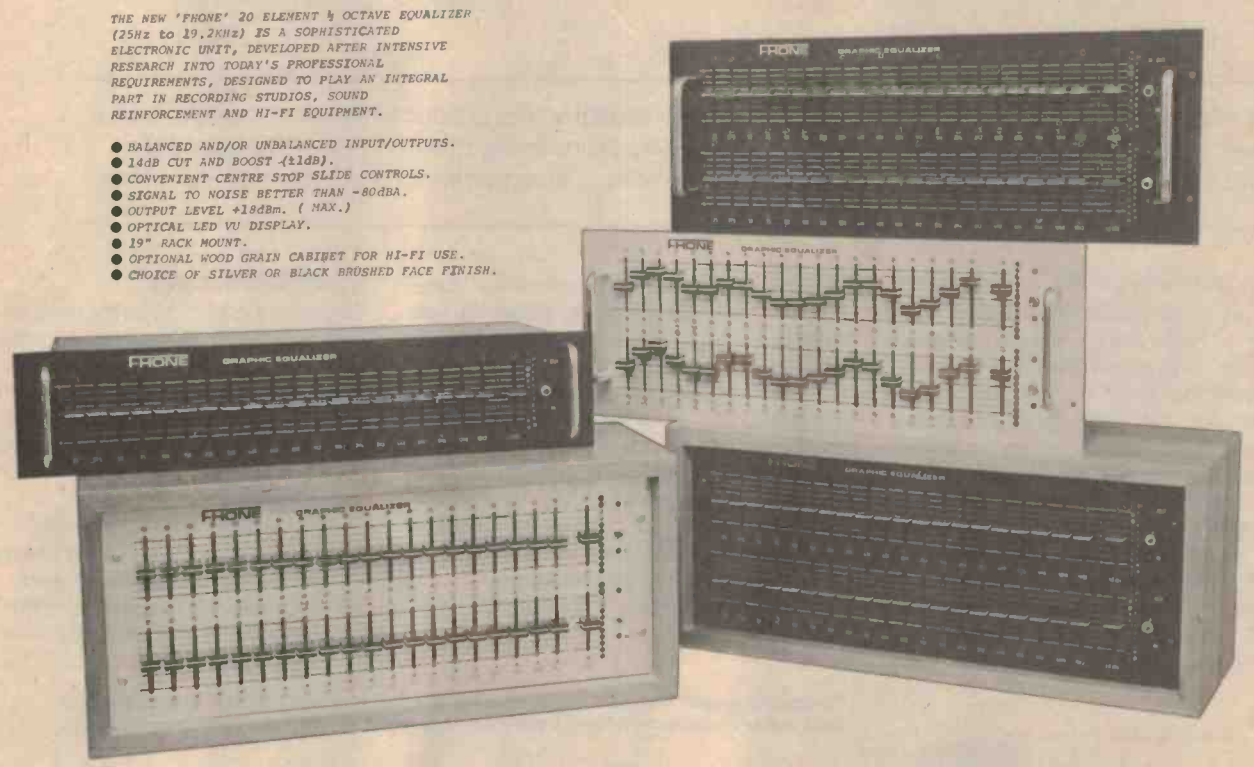

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Video Cassette Recorders

While manufacturers storm the market with a variety of attractive products the vital questions of a 'unified' recording format and copyright are a long way from being resolved. Nevertheless, the equipment beckons, what will it do and how does it do it.... a report from our international offices.

THE POPULARITY OF video cassette recorders with consumers, despite their relatively high price, is unquestioned. Certainly, one could spend the money on something much more useful – like another car, or even another colour TV set! Their appeal lies in the virtual 'library' facility they offer. Most television shows are evanescent things – fading quickly in your crowded memory, and if you miss a particularly interesting program you've little hope of catching it again. Also, where two programmes clash in time, you must miss one.

The video cassette recorder overcomes these annoyances, allowing you the options of permanently recording an important (to you) programme or recording a programme that may be inconveniently scheduled for you but need not be kept after viewing. Apart from that, libraries of video cassette programmes are beginning to become available – one can rent or buy feature films (black & white, full colour and 'blue'!) as well as entertainment and documentary type programs to view at home.

Operating Principles

In essence, video cassette tape recorders operate much like normal audio tape recorders, only umpteen times more complicated. The bandwidth of a normal audio channel ranges up to about 15 kHz, while that for television pictures is about 5.5 MHz – some 350 times greater.

To enable high bandwidths to be recorded, the tape is run at higher longitudinal speeds. Obviously such speeds are difficult to obtain – nevertheless, the BBC developed an early video tape

National's model NV8600 video cassette is a VHS format machine compatible with other varieties mentioned, although it is made to a different mechanical design.

recorder, called VERA, in the 1950s which ran tape at 5000mm/s (200 in/s) that was superseded very quickly by one developed in America by Ampex.

Although 25 years old, the mechanical transport format of the video tape recorders used by broadcasters today is identical.

The principle of video recording is simple. A 13mm wide tape is used in consumer machines. The video recording heads rotate at high speed, relative to the more slowly moving tape, thus laying a large number of long tracks at an angle across the tape (Fig. 1).

Audio is recorded as a separate longitudinal track, much like a normal audio tape recorder, and a third, control track is also recorded. This provides identification of the position of each video track so that when replayed the video tape can be precisely positioned, otherwise the video heads might not cover the same path as those during the recording.

Early video tape recorders used open spools of video tape in much the same way as tape recorders, but the complex rotating head assembly meant that threading was making it impractical for consumer use. The video cassette was developed to overcome this.

Although insertion of the cassette is simply accomplished, the video cassette recorder then has to remove tape from the cassette and thread it around the rotating video heads. When the cassette is inserted, the video tape is located

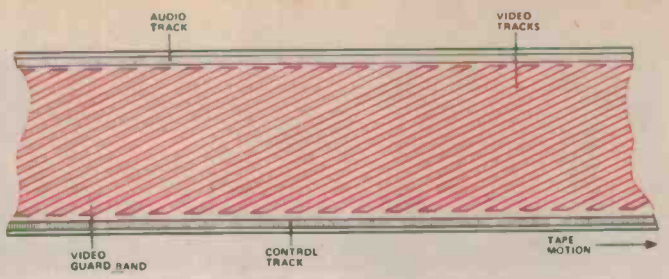


Figure 1. The video recording head rotates at high speed, laying down diagonal tracks. Audio and control tracks are recorded parallel to the tape travel direction. Most systems have a recording format similar to this, although the Beta system has adjacent tracks touching – see text.

behind four guides mounted on a platter that is rotated by a small motor. The tape is located around half of the head drum which houses the rotating video heads. There are actually two video heads, on opposite sides of the drum, which record alternate video tracks.

The audio and control tracks are recorded on a conventional looking audio head (but rather wider to cover both edges of the half inch tape) and a separate erase head covers the whole tape width. This type of tape threading, where guides rotate, is used on most video cassette recorders but has the disadvantage of requiring a few seconds to thread. With this in mind, JVC developed a slightly faster loading system, somewhat less mechanically complex, using two parallel guides moving in a single direction.

Because of these complex requirements for threading and rotating heads, video cassette recorders are extremely complex machines with a vast number of expensively produced mechanical parts including at least three separate motors (tape drive, rotating head drum drive, and threading). This is the primary reason why the price of video cassette recorders is unlikely to be reduced significantly in the future.

Electronics

The problems of recording colour television pictures economically took many years of research. It was only in 1973 that the first consumer oriented video cassette recorder was introduced by Philips. Late 1977 saw the introduction of the 'second generation' of video cassette recorders. These brought considerably improved recording time and are the subject of this article.

Figure 2 is a block diagram of the basic signal processing circuitry in a consumer video cassette recorder. Since domestic television receivers have no facilities for video inputs or outputs, the video cassette recorder must be designed ▶

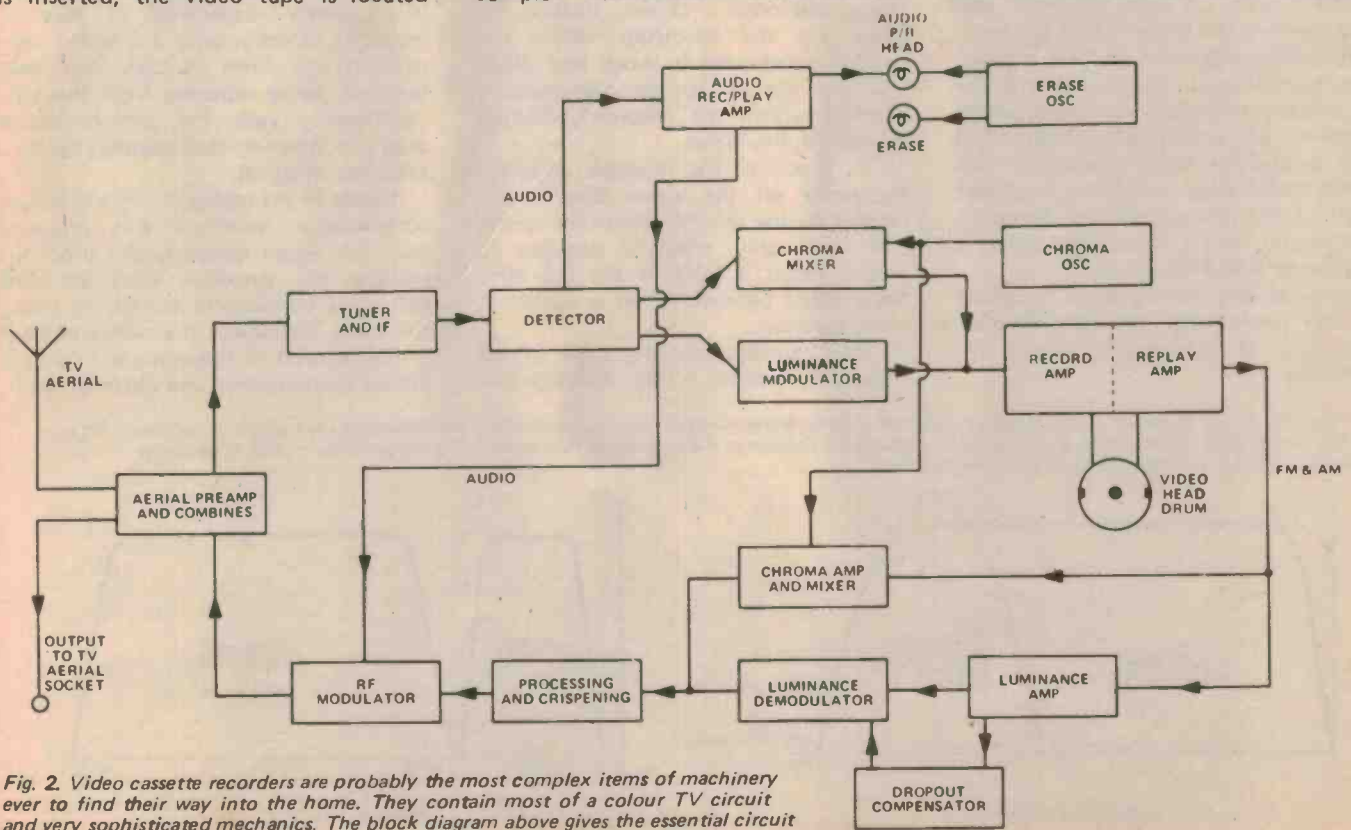
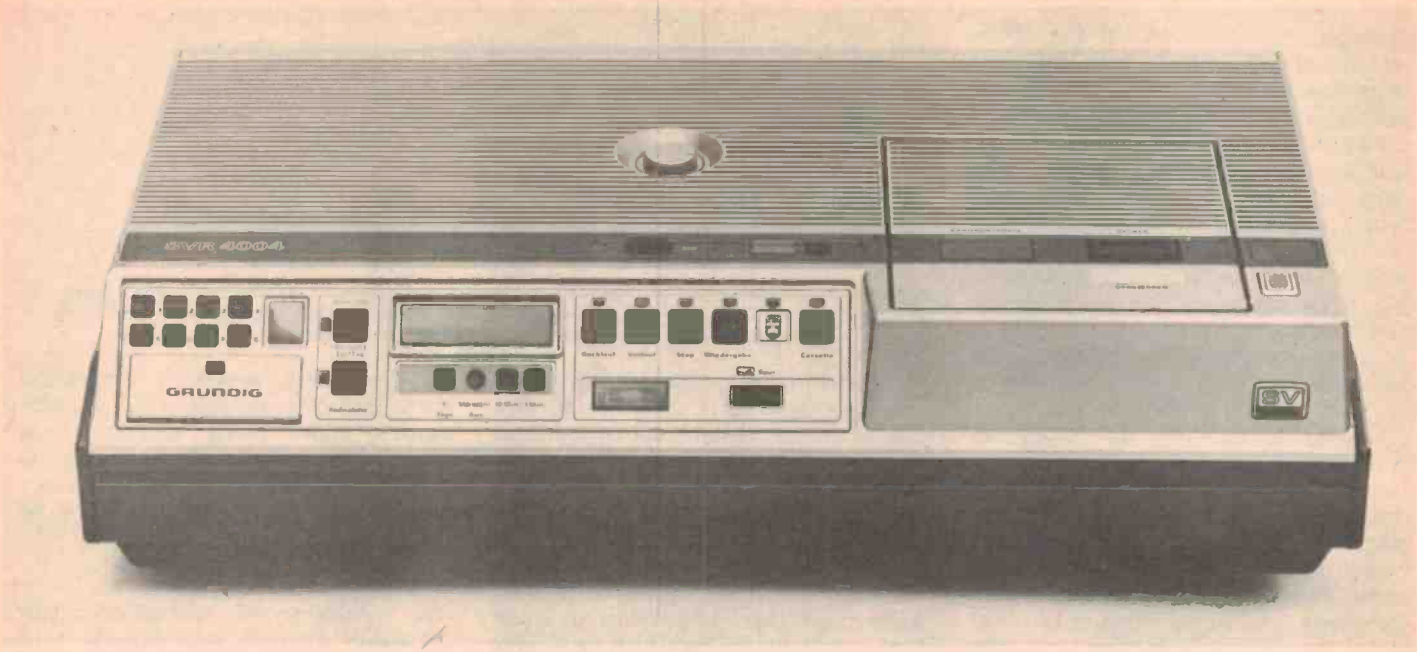


Fig. 2. Video cassette recorders are probably the most complex items of machinery ever to find their way into the home. They contain most of a colour TV circuit and very sophisticated mechanics. The block diagram above gives the essential circuit elements inside a VCR.



Grundig's SVR4004 will accept four-hour tapes and claims the most advanced timer. Although one of the costliest systems available its advantages make it quite attractive.

to connect between the antenna and the television set. Thus the recorder needs some form of aerial splitter, usually with a preamplifier, which feeds the TV set and the built-in TV tuner. The detector separates audio, luminance (brightness of the picture) and chrominance (colour) which are then processed and recorded separately on the video tape using different techniques.

Audio is recorded conventionally using a single head for recording and playback with an erase oscillator and head covering the full width of the tape.

Recording television pictures is somewhat complicated. Figure 3 shows the transmitted television spectrum which comprises an amplitude modulated 5.5 MHz bandwidth luminance signal (the higher frequencies containing the finest detail of the picture) and the chrominance signal, phase modulated onto a suppressed 4.43 MHz carrier.

Since all the picture detail is carried in the luminance, the chrominance bandwidth is restricted to about 1.5 MHz total.

Although these high frequencies can be directly recorded on to video tape if the relative tape/head speed is sufficiently high, there is a limitation. There is a theoretical limit to the bandwidth of a signal that may be directly recorded on magnetic tape. The wavelength of the higher frequencies and the physical gap distance in the recording head limit this to about nine octaves. To overcome this limitation the wide bandwidth video signal is frequency modulated onto a carrier, shifting the signal up the spectrum where the relative bandwidth is much less allowing the signals to be conveniently handled within the recording method bandwidth limitation.

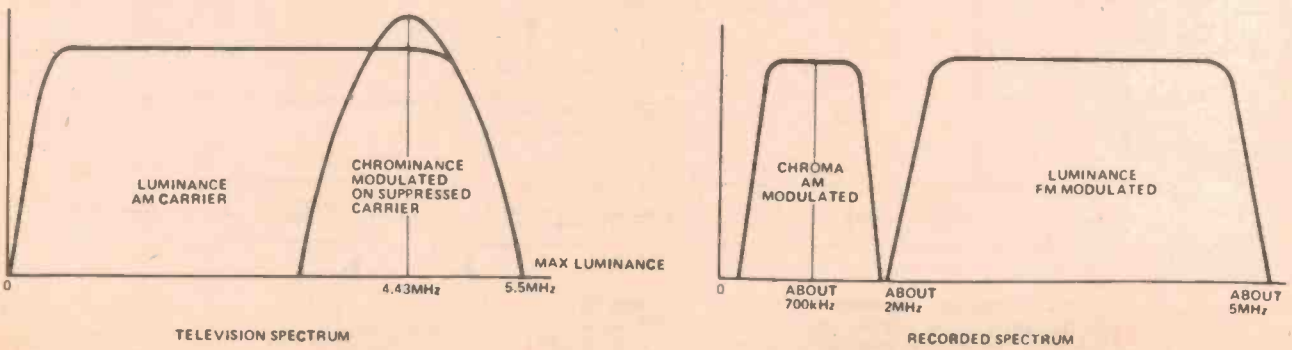
In practice, the highest recorded frequency on the video tape is still limited by the relative head/tape speed, and it is only typically possible to record about 3 MHz of the 5.5 MHz transmitted bandwidth on a consumer video recorder.

Thus, during recording some of the finer picture detail is lost, although this may be subjectively improved upon replay. The vital colour frequencies are located around 4.43 MHz, so a separate arrangement is made to record these. The chroma carrier is modulated with another carrier, the lower sideband of which falls somewhere around 700 kHz. This is then amplitude modulated and recorded directly on the video tape.

Thus the frequency limited colour signals are recorded bdlow the luminance information. Since this liminance is frequency modulated, it may be recorded directly onto the video tape without any form of bias. Nor does the level being replayed from the tape significantly vary the picture unless drop out (missing tape coating) causes a total loss of signal.

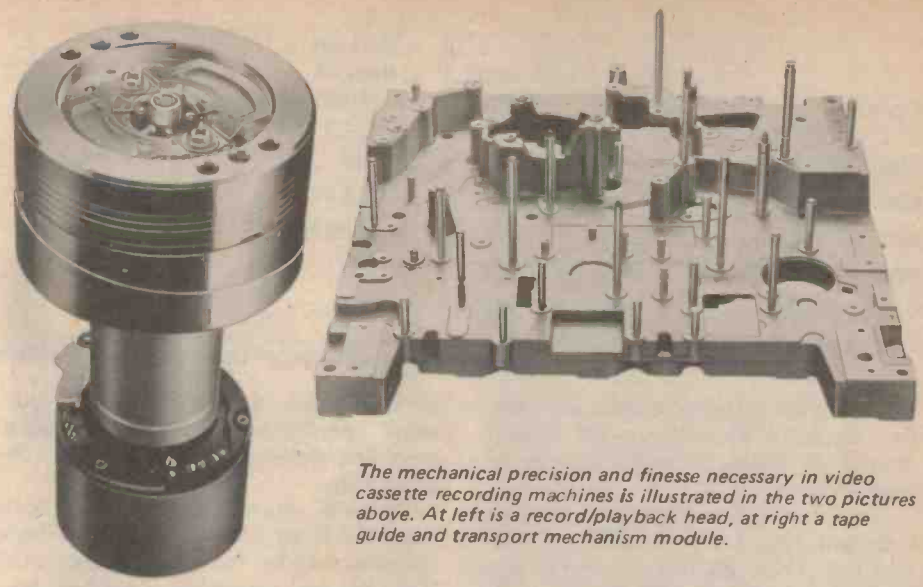
Hence in the replay chain, a drop out compensator monitors this replayed level and upon discovering a drop out replays the previous television line (which is continually stored) so filling the space. Otherwise the replay chain is similar to that of recording with a luminance demodulator and chroma mixer,

Figure 3. To get the most from a tape recorder the original television spectrum is considerably rearranged in the process of putting it on tape. The whole luminance section is shifted up the spectrum, frequency modulated on to a carrier. The colour information is slotted onto a lower portion of the spectrum and amplitude modulated.



after which the signals are combined, electronically 'cleaned up' and 'crispened' using high frequency boost to recreate some sharp edges or detail in the picture.

The replayed video and audio are then combined in the RF modulator which is essentially a microminature television transmitter. This is then combined with the incoming aerial signal and sent to the television receiver where it can be tuned on a spare preselector. There are also electronic servo circuits in video cassette recorders which ensure that the head drum spins at a precise speed which also controls the tape speed and physical location of the tape relative to the control track pulses. Speed accuracy is essential otherwise the picture will appear to shudder on the TV set and in the worse case, will break up and be lost altogether.



The mechanical precision and finesse necessary in video cassette recording machines is illustrated in the two pictures above. At left is a record/playback head, at right a tape guide and transport mechanism module.

Formats

The VHS, VCR and SVR recording formats are basically similar in that they all record slanted video tracks on the tape having guard bands between them, plus the audio and control tracks with guard bands separating them from the video (As shown in figure 1.) Head motion and tape direction are different; the actual physical dimensions of the recorded tracks differ also, between these systems — dependant on the mechanical design of each system. The most widely used is the VHS format, which, on current models allows up to three hours of recording on one tape.

The Beta format (Betamax, Betacord — from Sanyo, Sony and Toshiba) is a system that eliminates the wasted tape of the guard bands between tracks as recorded on the other formats. This provides considerably improved recording times.

The guard band between tracks on the other formats is to prevent cross talk between the tracks and interference due to mistracking.

In the Beta system, adjacent recorded tracks actually touch. The two rotating heads of a Beta format machine are tilted slightly in opposite directions so that alternate recorded tracks have a different azimuth. While scanning one track, if a video head slightly overlaps an adjacent track the azimuth misalignment is sufficient to eliminate the cross talk. Adjacent tracks will thus act as guard bands to their neighbours.

It has been claimed that three hour recording times would not have been possible without this development.

This development paved the way for video heads having very small thickness and gaps around 0.6 microns. Consequently, a very narrow video track can be recorded onto the tape, and a much lower writing speed than other formats may be used. The general effect is a reduction in linear tape speed, reduced tape thickness, minimum tape length for a given recording time and a relatively small cassette.

Sanyo's VTC 9300 'Betacord' is a Beta format machine, as the name implies. A remote 'pause' button allows you to 'drop' advertising segments from a recording — providing you are watching what you're recording.

Products

The various brands of video cassette recorders available come under the four different formats. Machines within a particular format have interchangeable video cassettes.

There are only five manufacturers who produce units which are then marketed by other companies, often with cosmetic changes. Although such multiple branding might not be particularly beneficial to the manufacturer's corporate image, it does mean that multiple organisations are promoting one particular product which does make for considerably improved impact in the all-important war to become the standard video cassette format.

Table 1 compares the four video cassette formats from Grundig, JVC, Philips and Sony. One point that should be made immediately is that the earlier Philips format, simply termed VCR and used until about a year ago, only provided one hour playing time.

Video cassettes to match all these formats are available from a variety of companies. For instance VHS cassettes can also be found under Thorn, TDK, Ampex and Fuji labels, VCR-LP from Agfa, BASF and 3M, while Betamax is available from 3M. Actual tape cost will ▶

Format	Max. play time	Cassette cost.	Cost per hour of play time	Rewind speed; mins per hour of play time	Cassette size	Approx retail price of machine.
VHS (JVC)	3 hrs	$30	$10	1.3 mins/hr	188 x 25 x 104 mm	$1200-$1300
SVR (Grundig)	4 hrs	$37	$ 9.25	0.93 mins/hr	127 x 41 x 146 mm	$1550-$1650
BETAMAX (Sony)	3¼ hrs	$28-30	$8.60-$9.20	1.6 mins/hr	156 x 25 x 96 mm	$1350-$1450
VCR-LP (Philips)	2½ hrs	$35	$14	1.8 mins/hr	127 x 41 x 146 mm	$1000-$1100
VCR-LP (Philips)	3 hrs	$39	$13	–	127 x 41 x 146 mm	* 3hr Philips cassette to be released shortly.

TABLE 1: Comparison of the four video cassette formats.

vary between different brands and upon the discount found but the figures quoted in Table 1 should provide an approximation.

All the video cassette recorders indicated in Table 2 offer similar facilities. These include all normal tape transport controls, built-in TV tuner with eight-channel preselectors and electronic clock/timers with varying facilities. The timer found on the VHS is currently the most basic and only allows the recorder to be set to start up to 24 hours ahead in one minute steps – the video cassette runs until stopped automatically, at the end of the tape. The Philips and Sony machines can both be set three days ahead, Philips in one minute steps, Sony in quarter hour steps. The Philips timer also provides a recording duration so the tape can be set to stop.

Grundig currently has the most advanced timer providing up to 10 days advance setting. However, expect this year to see up–market models becoming available with rather more complex timers. These will provide such facilities as permitting several different programmes, on varying channels, to be recorded during a 10 day period within the confines of a single cassette length. Such timers are essentially programmed microprocessors and should be considerably more versatile than existing recorders.

Apart from Sony and Grundig, still frame is not provided officially on consumer video cassette recorders, but can in some cases be found by careful manipulation of the pause control – on the other hand some VHS machines actually go into fast forward while slightly depressing 'pause'. Proper still frame and, in the case of JVC – double speed playing, will become available on the next generation of video cassette recorders.

Another facility that comes in particularly useful are connectors for video and audio. These enable recorders to be connected together for copying without the loss of quality resulting from connecting aerial leads due to

Philips' N1700 machine uses their own VCR system for which three-hour tapes will shortly be available.

losses in the modulator and tuner combination. Unfortunately however, there is no standard for these connectors and each manufacturer has his own ideas. Video and audio connectors are provided as standard with JVC and Sony (and derivatives), but are extras on Philips and Grundig.

One other point that bears examination is the video-tape threading. As mentioned earlier, the removal of tape from the cassette is performed automatically by the recorder, but different machines use different principles. The Philips N1700 automatically threads when turned on, but in order to protect the tape which is threaded around the rotating heads, the unit turns itself off after about one minute. This can be rather frustrating if one is waiting to record a programme, but has the advantage of immediate operation when play or record are selected. On the other hand the JVC HR-3300 recorder only threads when the play control is selected which gives a three second delay before pictures are seen. On the other hand fast winding is considerably better since the tape does not have to negotiate a multitude of guides. The Grundig SVR4004 follows the Philips principle and, in addition, has unique remote control of all operating functions. The Sony Betamax also follows the Philips tradition.

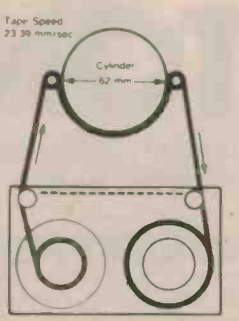
TABLE 2			
SVR	**VHS**	**VCR-LP**	**Beta (max)**
Grundig SVR4004	JVC HR-3300	Philips N1700	Sony SL8000UB
	Akai VS 9300		Toshiba V-5250
	Mitsubishi		Sanyo
	National Panasonic		

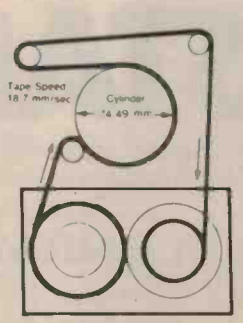
Other systems

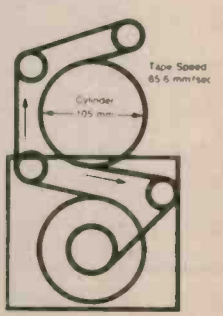
All the video cassette recorders mentioned so far have been designed to operate exclusively on the PAL colour system. If it is required to send video cassettes to other parts of the world or vice versa, another, older, format can be used called U-Matic which is available from Sony and National in multiformats. North America use the NTSC colour system, France, the Soviet bloc and much of the Middle East, SECAM, while PAL is used by civilised Europe. Provided a multistandard television receiver is used, video cassettes recorded in any of the areas can then be replayed in other countries. For instance, when one retires (for either age or tax purposes) to the south of France or the Caribbean, one can arrange a supply of civilised programmes to be flown over. However, U-Matics are much more expensive than the earlier formats and use rather more expensive and bulky tape. On the other hand, quality is somewhat better and twin audio tracks are available for stereo. The U-Matic format is somewhat more versatile than the others in that programmes can be made using special portable and editing video casette recorders. ●

COMPARISON OF VIDEOCASSETTE PARAMETERS

System	VHS	BETA format	VCR
Adopted Manufacturers	*Akai, Hitachi, Victor Matsushita, etc.*	*Sanyo, Sony, Toshiba*	*Philips, Grundig*
Recording Time	*180 min.*	*195 min.*	*150 min.*
Tape Speed	*23.39mm/sec.*	*18.73mm/sec.*	*65.6mm/sec*
Relative Tape Speed	*4.85m/sec.*	*5.83m/sec.*	*8.18m/sec.*
Tape Width	*12.65mm*	*12.65mm*	*12.65mm*
Video Head Gap Azimuth	$\pm 6^{o}$	$\pm 7^{o}$	$\pm 15^{o}$
Tape Length (Max. Time)	*257m*	*222m*	*708m*
Tape Thickness	*19 micron*	*14 micron*	*15 micron (150 min.)*
Cassette Dimensions (in mm)	*188 x 104 x 25*	*156 x 95 x 25*	*146 x 127 x 41*







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Larry L. Decker, Designer/Owner, examines finished control table for Disco use.

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State-of-the-art Transceiver

High technology invades CB products. American manufacturer, A.R.F. Products, have combined unique single sideband and AM circuitry with microprocessor technology in a top-flight transceiver. Report from Marvin Hobbs, consultant engineer, Chicago.

AMERICAN MANUFACTURER, ARF Products, has produced a CB transciever that completely alters the face and direction of CB technology. In their Model 2001 every effort has been made to use the latest state-of-the art electronics technology to the utmost. Twenty four ICs, equivalent to 7 500 transistors, are employed. Advanced communications theory and unique digital circuitry have been applied.

Two of these unique circuits are AM Silencing (abbreviated AMSIL) and Servo Amplitude Modulation (abbreviated SAM). Patents have been applied for these features and they are trademarked.

Microprocessor control

In addition to the above features, the Model 2001 offers the latest in microprocessor control of channel selection. It provides for all of the scanning and frequency selection features possible with a National Semiconductor type 57150 controller. The major keyboard functions are as follows:

1. Memory Storage of up to 10 channels.
2. Recall and display of the memorized channels.
3. All-channel selection by pressing "enter" key and two numbered keys.
4. Fast or slow up-down scanning of all channels.
5. Immediate emergency channel selection.
6. Monitoring of the emergency channel every 10 to 15 seconds, if desired.

In addition to the keyboard scanning, two modes are provided by a Scan lever switch. These modes are 'Busy' and 'Open'. The Model 2001 will act as a search receiver to find an open (or clear) channel or a busy one. For busy channels the frequency synthesizer is tuned from channel to channel until the receiver is unsquelched. It then locks onto the busy channel as long as it is unsquelched and for a short period of 3 to 6 seconds after the signal disappears. During this time the receiver is waiting for further communications before continuing its automatic search for busy channels. For open channels the frequency synthesizer is automatically tuned from channel to channel until the receiver is squelched. This condition indicates an open channel. At that point the operator can turn off the scan lever switch and proceed to communicate.

General specifications

The receiver employs dual gate MOSFETs in the RF amplifier and

Figure 1. The future arrives today! This state of the art CB transceiver from US firm A.R.F. Products features microprocessor control and sophisticated circuitry for top-quality performance under the stringent conditions encountered on 27 MHz.

mixer to provide good high level signal handling capability. It is a single-conversion superhet with an IF at 10.695 MHz. Separate 8-pole monolithic quartz crystal filters are used in both the AM and SSB modes.

Sensitivity at 10 dB (S plus N/N) is better than 0.25 uV in the SSB mode and better than 0.35 uV (50 percent) on AM.

Selectivity at 3 dB down for SSB is 200-3000 Hz (center frequency to lower band edge). For AM it is ±2.2 kHz minimum and ±2.7 kHz maximum. Adjacent channel rejection is greater than 65 dB (measured by EIA spec RS-382) and greater than 80 dB by common methods of measurement. Image rejection is better than 80 dB.

The AGC controls the audio output within 10 dB over an input signal range of 1 uV to 10,000 uV.

In the transmitter section the output stage is switched so that it operates Class C in the AM mode and linear AB in the SSB mode.

Power output is maintained at 12 watts PEP, through a microphone signal level change of 16 dB, in the SSB mode. Third order intermodulation distortion is greater than 25 dB down. Modulation frequency response at one-half rated PEP is plus minus 0.5 watt from 300 Hz to 2100 Hz. In the AM mode maximum unmodulated carrier power is 4.0 watts. At 100 percent modulation average AM power is 7.2 watts under servo amplitude control peak modulated power is 16 watts maximum.

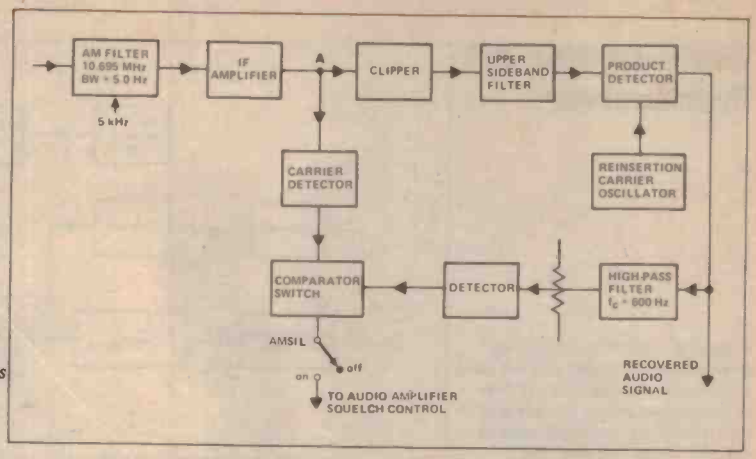

Figure 2. Block diagram of the AMSIL operation. When activated, the squelch remains closed for AM signals but opens for SSB signals.

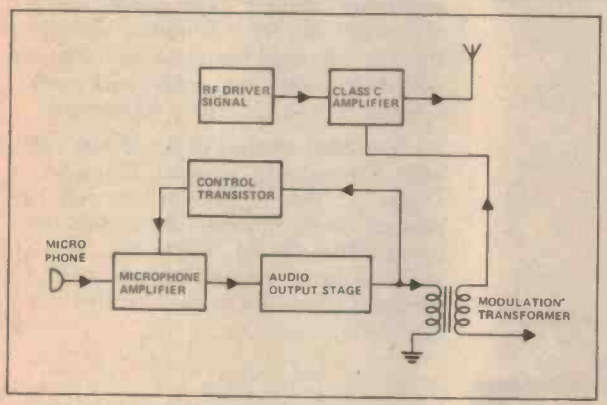

Figure 3. Simple speech compression circuit common in many transceivers. Transistor driven by audio output stage controls gain of mic amplifier in modulator.

