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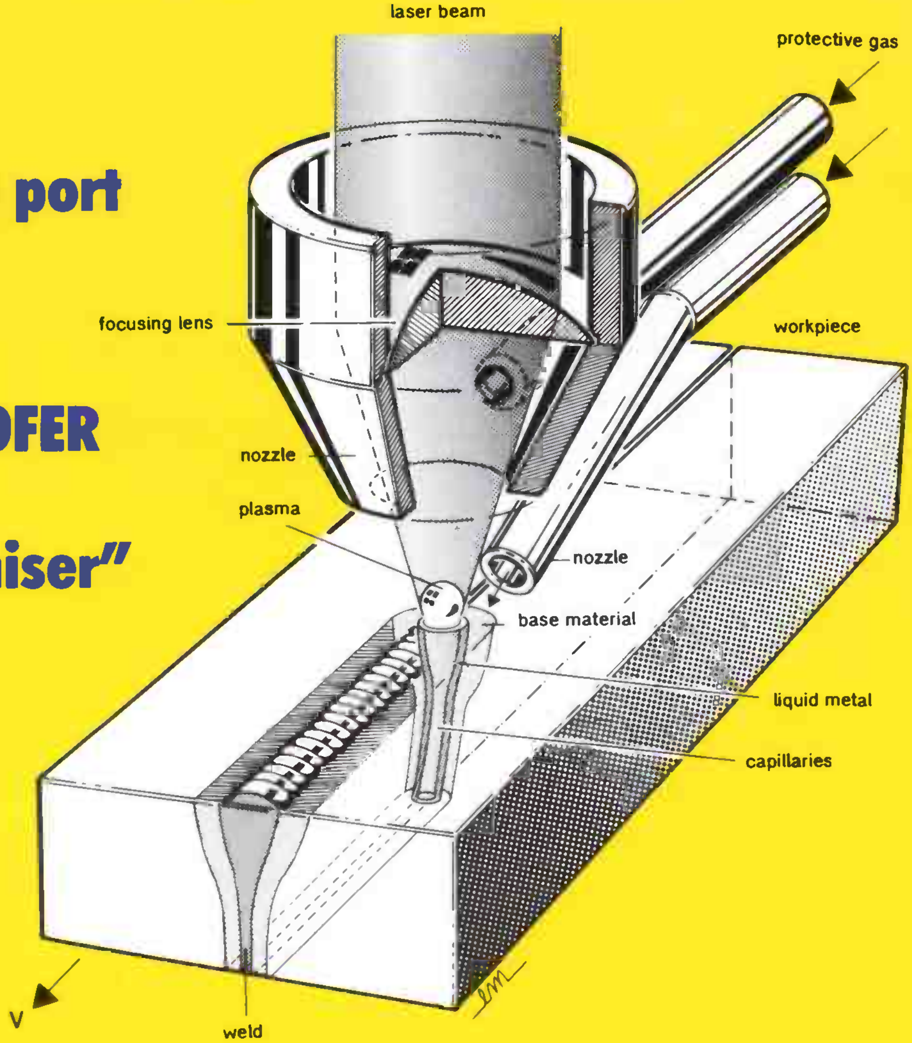
Incorporating Elektor Electronics

ROGER HARRISON'S AUSTRALIAN ELECTRONICS Monthly

Looking at LASER technologies



NEW COLUMN: Semiconductor Scene!

Convert your serial port to "true" RS232

Build a BANDPASS SUBWOOFER

80 metre "space miser" antenna to build

Solar power

HI-FI REVIEW: Bose Project X speakers

audio • video • computing • communications • projects • engineering • technology

THIS MONTH we introduce a new column which we've been planning for some months. It's called "The Semis Scene" and we've spent some time and effort gathering material for it, contacting distributors and suppliers, hunting down the new, the interesting and the useful. We think you'll find it not just informative, but exciting and an essential reading item each month.

The whole electronics industry, encompassing computers and communications too, literally hinges on what's happening in the "internal" semiconductor industry. Computing technology could not advance at the pace it is without the developments that are taking place in processor and memory technology and manufacture. Compact disc players would be bulky, expensive items and not the successful consumer product they are without the developments in large scale integration that made possible the chips that "compressed" the scale of circuitry and permitted the bulk manufacture that, together, reduced size and cost. Today, you can buy over the counter for a few dollars from an electronics retailer, a gallium arsenide FET with performance in RF amplifier applications that, a few short years ago, could only be achieved by rare devices costing around a month's salary!

"The Semis Scene" is aimed at keeping you abreast of developments ranging across what's happening in the world's research labs, the latest release in hybrid circuits from local manufacturers, to what new and interesting devices have just gone on sale. We'll also be including practical applications information – circuits and data on both new and "old" devices; in fact, we've already found it more of a problem as to what we have to leave out due to space limitations, rather than what the heck we're going to include!

The Semis Scene, we believe, will hold something of interest for everyone, every month.

Roger

Roger Harrison
Editor

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COVER
The illustration introduces this month's feature article on Lasers and laser technology. Design by Val Harrison.

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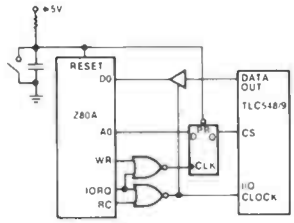

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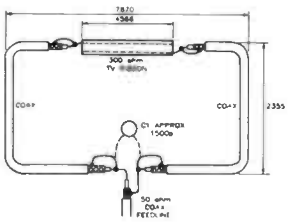

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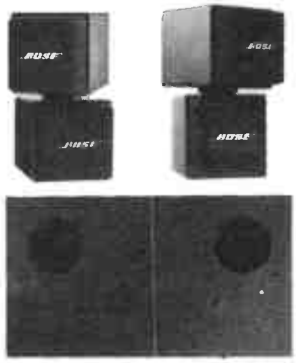

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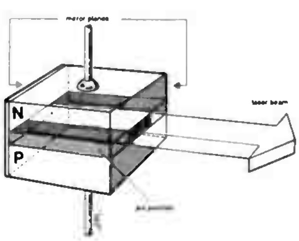


NEXT MONTH!

DISK DRIVE DOUBLE-UP FOR YOUR AMSTRAD 6128

Hands up all those 6128 owners who hate turning over their disk because that all important file is on the OTHER side! Or you run out of disk space at that vital moment and crash your program, or can't find the spleing chicker dictionary? Here's the solution. No soldering required!

BUILD OUR UOSAT SATELLITE DATA DECODER PROJECT

The University of Surrey's two amateur satellites provide an excellent opportunity to "get into" satellite and space technology at the ground floor. This simple, low cost project takes audio from an FM receiver covering the 145 MHz beacon transmissions of the UOSATs and permits decoding using a computer running any common terminal emulation program.

PERTH ELECTRONICS SHOW ANNUAL ROUNDUP

Perth's Annual Electronics Show never fails to reveal a few surprises along with the new equipment releases. AEM's Editor made the pilgrimage again this year, for fifth time in succession. Where is the industry and the PES headed? All is revealed next month!

While these articles are currently being prepared for publication, unforeseen circumstances may affect the final contents of the issue.

Major space agreement

An important space research and development agreement designed to boost Australia's expertise in remote sensing and other space technologies was signed in Canberra recently. Results and benefits will begin to flow from mid-1988.

The agreement, announced by Federal Science Minister Mr Barry Jones, is between CSIRO and Japan's Science and Technology Agency (STA) and the National Space Development Agency (NASDA).

Under the agreement, Australian and Japanese scientists will use data from Japan's Marine Observation Satellite (MOS) launched in February this year.

The data will be received at the Division of National Mapping, Department of Resources and Energy's facility at Alice Springs. Reception of information will begin in the second quarter of 1988 and experiments using the data will run for six months.

The agreement will give Australia the opportunity to further enhance its reputation and skills in the field of remote sensing, in a project that will benefit fisheries, marine and oceanographic research, geological exploration, atmospheric science and mapping and surveying.

Perth planetarium to open in October

Construction of the Perth Omni Theatre and planetarium is fast approaching completion. It is due to open in mid-October. The Omnimax Theatre is the first to be constructed in Australia containing a planetarium instrument and the first Omnimax in the world to be contained within a retail complex.

The most widely used modern planetarium instrument, the Spitz System 512, is being installed at the Omni Theatre. This custom-made Southern hemisphere model will project a complement of 4050 stars, accurately depicting not only position, but colour and magnitude of the Milky Way, major nebulae, galactic clusters, the Sun and the solar planets.

The planetarium productions will be choreographed through a Z-80 based dedicated microprocessor system designed specifically to control the special effects in planetarium productions.

Completing the high fidelity standards established by the Omnimax system, the Omni Theatre is installing a 20 000 watt, six channel programmable sound system. Driving eight stations of full range and two stations of eight channel sub-bass JBL drivers, this system rivals any permanently installed theatrical sound system in Australia, it is claimed. And we think they might be right!

Erasable optical recording material

Researchers at Philips Research Laboratories in Eindhoven have found a highly promising new group of materials for erasable optical recording of either analogue or digital signals.

These are semiconductor materials such as gallium antimonide (GaSb) and indium antimonide (InSb) "doped" with other elements. They possess properties which make them suitable for the repeated recording and erasure of information with a laser.

Information is read out by the familiar laser-optical system technique used in Videodisc and compact disc systems. Information is recorded by rapidly heating small areas in athin layer of crystalline material to slightly above melting point with a fairly powerful laser beam. These small areas then solidify, producing an amorphous area which can be detected optically by the variation in reflectance. The areas are sufficiently well defined for the reproduction of analogue video signals.

NOTES & ERRATA

AEM2000 0-55 V Laboratory Power Supply.

May 1987

Page 68: The 1M resistors across C2-C3 should be numbered R97 (shown as R1) and R98 (shown as R97). The 10,000 uF/100 V capacitor should read C16 (shown as C6). R2 in the +8.2 V rail becomes R1 and R3 in the –8.2 V rail becomes R2.

Page 71: R98 becomes R99 and should be 10R not 10k. C31 should read 1000 uF/16 V. The resistor nest to R78 (below ZD10) should read R83 not R38 as shown. The 100 pF capacitor between pins 1 and 8 of IC6 (LM301) should read C67 not C87 as shown. C69 shown as 10 uF/10 V should read 10 uF/25 V.

June 1987

Page 58: Board "B"; C40 shown with wrong polarity. The plus should be on the left side and minus near Q5.

Page 61: Board "A" (top); C59 shown with wrong polarity. The plus should be on the right side (connected to R40/D9). R55 is missing and should be above R41/IC4. Q15 c/b/e/ should read e/b/c from left to right. Q16 b/c/e/ should read e/c/b from left to right. C72 is missing and should be between IC7 and D13/D14. R86 is missing and should be at the right side of R85. R82 and R84 have been wrongly marked as R78 and R83. They are found below R68/R69/RV8. Change R78 to R82 and change R83 to R84. A link on the right hand side of R77 is missing and goes to the +8.2 V line. (not visible on the overlay).

Board "C" (bottom); ZD8 cathode is not marked. "k" should be on the right, near IC2. The resistor on the right side of R14, below Q3 should be marked R17.

Changes to boards "E" and "F" (digital panel meter)

Following publication, these boards were changed meaning that the circuit and overlay as published, no longer apply. New instructions are supplied with kits.

AEM4622 V.22 Modem

June 1987, page 66. A few transpositions, omissions and typographical errors crept into the article. Here are all the corrections.

On page 70, under "Completion and Testing", the first sentence of the third paragraph should read: Set SW3 to HANG UP (left), SW1 to ANS (left), SW2 to TEST LOOP (left). Connect the plugpack, power up again and quickly check the supply rails. In the same paragraph, a few lines down, you attach the CRO or audio millivoltmeter between pin 7 of IC6 and 0 V.

In the Parts List, ZD1 – a 12 V zener, was missed, R17, R18 are 2k2 and R12 was omitted, it's 1k. Note that the plugpack is optional with kits.

LASERS: AN OVERVIEW

The development of lasers since they first appeared in the early 1960s has been spectacular. In just over 25 years they have become virtually indispensable in such diverse applications as compact disc players, fibre optic communications, surgery, and the Strategic Defence Initiative.

The first lasers appeared in 1960-61 when Javan, Bennett, and Herriott of Bell Telephone Laboratories announced the helium-neon laser just after Theodore Maiman, working at the Hughes Aircraft Corporation, had made a practical ruby laser. In little over a year later a semiconductor laser had been developed more or less simultaneously in Britain and the USA.

Foundations

An atom may be represented by a Bohr model: Fig. 1 shows that of a hydrogen atom. Bohr considered one electron of charge $-e$ and mass m, moving with speed v, and acceleration v^2/r in an orbit around a central nucleus of charge $+e$. In classical physics, charges undergoing acceleration emit radiation and would, therefore, lose energy. On this basis, the electron would spiral towards the nucleus and the atom would collapse. Bohr therefore suggested that in those orbits where the angular momentum is a multiple, n, of $h/2\pi$, the energy is constant. In the early 1920s, de Broglie proposed that an electron may be considered to behave as a wave of wavelength $\lambda = h/p$, where h is the **Planck constant** (4.14×10^{-15} eV s) and p is the momentum of the moving electron.

If the electron can behave as a wave, it must be possible to fit a whole number of wavelengths around the orbit. In that case, a standing wave pattern is set up and the energy in the wave is confined to the atom. If there are n waves in the orbit and λ is the wavelength,

$$n\lambda = 2\pi r$$

so that,

$$\lambda = 2\pi r/n = h/p = h/mv$$

from which,

$$mvr = nh/2\pi$$

This shows that mvr, the angular momentum of the electron is an nth multiple of $h/2\pi$.

In Fig. 1, the electron moving around the nucleus has kinetic energy due to its motion and potential energy in the electrostatic field of the nuclear charge $+e$.

Bohr calculated the total energy E of the electron in terms of its charge, mass orbital radius, and the number n which quantizes the angular momentum. He then assumed that the electron can pass from one energy level to another. If, for instance, the electron jumps from energy level E_3, corresponding to $n = n_3$, to a lower level E_2, corresponding to $n = n_2$, the difference in energy is released as radiation of energy $h\nu$, where h is the Planck constant and ν is the frequency of the radiation. Therefore,

$$E_3 - E_2 = h\nu = hc/\lambda$$

where λ is the wavelength of the radiation and c is the speed of light in a vacuum.

Although Bohr's theory of the hydrogen atom was unable to predict the energy levels in atoms with many electrons, its fundamental ideas remain valid. For instance, the angular momentum of the electron has quantum values, and the energy levels of an atom have only discrete values: E_0, E_1, $E_2 \ldots E_\infty$; no other or intermediate energy level is possible. The lowest energy level, E_0, is called the **ground state energy**. All physical systems are in stable equilibrium in the lowest energy state.

If an atom absorbs energy, and the energy of the atom reaches one of its discrete levels, E_1, the atom is said to be in an **excited state**. Once an atom has been excited to a higher energy level, E_n, it will try to reduce its energy. The energy lost if the atom reverts direct to the ground state is $E_n - E_0$. This energy is radiated in the form of electromagnetic radiation, i.e., quanta of energy $h\nu$—see Fig. 2. These quanta are called **photons.** The frequency of the photons lies in the range 5 nm to 10 μm. From the foregoing, it follows that

$$h\nu = E_n - E_0.$$

An atom can interact with a photon in three ways: **absorption, spontaneous emission, and stimulated emission**—see Fig. 3. If an atom absorbs a photon of energy $h\nu$, and the difference in energy levels of the atom is equal to $h\nu$, the

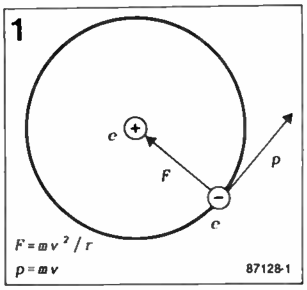


Fig. 1. Bohr's model of the hydrogen atom.

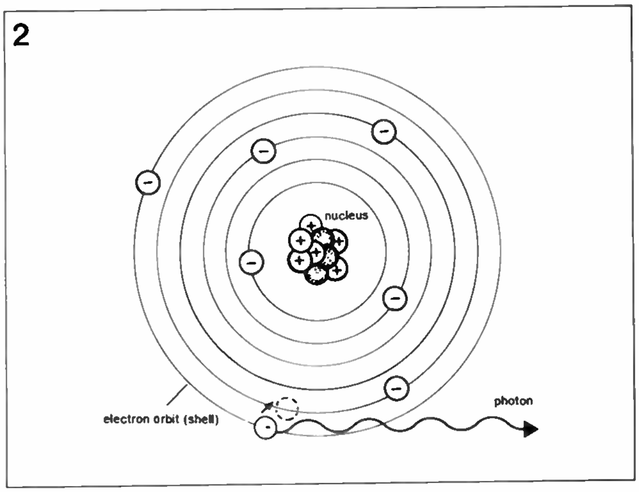


Fig. 2. Model of a many-electron atom. When an electron jumps to a lower energy level, a photon is released.

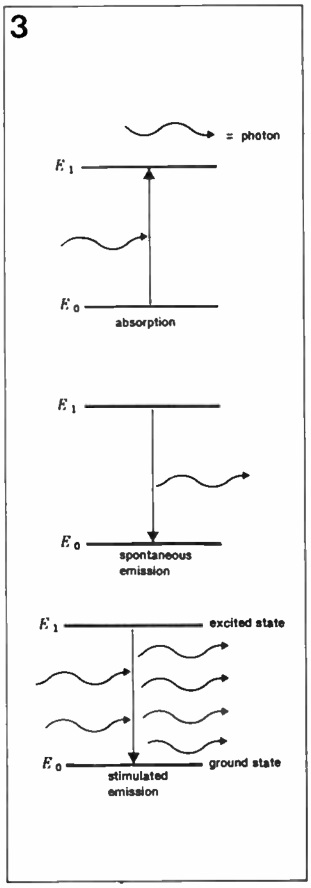


Fig. 3. An atom can interact with a photon in three ways.

photon will raise the atom to a higher energy level. In spontaneous emission, an atom in level 3 may of its own accord emit a photon $h\nu$, leaving the atom in the lower level 2. In stimulated emission, an atom in level 2 may be stimulated to emit a photon $h\nu$ by interaction with another photon of the same energy.

If in a system of atoms with an energy level E_n above the ground state there are no photons of energy $E_n - E_0$, where E_0 is the ground state energy, the atoms remain stable. If, however, a few photons of energy $E_n - E_0$ are introduced, these will immediately stimulate the emission of a number of photons of the same kind. This increases the number of photons in the system, which in turn stimulate the emission of more photons. In this way, an **avalanche effect** is produced, which results in all atoms in the system rapidly giving up their photons—see Fig. 4. This process is called **laser** action (light amplification by stimulated emission of radiation).

In a system of atoms in thermal equilibrium, the number of atoms in the ground state is much greater than that in a higher energy state. This is called a **normal population** of atoms. In such a system at temperature T, the numbers, n_1 and n_2, of atoms in two successive states, E_1 and E_2, are related by the Boltzmann formula (in which k is the Boltzmann constant — 1.38×10^{-23} J K^{-1}):

$$n_2 = n_1 \exp[-(E_2 - E_1)/kT]$$

from which it is seen that at room temperature ($T = 300$ K), n_2 is considerably smaller than n_1, i.e., a normal population obtains. If it is possible to make $n_2 > n_1$, a **population inversion** is produced, which enables laser action to take place.

The output from a laser may be continuous (CW operation) as is usually the case with gas lasers, or pulsed as that from solid-state lasers. Table 1 lists a variety of lasers and some of their characteristics.

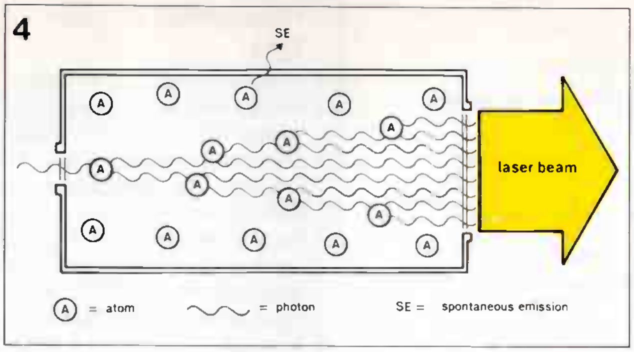


Fig. 4. Illustrating the avalanche effect if a photon or photons are introduced into a system of atoms.

Type of laser	Pressure	Efficiency	Power	Wavelength
He-Ne	0.1–25 mbar	0.01–0.5%	0.1–10 W	632.8 nm 1.15 μm 3.39 μm
CO_2	1.3 bar	10–30%	10–100 kW	9.6–10.6 μm
XE_2	30 bar	30%		200 nm
Dye		10–15%	0.1–10 W	
Cr^{3+}		1%	1000 W +	694.3 nm
Nd/YAG		1%	1–500 W	1.06 μm
GaAs			0.1–0.5 W (pulse: 1 kW +)	900 nm

Various lasers and some of their characteristics.

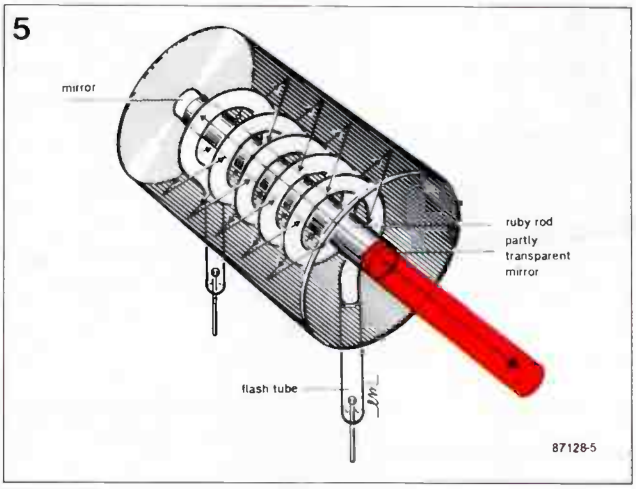


Fig. 5. Artist's impression of the construction of a ruby laser.

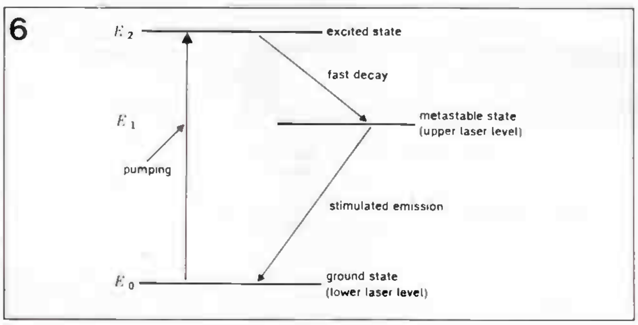


Fig. 6. Operation (simplified) of a three-level laser.

Three-level lasers

At present, the main solid-state lasers are the ruby (Cr^{3+}) and the neodymium/yttrium aluminium garnet (Nd/YAG) lasers. The ruby laser is a **three-level laser** ($E_2 > E_1 > E_0$), with a fast decay between levels 2 and 1, and a slow decay between 1 and 0. A typical construction of this type of laser is shown in Fig. 5.

Ruby consists of a small concentration of Cr^{3+} ions in a lattice of crystalline Al_2O_3. When a high potential is applied to the flash tube, the ions are excited, or pumped, by photons of wavelength 550 nm (green light) and energy $E_2 - E_0$—see Fig. 6. The excited ions decay spontaneously to the lower energy state E_1, emitting photons of energy $E_2 - E_1$.

The energy state E_1 has the special property of having a large stimulated emission probability and a low spontaneous emission probability. It is, therefore, filled with a far greater number of ions than the ground state E_0. There is thus a population inversion between these two levels, so that laser action can be initiated, resulting in the emission of red light ($\lambda = 694.3$ nm).

Four-level lasers

Except in a few cases, such as in the ruby laser, it is difficult to produce a population inversion between a ground state and an excited state, because initially all the atoms are likely to be in the ground state, and more than half the atoms have to be pumped to level 2 before a population inversion can be achieved. An easier method is possible in a **four-level laser** in which a population inversion is created between two excited levels—see Fig. 7. Initially, all the atoms are in the ground state, E_0, and none in the excited states 1, 2, and 3 ($E_1 < E_2 < E_3$). Level 3 is chosen so that it has a fast decay to level 2, and pumping between levels 0 and 3 immediately produces a population inversion between levels 2 and 1. As level 2 begins to fill up by the stimulated emission at frequency $(E_2 - E_1)/h$, the population inversion will decrease. To minimize this effect, level 1 is chosen so that it has a fast decay to the ground state.

Gas lasers are examples of a multi-level system, which can be pumped by an electrical discharge rather than by incident radiation. An important model is the He-Ne laser, in which the ▷

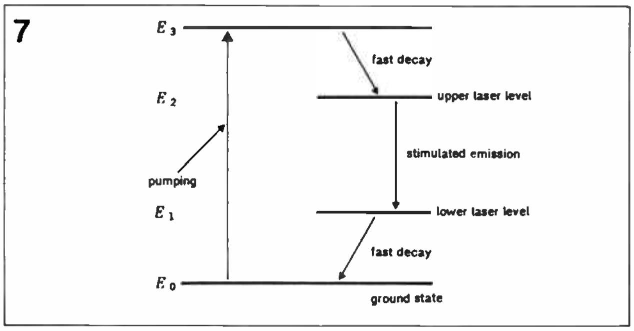


Fig. 7. Operation (simplified) of a four-level laser.

active material is a mixture of helium and neon gases contained at low pressure inside a long quartz tube with optically plane mirrors at each end—see Fig. 8. Two terminals near the ends of the tube enable a high potential to be applied to produce a discharge in the gas mixture. A typical construction of a He-Ne laser tube is shown in Fig. 9.

In an electrical discharge, the helium atoms are raised to the 2^1S and 2^3S levels which are metastable—see Fig. 10. By collision with these atoms, the neon atoms are excited to level 3, so that a population inversion is produced and laser action occurs as explained above. The wavelength of the emitted light depends on the reflectivity of the mirrors between which the gas is placed. Oscillation will take place at the wavelength for which this reflectivity is a maximum. In Fig. 10 it is—typically—633 nm (red light). It is seen that two other beams are also generated: one at 3.39 μm and one at 1.15 μm, but these are effectively suppressed by filter action of the mirrors.

Polarization of laser light

Although laser light is **coherent**, because all the photons (or waves) are in phase, polarization is random—see Fig. 11. To linearize the polarization, a Brewster window as shown in Fig. 9 is used. Such a window is a disk of plane glass (see Fig. 8) which is set at the Brewster angle to the incident light to ensure that only light of a given wavelength is passed.

Brewster's law states that when light strikes a glass surface at an angle of incidence given by $\tan^{-1}(n)$, where n is the refractive index, the reflected light is plane polarized. At this angle of incidence, the refracted ray makes an angle of 90° with the reflected ray.

Resonance cavity

The laser emitter is placed between parallel mirrors so that photons can be reflected back and forth many times, resulting in the build-up of a large photon density by the avalanche effect.

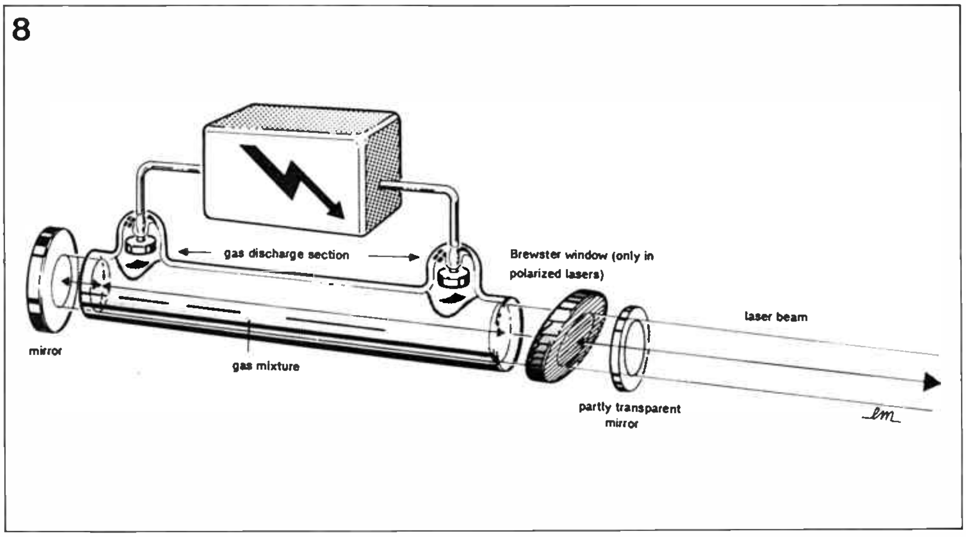


Fig. 8. Artist's impression of the construction of a He-Ne laser.

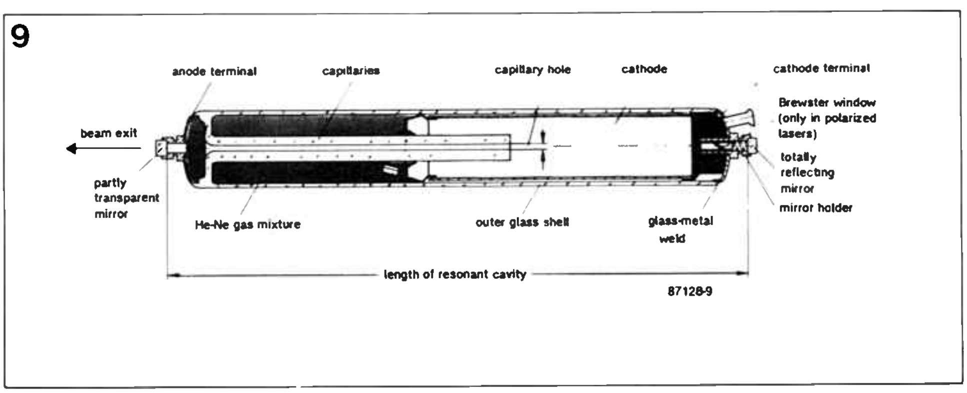


Fig. 9. Cross-sectional view of a He-Ne laser (courtesy of Siemens).

It is, of course, necessary that one of the mirrors be partly transparent, so that some of the light can get outside the tube used.

The mirrors may be plane or curved as shown in Fig. 12. When plane mirrors are used, part of the emission may be reflected spuriously outside the system. Such losses must be kept small: reflections must be higher than 99%. When confocal mirrors are used, the beam is kept exactly parallel within the cavity. The slight divergence at the exit is controlled by a collimating lens.

Beam spread

Many laser tubes are marked with their internal beam radius, r_{bi}, from which the beam diameter, D_x, at a distance m can be calculated:

$$D_x = 2\theta m$$

where 2θ, the angle of spread, is equal to $\lambda/\pi r_{bi}$; λ is the wavelength of the laser light.

If, for instance, a He-Ne laser, operating at a wavelength of 633 nm, has an internal beam radius of 0.375 mm, the beam diameter at a distance of 100 m is

$$D_{100} = 2\theta m = 2m\lambda/\pi r_{bi}$$

$$= 2\times100\times633\times10^{-9}/3.142\times375\times10^{-6} = 107.5 \text{ mm.}$$

Lasers and their applications

Since the development of lasers continues at a spectacular speed, only an outline of the state of the art will be given.

He-Ne lasers, because of their small output (0.1—10 mW) are best suited to use in laboratories and measurement techniques, but are also used for medical purposes. Their wavelengths are 632.8 nm, 1.15 μm, and 3.39 μm.

Argon-ion lasers, with outputs of up to 15 W, are frequently used in medicine for photo coagulation. Their bluish green light (488 nm and 514.5 nm) is selectively absorbed by haemoglobin and melanin. Their main application, however, lies in the field of eye surgery.

Carbon-dioxide (CO_2) lasers, operating in the infra-red

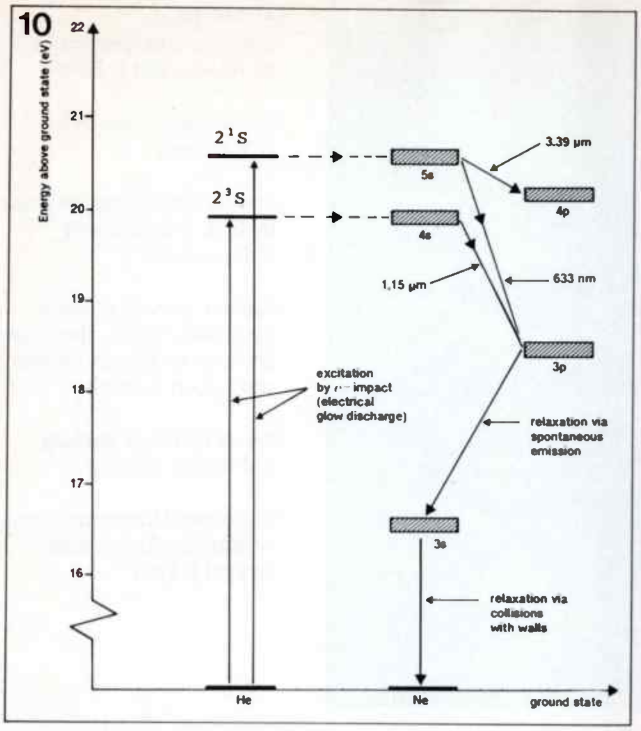


Fig. 10. Schematic representation of the operation of a He-Ne laser. The capital letter S is a code associated with the value of the total electronic orbital angular momentum quantum number L. The lower case letters s and p are used in the so-called spectroscopic notation, in which the value of the orbital angular momentum quantum number L is indicated. The superscripts to the left of the S give the value of 2S+1, or multiplicity, which is equal to 1 for singlet (S=0) states, and 3 for triplet (S=1) energy states.

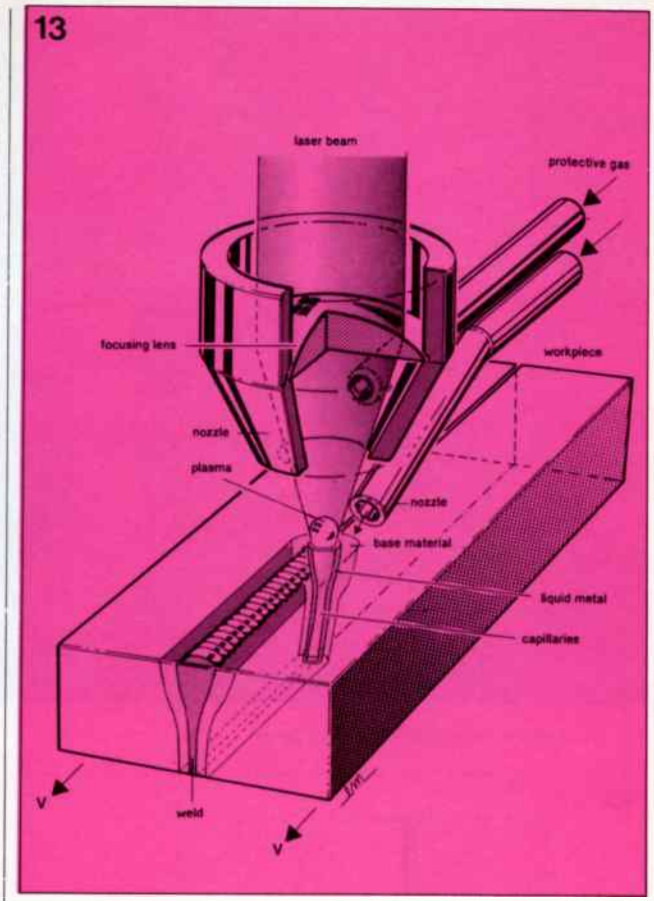


Fig. 13. Illustrating the operation of a CO_2 laser in industrial welding.

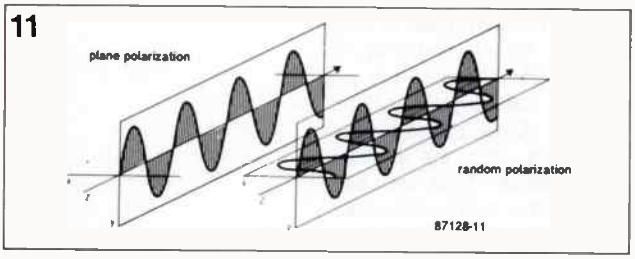


Fig. 11. Light may be randomly polarized, but in a number of laser applications it is required to be linearly polarized.

region (9.6—10.6 μm), are primarily used in industrial applications: hardening; drilling; welding; refining; and ageing are but a few of these. The use of a CO_2 laser for industrial welding is illustrated in Fig. 13.

The dye laser is pulse operated and pumped by a xenon flash tube—see Fig. 14—or by a pulsed beam from another laser. Continuous tuning of this type of laser is possible by making the grating that forms one end of the resonant cavity rotatable. With its very narrow line width and large frequency range, the dye laser is eminently suitable for use in spectroscopy and in the chemical industry.

Solid-state lasers find almost universal application in measurement techniques, be it the exact distance from the earth to the moon or the speed of motor vehicles. Many of these techniques are by-products of military research.

The only solid-state laser to be used in the medical world is the **Nd/YAG laser.** Because of its high power output (>100 W continuous) and operation in the infra-red region (0.9—1.35 μm), this type of laser is particularly suitable for operations in soft tissues, such as the removal of tumors in the oesophagus.

Solid-state lasers can produce pulses of extremely high power: a power of 100 TW (=10^{14} W!) at the peak of a 2 ns pulse has been reported. Such enormous powers are needed in the strategic defence in- ▷

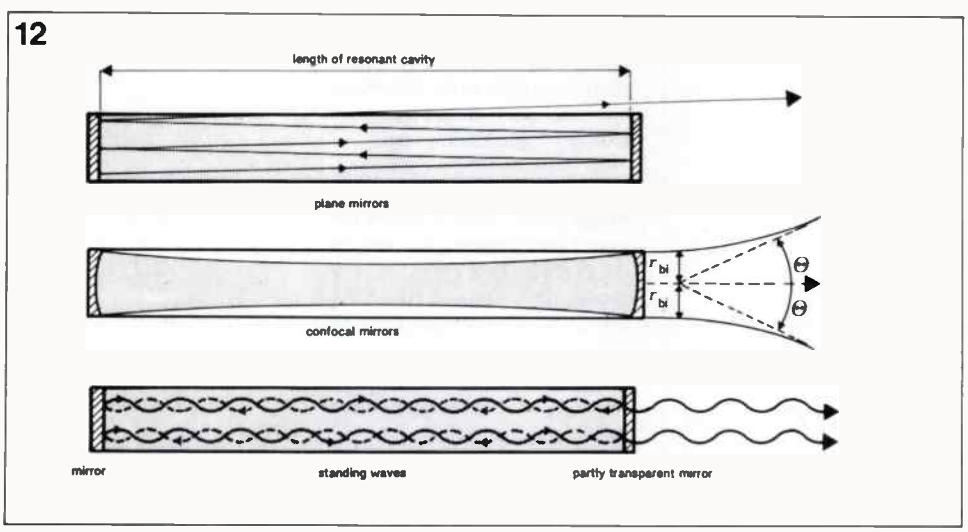


Fig. 12. It is essential that standing waves are generated between the mirrors terminating the resonant cavity. The shape of the mirrors has an effect on the efficiency of the laser.

14

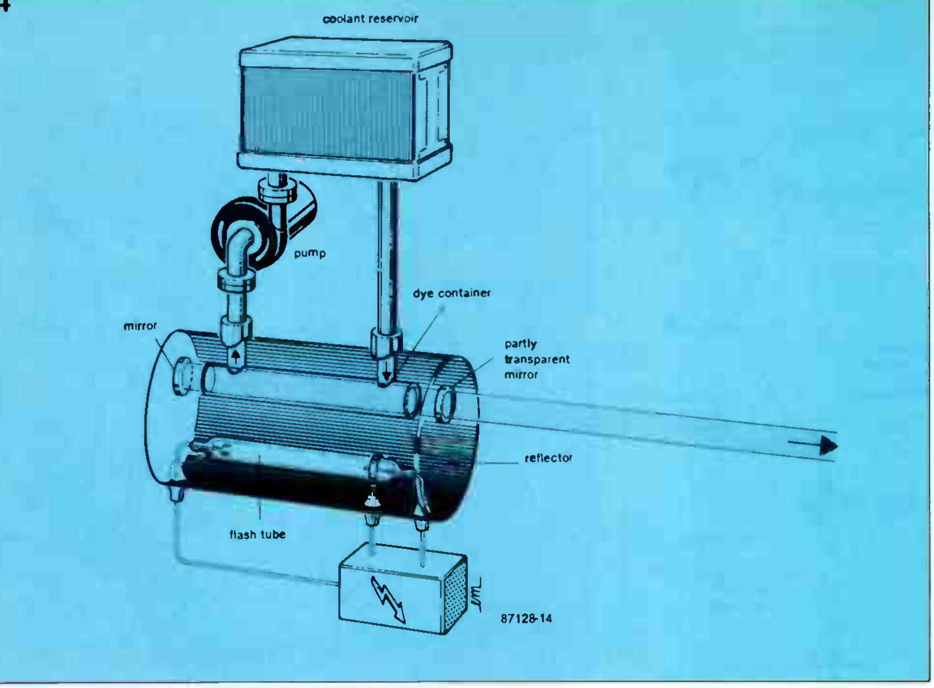


Fig. 14. Artist's impression of a dye laser.

15

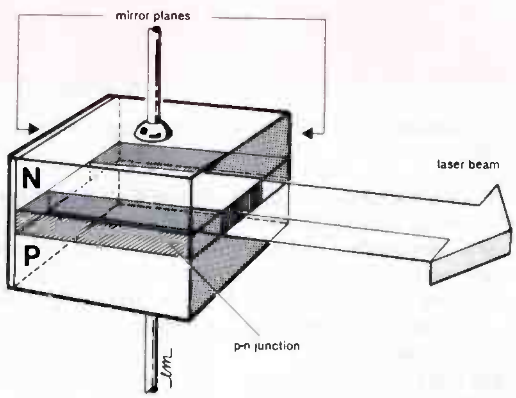


Fig. 15. Semiconductor (GaAs diode) laser.

16

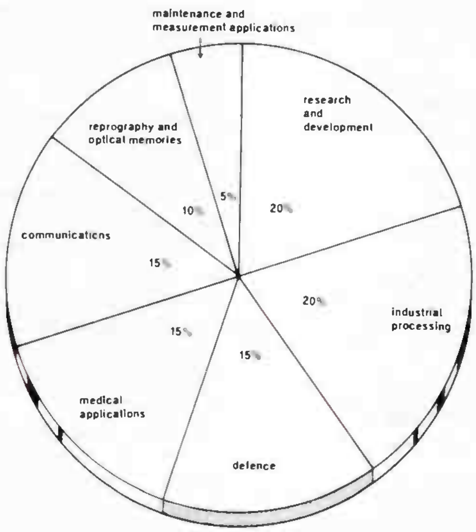


Fig. 16. Division of the world market for lasers in 1986.

itiative and in research into nuclear fusion. The exit beam diameter of such lasers is artificially increased to about 1 m to prevent vaporization of the lenses.

By far the most common lasers nowadays are **semiconductor or injection lasers**. These lasers are based on the fact that a population inversion of electrons can be achieved by applying a voltage across the p-n junction of doped gallium-arsenide (GaAs) material. Semiconductor lasers are available for operation from the near ultraviolet to well into the infrared regions. An artist's impression of the construction of a GaAs laser is shown in Fig. 15.

Semiconductor lasers are of prime importance in modern communications, optical memories, and in compact disc players. In fibre optic communications, for instance, they enable transmission rates of 1400 Mbit/s to be achieved. Without the small dimensions of the diode laser, it would not have been possible to develop the compact disc player. A very recent development based on the diode laser is compact disc video.

In the fore-front of laser development is the **excimer laser** which uses diatomic rare-gas hallides as the active material.

References:

Advanced level physics by M. Nelkon and P. Parker

Optics and its uses by G. F. Lothian

Physics of atoms and molecules by B. H. Bransden and C. J. Joachain

Quantum physics of atoms, molecules, solids, nuclei, and particles by Robert Eisberg and Robert Resnick

Physics by David Halliday and Robert Resnick

Fundamental University Physics by Marcelo Alonso and Edward J. Finn

Australia's laser industry – fledgling, but lusty nonetheless

Australian enterprise has not been slow off the mark to exploit the commercial possibilities offered by lasers and there is a small, yet growing band of companies offering a range of products and services.

LASERS find application in a wide variety of fields, ranging across medical services, surveying, barcode readers, high speed photography, beacons for major constructions, maritime lighthouse beacons, holographic imaging, non-contact gauging in manufacturing, promotional displays, entertainment, etc.

Gas lasers of various sorts find wide application in medical services, being used in laser acupuncture equipment, in the treatment of scar tissue, birthmarks etc outside the body and for surgical applications internally.

According to John Tobin of Laser Light Expressions in Sydney, optometry will soon feel the effects of technological development in laser applications. Currently, eye tests take some 15 minutes, requiring an essentially manual process. With a machine currently under development using a very low power laser, the process can be automated and the time to complete the test reduced to around one minute!

"Rubbing out" birthmarks

A Sydney doctor is using an argon gas laser to eradicate birthmarks on patients with remarkable effect. Lasers have been used for this purpose in the past, but the suffered because surface skin was burned in the process and some patients suffered scarring and incomplete eradication of the birthmark.

The new technique, using an argon gas laser, permits heating of the small blood vessels crowded beneath the skin that form the birthmark. The output of an argon laser is readily absorbed by red blood cells, but not by tissue in the surrounding skin, so selective heating of blood in the vessels involved in the blemish takes place. This coagulates the blood but does not burn surrounding tissue. The old blood is naturally swept away and the tiny vessels close up, effectively removing the birthmark.

A laser aligning tool for pipe laying. This is Laser Alignment's Model 4700, courtesy Laser Alignment of Leichhardt NSW.

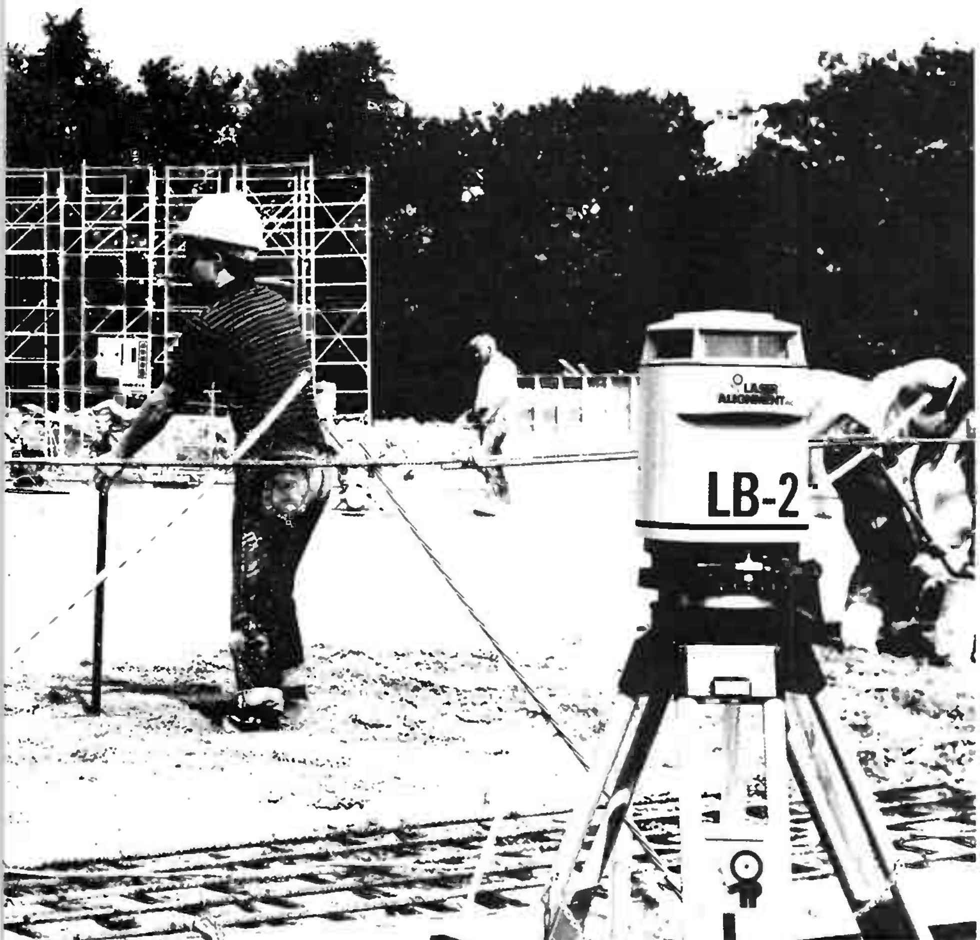
Survey and construction

Lasers have been used in surveying and alignment instruments for some time. Surveying construction sites can be done with greater accuracy and speed using specialised instruments for the job, and the task partly automated. Pipelaying is a task that demands accuracy and specialised laser instruments designed for the job are being increasing used to save time on civil construction work, building construction, in mines etc.

Laser Alignment (a Wrimco company) of Leichhardt in Sydney's inner west, specialises (as the name spells out!) in laser alignment and surveying instruments, carrying a range of products for the heavy construction, machine control and mining industries. They import and distribute equipment from Laser Alignment of Michigan in the USA. Lasers employed in this application have outputs in the one to three milliwatt range.

For survey work, site preparation and laying of formwork, a "beacon" is set up on a tripod and "eye" alignment unit used to show alignment with the beam.

– to page 54 ▷



Site surveying using a specialised laser instrument. This is the LB-2 system from Laser Alignment of Leichhardt NSW.

Correct use of XLRs and the 6011 Audio Balanced Line Driver

Dear Roger,

I am writing regarding the 6011 Audio Balanced Line Driver, and in particular the XLR sockets.

The XLR connectors have been around for as long as I can remember and over the past years of using professional equipment I have made the following observations.

1) The output sockets should be of the male type with the pins, not the females as indicated on the project.

2) Pin 1 is ALWAYS the ground/shield connection, and has the longest socket connection on the female end so that it mates first. VERY important on high power amp systems. This project shows pin 2(?) as ground/shield.

3) You have pin 2 and 3 shown wrong, they should be swapped around. Just look on a connector, it shows the numbers.

4) Again, Pin 1 = ground, Pin 2 = hot, Pin 3 = cold.

5) Jands and some other power amplifier manufacturers make pin 3 hot and pin 2 cold, which is confusing enough when using unbalanced to balanced connections. Please don't make it any more confusing.

6) Schools also make all fixed connectors male; I presume so that kids can't poke things in the holes.

Please do some further research on XLR connectors from Cannon and from leading pro sound companies and please publish errata on the project unless there was a reason for wiring it this way.

I hope you won't take offence to this letter, I'm only trying to help and keep a standard a standard.

Keep up the good work and happy birthday!

Mervyn Jack,
Cobram, Vic.

No offence is taken! The project was published as supplied under contract from Technical Systems Australia, which is headed by David Tilbrook.

The project was primarily designed to interface the output of a preamp to the balanced input of the 6503 Active Crossover (Feb. 1986) as part of an active, or electronic, loudspeaker system. However, applications for the project were clearly not restricted to that. I assumed, perhaps wrongly in retrospect, that as XLRs were specified, a standard connection scheme would be adhered to.

Even used purely in the electronic loudspeaker application in a dedicated role, the XLR scheme shown may present problems as pin 2 is used as the ground/shield, rather than pin 1. All would be well provided all connections were made with the equipment off, which is generally the case, but not always so.

So, thank you for your letter, we made an unwarranted assumption that Technical Systems would get it right and were caught out. The XLR connections for the 6011 should be amended as you suggest.

Roger Harrison

Disapproval over $600 modem approval fee

Dear Sir,

I can't tell you how disappointed I am with you and your organisation.

Your magazine has always impressed me as a professional publication, with the interests of your readers at heart.

Well, I find it hard to believe that you would publish several modem projects with all the pertinent warnings about the Telecommunications Act 1975, and not know that Telecom charge $600 just to look at an authorisation application.

For you to withhold this information is a gross dereliction of your responsibility to your readers.

J.M. McDonald
Tullamarine Vic.

On reading your letter, I was pleased to note your comment about having been impressed with the magazine in the past. This suggests to me, that like the vast majority of our readers, you might hang on to your back issues. If this is indeed the case, you will be able to refer to the past correspondence that has taken place on this subject.

If you refer to the "Dial Up" column on page 98 of the December 1986 issue, you will find a discussion on kit modems and approvals. The main thrust of this article concerns the $600 fee charged for modem authorisations and how this affects the hobbyist and kit constructor. The article goes on to propose a possible solution to the situation and invites comment from both interested readers and Telecom themselves.

