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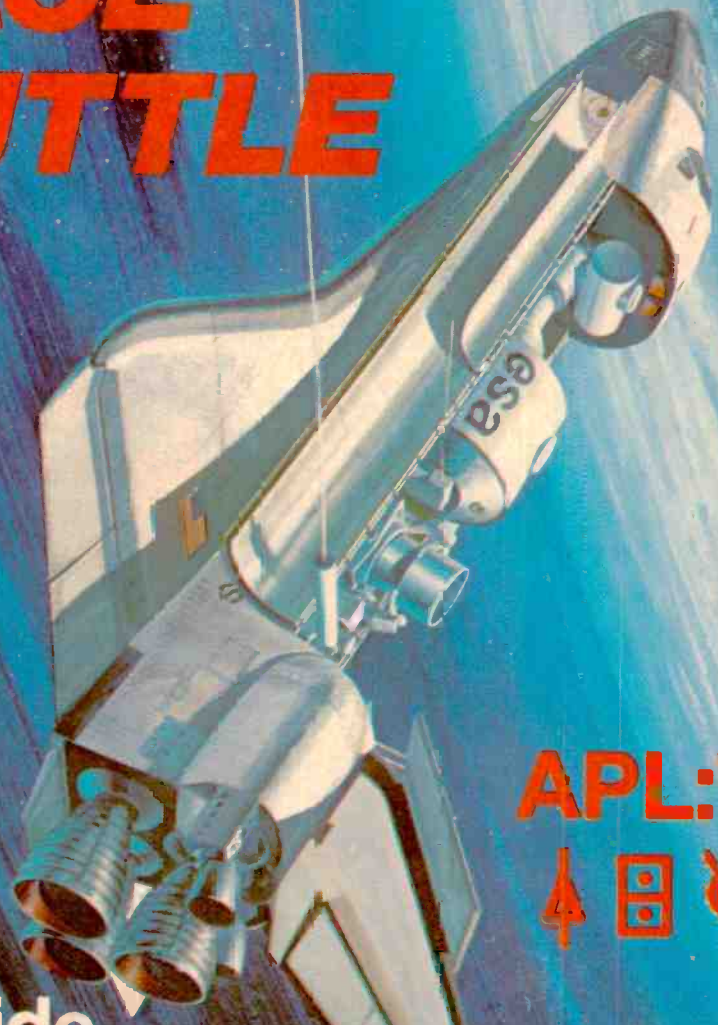
MARCH 1979

Cartoons Page 70

What's Up With The SPACE SHUTTLE



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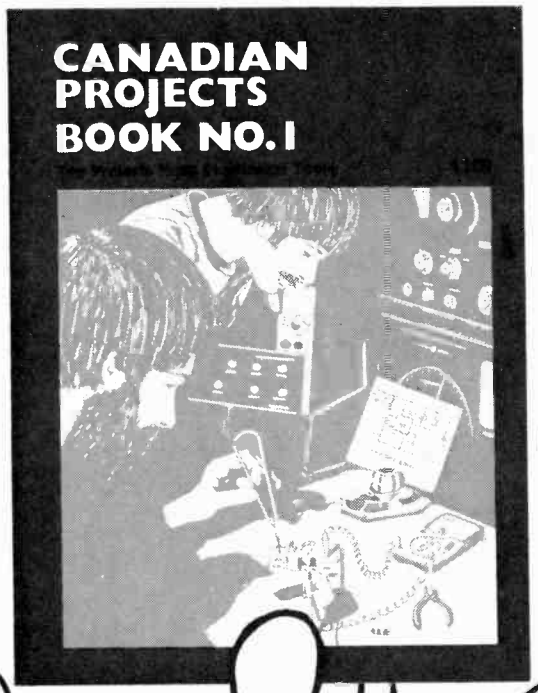

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There's got to be something in this book for all ETI readers. Canadian Projects Book Number One gives you twenty-five projects from issues of ETI sold in Canada. All the projects have been reworked since they were first published to update them with any information we might have received about availability of components, improvements, etc.

To order Canadian Projects Book Number One send $3.00 per copy + 45¢ for postage and handling to: Canadian Projects Book, ETI Magazine, Unit Six, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1.