Amplitude Modulation Silencing (AMSIL)

With the large amount of AM operation on most CB channels it would be highly desirable to use some form of selective calling. This type of operation is being considered seriously but is not yet available.

The ARF 2001 offers the next best thing. By using an AM silencing circuit, all incoming AM signals can be squelched when the transceiver is in the SSB mode. Thus, one does not hear all AM signals on a channel while waiting to hear from an SSB compatriot.

AMSIL relies on the fact that AM transmission has a carrier signal, while on SSB the carrier is suppressed.

In figure 2, a comparator switch controls the receiver squelch. The incoming signal takes two directions at point A. On one side the comparator is supplied with a negative voltage when AM signals are detected in the carrier detector below point A. An SSB signal coming through this detector produces only a very small negative voltage compared to that of the AM signal.

On the other side the comparator is supplied with a positive voltage derived from either an SSB signal, which will drive it quite positive or from the resultant of a clipped AM signal which will drive it only slightly positive. The result is that the comparator in its negative state squelches the receiver's audio circuit for AM signals, but in its positive state it opens the squelch for SSB signals.

Off-frequency AM carrier signals may appear as sideband signals and in that way have the potential for opening the squelch. The high-pass filter prevents such signals from opening the receiver squelch if they are less than 500 cycles off the allocated channel frequency.

One might also wonder how SSB signals would fare when they pass through the AM clipper and the USB filter to the right of point A. Actually the SSB AGC circuit controls the AM IF gain to avoid clipping of an SSB signal. SSB signals produce a recovered audio signal of sufficient strength to activate the SSB AGC and control the AM IF gain and thus avoid clipping in the SSB IF. On the other hand, AM signals do not produce enough audio signal to activate the AGC sufficiently to reduce the AM IF gain appreciably and in that way actually enhance the waveform clipping of the AM signal. When both AM and SSB signals are present in the IF amplifier, AMSIL acts to suppress the AM interference. However, it cannot eliminate AM heterodyne beat notes which may be heard if AM signals are present when the SSB signal is being received.

Servo Amplitude Modulation (SAM)

Speech compression circuits are essential to all CB transceivers (except toy types) to meet FCC requirements relative to the control of modulation level. However, there is some difference in the results they achieve. All of them have the mission of preventing the amplitude modulation from exceeding 100 percent. What they do to the average modulation level is another matter!

One of the simplest speech compression circuits is the feedback type shown in Figure 3. Unfortunately, if its threshold is set to hold the modulation below 100 percent, average modulation is about 30 percent, there will be only about 0.1 watt in each sideband and the AM signal will have a total power of about 4.2 watts. However, there is little point in comparing SAM with simple feedback type compressors because they are not used in most current CB transceiver designs – at least not exclusively.

Practically all modern CB transceivers use some form of speech clipping. A typical basic circuit is shown in Figure 4. A clamping circuit controlled by feedback around the audio amplifier output stage regulates the audio signal ▶

State-of-the-art Transceiver

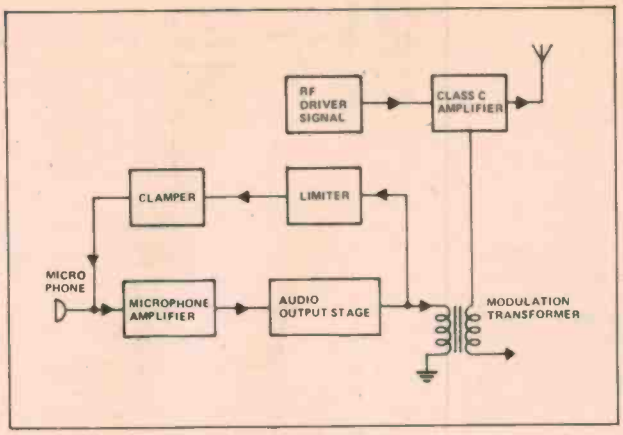

Figure 4. Another common speech compression circuit uses a clamper shunted across the microphone input circuit and controlled by a limiter driven by the audio output stage.

level. In some designs some of the transmitter's RF output is detected and fed back to act as a further control on the clamper in the SSB mode. These compressors hold positive (upward) modulation to about 70 percent and negative (downward) modulation to about 80 percent. SAM differs in that although it clips the signal as it comes from the microphone, it also has a feedback loop working off the transmitted AM signal.

As in Figure 5, this loop comes around from the transmitter's output through an envelope detector to a comparator. The modulation of the transmitted signal is compared to the processed speech signal and correction signals from the comparator control the solid-state modulator.

The main advantage of SAM is that it strives to keep the signal fully modulated at 100 percent regardless of the speech level, while other compressors are mainly concerned with keeping the modulation well below 100 percent to meet regulation requirements.

The tight servo control of SAM also keeps the modulation within the set limits. However, at the same time it results in sideband power from 50 to 100 percent greater than that resulting from typical speech compressors found in other CB transceivers.

Figure 6 is a complete block diagram of all the elements of the servo amplitude modulator. Some have been mentioned above.

The use of a clipper or symmetrical limiter after the microphone naturally produces some distortion, but this is eliminated by the low pass filter following the limiter. This filter ensures that the AM signal's occupied bandwidth is within specification at all times.

When the comparator detects a difference in either the recovered modulation envelope or signals coming from the filter following the speech processor, or in the DC reference signals associated with them, a self correcting error voltage is generated and applied to the solid-state modulator. The amplitude modulator then ensures that the processed speech signal is faithfully imposed onto the carrier signal envelope. This feedback control system maintains the average unmodulated carrier power over the operating frequency range of the transmitter even though the output of the power amplifier may vary.

Also, the audio frequency response is a function of the characteristic of the speech processor filter and not of the frequency response of the modulator circuit. This contrasts with conventional modulators, where the modulation transformer has an appreciable effect on the audio response. The final filter is a seven-pole elliptic type which sharply attenuates all RF harmonics and gives the CB operator the assurance that his neighbors will not experience interference in their electronic equipment.

The latest version of the Model 2001 with a frequency counter is shown in Figure 1. An 18 channel version has been developed to meet Australian standards. The Model 2001 can also be supplied in an amateur version with 40 channels operating in the 10 meter band (28 MHz). ●

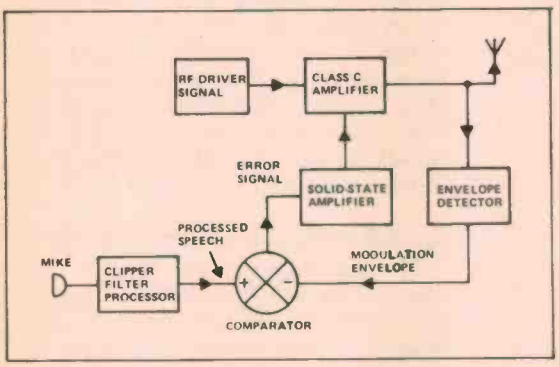

Figure 5. SAM consists of a clipper-filter processor monitored by a feedback loop detecting the modulation envelope of the transmitted signal.

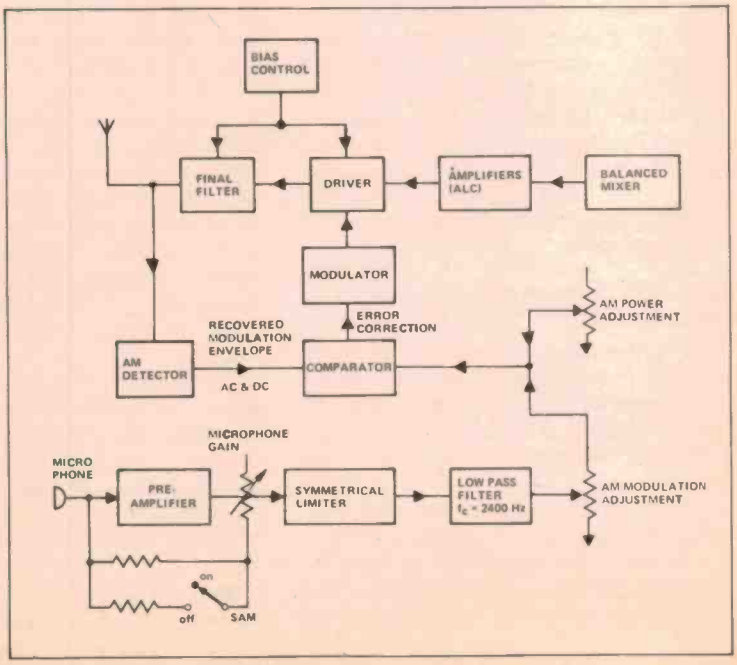

Figure 6. SAM circuit maintains high level of modulation and eliminates both audio and RF distortion with multi-pole elliptic filters.

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IM4148	.07
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IM4004	.08
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Project 249

COMBINATION LOCK

Mechanical combination locks abound – as do ideas for electronic ones. Unfortunately, electronic designs we've seen are either too simple (and of limited use) or too complex – and beyond the average hobbyist. Here's something that's in between these two extremes.

DIGGING THROUGH THE files produced a wealth of ideas for locks – most of them impractical for the constraints imposed on the project application. Tossing ideas around the office threw up some fascinating techniques . . . But we had to get a simple project together.

The simplest method is to connect several rotary switches in series to apply power to a solenoid-operated door lock when you dial up the right switch position on each. This has the advantage of extreme simplicity and a reasonable number of possible cominations. Problem is, if you leave that combination set on the switches then security is compromised because somebody, less trustworthy than your good self, may just take notice. Tch, tch.

What was needed was some techinique that was self-cancelling or did not reveal the combination once it was 'dialled up'.

It occurred to us that the rotary numerical combination locks, such as on safes (you know – spin the dial, 13 left, 37 right, 21 left), did not reveal the complete combination once the lock was opened.

Having digested that little principle, the next thing was to work out how to do it electronically – and in a simple way.

The rotary numerical combination locks operate by successively unlatching a mechanical 'circuit'. When the last combination is dialled the bolt is released. How to do this electronically?

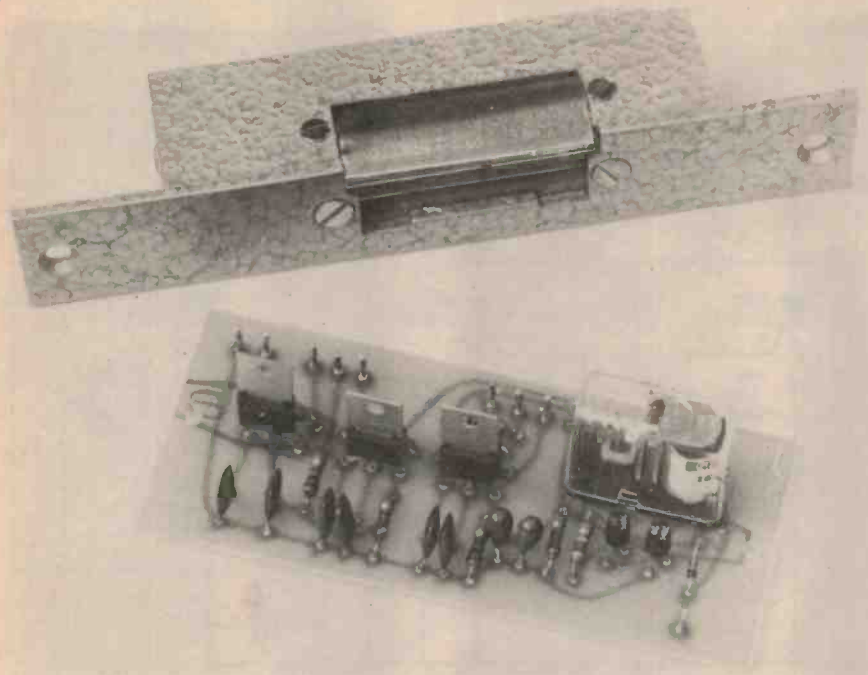
Latching Circuits

A number of 'latches' connected in series and operated in sequence such that power is applied to a solenoid lock when the last latch is selected will be an electronic equivalent to the mechanical combination lock. Next problem – the electronic latch. This can be made up in a number of ways. Relays can be connected to latch on when energised. But they're relatively expensive. Digital logic gates can also be connected to make a latch.

When a silicon controlled rectifier (SCR) has a voltage applied to the gate it will conduct and remain 'on' until the anode-cathode voltage falls to zero. That's a latching operation. SCR's are cheap and readily available and will handle the current required to operate a solenoid lock and for these reasons were chosen for the latches in this project.

To dial a sequence of numbers, providing the required combination, we first considered a multi-bank, multi-position switch. That turned out to be mechanically awkward and expensive. Suitable switches are also difficult for the average hobbyist to obtain. Two, 12-position, single-pole rotary switches were eventually chosen. They are an 'off-the-shelf' item obtainable from many component outlets.

Dialling three pairs of numbers in sequence on the switches simulates the operation of a rotary numerical combination lock – almost. This provides over 1.7 million combinations!



The printed circuit board and solenoid striker plate we used. Naturally any type of solenoid lock can be protected using this system.

Resetting

That solves the combination problem and the latch problem, but how do you reset the SCRs once you've operated the lock? Simple – turn off the power source. A switch could be used to momentarily disconnect the supply, 'unlatching' the SCRs, resetting the solenoid lock to await its next use.

What if you forget to push the button? Tch, tch, tch . . .

It seems a peculiarity of human nature that it is easy to memorise a sequence of numbers but very difficult to remember to reset a button or lock.

A simple timer operating a relay can do the job for you. Accordingly, the project has a timer incorporated.

The project is designed to operate from a battery. No current is drawn until the START button is operated. Current will only be drawn from the supply for the 25 seconds duration of the timer.

Mains operation, from a small transformer and rectifier is possible but a battery standby circuit should be included in case of mains power failure.

Solenoid Locks

There are two basic types: solenoid operated striker plates (i.e.: that are fixed in the door jamb) and solenoid operated bolts (attach to the door itself). We recommend you use a solenoid operated striker plate. Firstly, as they are fixed in the door jamb it is an easy matter to conceal all wiring. Secondly they may be used with existing deadlatching mortise locks. Solenoid operated bolt locks are made to fix on the door itself and require a flexible lead run across the door at the hinged side.

Solenoid operated striker plates or bolt locks are available from specialist locksmiths. We obtained a number of samples from: *North Shore Locksmiths, 75 Willoughby Rd, CROWS NEST, 2065* Ph: (02) 437-6263.

We used a solenoid striker plate manufactured by Golmar (model CV14). As the project operates from a 12 volt supply, a 12 volt version was used.

This striker plate suits common key-in-knob locks such as those made by Schlage, Weiser, Lockwood and Lanes.

Another type we looked at, manufactured by D.K. Security, model DKS 500, suits deadlatching mortise locks such as the Astra 300 and Lockwood 570 series.

For new installations the key barrel of a lock may be dispensed with. In existing locks, the key mechanism may be disabled if you wish.

Construction

The relay and all minor components are mounted on a printed circuit board. For convenience, and to avoid wiring errors, this method of construction is recommended.

Commence by putting all the resistors and capacitors on the board. Take note of the orientation of the tantalum capacitors. Next mount the transistors, diodes and SCRs – take note of lead orientation, carefully follow the component overlay diagram. Mount the relay last.

All external connections are made via pc pins inserted in the appropriate holes on the board. To avoid wiring errors, follow a sequence of wiring the connection from each pin, step by step.

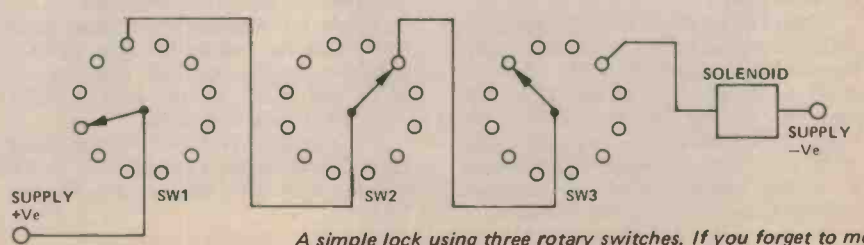
Wiring a 'code' on the switches is a fairly simple process. Using the table below, allocate switch position pairs for SW1 and SW2 for each code in the three-step sequence necessary to open the lock.

For example, the code sequence of switch position pairs as shown in the diagram is 4-1, 1-11, 8-4. These are respectively shown connected to pc pins A-A', B-B', C-C'.

TABLE 1

SW1 pos no	pc pin	SW2 pos no	pc pin
1	B	1	A'
2		2	
3		3	
4	A	4	C'
5		5	
6		6	
7		7	
8	C	8	
9		9	
10		10	
11		11	B'
12		12	

This shows how the connection of wires A to C and A' to C' determine the combination of the lock. The above table shows the connection pattern for the combination 4–1, 1–11, 8–4 which can be seen by looking at the switch contact numbers corresponding to A, A', B, B', C and C'.



A simple lock using three rotary switches. If you forget to move them off the combination after opening the lock, you'll reveal it.

Project 249

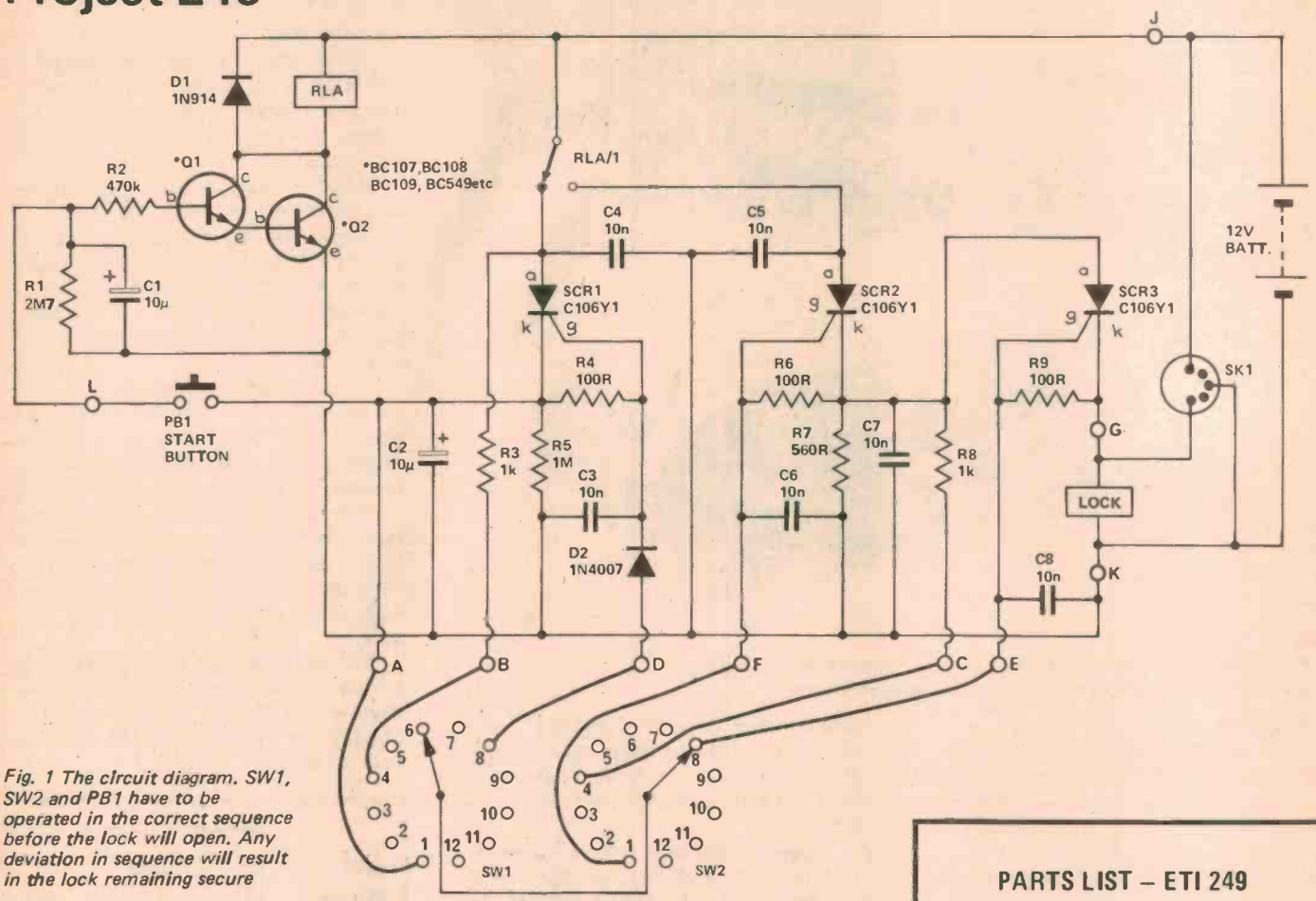


Fig. 1 The circuit diagram. SW1, SW2 and PB1 have to be operated in the correct sequence before the lock will open. Any deviation in sequence will result in the lock remaining secure

HOW IT WORKS - ETI 249

An 'initial' code is dialled on SW-1 and SW-2, 4 and 1 in this case. The gate of SCR1 will be forward biased via R5, SW-1, SW-2 and D2. SCR1 turns on, charging C2 to 12 volts.

The push-button PB1 is then pressed. This applies 12 volts from the cathode of SCR1 to the junction of R1/R2. Capacitor C1 will quickly charge to 12 V, Q1 and Q2 will turn on, operating the relay RLA. The circuit involving Q1, Q2, R1, R2, C1 and the relay is a 25-second timer. The relay will drop out after about 25 seconds as C1 will slowly discharge via R1, R2 and the input impedance of Q1, Q2, which is very high. The rest of the sequence must be completed within 25 seconds to operate the lock for when RLA drops out, the circuit is 'reset'.

When PB1 is pressed and RLA operates, the relay contacts, RLA1, will then transfer the 12 V supply from the anode of SCR1 to the anode of SCR2. SCR1 will turn off. C2 will then commence to discharge via R7, falling to a volt or so within 10 seconds. The next code sequence must be dialled within this period, otherwise you will have to return to the 'initial' code.

The second code is then dialled on SW-1 and SW-2, in this case 1 and 11. The gate of SCR2 will then be forward biased via SW-1 and SW-2, the current it draws will discharge C2. SCR2 will then turn on, applying 12 V to the anode of SCR3.

The third code is then dialled on SW-1 and SW-2, in this case 8 and 4. The gate of SCR3 will then be forward biased via R10, turning SCR3 on, energising the solenoid lock. At the end of the 25-second delay, the relay will drop out, resetting the circuit.

An external connection socket, SK1 is provided to enable power to be supplied to the lock should the circuit fail or the batteries run flat.

No current is drawn by the circuit until the operating sequence is commenced.

Diode D1 suppresses operating transients from the coil of the relay and D2 prevents possible spurious triggering of SCR2 and SCR3 via the gate of SCR1 when the latter is turned on.

The circuit is protected from spurious triggering by bypass capacitors C3 to C8 and the SCR gate resistors, R6, R8 and R11.

PARTS LIST – ETI 249

Resistors all ¼ W 5%
R1 . . . . . .2M7
R2 . . . . . .470k
R3 . . . . . .1k
R4 . . . . . .100R
R5 . . . . . .1M
R6 . . . . . .100R
R7 . . . . . .560R
R8 . . . . . .1k
R9 . . . . . .100R

Capacitors
C1,2 . . . . .10u 25V tantalum
C3–8 . . . . .10n greencap

Semiconductors
SCR1–3 . . .C106Y1 or C106D1
Q1,2 . . . . .BC107, BC108, BC109 or BC549 or equivalent
D1 . . . . . .1N914
D2 . . . . . .1N4007

Miscellaneous
SW1,2 . . . .1 pole 12 way rotary
PB1 . . . . . .miniature push to make
RLA1. . . . .Pye type 265/12/C2 78/45 single-pole change-over 12V 180 ohm coil, 240V/5A contacts. (Dick Smith type S-7125 or similar).
SK1. . . . . .DIN 5-pin or similar
Solenoid-operated lock (see text), 12V battery. pcb: ETI 249, diecast case.

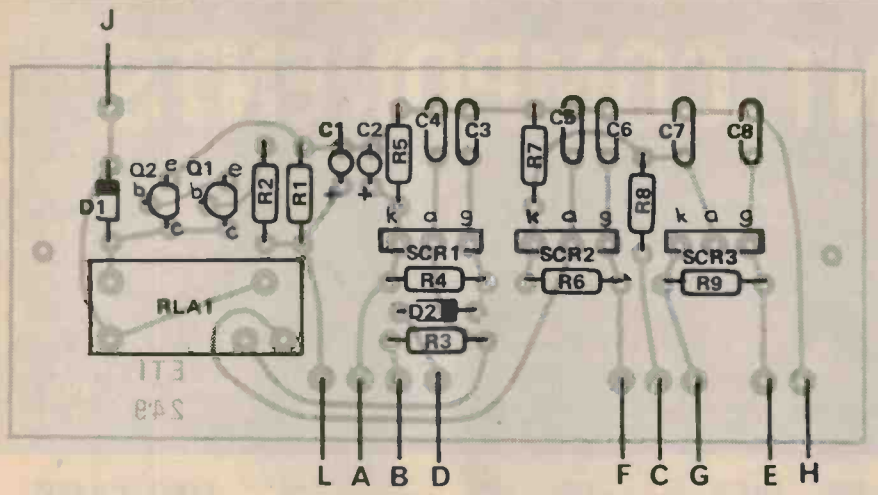
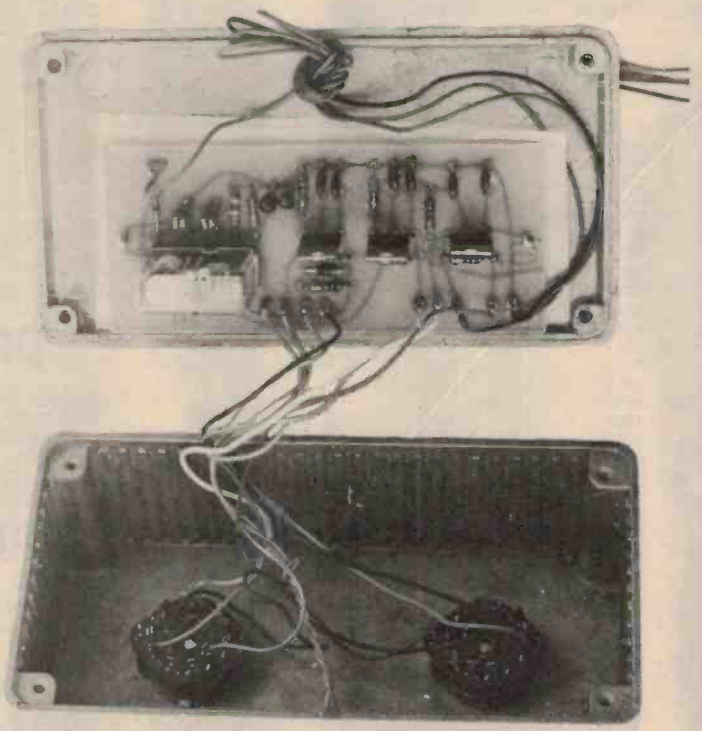


Fig. 2 The component overlay. See Table 1 and the circuit diagram for an explanation of the lettered AC pins.



Interior of the lock. A diecast box provides a rugged and safe housing.

Installation

As this will very much depend on individual circumstances, we can only give you general guidelines.

Firstly, there must be no externally exposed, or visible, wiring. The switches should be mounted such that their shafts protrude from the surface behind which the circuitry is mounted, without the shaft securing nuts being accessible. File a flat on the shafts so that you have a permanent 'location' point for knob grub screws. Better still, use collett knobs.

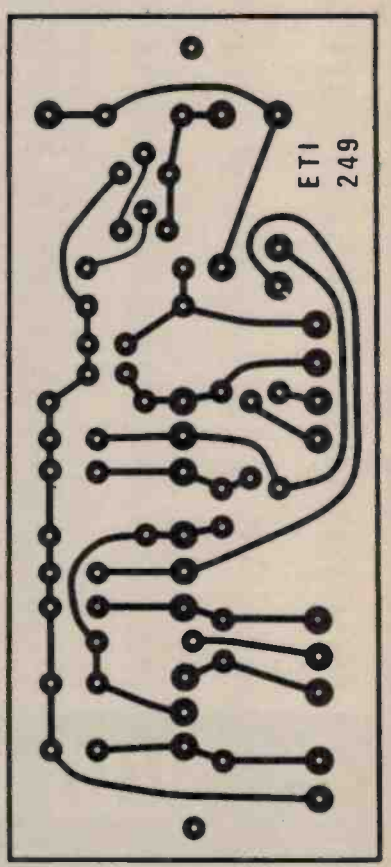
The external power/connection socket should be placed in a concealed location, known and accessible only to yourself, or those entrusted with the combination.

Installation instructions for the solenoid locks are supplied with the units.

Operation

1. Dial the 'initial' code. As illustrated in the circuit, turn SW1 to 4 and SW2 to 1.
2. Press the push button, PB1.
3. Dial the second code. As illustrated, turn SW1 to 1 and SW2 to 11. You have less than 10 seconds to do this.
4. Dial the third code. Turn SW1 to 8 and SW2 to 4, as illustrated.
5. The solenoid lock will release.
6. Twenty-five seconds after operating PB1, the circuit will reset and the lock will return to its latched condition.

PCB artwork shown full size.



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100 RED LEDS	$13.00	10 7490	$3.00
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6 LUG TAG STRIPS	5c	10 741	$2.90
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		10 723	$4.50

BD 139 — 50c ea.
BD 140 — 50c ea.
BC 547/8/9 — 15c ea
10 555 Timers for $2.80
MJ2955 — 90c ea.
2N3055 — 85c ea.
BC 557/8/9 — 20c ea.
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TTL

7400	20
7401	25
7402	28
7403	28
7404	37
7405	37
7406	50
7407	50
7408	34
7409	34
7410	20
7411	37
7413	54
7414	90
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	60
7448	60
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
7490	35
7491	1.00
7492	75
7493	35
7494	1.10
7495	95
74100	2.45
74107	65
74121	60
74123	60
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	40
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	1.30
4511	1.30
4518	1.30
4520	1.30
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	35
307	65
308	1.35
311	85
324	1.35
339	90
349	2.25
356	1.65
380	1.20
381	2.00
382	2.00
386	1.95
555	35
556	85
565	1.95
566	2.50
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7815	1.30
7818	1.30
7824	1.30
7905	1.50
7912	1.50
7915	1.50
78L05	50
78L12	50
78L15	50
79L05	85
79L12	85
79L15	85

OPTO

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Green LED	35
Yellow LED	35

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Project 594

DEVELOPMENT TIMER

The Watkins Factor method of development is little known and at present almost unused – is this due to the lack of a proper timer? Phil Cohen has designed one.

IN 1893, a photographer called Alfred Watkins noticed that the time taken for an image to appear during the development of a photographic plate was a fixed fraction of the total development time.

The Watkins Factor

The phenomenon that Watkins noticed was that the total development time was a fixed number (called the Watkins Factor) times the period taken for the plate to be seen to darken initially. Now, whereas development time varies with temperature, concentration and 'age' of the developer, the Watkins Factor does not. If you develop a film for a *fixed* period, you *must* keep these three factors constant. If, however, you develop it using the Watkins Factor you can (within reasonable limits) *forget* the age, concentration and temperature.

This is all very well, but you would have to be able to see the film as it develops. This is not feasible with modern high-speed panchromatic film, which has to be developed in complete darkness. For this reason the Watkins Factor has been all but forgotten, hardly rating a mention in modern textbooks.

Theory

In the process of developing a print, developer slowly diffuses into the paper, reacting as soon as it reaches the photosensitized areas. The reaction is *diffusion controlled*. The reason why nothing appears for the first few seconds of development (called the 'induction period') is that the developer is still working its way into the paper.

With film you can't watch it develop, with paper you can so the Watkins method of development timing should be extremely useful to the amateur who can't afford a constant-temperature bath for his developer.

The Timer

It works like this: you set the appropriate Watkins Factor (which is specific to a particular developer and paper) on the front panel control. When you put the paper into the developer, you push the switch to 'START'. As soon as the first image starts to appear, you flick it back to 'TIME'. At the end of the development period the buzzer will sound. Then pull the paper out of the dish, wash it and fix it . . . viola!, beautiful prints.

It may take a bit of experiment to find the correct Watkins Factor. Once you have it, though, you need not bother too much about developer temperature and (within limits) its age and concentration.

Building It

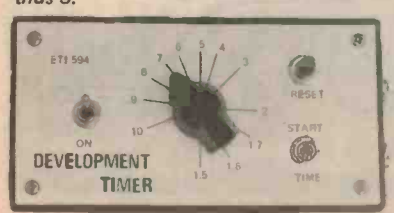
Construction should begin with the pc board. Make sure all of the capacitors, diodes, transistors and ICs are inserted the right way round. RV2 and RV3 are 'upright' preset pots bent over to fit flat against the pc board.

Mount C4 directly onto SW1, this keeps the batteries in place. The buzzer mounts on the end of the case with its leads passed through a hole. Note that the red lead goes to the '+' buzzer connection on the board.

Make sure that you use the correct tags of RV1. Refer to the wiring diagram. It is a log characteristic pot. A linear one will not have the same calibration scale.

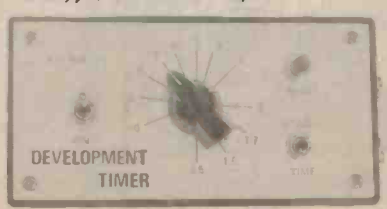
Readers who would like a front panel reproduction , please write to: Project 594, Electronics Today Int, 15 Boundary St, Rushcutters Bay, 2011 NSW.

This print was developed in fresh, normally diluted developer. The print darkened after 15 seconds and total development time was 45 seconds. The Watkins Factor was thus 3.



1

With the developer diluted to half its strength this print was developed for 45 seconds. Clearly, it is underdeveloped.



2

This print was developed in the diluted developer using the timer set for a Watkins Factor of 3. The result is very little different to the first print indicating that the Watkins Factor method is useful for 'old' developer.