A representative of Telecom subsequently responded to that invitation and their reply appears on page 92 of the May 1987 issue.

We regret that you feel that you have been misled, but the issue of connecting home constructed modems to the switched telephone network has been around for a good many years. I would have thought that the majority of enthusiasts would be aware of the situation as it stands. I also feel that we adequately fulfill our moral obligation to hobbyists and to Telecom, by pointing out the necessity of obtaining authorisation for modems which we present as constructional articles.

As indicated above, we have given considerable publicity to the situation regarding kit modems and so have many other publications. Despite this fact, we do not feel that it is necessarily part of our moral duty to publish details of the Telecom charges for work which they perform any more than we need to detail the cost of transmitting licences before publishing an amateur radio project. We must draw the line somewhere.

Andrew Keir

Speech synthesiser Centronics hookup

Dear Sir,

Congratulations on a very interesting magazine.

I would like to build the low-cost speech synthesiser (project AEM4504) from your February 1986 issue. Could you please tell me the correct pin connections for a Centronics interface. I would like to use the synthesiser on an Apricot and a Kaypro computer.

David I. Hoyer,
Cherrybrook, NSW

Thanks for the kind remarks. Here are the required connections to interface the 4504 to a Centronics (parallel) port:

Centronics connector	4504 16-pin DIL socket
2 (D1)	11 (A1)
3 (D2)	5 (A2)
4 (D3)	12 (A3)
5 (D4)	4 (A4)
6 (D5)	13 (A5)
7 (D6)	3 (A6)
11 (BUSY)	9 (SBY)
17 (GND)	8 (0 V/GND)

You will also need to connect pin 9 of the SPO256 (LRQ) to pin 19 of the Centronics connector (DATA STROBE). Pins 20 through 25 inclusive should all be connected to GND. Use a ribbon cable and and insulation displacement Centronics connector, ensuring lines 20 through 25 are included, although they don't have to be connected to GND at the 4504.

Roger Harrison

Project pricing

Dear Sir,

I have just gone through the July issue of your magazine and in the Letters section, I must agree with C. Hodgkiss of Blacktown concerning his remarks on the current financial state in which we find ourselves. A large number of kits are just overpriced.

However, one area I am keen on is the two metre amateur band. I have asked around clubs and people I know and this band, and all the others for that matter, are so expensive to get onto. One good touch would be a group of articles on making a receiver for this band, and maybe notes for us new chums to electronics.

Apart from tech. courses and/or WIA courses, there is no scope to help the "new" chum who, because of shiftwork etc, is unable to get to formal courses. Some of the "over the counter" courses may be good, but where do you go with questions when no clubs are in your area or not open?

Could we have a two metre receiver and maybe later a transmitter?

R. Cocks,
Cambridge Park, NSW

Keep reading!

Electrostatic discharge simulator from MiniZap

If you've got an electrostatic discharge problem, or frequently have to investigate such nasties, you'll be interested to know that electrostatic discharge (ESD) specialist, KeyTek Instrument Corp., has announced the MiniZap addition to it's series 2000 electrostatic discharge (ESD) simulators.

Available in two standard models,the MiniZap extends the high performance of it's top-of-the-line model 2000 to the manufacturing floor and the field in a one-piece, low cost rugged unit, which can be operated from built-in rechargeable batteries.

MiniZap offers both TRUE-ESD air discharge and Fast Rise Current Injection (FR/CI) modes and meets existing and proposed IEC standards.

The expanded 2000 series is the first to meet the mandatory requirements of company-wide testing (pulse integrity and repeatability), providing test results that correlate, no matter which model tester is used.

Further details on MiniZap are available from **The Dindima Group Pty Ltd, PO Box 106, Vermont 3133 Vic.**

New display module

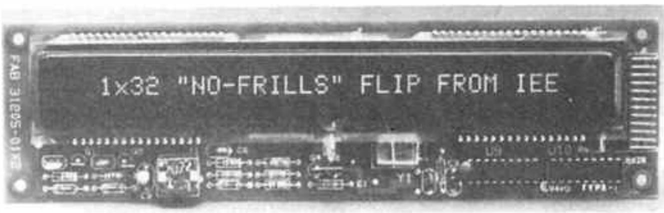
A new low-cost, 5 × 7 dot matrix, one-line × 32 character intelligent vacuum fluorescent display module has been released by M. B. & K. J. Davidson P/L.

Designated the Model 3601-83-020, is said to be ideal for high-volume OEM applications, such as copiers, point-of-sale terminals, pay telephones, and security systems. The module measures 205.7 by 56 mm by 20.8 mm. Characters are 5.1 mm high.

This new low-cost model shares many of the most convenient features of the FLIP family of intelligent VFD modules. An on-board microprocessor controller handles all scan, refresh, and data I/O tasks, permitting easy interface via an eight-bit ASCII parallel data bus. Only +5 Vdc power is required.

The 3601-83-020 displays an extended ASCII character set of upper and lower-case letters, numbers and symbols. Display characters are a bright, pleasant, blue-green colour that provides for comfortable short or long-term viewing. A wide spectrum of colour filters is available to fit almost any application.

For further information, contact **Kevin Davidson, M. B. & K. J. Davidson, 17 Roberna St, Moorabbin 3189 Vic.**



Sign of the times

Moving messages are a sign of the times and the latest innovation in this field is the multi-colour, high-intensity "Colour Cells" electronic display board just released by Display Systems Australia.

Text can be up to 70 mm high and varied to produce three-dimensional, flashing, bold or italic characters in upper or lower case. The unit also produces graphics and symbols suitable for illustrating all sorts of messages.

The Colour Cells display board measures 850 mm x 133 mm x 50 mm and is economical to run, consuming between 30 and 50 watts of power.

The Colour Cells board retails for $1795 and comes with a six month full parts and labour warranty. Enquiries should be directed to **Display Systems Australia, 127 McEvoy Street, Alexandria 2015 NSW. (02)690 1988.**

Miniature crystal oscillators

Fred Hoe and Sons of Brisbane has released a range of miniature oscillators in 8-pin DIP packages, each with a programmable frequency divider.

Division outputs from ½ to 1/28, simultaneously with the original frequency can be achieved with the device.

Composed of an AT-cut oscillator and a specially designed CMOS IC divider, the devices provide low power consumption, high speed operation and can be used on a wide range of supply voltages.

For further information, contact **Fred Hoe and Sons Pty Ltd, 246 Evans Road, Salisbury 4107 Qld. (07)277 4311.**

Non-metallic thermocouple

It has recently become possible to manufacture long thermocouples using non-metallic thermoelements. The principle has been known for forty years, but recent developments in Boron Carbide manufacture have made this a practical device.

The combination gives an output in the 500 mV range and is designed for use from 1900 to 2000 degrees Celsius where tungsten Rhenium thermocouples become unstable. The output is linear from 600 to 2200 degrees Celsius and usage may be extended to this range, it is claimed.

Further details from **Electro Chemical Engineering Pty Ltd, 7 Mobbs Lane, Carlingford 2118 NSW. (02)858 2044.**

semiconductor scene

WELCOME to this, the first column of what we aim to be an informative monthly series, containing news, new product information, data and applications information. Following our announcement of the forthcoming column to the various importers and distributors around Australia, we've received quite a mountain of interesting material which we'll attempt to digest and present over the coming months. There's some pretty interesting developments and devices to look at, so let's get on with it!

Local distribution for Novix and NCR MED

Energy Control International Pty Ltd, of Sumner Park, Brisbane, won the distributorship of Novix FORTH engine products just a few months ago (The Novix FORTH processor series has been discussed in Roy Hill's Dial Up column for some months) and was recently appointed the Australian Representative for NCR Microelectronics Division (MED).

The division specialises in the metal-oxide semiconductor (MOS) market and it's products include commercial, automotive and military Application Specific ICs (ASICs), Digital Signal Processing (DSP) devices, Customer-Owned Tooling (COT)/Foundry services, logic products, microprocessors and ROM products.

We'll keep you posted of developments.

Local chip maker on a winner?

In the last few issues our Dial Up columnist, Roy Hill, has enthused about several new species of chips which have just hit the market. He appended a comment to this issues column which we felt was better placed here. Here's what Roy had to say:

"I would be guilty of the greatest omission if I did not mention the the brilliant new microcache chip from Austek in South Australia, headed by Dr Craig Mudge. This chip, the A38152 is designed to be a co-processor chip for the Intel 80386 and should significantly reduce disk read/write times by pre-reading data into memory. This is not the equivalent of 'carrying silicon to Santa Clara,' as no-one in the US has come up with an equivalent chip. IBM would be very stupid (no correspondence will be entered into) if they don't clasp this chip firmly to their PS/2 line of beasties."

Analogue-to-digital converter features easy microprocessor interfacing

Texas Instruments has sent us, among a host of goodies, a sample and information on their TLC548/9 8-bit A/D converters which are designed to easily interface to most microprocessors.

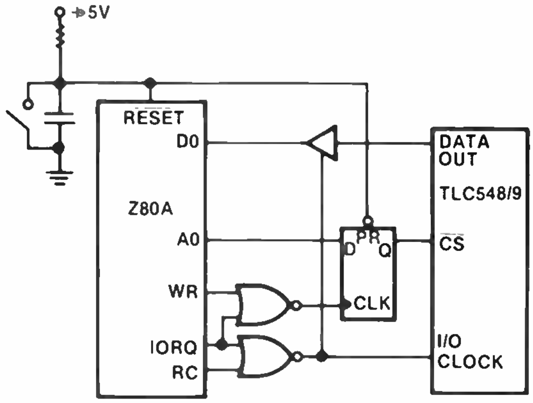
Manufactured using TI's LinCMOS technology the TLC548/9 comprises an 8-bit switched-capacitor successive approximation analogue-to-digital converter. Part of the TLC540/1 family, the TLC548/9 operation is very similar to that of the more complex 540 and 541 devices which have 11 analogue inputs. However, the TLC548/9 uses only the input/output (I/O) clock input and the chip select (CS) input for data control.

Unlike the 540/1 devices, the 548/9 provides an on-chip System Clock which typically operates at 4 MHz and requires no external components. This allows the internal device operation to proceed independently of the serial I/O data timing, thus allowing flexible software configurations. Independent clocks for I/O and system timing allow both high speed data transfer and a maximum sample rate of 40 kHz.

In addition, the 548/9 features an on-chip sample-and-hold circuit that can operate automatically or under microprocessor control. The high speed converter has differential high impedance reference voltage inputs that facilitate ratiometric conversion and scaling, while isolating the conversion circuitry from logic and supply noise. The 548/9 provides low-error conversion of ±0.5 least significant bit (LSB) in less than 17 microseconds, according to the specifications.

The TLC548 and TLC549 are available in an 8-pin plastic package for both commercial and military temperature ranges. Some operating data is reproduced here.

From the data supplied, the device is very easy to use. Here's the circuit of how it's interfaced to a Z80, for example, along with software.



Required Software

A simple program segment that reads in a previous conversion result and starts a conversion is shown below. Placing this program segment in a loop makes it possible to initiate a conversion and read previous conversion results in 111 microseconds.

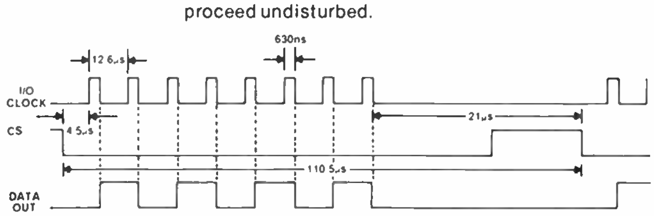
```
        LD C.08H          . Load bit counter
        LD B.00H          . Initialize result register
        OUT (CSLOW).A     . Bring Chip Select low
LOOP    RLC B             . Rotate result register left
        IN A.(BIT)        . Read in a bit & shift next
        AND 01H           . Mask off bit 0
        OR B              . Or new bit with result
        LD B.A            . Store in result register
        DEC C             . Decrement bit counter
        JP NZ.LOOP        . Get another bit if not zero
        OUT (CSHIGH).A    . Bring Chip Select high
```

The Operating Sequence

Latching in a low from address bit A0 brings Chip Select low. Execution of an IN instruction causes $\overline{RD}$ and $\overline{IORQ}$ to become active, generating one I/O Clock pulse. A data bit is read in just before the falling edge of the I/O Clock. The falling edge shifts out the next data bit.

Sampling of analog input begins at the falling edge of the 4th I/O Clock and continues until the falling edge of the 8th I/O Clock. At that time, conversion begins; conversion requires 17 microseconds.

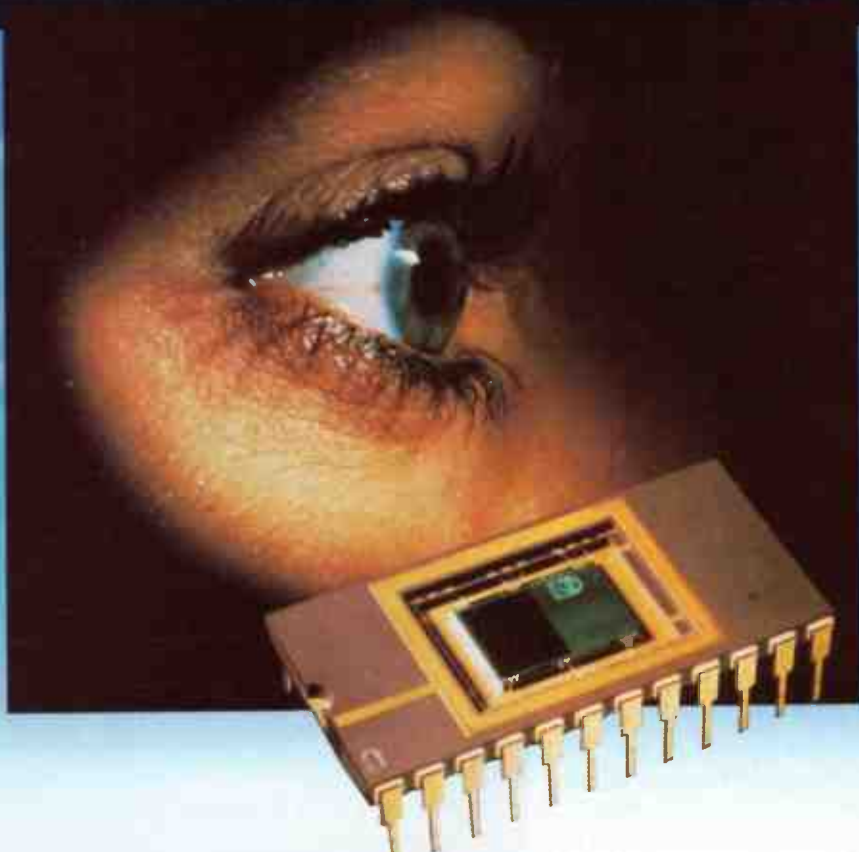
$\overline{CS}$ is brought high after the 8th I/O Clock to disable all inputs and outputs so that conversion may proceed undisturbed.



Timing Diagram

If you have a 6502-based computer system having a 6522 ▷

The things ICs will make possible...



At first it was seen as a technological curiosity. Now it's a practical reality, thanks to Philips.

Solid state imaging is a fine example of how Philips development of IC technology is changing the face of consumer electronics, medical technology, telecommunications and aerospace.

These amazing Philips Integrated Circuits allow the design of video cameras that are ultra lightweight with minute dimensions, low power needs, greater durability and longer life.

Already, Philips solid state imaging is achieving broadcast quality and in some applications replacing camera tubes altogether. A revolution.

The other things it will make possible were once the stuff of vivid imaginations – robot eyes, videophones and advanced character recognition devices.

As electronics approaches the precision and complexity of the human body, Philips ICs and microprocessor innovations are leading the conquest of new technological frontiers.

While you may not be in the market today for solid state imaging, the Philips quest for new technology solutions is applied to everything we do.

Some even more remarkable advances are on our drawing boards around the world.

Think of the things Philips leadership will make possible... we are.

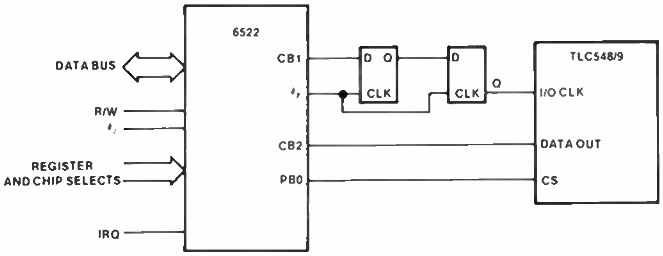
Sydney (02) 439 3322 Melbourne (03) 542 3333 Adelaide (08) 243 0155 Perth (09) 277 4199 Brisbane (07) 844 0191

PHILIPS Electronic Components and Materials

PHILIPS

United Notions 818

VIA peripheral interface chip (e.g: as used in the Commodore 64), then interfacing the 548/9 is a doddle! Look at this:



Software

```
;                  REGISTER ASSIGNMENTS
;
ORB        EQU 0000H
DDRB       EQU 0002H
SR         EQU 000AH
ACR        EQU 000BH
;
;
           LDA  #$01         ;
           STA  DDRB         ; Initialize port B I/O pins
           LDA  #$01         ;
           STA  ORB          ; Bring Chip Select high
           LDA  #$08         ; Shift in on Phi 2 mode
           STA  ACR          ;
```

The interface control software is given below.

```
           LDX  #$00         ;
           STX  ORB          ; Bring /CS low
           LDA  SR           ; Clock in previous results
DELAY:     LDY  #$03         ;
           DEY               ; Delay while results shifted in
           BNE  DELAY        ;
           LDX  #$01         ;
           STX  ORB          ; Bring /CS high
           LDA  SR           ; Load previous results into ACC
```

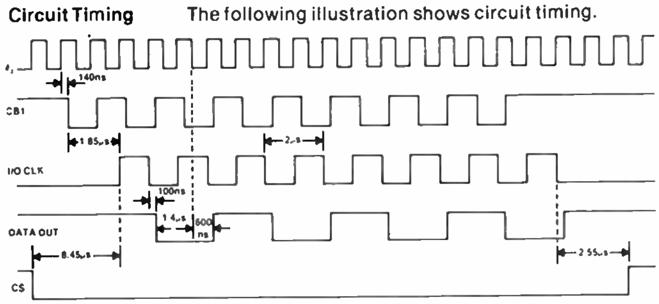
The Operating Sequence

A data-conversion cycle begins when a low is written to output pin PBO of port B, which brings Chip Select low. Previous conversion results are shifted in by reading the SR. The D flip-flops effectively delay the I/O Clock to meet all of the setup and hold time requirements. A software delay loop allows for the data to be shifted in.

Conversion of the analog input begins on the eighth falling edge of the I/O Clock and requires 17 microseconds. $\overline{CS}$ is then brought high by writing a high to PBO. Results of the previous conversion can then be read from the 6522 into the 6502 while a new conversion is in process.

Circuit Timing

The following illustration shows circuit timing.



Further information and data is available by writing on your company or departmental letterhead to Texas Instruments, 6 Talavera Rd, North Ryde 2113.

The TLC549 is stocked by Geoff Wood Electronics, 229 Burns Bay Rd, (PO Box 2066) Lane Cove West 2066 NSW. (02)427 1676.

Solid-state lasers threaten gas

Semiconductor laser technology is making rapid progress in the two important areas of wavelength and power output.

Short wavelength solid-state lasers have been produced in the past, but their lives have been very short. Similar problems hampered infrared semiconductor lasers from their invention in 1962 until 1970.

At a conference on lasers and electro-optics in Baltimore in April, Tohru Suzuki of NEC's research laboratories in Kawasaki reported success with gallium-indium-phosphorus lasers at 678 nanometres. Several lasted over 4500 hours whilst emitting a steady three to five milliwatts at room temperature.

Red semiconductor lasers have yet to reach the market, but if they can be manufactured economically, they seem sure to replace the bulkier, more power-hungry, gas lasers for many purposes.

Chipset shrinks IBM-compatible designs

Now they've shrunk an IBM PC motherboard to the size of a half-card! Well, almost. Faraday Electronics, of Sunnyvale California (where else?!) released at the end of April several chipsets that enable microcomputer system designers to build very compact, low power consumption, higher speed systems compatible with IBM PC, PC-AT and Personal System/2 Model 30 computers.

Faraday's 8- and 16-bit chipsets reduce the circuitry of IBM-compatible PC designs into two or four postage stamp sized ICs, respectively. Fabricated in CMOS technology, they offer lower power consumption and higher noise immunity than existing designs which predominantly employ LS (low power Shottky) chips, according to Faraday.

To support their propositions on shrinking compatible designs, Faraday has produced a single board PC bus computer called the Micro PC II on a card that measures 107 x 158 mm (4.2 x 6.2 inches), about 18 mm longer than a typical half card. The board is "form factor" compatible with standard IBM expansion cards.

It employs an 80C88-10 CPU, an 8087 coprocessor socket, reset port, keyboard port, speaker port, 256K of RAM on board and the Faraday PC-compatible ROM BIOS. Software selectable clock speeds are: 4.77, 7.15 and 9.45 MHz. It employs Faraday's FE2010A and FE2020 VLSI ICs which replace 79 chips in IBM's design. Faraday has released a "starter kit" based around this design.

And the good news is: Faraday Electronics is represented in Australia by J.I.T. (Australia) Pty Ltd, 15 Stud Rd, Bayswater 3153 Vic. (03)720 1333. They also have offices at 176 Harbord St, Brookvale 2010 NSW, (02)938 4539.

Fault-finding, tools and techniques

Part 2

Andrew Keir

Last month, we talked about the general methods of approach in diagnosing faults, with an emphasis on analogue types of equipment. This month, we are going to concentrate on the tools and techniques which apply to fault finding in digital equipment.

MANY of the techniques used in servicing analogue equipment can also be applied to digital equipment. You will still need to do the "preliminaries" before diving in boots and all. In any type of servicing, the aim is to narrow down the area of the fault by examining all the clues you can find. As we said last month, the clues are found by many diverse methods ranging from questioning the operator or owner of the equipment, a careful examination of the symptoms produced by the fault and a degree of experience and intuition.

Plenty of servicemen who predominantly work on analogue equipment seem to have the idea that digital equipment is simple by comparison. After all, you are only dealing with signals that are in one of two states. A logic signal should either be there or not, there's no halfway. If it were only that simple! What many fail to appreciate is the speed at which things happen in logic circuits. A missing pulse only a few nanoseconds long can have a profound effect on the circuit's operation.

So, how do you go about finding a missing pulse of such short duration? The answer to this leads us to examine the type of test equipment designed for logic fault finding and it is in this area that the main differences exist between servicing analogue and digital equipment.

General purpose instruments

Of the two "universal" instruments, multimeters and oscilloscopes, only the oscilloscope has a wide application in digital work. The usefulness of the multimeter extends only to checking power supply rails and other static measurements. Not even the latest type of digital meter with a "bargraph" display can give meaningful results if you are trying to examine the output of a gate in all but the slowest logic circuit.

In digital work, the instrument which could probably be regarded as the equivalent to the multimeter is the logic probe. This device will give you an indication of the state of any circuit node. Indication is generally by means of LEDs, although some types also use a beeper device which provides high or low tones according to the input. A logic probe will tell you whether the node you are checking is high, low, pulsing or floating.

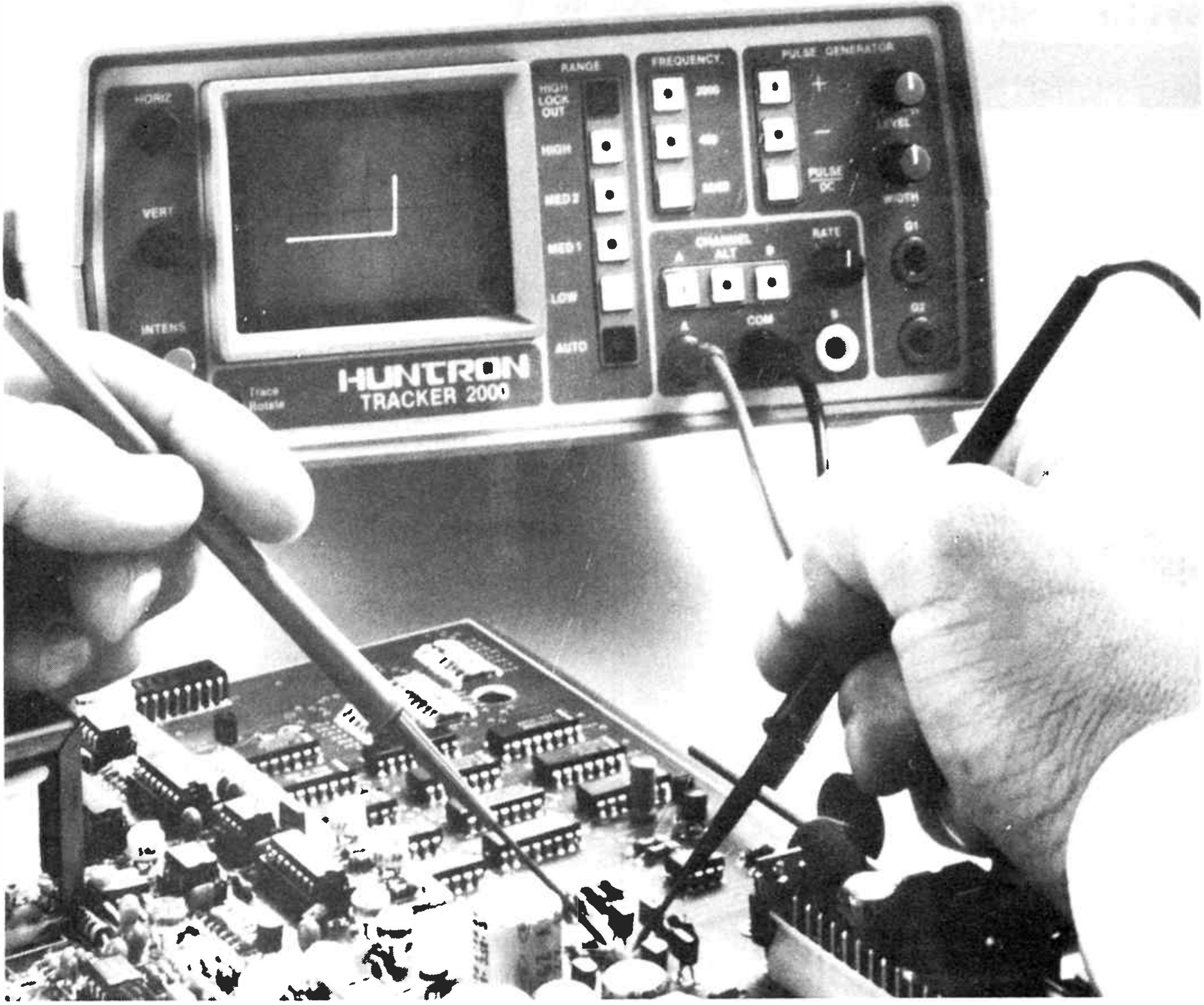
There are two basic methods of employing a logic probe. The first is for simply checking the activity of any given node. If you know that the output of a gate should be pulsing and the probe indicates either a static high or low signal, you know you have a problem. By checking the input of that gate for activity, you can reasonably well determine if the gate is faulty or whether the problem exists further back in the circuit. The same sort of thing applies to microprocessor circuits where logic probe can be used to check the activity of address and data lines. The one failing with this sort of approach is that a logic probe can only tell you if activity exists. You have no idea of how fast a node is pulsing or what the pulses look like, only that pulsing exists. For a detailed examination of the node's activity, you will have to resort to other instruments which we will discuss shortly.

The other method of employing a logic probe is in conjunction with a device called a logic pulser. A logic pulser is a device which can be used to force a given node to it's opposite state by applying a pulse of fairly high current but very short duration. By using a logic pulser and a logic probe, you can examine the output of a gate to see if it changes state when you alter it's input conditions. Of course, this sort of thing only works with simple gates. You can't go pulsing the address or data lines of a microprocessor chip and expect to see the results with a logic probe.

Oscilloscopes

You could use an oscilloscope to get a better idea of what is going on in a logic circuit, but your choice of instrument here will determine how much information can be extracted, just as it would when working with analogue equipment. As I mentioned in part one of this article, it's all a matter of horses for courses, but this extends beyond which instrument to use, to types of instrument within a group. As an example of this, a general purpose oscilloscope which would be ideal for working on audio equipment, may not be the best choice in servicing high speed digital circuits. Certainly you would be able to examine the activity present at different circuit nodes, but

The Toneohm 580 instrument from Polar is a low-cost current tracer that can be used to locate bus faults, multilayer board shorts and wiring loom problems. It uses a 0.55 V, 50 kHz drive source and a sensitive magnetic field probe. The drive source is applied to the suspect bus or the bus of a suspect board and the probe used to locate shorts or partial shorts by following the current path. The probe is sensitive enough, according to Polar, to detect current flow through an IC substrate and within layers of a multilayer board. Emona Instruments are the agents; contact them at PO Box K720, Haymarket NSW 2000. (02)519 3933.



with a basic instrument, it is only a small step beyond the logic probe.

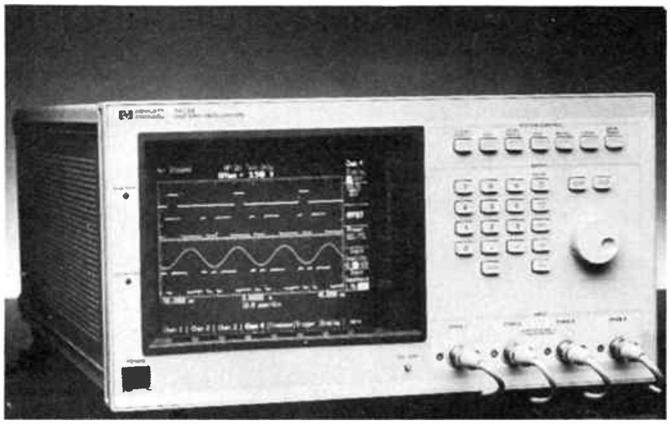
There are oscilloscopes which are specifically designed for digital work and the features that these offer will give you a much clearer picture of what is going on. The basic requirements are a wide bandwidth and good triggering characteristics. Dual traces are virtually essential so that you can make comparisons between different nodes. Beyond this level, you will start to see features such as storage capability where a monitored waveform or pulse string can be stored for further examination and deeper analysis. Falling into this category, you will find instruments which can operate as both a wide bandwidth analogue oscilloscope and a digital storage oscilloscope. At this point, the instruments are becoming less like oscilloscopes and more like the next step up the ladder, the logic analyser.

The logic analyser

The logic analyser is an instrument which can be used to examine multiple circuit nodes simultaneously. Unlike the oscilloscope, it does not display the actual amplitude of a signal or pulse, the trace simply indicates the logic level of the points being examined. The advantage of a logic analyser lies in it's ability to examine multiple points over a given time period. In logic circuits and in particular, microprocessor-based circuits, it is common for many parameters to change simultaneously. Take for example, the address decoding in a typical small microprocessor circuit, unless you have a static fault on one of the address lines such as a constant high, low or floating condition, you will find it most difficult to analyse exactly where a problem lies. By using a logic analyser to monitor the address bus over a short period, you will be able to see what is happening on each line with regard to every other line.

It is often an advantage to be able to see what happens when a particular set of circuit conditions are met. Most logic analysers can be set up to wait for a particular byte or binary code to be present on it's inputs and will trigger the display when this is seen.

When we were discussing analogue equipment, mention was made of "in-circuit" type testing apparatus which would enable the serviceman to compare a faulty pc board or assembly with a known working unit by monitoring various circuit parameters. In the logic world, a similar device is used, called a signature analyser. This device is connected to an assembly under test and monitors various functions of the circuit over a period of time. In this way, the device builds up a "signature" associated with that assembly. This signature can then be compared to that of a known working assembly and by analysis of the two signatures it is possible to arrive at the probable causes of any differences. Essentially, a signature analyser allows a serviceman to compare a good circuit with a possibly faulty one in much the same way as the "in-circuit" analogue board testers. ▷



If digital servicing is your game, here is your "dream machine"! The new HP 54112D digitizing oscilloscope from Hewlett-Packard has four channels, 64K datapoints deep of waveform memory and a bandwidth of 100 MHz for single-shot and repetitive applications. In addition, the HP 54112D provides triggering on edge, pattern, state, delay by events and delay by time.

Diagnostic software

Those who are involved in the servicing of computers will be able to make use of other "tools" to assist your efforts. It is unusual, especially in larger computers, for the whole thing to be dead, so it will often be possible to run some "diagnostic" programs on the machine which can be a great help in narrowing down a fault. Whether you can run these diagnostics will obviously depend on the extent and nature of the fault. If the CPU has failed, you probably won't be able to do much at all. Similarly, if an input device such as the keyboard has failed, you may not be able to load diagnostic software. Problems with computer peripherals can often be tracked down by means of simple substitution. If you suspect a faulty disk or tape drive, it is fairly straightforward to substitute another unit and confirm that the fault lies in the peripheral, not with the computer or interfacing circuitry.

Common faults

Now that we have looked at some of the tools that are available to help you, let's examine some faults that can occur and how to deal with them. Commencing with simple gates, faults within the chip itself are only likely to present a limited range of symptoms. Internal open circuits will provide a variety of symptoms which depend on whether the shorted node is an input or an output. In the case of an open circuit output, the node will usually float at an indeterminate logic level. This means that the voltage on the node is somewhere above the "low" threshold and somewhere below the "high" threshold. Depending on the logic family concerned, this floating level can have a variety of effects. In TTL (transistor-transistor) logic, a floating signal will usually have the same effect as a logic "high" as far as the following circuitry is concerned. The symptoms would therefore be the same as if that circuit node was in a static "high" condition but a good logic probe or examination with an oscilloscope would show that the actual logic condition was "in between".

If we look at the case of an open circuit input to a gate, the signals to that pin will appear as though all was well. As far as the chip is concerned though, it behaves as though that pin were disconnected or floating. As just mentioned, in TTL circuitry, the chip will interpret this floating condition as a logic "high". Finding this type of fault is therefore a little more difficult than the open circuit output, but by examining the input and output of the gate, you will realise that the output behaves as though there is a static signal on the input. Short circuits within the chip will cause various symptoms, depending on where the short lies. If a node is shorted to the ▷

POWER-OFF FAULT-FINDING

One method of isolating faults in a system is to hook up a variety of test equipment, turn the equipment on and then analyse it's functions and performance. This is called "functional testing".

A multimeter can tell you if the voltage or current levels are correct, an oscilloscope tells you about waveforms and a logic analyser provides information on bit patterns. From the data gained, an experienced technician attempts to deduce where the fault might lie. This sort of approach is quite valid but has the disadvantage of being rather time consuming.

Another approach to fault finding is the use of an automated test equipment (ATE) system. Unfortunately, these are expensive and do not always make economic sense for board repair. ATE systems usually require a large investment in software development and hardware jigs and fixtures. This sort of investment can not always be justified, particularly where only small numbers of faulty boards are concerned. ATE systems are primarily used in production line and warranty service applications where high volume throughput is encountered.

The Huntron Tracker range of instruments is designed to provide a fault-finding technique which overcomes these limitations and operates on a principle similar to a "semiconductor curve tracer". The Tracker generates a current-limited sinewave voltage signal which is injected across two points of the device under test. The voltage across the device produces a horizontal signal to drive a CRT display, while the current through the device produces a vertical signal for the CRT. In this way, the Tracker displays the current-voltage characteristic or "analogue signature" of whatever the test terminals are connected to.

The test signal is bipolar (both positive and negative) so that, if the Tracker is connected to any kind of semiconductor junction, both the forward bias and the reverse bias characteristics are displayed. Because of the current-limited signal, this technique is non-destructive. To troubleshoot a power-off circuit, you would typically clips one lead onto the supply or ground rail and uses the other lead to test components, observing the various signatures produced. Leakage, shorts and opens can be easily detected.

If a known good board of the same type is available, then troubleshooting is made even easier. By clipping onto the same reference (e.g: supply or ground) on both boards and then checking the same points on each, the user can find differences in the signatures. All Trackers feature a "Compar-A-Trace" feature to aid in this kind of comparative testing. The signatures from each channel are alternately displayed on the CRT so that differences are obvious.

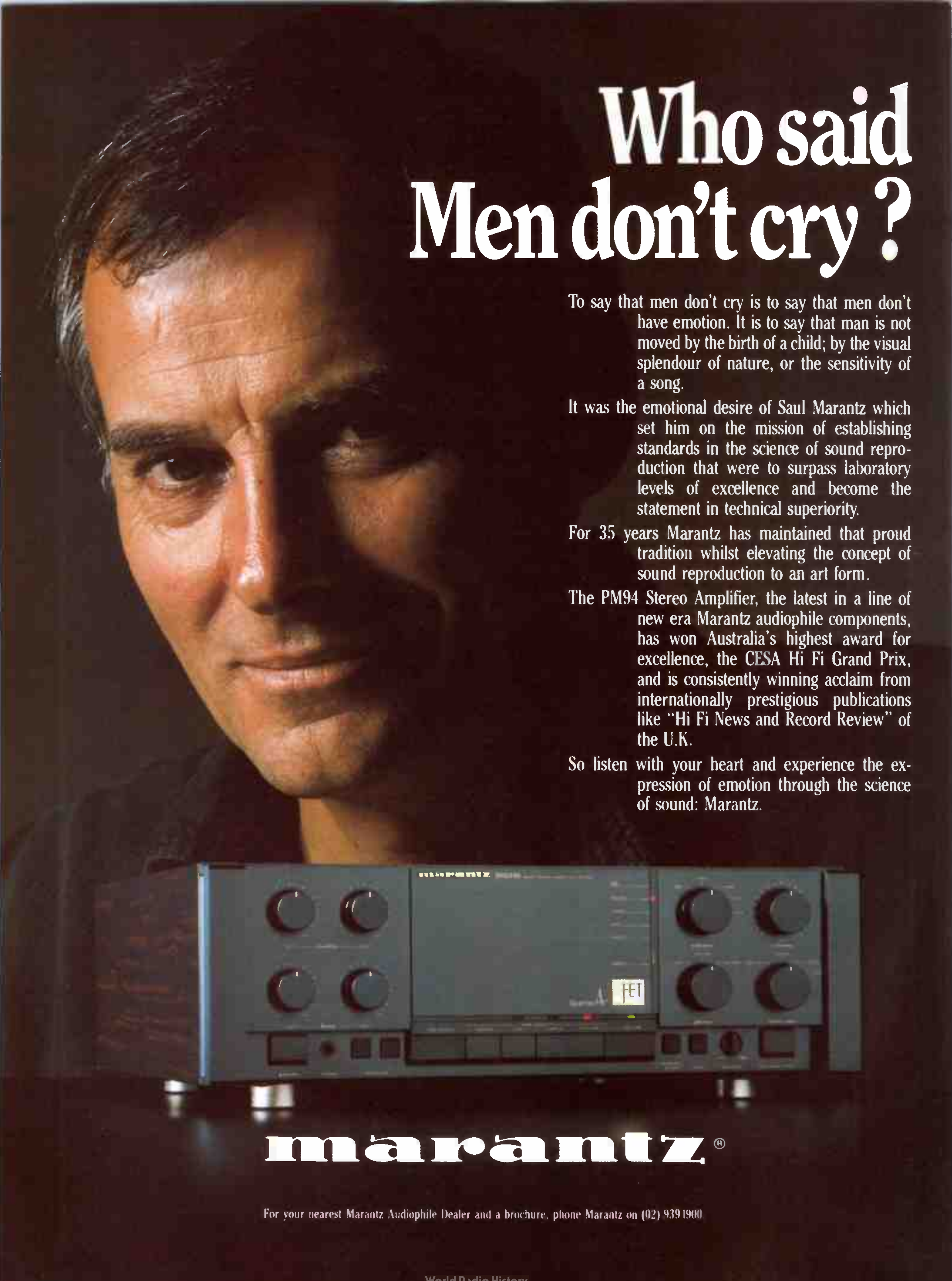
Huntron Trackers are easy to learn to use and greatly improve the speed and efficiency of servicing work, according to the makers. Huntron Instruments Inc. produce two models of the Tracker. The Tracker 1000 is a basic model with three impedance ranges. The Tracker 2000 is an enhanced model providing four impedance ranges and a variety of extra features.

Huntron Instruments Inc. are represented in Australia by **ECQ Electronics Pty Ltd. 16 Staple Street, Seventeen Mile Rocks, Queensland 4073. Telephone (07)376 5677 or toll-free, 008 777 112.**

supply or ground, you will see a static "high" or "low" signal imposed on the node. This type of fault is thus quite easy to find. More difficult is a short circuit to a node other than supply or ground. In this case, you will need a dual trace oscilloscope or a logic analyser to indicate the problem.

One point which should be made is that logic chips are most unlikely to develop intermittent problems. It is very rare for a device to only fail partially, almost every chip failure is quite definite and catastrophic in terms of it's performance. It's a bit like logic itself, it either works properly or not at all. There are no halfway failures.

Short or open circuits which are external to the chip, such as solder splashes or broken tracks on a pc board, will produce the same symptoms as those internal to the chip. In cases such as this, a good visual examination may reveal the problem, but failing this, a check with a logic probe and logic pulser will often prove fruitful. Similar techniques can be applied to more complex devices such as microprocessors. – to page 63 ▷


Who said
Men don't cry?
To say that men don't cry is to say that men don't have emotion. It is to say that man is not moved by the birth of a child; by the visual splendour of nature, or the sensitivity of a song.
It was the emotional desire of Saul Marantz which set him on the mission of establishing standards in the science of sound reproduction that were to surpass laboratory levels of excellence and become the statement in technical superiority.
For 35 years Marantz has maintained that proud tradition whilst elevating the concept of sound reproduction to an art form.
The PM94 Stereo Amplifier, the latest in a line of new era Marantz audiophile components, has won Australia's highest award for excellence, the CESA Hi Fi Grand Prix, and is consistently winning acclaim from internationally prestigious publications like "Hi Fi News and Record Review" of the U.K.
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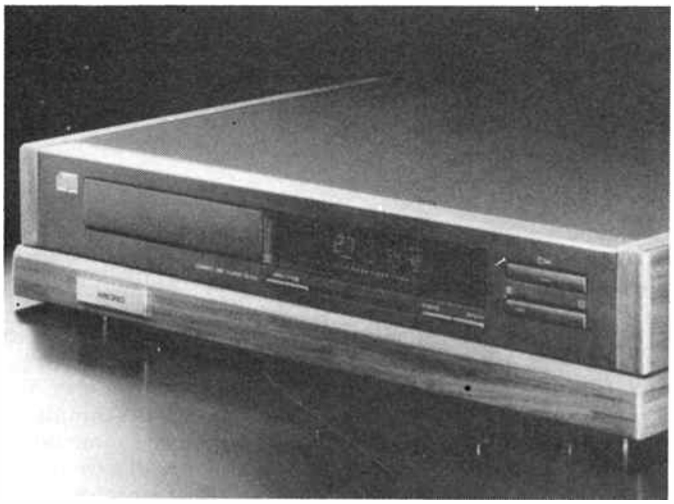
Micro Seiki CD player features both analogue and digital outputs



After receiving many accolades in the overseas press, the Micro Seiki CD-M2 CD player has been released here through Audax Loudspeakers of Melbourne.

The CD-M2 offers four times oversampling, true 16-bit resolution, twin digital to analogue (D/A) converters and a claimed signal-to-noise ratio of more than 104 dB.

The D/A section is followed by a low pass third order Bessel filter with a gentle roll-off rate to provide low distortion and avoid the stereo imaging problems said to be endemic to players which employ other filter types.

Micro Seiki has paid attention to the elimination of vibration, employing a triplex damping structure on the bottom panel comprising lead, ferrite and alloy materials.

Chassis frame rigidity is ensured, the company says, by the use of a zinc diecast frame. The CD-M2, not surprisingly, weighs 22 kg!

Multiple output configurations are offered on the CD-M2. balanced 600 ohm XLR outputs are provided for professional use, along with single ended gold RCA connectors. A digital output and an optically-coupled output are provided for direct digital output transmission.

Full remote control is offered, providing program play, direct access play, one track/whole side programme repeat, track/index search and programme scan.

Bill Webb, Managing Director of Audax Loudspeakers, Melbourne, says that the CD-M2 is designed for high quality and professional sound systems. It retails for $5500. It comes with a full two-year warranty. **Enquiries to Audax Loudspeakers, Melbourne (03)543 5266 .**

New speakers from Audiosound Labs

Audiosound Laboratories' new "Prague" 8045A loudspeakers are a medium size control monitor designed for small studios, control rooms and high quality PA systems.

The bass end is Thiele/Small aligned to give a roll-off which achieves –3 dB at 42 Hz. The driver employs a vented magnet and high temperature voice coil.

The dome treble driver is fed via an 18 dB per octave filter employing polyester capacitors and air-cored inductors.

The cabinet is all-timber veneered, is slim and well-braced, making it ideal for wall mounting, Audiosound claim.

These speakers were chosen for the new 2CA studios in Canberra and are to be used for the new FM station and the satellite service of Macquarie Broadcasting in Canberra.

Further details from **Audiosound Laboratories, 148 Pitt Rd, North Curl Curl 2099 NSW. (02)938 2068.**

New loudspeaker from Tannoy

Tannoy's new DTM-8 loudspeaker unit is a compact desk-top or near field monitor, offering an extremely wide dynamic range and claimed to be unsurpassed as a portable reference monitor.

The DTM-8 features an eight inch (200 mm) dual concentric drive unit capable of high maximum sound pressure levels, excellent phase response and a smooth, well balanced frequency response, according to Tannoy.

The black, textured finish cabinet, constructed of medite, is lined with TFI, an acoustically absorbent material which is extremely efficient in deadening reflections within the enclosure.

For further details on the DTM-8 loudspeaker, contact:

Hi-Phon Distributors Pty Ltd, Unit 1, 356a-358 Eastern Valley Way, Chatswood 2067, NSW. (02)417 7088.

The "Claytons" consumer electronics show!

Malcolm Goldfinch

The US Chicago summer Consumer Electronics Show has been the focus for the world's consumer electronics industry for many years – a "mecca" for marketers, buyers, distributors and media the world over. Perhaps this year the Chicago CES visibly passed its zenith. Video – or shall we broaden that to picture imaging – was the only field in which something really new was offered.

IT WAS a Clayton's sort of show, by all reports – a show when you have nothing to show. Attendances were down from previous years. There were rooms to spare in the hotels convenient to the convention, exhibits were easy to see and to try equipment hands-on. There was no great new gee-whizzery – unless you consider Super VHS (SVHS) as the toe of an elephant which will trample all before it in the next few years.

CD-Video (CD-V) has arrived, without any great enthusiasm from the trade. But a total new configuration for laser disc players has hit the fan. Magnavox announced the release, for the third quarter this year (i.e: now), a combi player that will playback CD, CD-V and laservision (12") discs. A horizontal disc loading tray senses the disc size and makes the adjustments. Remember the swinging arm for sensing the size of stacked discs on record players of 20 years ago?

So what are this year's hot products?

Picture-in-picture (PIP) TV and VCR add-on boxes abound. Any new television set without PIP will be pipped in the marketplace from now, it seems. Handheld copiers are now well established as a "legit" new line. Cellular radio portable telephones also made the grade as a new fast mover this year. But, all these lines are just plus products on staple consumer lines. This left the front running again to video for any exciting new novelties.

Camcorder video leads again

Opinion at Chicago clearly recognised the camcorder as the top dollar catcher again. With VHS-C sprinting ahead and full format VHS not far behind, 8 mm video was lagging in spite of brilliant new models from Sony and their camera industry cohorts.

Retailers point to consumer reluctance to buy another VCR just to play back V8 video from the no-replay models, or to connect the camcorder to the TV for those with replay. V8 software from video libraries is still special order. A complication is the Kodak version 8 mm video introduced some three years ago which has compatibility problems with current V8 format recordings. Owners of older Kodak 8 mm machines are not giving testimonials for new improved V8. Kodak appears to be very low key in video, except in the marketing of blank video cassettes.

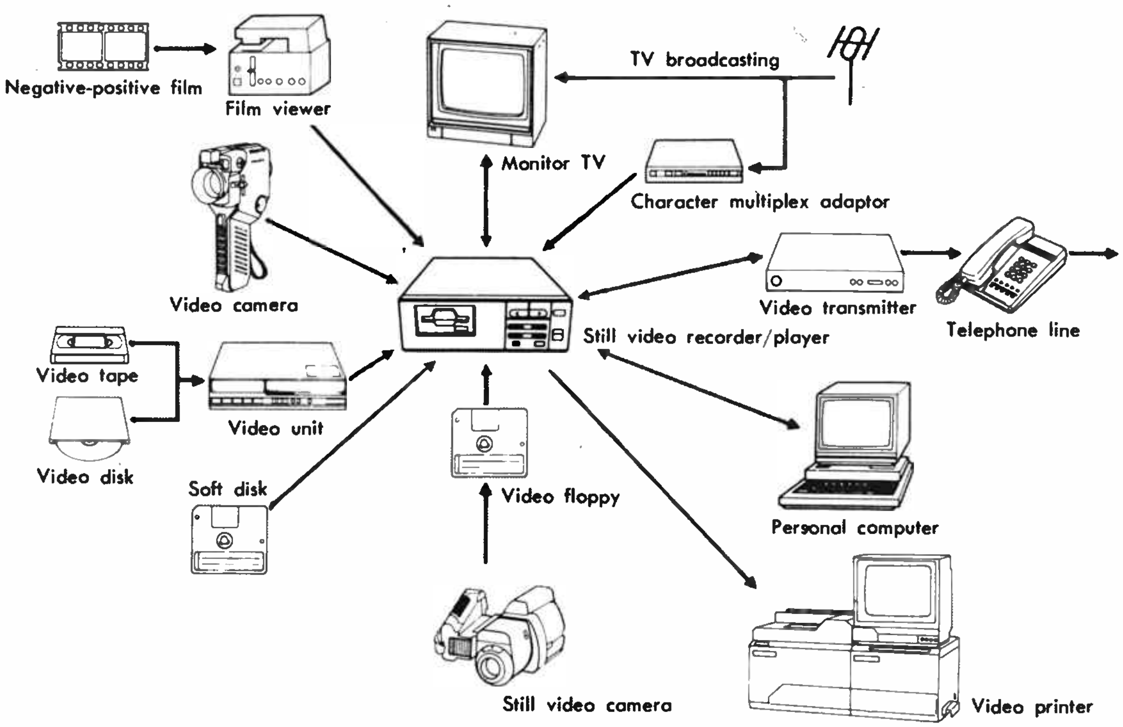
Electronic photography – is it here?

Well, nearly. Konica released three major products which could show the way in this new branch of electronics that may well see the demise of the mass consumer base of the chemical photographic industry. The Sony "Mavica" solid state camera dream of 1982 has now come true through the consumer marketing of electronic photography. Until now, electronic photography was only for professionals.

The fact that Konishiroku were making a big presentation to the electronics trade at Chicago shows which way the wind is

Figure 1. Konica's KR-400 Still Video Recorder (SVR) is central to the new electronic imaging concept. The media is a two-inch floppy disk on which up to 50 pictures can be recorded.

Figure 2. The electronic imaging system, as seen by Konica, showing how the SVR is central to the whole concept.



blowing in the photographic imaging industry. Camera companies are backing electronics sales and servicing. As came out at the January Las Vegas CES, chemical photofinishing modules were again to the fore as an adjunct to video retailing. When it's summer and video software sales and rentals take a dive, camera film processing is up. Now the video outlets look like adding electronic picture processing and camcorder sales.

The competition for film photography is not just a replacement of the snapshot, it is a whole new system operating within the well-worn tracks of world TV/video formats. Figure 1 shows the KR-400 Still Video Recorder ("SVR", a new acronym to remember!) as the epicentre of seven different inputs. It is the central imaging concept; now a fact, no more a theory. The concept is illustrated in Figure 2.

The KR-400 SVR will accept images from negative or positive process film via the film viewer, from a TV transmission or videocassette recorder, a video disc or CD-V stills, from software on disk, through to PC text and graphics, and of course, from the KC-400 Still Video Camera (Figure 3). The latter looks not quite like a cross between a common SLR film camera and a mini-mini camcorder!

The KC-400 uses an f1.5 aperture, 12-36 mm zoom lens optical system, tried and proven in film camera use. Here the image is focussed onto a ⅔" CCD (charge-coupled device) imaging chip with 380 000 pixels. Where it departs from video practice is that it actually uses a shutter, of the focal plane variety, which allows frame (two fields) and/or full field pictures in the recording mode. Dedicated flash with auto shutter setting make lighting a breeze. All status is shown on an LCD display. Colour temperature compensation is manually selected to taste.