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Vol. 3. No. 3.
MARCH 1979

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PROJECTS

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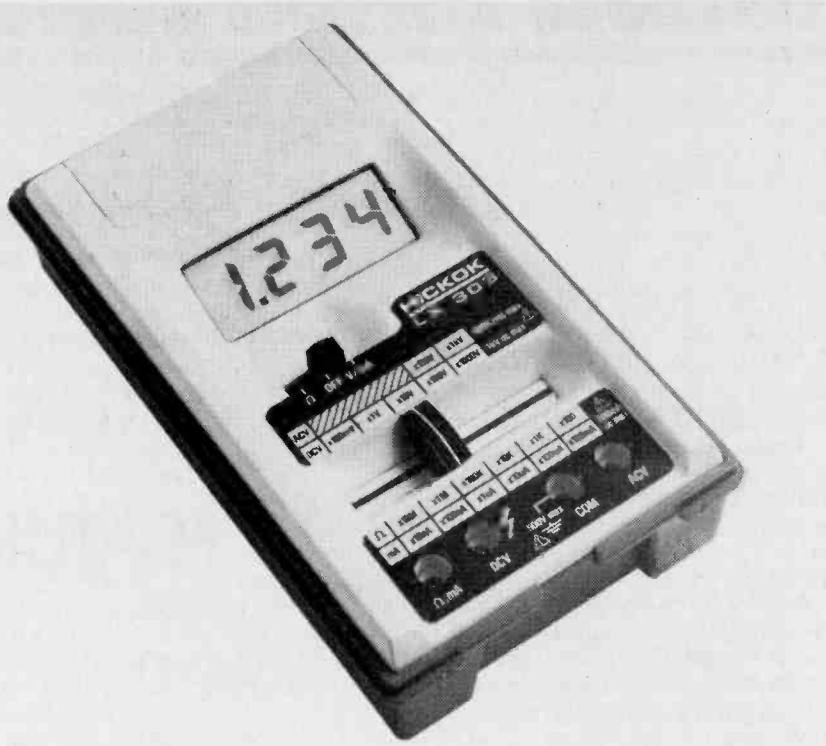
NEWS & COLUMNS

INFO & MISCELLANEOUS

NEWS DIGEST



Cheap DVOM

A new 31/2 digit pocket-sized digital multimeter has been introduced by The Hickok Electrical Instrument Company. The instrument, designated LX 303, features auto-polarity, auto-zero and automatic over-range indication. The rugged, compact unit fits easily in the palm of the hand, and uses a half-inch LCD readout. The reading rate is 3 reading per second. Battery life is 200 hours minimum (300 hours typical) from 9V alkaline battery. Handy battery check capability is also provided.

Ruggedness is achieved in the LX 303 by combination of light weight (12 oz. including battery), a high-impact thermo-plastic case, a glass-epoxy pc board, and a snap-on cover which protects the front panel (during storage or transit). The snap-on cover can also be used to store the test lead set. All input jacks are recessed for operator safety.

Reliability is assured by the use of LSI circuitry and laser trimmed thin film resistor networks for low parts count. the excellent overload characteristics provide 1000 volt protection on all DC voltage ranges except the 200mV range which is protected to 500V. All AC ranges are protected by 600V. All ohms ranges are protected to 120V. Maintainability is also excellent due to the use of sockets for the major components including the display and the extensive use of standard components. The unit is covered by a 1 year warranty.

The LX 303 measures DC volts from 0.1mV to 1000V with accuracy of+/-0.5 of reading +/-0.5 f.s.; resistance from 0.1 ohm to 20 megohms with accuracy of +/-0.5% of reading +/-0.5 f.s. and DC current from 0.01nA to 200mA with accuracy of+/-1% of reading +/-0.5% f.s. Operating temperature is 0 to 50 C. Size is 5-7/8" x 3-3/8" x 1-3/4" (147mm x 85mm x43mm) and weight is 12 oz. (330 gm).

A full complement of accessories is also available including an AC adapter (115VAC and 220VAC versions) a padded vinyl carrying case, a 10 A DC current shunt, an X10 DCV probe adaptor that protects the input to 10kV; and a X100, 40kV DC probe.

$99.95 from H. Rogers, Box 310, 595 Mackenzie Ave., Units 1 & 2, Ajax, Ont., L1S 3C5.