3

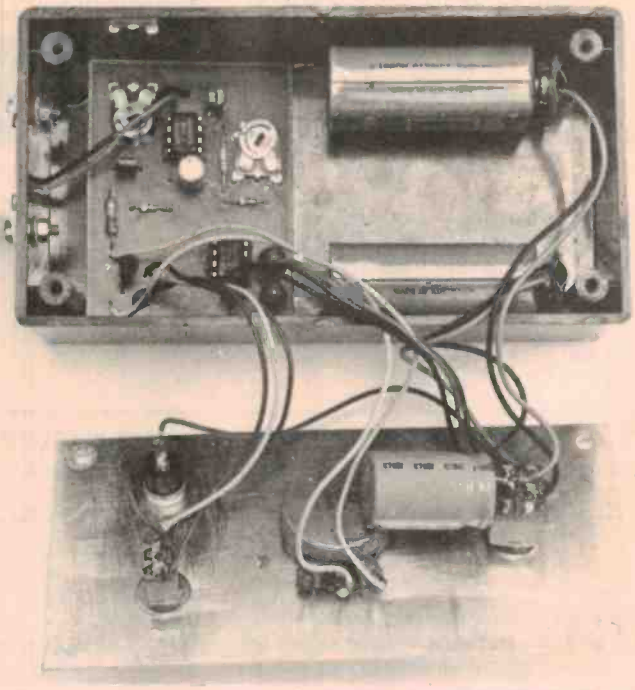
Setting Up

After finishing the unit, disconnect the 'TIME' and 'START' wires from SW2. Solder them together and put the most sensitive current meter you have between this joint and 0V (most medium-priced multimeters will do). Disconnect the wire which goes to the middle contact of SW2 and connect it to the + end of C4. Set RV1 to '2'. Switch on and adjust RV2 for a zero meter reading.

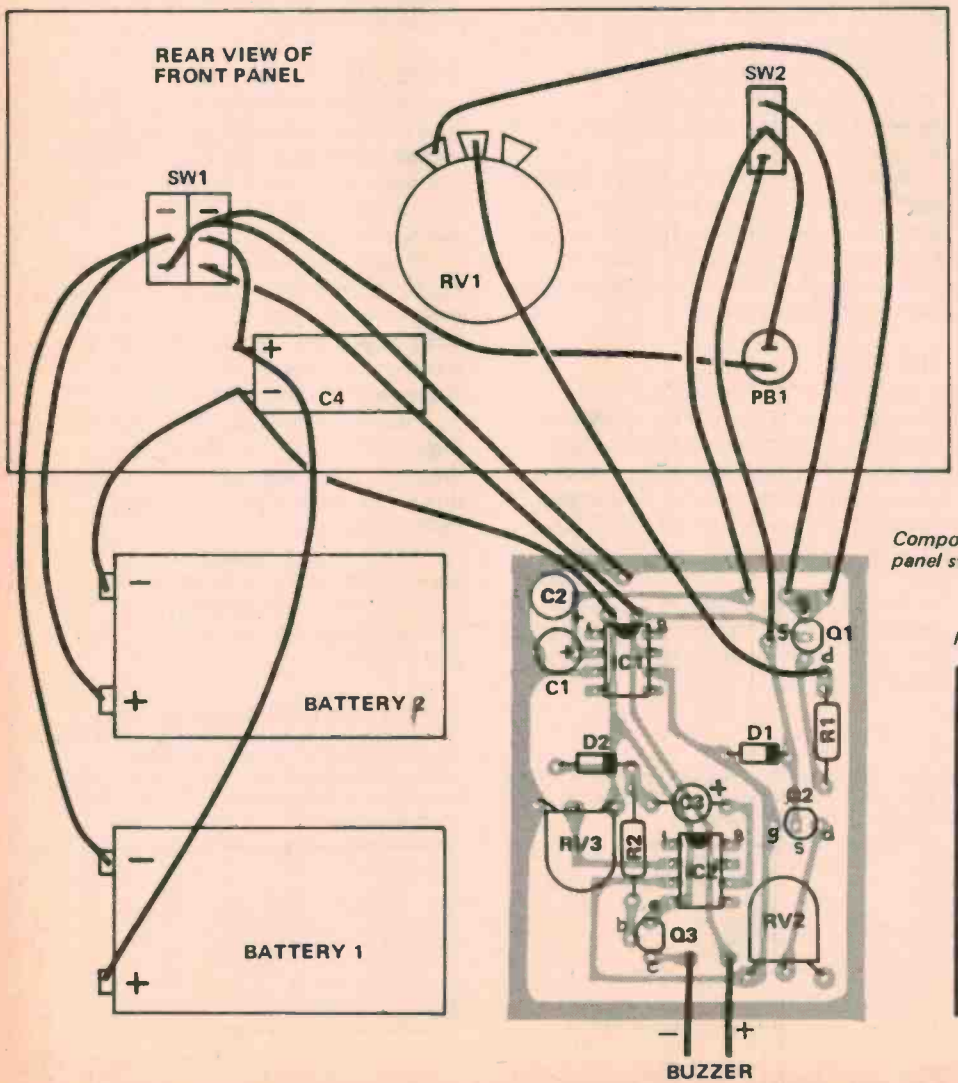
What you have just done is to ensure that when the resistance of RV1 is at the '2' value, the current through Q1 is the same as that through Q2 (see 'How It Works'). This is to correct for differences between the two FETs which seldom have the same characteristic.

Now adjust RV3. Turn it fully clockwise and then slowly rotate it until the buzzer sounds (if it doesn't – there's something wrong). After this happens, turn it back about one-eighth turn. The timer is now fully set up.

Re-connect the unit as shown in the diagrams. Switch on and set SW2 to 'TIME'. Short out C1 temporarily to remove the charge put on it during the setting-up. With RV1 set to 2, switch SW2 to 'START' for five seconds and then push it back to 'TIME'. Five seconds later, the buzzer should sound.



An interior view of the Timer. Note how the batteries are arranged. C4 can be seen mounted on the switch. This keeps the batteries in place when the box is closed.

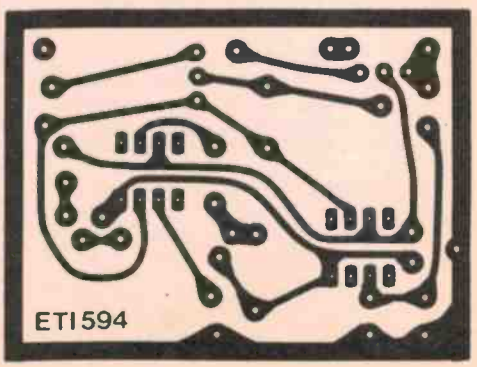


Component overlay, including the front panel switch and potentiometer arrangements

Summary

The theory behind the use of this unit needs development. It should make a fascinating study for any photographer, amateur or professional. This device will make an interesting addition to any darkroom.

PCB artwork shown full size.



HOW IT WORKS - ETI 594

The Watkins Factor is the ratio of two time periods. A timing circuit having one variable period, which you set, and one fixed period is arranged to indicate when the correct ratio of time periods has been reached.

This is achieved by charging and then discharging a capacitor. The time taken to charge the capacitor is varied while the discharge time is fixed. The control used to vary the charging time is calibrated in terms of the Watkins Factor.

When a capacitor is charged at a constant current, the voltage across it will rise linearly with time – or 'ramp' upwards. Similarly, when it is discharged at a constant current, the voltage across it will 'ramp' downwards. This technique allows good accuracy to be obtained in timing applications.

In this circuit, the current at which the timing capacitance is charged is varied by means of a potentiometer control.

Q1 is connected as a 'constant current' source; that is, it will only allow a constant current to pass, the amount being determined by R1 and RV1. The potentiometer RV1 sets the Watkins Factor.

When SW2 is set to START, C1/C2 will charge via Q1/R1/RV1, the voltage across it ramping upwards at a linear rate The lower the resistance of RV1, the higher the charging current causing C1/C2 to charge at a faster rate. The converse is also true.

Q2 is connected as a 'constant current' sink – when SW2 is set to TIME, C1/C2 will discharge via Q2/RV2, these components 'sinking' the current. The discharge current will be constant and the voltage across C1/C2 will ramp down at a linear rate.

A Watkins Factor of '2' requires equal charge/discharge times for C1/C2. So that the currents through Q1 and Q2 will be equal when RV1 is set for a Watkins Factor of 2, RV2 (a trimpot) is provided to set the current through Q2. This is used to calibrate the timer.

When the timer is switched on initially, with SW2 in the TIME position, any positive voltage on C1/C2 will cause the output of IC1 to go negative, drawing current through Q2/RV2, discharging the capacitors. Any negative voltage that may appear on C1/C2 will cause the output of IC1 to go positive. This will forward-bias D1 and 'pull up' the voltage across the capacitors. The combined action of these processes ensures that the voltage across C1/C2 stabilises at zero volts.

When the timing period is commenced at the start of developing a print, SW2 is set to START. As C1/C2 charge, the output of IC1 will go negative. When the image first appears on the paper, SW2 is set to TIME. C1/C2 will then discharge, as previously explained, and the voltage across the capacitors will go to zero. At this time, the buzzer will sound.

IC2 is arranged as a 'trigger'. When C1/C2 first begin to charge, the output of IC1 goes negative. When this negative voltage passes the value of the negative voltage applied to the inverting input of IC2, set by RV3, the output of IC2 will go very rapidly to about -7 V. At the end of the timing period, the output of IC1 goes to zero volts. As this drives the non-inverting input of IC2, the output will swing rapidly from about -7 V to +7V.

This will force a pulse of current through C3/R2, forward-biasing the base of Q3. When Q3 turns on the buzzer will sound.

C3 will take about one second to charge, Q3 will not receive sufficient base current and the buzzer will cease its cacophony. It sounds not unlike the wheeze from expiring bagpipes! This project was designed by a homesick scotsman.

D2 discharges C3 when the output of IC2 goes low when next you turn SW2 to START.

A pushbutton, PB1, allows you to abort a timing sequence by shorting C1/C2.

Note that the buzzer will sound whenever the unit is turned on. IC2 will trigger as the output of IC1 will initially be zero and the output of IC2 will thus jump to about + 7 V, setting off the buzzer.

PARTS LIST – ETI 594

Resistors
R1 . . . . . 27k
R2 . . . . . 12k

Potentiometers
RV1 . . . . . 1M log
RV2 . . . . . 1M trim
RV3 . . . . . 250k trim

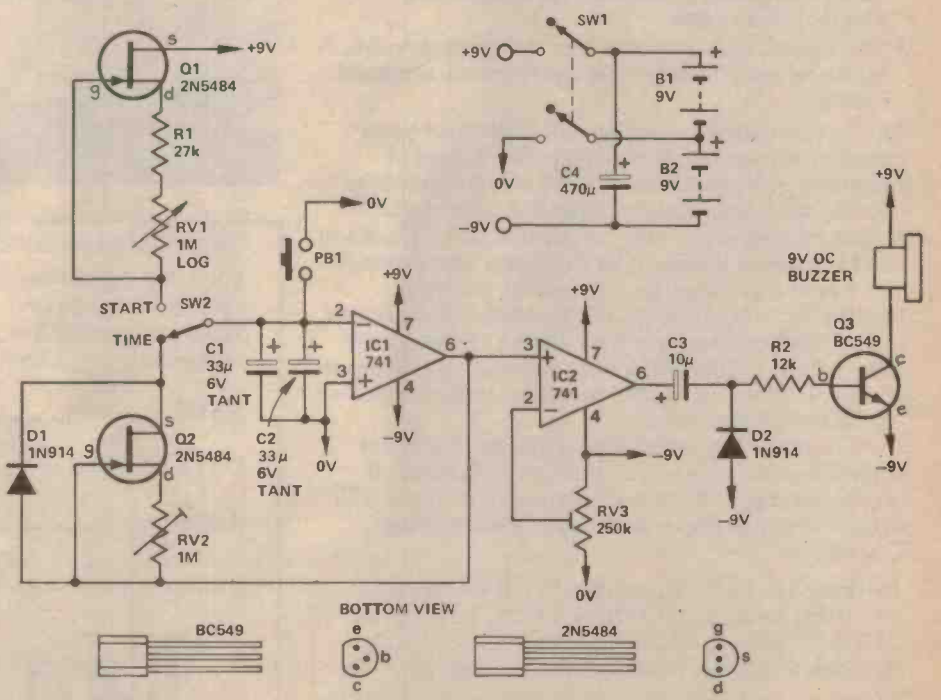
Capacitors
C1, 2 . . . . . 33µ 10V tantalum
C3. . . . . 10µ 25V electrolytic
C4. . . . . 470µ 25V electrolytic

Semiconductors
IC1, 2. 741

Q1, 2 . . . . . 2N5484
Q3 . . . . . BC549

D1, 2 . . . . . 1N914

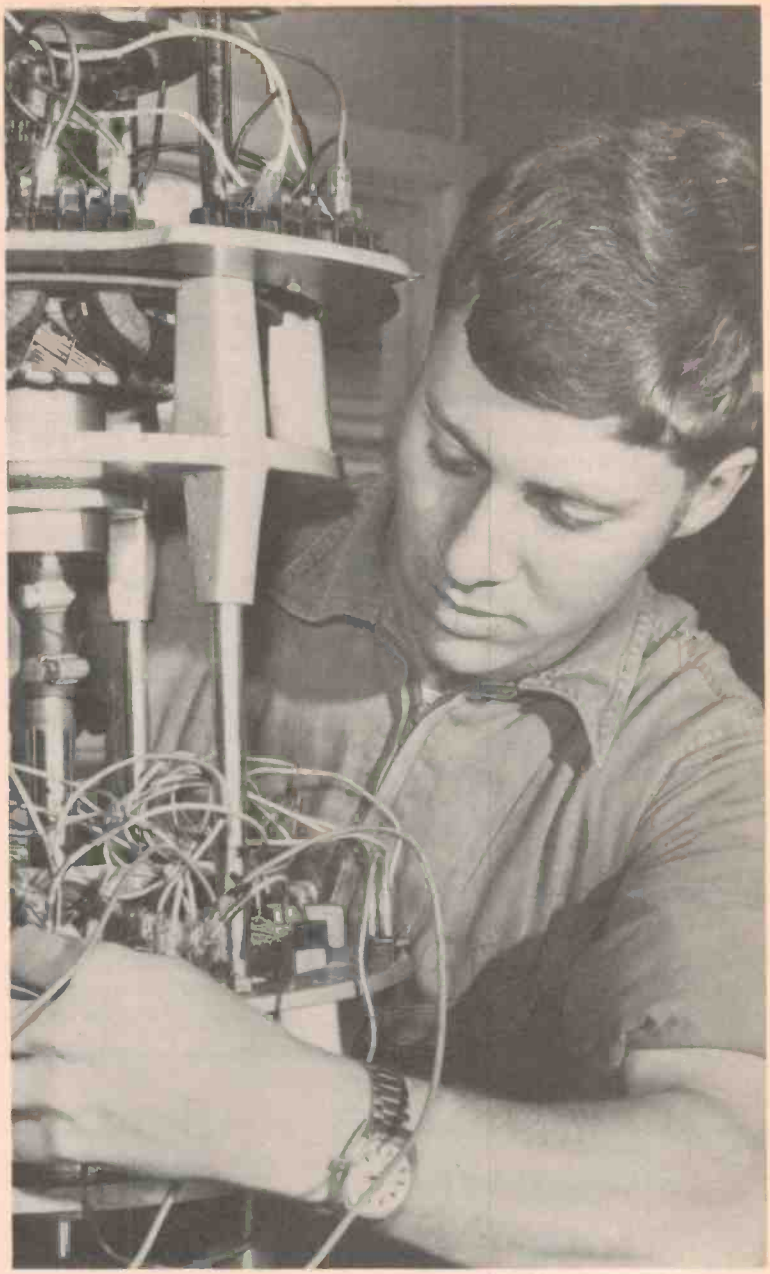
Miscellaneous
pcb . . . . . ETI 594
SW1. . . . . miniature dpdt toggle
SW2. . . . . miniature spdt toggle
2 off 9V batteries with clips; case to suit; 9V dc buzzer and mounting bolts; knob with pointer.



The circuit diagram. C1 and C2 are in parallel to achieve the required total capacitance and voltage rating.

Army Apprenticeships

Opportunities for young men (15-17*) in the Electronics and Electrical Trades.



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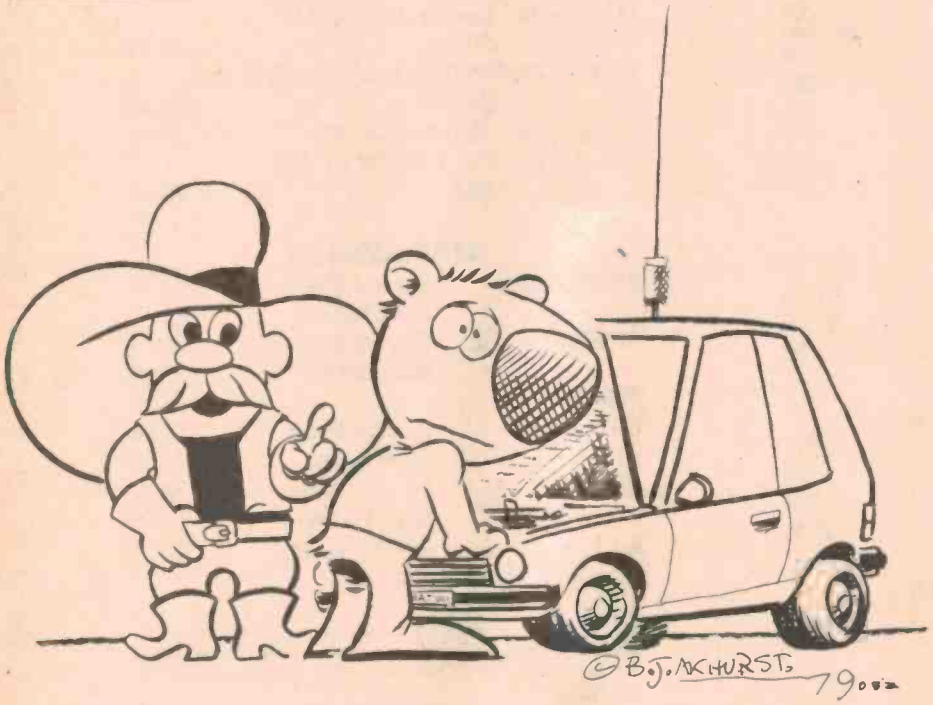
Project 320

BATTERY CONDITION INDICATOR

Ever been caught by a battery that went flat at an embarrassing moment – like when you've just offered a friend a lift? The conversation goes a little flat when you're both riding the bus to work, 20 minutes late. Jonathan Scott found a solution . . .



THE OLD, RELIABLE lead-acid battery may be way ahead of what ever is in second place for vehicle electrical systems, but they do need a 'weather eye' kept on them. Particularly if they're out of warranty. The same applies to 'reconditioned' batteries, so often found in secondhand vehicles of some age.

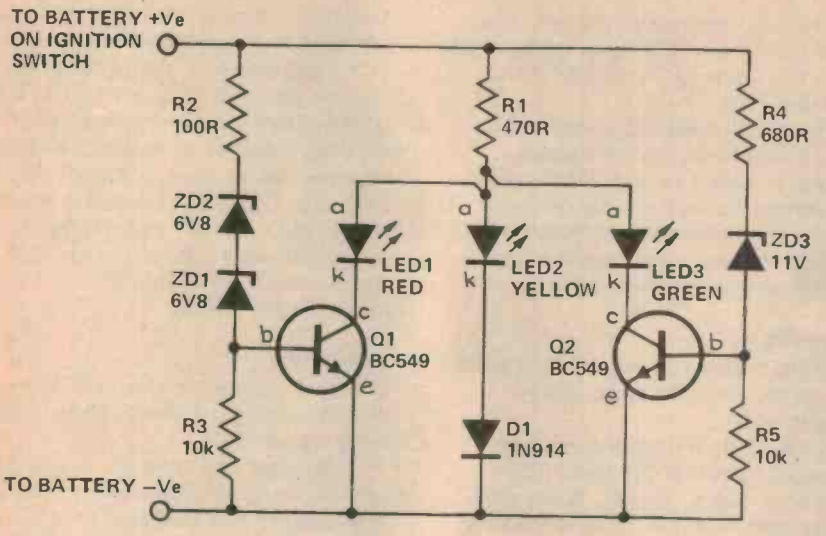
That's the problem with cars – running out of petrol and running out of battery produces the same heart-rending result. Immobility.

Most vehicles have a petrol gauge. Few have an equivalent for the battery. Many 'older' cars included a 'charging current' meter. This told you something about the car's generator-regulator and required some interpretation to figure out whether the battery was in good health.

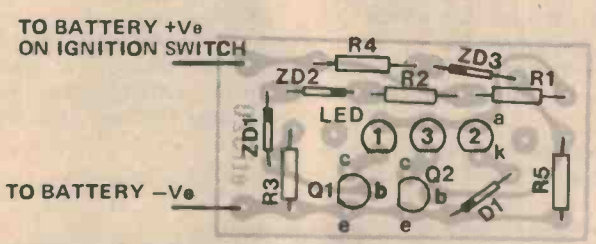
Probably the best way to check on the state of your battery is to use a hydrometer. However, hydrometers have a number of drawbacks. Being made of glass, they're fragile and can't be used while a car is in motion. The small amount of battery acid that remains on them presents a storage problem – the drips and fumes attack most metals and materials. They're okay for the corner garage but justifying their cost, for the occasional use they get in home workshops, is not always possible.

Another method of testing battery condition is by checking the voltage 'on load'. A lead-acid vehicle battery in a reasonable state of charge will have a terminal voltage under normal working load somewhere between 11.6 and 14.2 volts. When a battery shows a terminal voltage below 11.6 volts its capacity is markedly decreased and it will discharge fairly quickly. Like as not, it won't turn the starter motor for very long! On the other hand, if the voltage on load is above 14.5 volts then the battery is definitely fully charged! However, if it remains that way for any length of time while the car is on the road, the vehicle's alternator-regulator system is faulty and the battery may be damaged by overcharging.

Reading the battery voltage can be done in a number of ways. You could use a digital panel meter, set up as a voltmeter. Their drawback is that they cost nearly ten times as much as a hydrometer! The next best method is to use an 'expanded-scale voltmeter'. Reading the voltage range between 11 and 15 volts on a meter face calibrated 0-16 volts is a squint-and-peer exercise. On a 0-30 volts scale, as used on many modern multimeters, it's worse. A meter which reads between 11 volts at the low end of the scale and 16 volts at the high end is ideal. Hence, the term 'expanded-scale'.



The circuit diagram and component overlay (below). During construction, make sure all of the diodes and LEDs are the right way round.



HOW IT WORKS – ETI 320

This circuit depends for its operation upon the different voltage drops across different colour LEDs.

At 20 mA the voltage drops across red, yellow and green LEDs are typically 1.7, 3.0 and 2.3 volts respectively. When the vehicle battery voltage is too low to cause either ZD1/ZD2 or ZD3 to conduct, Q1 and Q2 are held off by R3 and R5. Under these conditions the yellow LED is forward biased and conducts via D1 producing a potential of about 3.7 volts at point A (see circuit diagram). When the supply rises above about 11.6 volts ZD3 conducts, biasing Q2 on. By virtue of its lower voltage requirements the green LED conducts, reducing the voltage at point A to approximately 2.6 volts. This is not enough to bias D1/LED3 on, so the yellow LED goes off. The green LED 'steals' the bias from the yellow LED. When the supply rises above about 14.2 volts, Q1 is biased on and the red LED 'steals' the bias from the green. The potential at point A falls to two volts and only the red LED conducts.

R1 limits the current through the LEDs. R2 and R4 limit the base currents into Q1 and Q2.

PARTS LIST – ETI 320

Resistors all ¼W, 5%

R1	470R
R2	100R
R3, R5	10k
R4	680R

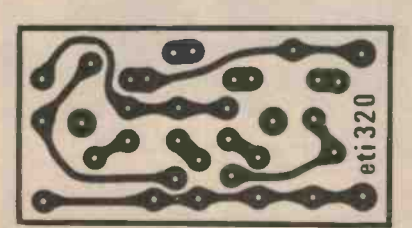
Semiconductors

D1	1N914
ZD1, ZD2	6V8 400 mW zener
ZD3	11V 400 mW zener
Q1, Q2	BC547,8,9 or BC107, 8, 9 or common silicon NPN type

Miscellaneous

pcb ETI 320

Aluminium angle bracket for under-dash mounting.



The printed circuit board pattern

However, you don't want to be peering at a meter on the dash board when you're driving through traffic. The range of voltage over which your battery is healthy is some two volts. An indicator which simply requires the occasional glance, and needs no 'interpretation', is what is really needed.

With this project, that's exactly what we've done.

Go, caution, stop

We have devised a simple circuit that indicates as follows:

Yellow:	battery 'low'
Green:	battery okay
Red:	battery overcharging

When the battery voltage is below 11.6 volts, a yellow indicator lights. This indicates the battery is most likely undercharged or a heavy load (such as high power driving lights) is drawing excess current. When it is between 11.7 and about 14.2 volts the green indicator lights, letting you know all is sweet. If the red indicator lights, as it will if the voltage rises above 14.2 volts, maybe the vehicle's voltage regulator needs adjusting or there is some other problem.

The circuit

The circuit is ingeniously simple, having barely a handful of parts. Reliability should be excellent.

We actually started out with a somewhat complex circuit. It used only two indicators and required you to 'interpret' what was happening. In trying to convert that to a yellow-green-red style of indication it sort of grew like topsy. This circuit had four transistors, a dozen resistors etc and didn't look at all attractive as a simple project that the average hobbyist or even handyman could build one Saturday afternoon and get going immediately. A rival circuit was devised by another staff member using a common IC. This sparked a controversy as to which was the better! Certainly, both did the job required . . . but maybe there was a simpler method.

It was discovered that different coloured light emitting diodes (LEDs), which we had decided to use for the indicators in the project, had different voltage drops when run at the same current. Seizing on this idea, the original circuit (four transistors, a dozen resistors . . .) was modified to exploit this characteristic and the simple circuit you see here was the result.

Construction

Construction is straightforward. If you haven't soldered electronic components

before – and this project was designed for the motorist/handyman as well as electronics enthusiasts – then we suggest you practice on something before tackling this project. Soldering is one of those things like swimming or riding a bicycle, or sex – it's okay once you've done it once or twice but you don't practice out on the street!

We recommend you use the printed circuit board designed for this project. The actual layout of the components themselves is not critical but a printed circuit board reduces the possibility of errors.

It is best to mount and solder the resistors first. Follow this by soldering in the diodes D1 and the zener diodes ZD1, ZD2 and ZD3. Carefully follow the accompanying component overlay making sure the diodes are all inserted the correct way around. Next, mount the transistors, again referring to the overlay, checking to see they are inserted correctly before soldering.

Finally, mount the light emitting diodes. These too may only be inserted one way. Check with the component overlay and connection diagrams. Make sure they are in the correct sequence. On the component overlay, LED 1 is the red LED, located at the left. The yellow LED is on the right, marked with a '2'. The green LED, marked '3' is between them.

The circuit could be tested at this stage if you have a variable power supply, or access to one. Simply vary the voltage across the range between 11 and 16 volts and note whether the LEDs light up in the correct sequence and close to the voltages indicated.

Mounting

As vehicles vary so much in dash panel layout, we can only make general suggestions.

Clearly, the indicator should be mounted such that the three LEDs are not in direct sunlight. A low part of the dash, but make sure it's readily visible from your normal driving position, will pretty well ensure the display may be easily read during the daytime. Alternatively, if you have an 'overhung' dash, or a portion which overhangs (usually where the instruments are mounted anyway), then a suitable position will generally suggest itself.

Exact mechanical details will have to be determined according to your particular situation. Two holes are provided in the pc board for mounting bolts. Alternatively, the whole assembly may be mounted from the LEDs. Three LED holders inserted through part of the dash panel, or an escutcheon plate mounted on the dash, will hold the LEDs quite securely. Providing the leads on the LEDs are fairly short, the pc board will place little strain on them and the assembly should be mechanically secure.

Connection

The indicator may be installed in vehicles having positive or negative earth electrical systems.

The component overlay shows the connection for a negative earth vehicle. The 'battery +ve' lead goes to the ignition switch – the indicator only operates when the vehicle is being used – the battery negative lead should be taken to a good 'earth' point on the vehicle frame.

For a positive earth vehicle, the lead marked 'battery –ve' goes to the ignition switch connection, while the 'battery +ve' lead goes to the vehicle frame.

BUILD A COMPUTER KIT AND SAVE

KB05 FULLY ENCODED KEYBOARD

Eliminates messy wiring between keyswitches and encoder. The KB05 is a full featured keyboard kit fully encoded for all 128 ASCII characters. Based on a design published in ELEKTOR November, 1978, it is an ideal low cost keyboard for microcomputer use. This clever design uses a single sided PCB to connect the switches and the encoder IC and few links are required. The kit includes 2 spare user definable keys and a metal mounting bracket to hold each switch accurately in place. The switches are supported on this bracket not on the PCB as with inferior designs. Spare mechanisms, cursor option and number pads are available.

KB05 encoded keyboard kit $84.00
KB06 cursor option $4.95
KB07 number pad $11.95

EA2650 STARTERS KIT

Described in EA May, 1978, this is an ideal project ideal for the beginner or educational applications. The kit comes complete with all instructions for assembling and running the 2650 computer, all components including 2650 microprocessor, PIPBUG ROM and 1K of RAM. The kit can be expanded to 4K and requires a serial terminal such as the EA LOW COST VDU detailed below. Sample programs are included for you to run and a cassette interface can be readily added so that programs can be stored on low cost cassettes.

EA2650 starters kit $65.00

EA LOW COST VDU SELLOUT!

This low cost stand alone VDU was described in EA February, 1978. Accepts parallel ASCII input and produces 16 lines with 32 characters per line with onboard sync generation and video driver. Supplies direct video to a converted TV set or to an RF modulator if required. The kit includes sockets for the RAM and character generator IC's, all components plated thru PCB, and step by step instruction manual.

EA VDU sellout (until stocks cleared)
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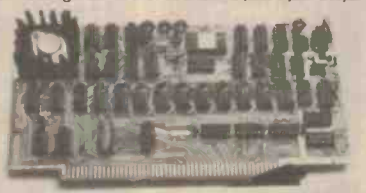
- comprehensive owners manual (54 pages) describing assembly, troubleshooting, and operating software for 2650,Z80,8080,6800.



DG640 kit $149.50 (PCB with manual $35.00)

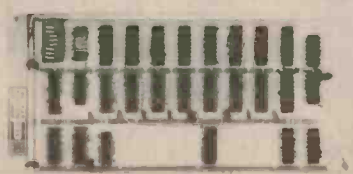
EUROCARD 2650 SINGLE BOARD EXPANDABLE 2650 COMPUTER

This professionally engineered 2650 single board computer is the answer to all those who want a systematically expandable computer system. The DB1001 uses a simple E58 bus which is readily adapted to S100 and Z80 bus requirements. The DB1001 uses the 2650A chip and has fully buffered address and data lines, on board 1K operating system in Eprom (PIPBUG SUPPLIED but easily reprogrammed), 1K RAM and a crystal controlled clock on a top quality plated thru PCB with hard gold edge connector. Readily expanded on the E58 bus for more memory, I/O and will accept floppy discs and high speed printer. The kit is supplied with all components, owners manual and full service backup. A conversion kit for the EA2650 is available.

DB1001 single board computer $135.00
($35.00 PCB with manual)
DB1001/EA2650 conversion kit $99.00

DB1008 8K STATIC 2114 RAM

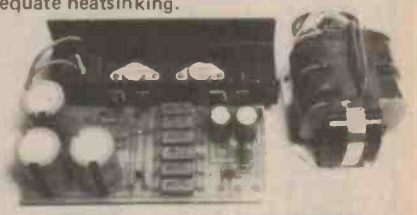
A very useful add on memory module to support the DB1001 computer on the E58 bus, this 8K RAM is fully buffered and has been arranged as 2 4K blocks with DIP switch address boundary selection. The kit is supplied with all components, sockets for all memory IC's and a plated thru PCB with hard gold edge connectors and full instruction manual.



DB1008 8K memory kit $175.00
($35.00 PCB with manual)

EPS100 ECONOMY POWER SUPPLY

This popular modular power supply kit is ideal for use with micros. Based on the EA "BRUTE" power supply the EPS100 supplies 5V @10A regulated, +,– 12V @1A regulated as well as unregulated 8V,+/–16V for the S100 BUS. The module includes an on board heatsink which must be mounted on a suitable metal case for adequate heatsinking.



EPS100 power supply kit $60.00

ET1632 UART/BAUD RATE GENERATOR

Converts serial to parallel and parallel to serial. This low cost baud rate generator can be set for any speed from 50 to 9600 BAUD (continuously adjustable with multi turn trimpot) and can be set for 5 to 8 bits per character with 1 or 2 length stop bits. Requires +5V, –12V. and kit includes all components and 40 pin socket.

632U with full instructions $18.50

ETI 630 HEX ENCODER/DISPLAY

This simple kit includes a pair of 4 bit encoder/latches driving large .5" digits to display the HEX equivalent of any 8 bit data word. Ideal for troubleshooting and also programming in machine code.

ET1630 HEX DISPLAY $14.50

SECI CASSETTE INTERFACE

This reliable unit is easily aligned without a CRO and is KANSAS CITY STANDARD useable up to 1200 Baud. The SECI uses top quality multiturn trimpots for accurate long-term timing adjustments and is supplied with the clock preset to 4800 Hz. A computer generated test tape is included so that you can readily check the operation at any time. Connects directly to a low cost tape recorder and has TTL level input/output for connection to the microprocessor. Requires +5V and provision for optional regulator has been made on the PCB.

SECI Cassette Interface kit $24.50

DB1048 4/8K ROM BOARD WITH HIGH SPEED CASSETTE INTERFACE

This card supports the DB1001 on the E58 bus and has provision for 2708 or 2716 EPROMS. Included on the board is a software controlled cassette interface (300 characters/sec!) controlling two tape recorders with full file handling. The DB1048 is supplied with a preprogrammed EPROM with the tape interface software, a utility tape with useful routines, all components, plated thru PSB and owners manual.

DB1048 ROM Board/Cassette interface $130.00

Project 799
FM TUNA

ONE THING we've never done a constructional article on up to now is food. Why not, you cry? Why not indeed, comes the reply.

In this April issue, we've decided to break with tradition and give our readers what they really want – a decent meal.

Why, some of the poor souls who attend our 'synergistic beer drinking' sessions have subsisted for so long on liquids that it's all they can do to force down a second packet of peanuts.

Enough of this, we've decided. ETI now proudly presents the first – the very first – FM Tuna.

Construction

First, buy a can of Tuna. This shouldn't be too difficult, although a certain large retail business based in Sydney is known *not* to stock them. We hear they're thinking of importing 400 dozen cans later this month, though. This will probably mean another iceberg to keep them cool.