All the imaging data is recorded on one of the newly-approved format video floppy discs ("VFD" - put that in your glossary!) These record 50 pictures in field mode, or 25 in the frame mode with full 2:1 field interlace.

The "exposed", or "written" to be more precise, VFD is removed from the camera and inserted into the SVR which will instantly image the shots on a TV or monitor. Random field/frame selections can be made by a hand controller. Dubbing for direct image copying is an option, and single track/frame erasing is possible.

The system at present is NTSC, but PAL will likely follow.

What really frees this technology from the tyranny of hard copy is the ability to shoot the images from the SVR into any 'phone system or network and have the third item of Konica's still video system decode the RGB and turn out glossy colour prints every 7.5 minutes; and the prints are of very high definition.

This unit is called the Colour Video Printer (CVP!) and is much smaller than minilab film processors. It is dry – no water in or drain out. It is not likely to be a consumer product for the home. Rather, you take your disc to the corner store with the CVP and you can pick the pictures to make 111 x 148 mm prints from on the monitor.

Electronic photography really is here, but for the camera buff, you'll have a long wait yet.

Super VHS S-VHS

Undoubted star of the show was JVC's Super VHS demonstration, another "soon" product, though. The format offers greatly improved horizontal video resolution – from a typical 230-240 lines (at best) with current technology to 430 lines. A staggering upgrade for an old format. You also get stereo hi-fi sound, depth-modulated along with the video. ▷ – to page 93

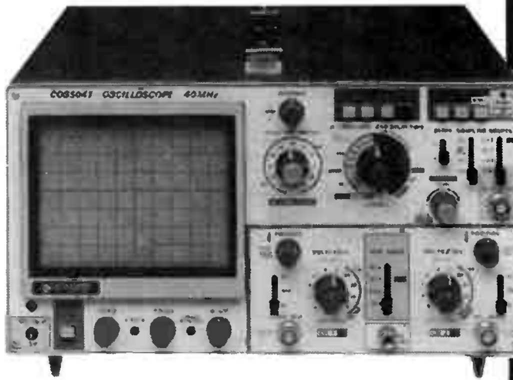
Figure 3. Konica's KC-400 all-electronic camera.

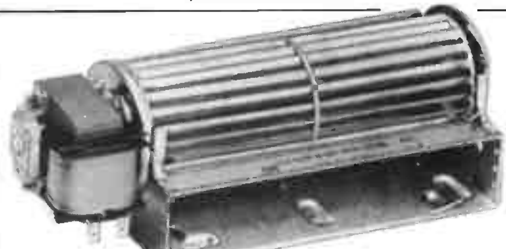
COS5041 40MHz Dual Channel Oscilloscope for the Workshop or Laboratory

The Kikusui COS5041 is intended for production line, lab, workshop and field maintenance use. With a wide bandwidth of 40MHz and 1mV maximum sensitivity it will find a wide range of applications. Versatile triggering is one of the big advantages of this scope - including Auto trigger level lock, vertical trigger mode, variable hold-off and dc trigger coupling. Sweep modes include Auto, Normal and Single sweep. A CH1 output is also provided. Price includes two switchable probes.

COS5041 ...... **$1348.60 ex tax**
$1573.40 inc tax

- **Two channels**
- **Versatile triggering**
- **Sensitivity - 5mV/div to 5V/div, dc to 40MHz**
- **Main Timebase - 20nS/div to 0.5S/div**
- **Delayed Timebase - 0.2µS/div to 0.5mS/div**
- **Auto trigger level lock function**
- **1mV/div max sensitivity**





ITT High Quality Tangential Blowers

Geoff has obtained a very limited quantity of ITT Tangential Blowers manufactured by the German company Standard Lorenz AG. The flat stretched construction ensures a high throughput of air over the whole width of the impellor at low pressure. Noise level is whisper quiet. Self-lubricating, sintered bronze sleeve bearings are used with the drive end directly connected to the 240V ac motor via an elastic coupling. Delivers 34litres/second. Measures approx 250 x 96 x 85mm. A fraction of their true value at $49.50 (P&P $10.00 due to their bulk!). Hurry they won't last at this price and we can't get any-more.

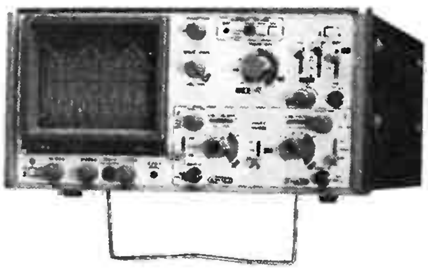
Mains Interference Filter Cord Set

This filter has been specially designed to protect equipment from mains-borne interference. It plugs into a normal IEC socket, has a 300mm lead and IEC socket for easy connection. So why tear your computer etc apart to fit a filter when you can simply plug this one in and get on with the job? Rated to 6A and made in the UK by Belling Lee, it can also be used to improve filtering in existing equipment. **$25.90**
Geoff also carries a wide range of IEC plugs and sockets etc.

20MHz SCOPE WITH ALTERNATE TRIGGERING

- *Economical 20MHz scope*
- *Sensitivity - 5mV/Div to 5V/div, dc to 20MHz*
- *Timebase - 20nS/div to 0.5s/div*
- *Max sensitivity 1mV/div*
- *Modes - Ch1, Ch2, Dual, Ch1 + Ch2, X-Y*
- *Sweep - Auto, Normal, Single*
- *Variable hold-off*
- *External horizontal mode*

Price INCLUDES two FREE probes
GOS522...........$869.95
(inc tax) $745.67 (ex tax)

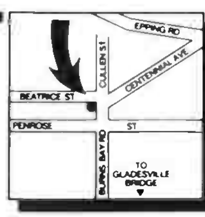


Geoff chose the Goodwill GOS522 as outstanding value in a 20MHz scope. It offers dual channel operation with a big 150mm screen and a 20nS max sweep for high precision. Alternate triggering greatly simplifies the knob-tiddling to get a stable display on both channels. Ask Geoff for a demo, you'll be delighted with the performance!

10pin SIL Resistor Networks

By popular request Geoff now stocks a range of resistor networks. They consist of nine resistors sharing a common connection in a ten pin single in-line package. They are available in the following values:
220, 330, 470, 680, 1k0, 2k2, 3k3, 4k7, 10k, 22k, 33k, 47k, 100k, 200k. 1/8W rating. Fits 0.1" grid.
Specify Value all 60cents each

8.30 to 5 Monday to Friday, 8.30 to 12 Sat.
Mail Orders add $5.00 to cover postal charges.
All prices INCLUDE sales tax.
Tax exemption certificates accepted if line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES



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Elektor Electronics in AEM

The projects and circuits chosen for inclusion in the Elektor section are selected on the basis of interest, local relevance and component availability. Intending constructors should consult our 'PROJECT BUYERS GUIDE' in this issue for a guide to component sources and possible kit suppliers.

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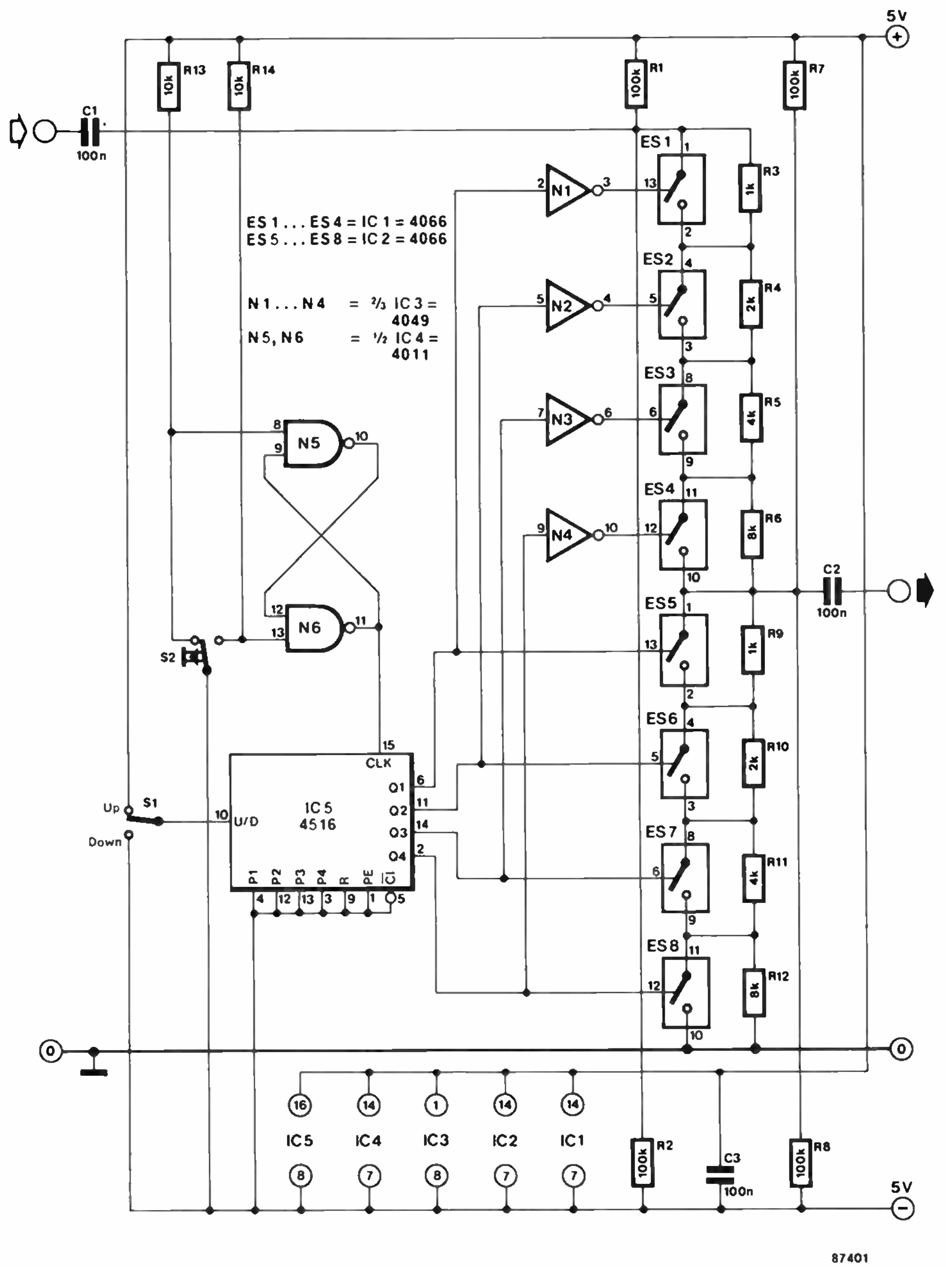
DIGITAL VOLUME CONTROL

Many of today's HiFi amplifiers feature a "clicking" volume control, but this is only rarely a real stepped attenuator based on a wafer switch. In nearly all cases, this expensive system is based on a normal potentiometer, whose spindle is fitted with a mechanical construction to simulate the stepping movement. A normal rotary switch is not suitable for adjusting the volume of an amplifier because it briefly disconnects the input from the signal source when operated, and so readily gives rise to clicks and contact noise. Different problems crop up when designing an electronic volume control. Of these, distortion is probably the hardest to master, but reasonable results are still obtainable, as will be shown here.

Basically, there are two methods for making an electronic potentiometer. One is to create a tapped resistor ladder (which is not much different from a normal potentiometer), the other is to change the resistance of the two "track sections" such that the total resistance remains constant. The circuit proposed here is based on the second method, and features 16 steps in its basic form. The number of steps can be increased to, say, 64 by adding four switches and resistors.

The electronic potentiometer is composed to two equal sections, which have a total resistance of 15 kΩ each. The electronic switches in each section are controlled by binary counter IC_5. Since the switches in section ES_1-ES_4 and those in ES_5-ES_8 are controlled in complementary fashion, the total resistance of the potentiometer remains constant. Resistors R_1-R_2 and R_7-R_8 serve to keep the potential at the input and output at 0 V so as to preclude clicks when the step switch, S_2, is operated. Switch S_1 is the up/down selector. Gates N_5-N_6 form a bistable to ensure that the counter is clocked with debounced step pulses.

The number of steps can be increased by adding a counter and the required number of electronic switches, divided over the two "track sections". These switches are then connected in parallel with resistors whose values correspond to binary order 1-2-4-8, etc., as shown in the circuit diagram. Fortunately, precise binary ratios are not required here, since adequate results are obtainable with approximations of the theoretical resistance values, and as long as the actual resistors are kept equal in both sections. *D*

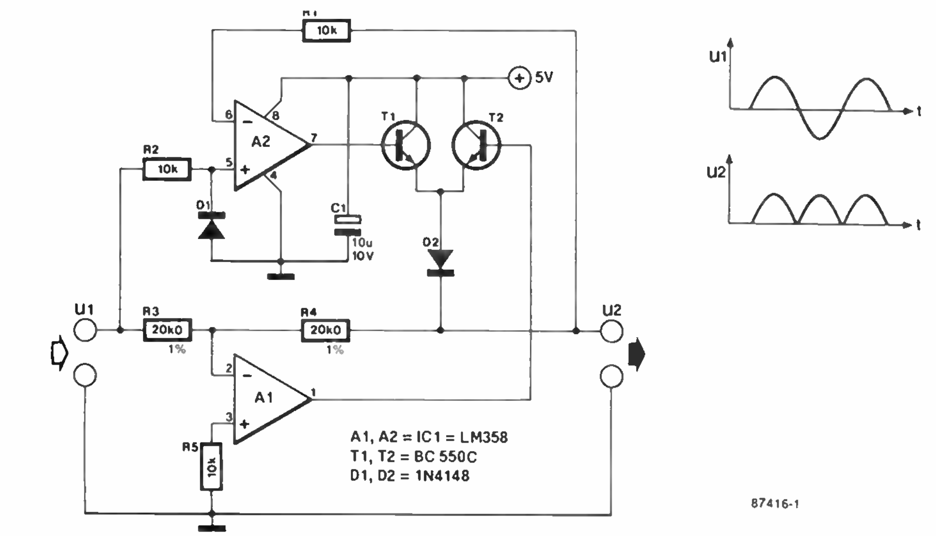


PRECISION RECTIFIER

This precision rectifier operates from an asymmetrical supply, handles input signals up to 3 V_{pp} and has a frequency range that extends from DC to about 2 kHz. Its amplification is unity, and depends mainly on the ratio R_4/R_3. Opamp A_1 is connected as a voltage amplifier ($A_0 = 1$), A_2 as an inverting amplifier ($A_0 = -1$). Opamp A_2, transistor T_1 and diode D_2 ensure that the output voltage, U_2, is identical to the positive excursions of the input voltage, U_1. When U_1 is positive, the output of A_1 is held low at about 0.25 V, so that T_2 is disabled and can not affect the rectified output signal.

Components R_2 and D_1 protect the pnp input stage in A_2 against negative voltages, which are effectively limited to −0.6 V. For negative excursions of the input signal, the function of A_1, T_2 and D_2 is similar to the previously mentioned components. The peak output voltage of the rectifier circuit is determined mainly by the maximum output swing of the opamps and the voltage drop across the transistors plus D_2: this amounts to about 3 V in all.

When the circuit is not driven, it consumes about 1 mA, and is therefore eminently suitable for building into portable, battery-operated equipment.



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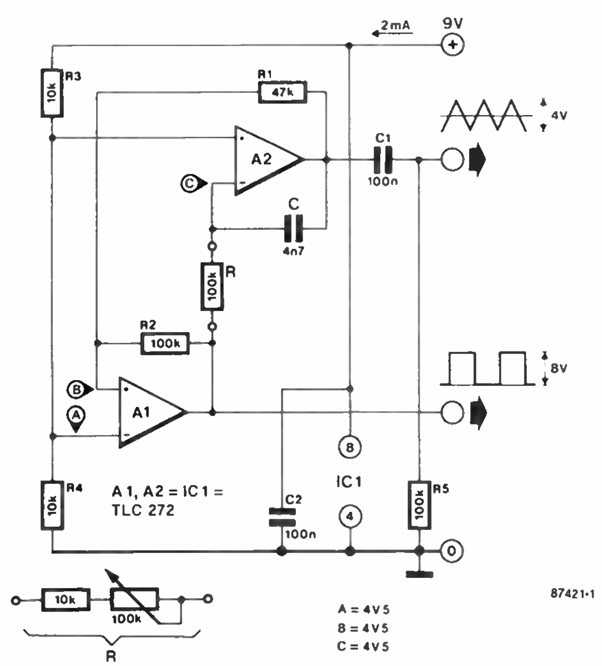
FUNCTION GENERATOR

This is a downright simple design for an AF function generator that supplies a rectangular and triangular signal, and can be fed from a single 9 V supply. The signal generator proper is a Type TLC272 dual CMOS opamp from Texas Instruments. This chip is remarkable for its low current consumption and wide operating range.

The circuit is essentially composed of two functional parts. Opamp A_1 is connected to function as a Schmitt-trigger whose toggle point is set to 4.5 V, while A_2 is an integrator that converts the rectangular signal from A_1 into a triangular waveform.

The oscillation frequency of the circuit is fixed solely by the ratio R/C and can be calculated from $f_0 = R_2/4RR_1C$. Resistor R may be replaced by the combination of the 10K resistor and 100K potentiometer as shown to effect continuous adjustment of the output frequency within the AF signal band. The generator should not be terminated in less than 10K.



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MORSE FILTERS

Morse, or CW (continuous wave), is still widely used thanks to the fact that the necessary equipment can be kept relatively simple, and therefore inexpensive, if the operator is sufficiently trained in selective listening. A morse decoding computer, however, requires an adequately filtered input signal, because it lacks the noise discriminating capability of the human ear. Some receivers can be upgraded with a 250 Hz IF filter for this purpose, but such an extension is usually well beyond the financial reach of most radio amateurs. The filters discussed here operate in the audible frequency range, and compare favourably with far more expensive types for 455 kHz. Figures 1 and 2 show the circuit diagram and the typical response of an eighth-order inverse Chebishev filter which has been optimized for non-computer using listeners. The filter of Fig. 3 is less complex, and intended for driving a computer. The associated frequency response is shown in Fig. 4. Both filters were designed with *Eldesign IIe*, an advanced filter design program for the BBC micro. The inverse Chebishev response gives a smooth pass-band, while the characteristic ripple ends up in

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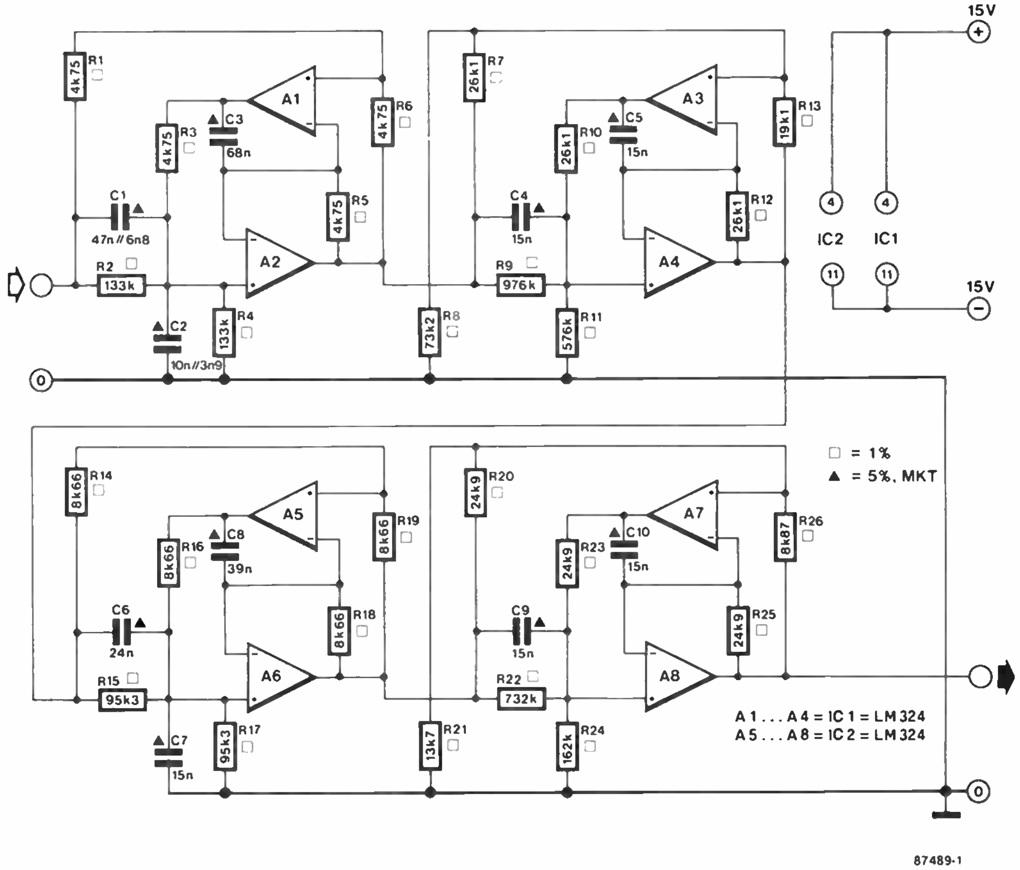

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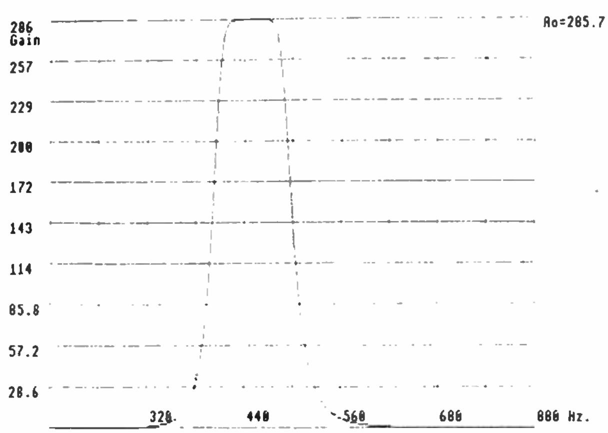

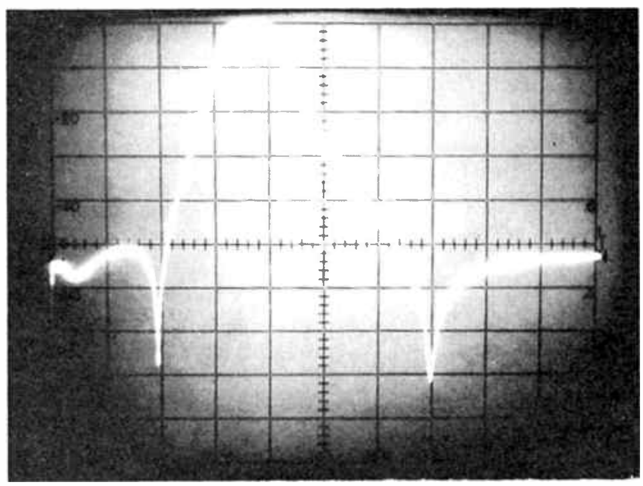

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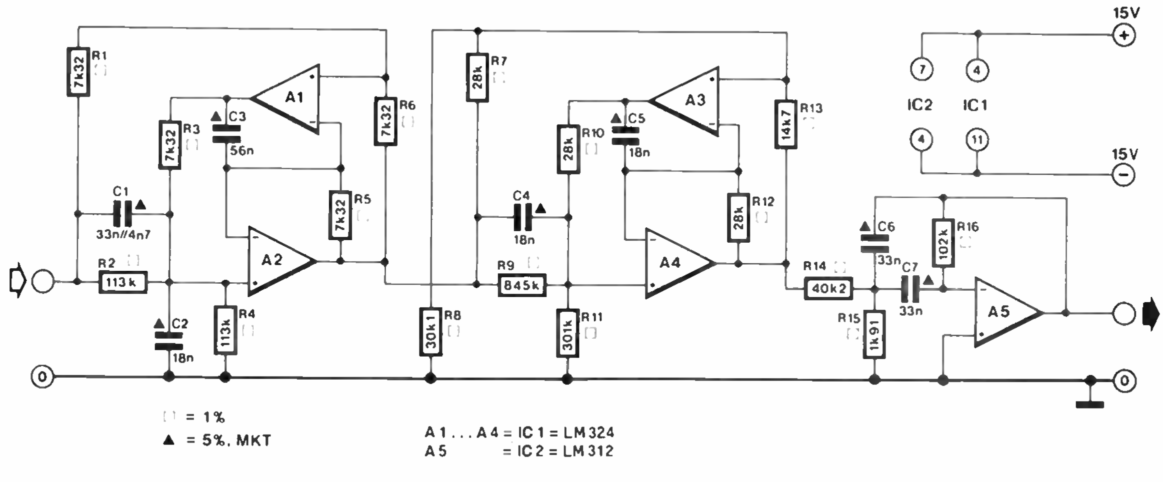

the stop band. This ensures the required phase stability in the pass-band, which is a must for processing burst-like signals such as morse.

Prototypes of the filters gave excellent results: normally hardly audible signals could be recovered for reliable decoding. The supply for the filters is preferably a symmetrical 15 V type to ensure an optimum dynamic range. Do not use any other opamp than the LM324, since types with a higher cut-off frequency may give rise to oscillation. Note that C_1 in Figs. 1 and 3, and C_2 in Fig. 1, is a parallel combination of two capacitors from the E12 range of values, while all resistors used are from the E96 range. Should any of the filter sections persist in its tendency to oscillate, either one of the even-numbered opamps may have to be dimensioned for a slightly different roll-off point by connecting a 100 pF capacitor across the output and the – input, and a 390 Ω resistor between the – input and junction C_3-R_5-(-A_1) (example refers to opamp A_2).

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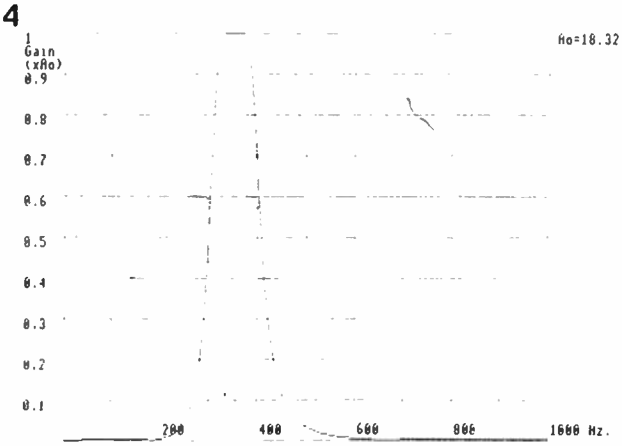

WIEN BRIDGE OSCILLATOR

This AF oscillator can be built with only one active component, and draws so little current that it is conveniently fed from a 9 V (PP3) battery.

The basic circuit of the Wien bridge oscillator is shown in Fig. 1. The oscillator consists of two sections, namely the opamp plus R_3-R_4 which determine the amplification factor, and positive feedback network C_1-R_1-C_2-R_2 which enables the circuit to oscillate. This network is composed of a low-pass section $R_2//C_2$, and a high pass section R_1+C_1. The phase difference incurred in these is nulled at the frequency of oscillation, when the filters form a pure ohmic potential divider with an attenuation of 3. Therefore, the opamp must have an amplification of 3, to keep the overall amplification at unity, so that the oscillation is maintained. The output frequency, f_o, of the oscillator is

$$f_o = 1/(2\pi\sqrt{R_1R_2C_1C_2}) \quad \text{[Hz]}$$

but only if $R_1 \approx R_2$ and $C_1 \approx C_2$. In the practical design shown in Fig. 2, the oscillation frequency is about 1,000 Hz.

Both the inverting and the inverting input of the opamp in Fig. 1 must be held at half the supply voltage to ensure minimum current consumption if the oscillator is to be fed from a battery. Figure 2 shows how this

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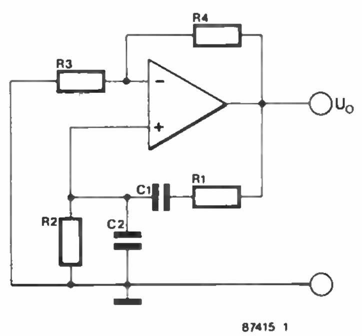

is realized in the practical version of the Wien bridge oscillator. Here, resistors R_2 and R_3 from Fig. 1 are seen as R_{2a}-R_{2b} and R_{3a}-R_{3b}, respectively, connected as voltage dividers. This can be done with impunity, because the voltage source is a virtual short circuit for alternating voltages, and there is also C_3 as an effective decoupling device. For an alternating voltage, therefore, the resistors are parallel combinations. Evidently, R_{2a}, R_{2b}, R_{3a}, and R_{3b} have two times the calculated resistance of the respective components R_2 and R_3 in Fig. 1. The amplification of the opamp is adjustable with P_1, which should be set for reliable oscillation at virtually no distortion of the output sine wave. When the oscillator is properly aligned, the distortion should be less than 0.1%.

The use of the Type TLC271 CMOS operational amplifier results in a current consumption of only 0.32 mA at U_o = 6 V_{pp}. It is possible to use a special low-power opamp such as the type OP-22 biased with a resistance of 1 MΩ to reduce the current consumption to 0.1 mA. However, this will cause the oscillation frequency to be limited to 1,000 Hz, due to the reduced slew rate at very low bias settings, which in turn give rise to a strong increase in the distortion level.

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PMI Application Note AB111.

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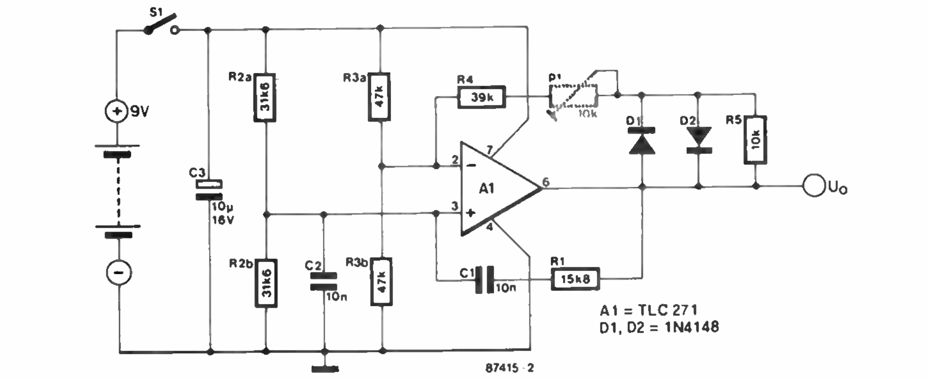

PRECISION CRYSTAL OSCILLATOR

from an idea by R Shankar

When designing crystal oscillators, it is good practice to ensure minimum capacitance of the active element(s), since any parasitic loading of the crystal is bound to derate the overall stability to some extent. This forms the underlying principle of the design described here, albeit that good results are also obtainable when an additional load capacitance is connected in parallel with the existing parasitic capacitance, but only if the former is known to possess a low loss factor and a low temperature coefficient, i.e., if it is a very high quality capacitor (and possibly difficult to obtain).

The oscillator proposed here is a Pierce type, in which the crystal operates in parallel mode. The input is formed by a bootstrapped source follower, DG MOSFET T_1, which has a parasitic capacitance of only 1 pF. RF transistors T_2-T_3 are set up as a cascode amplifier. A type BF494 transistor is used in the T_2 position because of its low B-E capacitance (0.15 pF typ.), which ensures a low output capacitance. The oscillator signal is taken from the source of T_1, buffered in T_4, and made logic compatible with the aid of gates N_1-N_3. The optimum inductance of L_1 is approximated with $L_1 = 1/f$, where the inductance and frequency are in milli-henries and megahertz respectively. Example: for f = 10 MHz, L_1 works out at 100 μH. Trimmer C_2 serves to accurately tune the crystal oscillator to the required frequency. The oscillator works well up to about 20 MHz.

Finally, although the dissipation of the crystal is not expected to give rise to instability, it is still a good idea to keep an eye on its output amplitude so as to preclude the protective diodes in T_1 being activated and causing unacceptable instability. If required, R_7 is altered until the signal amplitude at the emitter of T_4 is less than 1 V_{pp}.

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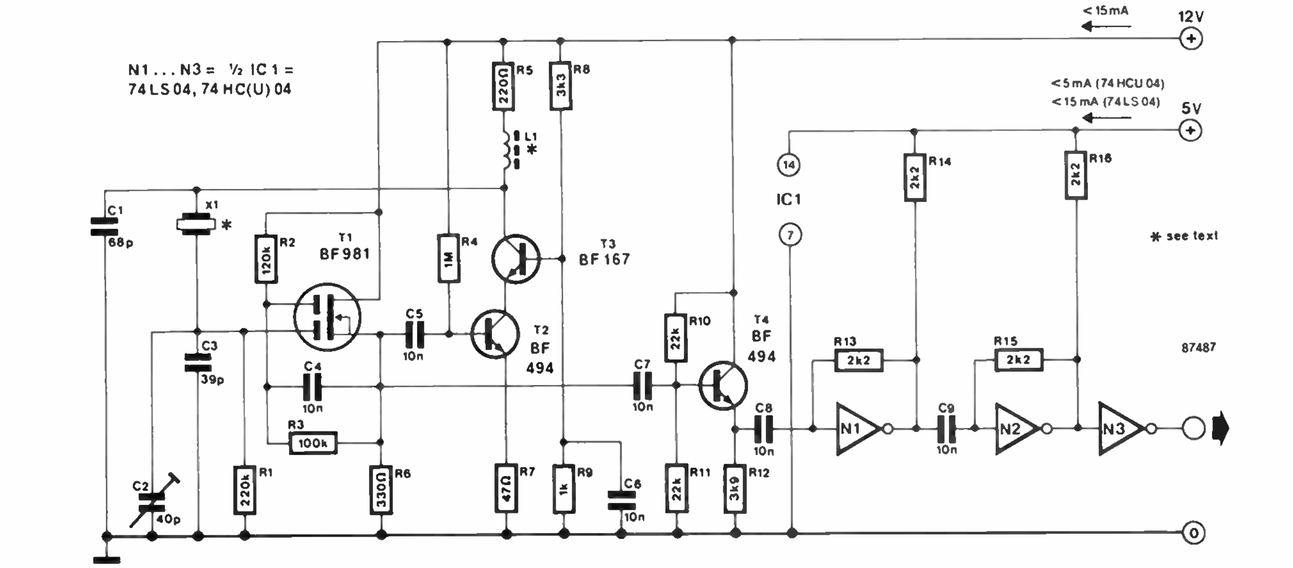

LIMITER FOR GUITARS

by W Teder

The basic dynamic characteristic of a chord can be analysed as a fast rising, needle-shaped pulse with a virtually exponential decay—see Fig. 1. This typical amplitude characteristic can only be faithfully reproduced by an amplifier if this is operated well below its overload margin, and that, many guitar players know, generally results in too low an average sound level. Also, when it is desired to use a high volume setting, the distortion soon rises to an unacceptable level. Although the above difficulty is widely remedied by means of a tightly set compressor or limiter, the sound may then lack the required agressiveness. This circuit is expected to give better results than most other limiters, because it is only active in the upper range of the dynamic characteristic.

The gain of the preamplifier set up around IC_1 is asjustable with P_1. The inverting input of the opamp is grounded via the drain-source junction of n-channel FET T_1, which operates as a voltage-controlled resistance here, and is driven with a negative gate voltage derived from the limiter's output signal. The gain of the opamp is therefore inversely proportional to the gate voltage of the FET, whose drain-source resistance is reduced as the gate voltage becomes more negative. Network R_5-C_4 effectively reduces the distortion incurred by the regulating action of the FET. It may be necessary to redimension R_5 and C_4 to compensate for the tolerance on the FET—use an oscilloscope and a function generator to find the optimum values for these components while the circuit is being arranged to operate at maximum compression.

The limiter is fairly simple to align. Apply a 1 kHz, 150 mV input signal to the input, and monitor the output signal with an oscilloscope. Adjust P_1 such that maximum amplification is obtained with virtually no distortion. Increase the input amplitude to 300 mV: this is likely to make some distortion noticable. Carefully turn P_1 back until the distortion is reduced to an acceptable level. In some instances, when the distortion remains too high whatever the setting of P_1, it may be necessary to replace T_1, since the Type BF256C is manufactured with a relatively loose tolerance.

The proposed limiter leaves the lower dynamic range unaffected, while slightly compressing the peak amplitudes in the input signal. Optimally aligned, it suffers none of the notorious side-effects such as "noise breathing" and clipping commonly associated with other units, while it enables guitar amplifiers to be driven 3 dB harder without producing appreciable distortion.

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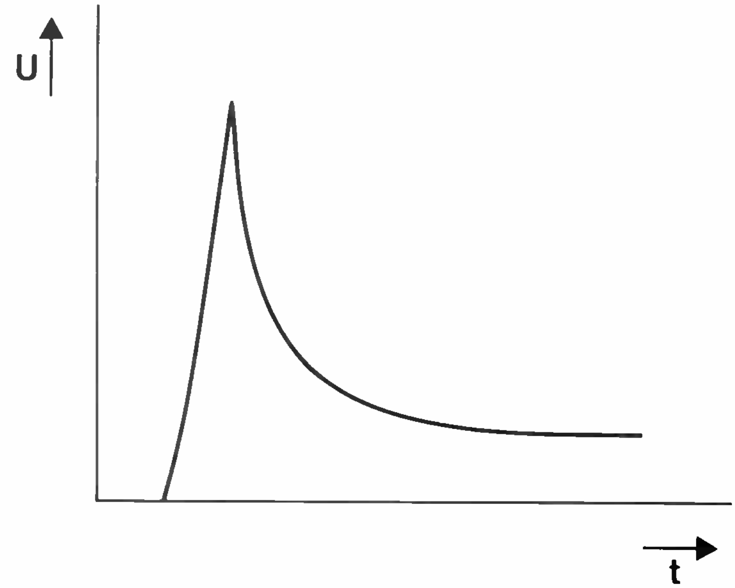

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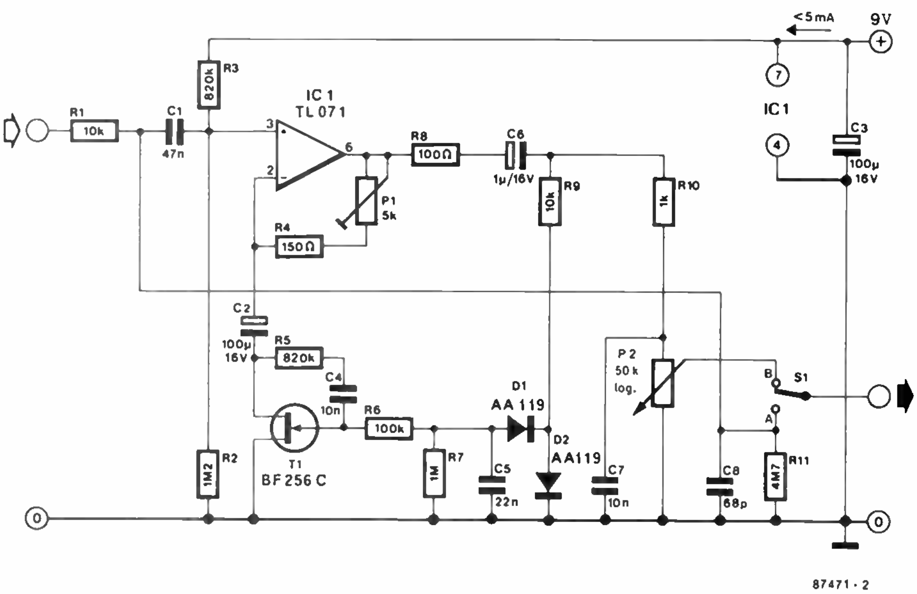

SERIAL DATA CONVERTER

Some computers and communication programs are unable to output serial data composed of 7 data bits and a parity bit. The present circuit has been designed to output this data format when it is driven with serial data organized as 1 start bit, 8 data bits, no parity bit, and 1 stop bit. This format is widely used for accessing bulletin boards, data banks, and the like with the aid of a modem, and should be available on most computers equipped with an RS232 port. The converter has a built-in clock generator which can be set to the baud rates shown the circuit diagram, Fig. 1. Both odd and even parity can be generated, and no handshaking is required with the computer or console.

The basic operation of the converter is as follows (also refer to the timing diagram in Fig. 2). The rising edge of the start bit in the incoming 10-bit word clocks bistable FF_1, whose output $\overline{Q}$ goes low and so enables counters IC_1, IC_{2a} and IC_{2b}, which were previously blocked by the high level of RST. Binary counter IC_{2a} starts counting the clock pulses provided by baud rate generator IC_6. The frequency of this clock signal is 16 times the bit rate on the serial input and output line. Bistable FF_2 and counter IC_1 are clocked with signal CK, whose period corresponds to that of the bits in the data stream. The received start bit and the next seven data bits are passed through FF_2, while IC_1 keeps count of the number of transmitted bits, and actuates output 9 during the reception of the ninth bit (i.e., databit 7). The rising edge of the counter output pulse is differentiated in C_5-R_6 and then applied to NAND gates N_1-N_2. These make it possible for FF_2 to be set or reset, depending on the state of parity counter IC_{2b}, which keeps count of the logic high bits in the serial word applied to the converter. Its output Q_A indicates whether the number of detected high bits is odd (Q_A=1) or even (Q_A=0), and causes FF_2 to toggle when the differentiated pulse from IC_1 makes the output of N_8 or N_9

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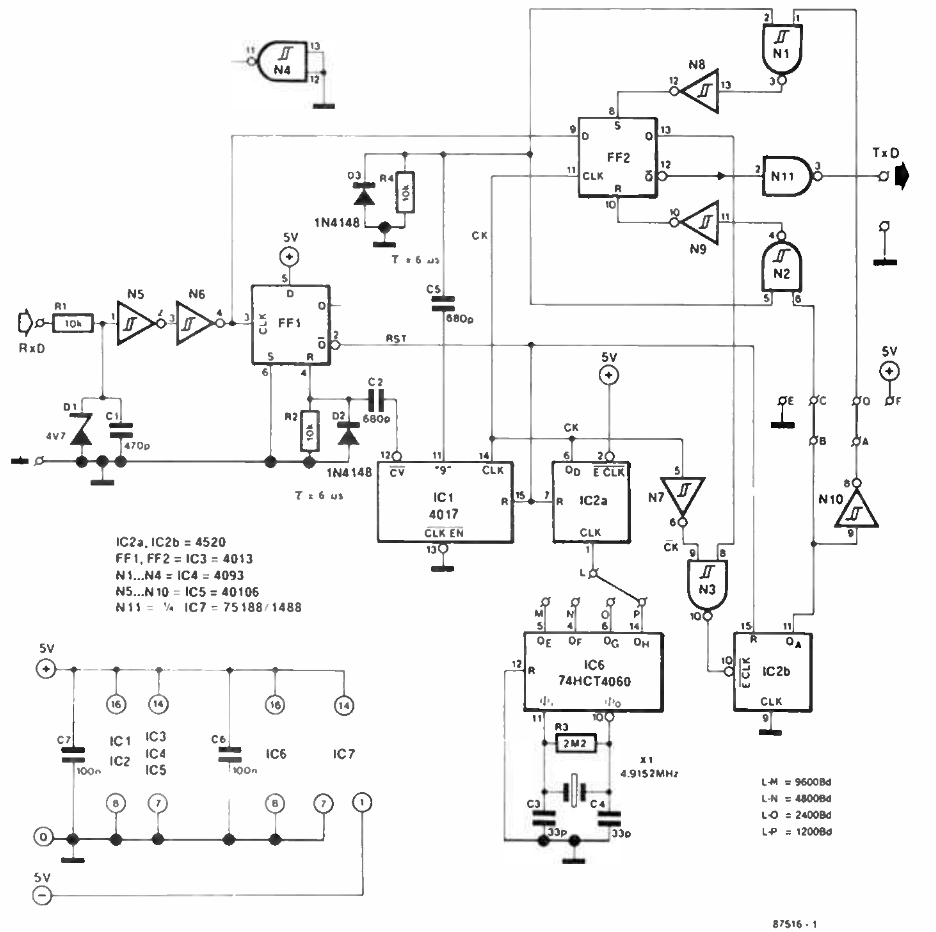

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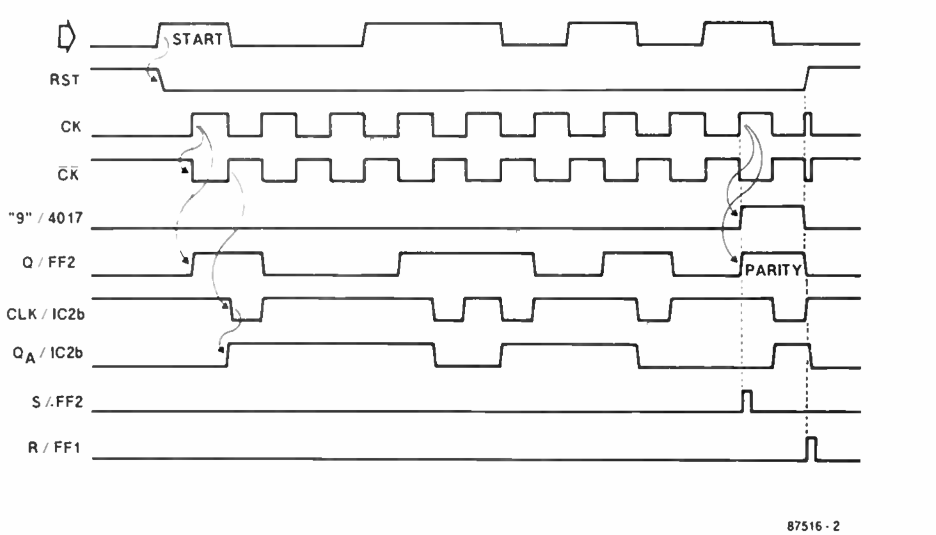

go high for a very short period. When Q_A is low, the parity bit at Q of FF_2 is high because in that case the S (set) input is driven high. Similarly, the parity bit is low when Q_A is high because the R (reset) input on FF_2 is then driven high. These two situations can occur when **even** parity is selected by fitting wire links A-D and B-C as shown in the circuit diagram. **Odd** parity is obtained by fitting links A-C and B-D, and **permanently low** parity by fitting C-E and D-F (note that a "low" parity level means that the relevant bit is logic high in the RS232 convention).

After transmission of the parity bit, the circuit is prepared for the next word by the carry (CY) output of IC_1 providing a high level to differentiator C_2-R_4. This resets FF_1, which in response drives the RST line high to reset the counters.

The convention adopted for the logic high and low levels of the data bits in the proposed converter requires that this is inserted in an RS232 or RS432 data line. Line driver N_{11} may be omitted, and the serial output signal taken from Q on FF_2, if the driven input can operate with pulse levels of 0 and +5 V. Finally, Fig. 3 shows a suitable alternative for the crystal-operated clock generator, which may be considered too extensive if the circuit is to work at a fixed baudrate of 1200. Multiturn preset P_1 is set for an output frequency of 19,200 Hz.

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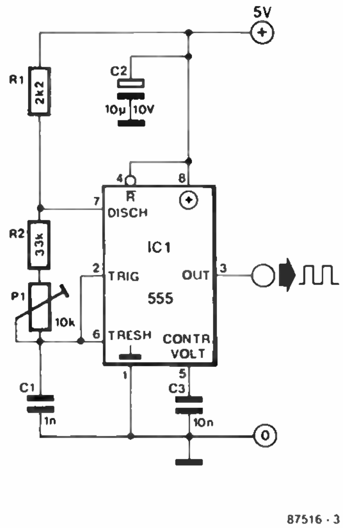

TRANSMISSION LINES FOR TTL CIRCUITS

Although cable connections between TTL circuits are normally not as critical as those for, say, RF applications, it is still worth while to reflect on this subject because strange things often happen when a TTL transmission line is not correctly terminated. In particular, this discussion is about terminating coaxial cable and flat ribbon cable. The latter is frequently used for driving Centronics compatible inputs.

A commonly used coaxial cable is RG59B/U, which has a characteristic impedance of 75 Ω and a propagation delay of 5 ns/m. With signal rise and fall times of 4 ns, the cable may be considered electrically long if it exceeds 40 cm. One of the most common terminations used when driving a long coaxial cable with an LSTTL gate is shown in Fig. 1. This set-up is unsuitable for a HCT bus driver, since the termination provides a poor impedance match, and requires a current sinking capability of 20 mA.

An improved termination circuit is shown in Fig. 2: this ensures reliable signal transmission for cables up to 15 m. Note that the 1 kΩ pull-up resistor is only required when the driver is an open collector gate or buffer.

Flat ribbon cable often introduces considerable crosstalk between wires, especially when terminated in HC(T) gates, which form a high input impedance. In general, a flat ribbon cable should not be longer than about 60 cm, but longer runs are possible when individual wires are separated by grounded wires (1.8 m max.), or when each wire is terminated with a 1 kΩ pull-up resistor (1.2 m). A combination of these methods makes it possible to use flat ribbon cables with a length up to 2 m, but this is also attainable without ground wires—see Fig. 3. The combined use of this termination network and grounded wires in the flat ribbon cable should enable a cable length of about 5 m.

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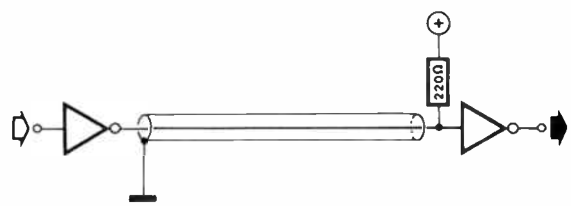

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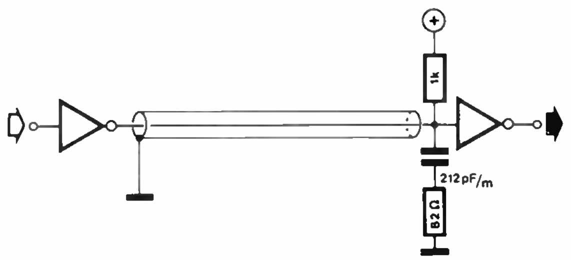

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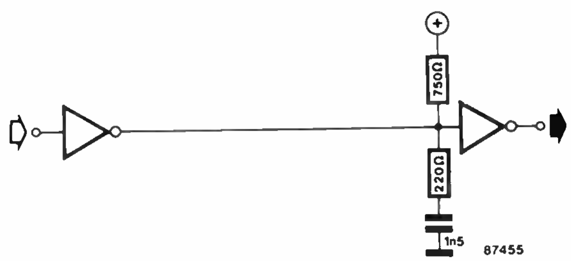
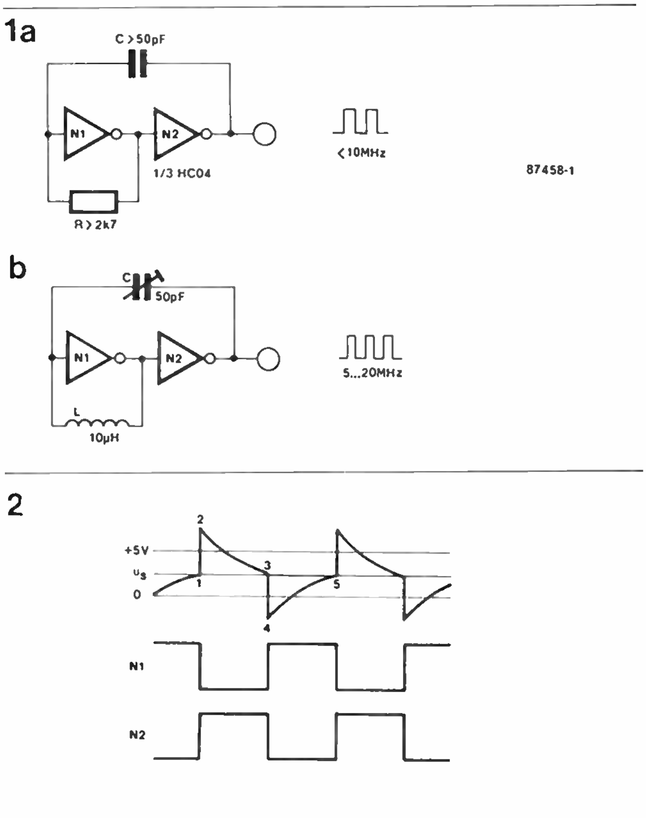


HC-BASED OSCILLATORS

Two inverters, one resistor and one capacitor are all that is required to make a HC(T)-based oscillator that gives reliable operation up to about 10 MHz. This sort of circuit is well-known, and appears in Fig. 1a.