Having bought your tuna, open the can. To do this, grasp the tin firmly in a vice (drinking and gambling being the least energetic of these) and then go and buy a tin opener.

(By the way, did you hear the one about the engineer, the chemist and the economist trapped on a desert island with a tin of tuna and no can opener? The engineer suggested that they smash the can flat with a rock and then pick out the pieces of fish. The chemist said that wouldn't do and that they should dump the can in the sea and wait for the metal to rust away. The economist stroked his beard, looked into the middle distance and said "First, let's assume we have a can opener . . . ".)

Having opened the can, buy a tin of bandages and repair any minor damage you may have done to your fingers or other protruberances which may have got in the way while opening it.

The tuna should now be emptied onto a plate by turning the can a full one hundred and eighty degrees around its long axis and giving a couple of taps on the (now) uppermost side with a small wrench.

Place small pieces of tuna (about two to three cubic centimetres each) into your mouth. After that, you'll have to use your common sense.

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TP4028AN	B.C.D. to decimal decoder	1.85
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TP4051AN	Single 8 channel multiplexes	1.85
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TP4306AN	Dual Schmidt trigger	1.65

Look at these Specs!

12" Range 30 Watt RMS
The frames of this range are pressure die cast in high rigidity, top quality aluminium alloy. The 30 watt models use a 4" magnet with a 1¼" coil wound on a half-hard brass former. Polarised self-connect terminals are fitted and all speakers are finished in stylish black with facility for front or rear mounting.
LA12/30WA medium power woofer with a 25Hz free air resonance. This unit has a frequency response extending to 300Hz and is suitable for a two or three way hi fi speaker system. The cone is a semi-rigid "ribbed body" with a foam half roll surround.
LA12/30T
Utilising the same semi-rigid "ribbed body" cone fitted with half roll surround as the LA12/30W, this unit incorporates a sub-cone, or whizzer, which gives a 25Hz-12000Hz frequency response. Ideal for single or dual hi fidelity enclosures.
LA12/30G
This speaker has been designed for musical instrument use. It features a "seamed" cone, an aluminium centre dome and is ideal for medium power electronic organs, power guitar amplifiers, P.A. systems, disco systems. Free air resonance is 65Hz and extends to 500Hz.

12" Range 50 Watt RMS
These use the same frames and features as the 30 watt range except 5" diameter magnets are used with 2" high temperature coils wound on anodised aluminium formers.
LA12/50W
This is fitted with a high mass woofer cone mounted on a foam half roll surround. Free air resonance is 20Hz and the frequency response extends to 200Hz. This unit is ideal for high power, high quality acoustic suspension systems.
LA12/50G
Designed specifically for musical instrument applications, this speaker has many features. In standard form it includes a stiff edged, roll doped rigid cone and is fitted with an aluminium anodised centre dome. The unit is a superb lead guitar, rhythm guitar, electronic organ speaker. Free air resonance is 52Hz and response covers frequencies to 8000Hz.

30 Watt		50 Watt	
LA12/30W	$47.50	LA12/50W	$54.50
LA12/30T	$46.50	LA12/50G	$54.50
LA12/30G	$45.50	LA15/100G	$81.33

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SN7402N	Quad 2 input nor gate	.44
SN7403N	Quad 2 input nand gate open/collector	.44
SN7404N	Hex inverter	.44
SN7405N	Hex inverter open/collector	.44
SN7407N	Hex buffer/driver (30V open/collector)	.75
SN7408N	Quad 2 input nand gate	.44
SN7410N	Triple 4 input nand Schmitt trigger	.44
SN7412N	Triple input nand	.44
SN7413N	Dual 4 input nand Schmitt trigger	.90
SN7420N	Dual 4 input nand gate	.44
SN7430N	Single 8 input nand gate	.44
SN7432N	Quad 2 input nor gate	.65
SN7437N	Quad 2 input nand buffer	.75
SN7442N	B.C.D. to decimal decoder/driver	1.10
SN7447AN	B.C.D. to 7 seg. decoder/driver 15V	1.65
SN7448AN	B.C.D. to 7 seg. decoder/driver	1.55
SN7454N	4 wide 2 and-or-invert gate	.44
SN7460N	Dual 4 input expander	.44
SN7472N	JK m/s flip flop	.75
SN7473N	Dual JK m/s flip flop	.85
SN7474N	Dual D flip flop	.90
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SN7476N	Dual JK m/s flip flop	1.10
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BZX83C-3V9	3.9	IS3008A	8.2
BZX83C-4V7	4.7	IS3009A	9.1
BZX83C-5V1	5.1	IS3010A	10
BZX83C-5V6	5.6	IS3012A	12
BZX83C-6V2	6.2	IS3015A	15
BZX83C-6V8	6.8	IS3016A	16
BZX83C-7V5	7.5	IS3020A	20
BZX83C-8V2	8.2	IS3024A	24
BZX83C-9V1	9.1	IS3027A	27
BZX83C-10	10	IS3030A	30
BZX83C-12	12	IS3033A	33
BZX83C-13	13	IS3036A	36
BZX83C-15	15	IS3039A	39
BZX83C-16	16	IS3047A	47
BZX83C-18	18	IS3051A	51
BZX83C-20	20	IS3056A	56
BZX83C-22	22	IS3062A	62
BZX83C-24	24	IS3068A	68
BZX83C-27	27	IS3075A	75
BZX83C-30	30	IS3100A	100
BZX83C-33	33	IS3150A	150
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INDEX 1977

AUDIO

COMPONENTS

COMPUTERS

ELECTRONIC TECHNIQUES

GENERAL

PRODUCT TESTS

DATA SHEETS

PROJECTS

ERRATA & ADDENDA — ARTICLES

'High Voltage, High Current Supply', Dec 76, page 26

It is theoretically possible with the circuit as it stands to achieve secondary breakdown of the series pass element Q2 (MJ413) on slow risetime switch on into full load. In fact one failure has been observed under these conditions. The recommended modification is to parallel Q2 with another MJ413 and insert 4.7Ω 5W balancing resistors separately in each emitter lead. With this combination no failures have been observed under extensive testing with the adverse conditions. We should emphasize that no modification is necessary if fast risetime is desired (i.e., C2 absent), and similarly if switch on into full load is not anticipated.

Modifying TV Receivers for Graphic Display, Dec 76, page 86

Point 1 in the section 'Before You Start' should have advised you to check that the power supply section of your TV set does use an isolating transformer.

November 77, p.42 — 44 — Batteries

The diagram in figure 10 should be swapped with the diagram in figure 12. The captions are correct.

ERRATA & ADDENDA — PROJECTS

ETI 132, Feb 77 — Experimenter's Power Supply

Parts List — Circuit Diagram ETI 132 — RV2 should be 10k not 2k2.

ETI 482, Jan 77 — Stereo Amplifier, page 56

Parts List ETI 482A Jan 77 — 'Q1, 2 BC549' should read 'Q1-Q4 BC549'.

ETI 316, May 77 — Transistor Assited Ignition — circuit diagram, page 52

The connection between the base and emitter of Q2 is an error in the drawing, and should be deleted.

ETI 582, July 77 — House Alarm, page 51

As the system was being finalised it was seen that SW2 could be simplified to a single pole toggle switch by inverting it. This change was not shown in circuit fig. 1. Trace out the wiring from the overlay, etc., and all will be clear. Note that the circuit will work either way. B6 on SW3 should read B9, B6 beneath B7 fig 2 is also B9.

ETI 585, Sept 77 — Ultrasonic Switch, page 83

Power supply current and voltage specs. for TX and RX have been transposed. Swap them and it makes more sense, ie. Receiver; 10-20 Vac, or 14-25 Vdc; Transmitter; 8-20 Vdc (only).

ETI 805, Oct 77 — Drunken Sailor Puzzle, page 82

On figure 1, the circuit diagram of the Drunken Sailor Puzzle has a short circuit across the battery at the left end of the drawing. This should be ignored.

ETI 631, Dec 76 — ASCII Keyboards, page 47

Since publishing our ASCII encoder project in December 1976 we have changed the values of R30 and R31 to 47k and 10k respectively. This was because Q17 was not saturating sufficiently.

ETI 632, Feb 77 — VDU, page 69

Parts List ETI 632A
IC4 should be 4051
IC5 should be 74123
IC6-7 should be 74LS367

CONTINUED ON PAGE 59

HERE ARE JUST A FEW OF THE NEW ITEMS FROM DICK'S 1979 JUMBO CATALOGUE!

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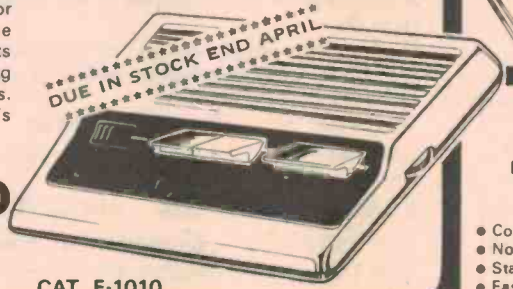

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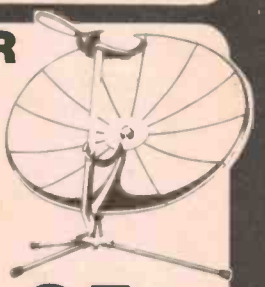

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2N3053 transistor ... Cat. Z-2130 $0.80

FET INPUT AC-DC VOLTMETER (See Sept EA)
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Not produced as a kit - most parts available from stock.
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C106Y1 SCR ... Cat. Z-4315 $1.00
2N2646 (DS2646) unijunction ... Cat. Z-1786 $1.20

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3.579545MHz crystal ... Cat. K-6031 $3.00
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PHOTO TACHOMETER (See Aug EA)
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Langman's Sound Centre	Shop 15, Treasure Island, Coffs Harbour Jetty NSW. Ph 521-570
Sumner Electronics	95 Mitchell Street, Bendigo VIC Ph 43-1977
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ADS Electronics	312 Oxley Ave, Margate QLD. Ph 204 1276
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Aero Electronics	123a Bathurst St, Hobart TAS. Ph 34-8232
Hutchesson's Comm. Centre	5 Elizabeth St, Mt Gambier SA. Ph 256 404
Gawler CB Centre	51 Hillier Road, Evanston SA. Ph 222-149
Altronics	105 Stirling St, Perth WA. Ph 328-1599
Hocks TV Rentals	87 Hannan St, Kalgoorlie WA. Ph 211-906

NOTE: Prices & stock availability could change between publication deadline & on-sale date due to circumstances beyond our control. Please check with our stores for latest availability & prices.

INDEX 1978

AUDIO

COMPONENTS

COMPUTERS

DIGITAL ELECTRONICS

ELECTRONICS TECHNIQUES

GENERAL

PRODUCT TESTS

DATA SHEETS

PROJECTS

ERRATA

ETI 716, Jan 78, p. 51 — VHF Power Amplifiers, Part 2

Parts List — 40W Stripline Amp

Cin	680-1000p ceramic
C1, C4	47p metal-clad mica cap
C2, C3	100p metal-clad mica cap
C5, C8	two each 200p metal-clad mica caps
C6	200p metal-clad mica cap
C7	82p metal-clad mica cap
C9	150p metal-clad mica cap
C10	68p metal-clad pica cap
C11	33p metal-clad mica cap
C12	680-1000p button standoff cap
C13, 15, 17	1500p ceramic
C14, 16, 18	1μ 25 or 35 V DC tantalum
R1, R2, R3	15 ohm, ½W resistor
RFC1, 2, 3, 7, 10	printed inductors, on PC board
RFC4, 5, 6	4.7μH moulded RF choke
RFC8, 9	5 turns, 18 or 20 gauge tinned copper or enamel wire, 6mm i.d., 15mm long
SL1—9	50 ohm *stripline*
Q1	CTC B3—12
Q2	CTC B12—12
Q3	CTC B40—12

ETI 483, Feb 78, p. 28 — Sound Level Meter

Some nonlinearity occurs in the meter circuit due to the offset current of IC3. It is recommended that this IC be replaced with a CA3140 (same pinout) and C14 be deleted (it is not required with this IC).

ETI 132, Feb 77, p. 45 — Experimenter's Power Supply

A few errors in the 132 Power Supply slipped past us (and all but one of the readers who built it!). In the parts list, ZD1 and ZD2 have been transposed, and RV1 should be 10k. On the overlay diagram, R1 and R2 have somehow been transposed, but they are of the same value, so the operation of the circuit is unaffected.

ETI 136, Mar 78, p. 11 — Linear-Scale Capacitance Meter

In the parts list, R2 is omitted — is should be 120R. On the circuit diagram,R7 should be 1k,R8 should be 10k, and the battery polarity is shown reversed. The orientation of IC2 shown on the component overlay is incorrect — for a 78L12 the flat should face to the right of the drawing, while for a 7812 the flat metal back of the TO-220 pack should face to the left. The markings on the printed circuit board are correct. R7 to R12 and the pilot lamp connect to the point marked '+12V' on the overlay. The common connection to switch S3 should be taken from the point marked 'red terminal' on the overlay.

ETI 581, Jun 77, p. 36 — Dual Power Supply

Some readers have had problems with failure of low powered regulators when using loads connected between the positive and negative outputs. This is caused by one filter capacitor discharging before the other switches-off and the load pulling the output of the regulator into reverse voltage. This can be prevented by adding diodes (1N4001, 1N914, etc.) across the outputs to limit any such voltage to 0.6V.

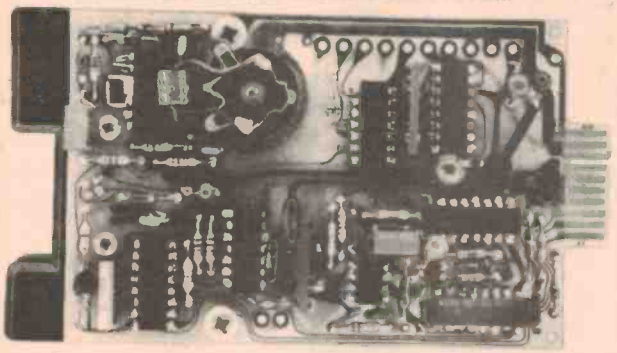
ETI 319, Sept 78, p. 40 — Vari Wiper Mk 2

An error was made in the circuits of the SCR output version of the vari-wiper. As shown, a wire is connected from the supply line to the self parking contacts on the motor. This wire is not used for wound field coil motors and should be left out of the circuit.

Continued on page 59

LOW COST DIGITAL TAPE TRANSPORT SYSTEMS

NEW ELECTRONIC READ/WRITE TAPE SYSTEM



The Micro Read/Write Digital Data Storage System is a complete digital input/output system designed for use in storing and retrieving digital information.

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2 2114 type static RAM (1k x 8)
1 35391 type static RAM (256 x 8)
Sockets for 3K bytes of 2708 type EPROM
The bus is Motorola - EXORciser 1 compatible and fully buffered
Romtech Microcomputer Module 1A
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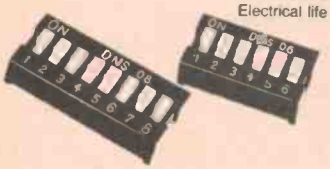
* EXORCISER BUS compatible: * Configuration 16K (2708), 32K (2516), 64K (2532).

mini DIP switches



SPECIFICATIONS

Rating . . . 50V DC 100mA without switching
5V DC 100mA with switching
25V DC 25mA with switching
Contact resistance . . . less than 50m at 2V DC 10mA
Insulation resistance . . . more than 100M at 100V DC
Insulation voltage . . . 500V DC for 1 minute
Electrical life . . . more than 10,000 switching

OTHER MODULES TO BE RELEASED:
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INDEX

1977

CONTINUED FROM PAGE 53

ETI 632, Feb 77 — VDU, page 77, Interconnections

V7-C18 (Not V9-C18)
C2-B4 (not C2-B3)
C3-B3-B25 (not C3-B4-A26)
B15-A22 (not B15-A23)
B21-A23 (not B21-A22)
+5V-C9 (not C8)
0V-C8 (not C7)
−12V-C7
M2-B25
Testing page 74 — Also connect −12V

ETI, 712, June 77 — CB Power Supply, page 58, Parts List

Q2 and Q3 have been transposed, i.e. Q2 is a 2N3055 and Q3 is a BD 140.

1978

CONTINUED FROM PAGE 57

8080 Octal Monitor Program, Dec 77, p.95

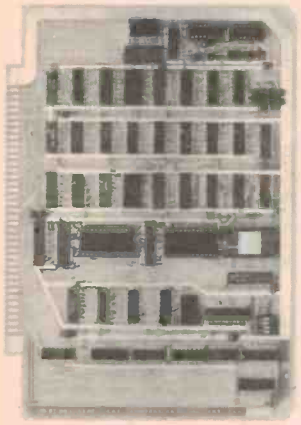
A section of code was unfortunately omitted from page 95, between locations 234 and 250 of the second page. It is reproduced here with apologies to the many frustrated programmers who are out there, and thanks to the chap who brought it to our attention.

```
234-007          RLC
235-346 003      ANI "3"      ;MASK OFF ALL BUT 3 BITS
237-366 260      ORI 260      ;FORM ASCII DIGIT
241-315 362 377  CALL PNT     ;PRINT FIRST OCTAL DIGIT
244-175          MOV A,L      ;MOVE L TO ACCUMULATOR
245-017          RRC          ;ROTATE RIGHT 3 TIMES
246-017          RRC
247-017          RRC
250-346 007      ANI "7"      ;MASK OFF ALL BUT 3 BITS
```

SEMCON MICROCOMPUTERS PTY. LTD.

AUSTRALIAN MANUFACTURERS OF MOTOROLA COMPATIBLE PRODUCTS

CRT-01 VIDEO INTERFACE



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This powerful unit has been designed to efficiently interface the memory of Motorola compatible sys tems directly to a CRT display. It is software driven and with appropriate program can be made to emulate the majority of functions of currently available intelligent terminals.

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- Displays full 128 ASCII character set. (Control characters optional).
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- Link programmable lines/page (20, 22, 24).
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- Power rails in grid network for improved noise immunity
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- Quality PCB with solder resist

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No Rams	145	—

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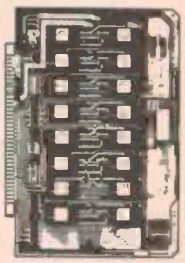

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A look at the Exidy Sorcerer

Dick Smith is now selling the Exidy Sorcerer personal computer. How good is it? Phil Cohen has the answers . . .

THE SORCERER is a Z-80 based multi-language system. It comes as a moulded plastic case containing CPU, RAM, monitor, keyboard and modems for TV and tape recorder. The price is somewhere around $850. A socket on the side of the case allows the insertion of 8K of ROM in a cartridge form.

The ROM cartridge looks very much like an 8-track tape cartridge – except that it has an edge-connector at the business end. The sockets at the back, as well as TV and tape inputs and outputs, include an RS232 interface and a parallel interface with handshaking. The whole thing can be carried under one arm (although at its price, I wouldn't recommend it), and looks very smart indeed. The video output produces a rock-steady picture giving 30 lines by 64 characters. The characters set includes upper and lower case alphanumerics and full graphics set including clubs, diamonds, hearts and spades! There are three shift keys:
SHIFT produces the upper case alphabet;
GRAPHIC produces the full graphics set; and
CONTROL produces ASCII control characters such as form feed, carriage return and bell. Pressing SHIFT and GRAPHIC together gives the user-defined character set stored in RAM. This can be altered from BASIC or machine code to give a set of 64 8 x 8 dot matrix characters. It is also possible to re-define the graphics characters in the same way, giving 128 possibilities.

There are two RESET keys – as a safety feature. Only pressing both at once has any effect. It's little tricks like this that make a machine a pleasure to use. There's also a REPEAT key. Normally, a REPEAT key has to be pressed while pressing the character to be repeated. This one's different – when pressed, it repeats the last character to be input; this saves the trouble of pressing SHIFT, GRAPHIC, a letter and REPEAT all at the same time.

Back to BASICS

The BASIC comes in 8K of ROM – this may not seem like all that much, but it's Z-80 code, remember!

With the BASIC ROM cartridge plugged in, pressing RESET will give the impressive message:

31976 BYTES FREE.

This is the amount of space available for storing programs, variables or whatever. This is enough for a floating-point array with just under 7 000 elements!

The version of BASIC is similar to that found in the Commodore PET – not surprising since both BASIC's were written by the same software company. The Sorcerer uses standard BASIC line-replacement editing with a colon separating statements on the same line. One thing we found out early on, though, is that the Sorcerer does not like long lines. On occasion we have managed to 'crash' the system completely, requiring reset to get any response. This can be achieved by INPUTting a string longer than one line. When writing a line of a program, the Sorcerer will accept up to two lines of text but will ignore the second line! Although this seems like a major bug, it should be borne in mind that the Sorcerer's lines are 64 characters long and so most programs will not cause any problems.

The system supports the usual commands, such as LIST, RUN, CSAVE, CLOAD (with file names), CONT and NEW. In addition, it also enables the saving and reloading of numeric array files from cassette. Another command allows the user to set the number of nulls which are sent to an output device following a carriage return (e.g. to allow a printer head time to return).

Variables

The variable types are: floating point, string and array. There are no integer variables! Presumably, with 32K of memory to play with, the designers decided that most users wouldn't need the saving possible by using integers rather than floating point numbers for large arrays. The arrays can be of up to 12 dimensions (in theory, there's no limit – but with a floating point array with each dimension's subscript range equal to 2, 12 dimensions gives 4096 elements).

The string variables can hold up to 255 elements each and the floating point range is 6 significant figures with a range of 1.70141E38 to 2.93874E-39. The six significant figure limit does not, however, apply to arithmetic:

```
10 A = 111111111111
20 B = 100000000000
30 PRINT A
40 A=A–B
50 B=B/10
60 GOTO 30
RUN
1.11111 E + 11
1.11111 E + 10
1.11112 E + 09
1.11121 E + 08
etc.
```

The results of the above run show that the actual arithmetic accuracy is 7 significant digits. The fact that the 'noise' digit is a 2 rather than a zero leads us to suspect that the storage is in a binary representation of some sort, rather than BCD.

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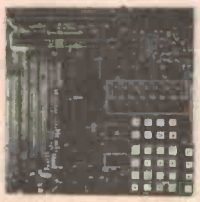

The ideal choice for the beginner, this is a complete Z80 system on a board. Includes 1k static RAM with sockets for another 1k, powerful 2k ZBUG monitor, extra PROM socket PLUS on-board PROM programmer. There's also a Kansas City standard cassette interface, hex keyboard and six digit display, twelve command keys, four counter/timer channels, two eight-bit parallel I/O ports, and room for you to expand: a generous 2½" x 8" wire-wrap area for custom circuitry AND S-100 INTERFACE WITH POSITIONS FOR TWO S-100 EDGE CONNECTORS ON BOARD.

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PIO Tech. manual.....7.50
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assembled and tested 189

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16k	299	449	32k	689	849
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32k	475	599	64k	1049	1299

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Add 15 percent sales tax where applicable — we pay postage on pre-paid orders — orders accepted pre-paid or COD.

The Exidy Sorcerer, pictured on Dick Smith's stand at the recent Melbourne Home Computer Show.

Statements

The Sorcerer supports normal BASIC statements: DATA, DEF, DIM, END, FOR . . NEXT, GOTO, GOSUB, IF . . GOTO, IF . . THEN, IF . . GOSUB, INPUT, LET (optional), ON . . GOTO, ON . . GOSUB, PRINT, PEEK, POKE, RESTORE, READ, REM, RETURN, STOP.

In addition to these it supports:

WAIT	Stops execution until a particular bit pattern appears at a specified port — very useful for interfacing with miscellaneous mechanical hardware: limit switches and the like.
OUT, INP	These allow communication via the ports. Double-byte numbers can be sent or received.

Functions

The intrinsic BASIC functions are: ABS, ASC, ATN (arctan), CHR$, COS, EXP, FRE (amount of memory left), INP, INT, LEFT$, LEN (of a string), LOG (base e), MID$, RND (random number-rectangular distribution), POS (cursor position), RIGHT$, SGN, SIN, SPC (prints spaces), SQR, STR$, TAB, TAN, USR (user-defined machine code subroutine with one parameter), VAL. The accuracy of these was limited by the 6-digit accuracy of the machine.

```
PRINT 30↑2
  900.001
  PRINT 2↑13
  8192.01
```

The above represent the two worst errors we cound find in about 15 mins, however, the computational accuracy in general was adequate.

Error Messages and Software Fragility

The error messages are a little cryptic:

```
? UL ERROR
or SN ERROR IN 20
```

for example, but they are fully explained in the manual. Anyway, which would you rather have — massive error messages or more functions?

Apart from long lines, the system seems quite stable — I 'crashed' it on only two occasions, once by entering too long a line on INPUTting a string and once by trying to get back into BASIC from the monitor while the ROM was removed! On both occasions, pressing the general reset got me out of trouble.

User-Defined Graphics

These can be changed by POKEing from BASIC or from the monitor. Each character requires eight two-byte numbers to define it and these are put into RAM between FE00 and FFFF, depending on which character is to be set. For example, to define the shifted graphic character associated with the "I" key (which happens to reside at the bottom of the user graphics RAM) as the Greek letter Omega (Ω), the memory locations FE00 to FE07 are set to 99, 38, 44, 82, 82, 44, 22 and EE respectively. The bit-patterns of these, when laid out one under the other in sequence, form an Ω (try it, if you don't believe me!). Whenever shifted graphic "I" is used after this has been done, the letter Omega will appear.

The graphics held in RAM can, of course, be stored on tape — so you can have a tape for Greek maths, wargames, or whatever. (By the way, try 3C7EDBE7 FF 42 7E 3C!).

COMPUTER BITS

S-100 HARDWARE & 8080 SOFTWARE

RETAIL PRICE LIST

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Thinker Toys *products*

- 8K Synchrofresh RAM (A&T) **$149(** ($16.50)
- 16K Static RAM (Kit) **$299** ($4.35).
- Disk Jockey Disk I/F (Kit) **$179** ($20.55) Assembled **$213** ($24.45).
- Discus I 8" Disk System (240v/50 Hz) Assembled **$995** ($114.60); Add-on Drives (Incl. power supply) Assembled **$795** ($91.50).
- Keyed-up 8080 CPU (Kit) **$250** ($28.80).
- Speakeasy I/0 (Kit) **$130** ($15).
- Wunderbuss 20 slot terminated & shielded Motherboards: Kit with 20 edge connectors **$154** ($17.70); with 10 E/C **$120** ($13.80); Kit with no edge connectors **$76** ($8.70); A&T with 20 E/C **$199** ($22.95).

DEALERS THROUGHOUT AUSTRALIA WANTED FOR THE ABOVE PRODUCTS

SOFTWARE FOR DISK SYSTEMS:-

- CP/M by Digital Research **$100** ($13.50).
- Microsoft Disk Basic **$268** ($36.18).
- Microsoft Fortran IV **$350** ($47.25).
- CP/M Users Group Library (per disk) **$10** ($1.35)

Processor Technology *systems and software systems*

SOL 20	**$1895** ($227.55)
SOL 20/16	**$2095** ($251.55)
SOL 20/32	**$2395** ($287.55)
HELIOS II/2	**$3195** ($404.70)
HELIOS II/4	**$5395** ($683.25)
SOL SYST. IIIb	**$6295** ($724.80)
SOL SYST. IVb	**$8550** ($984.45)

16K RA-1	**$429** ($50.10)
32K RA-1	**$750** ($87.60)
48K RA-1	**$1095** ($127.80)
64K RA-1	**$1350** ($157.65)

ALL ASSEMBLED AND TESTED

SOFTWARE: FOCAL (THE DEC LANGUAGE), BASIC/5, TREK 80, GAMEPAC-1, GAMEPAC-2, CHESS, ASSM, EDIT, DEBUG ON CASSETTE (1200 BAUD), ALL **$19.50** ($1.95). EXTENDED BASIC AND ALS-8, EACH **$45.00** ($4.50). PILOT (CAI LANGUAGE), **$24.50** ($2.40). DISK FORTRAN FOR HELIOS SYSTEMS, **$96.00** ($7.95).

ALL AVAILABLE FROM:

AUTOMATION STATHAM

PTY. LTD.

47 Birch St, BANKSTOWN. 2200. Phone: 709-4144. Telex: AA 26770.

Exidy Sorcerer

Monitor

The monitor is 4K (and 4K of Z-80 code is quite a lot!).

The commands are: (Parameters in square brackets are optional)

DUMP n (m)	Displays memory contents from n to m — nice output format.
ENTER n	Allows successive memory locations to be changed, starting with location n.
SAVE name n m (unit)	Saves memory onto tape from n to m and sends output to the specified unit. The output header will contain the name, begin address, block size, file type and GO address.
LOAD (name (unit) (n)	Loads file from specified unit. The start address will be the one in the tape header if n is not specified.
FILES (n)	Lists information in headers coming from unit n.
GO n	Calls a program starting at n.
MOVE n1 n2 (S) n3	This mirrors the Z-80 move instruction. It can either (depending on whether S is included) move information from n1 through n2 to locations beginning at n3, or move n3 locations starting at n1 to locations starting at n2.
TEST n m (C	Used to test RAM locations from n to m — inclusion of C makes it repeat continuously. This must be very useful for fault-finding in newly-completed units.
PROMPT=n	Changes the monitor prompt to character n.
CREAT	Causes the creation of a 'BATCH' tape. This is a macro of monitor commands on a tape which can be played back and executed a number of times. This must be to enable full RAM and ROM testing automatically at the factory — other uses would include multi-pass compiler overlay and other exotic applications.
LIST	Lists the BATCH commands from a tape as it is played back.
BATCH	Executes commands from a tape. Returns
OVER	control to the user from BATCH mode. This command would be the last on a BATCH tape.
SET S=n	Sets the delay between each letter output to the display. Used when output is to a slow printer.
SET T=n	n=0 means that the tape interface operates at 1200 baud; n=1 means 300 baud.
SET F=n	Sets file type in tape header store. This is a two-byte number with which the user can label a file in any way he chooses.
SET X=n	GO address in tape header.
SET 0=V 0=P 0=L 0=S 0=n	Changes output port to video, parallel output, Centronics printer driver, tape or address specified.
SET 1=K 1=P 1=S 1=n	Sets input port to keyboard, parallel port, tape r specified address
PP	Jumps to plug in ROM.

A very powerful selection altogether. Exidy hope to bring out a full assembler/editor which, in addition to the above, would make this an excellent development system.

Cassette Interface –

The baud rate of the interface is software-programmable at 1200 or 300 baud. I subjected it to the acid test — my little portable cassette recorder with auto level control!

We had to hand some tapes which had been recorded at 1200 baud on a good machine — these played without a hitch. However, when we tried to record a program at 1200 baud, the Sorcerer couldn't read it back — due, probably, to the fact that on small cassette recorders the playback circuitry is better than the record side, due to the availability of pre-recorded tapes.

Anyway, when we tried the same thing at 300 baud it worked perfectly (although slower!).

We couldn't get the machine to accept wrong characters without noticing — we tried various tricks like re-recording file headers, fiddling with the plug on the signal cable and even varying the playback speed mechanically — all of these either:

(a) had no effect, or

(b) produced an error message.

One rather annoying response, however, was that after aborting an attempt to load a BASIC program, typing LIST caused the same line number (and nothing else!) to be repeated ad infinitum until stopped by interrupt.

The facility for recording arrays of data and replaying them with a single command is nice, if marred by the fact that (as far as we can tell) it cannot be done with string arrays.

Manuals

The two manuals which are provided (one on the BASIC system and one on the system as a whole) are beautifully produced, although they contained the usual Americanisms which jarred occasionally.

One annoying thing was that these were both learning texts — there's no quick-reference hard information manual. The manuals also leave a few things out — the USR () function (which allows entry to a user-defined machine code subroutine) is mentioned, but not how to tell the machine the start address.

The glossary in one of the manuals is worth quoting: "PRINTER — a computer output mechanism that delivers hard copy data". Come back, NASA, all is forgiven!

Accessories

At present, the Sorcerer is available with BASIC only. Exidy hope to bring out other ROM packs including a word processor, an assembler/editor and an APL system. The re-definable graphics will prove useful with the latter, no doubt, as APL uses all manner of little squares, circles, and special symbols.

An S-100 extension will also be available soon from Exidy which will enable the machine to be expanded ad infinitum.

Summary

The Sorcerer is an excellent machine. What makes it different from the other units on the market is that it is designed for the amateur to use, but has full professional facilities. It would be quite happy linked to a mainframe — it even has the full ASCII control character set.

The BASIC is comprehensive and fast and the memory is massive. The best thing about it, though, is its flexibility. Anything which can be made user-accessible is made so. For instance, it is possible to re-define from BASIC, what size the string storage area is to be.

PRINT-OUT

ETI's COMPUTER SECTION

NEWS

Compiled by Les Bell

Stop Press!

Owing to a clash of booking dates, the Home Computer Show will now be held at Sydney Town Hall on the 24th - 27th May and not the 17th - 20th May as previously stated.

Word Management System

A new word processing system from Vector Graphic is now available in Australia from A.J. & J.W. Dicker Pty Ltd. The Word Management System Version 2.1 is designed to run on the Vector MZ small computer and is considerably more sophisticated than their earlier Memorite I and II programs.

The program automatically inserts carriage returns at the end of each line on the screen, allowing 'free-format' insertion of text, and tabs may be placed anywhere in a line – they are displayed on a rule on the screen. The system operates with extensive use of prompts, making long commands unnecessary, reducing the risk of errors.

Printing may be done on any length page, and the system will insert headings, footings and page numbers in the desired positions. The printing of super- and sub-scripts is possible, making the package especially attractive for the preparation of engineering and sceintific reports. The system can also print names and addresses on letters for mailing list operations.

The package offers many other features – too many to list here. Further information can be obtained from *A.J. & J.W. Dicker Pty Ltd., 24 Woodfield Bvde., Caringbah, NSW 2229.*

National Panasonic Offers Micro

A new microcomputer, manufactured in Japan by National Panasonic, has been released in Australia by The Computer Company Pty Ltd. Available in four

models, offering several types of floppy disc storage, the model 700 features 160 Kbytes on dual minidisks, the model 800 features 500 Kbytes on full-size floppies, the 850 1Mbyte on double-sided floppies and the 870 has 2 Mbytes on dual double-density floppies.

The processor's main appeal is that it is completely self-contained and is attractively packaged in a robust metal case. Overall construction is superb, the internal circuitry being well supported.

The processor itself is an Intel 8085, the entire computer is built onto a single board, including the disk and CRT controllers. Either 32K or 64K of memory is available in the form of 16K dynamic RAM chips. The floppy disk interface is based on the Western Digital 1771 chip, and the video driver is built around Intel's 8275 CRT controller.

Software? The machine is supplied with a customised version of the CP/M disk operating system and Microsoft BASIC as standard. The use of CP/M means that a variety of other software can be run, such as FORTRAN, COBOL, a BASIC compiler, and programs like Electric Pencil text editor.

Software support is available from the Computer Company, who have also available a variety of programs to suit small businesses. Maintenance of the hardware will be carried out by STC, who are already well established in the business.

The machine has some other interesting features, such as 21 programmable function keys, and the provision of three RS-232C interfaces. Prices start from around $5000. Further details can be obtained from *The Computer Company, 4 Cliff St., Milson's Point, NSW 2061.*

PRINT OUT

Best Micloplocessor?

Tests conducted by Continental Testing Labs of Fern Park, Florida have shown that Japanese microprocessors may outperform American parts. A sample of 56 Intel D8080As and 56 National INS8080ADs were compared against 110 Nippon Electric Company (NEC) 8080AFs, using a series of tests similar to the military reliability standard MIL-STD-883. The electrical performance of the NEC parts was comprehensively better, according to the programme manager, B. L. Hickey. Four NEC chips failed repeated electrical tests compared with 15 failures in the American camp (14 of them from National). This is a failure rate of 1.8% from Intel, 3.6% for NEC and 25% for National. It should be emphasised that the tests virtually force the devices to fail by imposing extreme environmental conditions on them – under normal circumstances nothing like this failure rate should be experienced.

Internal examination revealed that some of the National chips were bonded off-centre in the carrier body; this could indicate that the devices were from a faulty batch, so it would be dangerous to jump to unwarranted conclusions about National's devices. Further internal analysis at the Jet Propulsion Lab found construction defects in the NEC chips that may negate their electrical advantage in long-term life-cycle tests.

MICOM Film Night

The Microcomputer Club of Melbourne are organising a film day to be held on Saturday, 21 July, on the theme of (naturally enough) computers. From approximately 12.00 p.m. until 10.00 p.m. a number of films will be showing, including (tentatively) *2001, Dark Star, The Forbin Project (Colossus and Guardian), Demon Seed, Logan's Run, Billion Dollar Bubble, Powers of 10, GIGO* and maybe even others.

To get this show off the ground, MICOM must have at least 100 paid up people by 21 April (so get your cheque book out now). If less people apply, then the event will be cancelled and moneys refunded. If more come then the price will drop, and there will be a partial refund. The initial price is $5.00 to MICOM members and $6.00 to others.

Contact: *MICOM Film Day, PO Box 60, Canterbury, Vic 3126.*

DISCUS/2D

The latest board from digital designer extraordinaire George Morrow is the Discus/2D, a double density floppy disk interface which is compatible with IBM's new System 34 format. On the S-100 card there is a complete controller based on the Western Digital 1791 dual-density controller chip, power-on jump, 1K of RAM, 1K of ROM and a UART to interface to your terminal. The drive supplied is a Shugart SA800R, in a finished cabinet with power supply.

Software supplied with the system is powerful, to say the least. It includes the Disk Operating System, BASIC-V virtual memory disk BASIC and DISK-ATE assembler/editor (I've used the cassette version of ATE for some months now, and swear by it). The Discus/2D stores 600K bytes per side on a disk, and will operate either double or single density.

The Discus/2D will be available from the Computer Bits division of Automation Statham, 47 Birch Street, Bankstown, NSW 2200 (02) 709.4144). The price is $1149 + tax, which seems better than reasonable!

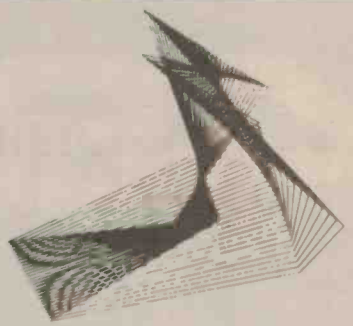
6800 Meets S-100

A new system has been released in the States which puts the 6800 microprocessor on the S-100 bus. The Microdasys System 1 features a custom console, keyboard, 16 A power supply, 64 by 16 video and graphics card, and the MD-690A CPU board. This board carries the processor, 2400 bits/s cassette interface, 10 K of PROM, 1 K of RAM, 20 bits of I/O and interrupt-driven keyboard interface.

Further details on the System 1, which costs US$549 in kit form, are available from: Microdasys, PO Box 36051, Los Angeles, Calif. 90036, USA.

Mostek 'One-chipper' is Two Chips

A number of single chip microcomputers are now available, based on on-chip memory, and some models, such as the Intel 8741, have on-chip EPROM. Rather than take this fairly expensive approach, Mostek are designing a microcomputer, the 3874, to work with a 2716 EPROM. On the other hand, Fairchild, who have an alternate source for previous Mostek parts, is going its own way with the 38E70, which has on-chip EPROM. We suspect that the Mostek part will be more popular with hobbyists, who often can only program standard EPROMs, and not the complex single-chip micros. Of course, hobbyists don't buy as many parts as industry . . .



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. 356 6176.

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.

VECTOR MZ

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The VECTOR GRAPHIC Program Development System featuring 49,152 bytes of read/write memory, 630,000 bytes of on line flexible disk storage and 16 x 64 or 24 x 80 memory mapped video terminals is a complete computer system ready to go to work for engineers, programers and serious end-users. The powerful hardware is supported by a wide range of standard operating system software including, Micropolis disk operating system, 8080 assembler and BASIC interpreter, C/PM disk operating system (including editor, assembler and debugger), C BASIC compiler basic and ZASM a Z80 assembler to take full advantage of the powerful Z80 instruction set. Also optional are COBOL and FORTRAN languages.

Thus supplied the system is ready to implement development of both high level and assembly language programs. It may be interfaced to a wide range of printers including the Qume incremental daisy wheel printer. Hardware options include a further 2 flexible disk drives expanding total storage to 1,260,000 bytes, and a read only memory Word Processing/text editing module. Delivery is ex-stock.

Dealer enquiries invited

MICROCOMPUTER DIVISION

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- ☐ 020H Rain Alarm
- ☐ 020I Photo Electric Switch
- ☐ 020J Singing Bird
- ☐ 020K Morse Code
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- ☐ 020M Water Purity Tester
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- ☐ 020O Electronic Metronome
- ☐ 020P Ammeter Volmeter
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- ☐ 020T Electric Fan

Dealer enquiries invited.

JM1001

WIDEBAND ANTENNA BALUNS

Few antennas are co-operative when it comes to feedpoint impedance. Matching them up or down to the required 50 ohms (occasionally 75 ohms) often proves awkward. Roger Harrison shows the easy way round.

IN ANY COMMUNICATIONS system the weakest link in the chain is always the antenna system. Even if the best antenna to suit the particular circumstances is chosen, it is necessary to provide efficient transfer of power to or from the antenna feedpoint. However, the antenna feedpoint impedance is not always conveniently the same as that of the feedline, the transmitter output impedance or the receiver input impedance. The latter are usually either 50 or 75 ohms to match the coaxial transmission lines normally employed. Coaxial transmission lines are, by nature unbalanced electrically, whereas many types of antennas have balanced feedpoints and thus require a balanced transmission line. To correct this a 'balun' is necessary — the word being derived from 'balanced — to — unbalanced'. Originally, the term applied to a device which only involved changing from the balanced to unbalanced condition without a change in impedance. Where a change in impedance is necessary the term transformer is, strictly speaking, the correct term.

There are a wide variety of methods of making antenna baluns and impedance matching devices. However, most techniques are suitable for use on a single, narrow frequency band. The most versatile technique, which results in baluns that may be used over a wide frequency range, employs sections of made-up transmission line wound on a ferrite core, usually in the form of a toroid or some other convenient shape. Sections of transmission line are wound together and connected in a series or parellel combination to effect the desired balanced-to-unbalanced transformation and/or an impedance transformation. Winding the transmission line sections on a ferrite core increases the inductance of the length of transmission line used. This article shows how to make the most useful types using locally available components.

High Power Transmitting Baluns

The following baluns to be described all employ toroids and are for use in transmitting applications at power levels up to 200 W, and up to 1 kW, CW or PEP output. Only two toroids are specified, both from the Neosid range. For applications up to 200 W, the toroid type 4328R/2/F14A/EC is employed, while that for powers up to 1 kW employ the type 4324 R/3/F14A. The first has an outside diameter of 25.4mm, an internal diameter of 19.05 mm and a thickness of 9.52 mm. It is coated in an enamel paint. The second, and larger toroid has an outside diameter of 38.1 mm, an inside diameter of 25.4 mm, is 19.05 mm thick and is uncoated. Both have bevelled edges and will not nick or cut the insulation of wire wound around them.

The smaller toroid may be used for purely receiving applications if desired, particularly for the higher transformation ratios of 9:1 and 16:1.

The baluns described are suitable for use from 2 MHz to 30 MHz and in some cases a wider range.

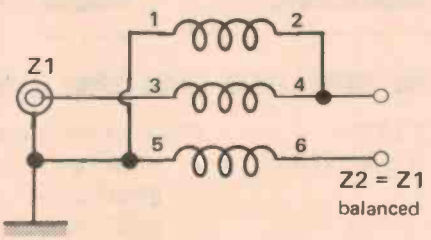
1:1 Balun

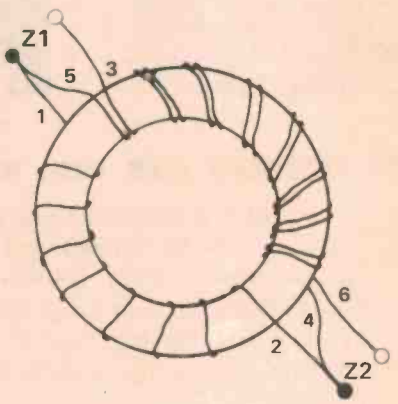
The circuit and connections for a 1:1 balun are given in Figure 1. This uses a bifilar winding wound around half the core and a single winding around the other half as illustrated. One wire in the bifilar winding is connected in series with the single winding. This balun is some times described with a trifilar winding but balance and bandwidth are not as good as with the method described.

This type of construction exhibits excellent balance at the Z2 termination and operates over a bandwidth of 1 MHz to 30 MHz in 50 ohm systems for assemblies on either toroid. The bandwidth is considerably better for 75 ohm systems constructed on either toroid, extending to 60 MHz for the 1 kW assembly but only 40 MHz for the 200 W assembly.

The exact gauge of the wire used is not very critical, a latitude of plus or minus one gauge being tolerated. When winding on the heavy gauge wires, a

Fig. 1. **1:1 Balun**





Note: To count turns, count the crests on the *outside* of the ring and include the finish lead. The 1:1 balun illustration has eight turns on each winding.

	200W	1KW
Winding details:	8 turns, 20 or 22 SWG enamelled wire for both bifilar and single windings.	6 turns, 18 SWG enamelled wire for both windings.
Response		
50 — 50 ohms:	1 — 30 MHz	1 — 30 MHz
75 — 75 ohms:	1 — 40 MHz	1 — 40 MHz

neat winding can be obtained by carefully forming each bend, holding the already wound part firmly against the core.

Some confusion arises when counting turns of a winding on a toroid. To count turns, count the 'crests' on the outside of the ring and include the finish lead. The assembly illustrated in Figure 1 has eight turns on each winding.

4:1 Baluns

An unisolated balun has a dc connection between input and output, the isolated type is a true transformer.

Figures 2 and 3 illustrate unisolated types. A 4:1 isolating balun is in Fig. 4.

A single bifilar winding is used. The wires may be twisted together lightly or wound together around the core as illustrated. The latter method is preferable. Identify the ends and connect in series as shown. The bifilar winding is spread around most of the circumference. For the larger toroid, it is difficult to spread six turns around the circumference so the winding is distributed around about two-thirds of the circumference of the toroid.

Balance of the high impedance is excellent. Bandwidth for both toroids is best for Z1 of 50 ohms. The 1 kW assembly in this case has the best bandwidth for either 50 or 75 ohm systems.

The same assembly can be connected as an unbalanced transformer. The arrangement is shown in Fig.3. Bandwidth is limited in this application but most vertical or loaded vertical antenna systems are used on the lower bands, below 15 MHz in any case. Best bandwidth is obtained for transformation from about 19 ohms to 75 ohm systems.

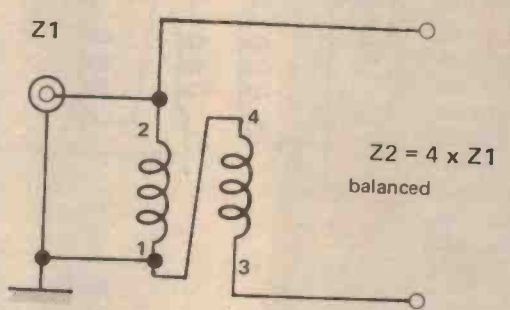
The isolated type is illustrated in Figure 4. This consists of a trifilar winding having two of the wires connected in series for the high impedance winding, the third wire being the low impedance, unbalanced winding.

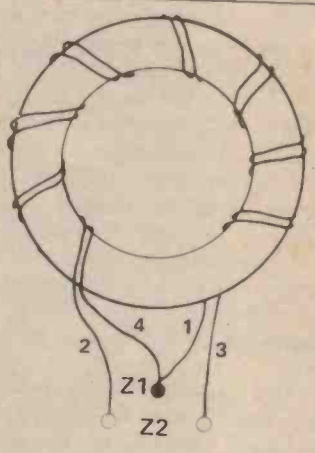
The 1 kW assembly has the best bandwidth, when matching to 50 ohm systems. However, the full HF range is covered by both assemblies.

9:1 Balun

Baluns providing high impedance ratios are rarely described. Recently, wideband transformers for use in HF transistor linear power amplifiers, having impedance ratios as high as 36:1, have been described, but the techniques used

Fig. 2. **4:1 Balun**





	200W	1KW
Winding details:	10 turns bifilar, 20 or 22 SWG enamelled wire, wound around most of circumference.	6 turns bifilar, 16 or 18 SWG enamelled wire, wound around most of circumference.
Response		
50 – 200 ohms:	1 – 75 MHz	1 – 60 MHz
75 – 300 ohms:	1 – 60 MHz	1.8 – 30 MHz

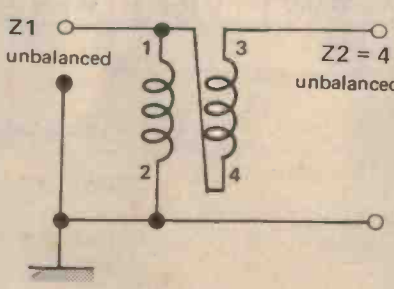
are not generally adaptable to the applications considered here.

Many types of HF beam antennae have high impedance feedpoints, such as the Lazy-H, Sterba curtain, V-beams and Rhombics, therefore presenting a matching problem that is usually solved by using resonant matching devices or 'match-boxes' involving tuned transformers. The wide bandwidth advantage of the V-beam and the Rhombic is compromised by such devices and a wideband balun provides a much better solution to the problem of matching the balanced, high impedance feedpoint to the unbalanced, low impedance transceiver antenna terminal. You don't have to tune up each time you change bands.

Conversely, you lose the harmonic and spurious suppression advantages of the tuned matching system. However, it is always good practice to insert a low-pass filter in the transmission line immediately following the transceiver, regardless of the matching system used.

For antennas having a feedpoint impedance close to 600 ohms the balun illustrated in Figure 5 is applicable. It consists of three separate bifilar windings wound on the ferrite toroid as shown. One wire from each winding is connected so that each is in series, this forming the balanced high impedance winding. The remaining wires from each winding are all connected in ▶

4:1 Unbalanced transformer



	200 W	1 kW
Response		
12.5 – 50 ohms:	1 – 15 MHz	1 – 18 MHz
19 – 75 ohms:	1.8 – 28 MHz	1 – 30 MHz

Construction as per Figure 2., connections as shown at left.

Fig.3. Circuit for 4:1 unbalanced to unbalanced transformer. Construction is similar to that in Fig.2. This type of transformer is suitable for matching to low impedance unbalanced antennas.

WIDEBAND ANTENNA BALUNS

parallel for the unbalanced low impedance winding.

A single pair stripped from a length of suitable ribbon cable, or rainbow cable as it is also called, may be used for the windings on the small toroid specified for the 200 W assembly. For the1 kW assembly on the larger toroid, a type of 'figure – 8' flex that is sold as speaker cable is conveniently used. It has one lead marked with a dark-coloured stripe which helps to identify the separate wires in each bifilar winding. The different coloured insulation of the ribbon cable wires serves the same purpose. The figure-8 flex sold as 240 V lamp and appliance cord is too large to be used here.

The assembly illustrated will cover the range 3 MHz to 25 MHz with eight turns per winding on the small toroid and six turns per winding on the larger toroid. More turns per winding are required if the balun is to be used at frequencies lower than 3 MHz. However, as the assembly only has a bandwidth of about 8:1 the upper frequency is then limited to about 15 MHz. The number of turns required barely fits on each core in this case.

Although the balun described is specified for matching 600 ohms to 75 ohms it can also be used to match antennas having impedances close to 450 or 500 ohms, to 50 ohms. The upper frequency limit is then reduced to about 20 MHz in this case. A slight impedance mismatch is readily tolerated by most equipment and there is little to be gained in trying to get an exact match.

16:1

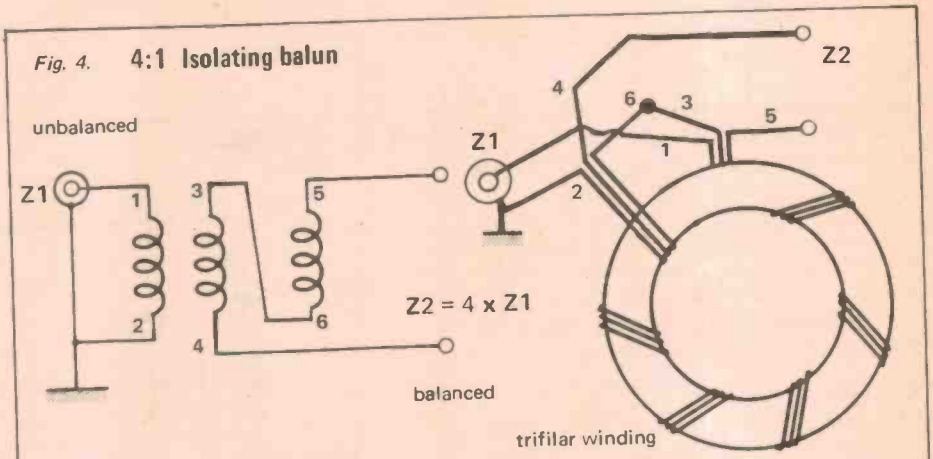
For antennas having feedpoint impedances in the vicinity of 800 ohms the balun illustrated in Figure 6 is applicable for matching to 50 ohms. It is constructed in a similar manner to the previous one. Four bifilar windings are wound on the core. Four wires, one from each winding are connected in series to form the high impedance balanced winding. The other four wires are connected in parallel for the low impedance unbalanced winding.

A single pair stripped from ribbon cable is also conveniently used for this balun on the small toroid, while figure-8 flex is convenient for the larger toroid, as discussed for the 9:1 balun.

This balun covers 3 to 25 MHz for assemblies wound on either toroid. Sufficient turns will not fit on the smaller toroid if you wish to go below 3 MHz. For purely receiving applications, use light gauge enamelled copper wire – such as 28 or 30 swg, and wind eight or nine turns per winding of bifilar pairs on the small toroid. As receivers are usually fairly tolerant of some degree of mismatch, a balun constructed in this manner may be used over the range 1 MHz to about 25 MHz.

The larger toroid will fit sufficient turns to cover the range down to 1.8 MHz but, as for the 9:1 balun, the upper frequency limit is about 15 MHz.

Fig. 4. **4:1 Isolating balun**



	200W	1KW
Winding details.	8 turns trifilar, 20 or 22 SWG enamelled wound around most of circumference.	6 turns trifilar, 16 or 18 SWG enamelled wound around most of cumference.
Response		
50 – 200 ohms:	1.8 to 28 MHz	1.8 to 75 MHz
75 – 300 ohms:	3.0 to 35 MHz	2.5 to 30 MHz

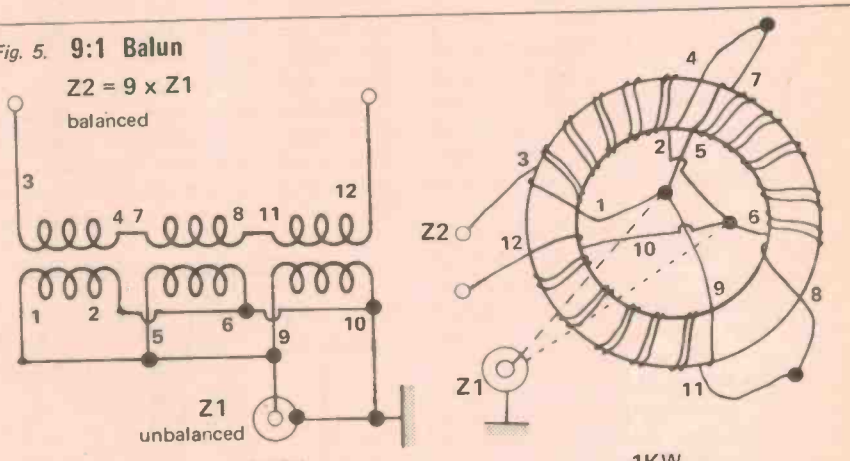
TOROIDS

200W: 4328R/2/F14A/EC
Size: 25.4 mm x 19.05 mm x 9.52 mm (od, id, depth). Suitable up to 200 W and for receiving applications. Also available from DAVID REID Electronics, 104-106 King Street, Newtown (PO Box 317) 2042.

1 kW: 4324R/3/F14A
Size: 38.1 mm x 25.44 mm x 19.05 mm (od, id, depth)

The toroids specified are manufactured by Neosid (Aust.) Pty Ltd, 23-25 Percival St, Lilyfield NSW 2040; phone (02) 660-4566.

Fig. 5. **9:1 Balun**

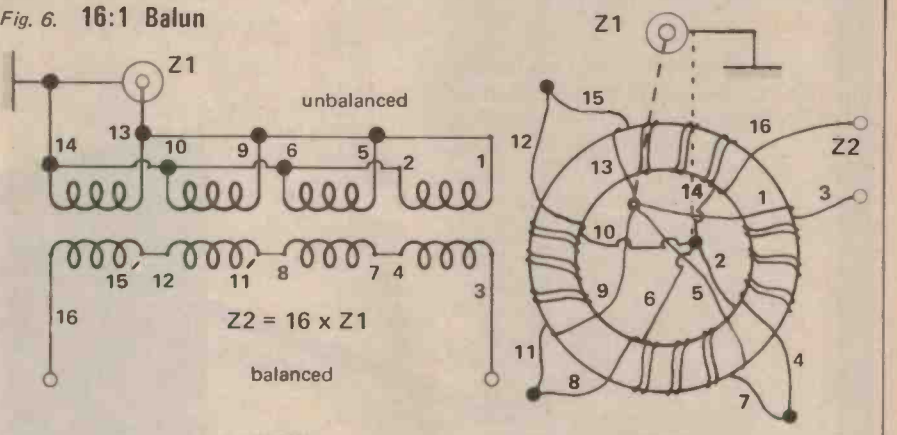


	200W	1KW
Winding details:	Three bilfilar windings 8 turns each, 12/0076 PVC covered hook up wire.	* For use between 3 – 25 MHz Three bilfilar windings 6 turns each, 10/010 PVC covered hook up wire or "figure 8" flex.
	10 turns per winding as above.	* For use between 1.5 – 15 MHz 8 turns per winding as above.

Encapsulating Balun Assemblies

Where necessary, to protect them from the weather, the balun assemblies may need to be encapsulated. A suitable mould may be fashioned from stiff paper or cardboard and the balun assembly potted in a suitable epoxy compound. The input and output terminations may be potted along with them, ensuring that no short circuits are possible in the process. Alternatively, they may be sealed in a suitable plastic moulding such as those produced for 240 V electric cable conduit. These are available as T-junctions etc, and are generally obtainable from hardware stores in sizes suitable to contain the toroids specified. A complete balun and dipole feedpoint termination can be encapsulated in an appropriate fitting. A suitable coax socket and eye-bolts to take the antenna strain are readily included also. The exact construction is left up to the individual to suit the circumstances, A little imagination goes a long way. ●

Fig. 6. **16:1 Balun**



200W

Winding details:

Four bifilar windings 6 turns each, 12/0076 PVC covered hook up wire.

Sufficient turns will not fit on the toroid. See text.

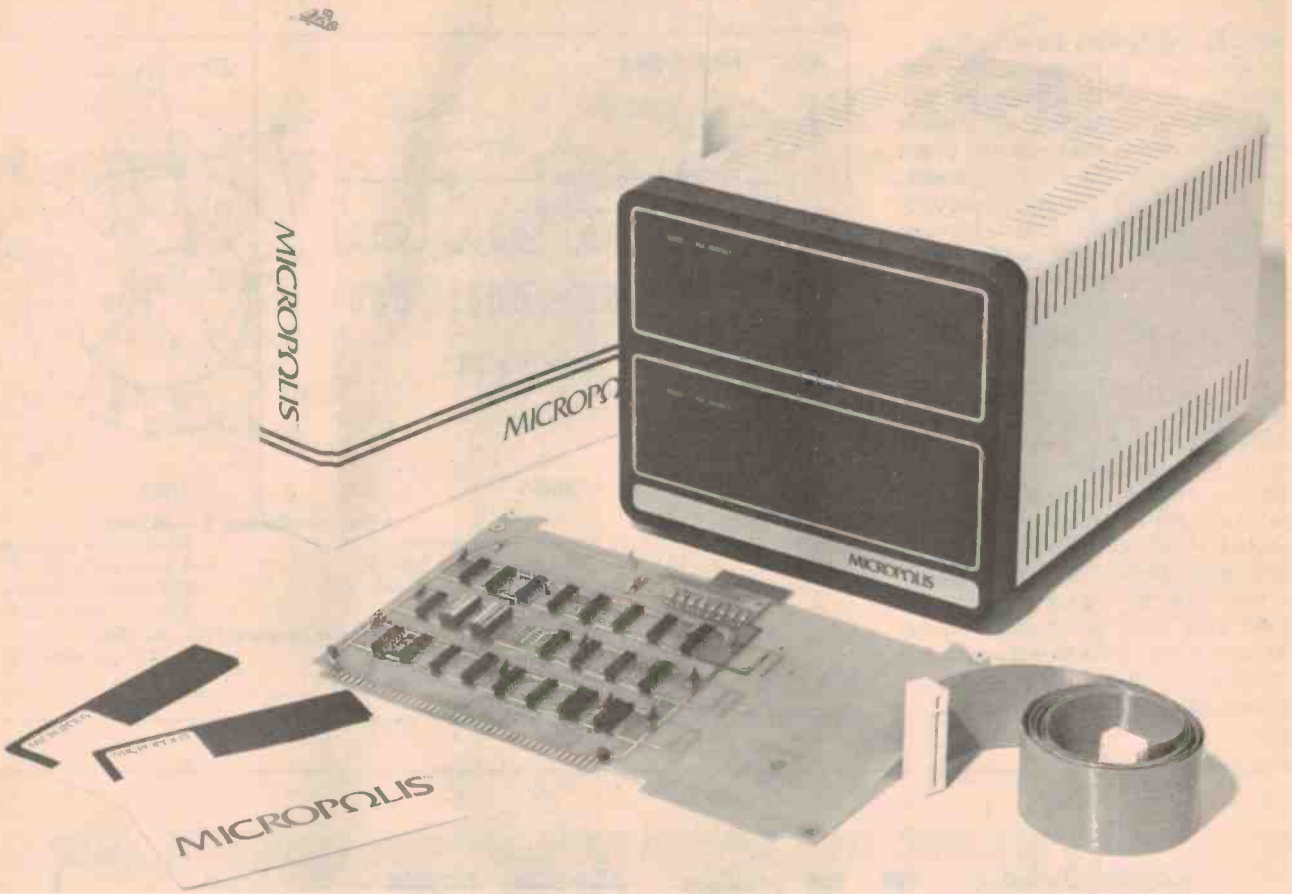
1KW

* For use between 3 – 25 MHz

Four bifilar windings 4 turns each, 10/010 PVC covered hook-up wire or "figure 8" flex.

* For use between 1.8 – 15 MHz

6 turns per winding as above.



Pictured is a dual drive unit also available.

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KITS FOR ETI PROJECTS

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish.

We have only listed the projects published in the last two years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). We will repeat a complete list every 6-12 months depending on space limitations. Any companies not included in this list should phone Jan Collins on 33 4282.

Key To Companies

- A Applied Technology Pty Ltd, 4A Paterson Avenue, Waitara, NSW 2077.
- C J R Components, PO Box 128, Eastwood NSW 2122
- D Dick Smith Electronics P/L, PO Box 747, Crows Nest NSW 2065
- E All Electronic Components, 118 Lonsdale Street, Melbourne Vic 3000
- J Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000
- K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109
- M Mode Electronics, PO Box 365, Mascot NSW 2020
- N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay NSW 2011
- O Orbit Electronics, PO Box 7176, Auckland, New Zealand
- P Pre-Pac Electronics, 718 Parramatta Road, Croydon NSW 2132
- R Rod Irving, PO Box 135, Northcote Vic 3070
- T Townsville Electronic Centre, 281E Charters Towers Road, Rising Sun Arcade, Townsville Qld 4812
- V Silicon Valley, 23 Chandos Street, St Leonards NSW 2065

Project Electronics

041. . . . Continuity Tester . . . . . T, D
042. . . . Soil Moisture Indicator . . . . . T, D
043. . . . Heads or Tails Circuit . . . . Oct 76. . T, D, E, A
044. . . . Two Tone Door Bell . . . . Oct 76. . T, D, E, O, A
045. . . . 500 Second Timer . . . . . T, D, O, A
047. . . . Morse Practice Set . . . . . T, D, O, A
048. . . . Buzz Board . . . . . T, D, A
061. . . . Simple Amplifier . . . . . Oct 76. . T, D, O, A
062. . . . Simple AM Tuner . . . . . Mar 77 . . D, E
063. . . . Electronic Bongos . . . . . D, A
064. . . . Simple Intercom . . . . . Nov 76 . . T, O, A
065. . . . Electronic Siren . . . . . D, O, A
066. . . . Temperature Alarm . . . . . Dec 76 . . T, D, E, A
067. . . . Singing Moisture Meter . . . . . D
068. . . . LED Dice Circuit. . . . . Oct 76. . T, D, E, A
070. . . . Electronic Tie Breaker . . . Jan 77
071. . . . Tape Noise Limiter . . . . . Jan 78. . . E
072. . . . Two-Octave Organ . . . . . Jun 78. . . D
081. . . . Tachometer . . . . . Mar 77 . . T, E, O
082/528 Intruder Alarm . . . . . T, E, A
083. . . . Train Controller
084. . . . Carl Arm . . . . . D, A
085. . . . Over-rev Alarm
086. . . . FM Antenna
087. . . . Over-LED
088 . . . Hi-Fi Speaker

Test Equipment

132. . . . Experimenter's Power Supply . . . . . Feb 77 . . E
133. . . . Phase Meter . . . . . Apr 77 . . E
134. . . . Ture RMS Voltmeter . . . . Aug 77 . . E
135. . . . Digital Panel Meter . . . . . Oct 77. . . E
136. . . . Linear Scale Capacitance Meter . . . . . Mar 78 . . E
137. . . . Audio Oscillator . . . . . May 78 . . E
138. . . . Audio Wattmeter. . . . . Nov 78
139. . . . SWR/Power Meter . . . . . May 78
140. . . . 1 GHz Frequency Meter-Timer . . . . . Mar 78 . . C

Simple Projects

243. . . . Bip Beacon. . . . . Apr 77
244. . . . Alarm Alarm . . . . . Feb 77
245. . . . White Line Follower . . . . Nov 77
246. . . . Rain Alarm . . . . . Apr 78
248. . . . Simple 12V to 22V Converter. . . . . Jul 78

Motorists' Projects

316. . . . Transistor Assisted Ignition . . . . . May 77 . . K, O, E
317. . . . Rev Monitor Counter . . . . Jul 77 . . . E
318. . . . Digital Car Tacho . . . . . Jul 78 . . . K, E
319. . . . Variwiper MK II . . . . . Sep 78. . . E

Audio Projects

448. . . . Disco Mixer . . . . . Nov 76
449. . . . Balanced Microphone Amp . . . . . Nov 76 . . J, E
450. . . . Bucket Brigade Audio Delay Line . . . . . Dec 77 . .
480. . . . 50-100 Watt Amp Modules. . . . . Dec 76 . . J,E,D,O,R,A
481. . . . 12 V 100 Watt Audio Amp . . . . . May 77 . . E
481. . . . High Power PA/ Guitar Amp . . . . . Jun 77. . . O
482. . . . Stereo Amp . . . . . Jan 77. . . O, E
482. . . . Stereo Amp Part 2. . . . . Feb 77 . . O, E
483. . . . Sound Level Meter. . . . . Feb 78 . . E
484. . . . Simple Compressor Expander . . . . . Jul 77 . . E
485. . . . Graphic Equalizer . . . . . Jun 77. . . J, E
486. . . . Howl-round Stabiliser . . . . Nov 77 . . J
487. . . . Audio Spectrum Analyser . . . . . Feb 78 . . E
489. . . . Audio Spectrum Analyser 2 . . . . . Apr 78 . . J, E
495. . . . Transmission Line Speakers . . . . . Aug 77

Miscellaneous

546. . . . GSR Monitor . . . . . Mar 77 . . E
547. . . . Telephone Bell Extender . . . . . Jun 77. . . E
548. . . . Photographic Strobe . . . . May 77 . . E
549. . . . Induction Balance Metal Detector . . . . . May 77 . . E
550. . . . Digital Dial. . . . . Aug 78 . . E
551. . . . Light Chaser . . . . . Sep 78. . . E
552. . . . LED Pendant . . . . . Sep 78
553. . . . Tape/Slide Synchroniser . . Oct 78. . . E
581. . . . Dual Power Supply . . . . . Jan 77. . . E
582. . . . House Alarm . . . . . Jul 77 . . . T, O, E, A
House Alarm — Installation Instructions . . Aug 77
583. . . . Marine Gas Alarm . . . . . Aug 77 . . M, E
585. . . . Ultrasonic Switch . . . . . Sep 77. . . R, O, E, T
586. . . . Shutter Speed Timer . . . . Oct 77. . . E
587. . . . UFO Detector. . . . . May 78
588. . . . Theatrical Lighting Controller . . . . . Dec 77, . . N Nov & Jan & Mar 78
589. . . . Digital Temperature Meter (PCB135) . . . . . Dec 77 . . E
590. . . . LCD Stopwatch . . . . . Oct 78. . . N
591. . . . Up/DownPresettable Counter . . . . . Jul 78 . . . E
592. . . . Light Show Controller . . . Aug 78 . . E