The use of two HC inverters gives fairly good symmetry of the rectangular output signal. In the same circuit, HCT inverters give a duty factor of about 25%, rather than about 50%, since the toggle point of an HC and an HCT inverter is ½V_{cc}, and slightly less than 2 V, respectively.

When the supply voltage for the oscillator is switched on, C initially has no charge, and the output of N_1 and N_2 are at the same logic level. Capacitor C is then charged via R, until it has acquired a charge voltage that corresponds to the toggle voltage, U_s, of N_1. Assuming the output of N_2 initially to be logic low, the waveform of the signal at the input of N_1 is essentially as shown in Fig. 2. When C is charged up to level 1, the output of N_1 toggles, and so does that of N_2. This causes the voltage at the input of N_1 to rise, via C, to about 1.5V_{cc}, so that C is reverse charged to level 3. From there on, the amplitude changes in a mirror-inverted way to reach the initial state again (level 5 is identical to 1), and the circuit oscillates. In practice, the curve in Fig. 2 is slightly flatter, because the peaks at levels 2 and 4 are clamped to +5 V and 0 V by the protective circuits internal to the inverters.



If the oscillator is to operate above 10 MHz, the resistor is replaced with a small inductor, as shown in Fig. 1b.

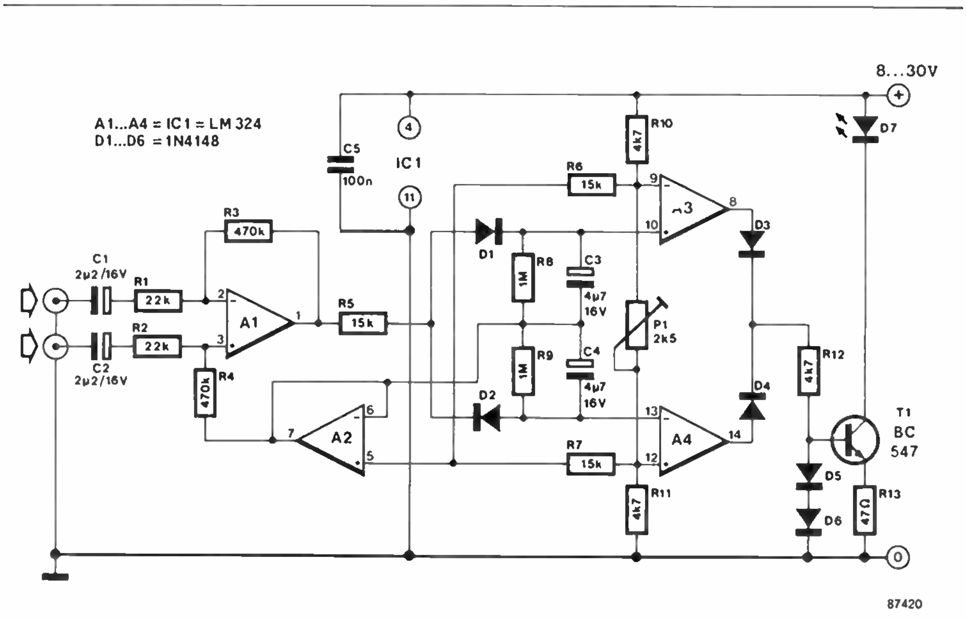
The output frequency of the circuit in Fig. 1a is given as about 1/1.8RC, and can be made variable by connecting a 100K preset in series with R. The solution adopted for the oscillator in Fig. 1b is even simpler: C is a 50 pF trimmer capacitor.

D

STEREO INDICATOR

On most FM tuners, the stereo indicator lights upon detection of the 19 kHz pilot tone. However, this need not mean that the programme is actually stereophonic, since the pilot tone is often transmitted with mono programmes also. A similar situation exists on stereo amplifiers, where the stereo LED is simply controlled from the mono-stereo switch.

The LED-based stereo indicator described here lights only when a true stereo signal is fed to the inputs. Differential amplifier A_1 raises the difference between the L and R input signals. When these are equal, the output of A_1 remains at the same potential as the output of A_2, which forms a virtual ground rail at half the supply voltage. When A_1 detects a dif-



ference between the L and R input signals, it supplies a positive or negative voltage with respect to the virtual ground rail, and so causes C_3 to be charged via D_1, or C_4 via D_2. The resistors connected in parallel to these capacitors ensure slow discharging to bridge brief silent periods in the programme. Comparator A_3-A_4 switches on the LED driver via OR circuit D_3-D_4.

When building the circuit into an amplifier, care should be taken to select the right point from which the input signals are obtained. In general, this should be before the volume and balance controls, but behind the mono/stereo selector. The signal level should not be less than 100 mV to compensate for the drop across D_1 or D_2. Also observe that the impedance at the selected "tap" location is relatively low. Should the stereo light come on when a mono programme is being received, the input signals are different, and the sensitivity of one of the amplifier channels should be altered. If this is impossible or undesirable, R_3 may be replaced by a series connected preset and a resistor. The sensitivity of the stereo indicator is adjustable with P_1. The current consumption is less than 7 mA when the LED is off, and about 20 mA when it is on.

TW

PIERCE OSCILLATOR

In addition to the description elsewhere in this magazine of HC and HCT based R-C/L-C oscillators for use up to 20 MHz, this design brief concentrates on quartz-controlled oscillators which find applications in digital equipment and microprocessor systems. Such oscillators can only be made with HCU gates, because HC and HCT ones have buffered outputs that make them unsuitable for use as analogue amplifiers.

The circuit diagram shows a Pierce oscillator set up around a single gate in a Type 74HCU04 package. The inverter functions as an inverting amplifier with a phase shift of 180°. The circuit can be modified into a Collpits oscillator by replacing the quartz crystal with an inductor. It should be noted, however, that the use of a quartz crystal is more appropriate because it ensures minimum current consumption and adequate suppression of the third harmonic frequency. Finally, R_2 must be replaced with a 33p capacitor if the oscillator is operated above 4 MHz.

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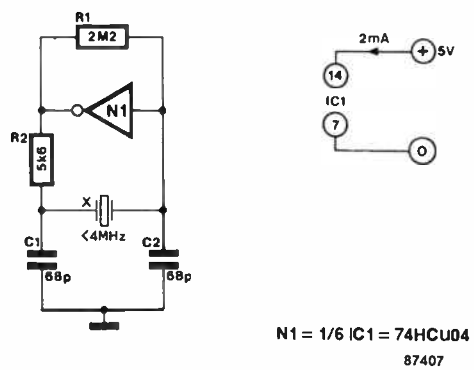

HIGH LEVEL WIDEBAND RF PREAMPLIFIER

A linear RF amplifier can be made in two ways: (1) with the aid of a linear active element, or (2) with a non-linear element operating with negative feedback. This circuit is of the second kind, using an RF power transistor as the active element. Feedback is also required to ensure correct termination (50 Ω) of the aerial, since bipolar transistors normally exhibit a low input impedance. Also, the noise figure is not increased because virtually no signal is lost.

The common-base amplifier is based on a UHF class A power transistor Type 2N5109 from Motorola. The feedback circuit is formed by RF transformer Tr_1. The input and output impedance of the preamplifier is 50 Ω for optimum performance. Network R_3-C_5 may have to be added to preclude oscillation outside the pass-band, which ranges from about 100 kHz to 50 MHz. The gain is approximately 9.5 dB, the noise figure is between 2 and 3 dB, and the third-order output intercept point is at least 50 dBm.

The input/output transformer is wound on a Type FT37-75 ferrite core from Micrometals. The input winding is 1 turn, the output winding 5 turns with a tap at 3 turns.

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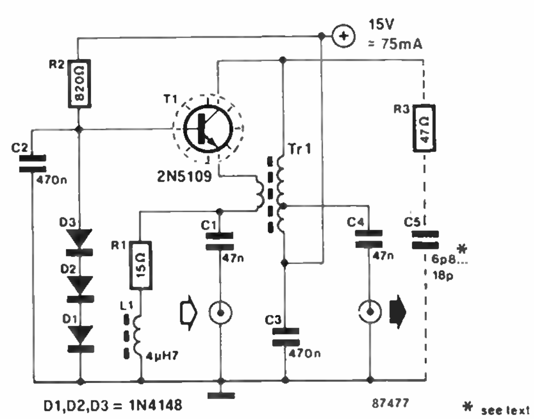


CURRENT CORRECTED AF AMPLIFIER

The majority of modern AF power amplifiers drive the loudspeaker(s) with a voltage that is simply a fixed factor greater than the input voltage. It is fairly evident, therefore, that the power delivered by such amplifiers is inversely proportional to the loudspeaker impedance, since the cone displacement of a loudspeaker is mainly a function of the current sent through the voice coil, whose impedance may vary considerably over the relevant frequency range. In multiway loudspeaker systems, this difficulty is overcome by appropriate dimensioning of the crossover filter, but a different approach is called for when there is but one loudspeaker.

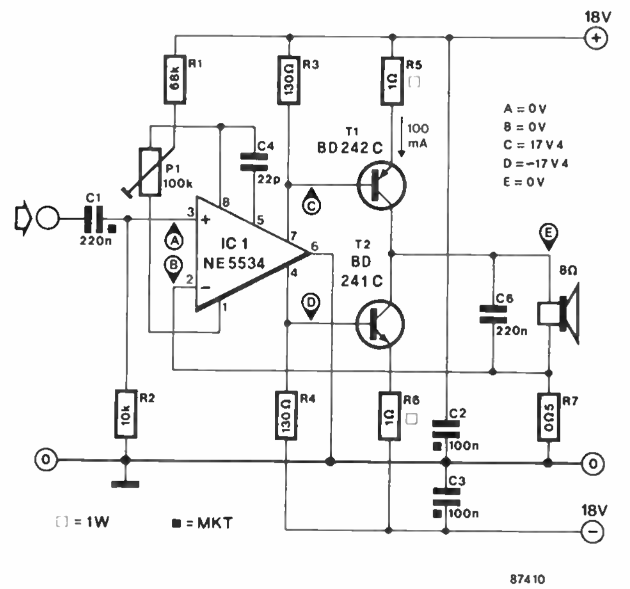
This amplifier is based on current feedback to ensure that the current sent through the voice coil remains in accordance with the input signal. The current through the voice coil and R_7 develops a voltage across the resistor. A negative feedback loop is created by feeding this reference voltage to the inverting input of IC_1. The overall amplification of the circuit depends on the ratio of the loudspeaker's impedance, Z_L, to the value of R_7. In the present case the amplification is 16 times ($Z_L/R_7 = 8/0.5 = 16$).

The connection of the opamp's output to ground is slightly unusual, but enables the base current for output transistors T_1-T_2 to be drawn from the supply rails, rather than from the opamp. Capacitor C_6 functions to set the roll-off frequency at about 90 kHz. The quiescent current of the amplifier is of the order of 50 to 100 mA for class A operation, and is determined by R_3-R_4 and R_5-R_6. The complementary power transistors should be closely matched types to avoid fairly large offset currents (and voltages) arising. Some redimensioning of either R_3 or R_4 may be required to achieve the correct balance for the power output stage. The emitter current of T_1 and T_2 is about 500 mA when the amplifier is fully driven.

The harmonic distortion of this amplifier is less than 0.01% at $P_o = 6.25$ W and $U_b = \pm 18$ V.

Sv

Source: *Texas Instruments Linear Applications.*



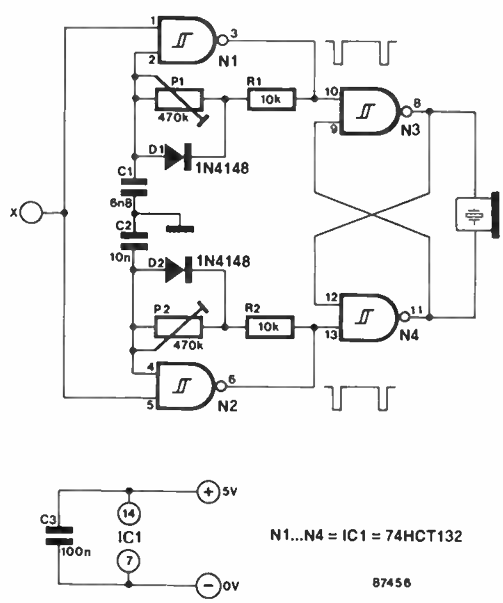
BUZZER DRIVER

Piezoelectric resonators, also referred to as *buzzers*, are frequently used for providing audible signals in all sorts of electronic equipment. Buzzers are small, light, simple to use, and yet provide a loud output signal. They are either of the passive or of the active type. The former are driven by an AF signal source, while the latter feature a built-in oscillator, and require a direct voltage only.

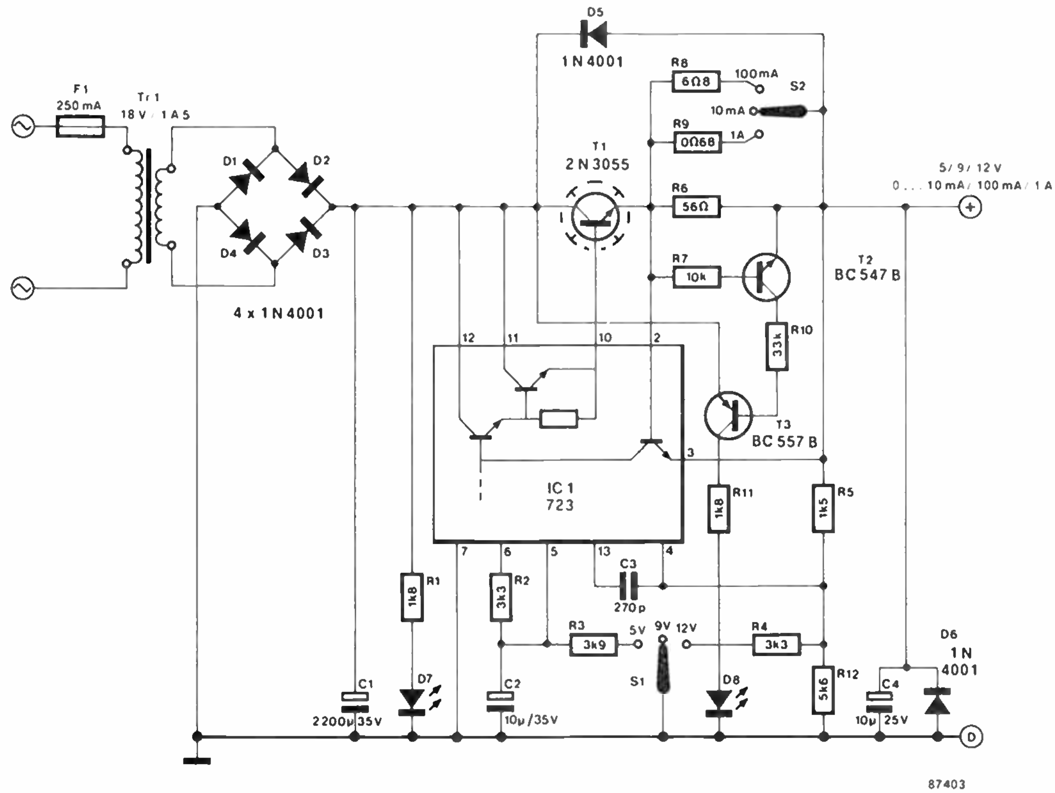
This circuit is a double AF oscillator for driving passive buzzers. It ensures a richer output sound than normally obtainable from a piezo buzzer due to the use of two oscillators, N_1 and N_2, whose output signal lies between 1 and 10 kHz. Gates N_3-N_4 form an S-R bistable which is controlled by the outputs of N_1-N_2, and drives the buzzer direct. The spectral composition of the output signal is fairly complex, due to the presence of both the fundamental notes and the difference and sum frequency. The timbre so obtained varies as a function of the ratio between the oscillator frequencies, which are adjustable with the aid of presets P_1-P_2. Note that diodes D_1-D_2 reduce the duty factor of the oscillator signals to about 25%. Optimum effects are achieved when a simple ratio is set between the oscillator frequencies, e.g. 3:4. The resulting waveform is always composed of rectangular signals, but these differ in respect of their period to ensure that the buzzer produces a rather agreeable sound.

The buzzer driver is controlled by a logic level applied to point X. The quiescent current consumption is virtually negligible, while about 10 mA is drawn in the actuated state.

D



CURRENT INDICATOR FOR 723



by P Needham

Although the Type 723 voltage regulator has been with us for quite a few years, it is still a favourite component for making simple and good quality power supplies. The 723 possesses excellent characteristics, including a highly stable output voltage, adjustable current control, and short-circuit protection, but it lacks an output for signalling the activity of the built-in current limiter.

The current limiter in the 723 consists of only one transistor, whose base and emitter are brought out to chip pins 2 and 3 respectively. When the voltage across these pins exceeds 0.5 to 0.6 V, the transistor is turned on and cuts the drive to the output transistors. In most applications, the voltage drop for the B-E junction of the current sense transistor is developed across an externally fitted resistor. In the the supply proposed here, this is either R_6, R_6//R_8, or R_6//R_9. A difficulty arises if it is intended to provide an overcurrent indication for the shutdown circuit with the aid of an external transistor fitted in parallel onto pins 2 and 3, since the external and internal transistor are highly unlikely to have precisely the same characteristics. When the internal transistor has the low B-E voltage of the two, the indication will not work, while in the other case the external transistor takes away the base current for the internal transistor, so that the current limiter is rendered ineffective.

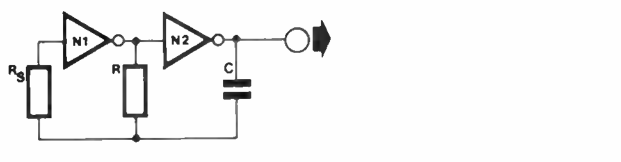
In this design of a power supply, a current overload indication was realized by fitting the external transistor with a high value base resistor, R_7, to ensure that the current limiter in the 723 is not disabled. A further transistor, T_3, has been added to keep the base current for T_2 as low as possible. Since the base-emitter junction then has a diode characteristic, the associated voltage drop is always lower than that of the transistor internal to the 723.

The three output voltages from this supply are probably the most commonly used for testing asymmetrically fed designs: 5 volt for many TTL and CMOS circuits, 9 volt for battery operated equipment or logic circuits equipped with a 7805 regulator (this requires an input of at least 8.5 V), and 12 volt for RS232 drivers, and miscellaneous opamp or transistor based circuits. The current limiter can be set to 10 mA, 100 mA, or 1 A for safely powering experimental circuits. Power regulator T_1 should be fitted with a heat sink sized at least 10 x 10 cm. LEDs D_7 (green) and D_8 (red) are the power on and current overload indicator, respectively.

The output voltages of the supply may not be as accurate as required, and this is mainly due to the use of resistors from the E12 series. Close tolerance is especially important in the 5 V range, since the value shown for R_3 gives a theoretical output of 4.9 V. This can be increased readily by fitting a resistor in parallel with R_3, until the output voltage is 5.0 V precisely. Switches S_1 and S_2 are preferably SPDT types with a centre position, but three-way rotary switches should also do if in both cases the centre contact is not used. *W*

HCU/HCT-BASED OSCILLATOR

When frequency stability is not of prime importance, a simple, yet reliable, digital clock oscillator can be made with the aid of relatively few components.
High-speed CMOS (HCU/HCT) inverters or gates with an inverter function are eminently suitable to make such oscillators, thanks to their low power consumption, good output signal definition and extensive frequency range.
The circuit as shown uses two inverters in a 74HCT04 or



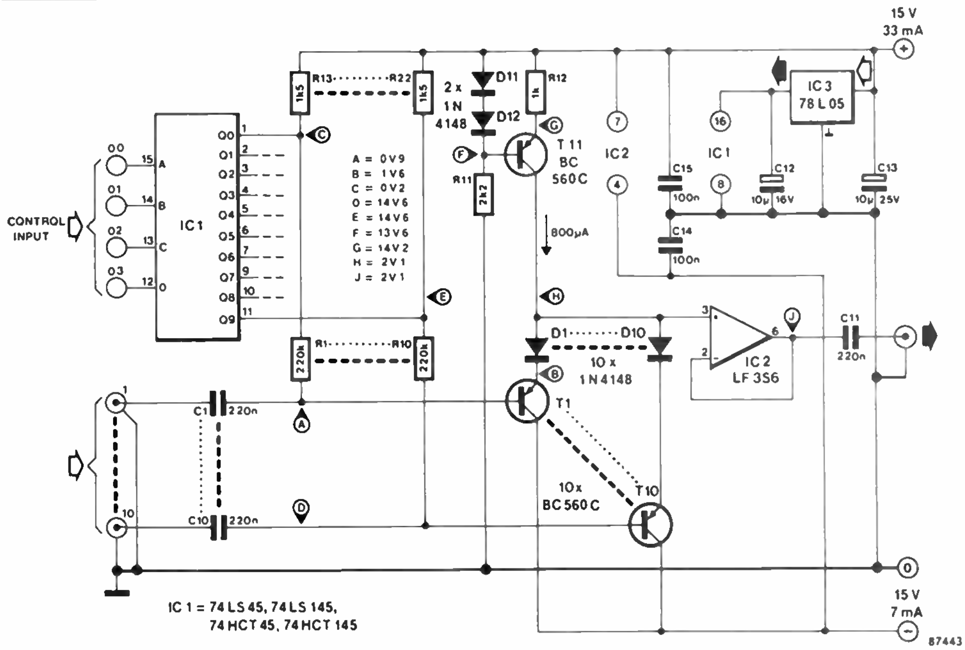
N1, N2 = 1/3 IC1 = 74HCT04, 74HCU04 87437

74HCU04. The basic design equations are
for HCU: $f = 1/T$; $T = 2.2RC$; $3V < V_{cc} < 6V$; $I_c = 13$ mA
for HCT: $f = 1/T$; $T = 2.4RC$; $4.5V < V_{cc} < 5.5V$; $I_c = 2.25$ mA
$R_s \geq 2R$; $1K\Omega \leq R \leq 1M\Omega$; $C \geq 10$ nF.
With R_s and R calculated for a given frequency and value of C, both resistors can be realized as presets to enable precise setting of the output frequency and the duty factor. Do not forget, however, to fit small series resistors in series with the presets, in observance of the minimum values for R and R_s as given in the design equations. The values quoted for I_c are only valid if the inputs of the remaining gates are grounded.
Source: *Philips CMOS Designers Guide*, January 1986, p. 105 ff. *St*

DIGITAL AUDIO SELECTOR

by R Shankar

Switching audio signals digitally could be done with the aid of CMOS analogue switches or multiplexers. Simple as this may seem, there is, however, an inevitable loss in the quality of the sound due to the noisy nature of CMOS switches. Furthermore, the high on-resistance of these devices together with the large parasitic capacitances generally present in CMOS circuits causes a high susceptibility to crosstalk. The circuit given here is a novel way of selecting one out of ten audio signals digitally without any of the foregoing drawbacks.
As shown in the circuit diagram, the ten input signals numbered 1-10 are applied to the bases of transistors T_1-T_{10} via capacitors C_1-C_{10} respectively. The bias voltages for the transistors are obtained with the aid of R_1-R_{10}. Depending on the binary state applied to IC_1, one of its outputs Q_0-Q_9 goes low. For example, if the input code is 0010, Q_2 goes low, pulling the base of T_3 to 0 V, while the bases of all other transistors are raised to nearly +15 V. Therefore, T_3 works as an emitter follower while the other transistors are effectively reverse biased. The output rail of the transistor array is connected to voltage follower IC_2, which provides the output signal of the digital audio selector.
Voltage regulator IC_3 is required only if a +5 V rail is not available. If the number of channels required for a particular application is less than 10, the relevant components can be omitted. If a mute facility is required, simply short one input to ground to silence the output on selection of the corresponding channel.
This circuit can handle input signals up to 4 V_{rms}. The total distortion does not exceed 0.01% for frequencies up to 20 kHz. The crosstalk incurred in this circuit is less than −80 dB. This value can be attained by paying due attention to the layout of the practical circuit, the decoupling of the supply lines (fit C_{14} and C_{15} direct to the relevant pins of the opamp), and the use of good quality components.
The measuring values indicated in the circuit diagram were obtained in a prototype. All voltages are measured with respect to ground with the aid of a DMM (Z_{in} = 1M0). The channel selected was number 1. *W*



IC 1 = 74LS45, 74LS145, 74HCT45, 74HCT145

PATCH CATCHER

by R van Laake & A Veen

This circuit facilitates switching between programmed settings on synthesizers, expanders, and other electrophonic instruments. Most of these have some provision for storing or saving user-defined instrument settings, which are usually referred to as *patches* in the electrophonics enthusiasts' jargon. Although this facility is a great asset to many musicians, a problem arises when patches are to be called up in rapid succession while playing. On some instruments, this problem is solved by a pedal that, when pressed, enables the instrument to operate with the next patch from the user-defined file (patch increment pedal). In practice, however, the increment function of the pedal may still be considered cumbersome. Assuming that the relevant instrument supports the use of eight patches, the pedal needs to be pressed no less than seven times to switch from, say, patch 3 to 2. This is obviously a distracting additional task when the keyboard is to be played simultaneously.

This circuit uses a relay whose contact is connected to the pedal input on the instrument. The user presses a key numbered 1-8 to select the relevant patch, and the circuit arranges for the relay contact to be automatically actuated, simulating the number of pedal operations that would be required otherwise. With reference to the circuit diagram, IC_1 is a priority encoder whose outputs Q_0-Q_2 supply the binary code of the pressed key S_1-S_8. The pulse at therminal E_{out} is delayed in R_9-C_1 and fed to N_5-N_6 which serve to clock 4-bit latch IC_2. Outputs Q_1-Q_3 of this chip are applied to the inputs of XOR gates N_1-N_3, together with the outputs of counter IC_3, whose binary output state is initially assumed equal to that of IC_2. Pressing one of switches S_1-S_8 causes the output of IC_2 to change, and one of the XOR outputs to go high. This enables oscillator N_7, so that its output pulses, inverted in N_8 and buffered with T_1, energize the relay and increment the patch number on the instrument. The oscillator pulses are also applied to binary counter IC_3, which is set up to count from 0 to 7 because its Q_3 output drives the RESET input. After a maximum of 7 pulses, the logic levels applied to each of the XOR gates are equal again, so that the oscillator is disabled via N_4.

The choice between the make or break contact of the relay is governed by the type of pedal this circuit is to replace. Preset P_1 is adjusted such that the instrument is just capable of reliably following the actions of the relay. After turning on the equipment, it is necessary to first press S_1, then select the first program on the instrument, and finally make the appropriate connection between this and the patch catcher.

The circuit, exclusive of the relay, consumes only a few milliamperes. The prototype, fitted with the stated Siemens relay, drew a mere 50 mA from the 9 V supply.

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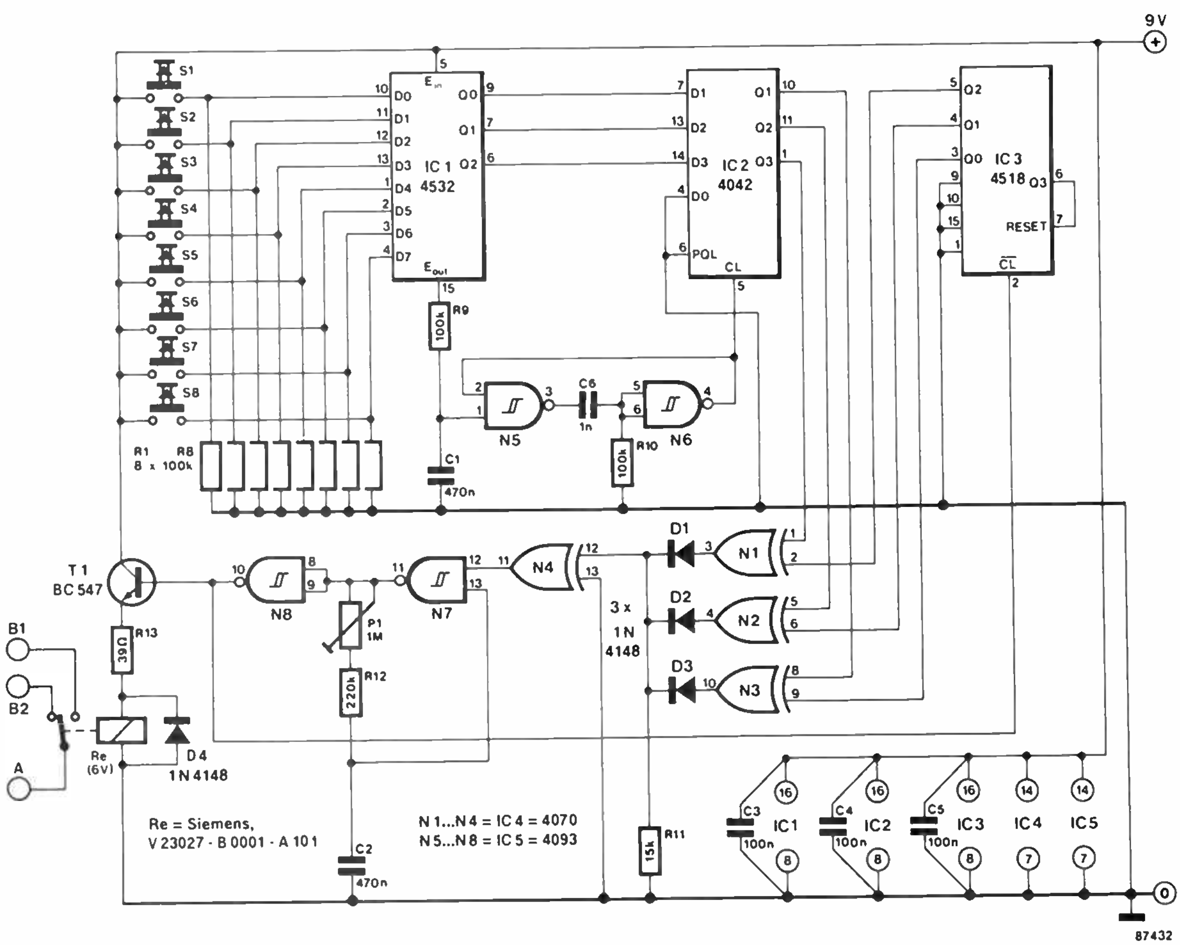
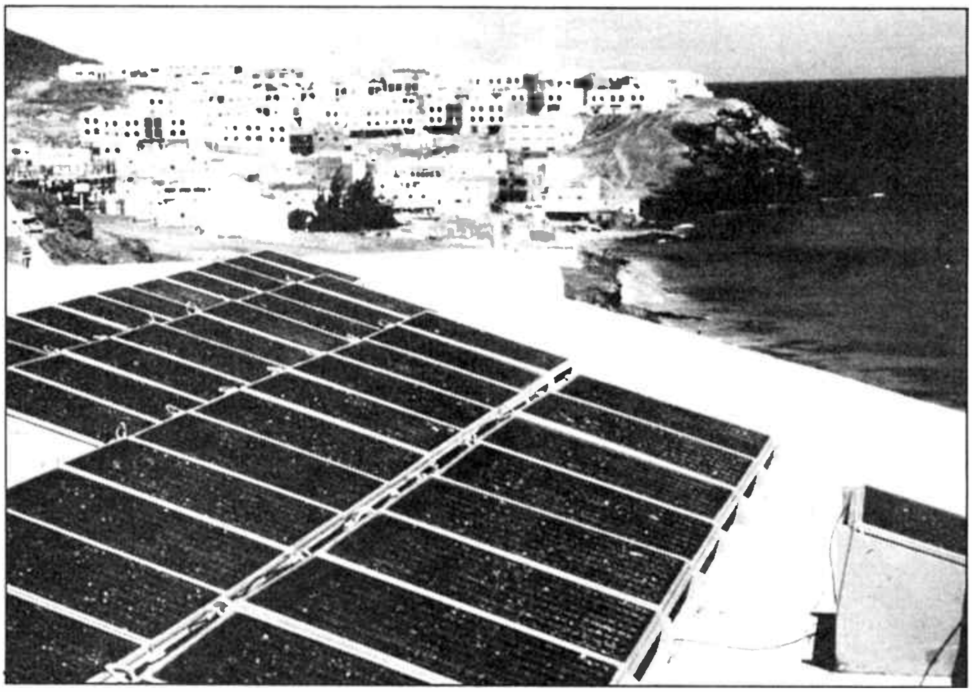


SOLAR POWER GENERATION



Research and development into the use of solar energy as an alternative source of energy have taken on new importance since the oil crises of the 1970s. Moreover, many of us are afraid of the spread of nuclear power stations, and all of us want to get rid of environmental pollution caused by oil or coal burning power stations.

The sun converts 600 million tons of hydrogen into helium through nuclear fusion every second, and in the process releases enough energy to meet our earthly needs for a million years. Of course, only a tiny part of the solar energy falls onto earth, which is readily seen when it is realized that the sun radiates equally in all directions. Since the average distance from the sun to the earth is near enough 150 million kilometres, the energy (in the form of electromagnetic radiation) takes about 8 minutes to reach the earth. In that time, the total energy radiated by the sun has spread over the inside of a sphere of surface area 3×10^{17} km^2. The total surface area of the earth that can be lit by the sun at any one time amounts to 113×10^6 km^2. This means that only about 4 ten-thousandmillionth parts of the totally radiated energy falls onto earth. The rest is lost in the universe.

The solar energy that reaches the earth can be converted into heat or electricity by various means, mainly solar collectors, magneto-hydro-dynamic (MHD) generators, and photovoltaic cells (normally called solar cells).

A major drawback to the widespread use of solar power generating systems is their high cost: at present, solar power costs £5-20 per watt as compared with a few pence for commercially produced electricity. On the other hand, solar power generation has a number of important advantages:

- Solar energy is free and in plentiful supply.
- Electricity can be generated, directly or indirectly, where it is needed, which in many cases would obviate the need for a distribution transmission line system.
- In the case of most solar power generating systems, there are no moving parts, which simplifies maintenance and enables unattended operation, for instance, solar cells on board satellites.
- It produces no waste or gases: it is clean.

Although the cost of solar power generation is at present such that it precludes the widespread adoption of solar power generating systems, it is expected that prices will fall dramatically over the next 10-15 years.

Solar collectors

Solar collectors are normally constructed in a way that allows the incident sunlight to be collected and converted into heat. The main types of collector are flat, concave, and heliostat. The flat type has the advantage of being able to operate from diffused light: the other two can only work from direct sunlight. All solar collectors operate on the same basic principle: sunlight falls onto a blackened absorbent surface and heats the material immediately underneath that surface. The material is often water, but it can also be air—see Fig. 1. To protect the collectors from atmospheric effects and soiling, they are commonly covered by a sheet of Perspex.

Concave (parabolic) solar collectors are able to generate temperatures of up to 4,000 °C. They are usually constructed as a dish similar to satellite TV antennas.

Heliostat-type solar collectors make use of plane or concave mirrors that can be rotated (nowadays usually under computer control) to follow the sun across the sky—see Fig. 2. This type of collector affords efficiencies of up to 30%.

Solar collectors generally have good efficiencies and are getting cheaper. This is particularly so in the case of flat types, which are used more and more in the roofs of industrial buildings as well as in those of private houses—see Fig. 3. ▷

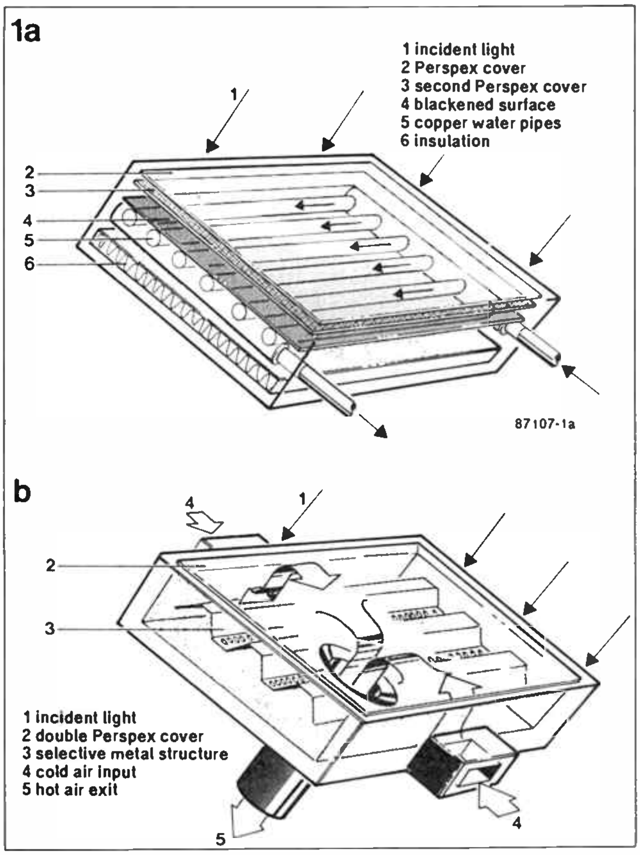


Fig. 1. Typical solar collectors operating with (a) water, and (b) air.

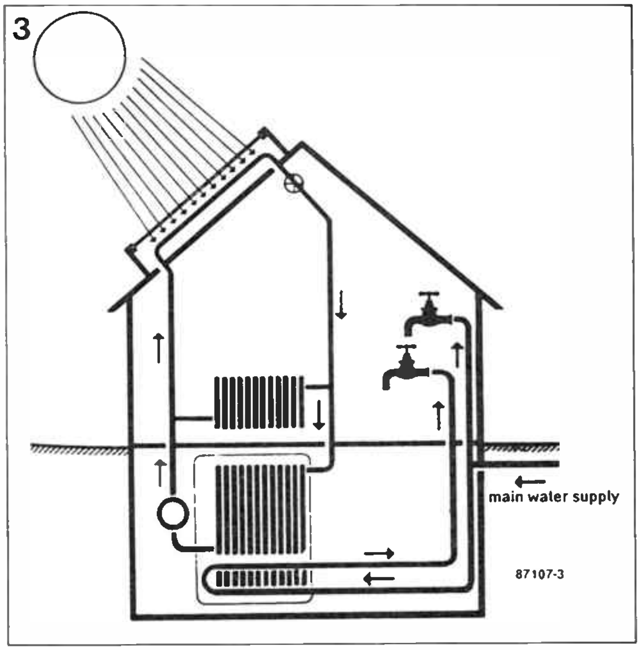


Fig. 3. Flat solar collectors installed in the roof of a private house.

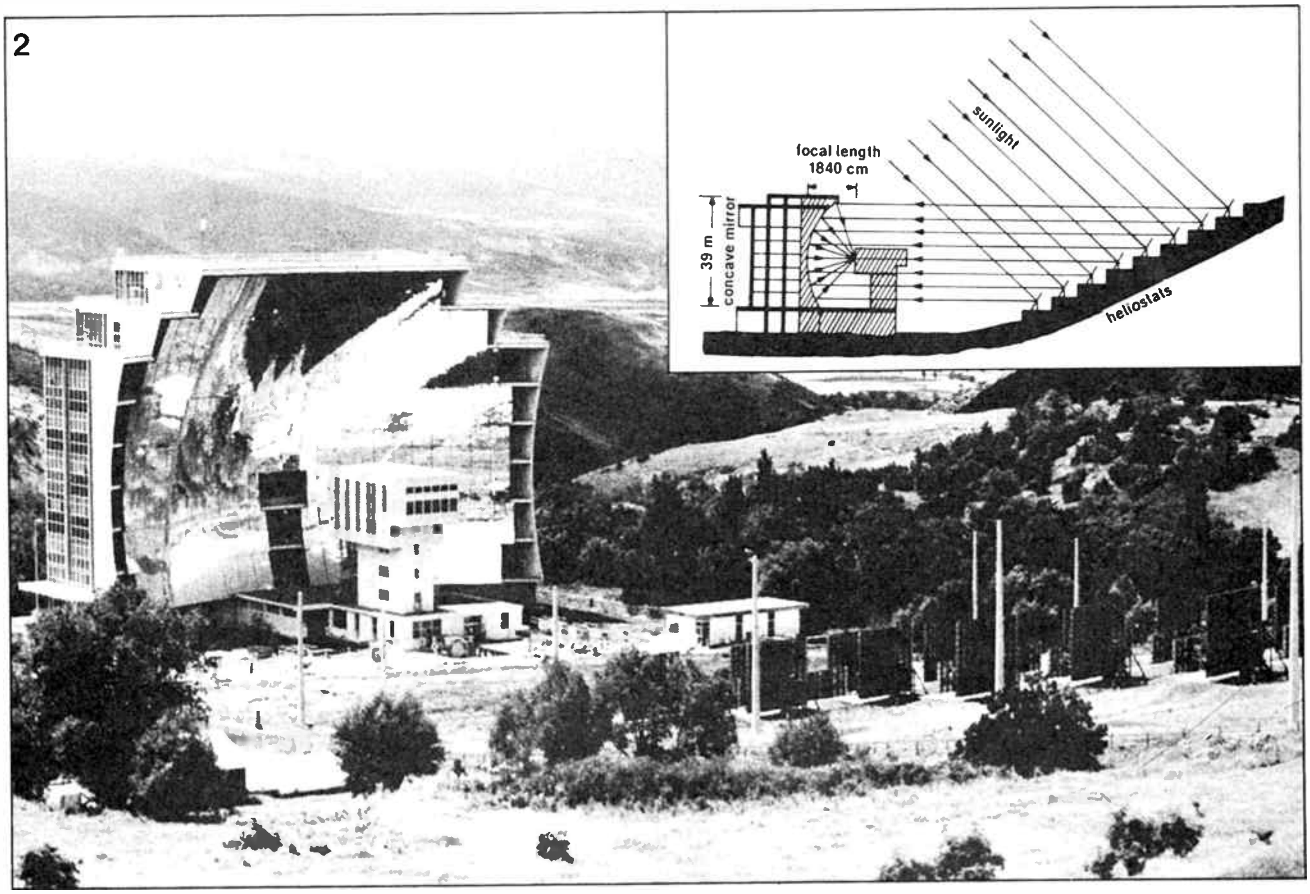


Fig. 2. The immense solar furnace at Odeillo in the French Pyrenees Mountains. The furnace uses a large number of heliostats, which deflect the sunlight onto a concave mirror. The total surface area of the heliostats is 2000 m²; the mirror is 39 m high and 54 m wide and its focal length is 18.4 m.

MHD generators

Magneto-hydro-dynamic generators convert thermal energy direct into electricity. A schematic representation of such a generator is shown in Fig. 4. The thermal energy is obtained by heating a gas to some 2500 °C by means of a large concave solar collector. When the temperature of the gas reaches 2500 °C, ionization occurs. This causes the gas molecules to accelerate to speeds of well over 300 m/s. The gas is then passed through a magnetic field, which separates electrons and ions, whereby an electric current is generated.
This type of generator is still in its infancy, although large prototypes are already in operation in the USA and the USSR. The main problem is the heating of the gas to the high temperature required. None the less, the prototypes work well and show efficiencies of up to 55%.

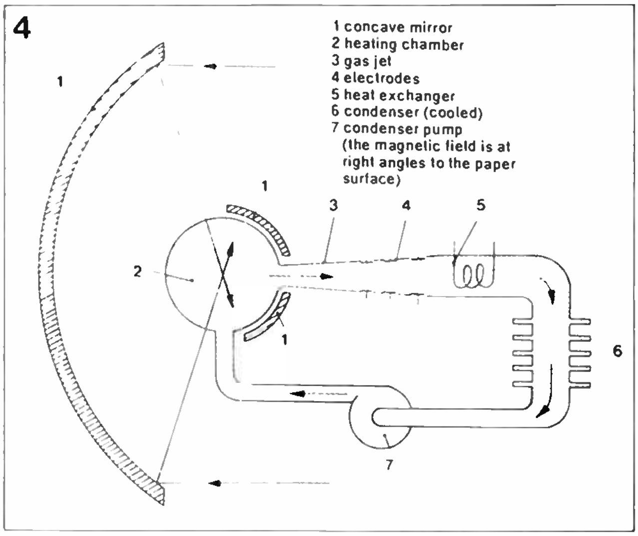


Fig. 4. Schematic representation of the magneto-hydro-dynamic generator used in the U02 plant in the USSR.

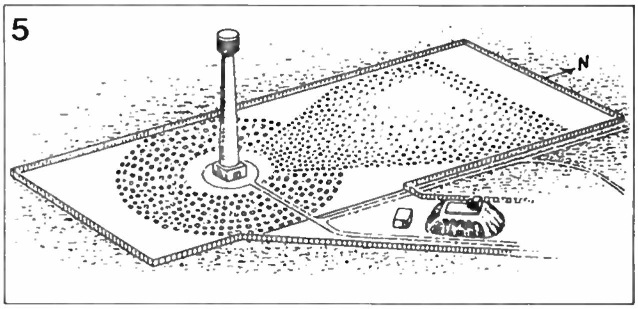


Fig. 5. Solar tower installation at Albuquerque in the USA. This type of installation is economically viable only where very large powers are required. It consists of a tower some 300 m high, around which plane or parabolic heliostats are grouped in circles. The mirrors beam the sunlight to the top of the tower where the solar collector is situated. The solar energy is converted into heat which is used to drive a large turbine.

Solar cells

Solar cells provide an attractive and promising source of alternative energy. Unlike solar collectors, they provide a means of direct conversion of solar energy into electricity.

Types of solar cell

Crystalline silicon, Si. By far the largest proportion of solar cells currently manufactured are made from crystalline silicon. The basic construction of this type of cell is shown in Fig. 6. Its operation will be discussed later in this article.

Amorphous silicon, a-Si. Amorphous silicon is, according to many researchers, *the* solar cell material of the future, because its production costs are a fraction of the price of crystalline silicon.

Amorphous silicon can be formed by a number of methods, such as sputtering, pyrolysis, and high-frequency glow discharge. At present, the glow discharge method is preferred. In this, a substrate is held at a temperature of about 300 °C in a vessel in which the pressure is about 5 torr. Silicon hydrides, such as SiH_4 or Si_2H_6, or silicon tetrafluoride, SiF_4, are introduced into the vessel. When an HF voltage is applied, amorphous silicon begins to accumulate on the substrate. Doping of the a-Si is achieved by adding a phosphorus hydride, such as PH_3, for n-type, or a boron hydride, such as B_2H_6, for p-type.

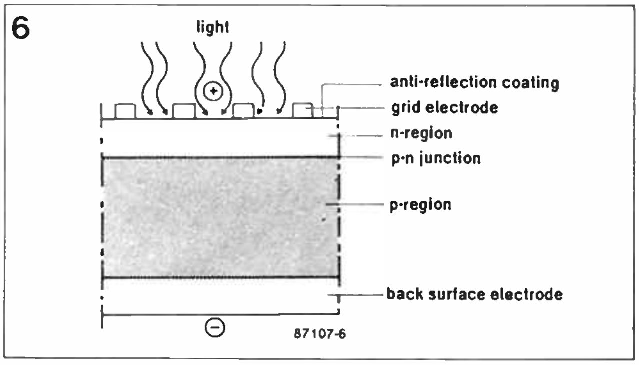


Fig. 6. Basic construction of silicon solar cell.

Table 1 Performance of various solar cells

Type of solar cell	Conversion efficiency (%)	Costs
Silicon		
monocrystalline	12	fairly high
polycrystalline	15	high
amorphous	8-10	very low
Copper(I)sulphide-Cadmium sulphide	7-9	high
Gallium-Arsenide	21	very high
Cadmium-Selenium	6-7	not known

Copper(I)sulphide-Cadmium sulphide, Cu_2SCdS. The electrical characteristics of this type of semiconductor are promising, although research into the material is still going on. From early prototypes, it is clear that both high efficiencies and high power outputs can be obtained.

Gallium-Arsenide, GaAs. Although this type of material affords a very high effciency, it is expensive to produce. However, it has a non-linear light-power characteristic, which makes it particularly interesting for use in combination with concave solar collectors. Moreover, compared with crystalline silicon, GaAs does not dissipate so much heat and, therefore, requires less cooling (smaller heat sinks).

Cadmium-Selenium, CdSe. This type of solar cell is still in the development stage.

Table 1 gives a comparison of these various types of solar cell. A number of other materials are actively being investigated in laboratories all over the world, but at present it does not look likely that these will find commercial application in this century.

Basic operation of a silicon solar cell

The characteristic behaviour of a semiconductor depends on the nature of the constituent atoms and on the way in which these atoms are grouped together. In other words, it is a function of the atomic structure as well as of the crystal structure of the semiconductor.
An atom consists of a positively charged nucleus surrounded by negatively charged electrons located in discrete orbits (shells) around the nucleus. Electrons can exist in stable orbits near the nucleus only for certain discrete values of energy, called energy levels of the atom. The allowed energies

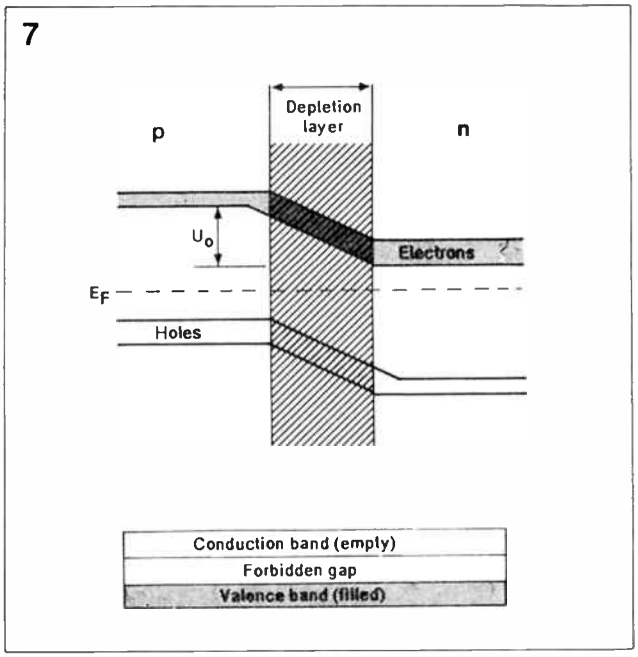


Fig. 7. Energy level diagram (simplified) of a semiconductor.

of electrons in an atom are represented by horizontal lines in the energy-level diagram shown in Fig. 7. Not more than two electrons can occupy a level: this results in electrons filling up the lowest possible levels first.

Since the atoms in a semiconductor are closely packed together, there are very many energy levels associated with each nucleus (because of the interaction between the atoms). This results in the energy-level diagram for the material becoming an energy-band diagram (each band contains very many levels).

The lowest energy band is called the valence band: this is filled with electrons, since there is an electron for each of the energy levels contained in the band. The upper energy band is virtually devoid of any electrons: it is called the conduction band. There is a small forbidden gap between the valence and conduction bands. Because of the thermal energy of the semiconductor at room temperature, some electrons can cross the forbidden gap into the conduction band. The consequent empty energy level in the valence band is called a hole.

The total current resulting from the electrons in a filled valence band is

$$j = nev = e\sum_{i=1}^{n} V_i = 0 \qquad [1]$$

where j is the current density, n the electron density, e the electron charge, and v the average velocity of electrons in the valence band.

If the kth electron crosses to the conduction band,

$$e\sum_{i=1, i\neq k}^{n} V_i = -ev_k \qquad [2]$$

from which it is seen that the vacancy (hole) in the valence band can be considered as a positively charged carrier fully analogous to the negatively charged kth electron. The velocity of the hole is equivalent to that of an electron in the same energy level.

At absolute zero, all the electrons occupy the lower energy levels, the valence band is filled to maximum energy, and no higher levels are occupied. This level of maximum energy is called the Fermi level, E_F, which is approximately constant with temperature. When the temperature is at room level, the electrons in a semiconductor are distributed between the valence band and the conduction band, and the Fermi level lies in the forbidden gap.

Since the Fermi level is constant throughout the silicon, the energy bands at the junctions in Fig. 8 are distorted, which causes an electric field accross the junction. This field is called the built-in field.

When the silicon p-n junction—see Fig. 8a—is in equilibrium (no bias), the cur-

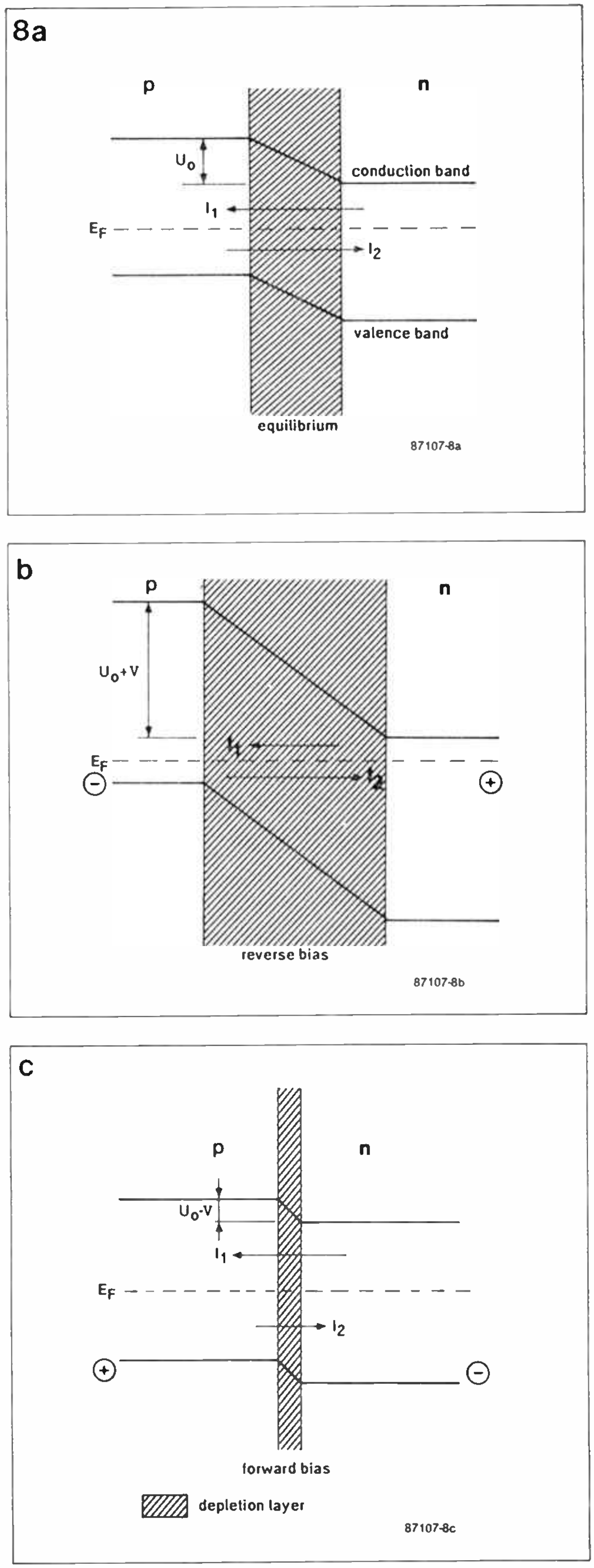


Fig. 8. Energy-band diagrams of a silicon p-n junction under different bias conditions. The net current across the junction depends on the strength of the built-in field, which is increased (b) under reverse bias, and reduced (c) under forward bias. The depletion layer is directly proportional to the built-in field. The built-in field, $E = U_o/x$, where U_o is the potential rise at the p-n junction due to small electron-hole pair movements in the semiconductor, and x is the width of the p-n junction.

rent I_1 resulting from electrons diffusing from the *n*-side is equal to the current I_2 which arises from electrons leaving the *p*-side. If a positive voltage is applied to the junction—see Fig. 8b—the built-in field is increased. The number of electrons diffusing from the *n*-region is then much smaller, since only few electrons have the energy required to overcome the built-in field. However, the number moving from the *p*-region to the *n*-region is not affected, because these electrons encounter no field. Therefore, a net current flows, but it is limited by the small number of electrons in the *p*-region. If the polarity of the applied voltage is reversed—see Fig. 8c—the built-in field is reduced and I_1 is large because the number of electrons in the *n*-region is so large. As before, I_2 from the *p*-region to the *n*-region remains unaffected. The net current is then large and corresponds to the forward direction.
The net current, I, under forward-bias conditions is given by the exponential expression

$$I = I_0\,[\exp(eV/nkT) - 1] \qquad [3]$$

where I_0 is the reverse saturation current, e is the electron charge, V the applied voltage, n a factor between 1 and 2 representing the deviation from ideal diode characteristics, k the Boltzman constant, and T the absolute temperature.
In a silicon solar cell, in the absence of incident light (called the dark state), the expression for the dark current, I_d is identical to that for I in formula [3].
When the cell is illuminated, a photo-generated current, I_{ph}, flows as junction reverse current. This current is directly proportional to the intensity of illumination. From Fig. 11 it will be seen that the net current, I, is given by $I = -I_{ph} + I_d =$

$$I = -I_{ph} + I_0[\exp(eV/nkT) - 1] \qquad [4]$$

The voltage U_L across the load and the current I_L through it produce an output power P_o, which is equal to $U_L I_L$ or $I_L^2 R_L$, and is the direct result of the incident light falling onto the cell. Finally, Fig. 12 shows that the sensitivity of a silicon solar cell is greatest at a wavelength of about 0.8 μm, i.e., at the lower end of the band of visible light towards the infra-red region.

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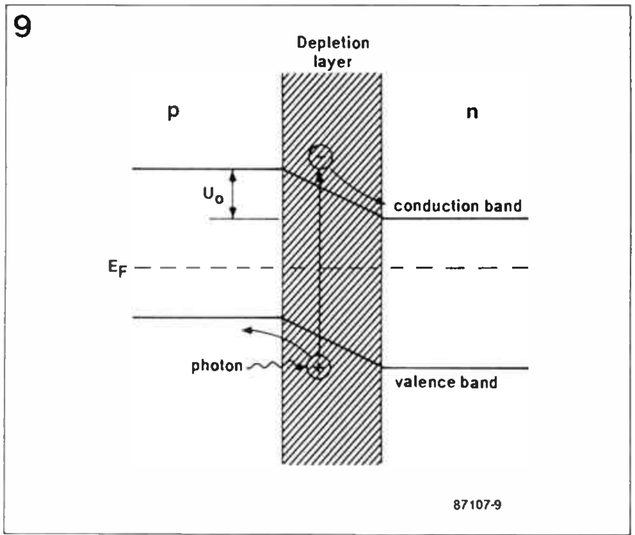

Fig. 9. Photovoltaic effect in unbiased p-n junction.

10

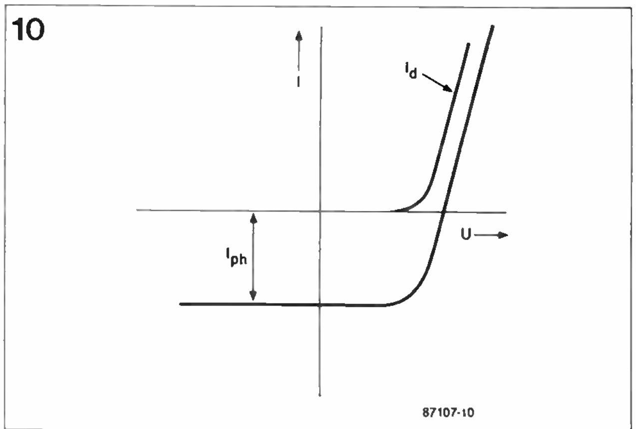

Fig. 10. Current-voltage characteristic of silicon solar cell.

11

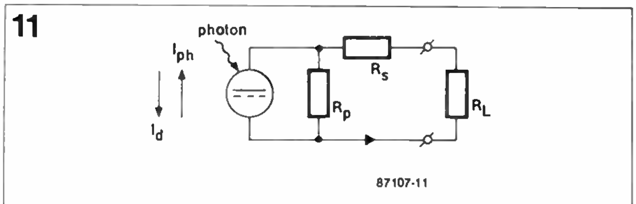

Fig. 11. Basic circuit of illuminated solar cell connected to load.

12

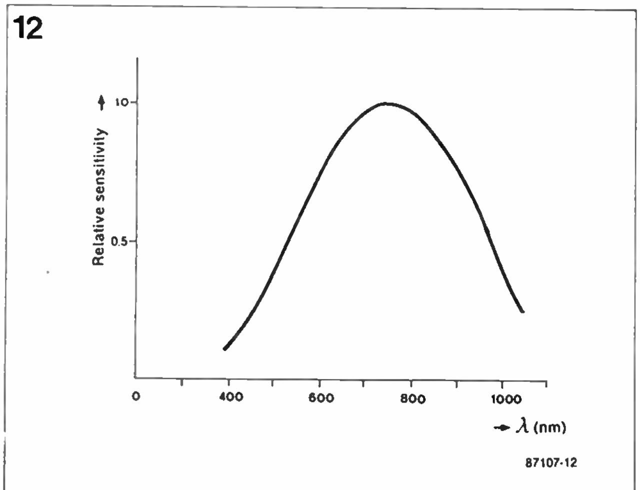

Fig. 12. Spectral response of a typical silicon solar cell.

References:

Physics of atoms and molecules by B. H. Bransden and C. J. Joachain

Quantum physics of atoms, molecules, solids, nuclei, and particles by Robert Eisberg and Robert Resnick

Die Technik der Solarzelle by Diaz Santanilla

▷ – from page 88

```
7040 REM
7042 PRINT:PRINT
7045 OPEN15,8,15:OPEN1,8,0,"$0"
7047 GET#1,B$:GET#1,B$:BY=26
7050 GET#1,B$:GET#1,B$
7080 GET#1,B$:BL=ASC(B$+CHR$(0))
7070 GET#1,B$:BL=BL+258*ASC(B$+CHR$(0))
7080 N$="":FOR K=1 TO BY
7090 GET#1,B$:IF ST<>0 GOTO 7130
7100 N$=N$+B$:NEXT
7110 PRINTBL;N$:BY=28
7120 IF ST=0 GOTO 7050
7130 PRINTBL;N$
7140 CLOSE1:CLOSE15
7150 PRINT:PRINT:PRINT"ANY KEY FOR MENU"
7160 GET S$:IF S$="" THEN GOTO 7160
7180 RETURN
8000 REM
8010 REM
8020 REM SUBROUTINE FOR SUB-MENU OF SCANNING COMMANDS
8030 REM ******************************************
8040 REM
8080 PRINT:PRINT:PRINT:PRINTTAB(15);"***  S SAVES TO DISK"
8070 PRINT"  ANY OTHER    ***  R SAVES TO REPLACE"
8080 PRINT"  KEY FOR      ***  1 FOR MENU PAGE 1"
8090 PRINT"  NEXT FREQ    ***  2 FOR MENU PAGE 2"
8100 PRINTTAB(15);"***  A FOR AUTOMATIC"
8110 PRINTTAB(15)"***  P FOR PAUSE"
8120 PRINTTAB(15)"***  CONT FOR CONTINUE"
8130 PRINTTAB(15)"***  $ FOR DIRECTORY"
8140 PRINTTAB(15)"***  T FOR TOGGLE(MANUAL)
8150 RETURN
```

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Holograms are widely used on pendants, stickers, magnetic 'stickers', on hire video cassette labels and in other promotional avenues and devices. Laser Light Expressions of Castle Cove NSW specialises in making holographic images for security and display applications.

A recently formed association looks after the promotion of the mutual interests of people involved in holographic image making. Called The Australian Holography Centre, they may be contacted at PO Box 1752, North Sydney 2059.

Penetrating the solar market – local firm leads the thrust

Australia is an ideal environment for the development of solar energy applications, with copious sunshine and plenty of areas where equipment requires a locally derived energy source.

PUMPS to lift ground water, powered by solar photocell/battery systems, electric fences powered by storage batteries kept charged by photocells, communications repeaters powered from photocell/battery systems – are all common applications that the Australian solar energy industry services.

Further development of current semicrystalline solar cell technology, continuing development of thin film (amorphous) technologies and improved manufacturing techniques will be the forces that shape the industry in the future.

Australia's oldest and claimably the largest solar energy system design and manufacturing firm, Solarex of Villawood in Sydney, specialises in photovoltaic cells, modules and ancilliary products. The firm's success in the local market has led them to export. Not content with having systems installed throughout Australia in applications ranging from channel marker buoys in Sydney Harbour to remote Telecom microwave repeaters, they have locally designed and manufactured solar power systems in operation throughout Asia, in Abu Dhabi and the Philippines.

Solarex power modules are to be found in railway signalling devices, powering aeronautical navigation aids, powering NSW Maritime Services Board marine navigation aids, providing power for communications relays used by Police and National Parks and Wildlife Services personnel and a host of other installations, large and small.

Mobile power

The solar panels to power several of the vehicles entered in the Pentax Solar Challenge race from Darwin to Adelaide were designed and manufactured by Solarex in Sydney. These ultra light, high power output panels represent an evolutionary manufacturing technique, according to Solarex.

Ford's Model 'S', recently unveiled in Victoria, is powered by a Solarex solar array which produces nearly a kilowatt of electric power, able to drive the vehicle to speeds in excess of 80 km/h, we're told.

Solarex aim the be there when solar powered vehicles are commonplace.

RAPS-ody

Solarex has spent some years developing and refining remote area power supply (RAPS) systems to provide an electric energy source where connection to the grid is not feasible. A Solarex RAPS system has been under evaluation by the Energy Authority of NSW for some two years. Powering a four bedroom home with four occupants is no mean feat, an Solarex equipment has managed to provide a service reported to be at levels in excess of initial electricity demand estimates.

In many cases, solar electricity is the answer in remote regions, where the cost of grid extension would be prohibitive and difficult to justify. When Solarex has perfected amorphous solar cell technology, dependence on good sunlight will be greatly reduced.

It seems Solarex is poised to take advantage of a market that should not be too much longer coming to the bubble.

▷ – from page 13

The system requires only one person, instead of two required with previous methods. Beacons are made for use in both horizontal and vertical applications.

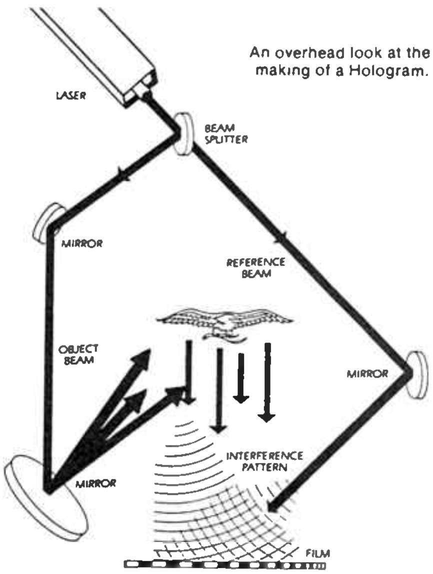
Alignment instruments for pipe laying and grading work are made so that they can be inserted in the end of a pipe.

Fast action pictures

Photographing very, very fast events or objects moving at very high speeds is extremely difficult, but often an important requirement in various research fields. Metal vapour lasers, which generally produce pulses in the sub-100 ns range at high pulse repetition rates find particular application in high speed photography.

Until recent times, the best illumination sources for high speed photography were limited to strobe sources having large bandwidths and poor collimation. Laser technology has seen their demise.

One specialist in metal vapour lasers is Oxford Lasers of the UK, represented here by Warsash Pty Ltd. Oxford manufacture gold and copper vapour lasers, the latter being described as ideal for high speed photography as they are capable of pulse repetition rates in the range two to 20 kHz and exhibit pulse durations of 40 ns or less, with an interpulse period of around 100 ms.



How a hologram is made. The laser beam is split, one part used to illuminate an object, the reflected light from which combines with the 'reference' beam to form an 'interference pattern' on film. When the film image is illuminated, an apparently 3D image appears.

Holography

One of the most promising growth areas in laser applications would have to be holography, the making of "three dimensional" images. For many years a laboratory curiosity or the realm of experimental artists, holography today has proven itself an effective and cost-efficient tool in display, security, industrial and military applications, according to John Tobin of Laser Light Expressions.

Holography was invented, well before lasers appeared, by Dennis Gabor who received a Nobel Prize for his work.

Holograms are no longer relegated to mere curiosity status, having become an every day device. Visa and Mastercard have been using embossed holograms on their plastic credit cards as a security device as well as a corporate identity symbol and promotional device with great success.

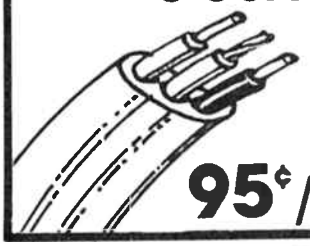
– to page 53

Calling ALL 'Sparks'...

Where do you get all those plugs, leads, sockets, switches and things to get your home working? Why, your DSE store of course!! DSE for great value, great prices and a great range.

Now you can get it at DSE!!

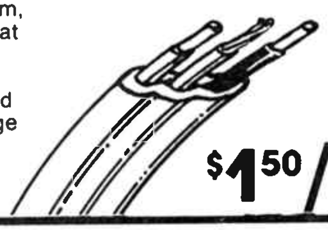
3 Core Flat Light Cable



Need an extra light in the bathroom, laundry, workspace, etc? 3 core flat 1/113 light cable with insulated earth and rated at 10 amps (1.13mm) at super low prices!! And at DSE there's no need to buy huge volumes to get the best price. Cat W-2060

95¢ / metre

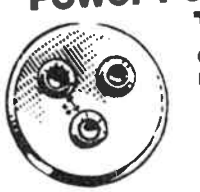
3 Core Power Cable



Save even more! 3 core flat 1/178 Power Cable with insulated earth at this fantastic low price. This stuff is usually referred to as builder's cable. Rated at 25 amps (2.5mm) you can have power wherever you need it! Cat W-2062

$1.50 / metre

Power Point Safety Tester



Check newly installed power points, old homes, etc. Just plug in and light pattern reveals any faults. Cat P-5300 $7.55

Child-Proof Protector

Stop young children's prying fingers by placing these plastic safety plugs into the outlet when not in use. Cat P-5420

$2.95

3Pin IEC Line Plug

Female line socket. Standard IEC. Cat P-5580

$4.15

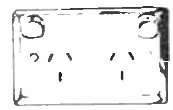
Suppressor Plug

Standard 3 pin AC plug, with capacitors fitted to reduce unwanted pops and crackles from audio equipment. Cat P-5425

$7.35

Double Power Point

Replace old single outlets with a double; much more convenient.



Cat P-5560 $11.80

3 Pin Plug Side Entry

Standard 3 pin AC plug with cable entry on the side — ideal for using with awkward equipment. Cat P-5402

$2.25

Wall Board Clip

Can be mounted from the front. Mount power outlets, switch plates, on any cavity wall (other than brick) without the need for a mounting block. Cat P-5530

$1.30

Surface Socket

Standard 3 pin AC socket that can be screwed to boards or walls — Ideal for workshop use. Cat P-5415

$3.70

3 Pin IEC Chassis Socket

Male Chassis socket, as used with above plug. 3 pin vertical IEC pattern. Cat P-5585

$3.15

Standard Mounting Box

Mount power points, plates, etc on any surface including brick. Cat P-5531

$2.25

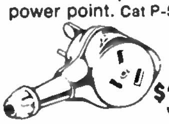
Architrave Switch

Standard architrave switch — can be used to replace old, worn out units in your home. Positive action switching. Cat P-5570

$4.95

3 Pin Piggy Back Plug

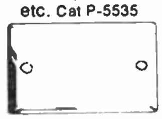
Standard 3-pin plug with 3 pin socket as well — doubles up one power point. Cat P-5405



$3.95

Blank Plate

Same size as power point, but blank: ideal for gap-filling when you move points, switches, etc. Cat P-5535



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Light Socket

Light socket for bayonet mount lamps. Ideal replacement for light fittings. Comes in white plastic. Cat P-5510

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Cat P-5925 20 Amp

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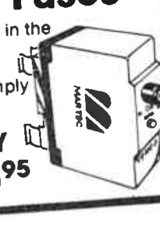
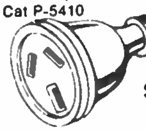


Line Socket

Ideal for making up extension cords — standard 3 pin AC socket. Cat P-5410



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$6.25

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Standard 3 pin AC plug into 2 AC sockets enabling you to use 2 appliances on one outlet. Cat P-5440

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High impact plastic moulded switch for insertion in any cord for remote on/off. Ideal for putting on/off switch in a floor standing lamp. Cat P-5515

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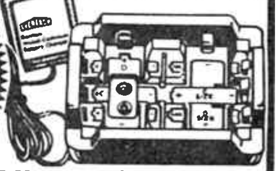

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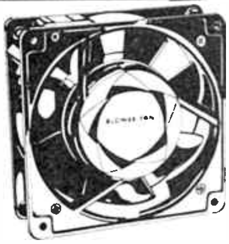
1	35	R-4720	70¢	63¢	56¢
2.2	35	R-4730	70¢	63¢	56¢
3.3	35	R-4735	70¢	63¢	56¢
4.7	35	R-4740	70¢	85¢	76¢
6.8	35	R-4745	70¢	85¢	76¢
10	25	R-4750	95¢	85¢	76¢
22	16	R-4760	95¢	85¢	76¢



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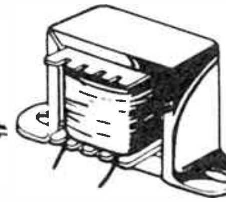

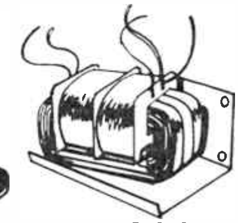

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Ideal for the home or workshop! Three Station Intercom comes complete with wire, two slave units and master. Cat F-1030

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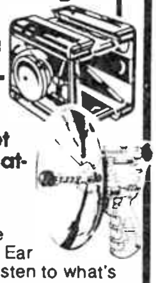
Listen to secret conversations



With the incredible Parabolic Ear you can listen to what's happening up to 6 metres away. Great fun!! Cat J-7046

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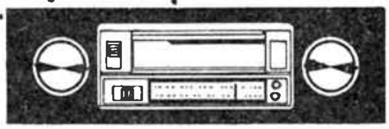

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Why not save a huge $70 off this Car AM/FM Radio Cassette? Top quality, unbelievable value!! Cat J-7048 WAS $199

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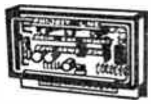

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Save an enormous $30 on our popular 2 Sector Alarm Module. Protect your property without spending a fortune! The bare bones system which doesn't cut corners on quality. Cat L-5055

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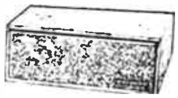

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Fully self contained Ultrasonic Alarm at an alarming low price! Everything is built into this one. Cat L-5108

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WAS $69.95 $39.95

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The Alternative Phone Company.

DSE Economy Phone

Perfect as a replacement or second phone in 5 fashion colours, attractive styling, features push button dialling, last number redial, mute button and ringer ON/OFF switch. Comes complete with coiled cord, wall plug and wall bracket!

Cat F-5185 White
Cat F-5186 Red
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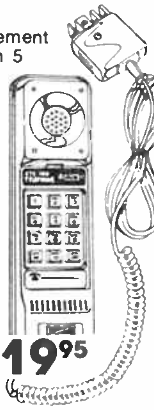
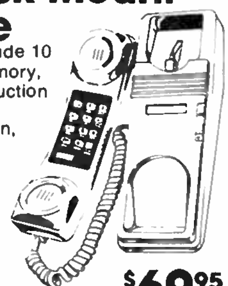
Cat F-5191 Blue
Cat F-5192 Brown



$19.95

10 Memory Wall or Desk Mount Phone

Features include 10 (18-digit) memory, sturdy construction and slim-line modern design, push button convenience, ringer ON/OFF with flashing LED for number redial and access pause for PABX systems, pulse dialling and much more! Cat F-5180



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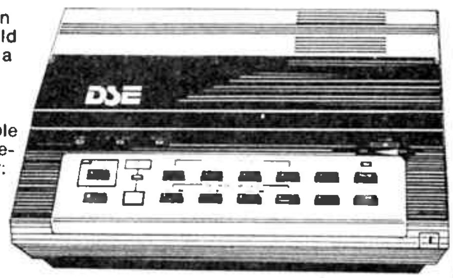
Call Forwarding 2 Tape Answering Machine

NEW

Totally Programmable — Totally controllable

You won't believe that an answering machine could offer so much - at such a low price. But then it's much, much more than an answering machine. Just look at the incredible features this state-of-the-art machine has to offer:

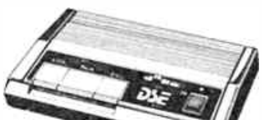
- Call forwarding
- Emergency message sending
- Security coded
- "Memo" fuction
- Answer delay
- Total remote control



$399 Cat F-6145

Expandable FM Wireless Intercom

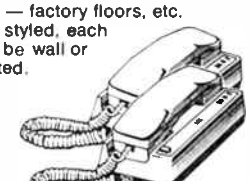
As your demands increase, so does this system. Add up to 6 stations allowing 3 simultaneous conversations. Built-in squelch for superior sound. Cat F-1013



$79.95 PR.

Phone-type Duplex 2-Station Intercom

Just lift the handset and use like an ordinary phone: full duplex operation means automatic 2-way operation...no buttons to press or hold. Perfect for noisy areas — factory floors, etc. Attractively styled, each station can be wall or desk mounted.
Cat F-1015



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Single Tape Answering Machine

This fantastic machine has got to be the simplest of all to use...in fact, the solid state microprocessor circuitry is activated by the slide of a button. Revolutionary VOX (Voice activated) remote control - no costly beeper required. Voice activated message time means more messages per tape and no wasted space. Unbelievable value! Cat F-6130

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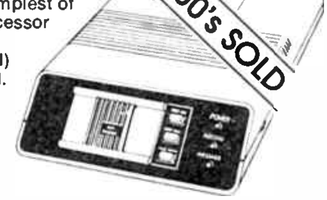
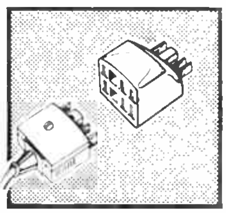


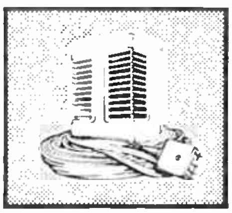
$199



Telephone Double Adaptor

Now you can plug two phones in, or a phone and an answering machine.
Cat F-5112

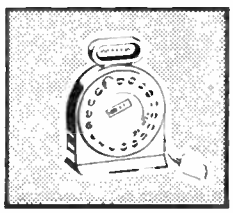
$7.95



Shh! Is that the phone?

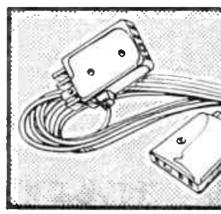
If you're in the garden, workshop you need never miss the phone again. Simply plugs into your existing telephone socket and gives you 5 metres of cord and extension bell.

Cat F-5119 **$19.95**



Phone Extension Reel

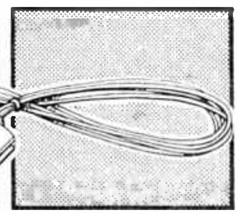
15 metre length provides freedom to move about the house or even outside. A retractable spool prevents any possible danger of tripping over a tangled cord. Features a convenient carry handle.
Cat F-5113 **$18.95**



10m Cord With Double Adaptor

15m of phone freedom — PLUS a double adaptor for your cordless phone, answering machine, etc.
Cat F-5103
Telecom authorised

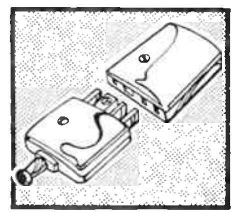
$16.95



15m Cord With Double Adaptor

A little shorter, a little cheaper. Also includes double adaptor. Cat F-5115

$12.95



Phone Plug and Socket

Easy connection for standard Australian phone systems.
Plug Cat F-5117
Socket Cat F-5118

$4.50 Ec.

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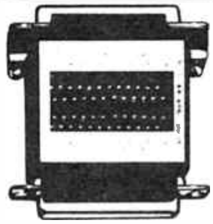
Computers for the clever buyer



RS232 Breakout Box

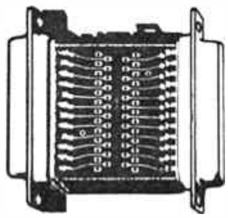
Ideal for modems and other serial applications where connections need changing. DB25 male to DB25 female, pin 1 permanently wired, all others open with wire links supplied.
Cat X-3568

$27.50

Permanent RS232 Jumper Box

Similar to above, but connections made internally and soldered for permanent applications. All 25 pins open. Wire links supplied ready for soldering. Cat X-3569

$17.50



Female/Female Gender Bender

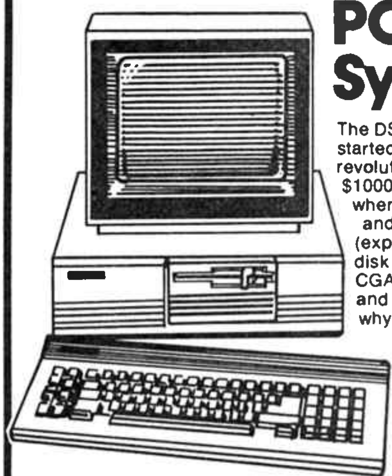
Adapts male serial cables without resoldering or reconnecting. Simply plug in — twin female DB25 sockets with all 25 pins wired pin to pin.
Cat X-3566

$15.95

Male/Maler Gender Bender

As above, but twin male plugs permanently wired. Cat X-3565

$15.95



PC-500 System 1

The DSE Multitech PC-500 System 1 started the Affordable PC compatible revolution by being the first to break the $1000 price hurdle. It's still the leader when it comes to quality, versatility and value! With 256K memory (expandable to 512K), single 360K disk drive, 4.77MHz clock speed, CGA card, parallel and serial ports and MS-DOS — it's not hard to see why! Cat X-8000

$995

*Monitor not included

VZ 300 Family Pack

$169

All you need to start computing immediately includes • popular VZ300 Colour Computer • Data Cassette • 2 game and 2 educational programs. Cat X-7307

Famous Xidex Diskettes

Single sided, double density (40 track): Box 10 disks. Cat X-3512

$44.95

Double sided, double density (40 track): Box 10 disks. Cat X-3514

$49.95

For "AT" machines with high (1.2Mb) capacity drives: Double sided, high energy (80 track): Box 10 disks.
Cat X-3516

$79

For laptops and other machines using 3½" (9cm) format disks: Double sided, double density: Box 10 disks.
Cat X-3503

$85

Budget DSE Diskettes

Why pay more? Top quality computer media at a realistic price, made exclusively for Dick Smith Electronics.
(13cm) standard size.
Single Sided:
Box 10 disks Cat X-3500 **$27.50**

Double Sided:
Box 10 disks
Cat X-3501 **$29.50**

More Modem — Better Value!

The New Bit Blitzer Modem is loaded with features and comes at a LOW, low price! 1200/1200 or 300/300 Baud, auto dial, answer and disconnect, Hayes AT command set compatability, fully keyboard controllable and some of the best instructions we've ever seen! Cat X-3306

$399

Software Made Simple

Now with Listen & Learn you can master those complex computer software programs in your own time, at your own pace! You'll save money on training programs AND you can use Listen & Learn over and over again.
MS-DOS Cat X-9800

$99

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– from page 26

It is usually quite easy to spot a short from an address or data line to either supply or ground, as the line will be held at a static level. Even shorts between address or data lines and other address or data lines can usually be found by judicious use of an oscilloscope or a logic analyser as it is most unlikely that two lines will be carrying the same signals.

Some misleading faults can often be traced to passive components in a logic circuit. An example of this is the failure of bypassing capacitors or pullup resistors can cause some strange symptoms. Failure of bypassing capacitors will often lead to "glitches" or noise spikes on the supply rails, but these can be spotted with a good oscilloscope. Another frequent cause of problems can be attributed to mechanical connections such as edge connectors and IC sockets, particularly in older equipment which has been in service for some time.

I remember one particular device which I worked on a few years ago. It had a mean time between failures measured in hours and contained a large pc board with over 100 TTL ICs, all in sockets. It was often the case that as soon as the board was moved, the fault would disappear. The eventual solution was to spend several days with a desoldering machine removing all the sockets and soldering the chips directly into the board. After that was done, the machine went for months without any failures.

As far as ease of replacement is concerned, sockets are a great idea, but in my experience, all but the very best types can cause more problems than they solve.

It is apparent that when compared to most analogue equipment, the types of faults which occur in digital circuits are generally more obvious in their nature. You will not have to deal with "vague" conditions such as distortion, but in view of the speed and overall complexity of many logic circuits, faults can be just as difficult to find. You will find that a comprehensive and accurate schematic diagram will be required, and even more essential with complex equipment, a thorough description of the circuit's operation. Without proper documentation, even the fellow who designed the device would find it difficult to remember how he made it work.

Whilst the technique of narrowing down the faulty area by testing and eliminating sections applies to all types of servicing, the number of simultaneous operations, the speed and the interaction between parts of the circuit, makes an understanding of the entire equipment's operation pretty well essential.

Don't be put off by the apparent complexity of some logic circuits, they can all be broken down into sections. I have surprised myself many times in the past by successfully repairing complex and unfamiliar equipment, simply by following a "logical" approach. Remember, it's all just "logic" isn't it!

FURTHER READING

Using the Modern Oscilloscope, Parts 1 and 2, Roger Harrison and George Smith, AEM July-August 1985.

Getting the Measure of Digital Oscilloscopes, Parts 1 and 2, Roger Harrison, AEM August-September 1985.

Inside the Modern Digital Multimeter, Roger Harrison, AEM June 1986.

So *You Want to Buy a Multimeter?*, Andrew Keir, AEM May 1987.

Range of RF componentry stocked by Stewart

Stewart Electronic Components of Melbourne stock a variety of RF component lines for enthusiasts (and professionals!) pursuing an interest or project involving RF circuitry.

The really good news is they stock the complete range of Amidon iron powder cores, ferrite cores and coil former assemblies. That's nothing, if not comprehensive! This range includes toroidal cores, twin-hole balun cores, cylindrical cores – both solid and with centre hole, E-I cores, etc. And the range encompasses more applications that just RF covers Yes, catalogues and design data are available.

Amidon components are often specified in US-published RF equipment designs, particularly in ARRL publications

Technical Director, John Day (VK3ZJF), advises that Stewart still stocks the Philips range of ferrite cores but have phased-out the Neosid range completely.

The ARCO range of compression mica trimmers, ideal (if not essential) in RF power amplifier applications, are also stocked in a variety of value ranges, including 60 pF max. and 115 pF max. types widely specified in US designs.

Stewart also stock a range of quality, high-Q low-loss air trimmers made by EF Johnson which are ideal for VHF and UHF small signal and low level power amp applications. They also carry a range of small ceramic trimmers suited to VHF/UHF applications.

Their fixed capacitor product line includes types specially suited to RF applications across the spectrum right up to the SHF region: dipped mica capacitors, discoidal and conventional ceramic feedthrough, conventional SMD ceramics, and high-Q ceramic chips (similar to ATC 100).

And their RF product line doesn't stop at passives. They stock Mini Circuits mixers (and RF transformers), MMIC broadband amplifiers, MOSFETs, GaAsFETS and RF power devices from makers such as Philips, Motorola and Plessey.

For Victorian residents, **Stewart Electronic Components' store may be found at 44 Stafford St, Huntingdale 3166.** Interstate residents can write to **PO Box 281, Oakleigh 3166.** Phone enquiries on (03)543 3733.

PROJECT BUYERS GUIDE

Kits for both versions of the AEM4510 RS-True-32er will be widely available. Jaycar – with stores in Sydney, Brisbane and Melbourne – will be stocking kits along with All Electronic Components in Melbourne. Geoff Wood Electronics in Sydney has been stocking the MAX232 IC for some time and proprietor Geoff Wood has indicated he'll be stocking the MAX231 as well. Force Electronics in Adelaide has indicated they may be stocking these kits, too.

Coax and TV ribbon to construct the AEM3013 80 Metre Space Miser Antenna can be obtained from a wide variety of suppliers: Dick Smith Electronics stores and dealers, Jaycar stores, Altronics, David Reid Electronics, Tandy stores, etc.

This issue's Star Project, the SW-1 Passive Subwoofer, is available from Scan Audio Pty Ltd, 52 Crown St, Richmond 3121 Vic. (03)429 2199. Drivers for this project, for constructors making their own enclosure, are available at Jaycar stores and Altronics.

This month's Elektor section contains a host of circuits and, for the most part, there should be few difficulties obtaining specified components. The exceptions are as follows:

In the High Level RF Preamp, a Motorola 2N5109 is specified. See your local Motorola semiconductor supplier. It may have to be ordered in. In Sydney, see Geoff Wood Electronics in Lane Cove; in Melbourne, Stewart Electronics in Huntingdale. A complementary pair of BD24½42 Philips transistors is specified in the Current Corrected AF Amp. Try the last-mentioned suppliers.

The Limiter for Guitars employs a BF256C, a "Process 50" JFET for which there are a numerous type numbers: Try MPF102, MPF106, 2N3819, 2N5484, 2N5485, 2N5486, 2N3823, 2N4416 or BF245. You'll find at least several of those commonly stocked by retailers.

In a number of circuits you'll find the TLC271 or TLC272 specified. Hi-Comm Unitronics in Caringbah, Sydney is stocking these. They're quite cheap. Rifa are the distributors.

The Philips BF981 specified in the Precision Crystal Oscillator is stocked by Stewart Electronic Components in Melbourne. Try Geoff Wood in Sydney, also.

The Patch Catcher specifies a 6 V Siemens relay. However, a common 5 V relay may be readily substituted, being available from many suppliers, in which case the value of R13 should be increased from 39 ohms to 47 ohms.

Constructors should note that printed circuit boards for the projects published in AEM will be available from All Electronic Components in Victoria and Queensland, Force Electronics in Adelaide and Hi-Comm Unitronics in Sydney. While All Electronic Components are gearing up to stock virtually all boards published, other suppliers only have selected project boards. Phone first to check availability.

DIN plug and socket bargains

Widely used in audio and computer equipment, DIN connectors are popular because they are highly functional, simple to assemble and easily plugged in and out. You should always have several varieties on hand.

All Electronic components in Melbourne are currently selling assorted DIN connectors for a dollar each, a bargain hard to beat almost anywhere.

Among the types available you'll find: right angle pc-mount 6-pin sockets with standard in-line plugs to match, locking type metal body bulkhead mounting 8-pin sockets (with earth pin) and plug to match, plus an all-plastic 10-pin bulkhead mounting type with right-angle plug to match. The metal body types are a quality connector, German-made by Preh.

Get a handful. Get them from **All Electronic Components, 118 Lonsdale St, Melbourne 3000. (03)662 1381.**

Shrunk on you

Retail Roundup's roving reporter spotted what is probably the best range and variety available in heatshrink tubing recently while on a tour of Sydney's "Silicon Alley", York Street, opposite the Queen Victoria Building.

There in the middle of the animal cage – er, sales floor – is a rotating stand chock full of metre lengths of Remtek brand heatshrink tubing. You can't miss it – they're in a gaudy rainbow of colours from white through, um, black.

Tubing sizes (unshrunk), include 1.6 mm, 3 mm, 4 mm, 6 mm, 10 mm, 12 mm, 19 mm and a monster 25 mm. Prices range from $1.95 for a one-metre length of the smallest diameter, to $7.50 for a metre length of the largest.

See **David Reid Electronics, 127 York St (PO Box Q103), Sydney 2000. (02)267 1385.**

Lab. Power Supply kits in stock

Force Electronics in Adelaide now has adequate stocks of kits for the AEM2000 0-55 V/100 W Power Supply. The project was published over the April-August issues.

The kits include comprehensive documentation, comprising a manual of some 40 pages, pre-punched chassis and every last component, nut and bolt.

Customers can now order the kits tax-free, where applicable (e.g: government departments, TAFEs, universities, etc).

Enquiries to **Force Electronics, 203 Wright St, Adelaide 5000 SA. (08)212 5505.**

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  – the best from our Australian designers and the cream from the British Elektor.
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- **Telephone technical enquiries**
  – yes, you can speak to the editorial team direct and have your queries answered. We don't live in an ivory tower!
- **Hi-Fi, sound and video news, reviews & features**
  – independent, professionally conducted reviews from Robert Fitzell Acoustics; features from well-known writers like Dennis Lingane and Malcolm Goldfinch.
- **Practical computing articles**
  – a whole section each month devoted to electronics enthusiasts exploring computing and computing enthusiasts exploring electronics.
- **Communications coverage**
  – news, reviews and practical features on RF techniques and radio communications, covering everything from circuit techniques to cellular radio, from satellites to amateur radio.
- **Topical technical features**
  – covering consumer electronics, topical technological and scientific fields, current issues and circuit techniques.
- **What's new in the market**
  – occasional features on new products and developments, giving topical and informative coverage of specific fields and product groups.

You'll find something to interest you every month in Australian Electronics Monthly, no matter what your special interest might be. The magazine is "sectioned" into categories for easy reading and easy reference, each section headed by its own news column.

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If you work in electronics, communications, computing or servicing, a subscription to Australian Electronics Monthly could be tax deductible.

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Build this passive 'bandpass' subwoofer — add a bass octave, or two!

Scan Audio

Extending the bass end of your loudspeaker system has a dramatic effect, irrespective of your tastes in music! This simple to build subwoofer provides a bass range extension down to 25 Hz, yet takes up little space and can be placed almost anywhere in the listening room. And, as it's a passive system, a special subwoofer power amp is not needed, so it's simply wired in to your existing stereo setup.

THIS SUBWOOFER is remarkably simple to assemble, yet embodies recently developed design principles that are now beginning to be widely employed in new loudspeaker designs from leading companies all over the world.

Good bass response, extending down to the "bottom end" of the audio spectrum has always been a goal of quality loudspeaker designers aiming for high fidelity reproduction. Two main design approaches for bass enclosures have evolved over the years – the sealed (or "pressure box") enclosure in which the driver is mounted on one face of a box which totally seals the driver's rear, and the "vented" enclosure, which can take a variety of forms, in which the driver is, again, mounted on one face of a box, but the radiation from the rear of the driver is controlled by a chamber which has an outlet to the 'outside world'.

This outlet may take the form of a "transmission line", a long tube which is generally constructed in a folded-up form to conserve space, a hole in one face of the box, or a "tuned port" (reminiscent of an organ pipe) let into a face of the box. The latter is known as a "bass reflex" system and is probably the most widely used of the vented enclosure schemes.

SPECIFICATIONS

Principle: bandpass bass reflex
Drivers: 2 x Vifa P25WO woofers
Frequency response: 25-88 Hz (DIN)
Power handling: 80-100 watts per channel
Sensitivity: 90 dB/one watt/one metre
Nominal impedance: 8 ohms
Dimensions: 602 x 410 x 340 mm

The pioneering research work of Neville Thiele and Richard Small in Australia on the bass response of drivers mounted in vented enclosures has been applied to dramatic effect on a positively huge variety of loudspeakers produced over the past few years. The critical "Theile-Small" parameters are now widely given as standard specifications on low frequency drivers from many manufacturers the world over. Their work enabled the accurate prediction of loudspeaker bass performance and truly contributed to the rise in quality and performance evidenced in many loudspeakers produced in recent years.

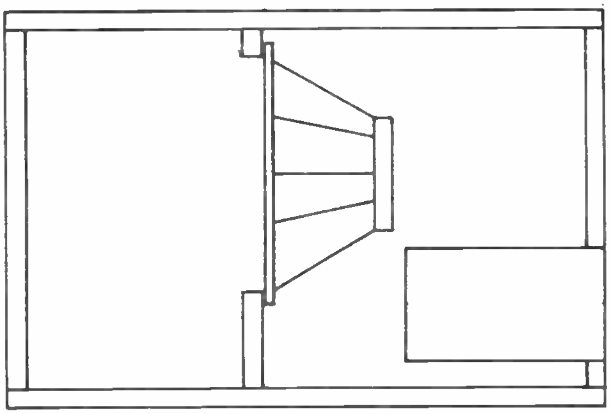


Figure 1. Laurie Fincham's basic sealed-box/bass-reflex subwoofer scheme. The front radiation of one driver is controlled by the sealed box, while the rear radiation is controlled by the ported box, all sound radiation coming from the port. This system requires a crossover and mono amplifier, driven from the preamp outputs.

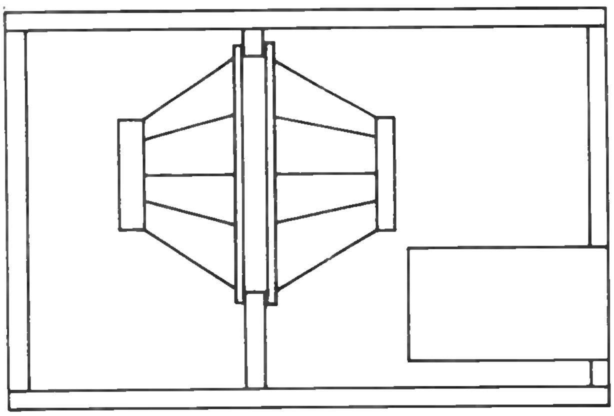
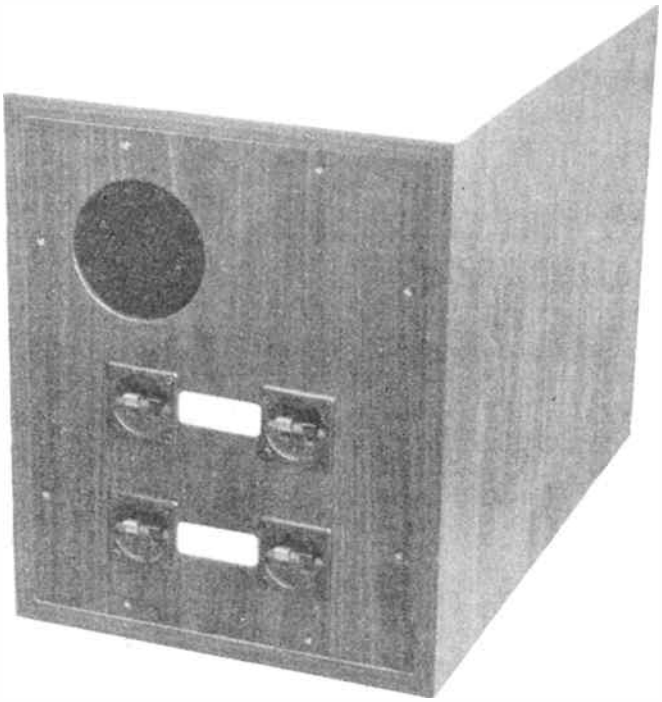


Figure 2. Vifa's passive subwoofer employs two drivers mounted face-to-face, one driver controlled by a sealed box, the other controlled by a bass reflex box, with sound radiation only from the port, as in Fincham's system.



Technicalities

A driver mounted in a sealed box behaves as a second-order high pass filter, with a gentle roll-off at the bottom end of the frequency range of 12 dB/octave. That is, beyond the point the response begins to roll off, the output decreases by 12 dB each time the frequency is halved. If a given speaker and enclosure rolled-off at 100 Hz, the system's output would be 12 dB down at 50 Hz and 24 dB down at 25 Hz. The outstanding characteristic of the sealed enclosure is its transient performance.

The bass reflex system, in contrast, acts as a fourth-order high pass filter, the bottom end roll-off depends on a number of parameters but is characteristically much steeper than that of a sealed enclosure. However, a bass reflex system of the same box size as a sealed enclosure is capable of a lower cutoff frequency and lower distortion.

In 1979, Laurie Fincham at the British speaker manufacturer, KEF, in an effort to gain the best characteristics of both the sealed box and bass reflex designs, obtained a second-order system response by mounting a woofer in a bass reflex enclosure, then building a sealed enclosure in front of the driver's cone, and using only the radiation from the port! This is illustrated in Figure 1.

Now known as the "bandpass" system, it is ideal for a subwoofer as it exhibits an inherent roll-off above about 100 Hz. Since Fincham's papers on this work were published, there has been a flurry of design work around the world and a host of variations and extensions on the technique developed. (See "Recent Developments in Bass Speaker Design", by Will Kennedy, Australian Electronics Monthly, May 1987, page 16).

A modification of Fincham's basic system, developed by the Danish speaker manufacturer, Vifa, effectively places two speaker systems face-to-face; with a sealed box on one side and a bass reflex box on the other, the two drivers facing one another, as shown here in Figure 2. This is the scheme employed in this project.

A subwoofer system need only be monaural ('mono') as stereo information is lost at frequencies below about 150 Hz, particularly in domestic situation, owing to the long wavelengths involved. Apparent localisation of low frequency sound sources arises from the harmonics generated, not the fundamentals. Hence, in any subwoofer system distortion is an important consideration. The natural harmonics of the recorded sound source are recorded and reproduced as stereo signals in the usual way.

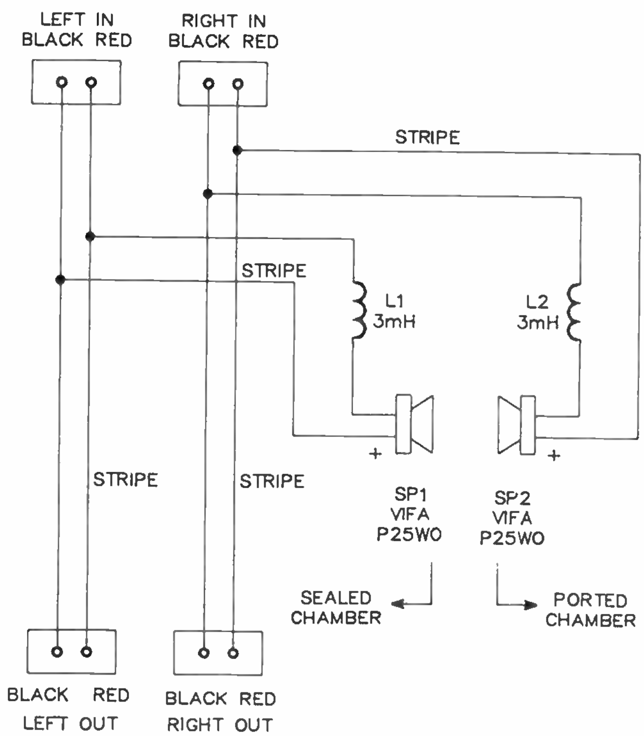
A single-driver subwoofer design requires a separate mono power amp to be added to an existing stereo system, taking signal from the preamp outputs, converting it to mono and applying suitable rolloff in the upper bass region, then amplifying that to drive the subwoofer.

The scheme described here does away with the requirement for an extra amplifier. The circuit is shown in Figure 3. It is known as the SW-1 Subwoofer System.

PARTS LIST SW-1 SUBWOOFER

2 x Vifa 254 mm P25WO/8 ohm drivers (SP1, SP2)
2 x 3 mH inductors, inherent resistance 0.8 ohm or less
4 x speaker connectors
Two metres of heavy duty (24 x 0.2 mm) twin flex cable with stripe, or special speaker cable.
Cabinet, 18 mm chipboard.
Cabinet stuffing (see text).

Figure 3. Circuit of the SW-1 Subwoofer System.



The SW-1 design

As can be seen from the circuit, one driver is connected to the right channel line going to the existing right channel speaker, while the other driver is connected to the line going to the left speaker. One speaker is connected in reverse phase to the other so that the cone excursions act in opposite directions. ▷

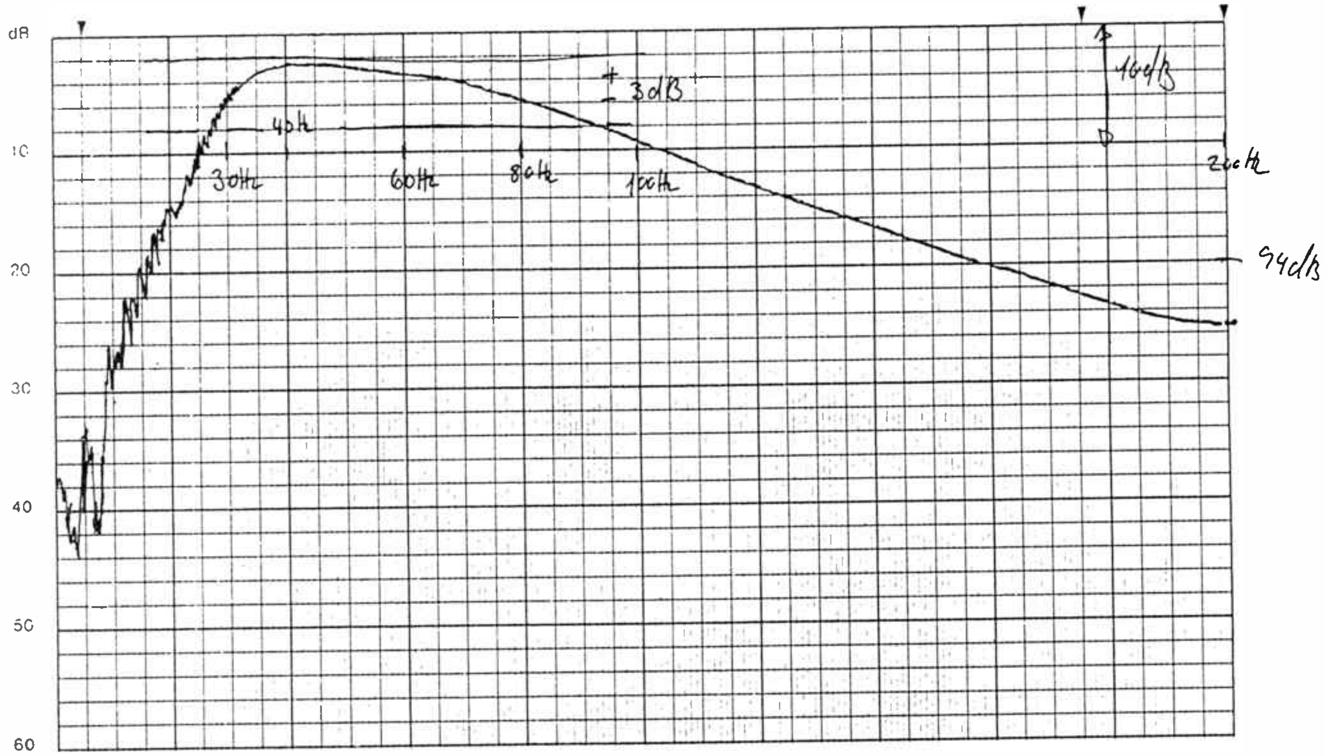


Figure 4. Measured frequency response of the SW-1 Subwoofer System (linear frequency scale). Response is within ±3 dB from about 25 Hz to nearly 100 Hz.

to the left ('forwards'). One's pushing while the other's pulling! Thus, the two cones effectively act as one 'radiator' mounted on the partition.