Electronic Music

602. . . . Mini Organ. . . . . Aug 76 . . O, E, D,
603. . . . Sequencer . . . . . Aug 77
604. . . . Accentuated Beat Metronome. . . . . Sep 77. . . E
605. . . . Temp Stabilized Log-exponential Converter . . Sep 78

Computer Projects

630. . . . Hex Display . . . . . Dec 76 . . E, A
631. . . . ASCII Keyboard . . . . . Dec 76 . . O, E, A
631. . . . Keyboard Encoder. . . . . Apr 77 . . O, E, A
632. . . . Video Display Unit . . . . . Jan- . . . . O, A Mar 77
633. . . . TV Sync Generator . . . . . Jan 77. . . E, A
634. . . . 8080 Educational/ Prototyping Interface . . . Jul, Aug 78
635. . . . Microcomputer Power Supply. . . . . Sep 77
637. . . . Cuts Cassette Interface . . . . . Jan 78. . . V, O, E, A
638. . . . Eprom Porgrammer . . . . . Jul 78 . . . E, A
639. . . . Computerised Musical Doorbell . . . . . Mar 78 . . A
640. . . . S100 VDU . . . . . Apr . . . . V, O, A Jun 78
641. . . . S100 Printer. . . . . Sep 78
650. . . . STAC Timer. . . . . Nov 78

Radio Projects

712. . . . CB Power Supply . . . . . Jun 77. . . O, E
713. . . . Add-on FM Tuner . . . . . Sep 77
714. . . . VHF-Log-Periodic Antenna. . . . . Feb 78 Mar 78
715. . . . VHF Power Amplifiers . . . Nov 77
716. . . . VHF Power Amplifiers . . . Jan 78 Feb 78
717. . . . Crosshatch Generator. . . . May 78 . . E
718. . . . SW Radio. . . . . Oct 78. . . E
719. . . . RF Field Strength Indicator . . . . . Nov 78

Electronic Games

804. . . . Selectagame . . . . . Nov 76 . . O
804. . . . Selectagame (Rifle Project) . . . . . Mar 77 . . O
805. . . . Puzzle to the Drunken Sailor . . . . . Oct 77
806. . . . Skeet . . . . . Jan 78
810. . . . Stunt Cycle TV Game . . . . Jun 78. . . O, D
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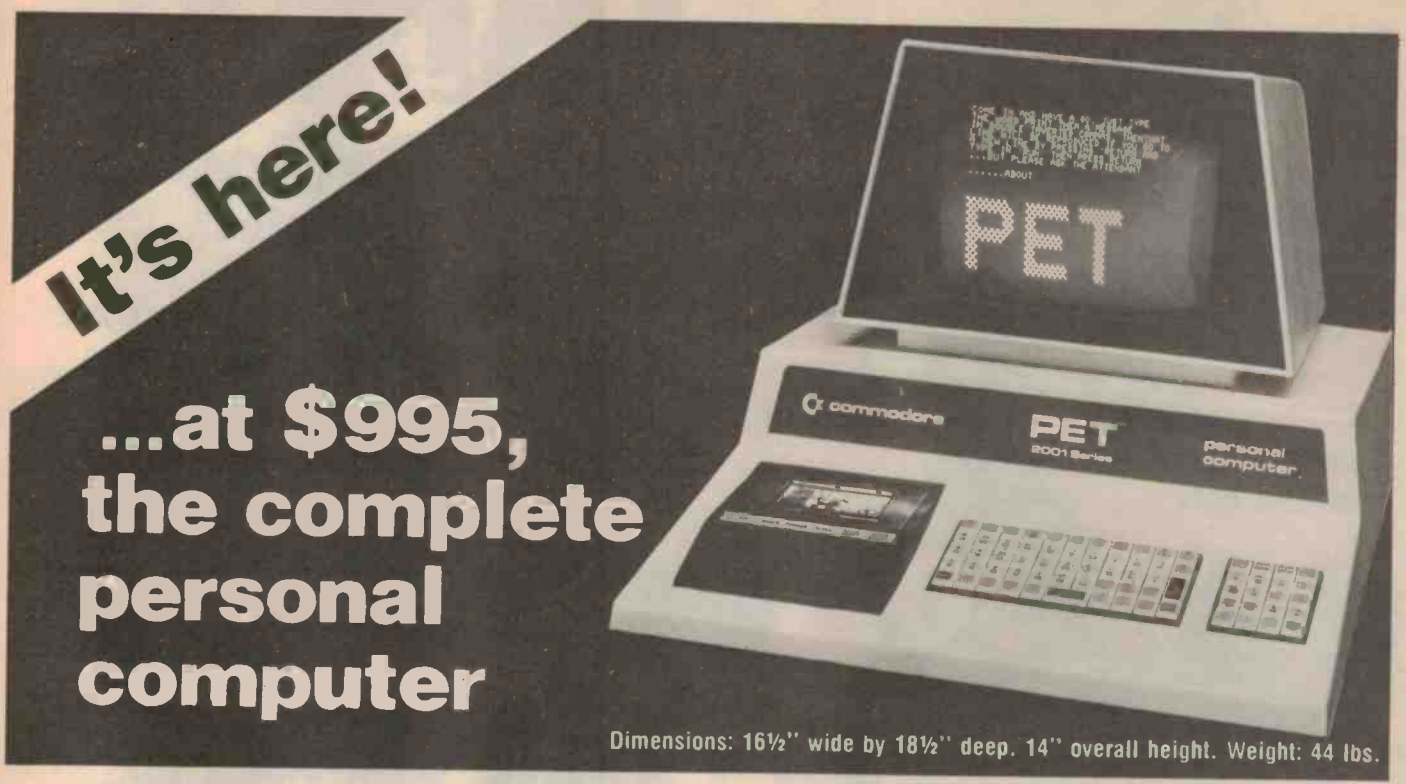

commodore PET 2001

MEMORY
Random Access Memory (user Memory): 8K included. Expandable to 32K bytes externally.
Read Only Memory (operating system resident in the computer): 13K bytes
8K BASIC Interpreter
4K — Operating system
1K — Diagnostic routine

VIDEO DISPLAY UNIT
9" enclosed, black and white, high-resolution CRT
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8 x 8 dot matrix for characters and continuous graphics
Automatic scrolling from bottom of screen
Winking cursor with full motion control
Reverse field on all characters (White on black or black on white)
64 standard ASCII characters; 64 graphic characters

KEYBOARD
9½" wide x 3" deep; 73 keys
All 64 ASCII characters available without shift. Calculator style numeric key pad
All 64 graphic and reverse field characters accessible from keyboard (with shift)
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Editing: Character insertion and deletion

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Fast Commodore designed redundant-recording scheme, assuring reliable data recovery
Cassette drive modified by Commodore for much higher reliability of recording and record retention
High noise immunity, error detection, and correction
Uses standard audio cassette tapes
Tape files, named

OPERATING SYSTEM
Machine language accessibility
File management in operating system
Cursor control, reverse field, and graphics under simple BASIC control
Cassette file management from BASIC
Pseudo random number Generator

INPUT/OUTPUT
All other I/O supported through IEEE-488 instrument interface which allows for multiple intelligent peripherals
All I/O automatically managed by operating system software
Single character I/O with GET command
Easy screen line-edit capability
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Upward expansion from current popular BASIC language
Strings, integers and multiple dimension arrays
10 significant digits; floating point numbers
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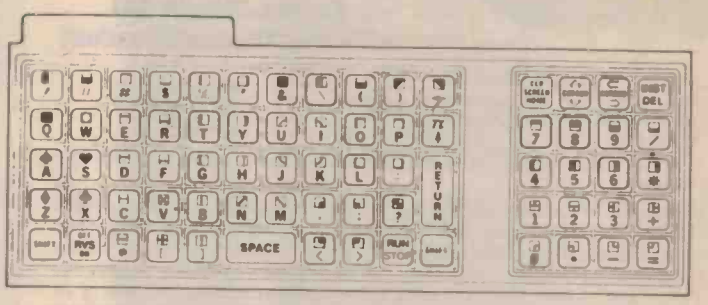

the PET keyboard

The PET keyboard consists of 73 keys. There are the usual alphanumerics (A-Z and 0-9) found on typewriters and calculators and some computers. But the PET has something more: 64 graphic characters. The graphics can be used for plots, for fun and games or for artwork. There are also special screen and keyboard control keys which allow the moving of the cursor in four directions, the reversing of characters and background, the inserting and deleting of characters. Shift keys and a run/stop key are also provided to facilitate keyboard operations. By the use of a POKE command, lower case letters are obtained instead of the graphic symbols above the capital letter keys.

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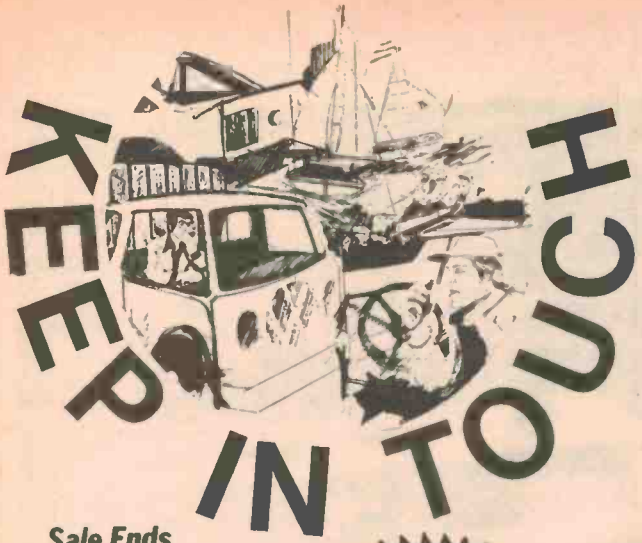

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Regular Retail Price 229.95

Specifications

Sensitivity for 10 dB S+N/N: SSB, 0.5uV; AM, 1.0 uV. Adjacent Channel Selectivity at 10 kHz: 60 dB. Image Rejection: 50 dB. Clarifier Range: ± 600 Hz, variable. Audio Output: 4 watts. RF Power Output: 12 watts P.E.P. SSB maximum; 4 watts AM maximum. Power Requirement: 12VDC positive or negative ground. Size: 6.0x20.3x26.0cm.

Realistic TRC-448. Loaded with many boastful features. PLL circuitry, clarifier for fine-tuning SSB reception, dual IF's and a crystal/ ceramic filter for superb selectivity. Noise blanker cuts impulse interference. There is a volume/RF gain control, squelch, switch for AM/LSB/USB mode selection, LED channel indicator, and illuminated S/RF meter. With mobile bracket, push-to-talk mike, DC power cord with inline fuse.

21-9448

Deluxe Mobile AM with LED Channel Readout

79.95

Regular Retail Price 109.95

Specifications

Sensitivity for 10 dB S+N/N: 0.5uV. Adjacent Channel Rejection: 70 dB. Audio Power Output: 4 watts maximum (10% THD). RF Power Output: 4 watts maximum. Power Requirements: 12 VDC positive or negative ground. Size: 5.5x15.8 x22.8cm.

Realistic TRC-469. Feature packed for outstanding performance! PLL synthesizer gives top frequency stability on all 18 channels. Switchable ANL eliminates or reduces interference from faulty ignition systems. Flip the 3-way PA/Monitor/CB switch to "monitor" and it functions as a PA system while continuing to receive CB calls! Comes with plug-in dynamic mike, universal mounting bracket and DC power cables. Suitable for any 12 VDC positive or negative ground vehicle or boat. 21-9469

Regulated CB Power Supply

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For all CB's including SSB, 13.8 VDC regulated output at 2.5 amps continuous, 5 amps, surge. 22-9124

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9.95 Regular Retail Price 12.95

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Roof-Mount Antenna

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Available from Tandy Electronics & Participating Dealers Mail Order to: Tandy Electronics P.O. Box 229, Rydalmere, NSW, 2116.

CB News

Homework on the UHF Band

ASPIRING ADULT students who loath a return to the schoolroom situation they may have experienced as children could have a happy alternative, a Melbourne teacher says.

They could combine correspondence courses with tutorials conducted over UHF CB radio, says Margaret Rivers, an HSC English teacher at Box Hill Technical College.

Mrs Rivers is already using a network on the UHF CB band at the college to coach a group of her off-campus students in their homes around Melbourne on predetermined evenings.

The college is experimenting with a two-way radio "school-of-the-air" concept – one of the first occasions that UHF CB radio has been used for formal education in Australia.

Installing two-way radio at the homes of her eight students was done simply as an added bonus to the off-campus HSC English correspondence courses at Box Hill Technical College.

Mrs Rivers has learned that housewives who feel they have been "out of touch" for too many years welcome the change for further education by "joining" groups without losing the security and comfort of staying at home.

"Women who have been tied to the house for a long time may not have the confidence to go 'back to school'," Mrs Rivers said.

"And both sexes can be put off with the thought of having to front up to a school if it means re-living the terror of unhappy classroom situations experienced when they were young.

"They may feel that they are going to make fools of themselves."

Mrs Rivers said that housewives working part time and men committed to fulltime jobs after perhaps failing their HSC, can find a correspondence course with group discussions done from home an ideal way to improve themselves without actually attending an adult-education course.

Her students age from 19 to 55, and talk to her and some of their fellows from their homes located in Melbourne suburbs at Hawthorn, Glen Iris, East Kew, Noble Park, Ferntree Gully, Eltham and Lilydale.

The idea to use the econimical UHF CB radio method came from Graeme Scott, 37, the Education Department training advisor for electronics, with Box Hill College funds.

"The radios work on the new UHF band, on a much higher frequency than the notoriously clogged channels of the conventional 27 MHz CB band", Mr Scott said.

"The students are not subject to unwelcome intrusions by other stations, by bad language or abuse".

"At the end of some sessions calls coming in have shown that there has been an interested listening audience, people who have been polite not to interrupt the tutorial", Graeme said.

Graeme, an active radio amateur – VK3ZR, is keen to adopt modern technology in education, wants to exploit and enlarge the network next term with more subjects and more sets.

"Our transmission coverage for radio is ideal from Box Hill", said Graeme.

"All we need now is the equipment to get on with the job we already know we can do".

Box Hill Technical College, which is a Technical and Further Educational (TAFE) College, is administered by the Technical Schools Division of the Victorian Education Department.

New RB14 Arrives!

In fact, there's two! RB14 and Son of RB14 . . . known as RB14a.

RB14 is the incomprehensible one with the legal-type words in it and sets out what they give you and what they don't. It is *the word.*

Son of RB14 is a document on "operating guidelines". This one is for the proles. Thee and me . . . and I'm not too sure about . . .

What's the bottom line, the good news and the bad news.

*The five sets per license is definitely a goer.

*Anybody will be allowed to use equipment licensed to you, with your permission – but you're responsible.

*Callsigns are required at intervals no longer than five minutes in any single transmission, license numbers to be given at beginning or end of a series of transmissions.

*Gain antennas will be permitted. Nothing bigger than a five-eighth groundplane on 27 MHz in the city, three element beam in the country. On UHF you'll be allowed an omni-directional antenna having up to 6.2 dB (over isotropic) in the city, up to 8.2 dB ▶

CB News

in the country. A five-element beam will be allowed in the country.
*No height limitations on antennas.
*Power mics are out, other than those sets type-approved having a power mic as standard equipment, e.g.: CPI rigs.
*Current policy "anticipates" 27 MHz operation will cease in 1972.
*23-channel sets will be licensed in future providing proof of prior license is available.

Interestingly, RB14 (big daddy version) does not give official sanction to the emergency channels on HF and UHF (channels 5). Only Son of RB14 gives the nod to the emergency channels.

It is going to be interesting to see how the new regulations, conditions (whatever), affect operation on the air and the performance of the market – currently wallowing in a further doldrum since the Christmas 'pimple' (it was no boom, believe me).

Somehow, the "All-new, singing-dancing, virgin-white, lemon-fresh . . ." RB14 (together with Son of RB14), while overcoming many of the shortcomings of the first document, has burst upon the CB world ". . . not with a bang, but a whimper".

It's going to be interesting to see how long it will take the craftier quasi-CBer-pirates to find and exploit the loopholes.

South Africa Legalises 27 MHz

South Africa introduced a CB service on 27 MHz during January. CBers there are allowed to use nine channels, transceivers that meet 1976 American FCC standards and antennas no larger than a quarter wavelength long. Our spies estimated there were maybe 10,000 pirates in Johannesburg alone so it seems there was a clear groundswell of enthusiasm for CB. A boom in demand for rigs and equipment is expected, naturally enough. Wonder if any Australian companies will export to South Africa?

CB Industry Association

A meeting held at the Sydney headquarters of the Australian Electrical and Electronic Manufacturers' Association (AEEMA) on 13 February saw the formation of a CB Industry Association . . . something which has been 14 months in gestation.

A steering committee has been formed with Mike Skovron (of Mike Skovron Agencies) as the Chairman, Greg Ackman from Mobile One and representatives from Pye Industries, Philips and Tandy.

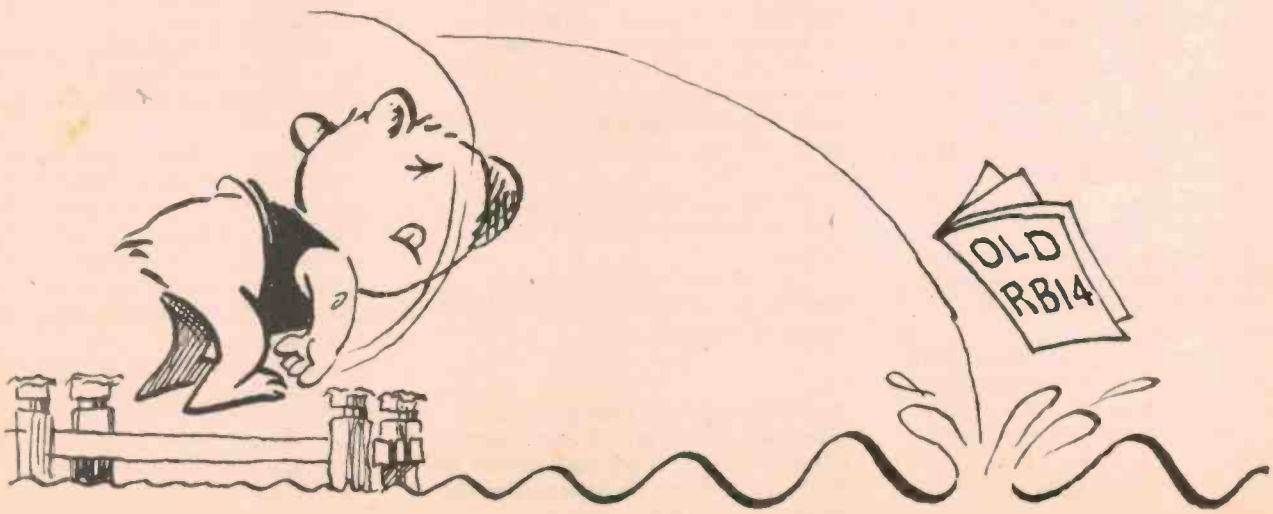
As Mike Skovron tells it, they'll be addressing themselves to the problems facing the industry from the poor image of CB radio to chaotic marketing and the severe slump that has persisted since mid-1978. They'll be pressing the P & T Minister and his Department over licensing and regulations as well as the question of more channels.

Secretarial support and other services to the embryo Association will be provided by AEEMA.

FCC Seek CB Restriction Around Radio Telescopes

The United States Federal Communications Commission launched rule-making proceedings late in October seeking to restrict CB and general mobile radio transmissions in the established "radio quite" zones around the radio telescope installations in West Virginia at the National Radio Astronomy Observatory at Green Bank and the Naval Research Laboratory's installation at Sugar Grove.

The zones have been established since 1958 and exist to prevent man-made interference to the super-sensitive radio astronomy equipment at the installations. Authorities have said that the large increase in CB and mobile radio use in the area was causing undue interference with the equipment. ●



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RD6B	C6	1·5W "	25c	7490	55c
ZD6·8	C6V8	5W "	25c	74154	$1
BZX79	C15	360mW "	20c	74C02	30c
ZL15	C15	10W "	25c	UA709	50c
RD16B	C16	1·7W "	20c	AY6108	25c
BZX79	C22	360mW "	20c	BFX89	35c
TIC44	40V 600mA SCR TO-18		25c	BC158/BC178	15c
2IPT60	600PIV 25A Rectifier		75c	BD434	50c
DG14/40442	TV Damper Diode TO3		$1	2N3643	15c
OA7	Gold Banded Diodes		10c	2SB405	35c
AAY-35	Diodes Gold Bonded		25c	14 Pin DIL skt	20c
BAP-35	Diodes		5c	16 Pin DIL skt	25c
10	Flag Transistor Heatsinks	10 for	$1	14 Pin DIL plug	10c
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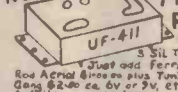

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3AG Chassis Fuseholders	6 for $1
9Volt Battery Snaps	10 for $1
7 Lug Tagstrips	20 for $1
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240Volt Neon Bezels ¼ diam	3 for $1
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3 Volt DC Buzzers (were $2·50)	now $1
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Car Noise Suppressor Res. 10 for	$1
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1KΩ Cermet Preset Pots	5 for $1
3-UM3 Battery Holders	3 for $1
50Ω 2W pots (Tweeter Cont)	2 for $1
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Kit HF310 . . . . . $49.00

HF330 STEREO DECODER

Gives 40-45 dB channel separation, just add to a good quality FM receiver.

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HF395 RF PREAMPLIFIER

Gain 30 dB to 20 MHz, 10 dB to 100 MHz and 5 dB to 225 MHz. Ideal to boost reception on short-wave receivers.

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Superb quality with two aerial inputs and one down lead which simultaneously supplies current from the power supply. Frequency range 40-250 MHz and 400-820 MHz. Gain 9-18 dB, depending on frequency.

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Turn your music into light. Simply connect this 3 channel light show to the audio terminals of your amplifier and this quality kit does the rest for you!

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This superb kit drives 4 lights (400w per channel) from the audio amplifier output.

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Box and knobs B3265 . . . . . $48.00

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HF65 FM TRANSMITTER 60-148 MHz

Will run 5w output with heat sink. Ideal for signal testing or for a miniature transmitter which could be received on a standard FM receiver.

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HF305 AMATEUR BAND 2m CONVERTER

Converts 2m FM down to the FM band 88-108 MHz.

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AM Receiver

HF61 MEDIUM WAVE RECEIVER

540-1600 KHz receiver complete with ferrite coil antenna.

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1 amp well-regulated supply for professional use. Complete with box and transformer.

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Amateur News

FT101E discontinued

Yaesu have discontinued the FT101E, replacing it with the FT101Z! The new 'basic' transceiver is styled after their top-line model FT901, and is expected to sell in Australia for around $850.

The FT101Z includes many of the features of its big brother, such as 6146Bs in the final, a noise blanker with adjustable threshold, AGC control (slow/fast/off), IF bandwidth tuning, clarifier on Rx and Tx etc. It has been designed to be fully compatible with the 901-series accessories, and will be available with either an anolog dial or analog-plus-digital frequency readout.

1979 FACT Symposium

The 1979 Symposium on "Future Amateur Communications Techniques", the FACT Symposium, will be held over the weekend September 29-30, October 1 at a venue to be announced.

The success of the 1978 FACT Symposium held in May last year at the Strata Motor Inn, Cremorne in Sydney, has created a demand for a 'return' performance. The papers for the 1978 Symposium, though nine months in gestation (!) will have been received by those who attended by the time you read this. Additional copies are available from the Symposium committee for $5 plus 50c post and packing.

The 1979 FACT Symposium will again be organised by Roger Harrison VK2ZTB and the NSW VHF & TV Group committee.

Call for papers: Any amateurs, or interested persons, wishing to present a paper at the 1979 FACT Symposium, topic of your choice – but related to communications techniques – should present a written synopsis or abstract to the committee by 30th May. It is intended to publish the Symposium papers before the event this year. To enable interstate amateurs to particupate in the Symposium, who may not be able to attend but would like to present a paper, the committee invites abstracts from authors who, if accepted, would be invited to submit a paper for publication in the symposium prodeedings.

For further information, contact the FACT Symposium Committee, 14 Atchison St, Crows Nest, 2065. Roger Harrison may be contacted on 33-4282, between 4pm and 5pm weekdays.

New 1296 MHz record

A pity we couldn't get this in last month but the news arrived after deadline. Once again, Wal VK6KZ, operating portable from Walpole west of Albany, W.A., set another world distance record for the 1296 MHz band at 1230Z on 29-12-78, in company this time with Chris VK5MC located at Hatherleigh, near Millicent in South Australia.

The equipment used by VK6KZ/P consisted of a Microwave Modules converter preceeded by a homebrew preamp using two BFR91s feeding an FT101E transceiver on 28 MHz. The transmitting line-up took output from the FT101E fed into a Microwave Modules 432 MHz transverter, followed by a homebrew varactor tripler. Power output: about 3 watts! The antenna was a one metre diameter, horizontally polarised, car-mounted parabola.

The gear at Chris, VK5MC's end comprised a homebrew receiving converter feeding a Drake R4C receiver. The transmitter took drive from Chris's 432 MHz gear to a 3CX100A5 tripler giving about 10 watts output. Antenna: 8.5 m diameter (28') parabolic dish.

The distance is 2109 km (1310 miles), an increase of nearly 13% on the previous record (set last year) of 1872 km.

The same day, about an hour after the record contact, David VK5KK at Wasleys, S.A., also worked VK6KZ/P. The distance between these two stations being 2024 km. David was running about one watt (!) to a one metre diameter dish.

Well done, fellas, that should keep Australian amateurs in the forefront of long-distance work on the UHF bands for some time.

Technical Standards

Dear Sir,

I read your magazine with interest, but found the article in January 1979 in "Amateur News" on 'Technical Standards for Amateur Equipment' to perhaps only give about half the story – mostly the "it's too hard and shouldn't be imposed on us" side.

The overall minimum and harmonic standard is, to my knowledge, set at a minimum of at least –40 dB for services operating under 30 MHz. A maximum spurious and harmonic energy level is also set which may mean that transmitting equipment may have to meet up to –60 dB suppression.

As the Vicom spokesman stated, marine services have to meet the –40 dB level, but in actual fact the equipment when installed would have attenuation of the undesireable output products of probably –50 to –60 dB owing to the fact that they are used via aerial tuning units and high "Q" loading networks. Therefore, the installation is markedly better than –40 dB.

I might also point out that the high frequency CB transceivers are required to meet a specification of at least –60 dB spurious and harmonic suppression. Also, VHF transceivers in the amateur service usually have spurious and harmonic figures of better than –55 dB, and the commercial services in the VHF range have to meet a figure of at least –70 dB. Impossible you might say, but it is not, as one well respected commercial VHF transceiver used by many organisations often exceeds –80 dB. It is, therefore, not impossible to meet the –45 dB figure being proposed.

With normal amateur design technique it is not at all difficult to exceed –35 dB with no instrumentation to measure such parameters. The normal pi-coupler will normally give you –35 to –40 dB of spurious suppression. The alteration of this circuit to a pi-L coupler can increase the suppression to –50 to –55 dB. A very simple modification surely.

The FT-7 that was tested in your laboratory gave –52 dB, and it uses only a very simple filter in the output consisting of two inductors and four capacitors following the broadband amplifier.

With broadband amplifiers it is necessary to have a filter which is suitable for each band in use. However, I have noticed that some amateur gear does not go anywhere near meeting even the –40 dB minimum level. I had some highly esteemed Collins equipment on a spectrum analyser at one time and it showed spurious at –28 dB, and a companion unit showed –38 dB.

I owned an IGL VHF transceiver at one stage, and this had numerous spurii, mainly harmonics of 36 MHz, at figures like –30 to –40 dB. This was not uncommon with some of these units when used as a 1-watt exciter, creating interference to channel 7 TV. Whether my figures are typical for these pieces of equipment I have no way of ascertaining.

As I see it, a little more care with our designs and the use of spectrum analysers, which are becoming more readily available, we could eat the –45 dB spurious output level proposed.

I, as an amateur, don't wish to cause interference to any other service on other frequencies, and as more and more services of various types are being crowded into the radio spectrum we must, of necessity, reduce our pollution in the form of harmonics and spurii.

Rodney Champness, VK3UG

Two major points were raised in the item on equipment standards in January issue's Amateur News column. The –45 dB spurious level proposed by P & T is not impossible to meet, as was pointed out from the tests conducted. ▶

Compiled by Roger Harrison VK2ZTB

Manufacturers' specifications quote levels of –40 dB (or 'better than' –40 dB). Would type-approval of commercially-made amateur equipment be based on manufacturers' specifications or tests on sample equipment submitted to the Department? This question is unresolved.

Another question raised is: would equipment that required an external filter to meet the specification be approved? Clearly, as you point out Rod, this applies in some fashion to marine installations. If an external filter would satisfy requirements then transceivers such as the Collins you mentioned and the NEC CQ110E (1st harmonic: –16 dB, 2nd: –32 dB) could be 'saved' by the installation of inexpensive CB market low-pass filters.

Personally, I would like to see a statement from the Department as to the exact purpose and the role of setting equipment standards for amateur equipment – even though it may seem self-evident. With the onus already on the amateur to ensure he does not interfere with other services, and perhaps morally, to reduce any possible contribution to spectrum pollution as a result of his activities, the imposition of equipment standards seems like another small example of over-regulation in government.

GFS release new Atlas line

Atlas Radio Inc, USA are due to release a new amateur transceiver line here through their Australian agents, GFS Electronic Imports early this month.

Known as the "Atlas 110 Line" the range consists of a high performance amateur band receiver, the RX-110, covering 80 through to 10 metres, and two "bolt on" transmitter modules, the TX-110L and TX-110H. When combined with the RX-110 these produce a high performance low cost transceiver.

The TX-110L is a low power module having 15 watts input while the TX-110H runs around 200 watts input.

Overall size of the combination is only 31 cm (W) x 9.5 cm (H) x 24.8 cm (D) which makes the RX/TX-110 ideal for mobile operation.

Initially, only the high power RX/TX-110H transceiver combination will be available from GFS Electronic Imports. Expected price will be around $499.00.

For further information on the Atlas 110 line and its accessories contact *GFS Electronic Imports, 15 McKeon Road, Mitcham, Vic 3137. Phone: (03) 873.3939.*

The Future of Amateur Radio

One of the main functions of the *Wireless Institute of Australia* according to many people, is to represent amateur radio nationally and internationally. This is quite apart from the various membership services, including the monthly journal "Amateur Radio", available to members. These are some of the functions of Amateur Radio Societies all over the world.

The WIA does represent Australian amateur radio. Officers of the Institute have spent countless hours of their own time negotiating better conditions for amateurs with the Post and Telecommunications Department. This concerns amateur radio in Australia.

Unfortunately this is not enough. Why?

Amateur radio in Australia is one of the many services governed by the Wireless Telegraphy Act and Regulations. A very large number of the Regulations stem from international radio regulations adopted by the member countries of the International Telecommunications Union. Australia is one of the 154 member countries of the ITU.

About once in every 20 years the ITU holds a general Administrative Conference to revise the international radio regulations relating to all the world-wide allocations in the frequency spectrum and various associated matters.

The *last World Conference* of this kind was held in *1959*. The next WARC is to be held this year, also in Geneva. We call this *WARC 79*.

At WARC 59, the amateurs of Australia were so concerned about the amateur service that, through the WIA, they lobbied for and were successful in obtaining *amateur observer status* on the Australian delegation. This amateur was the late *John Moyle, VK2JU*. His attendance highlighted the fact that the amateurs must always be present at the vitally important conferences and, of course, the International Amateur Radio Union (of which Australia through the WIA is a member) is best geared to cover the general interests of amateurs. His report also highlighted the need for an amateur to be part of the Australian delegation and consequently the WIA established a fund shortly afterwards to enable this amateur participation to occur in the future.

WARC 79 is a ten week conference. Leading up to this, each country's Government must make plans and prepare a brief for the delegation. Australia has been involved with this for two years and the amateur service is one of the Committees forming part of the Planning Group. As part of the preparations for WARC 79 a meeting of Government's technical experts (CCIR) will occur in Geneva later this year. Australia will participate.

Ministerial assurances have been given that an *amateur representative* will be included in the *Australian delegations.*

Simultaneously, a tremendous amount of preparatory work has been carried out by the IARU. Once again, Australia has been involved through the WIA. This preparation work is aimed at amateurs throughout the world influencing their governments, through amateur societies, to ensure as uniform and strong a voice as possible is heard from amateur radio. No stone is being left unturned to safeguard our future to the utmost of our ability. This is vital both now and throughout WARC 79 to ensure that commercial and other interests do not take away any of our frequencies and privileges without the strongest possible fight.

It is sadly true that all *these efforts cost money*. Members of the WIA have met the brunt of the financial burden but in comparison with America, Japan and Europe we are comparatively small in numbers.

Additional funds are essential if the radio amateurs of Australia are to assure themselves that no losses occur to our amateur service by default. Your contribution, however, small it may be, will help in the tasks ahead.

You can help in either or both of two ways. Send a donation to the ITU fund now, and join the WIA.

Donations should be sent by crossed cheque, money order or postal order made out to "WIA" and sent to PO Box 150, Toorak, Victoria 3142.

Every time you go on the air remember: the WIA helps safeguard your frequencies. *Please send your donation NOW.*

DICK SMITH ENDS

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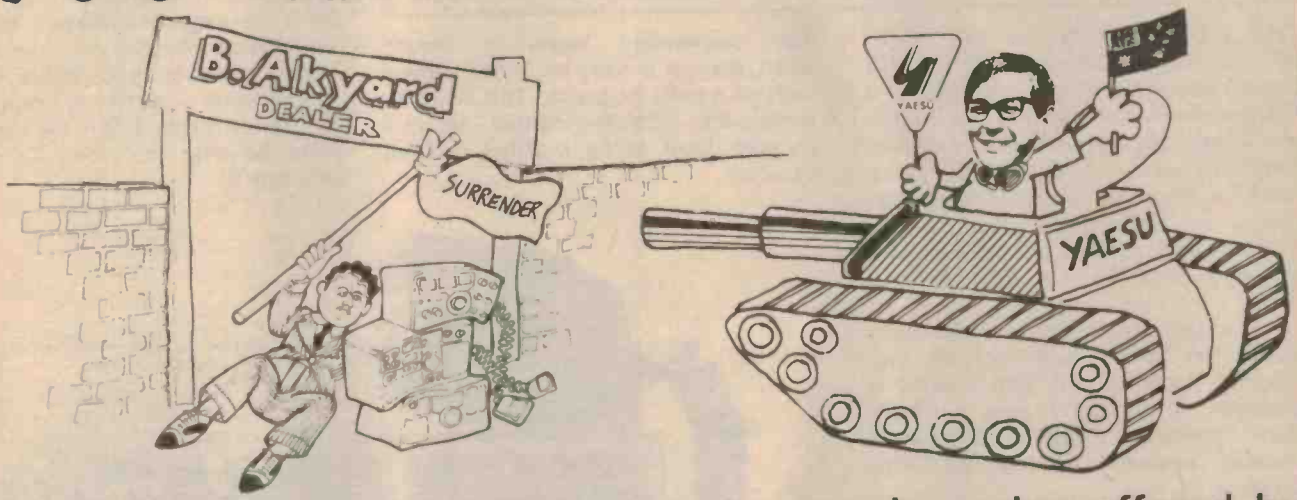

Dick Smith Electronics will better any genuine price offered by anyone on Yaesu products.