The enclosure measures 602 x 410 x 340 mm and is constructed of 18 mm high density chipboard. The internal baffle separating the sealed box and bass reflex enclosures is also of 18 mm chipboard.

The drivers are 254 mm (10") Vifa P25WO polycone woofers which exhibit quite low distortion. They have a 25 Hz free-air resonance, a rated sensitivity of 89 dB (1 W at one metre) and a nominal continuous power rating of 60 W, or 100 W on music. In this application they are operated only over the lower third of their piston operating range. The SW-1 is designed to crossover in the 90-120 Hz region and to this end, roll-off at the top end of the range is effected by the 3 mH inductor in series with each driver.

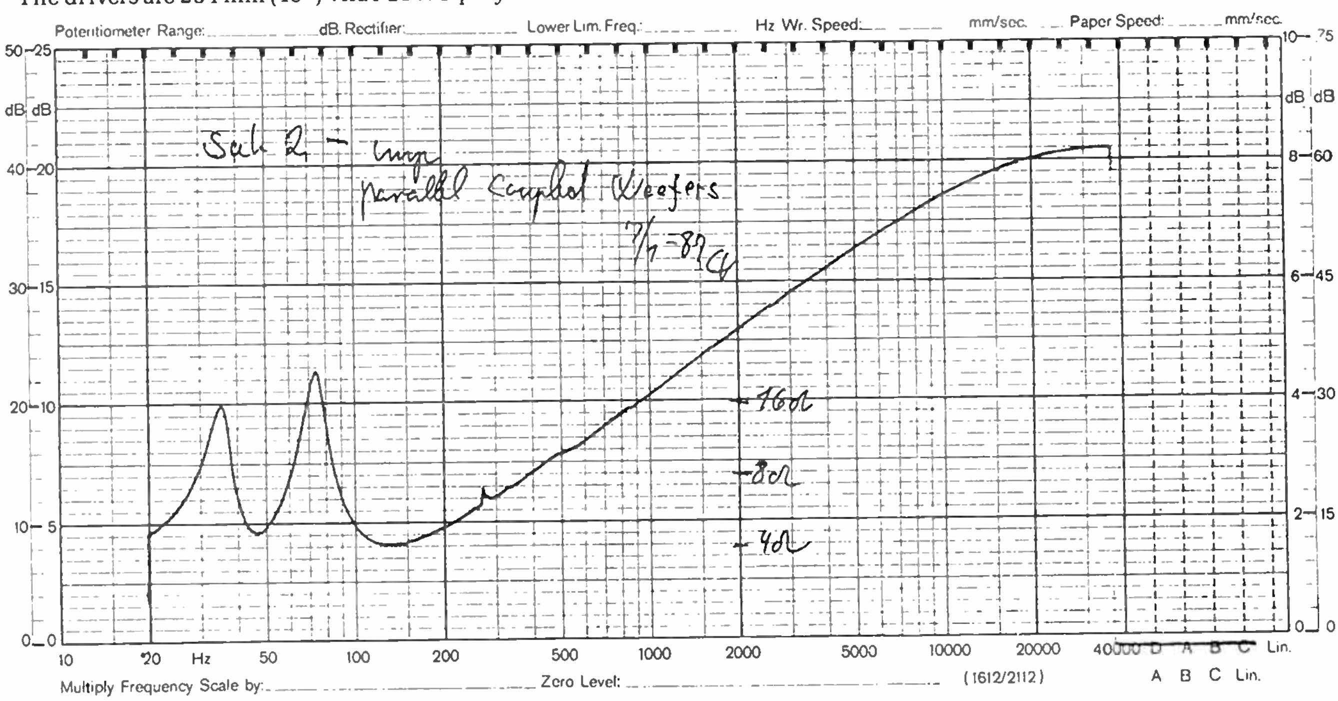


Figure 5. Measured impedance versus frequency characteristic of the SW-1 Subwoofer System.

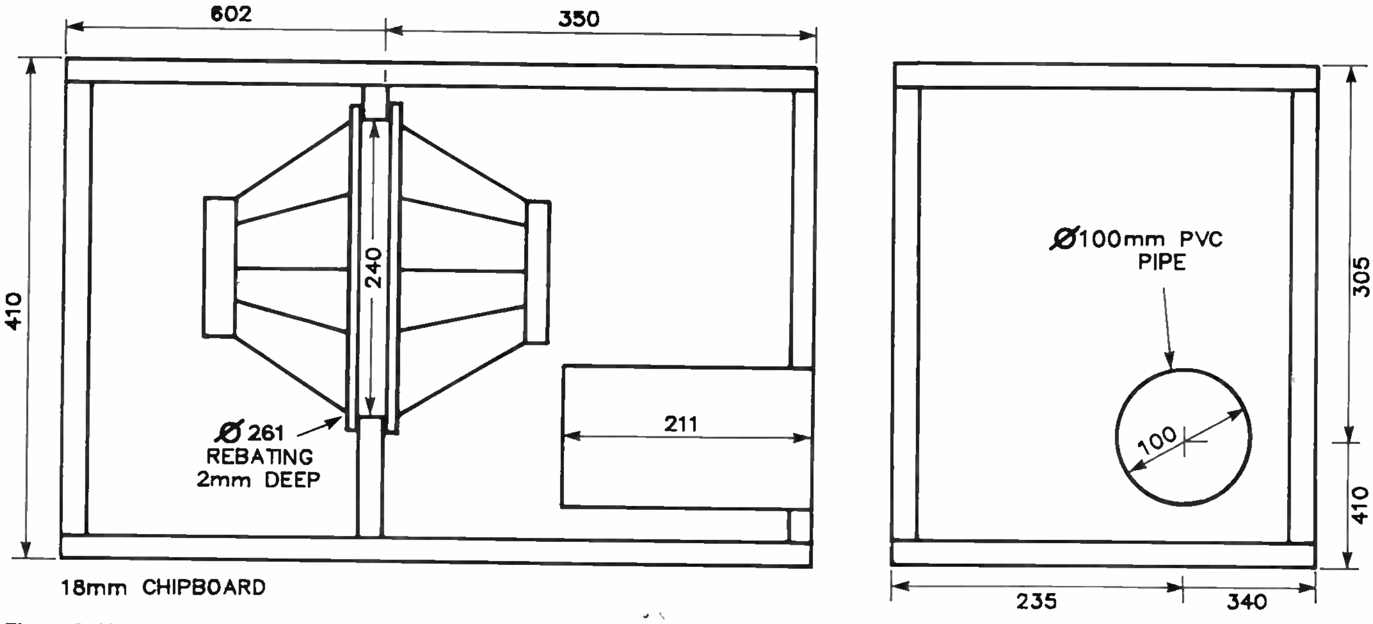


Figure 6. Side and end views of the SW-1 cabinet, with all relevant dimensions. The port is 100 mm external diameter PVC sewerage pipe, accurately cut 211 mm long. It mounts flush with the front face of the end panel. Spray the internal surface of the port matt black before assembly.

The system achieves quite a smooth frequency response with extended bass that falls off at around 12 dB/octave at the bottom end. Measured response, as shown in Figure 4, is within ±1 dB from around 33 Hz to just over 80 Hz, and within ±3 dB from about 25 Hz to very nearly 100 Hz, which is very good, indeed. Even at 20 Hz, response is only 10 dB down from the cutoff, subjectively a halving in output. Sensitivity is rated at 90 dB for 1 W at one metre and the nominal impedance is 8 ohms. The impedance curve, Figure 5, shows the impedance dips to a minimum of four ohms, which is well handled by the majority of modern amplifiers, and a rising response with increasing frequency, typical of bass reflex enclosures. The two impedance peaks, at around 33 Hz (16 ohms) and 75 Hz (18 ohms) reflect the interaction between the drivers and the two enclosures.

Construction

There are two ways you can tackle the construction of this project: a complete kit is available, comprising pre-cut ready-veneered cabinet, drivers, stuffing, inductors, wires and connectors etc; or you can elect to purchase the drivers, connectors etc as components and make your own cabinet. If you follow the latter course, drivers and suitable speaker connectors are available from Jaycar stores in Sydney, Melbourne and Brisbane, and Altronics in Perth.

If you elect to build your own cabinet, the general dimensions are given here in Figure 6. We will assume that, having elected to make your own cabinet, you already have a working knowledge of and some skill at woodworking. All panels should be accurately cut. The four side panels are glued together, employing small 50 x 60 mm chocks of chipboard glued at intervals along the long sides of each 410 x 602 mm panel, about six per side. Two should be positioned to secure the internal panel at the right place. Lengths of lath around the inside edge of each end of the box should be glued in place to take the end panels, permitting them to be screwed in place so that the end panels sit flush. Two screws per side are used to secure the end panels. Cabinet finish is left to you.

The input and output connectors mount on the end panel with the port. These must have colour-coded terminals, one red and one black. Use suitable speaker connectors that can be sealed around the edges.

If you're building the SW-1 from a kit, first unpack it all, lay everything out and identify all the parts. Check how the cabinet goes together before proceeding with its assembly.

Note that, whether making your own cabinet or assembling it from a kit, the cutout in the internal baffle is off centre so that the port of the bass reflex chamber does not foul the driver's magnet assembly. The cutout is rebated to set-in the rim of each driver. Use one driver to mark the positions of the mounting holes. Also, a hole is drilled in the internal baffle to pass the connecting cable from the sealed-box driver through to the connectors. The drivers are best mounted to the baffle before assembling it into the cabinet. The inductors are glued to the cabinet adjacent to the drivers.

In the kit, the pre-wound inductors are wound on plastic bobbins using 18 gauge (1.0 mm) enamelled copper wire and have a ferrite 'slug' glued to the inside of the bobbin. (This increases the inductance for a given number of turns, keeping the inherent resistance low for a given wire gauge). If you're winding your own inductors, note that the minimum resistance must be around 0.8 ohm or less. Use at least 16 gauge (1.25 mm) enamelled copper wire. The number of turns required will be dependent on the dimensions of the former employed, so you will have to experiment using an inductance bridge to measure test windings. Some electronics suppliers may carry air-cored or slug-cored crossover inductances of the right value (three millihenries).

Wire-up the drivers and inductors using heavy duty twin-flex or speaker cable which has one wire marked with a stripe. The 'active' or 'positive' lead should be identified with the stripe. Each driver has its positive terminal identified by a small spot or '+' mark adjacent to the terminal lug. The IN and OUT speaker connectors are wired together as indicated in the circuit.

All cabinet joints should be glued using PVA glue. All joints ▷

For example, if the cone of the left hand driver (sealed box) were driven to the left ('backwards') by the incoming signal, the cone of the right hand driver (ported box) would also move must be effectively sealed, including around the port where it meets the panel and where the cable passes through the internal baffle. Use a room temperature curing rubber compound or similar. Pay special attention to sealing around the speaker rims. The compound should be applied to the rebate and allowed to set before the drivers are mounted. The connectors should also be sealed around the edges.

Both chambers should be completely packed with a speaker stuffing material (supplied with kits) or 50 mm thick high density mattress foam.

Before glueing and screwing the end panels in place and stuffing the chambers, you need to test the system. Take a 1.5 V cell and solder a wire to each end. Watching the cone of the driver in the ported chamber, briefly touch the leads from the battery to the 'right in' terminals – positive to red, negative to black. The speaker cone should move backwards, towards the magnet. Do it again while watching the cone of the other driver, it should move forward, away from the magnet. If this doesn't happen with either driver as described, check and correct your wiring.

Having passed that test, you can fit the stuffing in the chambers and screw the end panels in place, putting some sealing compound around the edges to ensure an air-tight fit.

In use

The SW-1 is wired-in to your existing system as shown in Figure 7. It is best suited to systems where the existing speaker sensitivity is around 90 dB/1 W/1m; several dB difference either way can be readily compensated for by the positioning of the woofer or adjusting the system response.

You will need to experiment with the positioning of the subwoofer in the room to ensure the correct phase of the radiation in the crossover region. If you experience a "hole" in the response in the lower mid-range/upper-bass, change the subwoofer's position in relation to the existing speakers to eliminate it.

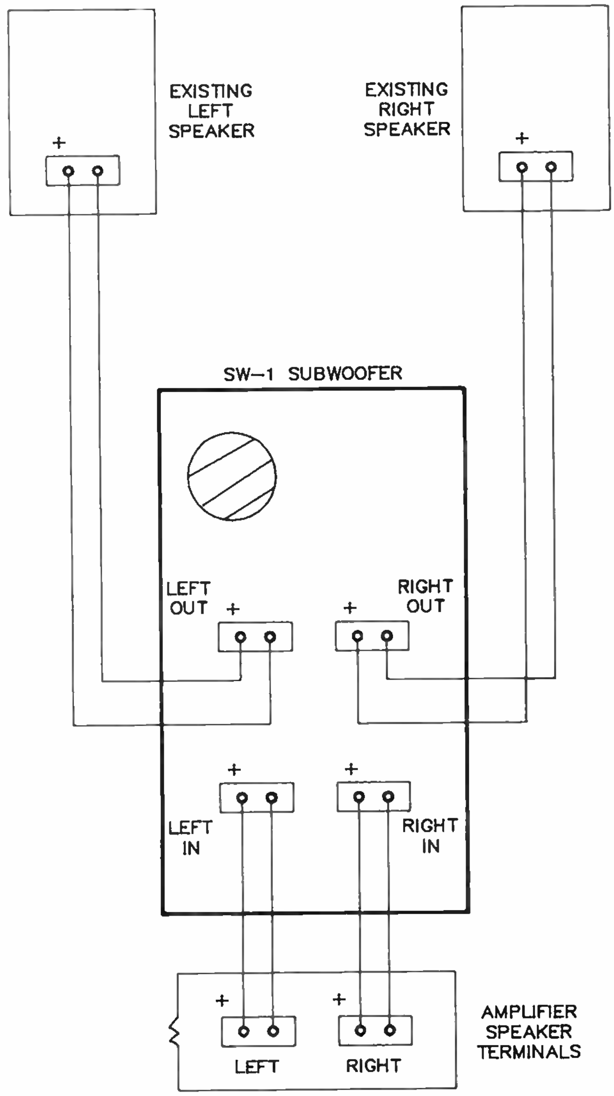


Figure 7. How the subwoofer is wired-in to your existing system.

The actual bass response can be varied by positioning as well. When the subwoofer is close to a wall, a boost in response will be obtained. Placing it in a corner will further lift the response. This is useful if the existing speakers are more efficient than the SW-1.

Don't place the port facing a wall and close to it, as this will restrict the response. If you place the unit near a wall, place the long side of the cabinet against it.

For best subjective effect, the subwoofer should be hidden from view or disguised.

This month's Star Project is from Scan Audio, 52 Crown St, Richmond 3121 Vic. (03)429 2199. Scan Audio are distributing kits as well as fully-built units. Contact them for more information and your nearest stockist.

SECOND-BIRTHDAY CONTEST

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RULES: You may enter as many times as you wish, but you must use a separate entry form for each entry and include a month and page number cut from the bottom of the contest page. You must put your name and address on each entry form and sign it where indicated. That is, photocopies are acceptable but an original month/page number from a copy of this month's magazine must accompany each entry form. The contest is open to all persons normally resident in Australia or new Zealand, with the exception of members and families of the staff of Australian Electronics Monthly, the printers, Offset Alpine, Network Distributors and/or associated companies. Contestants must enter their names and addresses where indicated on each form. Photostats or clearly written copies will be accepted if accompanied by an original page number and month cut from the bottom of this page. This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration that they have read the rules and agree to abide by their conditions. The winning entry will be drawn by the Editor whose decision is final; no correspondence will be entered into regarding the decision. Winners will be notified by telegram the day the result is declared and the winner's name and contest results published in the next possible issue of the magazine.

Send entries to:
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Q1: You remember AEM's 1st birthday? What was the prize offered by Philips Test & Measurement (Scientific & Industrial)?

. . . .

Q2: The 18 Series DMMs were reviewed in AEM's February 1986 issue. What does the last paragraph in Alan Ford's review say?

. . . .

Q3: Consider the following numeric string: 166622800. No to-ing and fro-ing now! You've seen it before. Philips advertise it a lot. What is it?

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Now, on a separate piece of paper, tell us in 30 words or less, why you'd desperately love to take home this prize!

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. . . .

Address . . . .

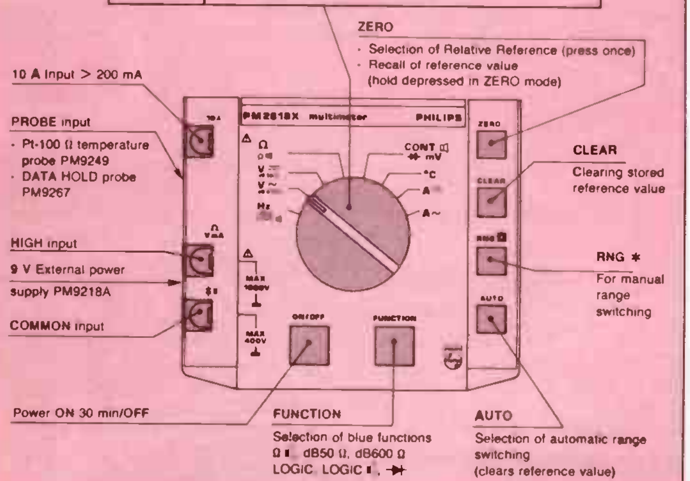
. . . . **Postcode** . . . .

I have read the rules of the contest and agree to abide by their conditions.

Signed . . . .

FUNCTION SELECTION

Ω ▮	1 k, 10 k, 100 k, 1 M, 10 M, 100 M (Manual only) < 10% ▮ ~ — < 1% ▮ ≋
V⎓	1 V, 10 V, 100 V, 1000 V, dB V ⎓ 50 Ω − 47 + 53.8 dB
V~rms	1 V, 10 V, 100 V, 1000 V, dB V~ 600 Ω − 51 + 43,1 dB
Hz	19 999 kHz 199.99 kHz Gate open 1 s
Hz LOGIC	OPEN, bAd, ‾‾‾‾ Logic 1, ____ Logic 0; positive pulse; negative pulse; symmetrical pulses
Hz LOGIC ▮	As Hz logic plus high tone = Logic 1, low tone = Logic 0, intermittent high tone = pulse(s)
CONT ▮ ⯈|	Continuity check < 10% ▮ ~ → < 1% ▮ ≋ Diode measurements 1 V, 1 mA
°C	− 60 + 200°C with Pt-100 Ω probe PM9249
A⎓ A~ rms	20 mA, 200 mA, 2 A, 20 A



The "RS-True-32er" TTL/RS232 converter

Andrew Keir

Whilst a great many computer peripherals are designed to interface via an RS232 serial data connection, modems and printers being common examples, some computers have "serial" ports which do not provide signal levels that truly conform to the RS232 signal standard, employing TTL-level signals instead. It might be convenient for the manufacturer and their own add-ons, but not for you when it won't "drive" some equipment you've purchased. Here's the fix!

THERE ARE MANY personal computers on the market these days which provide what their makers call a "serial" port. A lot of users assume this to mean that they have an RS232 serial port, but as many have found out, this is not necessarily the case. Whilst these "serial" ports indeed transmit and receive data serially, they do not always conform to the accepted standard of RS232 in a number of major areas.

The RS232 standard describes an implementation of a serial interface between two pieces of equipment. Most computer hobbyists will be familiar with this standard which is used on dozens of peripheral devices such as printers and modems. One of the main incompatibilities of some computers' serial ports lies in the actual voltage level of the signals that they transmit or receive. The RS232 standard describes a "high" or "space" signal as being represented by a voltage of between +3 V and +25 V. A "low" or "mark" signal is represented by a voltage of between –3 V and –25 V. The range between +3 V and –3 V is considered to be an indeterminate or undefined signal.

The problem arises from the fact that many manufacturers like to save a few dollars in production and thus don't feel inclined to provide the plus and minus 25 V power supplies which are necessary for the full RS232 standard. As a result of this cost cutting, the serial port of many machines will use the +5 V supply which powers the computer's circuitry. Instead of plus and minus 25 V, the serial port uses levels of about 0 V and +5 V or in other words, TTL levels (or 5 V CMOS). With some peripherals this may not cause a problem, but if the modem or printer which you are connecting expects to see true RS232 signals, you might find that it doesn't work.

A further complication becomes apparent in some machines when, not only are TTL level signals used for the serial port, but the signals are the wrong way around. Instead of using a positive voltage to represent a "high" or "space" condition, they use 0 V. The +5 V signal thus represents a "low" or "mark" condition. This will almost certainly not work with peripherals designed for true RS232 levels.

In addition, the output device employed in the computer to derive the "serial" port will not drive lengthy cables owing to the cable's inherent self-capacitance. So if you need to use a cable of a few metres or more, you'll need a proper interface for it to work.

For the owners of those computers which suffer serial port anomalies, we present two simple projects to overcome the incompatibilities.

Two versions of the TTL-to-RS232 converter are presented so as to cover the widest range of circumstances. One is designed specifically for the C64 and the pc board (AEM4510A) is designed to accept the 24-way Commodore user port connector on one end and a standard 25-pin "D" connector on the other.

The second version (AEM4510B) is a general purpose unit, the pc board for which accepts a standard 25-pin "D" connector on one end and has pads for flying leads at the other. Both units make use of the innovative RS232-to-TTL level converter ICs from Maxim. If you are interested in details of these chips, we published data sheets for both the MAX231 and MAX232 types in the August '87 issue.

Both chips will accept standard TTL level signals and convert them to true RS232 levels as well as accepting RS232 levels and converting them to TTL. The MAX232 device requires only a single +5 V supply and uses on-board "charge pump" circuitry to produce suitable plus and minus 12 V rails. The MAX231 is very similar except that it uses both a +12 V and a +5 V external supply to produce the RS232 levels.

Construction of the C64 version

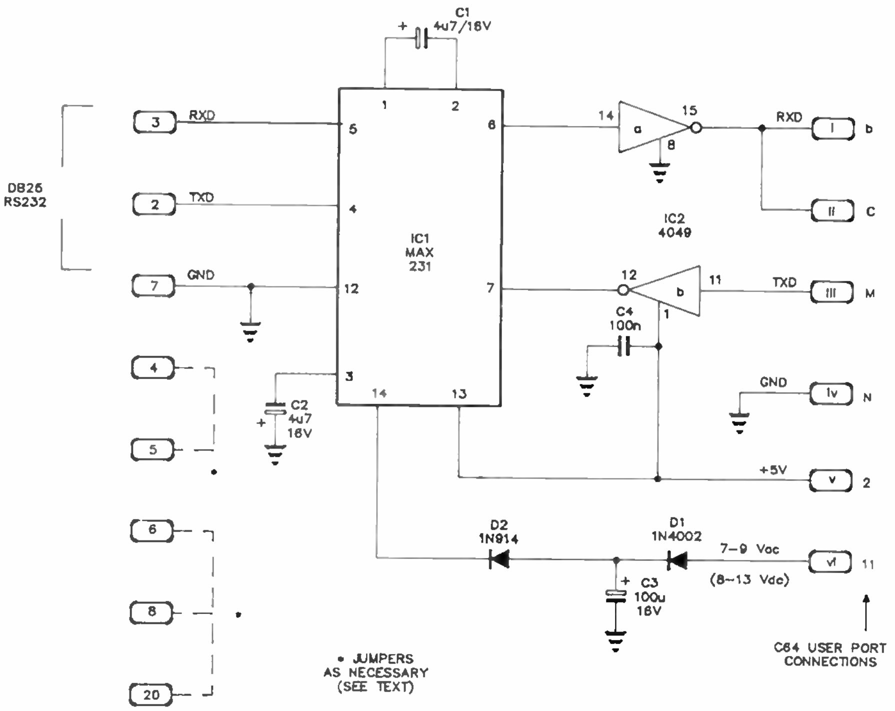
The C64 version is constructed on a pc board coded AEM4510A and includes provision for a 4049 CMOS inverter as the C64's signals are the wrong sense. On this board we are able to employ the cheaper MAX231 chip as we can provide the +12 V rail by rectifying the 9 Vac present on one of the user port pins. Construction is very straightforward as there are only a handful of components to be fitted. There are no resistors on the board so commence by fitting the capacitors. Take care with the polarities as all except the 100n C4 are either tantalum or electrolytic types. Next fit the diode D1 and then the two ICs. All that remains is to fit the connectors to the board edges and a couple of jumpers and the whole thing is ready to go. ▷

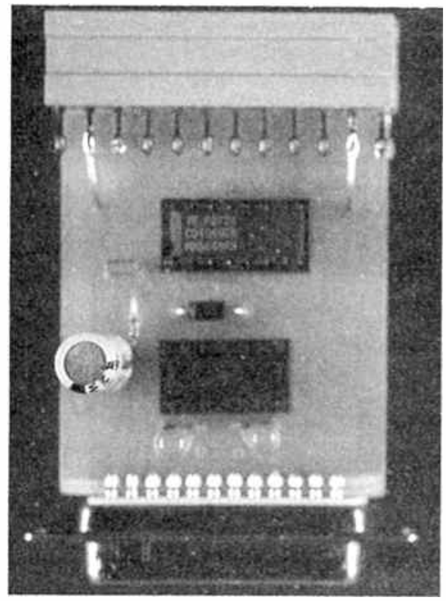
LEVEL

We expect that constructors of an

INTERMEDIATE

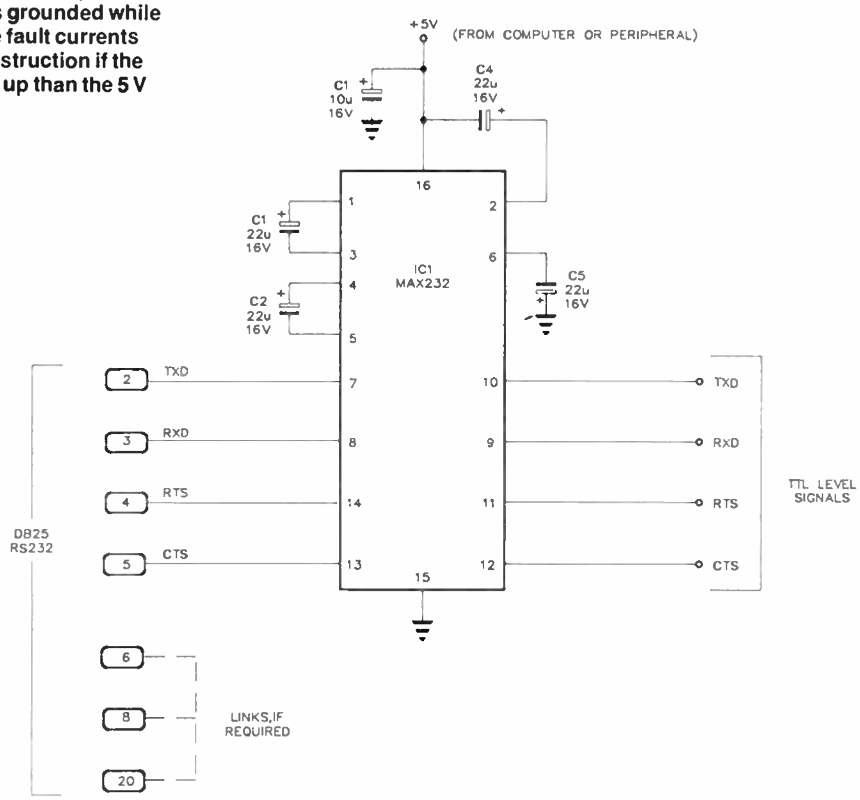
level, between beginners and experienced persons, should be able to successfully complete this project.

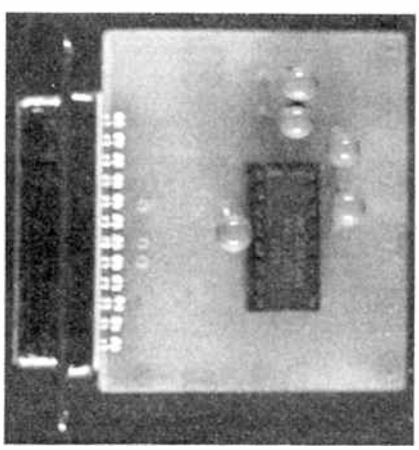




Circuit of the "A" version, which is particularly suited to the C64. The 4049 provides inversion of the C64's serial output so that the RS232 output has the correct sense. Power is derived from the +5 Vdc line on pin 2 of the C64 User Port and about 13 Vdc is derived by rectifying the 9 Vac on pin 12. The 1N914 in placed series with the +13 V supply at the cathode of D1 and the V+ pin of the MAX231 protects the MAX231 during power-up. The IC has a "parasitic diode" in its structure between pins 13 and 14. Large fault currents can flow if pin 14 is grounded while 5 V is applied to pin 13. During power-up, these fault currents can cause "latch-up" of the IC and possible destruction if the Vcc supply (applied to pin 14) is slower to start up than the 5 V supply (applied to pin 13).

Circuit of the "B" version. Only a single +5 V supply is required.





The board is designed so that the 24-way user port connector and the 25-pin RS232 "D" connector can be soldered directly to the foil pads at the board edges. The boards for both versions are single-sided so you only solder one set of connector pins. The connector pins which are on the component side of the pc board are connected via short pieces of tinned copper wire where required. You should not have any trouble getting the "D" connector the right way around as the board has 13 pads for connection to the 13 pins on the socket. If you get it the wrong way up, you will find 12 pins on the connector and thus have one pad left over on the pc board. The 24-way C64 connector is also quite straightforward. Just make sure that if the connector is fitted with a "key", it's at the end of the pc board nearest pin 1 of IC2.

The connections for the +5 V and the 9 Vac on the user port connector will be on the component side of the connector. Use short lengths of tinned copper wire to connect these pins (2 and 11) to their respective pads on the pc board. Some serial peripherals may require some of the "handshaking" signals to be present for correct operation. This is particularly true if you are connecting to another computer directly. The C64 does not provide any handshaking signals on its serial port so you will need to "fool" the other equipment into seeing them.

This is accomplished by jumpering various pins together at the 25-pin "D" connector. The pins concerned on the "D" connector are 4, 5, 6, 8 and 20. We have made provision on the pc board to use short tinned copper wire jumpers to connect pins 4 and 5 together (request to send and clear to send) as well as connecting pins 6, 8 and 20 together (data set ready, data carrier detect and data terminal ready. This will usually overcome any handshaking problems which may occur. You will notice that pin 20 of the "D" connector is on the component side of the board so you will need to pass the jumper through the board from the component side and solder it to the pad provided on the foil side. If you don't experience any handshaking problems, you can leave these jumpers out.

There is one thing you must always remember when you go to make use of this board, ALWAYS turn off the computer before plugging it in place.

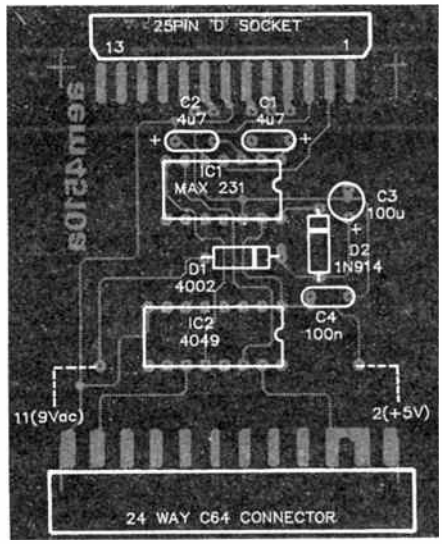
The universal version

This version is constructed on a pc board coded AEM4510B. Again, construction is very straightforward with five passive components (all capacitors) and a single IC, the MAX232 chip which can be powered from a single +5 V supply. Once again, provision is made to fit a standard 25-pin "D" connector to the board edge and pads have been provided to jumper some handshaking pins together if required.

This version uses all of the level translators in the chip to give you conversion of transmitted and received data signals as well as the two handshaking signals "request to send" and "clear to send". The TTL inputs and outputs are terminated at pads on the pc board to which flying leads can be soldered for attaching to your computer. If the RTS and CTS lines are not required, the pads can be jumpered to +5 V or ground as required.

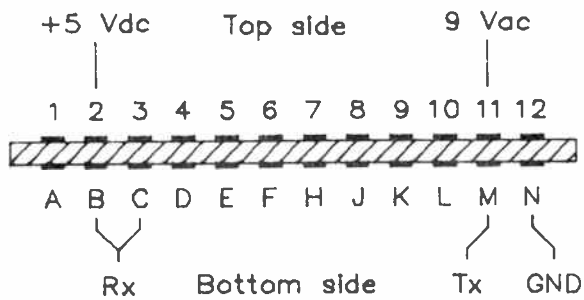
Further modifications

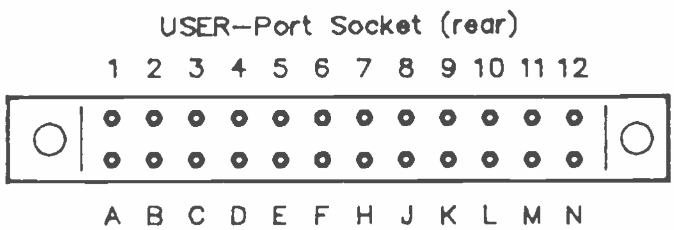
Both of these versions of the project lend themselves to modification to suit you particular requirements. If you have a computer which has a +12 V and a +5 V supply available, but does not require inversion of the TTL signals, you could use the C64 version and simply connect jumper wires between the respective pins of the 4049 inverter IC2. Both boards have been made small enough to be built into existing equipment if

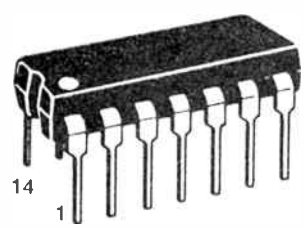


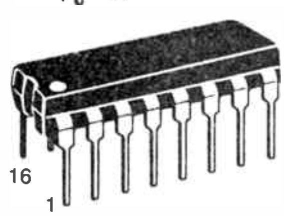
Component overlay, "A" version board.

The C64 User Port connections.









PARTS LIST AEM4510A (C64 version)

Semiconductors

IC1	MAX231
IC2	4049
D1	1N4002
D2	1N914, 1N4148

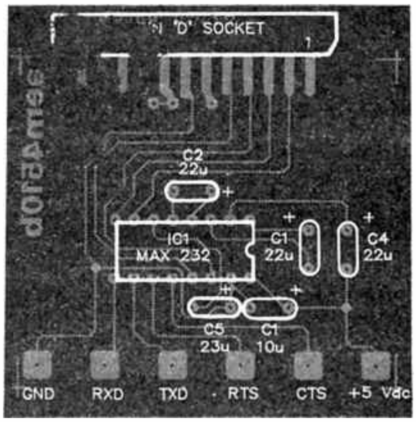
Capacitors

C1, C2	4u7/16 V tant.
C3	100u/16 V electro.
C4	100n greencap

Miscellaneous

AEM4510A pc board; 24-way C64 user port connector; 25-pin "D" socket; tinned copper wire.

Estimated cost: $29 – $31



desired and if your computer already has a 25-pin "D" connector, the pc board could be soldered to it inside the machine.

One final point concerns use of the project with the Microbee computer. This machine uses levels of +12 V and 0 V on it's serial port, fortunately of the same "sense" as the RS232 standard. i.e: the positive output voltage is "low". You will need to add a series current limiting resistor or even possibly a zener diode, before feeding the signals into the TTL inputs of either the MAX231 or MAX232 as they could get upset with the +12 V signals. Either version may be used as both +5 V and +12 V supplies are available. Pin 9 of the DB25 serial connector has +12 V on it and/or you could jumper across +5 V from pin 1 of the DB15 User Port to a convenient unused pin of the DB25.

PARTS LIST AEM4510B (universal version)

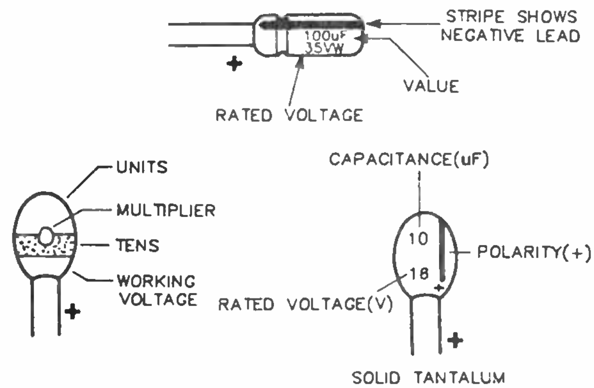
Semiconductors
IC1 .... MAX232

Capacitors
C1, C2 .... 22u/16 V tant.
C3 .... 10u/16 V tant.
C4, C5 .... 22u/16 V tant.

Miscellaneous
AEM4510B pc board; 25-pin "D" connector; tinned copper wire.

Estimated cost: $29 – $31

Component overlay, "B" version board.



New UHF transceiver sports many features

Sawtron's new model KG 107 mobile UHF FM transceiver from Imark provides two banks of 99 channels giving 198 channels total. Several versions are available to provide RF power outputs of one watt, five watts, 25 watts and 30 watts. And, with microprocessor control, the KG 107 incorporates a variety of sophisticated scanning options as well as features such as automatic LED display dimmer, high or low audio tone, error warning tone and transmit time limiter.

The KG 107 is compact and will fit into the smallest DIN size radio aperture in vehicle dashboards. Furthermore, it has been designed to facilitate remote mounting if desired. The power amplifier section includes circuits to protect against poor VSWR and excessive temperature, whilst the control head allows access to to channel selection, volume, squelch and optional Selcall.

A comprehensive range of accessories is available, including five-tone Selcall with automatic answerback, single or multiple CTCSS squelch system, multicall five-tone Selcall with multitone CTCSS squelch system, digital privacy system (scrambler) and DTMF signalling. Minor options such as selectable TTL, ANI, monitor busy channel, Tx inhibit when busy, community repeater function, etc. are also available.

Further details can be obtained from the importers, **Imark Pty Ltd, 167 Roden Street, West Melbourne Vic. 3003. (03)329 5433.**

New amateur packet radio society

The Summerland amateur packet society (SAPS) has been formed as a sub-committee of the Summerland amateur radio club, based on the north coast of NSW.

The society intends to establish a dual-port packet repeater linking the Summerland region with the national data highway as well as developing a UHF local area network with remote control facilities. A temporary installation has been constructed and is currently on test as VK2AGE-1 on 147.575 MHz.

It is anticipated that funding of the complete installation will be by way of an annual $10 donation from users and interested parties.

Contact and assistance is required and any donations can be sent to: **S.A.P.S.**, marked "attention: packet repeater fund" and addressed to **PO Box 524, Lismore 2480 NSW.**

Rugged UHF whip for rugged range riders

Captain Communications of Parramatta NSW has just launched what they claim is Australia's (and the World's) most rugged gain antenna for UHF CB use. Called the Safari Stick, it is a completely ground independent antenna for use on bull-bars, roof racks, gutter mounts and on fibreglass vehicles.

The Safari Stick boasts a claimed gain of 6 dB over a normal quarter-wave antenna mounted in the same position and got it's name after being the only antenna to survive the famous Winns Safari trials.

The antenna is mounted on a heavy-duty barrel spring made from high-grade stainless steel making corrosion problems non-existent. The spring prevents the antenna from tilting at more than 15 degrees from vertical, even at speeds of 160 kph, the makers claim, maintaining the radiation pattern remain virtually constant when driving at high speed.

The gain whip is made from high quality fibreglass flexible rod covered with copper braid and heavy duty heatshrink tubing. The antenna tip is reinforced with brass tubing to help protect the antenna from damage due to low branches etc.

Because the Safari Stick is a ground independent antenna, the mounting position on the vehicle is less critical than with normal groundplane types. Whilst it is still an advantage to mount the antenna as high as possible, it is not necessary to position it over a conductive groundplane such as a vehicle roof.

For further details on the Safari Stick antenna, contact **Captain Communications, 28 Parkes St, Parramatta 2150 NSW. (02)633 4333.**

Regulated power supply from Imark

Imark Pty Ltd has released the Australian designed and manufactured Imark PS-4 regulated power supply for use with CB transceivers, amateur transceivers, security systems, car cassette/radio players or as a bench power supply.

The PS-4 supply operates from the 240 Vac mains and provides a regulated output of 13.8 Vdc at up to four amps. The supply features all solid state devices and short circuit and overload protection. Dimensions are 190 mm (D) x 125 mm (W) x 85 mm (H) and it weighs 2.2 kgs.

Further details can be obtained from **Imark Pty Ltd, 167 Roden Street, West Melbourne 3003 Vic. (03)328 4431.**

New C64 packet software from AAPRA

The Australian Amateur Packet Radio Association (AAPRA) is ready to release an updated version of their Commodore 64 packet radio software. This software is an enhanced version of that which is intended to be used with our project 3505 packet modem.

Some of the new features are:

Easier to use command structure • Uncluttered screen pre-

sentation • 40 or 80 column display (keyboard selectable) • Faster file transfers (programs, etc) • Monitor ONLY selected stations if required • NOT monitor selected stations if required • Connects from illegal callsigns rejected (NOCALL, etc) • Connects from specific stations rejected if required • Clock and calendar feature included.

In addition, AAPRA is also testing "DEDICATED DIGIPEATER SOFTWARE" for the VIC 20. The program is contained in a plug-in module and is intended for use as a dedicated digipeater. All that is required for a CHEAP digipeater is the program module, C64 modem, power supply and radio (and one VIC 20, of course).

AAPRA will advise when both these programs are available. You can contact AAPRA by writing (include S.A.S.E. please) to: The **Secretary, AAPRA. 59 Westbrook Avenue, Wahroonga 2076 NSW.**

UHF gear from Sphere

Sphere Communications Pty Ltd has announced the release of four new models in their range of VHF/UHF communications equipment, comprising two handhelds and two mobiles.

Model TPU-44A is a UHF FM handheld transceiver operating in the 450-470 MHz band. It features four channels and 5 watts RF output. Model TPV-65 is a VHF FM handheld transceiver for the 140-174 MHz band providing six channels and 5 watts RF output. Both these models also feature a time-out timer, tone coded squelch (CTCSS), a desk-top battery charger and an optional external microphone.

Models TMV-225 and TMU-225 are respectively VHF and UHF FM mobile transceivers. These models cover similar bands to the handheld units and feature four channels with 25 watts RF output. Both models feature a time-out timer and CTCSS tone squelch.

All the new models meet or exceed the Department of Communication specifications and are type approved.

For further information on these new models, contact **Sphere Communications, PO Box 380 Darlinghurst 2010 NSW. (02)344 9111.**

Standard gain horns up to 300 GHz

Flann Microwave Instruments Ltd of Cornwall (UK) has available an extensive range of 20 dB standard gain horns, including models operating in frequency bands up to 300 GHz.

The horns satisfy a variety of applications including antennae for transmitting, receiving and sampling or as reflector feeds. Typical gain/bandwidth curves are supplied with each model and gains of 10, 15 or 25 dB are also available.

The model 1824-20 illustrated is a 20 dB gain horn operating in the 12 to 18 GHz band.

Further information is available from **Flann Microwave Instruments Ltd, Dunmere Road, Bodmin, Cornwall PL31 2QL, England. Telex 45456 FMINST G.**

Using the Microbee in your amateur station

G. J. Wilson VK3AMK

4) Towards a more versatile log.

IN PART 1 of this series (*AEM*, April 1987, pp. 82-83), I described a program to produce an amateur radio log. It was deliberately kept as simple as possible to limit the listing to reasonable proportions. The following routines may be helpful if you are interested in expanding your program to give it greater versatility. Each is complete in itself and can can be RUN for demonstration purposes.

Although listed as individual routines, there is no reason why several cannot be merged. e.g: you may wish to combine the input beep routine (2) and the frequently used callsign routine (3) – see later. This would then turn the CALLSIGN input point into a multi-option one. Please note that the line numbers and strings given do not equate with those in the original log program.

[1]

When screen display space is limited because the data being input remains on-screen, it may be desirable to use a single line to enter several values. e.g: a signal report plus a zone number as used in contests. The signal report is called for and entered normally, after which the line (but not the screen) is cleared. The zone number is then called for and entered; again, the line number is cleared. The combined data is then displayed, such as "Report Rec. : 59 30". Using this method, "59" and "30" are available as separate entities if need later in the program, rather than simply as "59 30".

Where a zone number is not required, entering [ESC] [RETURN] will advance the program to the next stage. If you are constantly working a particular zone, such as Japan, entering [J] or [j] will then enter "25" as the zone number. This same idea can be reworked in numerous ways. e.g: Entering [2] for "FREQUENCY" can be arranged to print as "144", or [2F] as "146", etc.

```
00010 REM (1) MULTI DATA ENTRY ON A SINGLE SCREEN LINE
00020 CLS: A0$ = KEY: A1$ = KEY: A1$ = "": GOTO 40
00030 PLAY 20; 0; 20: RETURN
00040 CURS 1,8: PRINT [A64 32]: CURS 16,8: INPUT
      "REPORT REC. ?:", A0$: CURS 28,8: PRINT " "
00050 IF A0$ = "" THEN GOSUB 30: GOTO 40
00060 CURS 1,8: PRINT [A64 32]: CURS 5,8: INPUT
      "SERIAL / ZONE No. REC. ?:", A1$: CURS 28,8:
      PRINT " ": REM ENTER [ESC] [RETURN] IF SERIAL /
      ZONE No. IS NOT REQUIRED
00070 IF A1$ = "J" OR A1$ = "j" THEN LET A1$ = "25"
00080 IF A1$ = "" THEN GOSUB 30: GOTO 60
00090 CURS 1,8: PRINT [A64 32]: CURS 16,8: PRINT
      "REPORT REC.  : " A0$ "   " A1$
00100 REM PROGRAM CONTINUES ->
```

[2]

Some optional facilities may not always be needed in a program. e.g: A beep following a data entry. By entering a single letter instead of say "CALLSIGN" (or any other entry point you choose in the program), the option can then be toggled on or off. If the letters [N] or [Y] are entered, this will be interpreted as meaning "BEEP NO" (N) or "BEEP YES" (Y) and the CALLSIGN data is then called for again.

When neither [N] or [Y] is entered, the normal callsign entry takes place and the option is retained in the form last selected. Default value for option is OFF.

```
00010 REM (2) OPTION ON - OFF TOGGLE ( NORMALLY OFF )
00020 CLS: A2$ = KEY: A3$ = KEY: A3$ = "N": GOTO 50
00030 PLAY 20; 0; 20: RETURN
00040 PLAY 15: RETURN
00050 CURS 1,8: PRINT [A64 32]: CURS 16,8: INPUT
      "CALLSIGN ?    :", A2$: CURS 25,8: PRINT " "
00060 IF A2$ = "Y" OR A2$ = "y" THEN LET A3$ = "Y":
      GOSUB 40: GOTO 50
00070 IF A2$ = "N" OR A2$ = "n" THEN LET A3$ = "N":
      GOTO 50
00080 IF A2$ = "" THEN GOSUB 30: GOTO 50
00090 IF A3$ = "Y" THEN GOSUB 40
00100 REM PROGRAM CONTINUES ->  ADD 'IF A3$ = "Y"
      THEN GOSUB 40' AFTER EACH ADDITIONAL DATA
      ENTRY POINT WHERE A BEEP IS REQUIRED
```

[3]

If a particular callsign is likely to be entered frequently, you can store the call and other details, such as name, QTH etc, for recall by a single letter or group instead of entering all the associated data each time the callsign is used. When the code which has been assigned to a given callsign, or the callsign itself is interpreted in the subroutines at lines 40, 50 etc, the appropriate data is then available to be automatically entered and displayed without further keyboard entries having to be made.

In the subroutine at line 40 the station can be identified by the entry of "LID", "3LID" or "VK3LID", or any other group you may allocate. Obviously, a particular code must be exclusive to one station, otherwise the first listed will always be selected when the code is input.

```
00010 REM (3) CALLSIGN, NAME & QTH DATA SELECTION
00020 CLS: A4$ = KEY: A5$ = KEY: A6$ = KEY: A7$ = KEY:
      A7$ = "": GOTO 80
00030 PLAY 20; 0; 20: RETURN
00040 IF A4$ = "LID" OR A4$ = "3LID" OR A4$ = "VK3LID"
      THEN LET A4$ = "VK3LID": A5$ = "Harry":
      A6$ = "Melbourne": A7$ = "*": RETURN
00050 IF A4$ = "XXX" OR A4$ = "7XXX" OR A4$ = "JQ7XXX"
      THEN LET A4$ = "JQ7XXX": A5$ = "Hideo":
      A6$ = "Obanazawa": A7$ = "*": RETURN
00060 REM LIST ADDITIONAL CALLSIGNS AND DATA HERE
00070 RETURN
00080 CURS 1,8: PRINT [A64 32]: CURS 16,8: INPUT
      "CALLSIGN ?    :", A4$: GOSUB 40: CURS 25,8:
      PRINT "      : " A4$
00090 IF A4$ = "" THEN GOSUB 30: GOTO 80
00100 IF A7$ = "*" THEN 130
00110 CURS 1,9: PRINT [A64 32]: CURS 16,9: INPUT
      "NAME ?        :", A5$: CURS 21,9: PRINT " "
00120 IF A5$ = "" THEN GOSUB 30: GOTO 110 ELSE 140
00130 CURS 16,9: PRINT "NAME          : " A5$
00140 IF A7$ = "*" THEN 170
00150 CURS 1,10: PRINT [A64 32]: CURS 16,10: INPUT
      "LOCATION ?    :", A6$: CURS 25,10: PRINT " "
00160 IF A6$ = "" THEN GOSUB 30: GOTO 150 ELSE 180
00170 CURS 16,10: PRINT "LOCATION      : " A6$
00180 REM PROGRAM CONTINUES ->
```

[4]

The amount of space available in each column of the log places a finite limit on the number of characters which can be fitted in. Dates, times, reports etc, are basically the same length each time and pose no problem, but more variable quantities such as names and QTHs or remarks can easily exceed the limits.

By showing the room available at the data entry point, the possibility of having mutilated words in the printout is then eliminated. As long as the text does not exceed the space defined, it will be printed in full. Do a careful check of the spaces in each column before assigning values for this routine. The input data limitation must match that allowed for in the printout.

```
00010 REM (4) SPACE LIMIT ( 13 CHARACTER SPACES )
00020 CLS: B0$ = KEY: GOTO 40
00030 PLAY 20; 0; 20: RETURN
00040 CURS 1,8: PRINT [A64 32]: CURS 44,8: PRINT
      "<--[ SPACE LIMIT ]": CURS 16,8: INPUT
      "QTH ?          :", B0$: CURS 20,8: PRINT " "
00050 IF B0$ = "" THEN GOSUB 30: GOTO 40 ELSE
      CURS 44,8: PRINT [A21 32]
00060 REM PROGRAM CONTINUES ->
```

[5]

With an extensive program it is often helpful to place a summary page or pages at the start to explain aspects of its operation, particularly where people unfamiliar with the program will be using it. This actually consists of a number of lines preceding the main program, detailing the features and various options available. The page display remains on screen until it is terminated with an input which operates when [RETURN] is entered.

When many different sub-programs are available it is frequently necessary to have several menu pages to list all the options. The menu may not have to be required every time the program is run and it is easy to arrange for the pages to be bypassed. By defining a particular character to be entered before [RETURN] on the introductory page, the program can be made to skip the menu and go directly to the beginning of the program.

```
00010 REM (5) MENU OPTION
00020 CLS: B1$ = KEY
00030 CURS 18,3: PRINT "INTRODUCTION TO THE PROGRAM"
00040 CURS 18,5: PRINT "..........................."
00050 CURS 18,7: PRINT "..........................."
00060 CURS 18,9: PRINT "..........................."
00070 REM LINES 30 - 60 INTRODUCE AND DETAIL PROGRAM
00080 CURS 2,13: PRINT "To access the menu page enter
      [M] before entering [RETURN]."
00090 CURS 26,15: INPUT "[RETURN]", B1$
00100 CLS: IF B1$ = "M" OR B1$ = "m" THEN 110 ELSE 170
00110 CURS 28,3: UNDERLINE: PRINT "MENU": NORMAL
00120 CURS 18,5: PRINT "..........................."
00130 CURS 18,7: PRINT "..........................."
00140 CURS 18,9: PRINT "..........................."
00150 REM LINES 110 - 140 MENU
00160 CURS 26,15: INPUT "[RETURN]", B1$: CLS
00170 REM PROGRAM CONTINUES ->
```

In the next part, I will describe some further routines you may find useful, including one for contest log-keeping.

The "space miser" coax loop antenna for eighty metres

Roger Harrison

The 80 metre amateur band (3500-3700 kHz) is a popular band for local and regional use, unhampered by the problems that beset the 40 metre band above and the 160 metre band below. Novice licensees are not permitted on either of these bands and the 80 metre band remains the lowest frequency band common to both Novices and "full"-calls. The biggest problem about using 80m, though, is the sheer size of any reasonable antenna. Here's a solution.

TO ANYONE with a modicum of experience in experimenting with or building antennas, the realisation dawns sooner or later that loops wrap up an electrically large antenna into a physically small space. Where space to fit an antenna is at a premium, a loop should be considered first.

"Loading" an antenna with capacitance or inductance also brings about a reduction in physical size, but often presents practical difficulties. In addition, these devices tend to restrict the operating bandwidth of the antenna and reduce an already low efficiency.

Possibly the best compromise in terms of space reduction, reasonable efficiency and bandwidth I have come across for an antenna designed to operate at the bottom end of the HF bands is the loaded loop constructed of coax cable, originally described by James Taylor W2OZH in the early 1970s. The design achieves reported efficiencies of 8-10 % where capacitively or inductively loaded verticals and dipoles are fighting to achieve efficiencies in the range of 1-5 %. Taylor's loop provides a close match to 50 ohms – great for today's rigs with solid state finals that demand this for maximum efficiency and output, and typically maintains a low VSWR over bandwidths of 100 kHz.

The Taylor loop

The general arrangement is shown in Figure 1, dimensioned here for the 80m band, centred on 3575 kHz, the middle of the Novice segment. It is a rectangular loop, as you can see, mounted vertically and with the feedpoint placed in the centre of one of the long sides (the lower side for convenience). It requires only around one-fifth the length of a dipole and only a few metres height (and you always need some height for an antenna). Hence, the "space miser" name!

The "secret" of Taylor's loop lies, firstly, in the use of coaxial cable as a low resistance conductor of relatively large diameter and comparatively low weight (compared to tubing). Secondly, it is capacitively loaded, to physically reduce the loop dimensions, using TV flat ribbon cable as a "distributed" capacitance that is also part of the radiator. Cunningly simple, and quite effective.

The loading reflects an inductive impedance at the feedpoint which can be readily compensated for with a parallel, low voltage capacitor. Note that, essentially, only the outer

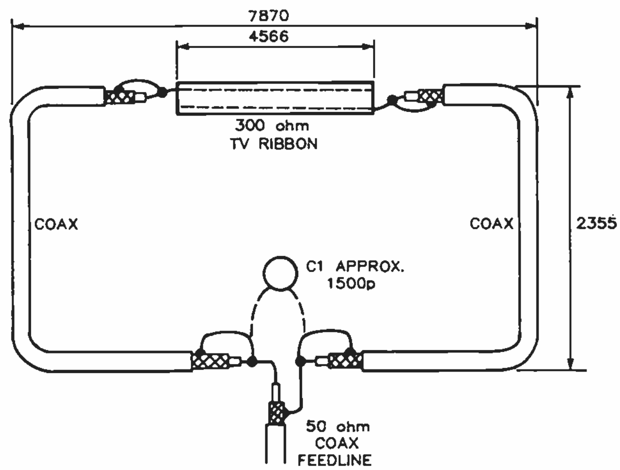


Figure 1. The general form and dimensions of the antenna. Now you can see why it's called the "space miser"!

conductor of the coax in the loop is used, the inner conductor may be ignored or shorted to the braid.

The antenna can be mounted at low heights, with the lower side only a metre or so from the ground, and still achieves good performance. It can be mounted on the side of a building (wood or brick – no metallic cladding!) or strung between suitable supports. So it's versatile.

Construction

For the radiator, you will need around 17 metres of coax and some five metres of 300 ohm flat TV ribbon; the common type, not the 'low-loss' type with slots punched out of the plastic between the conductors. You can use virtually any coax you can lay your hands on; it doesn't matter if it's 50 ohm, 70 ohm or whatever. Use the 9 mm diameter coax, such as RG8 or RG213, if you can, as the larger diameter achieves a greater operating bandwidth. If you don't need, or can live with, less bandwidth then the smaller diameter RG58 or RG59 ("TV coax") is quite adequate. The feedline, from the antenna to your rig, needs to be 50 ohm coax, though.

This antenna cannot be hung on its own, as the joints at the feedline and TV ribbon would not support the weight. It is best to secure the loop between two parallel rope supports, as illustrated in Figure 2. This shows two wooden pole supports bolted to fence posts, placed to fit the antenna between them

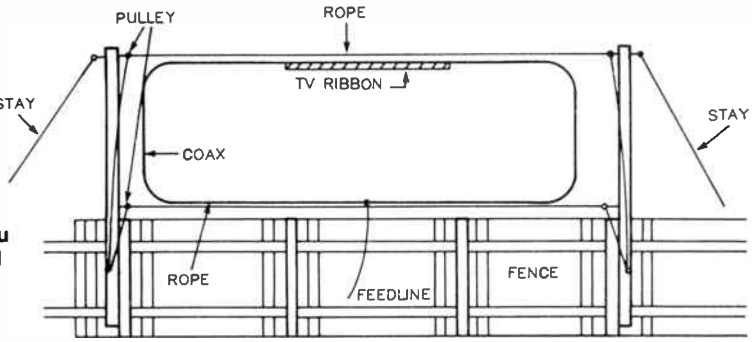


Figure 2. Suggested means of erecting the antenna. All you need is two supports a suitable distance apart and several metres high. Even the side of a house or building will do (providing it's not metal-clad).

(i.e: at least eight metres apart). The supports can be of 50 x 50 mm or 50 x 100 mm dressed or undressed timber. Use a timber suited to outdoor use, such as oregon or western red cedar, stained or treated to obviate the effects of weathering. The use of stays to counteract the tension of the antenna and its support is recommended.

Only a light, small diameter rope is required to support the antenna. Remember, though, that nylon rope exhibits considerable stretch and will require frequent tensioning. Plain hemp is better or plastic clothesline (not the variety with a wire rope covered in plastic).

Lay the support ropes out on the ground to assemble the antenna. The coax, and the TV ribbon, may be secured to the support rope by several means. Plastic cable "zip" ties are ideal. Heavy duty insulation tape is good, though deteriorates in time and will need replacement. At the corners, a length of heavy-walled plastic tubing having an internal diameter just larger than the outside diameter of the coax should be slipped over the coax to spread the load a little. Figure 3 illustrates how it's done.

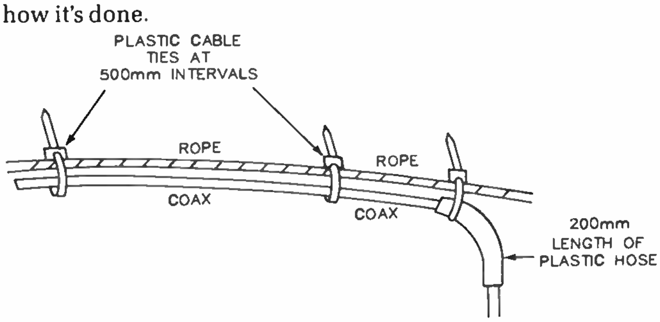


Figure 3. How the coax is supported. The TV ribbon loading section is also tied to the support rope in the same way.

At the feedpoint, the coax feedline should be well supported. A simple device to do this is illustrated in Figure 4. A rectangular piece of, preferably, perspex or perhaps Masonite, has four holes drilled centrally in each side. It is threaded on the lower support rope and the feedline threaded up through the other holes, then looped over to connect to the antenna's feedpoint.

The "matching" capacitor, C1, is connected in parallel with the feedpoint. It need only be a low voltage (100 V) type, a ceramic (not a "high K" bypass type) or film dielectric type. A value of 1500 pF is indicated, but this may need to be adjusted by paralleling smaller values to bring the SWR down at the centre frequency.

The support ropes are passed through pulleys at the pole supports so that the ropes may be properly tensioned and adjusted from time to time. The pulleys are secured to eye bolts screwed into the poles, allowing the pulleys some free play. The eye bolts should be spaced about 2300 mm apart, just less than the vertical side of the antenna, so that only the tension of the coax's own weight is on the vertical runs of the antenna coax. Tie the ends of the support ropes down to anchor points low down on the poles.

The feedpoint needs to be effectively sealed to prevent the ingress of moisture into the coax feedline. But before you do that, a VSWR check is in order. Use low power and quickly check the VSWR on a clear frequency around 3575 kHz, making sure not to interfere with anyone.

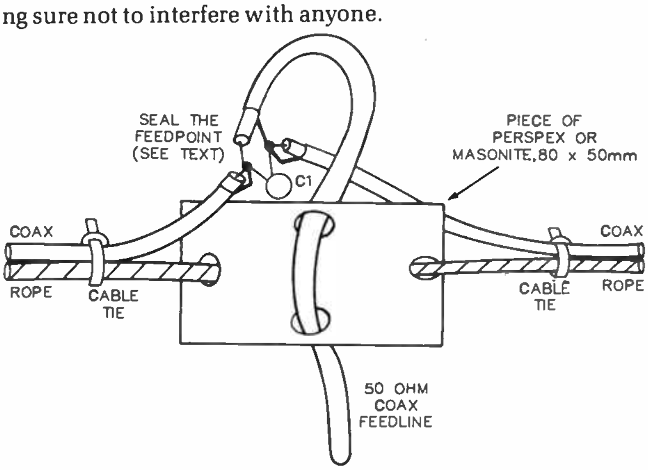


Figure 4. The feedline needs supporting at the feedpoint and this is a simple, effective way of doing it.

With the SWR at a satisfactory figure, apply a sealant, such as Selley's "Silastic" or similar, to the feedpoint and carefully wrap the joint in tape. "Self amalgamating" tape (a 3M product) is ideal. It's a rubber tape that "glues" itself together under its own tension once it's wrapped on itself. Make sure you don't short the joint. Treat the coax/TV ribbon joints similarly.

Your antenna is ready!

On other frequencies

This antenna is useful over the range from around 3 MHz to maybe 6 MHz or so, and is readily scaled for use on other frequencies. Find the ratio of the new frequency to the old frequency:

$$\frac{\text{New frequency (kHz)}}{\text{Old frequency (kHz)}} = \text{ratio}$$

Then multiply the three main dimension shown in Figure 1 by the ratio obtained, rounding off to the nearest 5 mm. Simple!

You will need to vary the value of the capacitor C1, reducing its value as you go higher in frequency.

Predicting weather satellite passes from data transmitted by AXM

Paul Hayden and Philip Webb

If you'd like to dabble in space science, one of the most interesting, and relatively easy, areas to start is with the polar orbiting "automatic picture transmission" (APT) weather satellites. (See AEM3503, July '86). But "catching them as they go past" is the problem! The Bureau of Meteorology's HF transmissions from AXM contain, apart from the popular weather FAX pictures, data on the orbit and transmission parameters of the American NOAA and Russian METEOR satellites, transmitted by radioteletype. Here's how to decipher the data to use in simple satellite prediction software.

BOTH OF US have been interested in the reception of weather satellite pictures for some time, but Paul has been more active in the reception of pictures than myself. I first contacted Paul a couple of years ago when I was called on to give a talk to the now defunct Microcomputer Society. Paul was unable to help me give the talk but he made available a veritable heap of information to pass on. I became so fascinated by this hi-tech hobby, I decided to set myself up with a satellite receiving station for (at least) the low resolution mode of the polar orbiting satellites.

After the publication of the excellent program submitted by Mr. Paul Butler in AEM November 1986, the problem of getting current equator crossing times and longitude raised its ugly head – a problem already alluded to by Tom Moffat in his article in AEM July 1986 (AEM3503 Satellite FAX Decoder project). I remembered the data Paul had made available on a previous occasion so I went over to see him, taking a printout of an AXM transmission on satellite prediction. Yes, he had most of the data and it worked out perfectly. We felt that it was clearly time others were made aware of the information.

The article we are presenting here is solely concerned with the decoding of data and the prediction of orbital parameters for use with programs such as Mr. Butler's, using AXM broadcasts as a source. The historical involvement of amateurs in the reception of weather satellite information goes back a long way and is really a subject for another time.

NOAA satellites

The information on NOAA satellites is normally broadcast by AXM at 00:15 UTC (10:15 AEST). The following information comes from the broadcast on February 1st, 1987. A shortened section of the transmission follows and will be discussed in detail.

74910
TBUS1 KWBC 311900
APT PREDICT
020335 NOAA 10
PART I
01979 00320 00638 00844 T0117 L2532
19830 25147 10972
19870 93656 24898
19911 62206 34769

NIGHT PART II
02820 070100 04820 141116 06820 211133
data

PART IV
1986 073A 01968 034064214125 870203013228100 1558198
01012290 01012885 00136131 23351852 06591744 09873173
12648181 07192268 P029395482 P065768228 P000000000
P01030099 M00460433 P07351074 001552517 074074009 9449
0000000000 M00300648 P00099075 P00512106 SPARESPARE
FREQUENCIES APT 137.50 MHZ, HRPT 1698.0 MHZ, BEACON
DSB 136.77 MHZ. APT DAY/NIGHT 2,4/3,4. /VIS CH. 2
/0.725 TO 1.0/ AND IR CH. 4 /10.5 TO 11.5/ WILL BE
XMTD DURING S/C DAY. IR CH 3 /3.63 TO 3.93/ AND CH 4
/10.5 TO 11.5/ WILL BE XMTD DURING S/C NIGHT. DCS DAY
TIME 005 63436.0.

The function of the first number in this broadcast is unknown!

On the next line TBUS1 means that the data is for a satellite travelling southbound during daylight hours. TBUS2 means the satellite is travelling northbound during daylight hours. KWBC is probably the originating station and the following numerical figure is the date and time (UTC). Occasionally, this line has the text TBOC AMMC and a number. We dont know the derivation of this code at this time.

The next line "APT PREDICT" is short for "Automatic Picture Transmission prediction." The following line gives a numeral, which is the date (American style 0203 for 3rd Feb.) and a satellite number (35) followed by the common name of the satellite.

Then we get to the nitty gritty – "PART I". In Part 1 are all the data required for Paul Butler's program. Before we get onto the analysis of the data, a couple of things to note as you read through the data:

ID – stands for an identifier which may be at the start of a group of letters.

Quadrant – results from dividing the Earth's surface on the compass points and at the equator. Quadrant 0 is north and west of 0 degrees followed by 1, 2 and 3 westward. Quadrant 5 is below quadrant 0 and 6, 7 and 8 to the west. We dont know what happened to quadrant 4.

"|" **The "fence" character** has been inserted by us to show where the information is divided.

Now the analysis of the data.

0|1979	ID | Reference orbit number for following data [1979]
0|03|20	ID | Day of reference orbit (not Julian)[03] | Hours [20]
0|06|38	ID | Minutes [06] & | seconds [38] of reference equator crossing
0|0844	Crossing into Quadrant 0 (not ID) | at XX.YY degrees west [8.44]
T|0117	ID | Nominal orbital period [Add 100 to this ie.01.17+100=101.17]
L|2532	ID | Longitudinal increment in degrees and hundredths.[25.32]

The remainder of part 1 gives the equator crossing data, in hours, minutes and seconds, the quadrant number crossed into and the longitude for the following fourth, eighth, and twelfth equator crossings.

"NIGHT PART II","NIGHT PART III","DAY PART II","DAY PART III"

Day and Night parts II and III relate to the ground track of the satellite for every 2 minutes on the reference orbit, and is made up as groups of firstly, five figures, then a space, then six figures. This is repeated for each two minute time interval of the reference orbit.

02|82|0|	Minutes into orbit | Altitude kms 100's & 10's | Quadrant number
070|100	Latitude | Longitude (in degrees and one-tenth deg.)

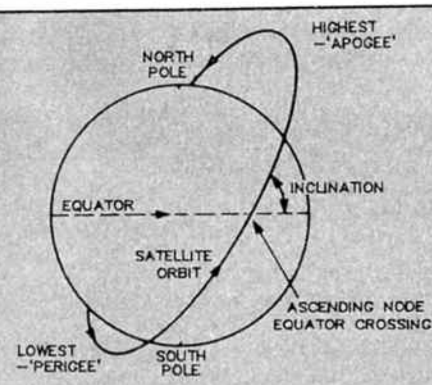
"PART IV".
This is where it really gets heavy and we are only going to deal with the entries on the first two and a bit lines for a number of reasons, the main one being that we are not sure that we have correct information for the remainder of the figures!

First line.
Launch year | International Catalogue. No | Orbit No. | Epoch Day (Time of ascending node in days from January 1 at 0000 UTC to 9 decimal places) | Epoch Year, Month, Day, Hour, Minute and Second (to three decimal places) | Greenwich Hour angle at first point of Aries at Epoch (four decimal places) |

Second line.
Anomalistic Period (four decimal places) | Nodal Period (four decimal places) | Eccentricity (eight decimal places) | Arg. Perigee (five decimal places) | Right Ascention of the Ascending Node (RAAN) (five decimal places) | Inclination (five decimal places) |

Third line.
Mean anomaly (five decimal places) | Semi-major axis (three decimal places)

Under the heading of FREQUENCIES.
APT stands for Automatic Picture Transmission which gives a ground resolution of approximately 4 km with panoramic distortion removed. (What's panoramic distortion? Imagine yourself scanning the surface of a rotating sphere and then trying to represent that in two dimensions. The modern satellites process the image from the optical scanner on board to produce something that is immediately recognisable. The early ones did not.)



The accompanying diagram shows the various orbital parameters. The time to complete one revolution of the orbit is called the 'period'. The angle between the orbital plane and the geographic equator (or equatorial plane) is called the 'inclination'. When the satellite is furthest from Earth, it is said to be at its 'apogee', when closest to Earth it is said to be at 'perigee'. The point (longitude) and the time at which the satellite crosses the Earth's equator going north is called the 'ascending node equator crossing (EQX)'. It is usually given in degrees west of the zero (Greenwich) meridian and UTC (coordinated universal time).

HRPT stands for high resolution picture transmission and gives a ground resolution of about 1 km also with panoramic distortion removed. Reception in this mode requires a great deal more gear starting with a dish antenna which tracks the satellite.

BEACON DSB is a sideband transmission from the satellite carrying telemetry.

APT DAY/NIGHT 2, 4/3, 4 and the information which follows gives information about the optical filters to be used in conjunction with the optical scanner. "2,4" means channel 2 visible filter and channel 4 infra red filter when passing over a daylight area and channel 3 and 4 infrared filters when passing over a night area. The transmission wavelengths for the respective filters are given below. (Source – TIROS-N Series; see ref. at end of article).

The use of channels 2, 3 and 4 is common. We can't recall having seen channels 1 or 5 in use – at least, not recently. ("S/C", in case you have not cottoned on yet, is Space Craft.)

That completes the description of the analysis of the data available from AXM about the NOAA satellites.

METEOR satellites

These are the Russian weather satellites and they broadcast on similar frequencies to the American satellites. The picture is a visible scan only in daylight, as opposed to the American ones which have visible and infrared in daylight and two infrared at different wavelengths at night. See above and Tom Moffat's article in AEM July 1986.

We have only been able to obtain a limited amount of information about the METEOR series of satellites with respect to predicting the times at which they will be "visible" over Australia. The English magazine Practical Wireless, July 1986 edition, contained a lot of data on a lot of satellites including many of the METEOR series. This data could be plugged into another satellite finding program which appeared in Orbit magazine in an article entitled Basic Orbits (See references). However, we have no way of knowing which satellite we are dealing with. It should be possible to come up with a fairly good guess for Paul Butler's program after observing the satellite using the graphical method outlined below. ▷

One method of making predictions is to graph the time of the pass of a satellite on a day-by-day basis. From this it is possible to build up sufficient data to enable a good estimate of when the next pass is likely to occur.

The first problem is that you have to find an active satellite. The Russians use a number of frequencies and unless you have a scanning radio receiver, finding the first pass can take a while. You can make use of the AEM project of Tom Moffat's, using a squelch operated tape recorder. However, this does not give any idea of the time of the pass, only that there is a satellite active on the frequency and it may tend to damage the pinch roller on the cassette recorder. (AEM3502 March '86).

There is a satellite active on 137.85 MHz which can be heard in the morning (Feb. '87). Originally, this satellite was found in the afternoon on 137.4 MHz, and another satellite was broadcasting in the morning on 137.85 MHz. On the 15 January 1987, they both went onto 137.85 MHz. Perhaps there is another one operating in the afternoon now.

In preparing this article, we were about to say that AXM did not broadcast any information on RUSSIAN satellites when they did. On Saturday Feb. 7, 1987 AXM did broadcast data on a Russian satellite in a bulletin headed with the word FANAS. (FANAS is an acronym for Forecast for Ascending Node for Automatic Satellites). FANAS data has been broadcast on odd occasions although not recently, to our knowledge. The data contained can be for any nationality of satellite, the broadcast dissected below is actually for METEOR 30 (we think). We have not been able to copy a signal on the frequency given in the broadcast and we would be most grateful to hear from anyone who has. By a stroke of marvellous timing, Paul has come up with information on how to read FANAS data and that will be given following a partial printout of the broadcast.

```
COLLECTIVE METEO FOR 070100Z
FANAS 00287
11330 T9619 57204 L2404 85905
07010 18360 02893 07230 45200 00562 08010 21320 02966
data
15000 05510 01071 15220 32350 31261 =
22330
11115
00207 01470 03240 05000 06360 08120 09480 11250
data
00214 02080 03440 05200 06560 08330 10090 11450
APT TRANSMISSION AT FREQUENCY 137.06 MHZ=
33330
91110 00241 91120 00523 91130 00805 91140 01049 91150 01333
data
92140 08524 92130 08807 92120 09048 92110 09330 =
55330
02593 70743 03044 04596 41485 03199 06599 32225 03360
data
92587 51559 54978 94589 10816 55133 =
ONEXT FORECAST WILL BE TRANSMITTED 13.02.87=
00287=
```

In the notes that accompany our information, the following points are made:

1. The code name FANAS shall always be included as a symbolic word prefixing any forecast message.

2. The code name FANAS shall always be given as the first line of text in the bulletin.

3. Group OMMJJ will follow code name FANAS to identify the validity period. (O=id | MM = month | JJ = least significant digits of year)

4. Code contains five sections. (Sections will be identified as they occur)

Starting at the top:–

FANAS O|02|87	As per notes above; valid for 2nd month 1987

Second line

11|3|30|	ID for section 1 | Launching country | Number (series) of sat.
T|96|19	ID | Satellite period in tens & units of minutes [096 mins.] |
57204	Fraction of a minute of period [i.e: 96.1957204 min. total]
L|24|04	ID for longitude increment | deg. |
85905	Fraction of a degree of increment [i.e: 24.0485905 deg. total]

Notes: Content of section 1. Satellites' period and longitdudinal increment plus daily data on ascending node (UTC).

Launching country: 0 = European countries; 1 = Japan, 2 = USA, 3 = USSR; 4 – 9 are reserved.

Number series of satellite. Examples are 21, 22, 23 ATS series (USA), 04, 05, 06 NOAA series (USA) 02, 03, 04 METEOR model 2 (USSR). The Information is clearly dated. We have assumed the reference above refers to the METEOR 30 satellite.

Next line.

07|01|0|	Odd numbered day of ea. month |Time of 1st Ascending Node for given day in hours (UTC) | 0
18|36|0|	Time of 1st Ascending Node minutes | and seconds | 0 [01:18:36]
0|28|93|	Quadrant of longitude of ascending node and sub-satellite track coordinates | Longitude of ascending node Tens | and units (hundreds for 100 to 180 deg. are omitted) [0] & [28.93]
07|23|0|	Odd No. day | Time of last Ascending Node for day hours (UTC)|0
45|20|0|	Last Ascending Node minutes | and seconds | 0 [23:45:20]
0|05|62|	Quadrant of longitude etc. for last Ascending node [0] & [5.62]
08|01|0	Even No. day | Time of 1st Ascending Node for day hours | 0
21|32|0	Time of 1st Ascending Node minutes | and seconds | 0 [01:21:32]
0|29|66	Quandrant of longitude etc. for 1st Ascending Node [0] & [29.66]

Notes: This pattern is repeated in single lines for the rest of section 1. We have only shown the first and last lines of section 1 for brevity. Note that the data finishes on odd number day 15.

Second section.
First line

22|3|30|	ID for section 2 | Launching country | Series of Satellite

The only other information we have on section 2 is that it may contain further information in plain language and indeed it does in the form of the APT transmission frequency of 137.06 MHz. We have no information on the coded information which comes before the APT information.

Notes: Content of section 2. Information on the operating mode of the onboard tv-system, frequency of APT, and possibility of changing frequencies.

Section 3.
First line

33|3|30|	ID for section 3 | Launching country | Series of satellite

Second line first two entries.

9|1|1|10|	ID | Hemisphere (1=Nth. 2=Sth) | Pass (1=Ascending 2=Descending) |Geographical latitude intersected (Tens & units of degree) [10]
002|41|	Time in minutes | and seconds from equator crossing to latitude intersected [2:41]

This pattern repeats for the remainder of section 3 and (from observation) is given for each 10 degrees of latitude up (and down) to 70 degrees.

Notes: Content of section 3. Data on the on-time satellite (sub-satellite track) intersects given geographical latitudes in the northern and southern hemispheres.

Section 4.
Section 4 was not transmitted.

Content of section 4. Explanation of the content of FANAS message and definition of the relevant digital groups of the transmitted message.

Section 5.

55|3|30|	ID for section 5 | Launch country | Series of satellite

Second line

02|593	Even minutes of the reference pass (100's omitted) | Satellite altitude to one-tenth of a km above the surface (over the Krasovsky ellipsoid); thousands of km are omitted.
7|07|43|	Tenths of km altitude [Total 593.7 Km] | Latitude of satellite sub-point in tens and units of a deg. | hundredths of deg. [07.43]|
0|30|44|	Quadrant for the sub-satellite points | Longitude tens & units | hundredths of deg. [30.44]

This pattern is repeated for the remainder of section 5 for even minutes of the reference pass.

Section 5 is completed by a plain language message about the next forecast date and finishes with OMMJJ as required for a FANAS message.

Notes: Content of section 5. Information on latitude, longitude for each even minute (from equator) of satellite pass (coordinates of sub-satellite point) and satellite altitude at these points. May also contain non-regular information on the operation of the onboard set of instruments, changes of operating modes, recommendations, requests as well as the time of transmissions from geostationary satellites. The next forecast information is clearly part of the message as originally transmitted and passed onto AXM. To the best of our knowledge AXM did not broadcast any further FANAS data on the 13th February.

That completes the information of the decoding of the data that we have available to us. We hope that this information is of use to those interested in satellite reception. We appreciate that what we have presented may be dated to some extent but most of it appears still current. For a definitive look at how to compute orbital parameters, see the article by Tom Clark in Orbit magazine.

In addition to the data on satellites mentioned above, there is also a feature article in the Practical Wireless (July 1986) on Weather Watch which is the 3rd article in a series and is worth looking up.

REFERENCES

TIROS-N series, Direct Readout Services, Users Guide, Washington D.C., March 1982. US Department of Commerce, National Oceanic and Atmospheric Administration, National Earth Satellite Service.

Weather Watch-3 (Jeff. Maynard) / Space and Satellites (reported By Pat Gowen), Practical Wireless, July 1986.

The Amateur Scientist, (Conducted by C.L. Strong), Scientific American, January 1974. pp 114-120.

BASIC orbits, Tom Clark W3IWI, Orbit, March/April 1981 pp. 6-11 & 19-20.

FURTHER READING

A Weather Satellite 'Finder', Paul Butler, AEM November 1986, pp. 89-90.

Project AEM3503, Satellite FAX Decoder, Tom Moffat VK7TM, AEM July 1986, pp. 68-77.

A Guide to Non-Voice Transmissions on Shortwave, Roger Harrison, AEM July 1987, pp. 24-26.

The Satellite Experimenter's Handbook, Martin R. Davidoff K2UBC, published by the ARRL, 1984.

Commanding the Yaesu FT757 transceiver from a Commodore 64

Part 2

Graham Blanchett VK2CJB

In Part 1, a method of interfacing the popular Yaesu FT757 transceiver with the also-popular Commodore 64 computer was described. This gives three ways of scanning the frequency spectrum and a number of other enhancements, such as disk storage of frequencies. The program given here provides many interesting and useful operating features based on the machine code routine described in Part 1.

HERE'S WHERE we get down to it! A full program listing is published here which you may key in and save to disk for your use. Alternatively, software is available through the magazine's Software Service; details are given at the end of this article. Readers availing themselves of this will be supplied with a connector for the Yaesu's CAT interface, saving you the trouble of sourcing this uncommon item.

Space does not permit a detailed, blow-by-blow explanation of the program to be given. Readers will find standard Commodore reference books very useful if a full understanding of the program is sought. Below follows a brief description of the program which should be read in conjunction with the full program listing published here.

The machine code for the communication routine described last month and loading instructions are contained in data statements 10 to 440. The rest of the program is in BASIC, which I shall now describe.

Clock

The clock is selected from the menus when required. It should be noted however that if the clock is activated, the program is slowed down considerably. This is only a nuisance when scanning.

For this reason, the clock is not selected automatically at the time the program is loaded. The reduction in speed is related to the need to clear strings from memory.

Menus

The menus are critical to the easy use of the software. The first menu, see Figure 7 (Part 1), is generated from lines 1000 to 1195 of the program. The time function is from subroutine 3000. Lines 1220 to 1327 direct program control to the item selected from Menu I.

Similarly, lines 1500 to 1590 cause Menu II (see Figure 8, Part 1) to be displayed and lines 1640 to 1710 call up the required routines.

Note that:

@ .. BAUD RATE ADJUSTMENT,
? .. TEST F 1-30 MHZ and
* .. TEST F 5.55555 MHZ

are test routines that are useful when checking the program for correct operation, especially if the baud rate needs fine tuning. Further details are given under "operation" here.

```
START FREQ---? 3.6

END FREQ-----? 3.7

STEP SIZE(HZ)? 10

* P  FOR 100 SEC PAUSE
* C  FOR CONTINUE AFTER PAUSE
* 1  FOR MENU PAGE 1
* 2  FOR MENU PAGE 2
* V  FOR VARY DWELL (SEC)
* I  FOR INCREMENT (HZ)
* J  FOR JOG TO NEXT STEP AFTER PAUSE
```

The scan menu.

Frequency input routine

The statements 1980 to 2140 group the data from the keyboard into pairs of digits – see Figure 3, Part 1. The machine language routine is then used to send a command to the FT757 (statement 2230). Statements following 2500 send the program back to the routine that originated the frequency.

Scanning routine

Frequency scanning is achieved by incrementing the transceiver frequency in user-defined steps. These steps can be as small as 10 Hz, giving for all practical purposes a continuous and smooth scan.

This routine starts at statement 4620. It is based on a simple formula which increments frequency in the user specified step size.

The scanning mode can be used to make a large step if, for example, you want to step from one shortwave broadcast station to another. Simply set the step size to, say, 5000 Hz and increase the dwell time.

The remaining parts of the program can be understood from the program listing and associated REM statements.

Operation

The program is really very easy to use. I recommend trying all the possibilities on the menus without reference to the description here – you will probably find it all self-explanatory.

To load the program from a disk supplied through AEM's software service, enter:

LOAD "COMMANDER",8

and when READY shows on the screen, enter RUN.

You will be asked to SET TIME? Enter four digits for the hours and minutes, or default with RETURN if you are not going to use the clock.

Do not press keys more than once for commands – buffers remember these and interpret them as additional commands.

Functions listed in Menu I are all duplications of the Yaesu front panel control switches with the exception of the last item 'next page of menu' selection.

The first item on Menu II is BAUD RATE ADJUSTMENT. This sets the frequency to multiples of 1.11111 MHz (2.22222, 3.33333 etc) to test the accuracy of data transfer from the Commodore to the Yaesu. It is very easy to see if one digit has been incorrectly sent in this repetitive pattern. If any errors are seen, they may indicate a small adjustment to the baud rate is necessary, although this was not necessary when the program was tested on another Commodore. The change is made by altering the value in line D of line 410 of the program, and then RUNning it again to reload the machine code routine.

TEST F 1-30 MHZ also generates frequencies for test purposes.

TEST F 5.55555 MHZ was used during program development to provide a repetitive signal that could be viewed on an oscilloscope. Among other things, this enabled me to establish that the baud rate timing was consistent.

SCAN – when E is selected, enter START FREQ, END FREQ and STEP SIZE as requested and start scanning. To take manual control of the scan, press P (for pause) and use J to manually "jog" to the next step of the scan.

SELECTED FREQ'S FROM KEYBOARD – when G is selected you are asked how many frequencies you want to enter and what they are. A location or comment can also be entered, which is especially useful if these frequencies are to be stored on disk. Use RETURN to default to the next frequency if you wish.

After all the frequencies have been entered, you can save to disk (use R to REPLACE if you want to re-use a file name).

SELECTED FREQUENCIES FROM DISK – use H to recall previously saved files.

To edit a disk file of frequencies, call up the file using H. Then select Menu 2 and G. You can then overwrite the file where you want and use RETURN to retain data you don't want to change.

DIRECTORY – use $ to view the directory without aborting the program.

UPDATE TIME – T provides this function.

TURN CLOCK ON/OFF – X provides this toggle function so that time updates are shown ion the screen every time a command is generated. This slows down the program considerably and is not normally used during scanning.

NEXT PAGE OF MENU – N returns you to Menu I.

Software and connector

By arrangement between the author and the magazine, a copy of the program on 5.25" floppy disk is obtainable by writing to PO Box 507, Wahroonga 2076 NSW. The specialised three-pole connector which plugs into the back of the Yaesu will also be supplied with the disk. Total cost, including disk, connector, post and packing, is $25.00. Or, you can 'phone (02)487 1207 during business hours and "pledge your plastic" to order. The edge connector which plugs into the Commodore User Port is available through various retailers, such as Geoff Wood Electronics and Jaycar.

Acknowledgements

Thanks to Bill Daniel, VK4BDE, who got me moving on this project and to Erik Fountain for ideas published in 73 Magazine, January 1985.

```
0 REM  ** A SINGLE CHARACTER OUTPUT
1 REM  ** ROUTINE , CALLED FROM BASIC
3 REM  ** TO OUTPUT A SERIAL CHARACTER
4 REM  ** AT 4800 BAUD ON THE USER PORT
5 REM  ** PIN "C" ( PBO ),USING 8 DATA
6 REM  ** BITS , NO PARITY. THE CHAR
7 REM  ** IS POKED TO 33280 BEFORE
8 REM  ** CALLING THIS ROUTINE .. EG
9 REM  ** POKE 33280,65:SYS 32768
10 DATA 120,169,1
20 DATA 141,3,221
25 DATA 169,0
30 DATA 141,1,221
40 DATA 162,8
50 DATA 160,30
60 DATA 32,0,129
70 DATA 110,0,130
80 DATA 144,8
90 DATA 169,1
100 DATA 141,1,221
110 DATA 76,36,128
120 DATA 169,0
130 DATA 141,1,221
140 DATA 202
150 DATA 240,20
160 DATA 160,30
170 DATA 32,0,129
180 DATA 76,18,128
210 DATA 160,30
220 DATA 32,0,129
230 DATA 169,1
240 DATA 141,1,221
250 DATA 88,96
255 DATA 76,62,128
256 DATA 76,47,128
260 REM  **  POKE CODE INTO RAM  **
300 FOR I = 0 TO 64
310 READ X
320 POKE 32768+I,X
330 NEXT I
340 REM  ** DELAY ROUTINE  **
350 DATA 136,208,253,96
360 FOR I= 0 TO 3
365 READ X
370 POKE 32768+256+I,X
380 NEXT I
390 REM
395 REM
400 REM ROUTINE TO FINE TUNE BAUD RATE.
402 REM ******************************
404 REM
405 REM SET D TO A VALUE FROM 25 TO 35
410 D=33
420 POKE 32768+14,D
430 POKE 32768+40,D
440 POKE 32768+46,D
445 REM SET CLOCK ROUTINE
446 POKE53280,6
450 PRINTCHR$(147):PRINTTAB(20)"TIME:";:TX$=LEFT$(TI$,4):PRINTTX$
453 PRINTTAB(20)"SET TIME";:INPUT TT$
454 IF TT$="" THEN GOTO 800
455 TA$=LEFT$(TT$,2):TB$=RIGHT$(TT$,2)
460 TC=3600*(VAL(TA$)*60+VAL(TB$))
465 TD=TC/65536:TE=256*(TD-INT(TD)):TF=256*(TE-INT(TE))
470 POKE160,INT(TD):POKE161,INT(TE):POKE162,INT(TF)
800 DIM FA(1000),LOC$(1000):W=1
1000 PRINTCHR$(147):P=1
1070 PRINT"S . SPLIT VFO A/B     *   COMMODORE"
1075 PRINTTAB(23);"*"
1080 PRINT"M . MEMORY OR VFO     *       C64"
1085 PRINTTAB(23);"*"
1090 PRINT"> . WRITE VFO INTO MEM*   COMMANDER"
1095 PRINTTAB(23);"*"
1100 PRINT"L . DIAL LOCK ON/OFF  *   FOR YAESU"
1105 PRINTTAB(23);"*"
1110 PRINT"V . VFO A/B           *     FT757"
1115 PRINTTAB(23);"*"
1120 PRINT"< . WRITE MEM INTO VFO*       BY"
1125 PRINTTAB(23);"*"
1130 PRINT"U . BAND STEP UP      *    GRAHAM"
1135 PRINTTAB(23);"*"
1140 PRINT"D . BAND STEP DOWN    *    BLANCHETT"
1145 PRINTTAB(23);"*"
1150 PRINT "C . CLARIFIER ON/OFF  *     VK2CJB
1155 PRINTTAB(23);"*"
1160 PRINT"= . SWAP MEM/VFO FREQ *  INSTRUCTIONS"
1165 PRINTTAB(23);"*"
1170 PRINT"F . ENTER FREQUENCY   *  IN AUS EL MON"
1175 PRINTTAB(23);"*"
1180 PRINT"N . NEXT PAGE OF MENU *     AUG 1987"
1195 PRINTTAB(23);"*"
1200 PRINT"ENTER CHOICE  ..? ";:GOSUB3000
1210 GET   A$: IFA$=""THENGOTO1210
1215 PRINTCHR$(157);:PRINTA$;
1220 IF A$="S" THEN A=1:GOTO 1400
1230 IF A$="M" THEN A=2:GOTO 1400
1240 IF A$=">" THEN A=3:GOTO 1400
1250 IF A$="L" THEN A=4:GOTO 1400
1260 IF A$="V" THEN A=5:GOTO 1400
1270 IF A$="<" THEN A=6:GOTO 1400
1280 IF A$="U" THEN A=7:GOTO 1400
1290 IF A$="D" THEN A=8:GOTO 1400
1300 IF A$="C" THEN A=9:GOTO 1400
1310 IF A$="=" THEN A=11:GOTO 1400
1320 IF A$="F" THEN A=10:GOTO 2000
1327 IF A$="N" THEN GOTO 1500
1330 PRINT
1350 PRINT "****** NOT FOUND  ******"
1360 FOR T= 1 TO 600
1370 NEXT T
1380 GOTO 1000
1390 REM
1391 REM
1392 REM ROUTINE TO OUTPUT MODE CHANGE COMMANDS TO FT757
1393 REM ***********************************************
1394 REM
1395 REM
1400 REM TURN OFF VIC-II CHIP
1404 POKE53265,11
1408 FOR X= 1 TO 4
1410 POKE 33280,88:SYS32768
1430 NEXT X
1440 POKE 33280,A
1450 SYS 32768
```

```
1454 REM TURN ON VIC-II CHIP AGAIN
1458 POKE 53265,27: GOTO 1000
1460 REM
1470 REM
1500 PRINTCHR$(147):P=2:DWELL=0
1510 PRINT" R .. BAUD RATE ADJUSTMENT":PRINT
1520 PRINT" ? .. TEST F=1-30 MHZ":PRINT
1530 PRINT" B .. TEST F = 5.55555 MHZ":PRINT
1540 PRINT" E .. SCAN":PRINT
1550 PRINT" G    SELECTED FREQ'S FROM KEYBOARD":PRINT
1560 PRINT" H .  SELECTED FREQ'S FROM DISK":PRINT
1570 PRINT" $ .. DIRECTORY": PRINT
1580 PRINT  T    UPDATE TIME":PRINT
1585 PRINT  X    TURN CLOCK ON/OFF":PRINT
1590 PRINT" N .  NEXT PAGE OF MENU":PRINT
1600 PRINT"ENTER CHOICE  ..? ";:GOSUB3000
1630 GET A$: IFA$="THENGOTO 1630
1640 PRINTCHR$(157); PRINTA$;
1650 IF A$="R" THEN GOTO 4055
1680 IF A$="?" THEN GOTO 5060
1670 IF A$="B" THEN GOTO 6260
1680 IF A$="E  THEN GOTO 4700
1690 IF A$="G" THEN GOTO 4900
1700 IF A$="H" THEN GOTO 5741
1710 IF A$="$" THEN GOSUB7000
1720 REM
1730 REM
1740 REM
1750 REM
1780 IF A$="T" THEN W=0:GOSUB3000
1765 IFA$="T" THEN 1500
1768 IFA$="$" THEN 1500
1768 IF A$="X" THEN W=1:GOTO1500
1770 IF A$="N" THEN GOTO 1000
1780 PRINT
1790 PRINT "****** NOT FOUND  ******"
1800 FOR T = 1 TO 800
1810 NEXT T
1820 GOTO 1500
1960 REM
1970 REM
1980 REM FREQUENCY INPUT ROUTINE
1990 REM ***********************
2000 REM
2010 PRINTCHR$(147)
2020 PRINT
2040 PRINT  " ENTER FREQUENCY IN MHZ  ";
2050 INPUT F
2080 F1=F/10+0.0000005
2080 FOR J=2 TO 5
2090 F2=INT(F1):F1=F1-F2
2100 F2=F2+INT(F2/10)*6
2110 A(J)=F2
2120 F1=100*F1
2130 NEXT J
2140 A(1)=10
2145 IF T=1 THEN 2225
2150 GOSUB3000
2222 REM TURN OFF VIC-II CHIP
2225 POKE 53265,11
2230 FORJ=5TO1STEP-1:POKE 33280,A(J): SYS 32768:NEXT
2280 REM TURN ON VIC-II CHIP
2290 POKE 53285,27
2500 IFA$="R" THEN GOTO 4190
2510 IFA$="B" THEN GOTO 8270
2520 IFA$="?" THEN GOTO 5150
2530 IFA$="E" THEN GOTO 4770
2540 IFA$="G" THEN GOTO 4946
2550 IFA$="H" THEN GOTO 4946
2551 IFS$="S" THEN 5545
2552 IFS$="R" THEN 5542
2553 IFS$="1"THEN  1000
2554 IFS$="2" THEN 1470
2556 IFS$="$" THEN 7000
2557 IFS$="A" THEN 4946
2558 IF V=1 THEN 4946
2580 IF A$="$" THEN GOTO 7000
2600 GOTO 1000
2980 REM
2990 REM
2998 REM
2999 REM
3000 REM CLOCK ROUTINE
3001 REM *************
3002 REM
3004 REM
3005 IF W=1 THEN RETURN
3010 FORA=1TO4:B$=MID$(TI$,A,1)
3020 POKE56288+A,1:POKE2016+A,ASC(B$)
3025 NEXTA:POKE56293,1:POKE2021,58
3030 POKE2022,ASC(RIGHT$(TI$,2)):POKE2023,ASC(RIGHT$(TI$,1))
3040 FR  = FRE(0)-(FRE(0)<0)*85535
3050 RETURN
4000 REM
4010 REM
4020 REM  TEST ROUTINE FOR ADJUSTING BAUD RATE, ETC
4030 REM  ******************************************
4040 REM
4050 REM
4055 PRINT:PRINT:PRINT:PRINT"   FREQ SET TO MULTIPLES OF  "
4080 PRINT"   1.11111 MHZ REPETITIVELY"
4065 PRINT:PRINT"   ANY KEY TO STOP  "
4070 FOR T=1 TO 9
4080 F=1.11111*T
4120 GOTO 4285
4190 IF F=10 THEN GOTO 4070
4191 NEXT T
4193 F=10.00000
4285 GET F$:IFF$<>""THEN 1000
4290 GOTO2060
4600 REM
4810 REM
4820 REM SCANNING ROUTINE
4630 REM ****************
4640 REM
4700 PRINTCHR$(147): PRINT:PRINT:PRINT:PRINT:PRINT" START FREQ---";:INPUT K
4710 PRINT:PRINT" END FREQ-----";:INPUT L
4720 PRINT:PRINT:PRINT" STEP SIZE(HZ)";:INPUT Q: Q=Q/1000000
4722 PRINT:PRINT:PRINT" * P  FOR 100 SEC PAUSE"
4724 PRINT:PRINT" * C  FOR CONTINUE AFTER PAUSE"
4726 PRINT:PRINT" * 1  FOR MENU PAGE 1"
4728 PRINT:PRINT" * 2  FOR MENU PAGE 2"
4730 PRINT:PRINT" * V  FOR VARY DWELL (SEC)"
4735 PRINT:PRINT" * I  FOR INCREMENT (HZ)"
4736 PRINT:PRINT" * J  FOR JOG TO NEXT STEP AFTER PAUSE"
4740 FOR P=K TO L STEP Q
4750 F=P:IF F>L THEN 4740
4760 GOTO 2060
4770 FORY=1 TO 870*DWELL:NEXT
4771 IFF$="J" THEN F$=" ":GOTO4774
4772 GETF$:IFF$="P" THEN 4777
4773 GOTO 4784
4774 GETF$:IFF$="" THEN 4774
4775 IF F$="J" THEN 4789
4778 GOTO 4772
4777 FOR A=1 TO 10000:GETF$
4778 IF F$="C" THEN A=50000:NEXTA:GOTO4784
4780 IFF$="J" THEN 4784
4781 NEXTA:GOTO4784
4783 GOTO4784
4784 IF F$="1" THEN 1000
4786 IF F$="2" THEN 1470
4787 IF F$="V" THEN PRINT:INPUT"DWELL (SEC)",DWELL
4788 IF F$="I" THEN PRINT:INPUT"STEP SIZE (HZ)";Q:Q=Q/1000000:P=L+1
4789 NEXTP
4790 GOTO 4740
4800 REM
4810 REM
4820 REM ROUTINE FOR SELECTED FREQ'S FROM THE KEYBOARD
4830 REM ********************************************
4840 REM
4850 REM
4900 PRINT:PRINT:PRINT:PRINT" HOW MANY FREQ'S";:INPUTZ:PRINT
4905 IFZ<1THEN4900:S$="":V=0
4910 FOR X=1TOZ:PRINT:PRINT" FREQ(MHZ)  -";X;:INPUT FA(X)
4915 PRINT:PRINT"LOCATION OR COMMENT  -";X;:INPUT LOC$(X):NEXT
4916 PRINT:PRINT:PRINT:FORX=1TOZ:PRINTFA(X),"MHZ  **  ";LOC$(X):NEXT:S$="":V=
4917 GOSUB8000:REM  PRINT:PRINT:PRINT:PRINTTAB(15);"***  S SAVES TO DISK"
4918 REM:PRINT"  ANY OTHER     ***  R SAVES TO REPLACE"
4919 REM:PRINT"  KEY FOR       ***  1 FOR MENU PAGE 1"
4920 REM:PRINT"  NEXT FREQ     ***  2 FOR MENU PAGE 2"
4921 REM:PRINTTAB(15);"***  A FOR AUTOMATIC"
4923 REM:PRINTTAB(15) ***  P FOR PAUSE"
4924 REM:PRINTTAB(15)"***  CONT FOR CONTINUE"
4925 REM:PRINTTAB(15)"***  $ FOR DIRECTORY"
4926 FORX=1TOZ
4930 F=FA(X):IF X>Z THEN 4926
4940 GOTO 2060
4946 IF V =1THEN FOR Y=1TODWELL*770:NEXT:GOTO4965
4950 IF S$="A" THEN V=1:PRINT:INPUT"DWELL (SEC)";DWELL:GOTO4965
4960 IF PEEK(197)=64 THEN 4980
4965 GETS$:IF S$="S" THEN GOTO 5545
4966 IF S$="R" THEN GOTO 5542
4967 IF S$="1" THEN GOTO 1000
4968 IF S$="2" THEN GOTO 1470
4970 IF S$="P" THEN STOP
4975 IF S$="$" THEN GOSUB7000
4976 IF S$="T" THEN V=0:S$=xx :GOTO4960
4978 NEXTX
4980 GOTO4926
5000 REM
5010 REM
5020 REM ALTERNATIVE TEST ROUTINE - TEST "A"
5030 REM ************xx********************
5040 REM
5050 REM
5060 PRINT:PRINT:PRINT:PRINT"PRESS ANY KEY TO STOP"
5070 FORH=1TO9
5080 I=H*0.11111
5090 FOR T=0TO19
5100 F=T+10+I
5110 FORY=0TO500:NEXT
5111 GETF$:IFF$<>""THEN 1000
5140 GOTO 2060
5150 NEXTT
5160 NEXTH
5170 GOTO 5070
5500 REM
5510 REM
5520 REM SAVE SELECTED FREQ'S TO DISK
5530 REM ****************************
5540 REM
5542 PRINT:PRINT:PRINT"ARE YOU SURE YOU WANT TO REPLACE Y/N --"
5543 GETR$: IFR$="" THEN GOTO 5543
5544 IFR$="Y" THEN CR$="@":GOTO 5546
5545 CR$=""
5548 PRINT:PRINT:PRINT"ENTER FILENAME  ---";:INPUT CM$
5550 OPEN 15,8,15
5560 OPEN1,8,5,"@0:"+CM$+",S,W"
5570 INPUT#15,E,E$,T,S
5580 IF E>19 THEN PRINT E;E$;T;S:CLOSE1:CLOSE15:STOP
5590 FOR L=1 TO Z
5600 PRINT#1,FA(L)
5610 PRINT#1,LOC$(L)
5620 NEXT L
5630 CLOSE1:CLOSE15
5635 PRINT:PRINT:PRINT:FORX=1TOZ:PRINTFA(X),"MHZ  **  ";LOC$(X):NEXT
5636 GOSUB8000:REM  PRINT:PRINT:PRINT:PRINTTAB(16);"***  S SAVES TO DISK"
5637 REM:PRINT"  ANY KEY FOR    ***  R SAVES TO REPLACE"
5638 REM:PRINT"  NEXT FREQ      ***  I INTERRUPTS"
5840 GOTO 4928
5700 REM
5710 REM
5720 REM LOAD SELECTED FREQ'S FROM DISK
5730 REM ******************************
5739 REM
5740 PRINT "TRY ANOTHER FILE NAME"
5741 PRINT:PRINT:PRINT"ENTER FILENAME --- ";:INPUT CL$
5750 OPEN15,8,15
5760 OPEN1,8,5,"0:"+CL$
5770 INPUT#15,E,E$,T,S
5780 IF E>19 THEN PRINT E,E$,T,S:CLOSE1:CLOSE15:IF E=82 THEN 5740:STOP
5790 Z=0
5800 Z=Z+1
5810 INPUT#1,FA(Z),LOC$(Z)
5820 IF ST<>64 GOTO 5800
5830 CLOSE1:CLOSE15
5870 GOTO4916
6000 REM
8010 REM
8020 REM TEST ROUTINE TO ENTER THE WORD 10101010 INTO FT757 REPETITIVELY.
8030 REM FOR USE WITH O'SCOPE.
6040 REM
6050 REM ****************************************************************
8080 REM
8090 REM
6280 REM
8282 PRINT:PRINT:PRINT:PRINT"FREQ SET TO 5.55555 MHZ REPETITIVELY"
6284 PRINT:PRINT
6286 PRINT"   ANY KEY TO STOP  "
6270 F=5.55555
6280 FOR Y=1TO500:NEXT
8295 GET F$:IFF$<>""THEN1000
6310 GOTO 2080
7000 REM
7010 REM
7020 REM ROUTINE TO DISPLAY DIRECTORY
7030 REM ***************************
```

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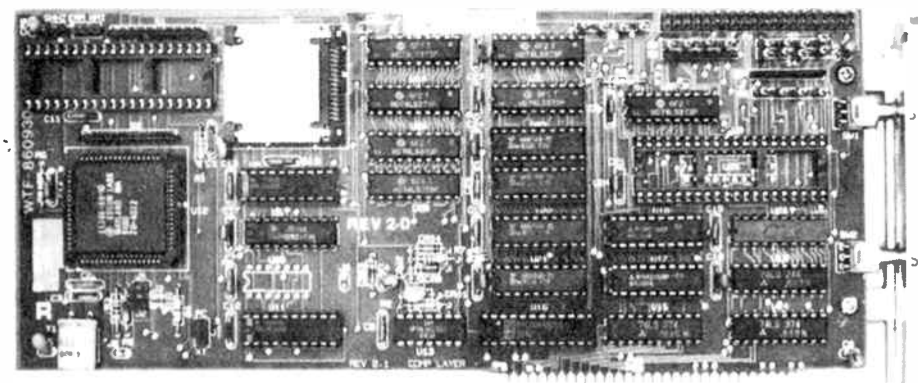

New PC speedup card

Electronic Solutions of Sydney has released their model ES-286 speedup card for the IBM PC and compatibles. The ES-286 can be fitted in minutes and, according to Ian Hardwick of Electronic Solutions, enables any IBM PC to go nearly twice as fast as a "real AT" whilst remaining compatible with existing software.