YES! This means that we will sell you a fully guaranteed, genuine unit at a cheaper price — even if we are competing with a backyard importer who probably hasn't even got provision for warranty service.

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FT-7 Mobile HF transceiver	Cat D-2866	**$375.00**
FT-7 2m FM transc with memorizer	Cat D-2890	**$379.00**
FC-301 Antenna tuning unit	Cat D-2896	**$219.00**
FL-2100B 1.2kW linear amplifier	Cat D-2546	**$529.00**
FRG-7 Solid State HF Rcvr	Cat D-2850	**$319.00**
FP-301 13.8V/20A supply	Cat D-2872	**$169.00**
FT-101Z New HF transceiver	Cat D-2862	**$775.00**
FT-901D Top class HF transceiver	Cat D-2854	**$1349.00**
FT-227RA 2m FM scanning transc.	Cat D-2891	**$379.00**
CPU-2500 computerised 2m transc.	Cat D-2889	**$549.00**
FC-901 antenna tuning unit	Cat. D-2855	**$249.00**
FL-110 200W linear amplifier	Cat D-2884	**$189.00**
FRG-7000 Digital HF rcvr	Cat D-2848	**$599.00**
YC-500S 500MHz Freq. Counter	Cat D-2892	**$475.00**

We believe that the prices above are better than any supplier in Australia. If you find someone cheaper for the same goods, tell us!
For us to better any price, simply show as the advertisement from any Australian company. After checking that they have stocks available at that price we will sell for a lower price. Offer remains open while present stocks last (approx. $250,000 worth).

DSE520

FT-7 amateur mobile transceiver

This all solid state transceiver is Yaesu's effort to provide for the increasingly popular portable/mobile amateur market. At the same time it meets the requirements of the Australian novice amateur licensee and, judging by the number on air, it's popular. Review by Roger Harrison.

THE FT-7 COVERS the five major HF amateur bands: 80, 40, 20, 15 and 10 metres. It provides only SSB and CW operation, the predominant modes, and covers 500 kHz segments spanning each amateur band. On the 10 metre band it covers 28.5 – 29.0 MHz, though crystals are available to cover other segments. Fixed channel operation is also available, as is the use of an external VFO.

A single 'tune' control peaks both transmitter driver and receiver pre-selector stages. A mic gain control is provided by the FT-7 does not have VOX operation. In the CW mode, semi break-in operation is provided, with sidetone.

A 100 kHz crystal calibrator is included.

Designed purely as a portable/mobile rig, an ac mains supply is not included but Yaesu recommend their FP-4 or FP-7 power supply if mains operation is desired.

Functionally, the FT-7 front panel is reasonably uncluttered with the controls logically placed and having good access. The usual clear, easily-read frequency dial is included along with a goodly-sized S-meter. The clarifier may be tuned on or off, as desired, and an indicator light just above the dial indicates the selected condition. A handy feature.

Immediately below the main turning knob is a linear 'calibrate' control which allows 'zero-ing' of the main dial. The crystal calibrator is used for this purpose.

The receiver audio gain and RF gain controls are piggybacked. This is a fairly common practise as the RF gain is not used nearly so much as the audio gain control.

The rig is supplied with a sturdy mobile mounting bracket, although, as the FT-7 is 230 mm wide you'll need to have a vehicle with plenty of dash space and leg room to mount it under the dash.

As can be seen in the lead picture, a pull-down stand is provided so that the front of the rig may be raised to a more convenient operating height when the rig is used on a flat surface such as a table or bench. This also prevents the bottom-mounted internal speaker from being muffled in that situation.

On the air

The FT-7's lack of 'frills' makes for extremely simple – and convenient – operation. Tune-up and general operation were a breeze.

Audio quality on both transmission and reception were very good, sounding 'well-balanced' with regard to highs and lows.

Tuning of sideband and CW signals was generally easy, the selectivity of the receiver being not so narrow as to make tuning finicky, yet having good rejection on signals close to the station of interest.

The clarifier control had a range of plus 3.5 kHz and minus 5.5 kHz – a bit too much for our liking as it made adjustment a little 'touchy', particularly when copying several stations in a 'net' where one or two were not quite on frequency.

While we're at it, the calibrate control (beneath the main tuning knob) we found a nuisance to use. Its range was measured at plus 6 kHz and minus 12.5 kHz. As it is a linear, or slide, type of control, this made zero-ing the VFO a rather awkward task. The location of the control does not help either – one tends to knock the main tuning knob – Grrrr! (I know, I know – fumble fingers! But we weren't all endowed with fine, long piano-playing phalanges).

The RF gain control needs some care when adjusting it as the main tuning dial is easily bumped.

Crossmodulation and overload performance, while nothing to write home about, were adequate to cope under reasonable conditions on the well-populated bands. Judicious use of the RF gain control improves matters – that's an operating technique you'll have to learn.

Receiver sensitivity was excellent. The FT-7 is a top-notch rig in this department. This reviewer had no difficulty copying weak DX signals on 28 MHz.

The noise blanker was quite good, no complaints here. However, in the common with most noise blankers of this type, overload and crossmodulation performance suffer somewhat when it is in operation.

Stability was superb. We found no

YAESU FT-7 TRANSCEIVER

* **Supplied by—**
  G.F.S. Electronic Imports
  15 McKeon Road
  MITCHAM 3132 VIC.
  (03) 873-3939
* **Serial No:** 87G060466
* **Recommended Price:** $599

MANUFACTURERS SPECIFICATIONS

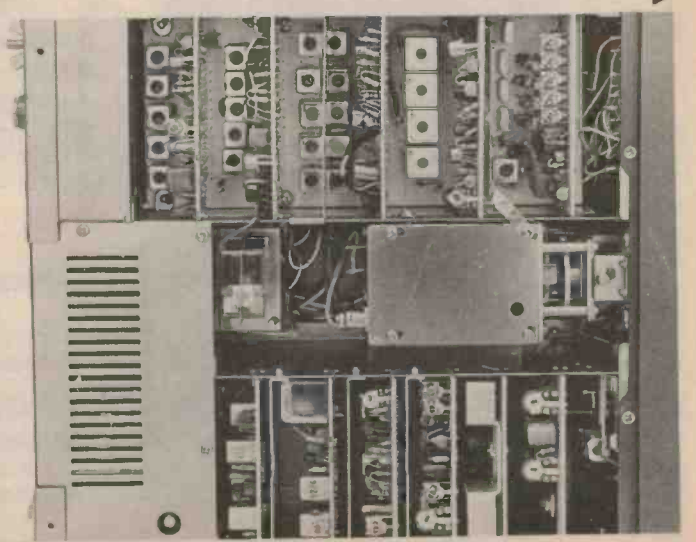
Frequency coverage:	3.5—4.0 MHz 7.0—7.5 MHz 14.0—14.5 MHz 21.0—21.5 MHz 28.5—29.0 MHz (other 10m crystals optional)
Voltage supply:	13.5 Vdc, +/— 10%
Current consumption:	3A on Tx 0.4A on receiver
	230mm (W) x 80mm (H) x 290mm (D)
Weight:	5kg
Transmitter	
Emissions:	SSB (A3j — USB/LSB); CW (A1)
Input power:	20W (A1 and A3j)
Carrier suppression:	Better than 50dB below rated output
Opposite sideband suppression:	Better than 50dB @ 1kHz
Spurious emissions:	Better than —40dB
Distortion products:	Better than —31dB
Tx freq. response:	350—2700Hz @ —6dB
Frequency stability	Less than 300Hz drift from cold start; less than 100Hz over 30 min. period after warmup.
Antenna impedance:	50 ohms
Mic. input impedance:	500 ohms
Receiver	
Sensitivity:	0.25uV for 10dB S/N
Image rejection:	Better than 50dB
IF rejection:	Better than 50dB
Selectivity:	—6dB: 2.4 kHz —60dB: 4.0 kHz
Audio output:	3W @ 10% THD
Audio output imp.	4 ohms

TEST EQUIPMENT

Hewlett Packard model 8553B spectrum analyser with model 8443A tracking gen./counter.
Hewlett Packard model 8558B signal generator
Hewlett Packard noise and distortion set 334A
Bird Model 43 RF power meter. Sierra 500 W dummy load.

TEST REPORT

Voltage supply:	*13.5Vdc*
Current drain	
Rx:	*500mA*
Tx (cw):	*3.3A*
Transmitter	
RF Power output	
CW (carrier):	*14.4W (on 3.5MHz)*
SSB (PEP):	*17.6W*
Harmonic emissions	
1st:	*—56dB*
2nd:	*—52dB*
3rd:	*—63dB*
Receiver	
Sensitivity at 10dB (S+N)/N ratio	*3.6MHz: 0.09uV* *7.1 MHz 0.06uV* *14.1MHz: 0.056uV* *21.1MHz: 0.074uV* *28.5MHz: 0.09uV*
Selectivity; @ — 6dB:	*2.4kHz*
@ — 60dB:	*4.4kHz*
Stability:	*+240Hz over 30 min. warm up*
Crossmodulation:	*A signal 55dB above wanted signal and 100kHz away produces a 6dB increase in audio output.*
Overload:	*Output distortion commences at 200mV signal input*
AGC performance:	*Less than 6dB audio change for 100dB change in signal level*
IF rejection	*78dB*
S-meter	*S1 = 0.6uV S6 = 4.9uV* *S2 = 1.1uV S7 = 6.9uV* *S3 = 1.7uV S9 = 16uV* *S4 = 2.6uV +20 = 140uV* *S5 = 3.5uV +40 = 1.8mV*



Yaesu Musen FT-7 mobile

cause for complaint here. Varying supply voltage had little effect and the rig would withstand a considerable jarring without noticeable 'warble' on the received signal. That's the sort of performance necessary in a mobile/portable rig.

On the test bench

Technical performance of the FT-7 is certainly up with the more sophisticated, and expensive, rigs.

Sensitivity right across the bands was well in excess of the specifications. Selectivity was also excellent.

Stability of this rig equalled some of the commercial gear we've handled. Drift during warmup was only 240 Hz, after warm up, the variation was no greater than plus/minus about 50 Hz, even with the clarifier on. Top one Yaesu!

As mentioned in the on-air report, crossmodulation and overload figures proved to be nothing spectacular. Still, the rig seems to be average in this regard and most operators seem to cope.

On the other hand AGC performance was very good, necessitating little use of the RF gain control in practise, except perhaps to improve matters when trying to copy a weak DX signal while the bloke two blocks away is calling CQ.

Little trouble should be experienced with signals breaking through the IF of the receiver (at 9 MHz).

The S-meter is definitely 'scotch' on weaker signals, but quite generous once they reached a 'reasonable' level. It definitely doesn't indicate the classic "6 dB per S-point", but then, few rigs do these days.

The transmitter comes up rather well on test also. The power output on CW was a little above that allowed for novices, but well within the limit on SSB. Spurious and harmonic suppression is very good for this sort of rig and little trouble should be experienced.

Current consumption at around 3.3-5 amps peak on transmit is good and certainly shouldn't be too taxing on a vehicle battery and is excellent for portable operation.

Construction of the FT-7 is very good – the usual high Yaesu standard. The majority of the printed circuit boards are mounted vertically and 'plug in' to a 'mother' board mounted horizontally along the bottom of the chassis.

The FT-7 would represent a 'basic' amateur HF transceiver, regardless of whether it is used, or intended for use, as a portable, a mobile or a home station rig. It provides all the required basic operating facilities, without frills, and performs very well under today's band conditions.

At a cost somewhat under $600 it represents excellent value for money. As a 'starting' rig for the novice, or as an extra rig for the old hand, it should be very hard to beat. ●

Comments and test results on equipment reviewed refer to the particular item submitted for review and may not necessarily pertain to other units of the same make or model number.

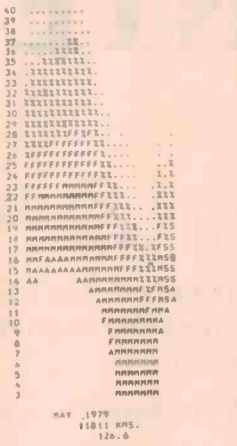
predictions

for May 1979

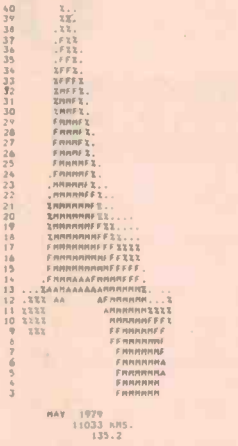
These predictions cover the frequency range between 3 MHz and 40 MHz showing the times propagation is possible over the paths designated for each chart, as well as the probable mode of propagation. For full information on how to use the graphs, refer to ETI issues Nov-Dec '78, Jan-Feb '79 or the ETI/Trio-Kenwood poster given free in the December '78 ETI.

For reliable predictions follow the times and frequencies indicated by the F character on the printouts. Time goes from 0000 UT to 2300 UT, left to right across the graph. These GRAFEX style of computer generated predictions provided courtesy of the Australian Ionospheric Prediction Service.

East Coast — Europe (Short Path)

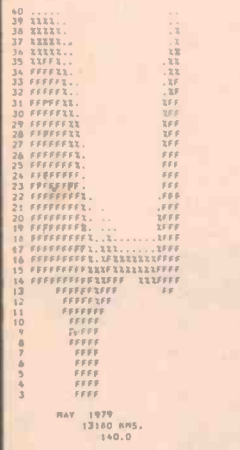


East Coast — Japan (also serves NE and South Central)

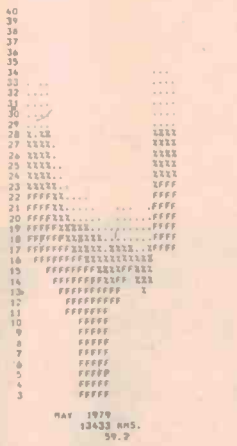


East Coast — South Africa (also serves South Central)

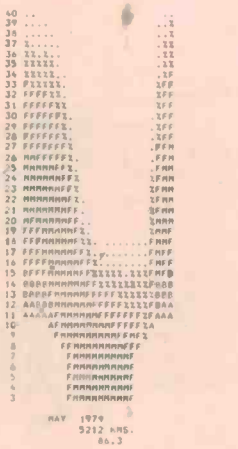
East Coast — North Africa (also serves South Central)



East Coast — South America (also serves South Central)

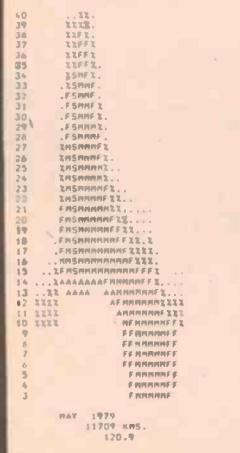


East Coast — North America (also NE and South Central)

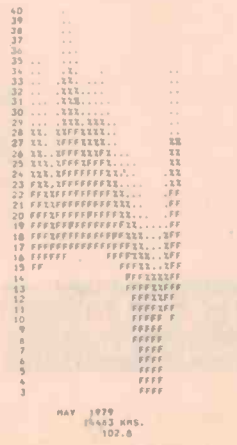


East Coast — South Pacific

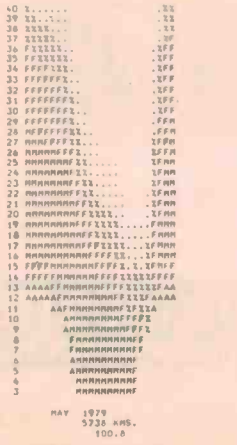
North East — Europe (Short Path)



North East — South Africa

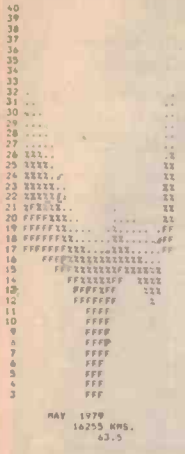


North East — North Africa

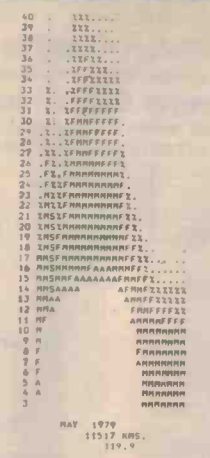


North East — South Pacific (also serves South Central)

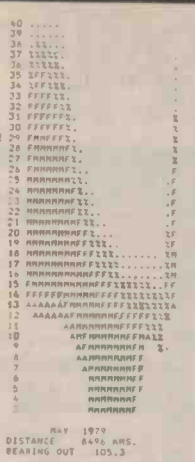
South Central — Europe (Short Path) (also West Coast)



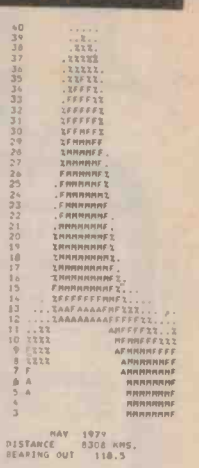
West Coast — North America



West Coast — North Africa



West Coast — Japan



West Coast — South Africa

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- ★ Low Power
- ★ Selectable Memory Protect
- ★ Totally Buffered
- ★ Battery Back-up
- ★ Address on 1K boundary
- ★ Requires no front panel
- ★ No wait states

ASSEMBLED & TESTED
250ns. 199.95
450ns. 179.95

KIT
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450ns. 125.95

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Bare PC Board w/Data **$21.95**
Now over 1 year successful field experience
"Special Offer" Buy (4) 8K 450ns. Kits $117.00 ea.

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- ★ On board 2708
- ★ Power on jump
- ★ 2708 included (450ns.)
- ★ completely socketed

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- ★ Individual Prom Address
- ★ Uses Low cost 16K TI EPROMS
- ★ Optional 1K RAM ★ Phantom control

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Kit 99.50

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2708-6 Eprom ....8 @ $ 5.50 ea.
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IMS 16K STATIC RAM

- ★ Memory mapping
- ★ Phantom
- ★ Address 16K Bound
- ★ Use with or w/o front panel
- ★ Power 2.1 amps typ.
- ★ Uses 2114

ASSEMBLED & TESTED ONLY
450ns. $439.95 250ns. $495.95

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★ Power on Jump ★ Reset Jump

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Kit 64.95
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NOTE: 2708-6 only $5.95

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- ★ Fully Buffered
- ★ Phantom can be added
- ★ 2114/TMS4045 or 9135

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★ Jumper Selectable ★ Persci,Shugart,etc

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Bare PC Board .... $ 39.95
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(Specify Level I or Level II)
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Allows Pet to be interfaced to popular S-100 Bus.
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Assembled $269.95
For Low Cost 8 Slot Bus to expand your Pet only .... $149.95 Kit

DC HAYES DATA COMMUNICATIONS ADAPTER

★ Telephone/TWX ★ S-100 compatible
★ Bell 103 freq. ★ Originate & answer mode

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NSC Linear Data	4.95
NSC Linear APP/note I	3.95
NSC Linear APP/note II	3.95
NSC CMOS Data	2.95
NSC Audio Data	3.95
NSC Volt Reg Data	2.95
NSC Memory Data	3.95
NSC MOS/LSI Data	3.95
NSC Power Transistors	2.95
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Intel MCS85 Manual	7.80
Intel MCS80 Manual	7.95
Intel MCS40 Manual	4.95
AMD 8080 Handbook	5.95
AMD Linear Data	4.95
AMD Schottky Data	4.95
AMI MOS/LSI Data	3.95
GI MOS/LSI Data	4.95
Osborne Intro to Micro Vol 0	7.50
Osborne Intro to Micro Vol I	7.50
Osborne Intro to Micro Vol. II	7.80
Osborne 8080 Programming	7.80
Osborne 6800 Programming	7.50
Osborne Z80 Programming	7.50
TI Powr Semi's Data	7.80
TI TTL Data	6.95
TI Transistors & Diodes	8.50
TI Memory Data	3.95
TI Optoelectronics	3.95
TI Linear Data	3.95
TI Bipolar Memory	3.95
TI Interface Data	4.95
Motorola Semi Data 1, 2, 3	9.95
Mot. Vol 4 Meci Data	3.95
Mot. Vol. 5 CMOS Data	2.95
Mot. Vol. 6 Linear Data	3.95
Mot. Vol 8 Schottky TTL	2.95
Mot MPU Applications	25.00
Mot MPU Prog Ref Manual	3.95
Mot Power Data	2.95
Mot Rectifier Data	2.95
Mot. Switching Tran	2.95
Mot Zeners	2.95
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Basic Software SRI Vol VI	49.95
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- ★ 10 Sector
- ★ 16 Sector

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- ★ Soft

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★ Motorola Compatible Modules*

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9603 8 slot Mother Bd.	99.00
9604 System Power Supply	250.00
9610 Prototype Board	36.00
9615 4KEprom Module	250.00
9620 16 port parallel I/O	375.00
9626 8K Static RAM	295.00
9626K 8K Static RAM Kit	225.00
9630 Extender Card	60.00
9640 Multiple Tuner Prog.	395.00
9650 8 port Duplex Asyn. I/O	395.00
Mot 43/86 Connectors w/w or s/t	5.95
AMI EVK 99* 6800 sub Kit	99.00
AMI EVK 200 Kit	249.95
AMI EVK 300 Assembled	275.00
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EVK 16K Byte Ram Board	75.00
EVK 6 Slot Motherboard	35.00
EVK Extender Board	45.00
EVK Solid Frame Chassis	129.00
EVK Connectors	6.50
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AMI 6800 Micro Assembler Rom	30.00
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- ★ High Resolution
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3882 (Z-80 CTC)	10.45
3882-4 (4MHz)	14.95
8205/74S138 Decoder	2.95
8212 8 bit I/O	2.50
8214 Priority Int.	6.95
8216 Bus Driver	2.50
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	3.95
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8228 Sys. Control	6.95
8238 Sys. Cont.	6.95
8251 Prog. I/O	11.50
8253 Int. Timer	19.50
8255 Prog. I/O	11.50
8257 Prog. DMA	19.50
8259 Prog. Int.	19.50
8275 CRT Controller	74.95
8279 Prog. Keyboard	19.95
6810-1 128 x 8 RAM	4.75
6820 PIA	7.20
6821 PIA	7.25
6828 Priority Int	11.95
6834-1 512 x 8 Eprom	12.95
6850 ACIA	7.20
6852 Serial Adapter	9.95
6845/HD46505 CRT Contr.	39.95
6860 Modem	14.50
6862 Modulator	14.50
6871A 1.0MHz OSC	25.95
6875	8.25
2350 USRT	9.95
6880 Bus Driver	2.39
1821 SCD 1K RAM	25.00
1822 SCD 256 x 4 RAM	16.95
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1852 CD 8 bit I/O	10.95
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6520 PIA	7.50
6522 Mult	9.95
6530-002	15.50
6530-003	15.50
6530-004	15.50
6530-005	15.50
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Item	Price
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2708-6	5.95
1702A	3.95
1702A-6	3.50
2716-5V	44.95
2716-5V, 12V	24.95
2758 5V	28.95
5203AQ	11.95
5204AQ	9.95
6834-1	12.95
IM 5610	2.95
82S123	2.95
82S126	4.50
82S129	4.95

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Item	Price
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4050 4K x 1	4.45
4060 4K x 1	4.45
4096 4K x 1	4.25
2104 4K x 1	4.95
2107B-4 4K x 1	4.25
5261	1.95
5262	1.95
5270	4.95
5280	4.95
1103	1.95
4008L	4.95
TMS4070 16K x 1	19.95
4027-3	4.95
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Item	Price
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MCM6571	10.75
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MCM6574	14.50
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Item	Price
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AY5-3600	13.75

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AY51013 (5V, 12V)	5.50
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AY51015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	9.95
IM6403	9.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	8.95

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Item	Price
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4702	14.95
WD1941	9.95

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MM5369 Prescaler	3.95
LM1889 Modulator	3.95
CW300 Saw Function	1.50
MM57100 Color TV Game	8.95
MM57104 Clock	3.75
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AY38600 Color TV Game	24.95
AY38615-1 Color Converter	8.95
AY38700-1 Tank Chip	29.95
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Item	Description	Price
8700	8 bit Binary	13.50
8701	10 bit Binary	22.00
8702	12 bit Binary	36.95
8705	12 bit TS	42.95
9400	Volt to Freq. Conv	7.25
8750	3-1/2 Digit BCD	13.95
8038	Multifunction	3.95
1408L6	6 bit	3.95
1408L8	8 bit	5.95
DAC01	A/D	5.95

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Item	Price
Pixie-Verter	8.50
TV-1 Video Interface	8.95
Pickles & Trout TV Mod. Kit	20.00
Multiverter	35.00
M&R Modulator	35.00

MICROPROCESSORS

Item	Price
Z-80	$19.95
Z-80A	28.95
F-8 (3850)	16.95
2650	24.95
CD1802	19.95
8080A	9.95
SALE 8085	18.95
8008-1	14.95
2901	21.95
2901A	29.95
TMS 9900JL	69.95
CP1600	39.95
6502	13.95
IM6100	29.95
6800	19.95
6802P	32.95
8035	17.50

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16 Pin W/W	.38	16 Pin S/T	'22
18 Pin W/W	.60	18 Pin S/T	.31
20 Pin W/W	.90	20 Pin S/T	.34
22 Pin W/W	.93	22 Pin S/T	.35
24 Pin W/W	.85	24 Pin S/T	.41
28 Pin W/W	1.15	28 Pin S/T	.49
40 Pin W/W	1.49	40 Pin S/T	.63

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Item	Price
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15/30 Dual S/E	1.95
18/36 Dual S/E	2.35
22/44 Dual S/E	2.95
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43/86 Dual W/W/S/T	6.50
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50/100 IMSAI S/T	4.75
50/100 Altair W/W/S/T	5.95
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Item	Price
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Set w/Hood	6.50

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Item	Price	Item	Price
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The hottest version of STARWARS available
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8K Static Logos	21.95
8K Eprom Byteuser	21.95
32 Static S-100	59.95
Tarbell Floppy I/O	39.95
Tarbell Cassette	29.95
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ACP Extender w/conn	15.95
Realtime Clock	34.95
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S-100 8 Slot Mother Bd	34.95
Vector 8803 11 Slot M. Bd.	29.95
SSM Video I/O	27.95
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Professional Industrial Model

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[illegible] .... 8.75 pair
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- [illegible] 16.95
- [illegible] 15.95
- [illegible] 16.00
- [illegible] 16.00
- [illegible] 16.00
- [illegible] 27.95
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Communications Interface Card 180.00
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[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] 18.95
[illegible] 38.95

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21L02 250ns	1.59	1.55	1.45
2102	1.25	1.15	1.10
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21L11-1	4.10	3.95	3.75
211-1	3.75	3.65	3.55
21L12-1	4.25	4.10	3.95
2112-1	2.95	2.85	2.65
21L01-1	3.95	3.75	3.65
2101-1	2.90	2.70	2.55
2114-3 300ns	9.95	9.75	8.25
2114-4 450ns	7.95	7.80	6.50
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TMS4045	9.95	9.75	8.25
EMM4200A	12.50	11.95	9.95
EMM4402	7.95	7.25	6.25
5101C-E	7.95	7.95	7.25
upd410 (4200)	10.95	10.25	9.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
FSC 460/464 16K CCD Only $18.95 Each			
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6508 1K x 1 CMOS	7.95	7.95	7.25
6518 1K x 1 CMOS	7.95	7.95	7.25
74S189 64 bit Ram	3.95	3.25	2.50

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Item	Price
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MC4024 VCO	2.45
LM566 VCO	1.75
XR2206 Function Generator	5.25

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16K CCD - First time offered Fairchild 460 CCD 16K Memory (now you can experiment with CCD technology at a reasonable price. 17 page Application note supplied with each order. Quantity limited)

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1.8432	4.95	6.144	4.95
2.0MHz	5.85	6.5536	4.95
2.01MHz	2.95	10.0MHz	4.95
2.097152MHz	5.85	13.0MHz	4.95
2.4576MHz	5.85	14.31818	4.95
3.579545MHz	1.50	18.0MHz	4.95
4.0MHz	4.95	18.432MHz	5.95
4.194304MHz	5.95	20.0MHz	4.95
4.91520MHz	8.95	22.1184MHz	8.95
5.0MHz	4.95	27.0MHz	5.95
5.0688	4.95	36.0MHz	5.95
5.7143MHz	5.95	48.0MHz	5.95
		100KC	12.95

DISPLAYS/OPTO

Item	Price
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FND359 CC .357	.95
FND 500/507/CC/CA .500	1.35
FND 503/510 CC/CA .500	.95
FND 800/807 CC/CA .800	2.50
Bowmar 9 digit bubble	.99
FSC 8024 4 digit CC .800	4.95
HP7340 HEX Display	19.95
TIL 305 5 x 7 Array	4.50
TIL 306 7 seg w/logic	8.95
TIL 308 7 seg w/logic	8.95
TIL 309 7 seg w/logic	7.95
TIL 311 HEX Display	12.95
MA 1003 12 auto clock	17.95
MA 1002 4 digit clock module	9.95
MA 1010 4 digit clock module	9.95
Bezel for above	4.95
NSN 373/374 dual CC/CA .300	2.20
NSN 583/584 dual CC/CA .500	2.60
NSN 783/784 dual CC/CA .700	3.00
4N25 Opto Isolater	1.10
MCT 2 Opto Isolater	.89
4N33 Darlington ISOL	1.75
Red Led's .185 Dia.	5/1.00
Green/Yellow	4/1.00
HP 5082/7731 7 seg	.90

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14 Pin S/T sockets 1000 pcs	.10
16 Pin S/T sockets 1000 pcs	.11
22 Pin S/T sockets 1000 pcs.	.12
FSC460/464 16K CCD's	18.95
AMD 9140CDC Static Ram	10.95
4116/416 16K Dynamic Ram's	8 for/149.95
1488 or 1489 RS232 Driver	.95
8T97 Buffer	1.25
8130 or 8131	2.45
8833 or 8835	1.99
74367 or 74368	6/5.00
75451/52/53	10/2.80
8T26 Bus Driver	2.39
78L05 Regulator	2/1.00
MCT2 Optoisolator	.89
2510A Shift Register	2.95
2519A Shift Register	2.95
MM5056 Shift Register	2.95
LM760N-14 Compartor	1.10
DS0025CN Clock Driver	1.49
DS0026CN Clock Driver	2.50
8T20 Bidirect oneshot	3.49
1403AN Shift Register	1.50
9368	2.95
Intel 8155 22 I/O w/Ram	17.95
ICL 7107 CPL 3½ Dig. A/D	11.95

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TEI PT208	4599.00	4699.00
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ADM 3 Assem	829.95	865.00
Sorac IQ 120	895.00	945.00
Teletype Model 43	1199.00	1230.00
AM100	Contact sales desk	
Imsai w/22 slots	599.00	617.00
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MEK 6800 D2 Kit	235.00	Same
KIM I 6502	229.95	Same
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Retail Store Open Mon. – Sat.
Located at 1310 "B" E. Edinger,
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SWL News

Compiled by the Australian Radio DX Club (ARDXC). For further information regarding shortwave radio and ARDXC's activities, write to either PO Box 67 Highett, Vic. 3190, or to PO Box 79, Narrabeen, NSW 2101, with a 30c stamp.

All times are in Greenwich Mean Time; add 10 hours to convert to Australian Eastern Standard Time. All frequencies are in kiloHertz.

Nigeria

The Voice of Nigeria in Lagos has introduced the new outlet of 15185 replacing 15120, for the English language service daily from 0555 to 0835.

The 19 metre band outlet is used in parallel with 11770 and 7255. Also, 15185 is used for the French language program from 1930 each day. Both these services are directed to Europe, but also give generally reliable signals in east Australia.

Malawi

The Malawi Broadcasting Corporation in Blantyre provides its schedule for shortwave transmissions, which shows the use of 3380 from 0257-0520, and again between 1750 and 2215.

The 49 metre band channel of 5995 is in use between 0500 and 2110, and 7130 is used from 0600 until 1715 each evening.

Most programs are designed for domestic audiences, however there is a daily International Service on 7130 only, from 1600 until 1800 in both English and the local Chichequa language.

The station is pleased to receive reports from overseas listeners, and these may be forwarded to: Malawi Broadcasting Corporation, PO Box 30133, Chichiri, Blantyre 3, Malawi.

Oman

The Sultanate of Oman, at the strategic entrance to the Arabian Gulf, has introduced shortwave transmissions only in very recent years.

Radio Oman operates from the capital, Muscat, with one 50 kilowatt and one 10 kilowatt shortwave unit. The current transmission schedule received from the station shows English programs between 0900 and 1100 on 11890.

Other programs are in Arabic and are broadcast on 6175 from 0200 to 0715, and again from 1400 to 2015. Arabic programs on 11890 are broadcast from 1100 until 1315 daily.

The station advises that its schedule will be slightly revised from the beginning of May, with the 0200-0715 transmission being switched from 6175 to 11890. Radio Oman's address is PO Box 600, Muscat, Sultanate of Oman.

Indonesia

Closer to home, the Voice of Indonesia in Jakarta has introduced the new outlet of 15200 for foreign language programs. Voice of Indonesia's English service may be heard on the new outlet from 1400 until 1500 each evening and 15200 also carries English from 0130 until 0200 daily.

Chile

The Voice of Chile in Santiago has a new outlet for foreign language services, with 11780 now being used in our local mornings. Italian is now on 11780 from 2200 until 2230, with German noted from 2230 to 2300.

The Voice of Chile's language schedule is somewhat unreliable, with different language segments being aired at varying times from day to day, though English segments are listed for transmission in half-hour segments at 2330, 0230 and 1100 daily.

Current frequencies for the 1100 service are 11755, 11775, 15110 and 15125.