The ES-286 card replaces the PC's existing 8088 microprocessor with an 80286 16-bit processor as used in the PC/AT. The 80286 runs at 8 MHz, as compared to the PC's 8088 clock speed of 4.77 MHz. As a result, software can run up to seven times faster with the ES-286 fitted, according to Hardwick.

The ES-286 includes 8K of cache memory to improve throughput and also has provision to refit the original 8088 chip on the card to maintain compatibility with all software written for the IBM PC by switching it in if required.

Features of the ES-286 include:

- 80286 microprocessor.
- Fast clock speed of 8 MHz.
- 8 k of high speed zero-wait-state cache memory.
- Support for 80287 co-processor running at 5 MHz or 8 MHz.
- Hardware switchable 8088 remains in system for full compatibility.
- Automatic cache disable during self-test for compatibility with most BIOSs.
- Hardware switchable cache disable.
- Full documentation and fitting instructions.

Price is $595.00, including tax, and a 14-day money-back guarantee is also offered. For further information, contact: **Electronic Solutions, PO Box 426 Gladesville, 2111 NSW. (02)427 4422.**

The "Dicky" mouse

The mouse has become a convenient tool for the computer user, offering quicker and easier input then the keyboard in many applications. Dick Smith Electronics has just released a new mouse which they claim offers faster, smoother and more precise operation than others on the market.

The PC Mouse, which is exclusive to DSE, uses optical sensing rather than the conventional mechanical rolling ball systems found on other devices.

The PC Mouse is supplied complete with it's own software and has three control buttons which allows six discrete states to be sensed by the host computer.

The DSE catalogue number for the PC Mouse is X-3800 and is priced at $249. Contact your nearest Dick Smith Electronics outlet for further details.

Sales and support of Amstrad PC1512 to continue

Amstrad's popular PC1512 computer, distributed and supported in Australia by Mitsubishi Electric AWA Pty Ltd, will continue to be sold in Australia with support and service maintained.

This was announced recently by Mr. John Chandler, Amstrad Product Manager for Mitsubishi Electric AWA, to allay fears that the PC1512 was being replaced by Amstrad's newest model, the PC1640.

Mr. Chandler emphasised that the unveiling of the PC1640 had been incorrectly interpreted as the end of production of the PC1512. "We want to assure our retail outlets and our many thousands of users that continued supplies of the PC1512 are assured," said Mr. Chandler.

Mitsubishi Electric AWA plans to introduce the new Amstrad model to Australia towards the end of this year as an addition to the successful PC1512.

The PC1640 will offer 640K memory as standard, built-in EGA and a new high resolution screen option. Costing at least $500 more than the PC1512. The new model will complement the PC1512 range and further increase the success of Amstrad in the personal computer market, the company says.

Pulsar Electronics makes DoLGAS list

Melbourne-based electronics manufacturer, Pulsar Electronics has been advised that it's full list of tendered products have been included on the Department of Local Government and Administrative Services (DoLGAS) microcomputer period contract.

"This puts the crowning touch to the company's best ever year," said Pulsar Managing Director Philip Delacretaz on receiving the news. "This is the first time we have tendered for the annual DoLGAS contract and to get acceptance of every product we put forward is unbelievable," he added.

Pulsar has been advised of acceptance of it's multi-user Turbo-Dos computer systems, it's locally designed and built XT and AT personal computers, the SAM modem and it's yet to be publicly released diskless workstation and accessories.

Pulsar had not tendered in previous years in case it's tender was accepted, but this year they have been able to get their manufacturing plant scaled up sufficiently to handle the demands that can come from Federal Government departments.

During the past year, the company has been able to gradually double their manufacturing facilities due to the success of the SAM modem and PC style motherboards. The company is also now manufacturing large quantities of it's newly released ESDI hard disk controller for export and it's CopyAll disk copying units.

Pulsar Electronics are located at **Lot 21 Catalina Drive, Tullamarine, Vic. (03)330 2555.**

Potpourri

MY TWO FAVOURITE communications books have just been released in their second editions. The books are both published by Prentice-Hall (Brookvale N.S.W.) and are called "*Data Communications & Teleprocessing Systems*," by Trevor Housley and "*Data Communications, Networks and Distributed Processing*," by Uyless D. Black. Housley's book has been expanded considerably, containing almost twice the information of the first edition. There is now a complete chapter on modems and their methods of operation, and the first edition chapter on Networks and Line Protocol Procedures has been expanded into thirteen new chapters. A completely new section (four chapters worth) on Common Carrier Networks (including ISDN) has been added to the book. The additions to this book make it a very valuable reference for anyone involved in Communications and Networking.

The book by Black has only one new chapter added – dealing with divestiture of communications utilities. Other chapters have been extensively updated, in line with recent advances in telecommunications. For example, the chapter entitled "Digital Transmission" now has both ISDN and Digital PBXs added to its contents. The major emphasis of both of these of these books is towards the implementation of Local and Wide Area Networks. This field is rapidly expanding and would appear to be one of the major growth areas in the next couple of years. LAN and WAN manufacturers appear to have their act together at last and fully operating systems are being offered by major suppliers. The books will serve as a handy reference for anyone considering the installation of a network.

Both these books lack one feature that I would consider mandatory in any treatise on communications – neither has a section on modem protocols – an omission that I find staggering. However, most comms books also seem to consider a discussion of comms protocols unnecessary, so I can't really take issue with these two books. With that one gripe aside, both books represent excellent value for money. If I had to choose between the two (a choice that I'm glad I don't have to make), I would probably choose the Housley book, simply out of loyalty. Individuals can order either of these books through their local bookshop, or direct from Prentice-Hall.

ISDN revisited

Telecom is "charging" ahead with its plan to install fully operative ISDN networks by mid-1988. The network will initially only be available in the Central Business Districts (CBDs) of major cities and it will be based on the European (I guessed right for a change) Primary Access standard. According to an official Telecom document that the Editor sent me the other day, the initial offering will be for digital telephones, supplementary services (messaging, meter enquiry & calling number), leased line (point-to-point), Austpac access, Teletext access, 64 kb/s switched access and high speed fax. A very interesting feature is the provision of calling number enquiry, as part of the supplementary services. This will enable anyone to obtain the number of the originating call and should significantly reduce the number of crank, obscene and hoax phone calls that currently plague subscribers.

Private subscribers will have to wait a little longer for the CCITT Basic Access mode to become available. This will be the 2B+D configuration (144 kb/s without overheads, or 192 kb/s including overheads), which will give subscribers two 64 kb/s voice/data channels and a 16 kb/s signalling channel. Current analogue phones will still be usable on the new service, but will need to have a special adaptor (a glorified A/D converter) attached to the phone to connect to the 'S' interface. Non-ISDN data terminals and computer equipment will also require a terminal adaptor to enable their use. For anyone out there considering the purchase of a terminal for comms use, it might be worthwhile finding out prior to purchase if the unit is ISDN compatible. It could save lots of headaches and wasted money. In their documentation, Telecom have provided lots of hype about how this brilliant new system will benefit customers. Let's just hope they don't use it as a justification for sending charges skyrocketing.

Echomail for BBS enthusiasts

There is a brilliant new service available on my BBS (and most of the others I know of) called "ECHOMAIL." This service is designed to provide a BBS question/answer service and users can get in contact with any other co-operating OPUS service throughout Australia, New Guinea and the United States. Questions (and answers and just plain informative statements) are placed on the BBS by the user and are then downloaded all over in the wee small hours of the morning.

The cost? It's free. Let it be officially recorded in this column that I salute ALL the operators of BBS throughout the world. They provide an excellent service at minimal cost to the user and the only recognition they receive is the knowledge that they are providing a public service.

There are about 15 different "conferences" on Echomail, ranging from Technical Q & A, through Comms and even a Buyer/Seller Market for just about anything. Try it out – I'm sure you'll be fascinated.

Public domain and shareware comms packages

Over the next several issues of this column I have decided to introduce (and review) some of the very popular (and very powerful) public domain comms packages available for use via many of the BBS' around the country. I consider myself to be fairly brave for doing this, for two reasons. The first is that I am surely going to offend those people who consider that the package that they use is the BEST BAR NONE (this includes vendors and distributors of commercial comms packages, too) and second, by the time that these reviews get to print, the version that I have tested will be superseded by an all-singing/dancing etc version that immediately eliminates any of my criticisms. Nevertheless, I have always considered this column to be one for starters and so this is my justification.

The first package that I am going to place under the microscope is Procomm V 2.4.2, simply because it was the one I have been using until last week. Procomm is an exceedingly powerful package, which is quite user friendly (a very big issue with me at the moment) and which enables the tyro to get up and running fairly quickly. The introductory screen disappears after the first couple of uses, and the user is presented with a blank screen with a menu bar at the bottom of the screen, showing, in order, the "hot" key (the key sequence used to activate a "pull-down" help menu), the terminal emulation in current use, the duplex setting (half or full) the comms protocol, the status of the disk and printer logs and the settings for the incoming/outgoing carriage return/line feed (CR/LF) sequence (see Figure 1).

The major menus are activated by using the 'ALT' key in combination with another (usually alphabetic) key. For exam-

```
+------------+--------+-----+-------+----------+-------+--+--+
|ALT F10 HELP|ANSI-BBS| HDX |300 N81|LOG CLOSED|PRT OFF|CR|CR|
+------------+--------+-----+-------+----------+-------+--+--+
```

Figure 1. procomm's status line(1).

ple, the dialling directory (which stores the phone numbers of BBS', other modem users and even people), is activated by pressing 'ALT/D'. The comms parameters are accessed with 'ALT/P' and the modem and terminal setup are accessed via 'ALT/S' (see Figure 2).

The documentation for Procomm is considerable, both in terms of its coverage and weight. There are 111 pages in all, containing notes on the differences between the current version and previous versions. The complete Procomm program and documentation fit on a single 360k floppy drive, in a file called Procom24.arc. This will require de-arcing using the PD program called "ARC.EXE." When de-arced, the documentation needs to go onto a separate floppy from all the .EXE, .CMD, .KEY and .HST files etc. Downloads and Uploads can use any of the following file transfer protocols:

1. ASCII
2. XMODEM
3. MODEM7
4. YMODEM
5. YMODEM Batch
6. Telink
7. Kermit
8. Compuserve B
9. WXMODEM

I have noticed, however, that very few BBS systems make use of the YMODEM batch features (they're usually not part of Opus or Fido). Also, WXMODEM definitely does not work on batch transfers (most sysops I have conferred with think WXMMODEM to be a total disaster), whilst Telink appears to have batch upload problems. I tried to upload some files to my local sysop, using Telink, and it consistently aborted after renaming the last two file extensions. Telink does, however, work fine for downloads. The only answer is ARC the files into one and use XMODEM or YMODEM (or Telink for downloads).

Previous versions of Procomm have been released under the "shareware" type of system. This was when the name of the firm was PIL Software Systems. With the release of V 2.4.2, and a name change to Datastorm Technologies Inc, The status of the program has now changed. I am not quite sure what the status is, but it is certainly NOT Public Domain nor is it Shareware. Perhaps an enlightened reader can also enlighten me. Procomm V 2.4.2 is available through the Central Coast BBS (Sysop John Caine – 043-693658), through the PC User Group (Sysop Geoff May – 02-238-9034 300 bps – 02-221-5520 1200 bps) and from Software Tools of Australia (Sysop Bill Bolton – 02-449-2618). Next month I will look at PC-TALK and Telix V2.12. I will also discuss what I consider to be the essential elements of any comms program.

REFERENCES

1. The diagrams included for the Procomm data were derived from the Procomm documentation.

Figure 2. procomm's pull-down HELP menu(1)

```
++------------------------------------------------------------------------++
||                         P r o C o m m   H e l p                        ||
|+------------------------------------------------------------------------+|
| MAJOR FUNCTIONS            UTILITY FUNCTIONS           FILE FUNCTIONS    |
|                                                                          |
|Dialing Directory   Alt-D  Program Info .....  Alt-I  Send files ...  PgUp |
|Automatic Redial..  Alt-R  Setup Screen .....  Alt-S  Receive files  PgDn |
|Keyboard Macros ..  Alt-M  Kermit Server Cmd   Alt-K  Directory ....  Alt-F|
|Line Settings ....  Alt-P  Change Directory .  Alt-B  View a File ..  Alt-V|
|Translate Table ..  Alt-W  Clear Screen .....  Alt-C  Screen Dump ..  Alt-G|
|Editor ...........  Alt-A  Toggle Duplex ....  Alt-E  Log Toggle ..  Alt-F1|
|Exit .............  Alt-X  Hang Up Phone ....  Alt-H  Log Hold ....  Alt-F2|
|Host Mode ........  Alt-Q  Elapsed Time .....  Alt-T                       |
|Chat Mode ........  Alt-O  Print On/Off .....  Alt-L                       |
|DOS Gateway .....  Alt-F4  Set Colors .......  Alt-Z                       |
|Command Files ...  Alt-F5  Auto Answer ......  Alt-Y                       |
|Redisplay .......  Alt-F6  Toggle CR-CR/LF . Alt-F3                        |
|                           Break Key ....... Alt-F7                        |
+--------------------------------------------------------------------------+
```

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You would be excused for being cynical and thinking Super VHS (dubbed SVHS) is another advertising department research product, there have been so many in video recently. JVC announced it at the end of the Las Vegas show in January. Few believed it would live up to JVC's claims. One look at the side-by-side standard VHS and Super VHS display sent press and trade into raves.

SVHS comes at the expense of VHS's 10-year moratorium on obsolescence. The first tapes and VCR in VHS are still compatible with the latest, and vice versa. SVHS cassettes play gibberish on an old VCR, although the new VCRs have a recognition sensor which feels the hole already in all VHS video cassettes to tell it to switch to the old VHS mode. Incompatibility is not total, there's upward compatibility – old with the new – but the double inventory problem, just eliminated by most video software traders stocking VHS only, will rear its ugly head again with two VHS versions in hire and sale stock. Such is the cost of progress.

At present, SVHS is NTSC video standard only. Your reaction to the raves in the US may be a reasonable "so what!", unless you've travelled in the US and seen how poorly NTSC colour rates against our PAL system. Super VHS is a badly needed advance in countries condemned to NTSC, like the Americas and Japan. The problem in NTSC-land is that the average TV cannot reproduce an image as good as that possible from an existing VCR, so new, higher quality monitor TV sets of the Sony Profeel class will be required before SVHS is an advantage. Maximising the existing NTSC system is the plan. Extended definition is JVC's name for such hardware, and software emergent from TV sources. (This is not to be confused with high definition TV – HDTV – which requires gobs of transmission bandwidth not yet available in the spectrum). We may never see a PAL version.

Part of the JVC SVHS package is a new line of TV/monitors with a special "S" jack. Other manufacturers will soon have this feature in their sets, including Sony who have announced extended definition Beta (ED Beta).

Products to watch

Remember LV stands for "laservision" – the original big digital disc that flopped years ago. The compact disc and personal computers are helping it make a comeback.

National Panasonic, claimably the biggest name in world video, released its first VHS-C product, the PV-50 record-only camera. Like other VHS-C machines, you play back the cassette using an adaptor in any VHS VCR. The PV-50 weighs a mere 816 grams, with battery! It also incorporates an auto index search system to locate points in fast winds. RCA also announced two VHS-C models.

With the rush to compact VHS, US pundits predict the 40% share of the market for 8 mm camcorders last year will erode to about 20% by the end of 1987.

JVC has a new VHS-C camcorder, the GRC-11. It weighs 1.179 kg and is smaller and more rounded than the now legendary GRC-7. Sony has matched this release with a highly featured new model, the CCD-M7.

The Samsung 4 mm tape camcorder shown at the Las Vegas CES in January, mentioned in *AEM* last March and shown on *Towards 2000* in July, is to be released "shortly". It is said to have lobbed an exocet amidships the 8 mm video battleship. It uses the standard R-DAT cassette and lays down no side tracks for audio or sync. Some influential industry names believe that the next major video format move will to to 4 mm on DAT cassettes, rather than 8 mm which may finish up like the Kodak disc film product – looked like a good idea at the time.

Software at the CES is always less dramatic, except in the extravagant presentations of hit video numbers. But the bubble buzz in CES taverns was the shift to mass supermarket sales of video movies; in preference to hiring. Consider "Top Gun", a box office hit of '86 selling at US$18-20 in chainstore bins at the rate of over 40 000 the first day for one chain, and sales holding up thereafter. Shockwaves travelled through the renters; the TV industry must be quaking, too. Advertisers are asking how to buy time on video cassettes!

Bose 501X speakers

Robert Fitzell AAAC

These speakers, promoted as Bose's "Project X", maintain the Bose design philosophy of direct/reflecting loudspeakers, yet embody a new concept, comprising tiny mid and high range stereo "cubes" and a mono bandpass bass unit (see AEM, May '87, p.16) you can "hide" virtually anywhere in a room. It's an interesting and versatile design, with interesting performance.

UNDOUBTEDLY one of the more innovative manufacturers in the audio industry is Bose. In the field of professional sound, Bose has an enviable reputation, being seen as a yardstick for comparison for loudspeakers manufactured by many competitors. Many times, I have had salesmen and engineers promoting their loudspeakers for use in professional sound reinforcement systems by using such phrases as "equal to Bose", "this is our Bose copy".

There are many purists who might argue that the Bose loudspeaker range has all sorts of failings, but often the summary of the criticism is that "they are not as good as they are supposed to be", "they are too expensive" or "we can do better". In many cases, the complaints have truly to be seen as sour grapes.

In my own view, one of the major reasons for Bose's excellent reputation is that they are indisputably an innovative company, that they have identified a broad market for their products extending from professional sound reinforcement right through domestic hi-fi, and that they build loudspeakers to last. That they have effectively managed to satisfy the market demands in such wide spheres is a credit to their management, and their engineering skills.

Interesting ideas

In domestic hi-fi, Bose follows has a strong theme of producing and promoting "direct/reflecting" loudspeakers. Direct/reflecting loudspeakers are simply an arrangement which uses a combination of drivers, some of which face directly toward the listener whilst others face away. Before leaping to a conclusion that the design principle is a trivially simply one, it is worth noting that not many manufacturers use the same design principle. Some, clearly, perceive that there is little advantage in the design principle. Others however, would probably gladly adopt the principle if they had the technical skills to develop loudspeakers that use direct/reflecting principles and still sounded good.

One of the fundamental facts of domestic hi-fi in particular, is that room effects are significant. In large auditoria the colouration of tonal quality of the sound reinforcement system may be quite small since most strong room effects occur after an appreciable time delay. Rarely is this the case with domestic hi-fi since room volumes are small and initial room reflections occur within a time period in which the human ear cannot differentiate sources. Added to the problem of the time period, is the fact that most domestic rooms can be rather "dead" (little reverberation).

While this might suggest that room effects are reduced, the opposite is often the case. The net result can frequently be that instead of many small intensity reflections merging with the direct sound, a few rather strong reflections occur from the few reflective surfaces. The net result of all of these effects is to cause tonal colouration at various frequencies and levels. One of the benefits of the direct/reflecting loudspeaker arrangement is to force better control of the reverberant field. It is certainly not a foolproof system and there are rooms in which the direct/reflecting arrangement offers no advantage at all, but it is one in which the resulting sound system can have far better quality of ambience.

REVIEW ITEM:
BOSE 501-X Loudspeaker
Separate, Midrange and Woofer Units
Price: $2080 rrp

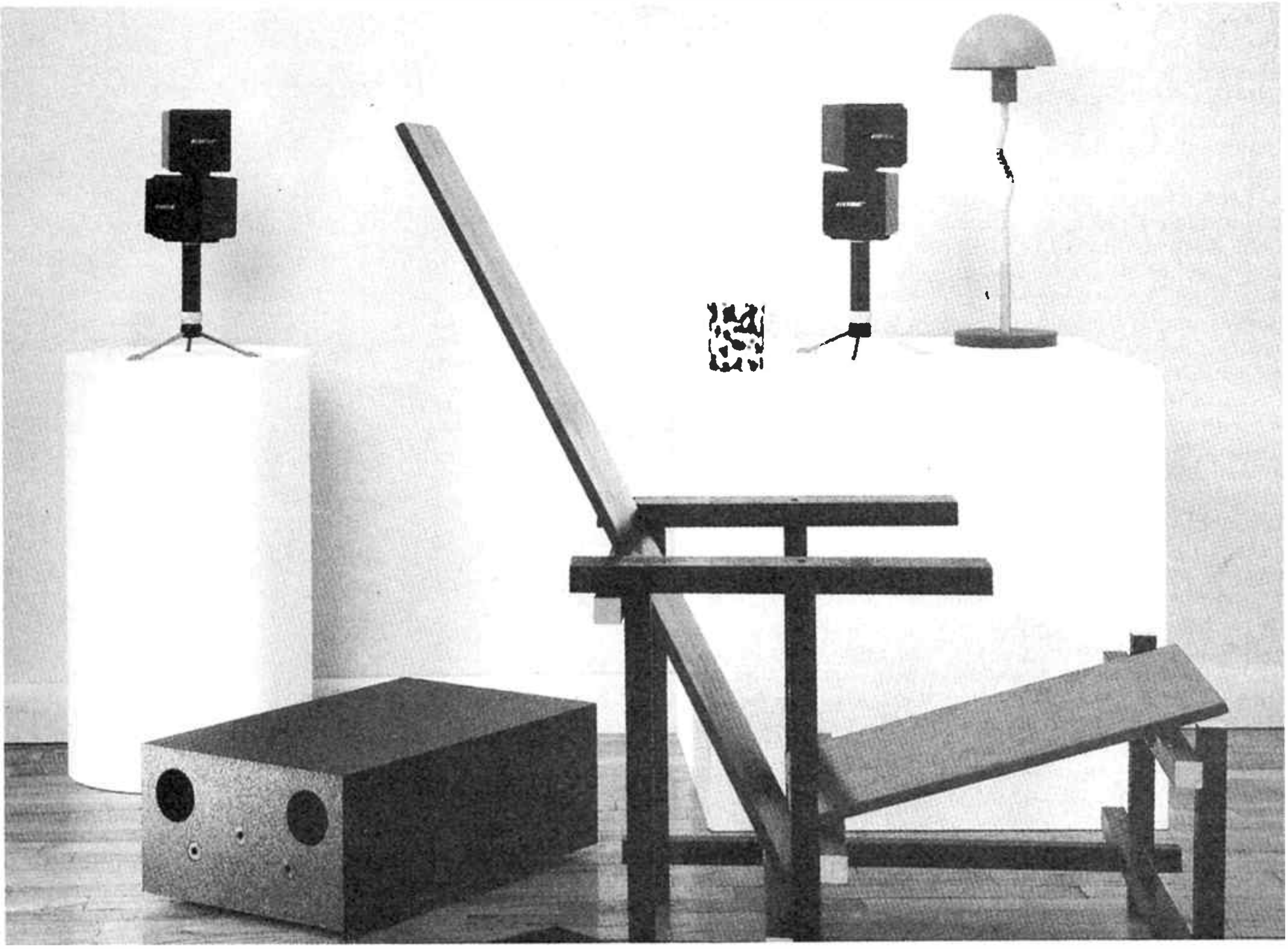
The other feature of Bose design, more commonly used in their professional sound equipment, is recognition that electronics has an integral part to play in the performance of loudspeakers. For many years, the fact that Bose used active equalisation in some of their professional loudspeaker products was seen by many of its competitors as a basis for criticism. Active equalisation simply means a very sophisticated tone control which compensates for the physical limitations of cone loudspeakers, for the varying sensitivity with level of human hearing, as well as protecting the loudspeaker system against excessive input level.

The result of this design principle is that one can produce loudspeakers that sound good, can make use of loudspeaker components that offer advantages in the midrange, most sensitive to human hearing whilst compensating for the deficiencies in other areas, and are difficult to blow up. Now that we are a few years down the track, it is interesting how many professional loudspeakers now include some form of electronic control circuitry. Bose are probably just sitting back smiling.

The Model 501X (or "Project X")

The 501X loudspeaker is a remarkably flexible product. The loudspeaker system comprises a separate bass loudspeaker box with a mid-high unit comprising two very small separable loudspeaker enclosures referred to as "cubes".

By small, I mean small! The cubes are just 91 mm wide by 91 mm high by 117 mm deep. Each enclosure contains a 57 mm loudspeaker driver unit. Connection between the two upper frequency units is a standard Bose phone jack, which permits the two components to be rotated, or entirely separated using a patch cable between each component. In a broad arrange-



ment, the 501X could comprise four separate cubes with one separate bass box.

The bass frequency unit in the system comprises a plain black box designed with the intention of being unusually unobtrusive. The bass bin is not front radiating, but instead contains a pair of fully enclosed 165 mm diameter drivers radiating through side mounted circular ports. The crossover frequency to the base unit is stated as 150 Hz, with the result that the box can be placed just about anywhere within a room as sound sources below this are non-direction. It could, for example, be hidden under a bed, on a bookcase, beneath a desk, or any other relatively out of the way place.

The 501X is clearly a new product which presented some difficulties in review, in part since the manual was written entirely in Japanese! Fortunately, there are sufficient diagrams to enable most of the instructions to be understood.

In a sense, the 501X loudspeaker is Bose' concession to the ghetto blaster industry. The loudspeaker is clearly aimed at a market where space is a priority, where the primary medium is likely to be pop music but where the listener is interested in much higher quality sound than the traditional ghetto blaster. In typical fashion, the Bose 501X loudspeaker is designed for high power handling capacity, rated at 65 watts RMS up to 165 watts maximum for the loudspeaker's impedance of four ohms.

The format used for the loudspeaker takes advantage of the fact that human hearing is relatively insensitive at low frequencies. Very little stereo information is conveyed at frequencies below about 250 Hz with the result that the single bass unit will still give quite satisfactory performance in a stereo system. Additionally, we are all fairly insensitive to direction for low frequency sources, particularly when in small rooms.

This arrangement does, however, have its problems. An important one is wires. It is impossible to install the 501X in any likely arrangement without need for trailing wires between each component. The installation uses a pair of cables from the amplifier into the bass unit from which a further pair of cables connect to the cubes. If the cubes are separated then there are further cables again. This will not be a problem to those able to conceal wires or for whom wires are no problem, however there will be many who see this as a disadvantage in the separate component arrangement.

From a loudspeaker test viewpoint, a system with separate components presents other difficulties. In particular, how does one test frequency response? A major problem with separate components in which there is phase coherent information is that phase cancellations occur. For multiple source sound systems, this can be a major problem and in the case of the 501X, I decided to conduct frequency response tests with the cube loudspeakers mounted on the front edge of the bass unit. In this arrangement, the frequency response comparison of the 501X should be possible with most other flat faced loudspeakers, however it is important to note that an infinite ▷

arrangement is possible and in some instances, problem rooms could be well treated using the separate component arrangement.

Figure 1 shows the frequency response under two mounting arrangements for the 501X with a pink noise input.Roll off occurs quite abruptly below the 63 Hz one-third octave band whilst at the high end, frequency response extends clearly to at least 16 kHz.The pronounced dip in the 200 Hz band is an important one since it coincides with the crossover frequency region.

Two curves are shown on Figure 1. The solid curve indicating frequency response with the loudspeaker mounted at floor level, the dotted curve showing the same frequency response but elevated approximately 600 mm above floor line. Ground contact gives the expected boost in low frequency output from the speaker system but shows corresponding loss in high frequency response as a result of moving off axis. The large boost in the 12.5 kHz band is evident in both traces. In subjective testing, both the 12 kHz boost and the 200 Hz deficiency are both strongly evident and adversely effect the quality of the loudspeaker performance. Figure 2 shows frequency response for the cube units alone.

Figure 3 shows the results of distortion testing at power levels of 1 W and 10 W. These test results are quite reasonable, although higher distortion levels around the crossover frequency are evident, particularly at lower output level as is a lift in overall distortion levels around 6-10 kHz. Both of these frequency zones are sensitive to colouration affects.

Intermodulation distortion test results are shown on Figure 4 for the 11 + 12 kHz test frequencies with an amplitude difference of a little over 6 dB. The sum frequency distortion at 23 kHz is the highest anomaly shown on the trace and at 57 dB below the fundamental is really quite a good result.

For those interested in square wave testing of loudspeakers, the results of Figure 5 and Figure 5A are an amusing and perhaps expected result for a square wave test at 100 Hz. The 501X doesn't reproduce a 100 Hz square wave well, nor would I really have expected it to.

Perhaps more important is the 4 kHz tone burst test results of Figure 6.This trace shows the decay transients on cessation of a 4 kH tone burst and, whilst the time duration is very short, there is considerable ringing on the loudspeaker.

Figure 7 shows a similar test but with a result that requires more explanation. The test signal is a 1 kHz tone burst overlaid on a 1 kHz carrier at 20 dB less amplitude. The coherence of the waveform at the termination of the larger amplitude is not good and considerable distortion of the wave form occurs at that time. Overlaid on the trace is a 100 Hz tone which we can only assume is a harmonic product of a 50 Hz hum in the system during the test. The 100 Hz tone was certainly not part of the source material but is very unlikely to be a loudspeaker anomaly apart, perhaps, from cable problems.

Impulse testing for the 501X is shown on Figure 8. Overall, this result is less than spectacular, with many time and frequency anomalies extending well across the time record. Low frequency lag is strong and there is considerable interference in the mid frequency region where sensitivity to tonal quality is critical.

Graphical test results apart, the remaining measurement of interest with the 501X is overall sensitivity for which we measured a result of 83 dB at 2.83 volt input at one metre. Into 4 ohms, this of course, equates to a 2 watt input value although we have chosen the 2.83 volt input level for consistency with most recent testing practices. At 65 watt r.m.s. input into the rated load of 4 ohms, the RMS sound pressure level limit for the loudspeaker is 98 dB at 1 metre. To listen to the 501X loudspeaker at this level in most domestic rooms would need

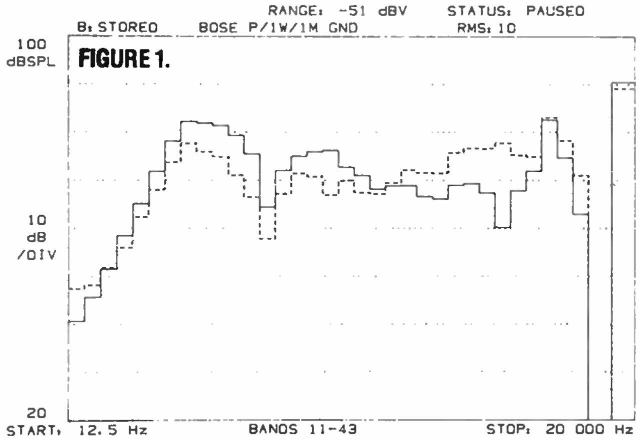


FIGURE 1.

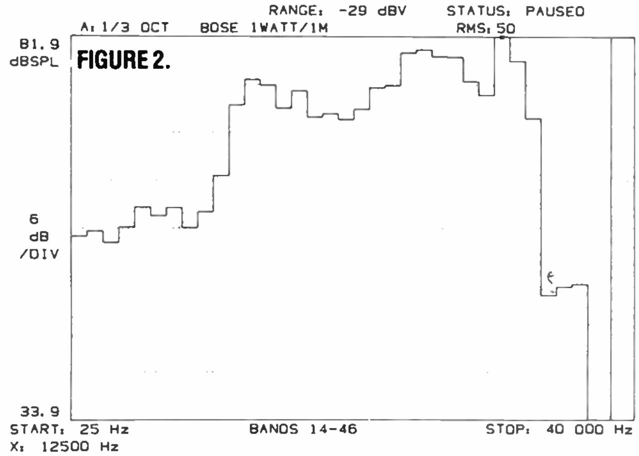


FIGURE 2.

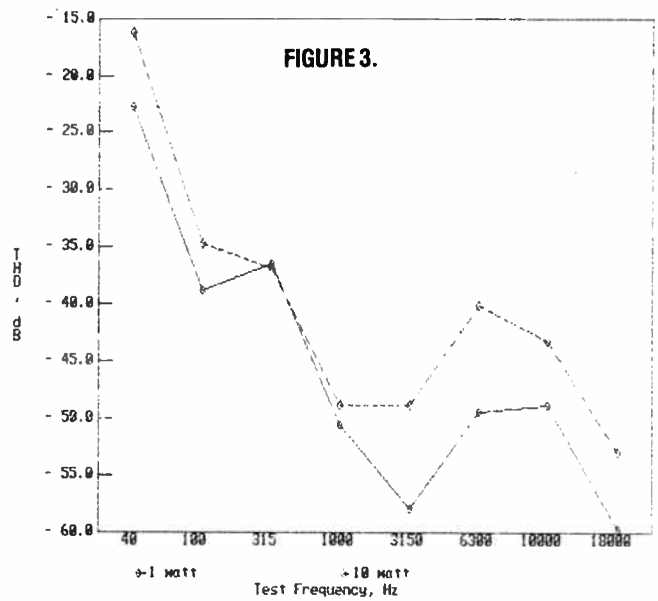


FIGURE 3.

a very strong pair of ear muffs!

Subjective testing

For my own part, I did not particularly like the sound of the 501X system. In broad terms, the loudspeaker is strident due to an obvious peak in output around 12 kHz, suffers from a "hole in the middle" sound due to the dip at the crossover region, but does have a lot to offer in terms of power handling

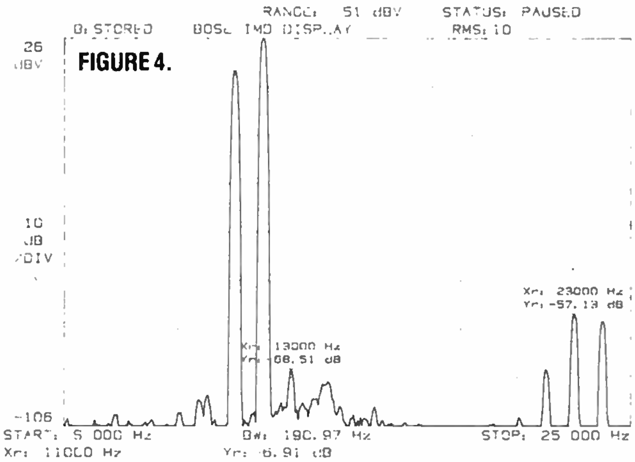


FIGURE 4.

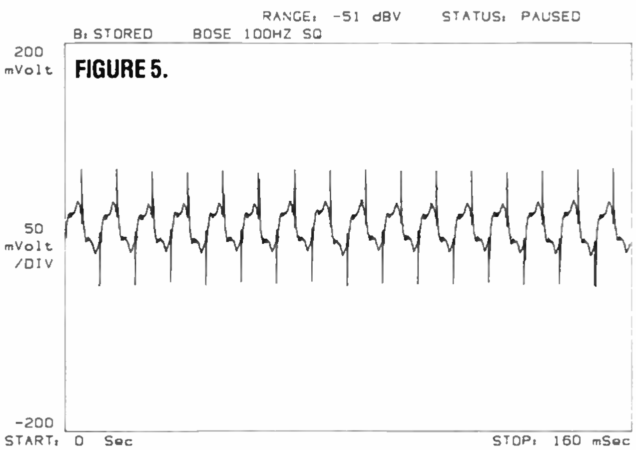


FIGURE 5.

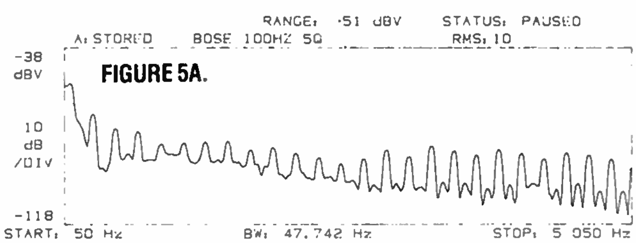


FIGURE 5A.

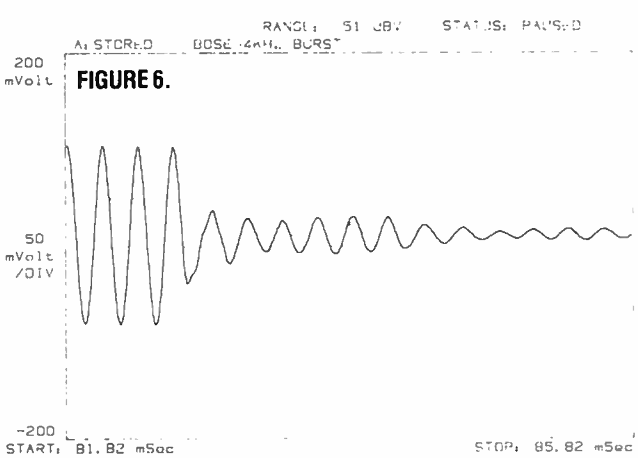


FIGURE 6.

capacity, overall tightness for rock music and an ability to create an interesting and wide sound field. For those who primarily listen to classical music, the 501X is clearly not the loudspeaker. This, however, is unlikely to be a real problem to Bose since the serious classical music listener would proba-

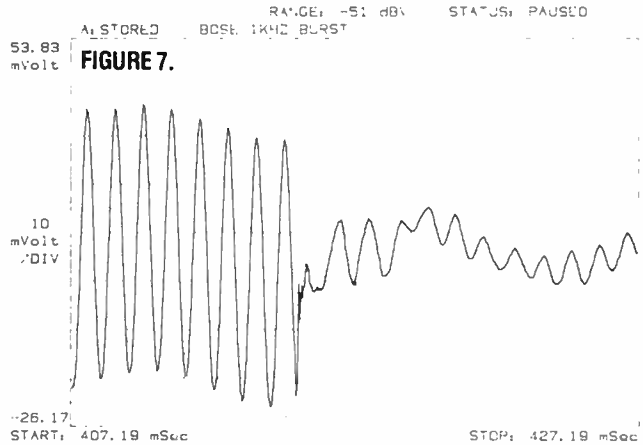


FIGURE 7.

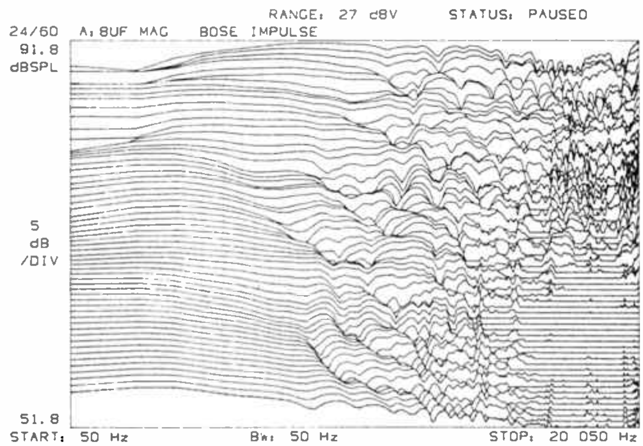


FIGURE 8.

bly not be looking at a loudspeaker arrangement like that of the 501s.

With the bass unit hidden away under a coffee table, the impact of the 501X on any of your dinner party guests would be little short of stunning – the sound level and ambience obtained by the system, for such tiny boxes, is quite remarkable. The system needs to be driven reasonably hard to get the full performance of the bass unit, although with a little more tweaking, it is possible that a better crossover would lead to a better subjective impression of system bass response.

Directional properties of the 501X are excellent due to being such small midrange units and a very good coverage of relatively small rooms can be achieved with the cubes mounted on a bookcase. The cubes can be rotated so the benefits of direct/reflecting sound systems can be experimented with and for readers who may want to have a tiny pop music system, but one which they can get a lot more pleasure and experimentation from, the 501X is well worth looking at. If you're a strictly classical fan, this isn't the system for you. For background music during dinner parties or for daytime radio, with the excellent room coverage achieved with the small cubes, this system could be excellent.

TABLE 1: BOSE 501X TEST RESULTS SUMMARY

Sensitivity	83 dB/2.83 volt/1 metre
Frequency Response	50 Hz – 17 kHz
Cross-over Frequency	150 Hz
Rated Power (not tested)	65 watt
Maximum SPL	98 dB at 1 metre

The Last Laugh

A LEARNED, and much travelled, colleague swears the following story is true. As an academic of impeccable standing in his field, we have no reason to doubt him. And it is in that spirit that we pass on his story.

In recent years, museums of all categories have shucked-off their mantle of stuffy academia, exchanging their once dull, but nonetheless awesome, image for a much more proletarian (or is that egalitarian?) one. Instead of the once static, sterile, glass-cased displays, now we are engulfed in an almost overstimulating experience of "touch,hear, see and do". Exhibits now involve the audience. Or, in the jargon, they've become interactive!

All that's a fine and laudable thing. And the gate takings have increased a dozen-fold or more, reducing such institutions' dependence on the ever-withering public purse.

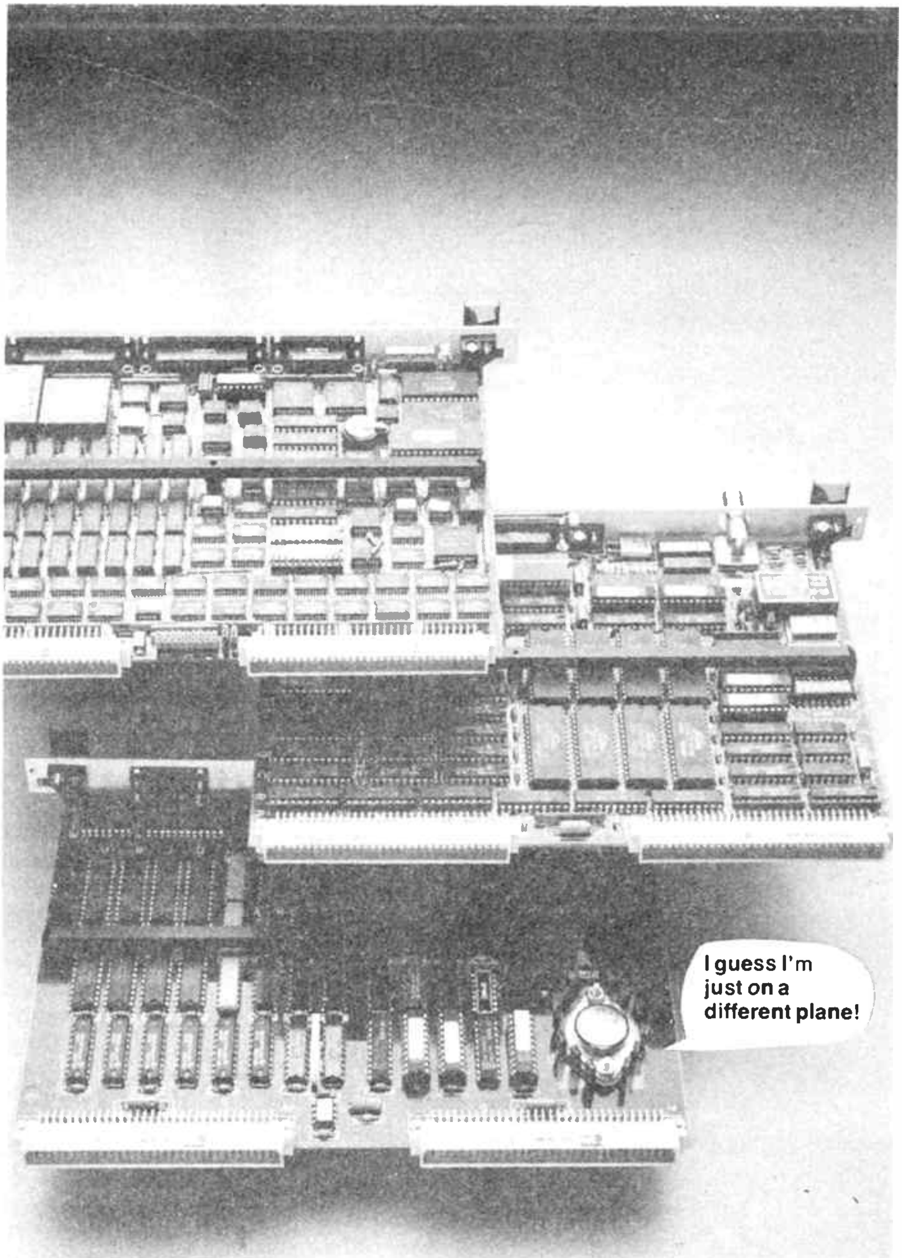
However, when you mix interactive exhibits and (hyper)active children, unexpected results are to be expected.

At an un-named, prominent technological institution in a certain English-speaking country overseas, one of the exhibits concerned an "AI" – artificial intelligence – machine. At least, it was a machine (of the digital persuasion) which demonstrated some salient features of AI in a relatively simple way, understandable to Mr/Ms J. Q. Public. Interaction with the machine was by means of everyday speech – in English.

You could speak to the machine using a microphone and it would display on-screen your words (but without punctuation). By pressing a button, it would then read back what you had said, but insert pauses and inflexions of its own. You could ask a number of simple questions and get a (seemingly) cogent reply. You could engage the machine in common small talk; "Hello, how are you?", "What's your name?", "The weather's good, isn't it?" etc, and it would reply in the manner expected during such every-day inanities. In other words, it wasn't just a simple "electronic tape recorder" without the tape or moving parts. And it didn't do a bad job, either. Enough to baffle or amuse all but the hardest of cynics.

But. And that is a big BUT. Some people, being of permanently devilishly intent – and one must include a large body of children in this category, were sure to attempt entering a substantial lexicon of, er – what are euphemistically called "unsavoury" words.

So, to counteract this propensity of



certain portions of J. Q. Public, an input buffer was created in which all incoming verbiage was checked against an internal lexicon of words and phrases – including a cunning facility that checked the leading letter of each word and each line for unsavoury acronyms. Safe enough, you'd reckon. There was no keyboard, so no unscrupulous hackers could create havoc.

The exhibit was popular with visitors, and the institution's governors. All was well with the world.

Until the day something went awry. The senior girls from nearby St Scholasticas convent school were on an excursion with the school's deputy head, whom we'll call Sister Emily for the sake of this tale. All crowded around the AI machine as Sister Emily sketched the details of the technology before demonstrating its capabilities.

Picking up the microphone, she enunciated in clear tones, "Good morning!". After a slight, undoubtedly pregnant, pause – the machine's screen began to fill with the contents of the lexicon and it's speech output to utter a torrent of foul abuse – all without a single repetition of word or phrase!

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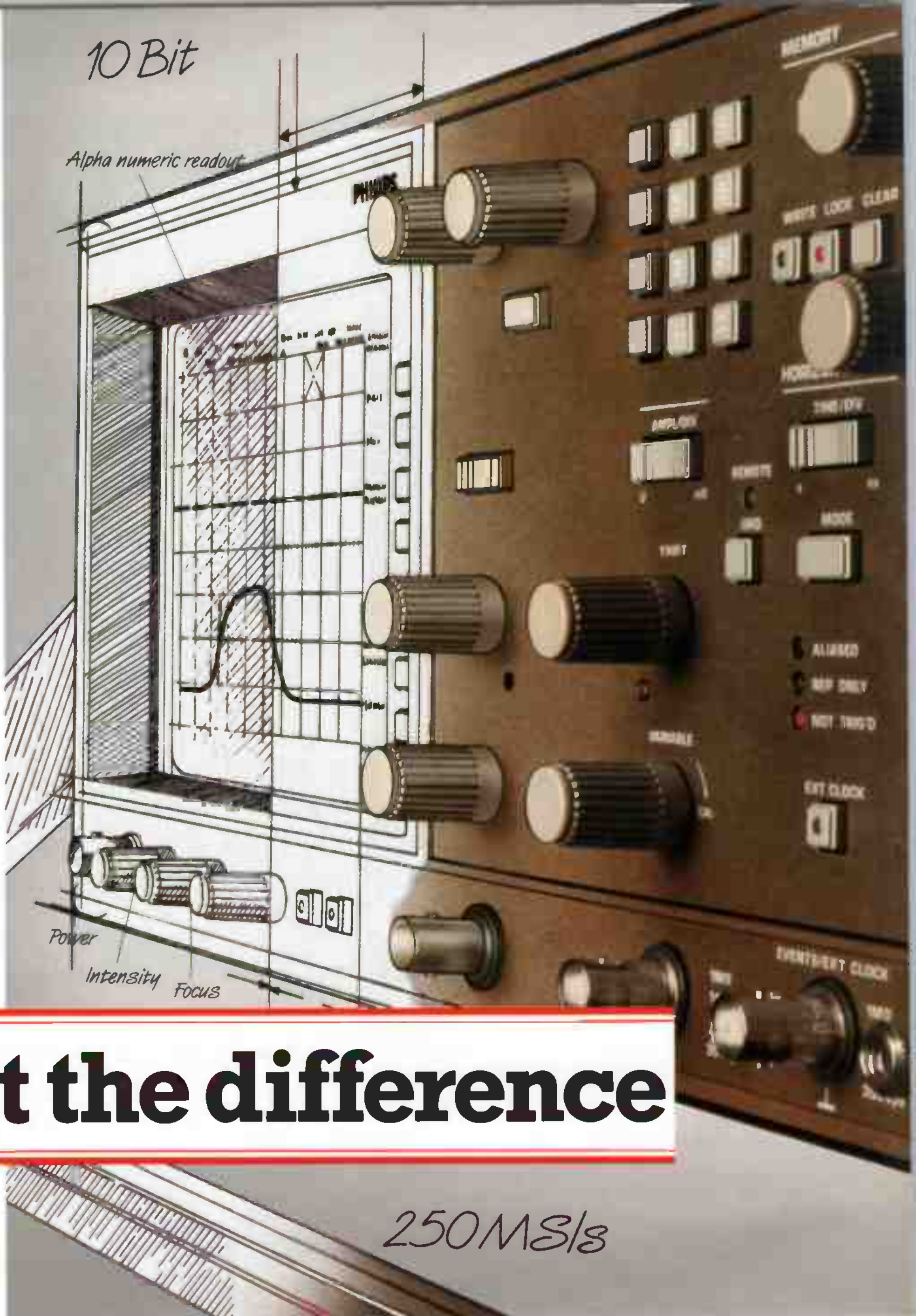

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