Belgium

Radio-Television Belge, the French language section of the Belgian radio, provides the following details of its schedule for broadcasts from Monday to Saturday up until March next year. All transmissions are in French:

0500–0615 on 11850 and 9615.
0630–0800 on 17765 and 15210.
1030–1330 on 21460 and 15210.
1530–1645 on 21460 and 5965.
and 1700–2130 on 17715 and 11735.

The DX program is broadcast every Friday at 1830, with DX host being Paul Renard.

Hungary

Radio Budapest has a DX program in English, broadcast every Wednesday and Saturday from 0400-0415 on frequencies of 15220, 11910, 9833, 9585, 6105 and 6040.

Bill Edge's ELECTRONIC AGENCIES

115-117 PARRAMATTA ROAD, CONCORD. 2137. Tel: 747-6472.

SUNDAY OPENING

As from 1st April 1979, Bill Edges' Electronic Agencies will be open on Sundays. For all you electronic experts who have to work 5½ days a week. If you're looking for that particular piece of equipment to finish a job, or you just want to browse, we have a great selection of goods which are all well displayed. **Remember, we're open Sunday 10am to 2pm. Every Sunday.**

100 WATT RMS 8 OHM SPEAKERS

Beautifully manufactured Australian made speakers. Use as a woofer in your hi-fi system, for disco's, clubs — wherever a great deal of power has to be handled. Frequency response: 25-4 KHz. Resonant frequency: 30-35 Hz. Sensitivity: 96 dB. Power: 100 watts RMS.

CAT. 1203 **$75**

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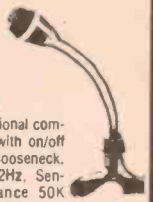
No connecting wires required. Merely plug into a power outlet (240 VAC) and the audio is sent via the electrical wiring. No batteries required as the 240 VAC also powers the units. Both stations must be plugged on same side of power line distribution transformer. All intercoms use same audio frequency so adding extra stations is no problem. We also have very large stocks of conventional intercoms. CAT. 1950: $48.95 pair

Extremely LONG GOOSENECK MICROPHONE



High impedance, uni-directional complete on heavy-duty base with on/off switch & a gigantic 12" gooseneck. Frequency response 70-12Hz. Sensitivity —50dB, Impedance 50K ohms, 3.5 meters cable. Just one of many mikes we carry.

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PHILIPS FM320 UHF, 40 Ch. 2-WAY RADIO

With the only licensable freq. band for CB in 1982 (all 27MHz equipment will then be illegal). 5W RF output. Because UHF operates on FM, interference has little effect on reception. UHF does not cause TVI.

CAT. 2050. **$269.**

(RRP $330) Save $61.

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Beautifully made tweeter — looks fantastic mounted onto board — adds good looks and all good treble — just look at these specs: 2KHz-20KHz, max power 30W, 8 ohms.

CAT. 1235. **$9.75**

This tweeter is one of many we have!

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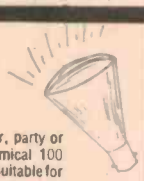

Liven up your Musicolour, party or house with these economical 100 watt bayonet cap lamps. Suitable for Discos too. Approx 200mm across front.

CAT. 6750. Red	$5.99
CAT. 6752 Green	$5.99
CAT. 6754 Orange	$5.99
CAT. 6756 Yellow	$5.99

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	1 to 9	10 UP
C60 SQ	89c ea.	81c ea.
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C90 LH	$1.65 ea.	$1.49 ea.

We also stock DINDY Cassettes.

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Kits marked right down to give novices a chance. For economy no circuits are included — they are all available in one volume of "Project Electronics" — only $4.75. No batteries or cases included but everything supplied to get them working.

Continuity Tester, Cat. 9018	$3.00
Soil Moisture Indicator, Cat. 9016	$4.75
500 Second Timer, Cat. 9014	$4.50
Morse Practice Set (less key), Cat. 9012	$3.50
Morse Key to suit	$1.95
Basic Amplifier, Cat. 9010	$5.50
Electronic Bongos, Cat. 9008	$5.00
Electronic Siren (less speaker), Cat. 9006	$5.50
LED Dice, Cat. 9004	$5.90
Battery Saver (12VDC to 9VDC), Cat. 9002	$3.90

10 percent discount available on above if 10 or more purchased. These kits are just a few of a very comprehensive range including Amps, Musicolour, Strobe, Drill Speed Control, TV Games, many many more.

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Flat ballast type — extremely good value — enormous voltage and current range. Made by Ferguson Transformers.

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PL15/20VA, 15V at 1.33A (7.5V-0-7.5V), 7.5V at 2.67A **$8.50.**

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PL40/20VA, 40V at .5A (20V-0-20V), 20V at 1A **$8.50.**

There are 15 other types of transformers in our varied range.

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AD12K12 12" 3-way Kit, Cat. 1287. $337 pair (RRP $399) **Save $62.**

AD8K30 8" 3-way Kit, Cat. 1282. $242 pair (RRP $299) **Save $57.**

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ADF500/4500/8 3-way Crossover, suit AD12K12 system, Cat. 1256. $50 pr.

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(includes leads, fastons & attenuators)

First-class quality (European made). Virtually nothing to compare them with in this price range.

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Just one of a complete range of CB and Amateur radio accessories.

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AA (Penlite), 1.2V 500 mAH, $1.75.

C size, 1.25V 1.2 AH, $3.63.

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NI-CAD CHARGER — 12V at 25mA, will charge from 3 to 10 1.2V batteries at one time, current automatically adjusts. $11.50.

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You want to put your aerial on the bonnet, boot or mudguard but can't get it vertical. What you need is a SLOPE ADJUSTER. Extremely strong with wide angle.

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This German made Timer operates from 240VAC and can switch 240VAC at up to 16 A. It has capabilities for 3 on/off settings in a 24 hour period. Can handle times from ½ hour to 23½ hours. Very robust.

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MOST FANTASTIC BUY OF THE SEASON

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MAIL ORDER: PO BOX 1005, BURWOOD NORTH. 2134.

SWL News

World Radio TV Handbook 1979

This is 544 pages of up to date information on broadcasting in every country in the world and is essential reference material for any shortwave DXer.

Not only are the detailed schedules of all radio broadcasters given, but also listed are station personnel, postal addresses and current policy regarding listeners' reception reports.

Such details are essential for those DXers interested in gaining verifications from stations around the world.

The ARDXC is still taking orders for the WRTVH 1979, and you can get your copy delivered to your door for just $16, which includes packing and airmail registered postage from the publishers in Denmark.

Special features this year in the WRTVH include an article about missionary broadcasters around the world, and an article outlining the expected High Frequency broadcast reception conditions during 1979.

Mexico

Radio Mexico in Mexico City has introduced the new outlet of 15430 for broadcasts in Spanish every day from 2155 to 0500. This frequency replaces the long-used 15385, but suffers interference from both the Voice of America and the American Forces Radio and TV Service, both using 15430 for much of the day.

However, Radio Mexico is generally free of interference from 0400 until sign off at 0500.

Australian DXers meet

This month, over the Easter break, members of the Australian Radio DX Club from all over Australia will meet in Mount Gambier, South Australia for the 6th annual ARDXC Convention.

The program for the weekend will include films on DXing, discussions, the club annual general meeting, and the chance to renew or strike up new friendships with fellow DXers in an informal atmosphere.

People interested in the DX hobby would find Easter an ideal time to come along to Mount Gambier and find out more about our fascinating pastime.

Libya

This is another country of the Arab world which has recently introduced a new channel, being observed on 7120 kHz, also signing on at 1500 daily with the anthem and Koran readings. This may be a new service relayed from the Malta relay site, as the transmission is observed to conclude at 1530 on 7120 kHz.

Laos Broadcasters

Laos is an unusual country in that most of the regional stations broadcasting for the home audience in their own region provide better reception in Australia than the program for overseas listeners transmitted daily from the capital, Vientiane.

The regional station at Houa Phan is audible in Australia during the evenings during the 1300-1430 service, using both 6198 and 4657.

The Pakse station uses 6597, for programs between 1000 and 1400 daily. The station at Xieng Khouang is well received in Australia on 6675 during its evening service 1000-1400, and you may also be able to hear the station on its parallel channel of 4757, which should fade in by 1200 in east Australia.

Probably the best Laotian signal in our evenings is provided by the station at Savannakhet on 7383 during its 1100-1400 transmission.

The stations at Pakse, Xieng Khouang and Savannakhet all relay the news from Vientiane at 1200 every night, and this will begin with a clock chiming 7pm local time, and station identification.

The identification announcement may be difficult to catch, and it is recommended that a tape recorder be used. The identification at the start of the news from Vientiane will usually go like this: "Thini Withaya heng Sat, kachai sieng chak Wianchan . . ." which translates as: "This is the National Radio, broadcasting from Vientiane . . .".

Vientiane itself has a shortwave service on 6130 for domestic coverage, and this is audible most nights in east Australia between 1200 and 1530. The Overseas service from Vientiane is broadcast on 7145 each evening, but at the time of writing this channel was suffering severe interference from jamming transmitters, making reception of the program very difficult. When 7145 is free of interference, Vientiane may be heard in French 1300-1330, and in English 1330-1400.

Vientiane has recently began to verify correct reception reports from listeners overseas. If you would like to try your luck, then the address is: The National Radio of Laos, B.P. 310, Vientiane. The exact address for the regional stations are not available, but it would be advisable also to write to Vientiane for verification of reception of a regional outlet.

Mini-Mart

send your ad to –
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15 Boundary Street,
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WE'LL PRINT your 24 words (maximum) totally free of charge. Copy must be with us by the 1st of the month preceding the month of issue. Please, please write or preferably type your adverts clearly.

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Name and address plus phone number (if required) must be included within the 24 words allowed.

Reasonable abbreviations, such as 25 Wrms, count as one word.

Private adverts only will be accepted. Please let us know if you find a commercial enterprise using this service.

Every effort will be made to publish all adverts received – however, no responsibility for so doing is accepted or implied.

Adverts must relate to electronics or audio – general adverts cannot be accepted.

SELL: 2650/PIPBUG ICs. Never used $40 inc manual, data, postage. Keyboard wired cost $60, sell $45. R Munn, 46 Dudley Ave, Daw Park, 5041. Phone (08) 293.4925.

WANTED: Used 3-speed turntable without arm. Garrard 301 or similar Collaro, Neat, etc. (02) 451.9608 evenings.

COMMUNICATIONS receiver Marc NR-52F1 12 band, .15-30, 65-175, 430-475 MHz. Ex cond, hardly used $200. Details from G C Williams, 19 Wicklow Avenue, Athelstone, SA 5076 (08) 337.4705.

SELL: Mint condition. Teletype ASR33 complete with 20 mA, & RS232 interfaces , manuals, etc. $580. Phone (02) 487.2972.

SELL: Honeywell key tape computer has 9 track NRZ. 10½" drive keyboard, memory, etc. $200 ONO. Phone: (02) 487.2972.

SELL: Three American Field Manpack, Combat FM Transceivers, Type ANPRC25 2000 channel digital select complete with unused clip-on RF amps. $1900, will not separate. Phone: (02) 487.2972.

NAKAMICHI 600 cassette deck, brushed aluminium, 18 months old. Excellent condition & performance. Sell for $600 or best offer (02) 239.1519 (ask for Alfie).

SELL second hand: 100 electronic projects book, $1.25; 741 IC, 50 cents; tagstrip, 25 cents; ceramic capacitors and wirewound resistors 25 cents each. Andrew Pam, phone (03) 80.4221.

SELL Garrard MRM101 noise reduction unit as featured in ETI January 1979, 1 month old. Changing to all tape system $90 BH (03) 697.7354, Wright.

ETI 3600 Synthesizer for sale. Fully assembled and working $900. Contact Nigel Smith, Baulkham Hills, Sydney on 639.1868.

SELL: Texas Instruments TI30 calculator with adapter/charger. Cost $36, sell $25. Suit tertiary or secondary student. Phone: (02) 80.1296.

HP67 224 step, card programmable scientific calculator. 100 blank mag cards, std pack and users library. $450, R King, PO Box 474, Sandy Bay, 7005.

WANTED to buy TV service manuals. Colour, black and white. J Ferrie, 5 First Avenue, Lane Cove (02) 427.6767.

FREE membership, Lakeside QSL Swap Club, send any number your personal QSL cards and 25 cents stamp for equal swaps and free membership registration. PO Box 114, Toukley, NSW 2263.

RAM 8K-450 ns, S100 memory card (assembled) $185 (02) 84.2130 (business), ask for Bernie, or after 5 pm 14 Northmead Avenue, Northmead.

SELL power supplies: 5th desperate attempt at a sale. -90V to +30V at 1A – $15; -14V to +20V at 5A – $30; +5V to -5V at 50A – $40 ONO. (02) 682.4015, K McLean, 6/34 The Trongate, Granville.

SELL multi 7 2m FM transceiver. RPTRS. 1 to 8, simplex 40, 50 and 51. $150 - 3 years old. Extra 'Xtals $7/pair from 'Jan' (02) 682.4015, K McLean, 6/34 The Trongate, Granville.

WANTED CRT monitor - green preferably. Ring AH John Pitman (08) 45.4372 or write 12 Percy Street, Seaton, SA 5023.

SELL: K25 MR 3W 3ch hand held with CB Xtals and touch tone and rubber duck $60 (07) 264.1817, Brisbane.

SELL: Yaesu FR-101 deluxe digital receiver. AM. SSB. FM. Ham-SW. Broadcasts 5m and 2m. As new, cost $900, sell $500. Further details, Mr Lockerbie, Cameron Street, Merimbula 2548.

SELL General Electric A3-5825 18 chan. LED SSB/AM with ant. Warn & TX mod lights RF gain extras $150. Cole, 5 Belmont Road, Glen Waverley, Vic 3150 (03) 232.3626.

MICROCOMPUTER system - Baby 2650, EA economy VDU, RECI cassette interface, housing, games and programming paks. All assembled and working. $345 - Garry (02) 90.4919.

ETI for sale: June '77 to Dec '78 except Feb & Nov '78. Also 9 assorted EA, PE - $20. B Easton, 52 Frenchs Forest Road, Frenchs Forest. Phone 451.4795.

60 Watt car amplifier, Ferris FA-204. Brand new, has not been unpacked. $39 plus postage. Edward Jozis 170/332 Park Street, South Melbourne, 3205.

SELL: Heath H8 computer, 16K RAM, serial, parallel I/O. Minifloppy disk operating system. Lot of software. Cheap printer VDU available. Melbourne (03) 56.5731.

SELL: 2650 System in EA terminal case, 2K, EA VDU, cassette interface, EA keyboard. $300. Write: M E Kenny, Box 29, Blackwood, 5051.

SELL: Working SCAMP LCDS prototype system with 4K RAM, manuals, circuits. $400 ONO write airmail to Mark Edwards, Box 3456, Port Moresby, Papua New Guinea.

FOR sale: 4600 synthesizer keyboard controller $70, transient 2 $20. Master mixer dual input preamps $5. Carl Vine, 125 Arthur Street, Surry Hills. (02) 33.5647.

2650 micro BASIC. 1.6K integer +/-32K + - x/18 statements. Editor. Complete source listing + manual + CUTS tape. $8.50, A Peek, 10 Gale Street, Woolwich, NSW 2110.

WANTED: Midland 13-894 must be one left in Aust in working order. Send info and price to Ray, VCF126, PO Box 76, Mordialloc, Melb, 3195.

"ELEKTOR" Dutch electronics magazine, English Edition really different; interesting. All 1978 issues in mint condition $18.00. R Martin, 8 Holmes Avenue, Sefton (02) 645.3737.

AUSTRALIAN Radio DX Club, for shortwave and mediumwave DXers. Monthly magazine published. Write for details, with 20 cent stamp to PO Box 67, Highett, Vic or PO Box 79, Narrabeen, NSW 2101.

SC/MP micro kit with documentation, P/S, hex k-board & disp. Also new hall effect ASCII k-board. The lot $150, phone Ray, Perth 342.5929.

SELL: CRO 3" single beam, working $45. G Mann, 5 Rason Place, Curtin ACT 2605.

FOR sale: 5 x 7 dot matrix displays type TIL 305. Leads trimmed for pcb insertion 10 for $12 or $1.50 for sample. L McClure, 20 Sartori Street, East Burwood, 3151 (03) 233.5664.

FOR sale: Electros 55V/65V 20,000 microfarads, West Ryde, (02) 808.2463.

WANTED Teletype ASR 33 with paper tape facility - Barry Griffiths, 93 Glenlyon Drive, Wulguru, 4811, phone (077) 72.2077 or (077) 78.1819 AH.

WANTED transistorised amplifier circuit, Seimens 2000 projector - also Astro Kino colour IV, 1:1.4 35 mm lens. A Schmidt, PO Box 241, Southport, Qld 4215.

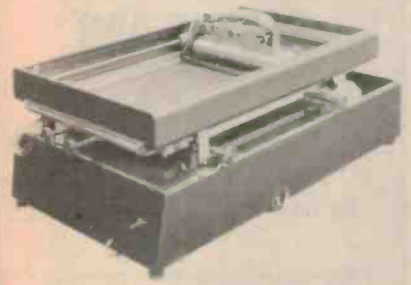
EDDYSTONE Model EC10 solid state communications receiver. .55 to 30 MHz, excellent condition, $160. WHR Treloar, phone (02) 239.5267 (office hours).

SELL: HP9815 desktop computer, hardly used, $2900. Also several interfaces and ROMs for Hewlett Packard desktop computers. Rex Jooste, Pymble, NSW (02) 449.6566 (weekdays).

40 ETI Dec 73 - May 78, $32.00. 46 EA Jun 73 - Feb 78, $35.00. 27 PE Oct 73 - Aug 77, $15.00. The lot $75.00. (02) 624.4485.

Dek

Model 250



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That's roughly the promise of the new Dek 250 precision screen printer. Double benefits all round. Whether you are resisting P.C.B.'s, printing front panels or producing foil or plastic lables.

The Dek 250 prints an area of 18" x 10" (450 x 250mm) More than twice the size of the well established Model 240.

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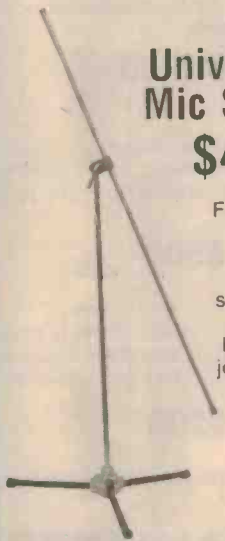
Also available — 9 channel expander to make 17 input mixer. $575



Universal Mic Stand $45

Features: Matt stainless steel barrels, heavy folding solid steel legs, universal height/position joint, maximum height 2m.

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Top of the TDK Range	C90	$3.99	~~$6.50~~
*Hitachi LN	C60	$1.89	~~$2.32~~
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Ideas for experimenters

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

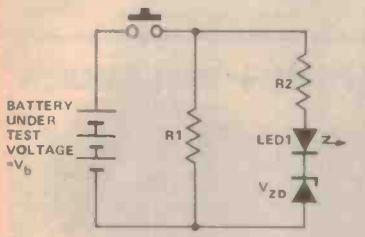
Battery Condition Indicator

This simple circuit loads the battery under test and then checks to see if the output voltage is above 80% of its specified value. The resistor, R1, draws a steady load current (I_{load}) and the total current drawn from the battery is thus I_{load} plus I_{LED}. The zener voltage is selected so that the LED will not light when the battery voltage drops below the required value.

$R_1 = 0.8 \times V_b / I_{load}$; $V_{zd} = 0.8 \times V_b - V_{led}$; $R_2 = (V_b - V_{zd} - V_{LED})/I_{LED\ (max)}$

V_b	R_1	R_2	V_{zd}
3	270	68	0.7*
4.5	390	100	2.1*
6	470	120	3.3
9	820	180	5.6
12	1k	220	8.2
18	1k5	390	13.0

* For these low zener voltages, use one or more silicon diodes in series, forward biassed.

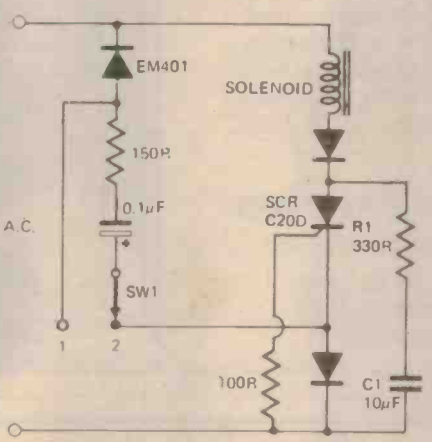


Supply Protector

For those expensive (computer) boards, place a 1W (or bigger) zener diode across each supply rail, with a voltage rating 1–2V above the rail voltage. A 6.2 V one will be ideal for a 5 volt rail, for example. It doesn't cost much and when you drop the 50 V supply leads across the 5 V rail (accidentally), the zener will protect the circuit and in the case of gross overload will go short (usually). You blow a 50c zener instead of $50 of ICs.

TO-3 Template

Sometimes it's a bit trickey trying to mark out the holes for a TO-3 case on a heat sink. If, however, you keep a blown TO-3 device (and most people will have plenty of those!), then by removing the cap and the leads it will form a useful template for centre-punching the holes.

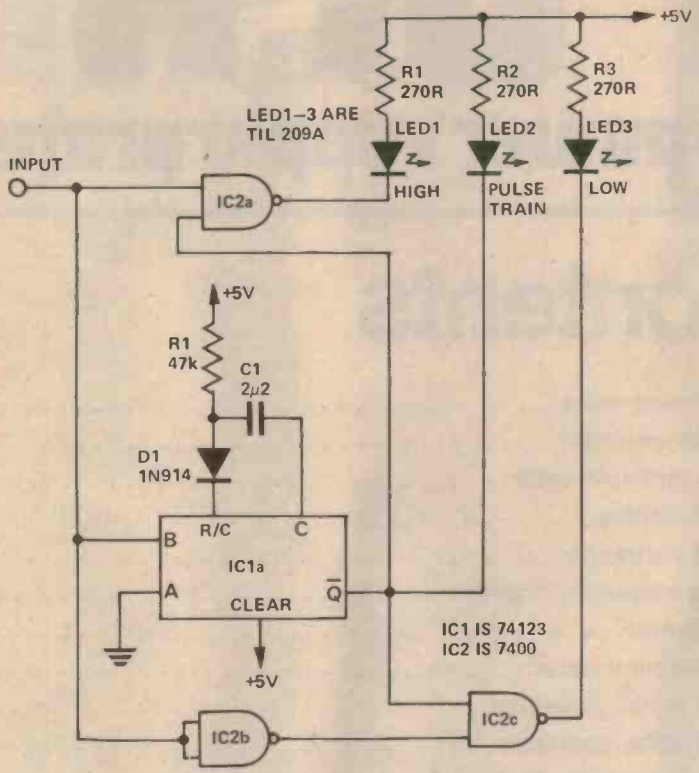


Impulse Power

This circuit is often used in electrically powered stapling machines, impulse hammers etc. and causes load current to flow through the load for one complete half-cycle of the ac supply whenever SW1 is actuated (i.e. moved from its normal position [1] to energise-load position [2]). The circuit is arranged so that the SCR is always triggered at the beginning of a positive half-cycle of the ac supply, even though the switch may be closed randomly at any time during the previous two preceding half-cycles.

Resistor R1 and capacitor C1 should be chosen so that their series combination supplies just sufficient holding current for the SCR for one complete half-cycle.

Ideas for experimenters



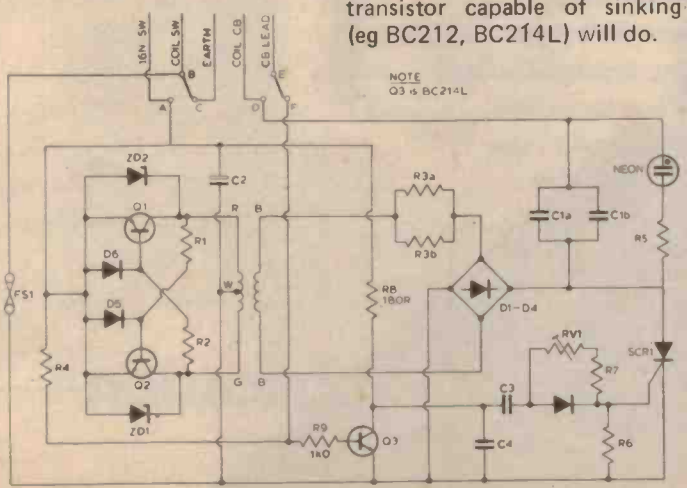
TTL Logic Probe

This two-IC circuit indicates one of three states: 1) high 2) low or 3) pulse train at greater than 40 Hz. IC1a is a monostable and with the component values given, the Q output will be high for as long as there is a pulse train present with a frequency of 40 Hz or greater. The 7400 buffers the input to the LEDs and its logic prevents either the 'high' or 'low' LED from being lit when a pulse train is present.

CDI for Positive Earth

The CDI Mk II ignition published in the May 77 issue has been designed for negative earth cars. Attempting to install it in positive earth vehicles by reversing the supply connections will lead to problems caused by SCR1 triggering as C3 is discharged (ie as the contact points close, and not as they open).

This modification provides a solution by discharging C3 through transistor Q3 which conducts when the points open. Any general purpose PNP transistor capable of sinking 200mA (eg BC212, BC214L) will do.



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DIODES/ZENERS

QTY.			
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

QTY.				
8-pin	pcb	.20	ww	.35
14-pin	pcb	.20	ww	.40
16-pin	pcb	.20	ww	.40
18-pin	pcb	.25	ww	.95
20-pin	pcb	.35	ww	.95
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
Molex pins	.01	To-3 Sockets		.25
2 Amp Bridge		100-prv		.95
25 Amp Bridge		200-prv		1.50

TRANSISTORS, LEDS, etc.

QTY.		
2N2222	(2N2222 Plastic .10)	.15
2N2222A		.19
2N2907A	PNP	.19
2N3906	PNP (Plastic Unmarked)	.10
2N3904	NPN (Plastic Unmarked)	.10
2N3054	NPN	.45
2N3055	NPN 15A 60v	.60
T1P125	PNP Darlington	1.95
LED Green,	Red, Clear, Yellow	.15
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MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

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QTY.		QTY.	
9301	.85	9322	.65
9309	.35	9601	.20
9316	1.10	9602	.45

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QTY.		QTY.	
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8T23	1.50	2114	9.50
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8T97	1.00	2708	10.50
74S188	3.00	2716 D.S.	34.00
1488	1.25	2716 (5v)	59.00
1489	1.25	2758 (5v)	23.95
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MM 5369	2.95	8214	4.95
TR 1602B	3.95	8216	3.50
UPD 414	4.95	8224	3.25
Z 80 A	22.50	8228	6.00
Z 80	17.50	8251	7.50
Z 80 PIO	10.50	8253	18.50
2102	1.45	8255	8.50
2102L	1.75	TMS 4044	9.95

C MOS

QTY.	
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
4029	1.15
4030	.30
4033	1.50
4034	2.45
4035	.75
4037	1.80
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4048	.95
4049	.45
4050	.45
4052	.75
4053	.75
4066	.55
4069/74C04	.35
4071	.25
4081	.30
4082	.30
4507	.95
4511	.95
4512	1.10
4515	2.95
4519	.85
4522	1.10
4526	.95
4528	1.10
4529	.95
MC14409	14.50
MC14419	4.85
74C151	1.50

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QTY.		QTY.		QTY.	
MCT2	.95	LM323K	5.95	LM380 (8-14 Pin)	1.19
8038	3.95	LM324	1.25	LM709 (8-14 Pin)	.35
LM201	.75	LM339	.75	LM711	.45
LM301	.45	7805 (340T5)	.95	LM723	.40
LM308	.65	LM340T12	.95	LM725	2.50
LM309H	.65	LM340T15	.95	LM739	1.50
LM309K (340K-5)	1.50	LM340T18	.95	LM741 (8-14)	.35
LM310	.85	LM340T24	.95	LM747	1.10
LM311D	.75	LM340K12	1.25	LM1307	1.25
LM318	1.75	LM340K15	1.25	LM1458	.65
LM320H6	.79	LM340K18	1.25	LM3900	.50
LM320H15	.79	LM340K24	1.25	LM75451	.65
LM320H24	.79	LM373	2.95	NE555	.45
7905 (LM320K5)	1.65	LM377	3.95	NE556	.85
LM320K12	1.65	78L05	.75	NE565	.95
LM320K24	1.65	78L12	.75	NE566	1.25
LM320T5	1.65	78L15	.75	NE567	.95
LM320T12	1.65	78M05	.75		
LM320T15	1.65				

— T T L —

QTY.		QTY.		QTY.		QTY.	
7400	.10	7482	.75	74221	1.00	74LS02	.30
7401	.15	7483	.75	74367	.95	74LS04	.30
7402	.15	7485	.55	75108A	.35	74LS05	.35
7403	.15	7486	.25	75491	.50	74LS08	.35
7404	.10	7489	1.05	75492	.50	74LS09	.35
7405	.25	7490	.45	74H00	.15	74LS10	.35
7406	.25	7491	.70	74H01	.20	74LS11	.35
7407	.55	7492	.45	74H04	.20	74LS20	.30
7408	.15	7493	.35	74H05	.20	74LS21	.35
7409	.15	7494	.75	74H08	.35	74LS22	.35
7410	.15	7495	.60	74H10	.35	74LS32	.35
7411	.25	7496	.80	74H11	.25	74LS37	.35
7412	.25	74100	1.15	74H15	.45	74LS38	.45
7413	.25	74107	.25	74H20	.25	74LS40	.40
7414	.75	74121	.35	74H21	.25	74LS42	.75
7416	.25	74122	.55	74H22	.40	74LS51	.45
7417	.40	74123	.35	74H30	.20	74LS74	.45
7420	.15	74125	.45	74H40	.25	74LS76	.50
7426	.25	74126	.35	74H50	.25	74LS86	.45
7427	.25	74132	.75	74H51	.25	74LS90	.65
7430	.15	74141	.90	74H52	.15	74LS93	.65
7432	.20	74150	.85	74H53	.25	74LS107	.50
7437	.20	74151	.65	74H55	.20	74LS123	1.20
7438	.20	74153	.75	74H72	.35	74LS151	.85
7440	.20	74154	.95	74H74	.35	74LS153	.85
7441	1.15	74156	.70	74H101	.75	74LS157	.85
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7443	.45	74161	.55	74H106	.95	74LS164	1.20
7444	.45	74163	.85	74L00	.25	74LS193	1.05
7445	.65	74164	.60	74L02	.20	74LS195	.95
7446	.70	74165	1.10	74L03	.25	74LS244	1.70
7447	.70	74166	1.25	74L04	.30	74LS367	.95
7448	.50	74175	.80	74L10	.20	74LS368	.95
7450	.25	74176	.85	74L20	.35	74S00	.35
7451	.25	74180	.55	74L30	.45	74S02	.35
7453	.20	74181	2.25	74L47	1.95	74S03	.25
7454	.25	74182	.75	74L51	.45	74S04	.25
7460	.40	74190	1.25	74L55	.65	74S05	.35
7470	.45	74191	1.25	74L72	.45	74S08	.35
7472	.40	74192	.75	74L73	.40	74S10	.35
7473	.25	74193	.85	74L74	.45	74S11	.35
7474	.30	74194	.95	74L75	.85	74S20	.25
7475	.35	74195	.95	74L93	.55	74S40	.20
7476	.40	74196	.95	74L123	.85	74S50	.20
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7481	.75	74198	1.45	74LS01	.30	74S64	.15
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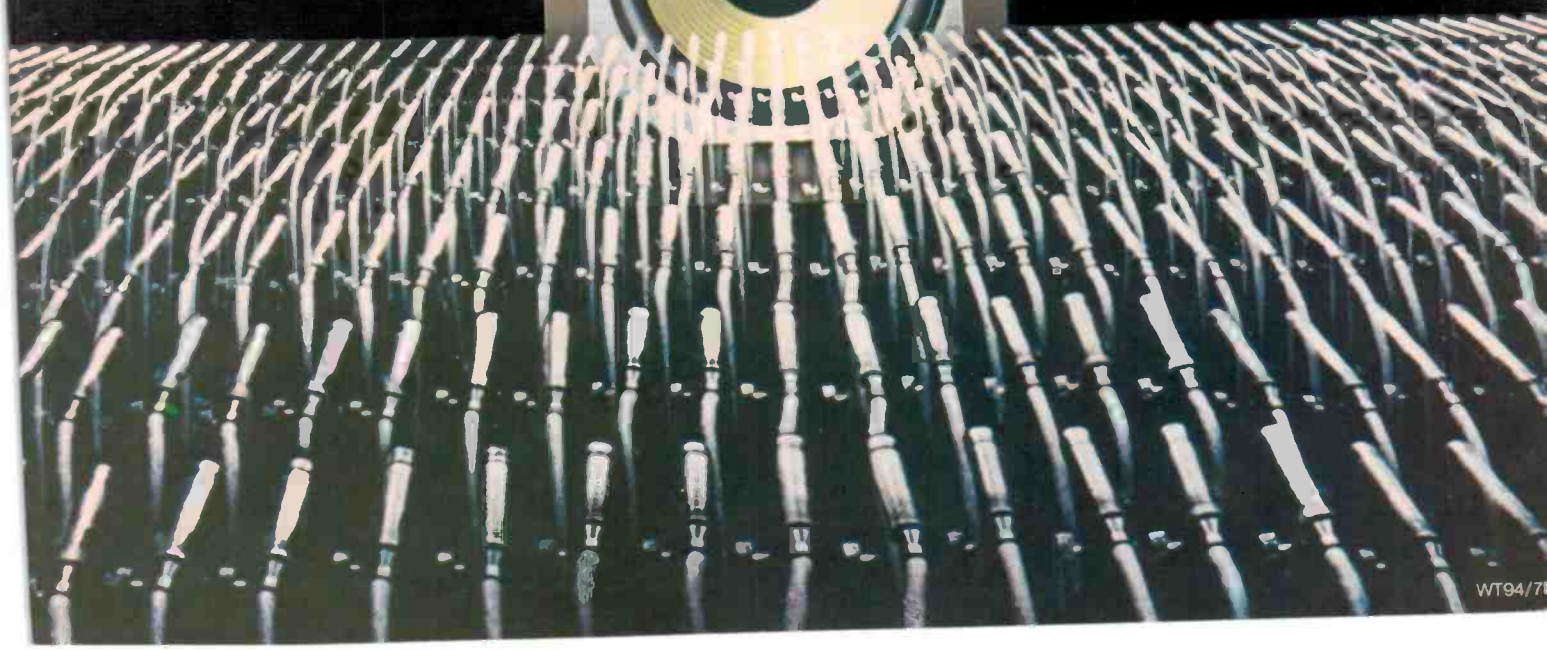

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