TI Bubble

TI's 92Kbit TIB0203 magnetic bubble memory is available now on 4 to 6 weeks delivery at a US price of $100 in 100 quantities.

Linear Opto-Coupler

Motorola has introduced the industry's first optically-isolated ac linear opto coupler, the MOC5010.

The new linear coupler uses a gallium arsenide infrared emitting diode, optically-coupled to a bipolar monolithic amplifier. It converts an input current variation to an output voltage variation while providing a high degree of electrical isolation between input and output. Its use replaces a normal coupler, plus an operational amplifier and a discrete transistor from circuitry where isolated linear output is desired.

The device can be biased to maintain a linear output of up to 4 volts peak-to-peak with a 12 volt supply voltage. The MOC5010 offers 250 kHz (typ) bandwidth, 200 mV per mA gain, and low-impedance, emitter-follower output of less than 200 ohms.

Applications include telephone couplers, peripheral equipment isolation, medical electronics and audio uses. Available in the 6-pin, DIP plastic package, the MOC5010 linear opto coupler is priced in the states at $3.25 each in 100-up quantities. Delivery is from factory stock and authorized Motorola distributors.

Atari Computer

The Atari 800 is a personal computer with built-in modulator for TV display, standard keyboard, cassette or disk memory, and 'memory cartridges' offering BASIC and other languages. A printer (40 column) and other peripherals are under development. Start hinting now in time for next Christmas – the product is likely to appear in the shops in August or September. Price in the US will be around $1000.

Atari will also launch their '400' computer around the same time – this model will sell for about half the price of the 800 and is designed as a transitional machine to wean consumers from video games to personal computers.

NS Tape Recorder IC

The LM1818 is a single-chip tape recorder (electronics only!) with built-in record/playback switching. Just add the mechanics, playback amplifier (there's a preamp on the IC) and simple switches, sockets & battery.

Projection TVs

Sony of Canada's Industrial Division has two new projection TVs. These 50" (KP-5000) and 72" (KP-7200) models incorporate three 8" 'High-bright' picture tubes for the red, green and blue color beams. Two large aperture 170mm lenses project the picture onto a concave screen.

Among the many standard features incorporated in this system are built-in VHF/UHF TV tuners with electronic channel selectors, built-in stereo speakers and a remote control unit for power, channel selection and audio volume.

Sony Of Canada, Ltd., 88 Horner Ave., Toronto, Ont. M8Z 4X8.

Cesco Book Catalogue

The Cesco Book Catalogue has just been published. Cesco believe that this is the first catalogue of its kind put out by an electronics distributor and devoted to electronics books. It is available free to anyone who wants it.

The 32-page catalogue contains 11 pages of info on French-language books, plus large listings of Sams and Tab publications.

Cesco Electronics Ltd., 4050 Jean Talon St. W., Montreal, H4P 1W1.

Kepco Power Supply Catalogue

A free 144-page catalogue describes Kepco power supplies describes that use switching techniques ferroresonance, linear feedback.

The range includes programmable types, in both unipolar and bipolar designs with new automatic test equipment featured. Also featured are new IEEE-488 GP-IB interfaces for the programmable power supplies.

The catalogue contains 32 pages of helpful application hints and design tutorial. Receive your free copy of the 1979 Kepco Power Supply Catalogue by writing: Radionics Ltd., 195 Graveline St., Montreal, Quebec, H4T 1R6.

Philips Videodisk?

Rumour has it that the videodisk machine that was meant to be on the market in 1976 is due to hit the shops about now. The 60 minutes a side machine from Philips/Magnavox will cost something like $700 in the states.

Bell Tries Fibre Optics

On December 12th last year field trial of an integrated fibre optic system designed by Bell Northern Research and furnished by Northern Telecom demonstrated the capability of simultaneous transmission of telephony, data and video.

The trial is taking place in the Yorkville area of Toronto and will continue for two years. The experimental fibre optic customer-loop system consists of 1.2 kilometers of graded-index fibre optic feeder, and up to 200 meters of graded-index fibre optic buried-entrance service cable to each of 35 subscriber participants and to a Bell Canada test site.

The trial is unique in that it uses fibre optics in the loop-plant with actual subscribers' telephones, and in the use of bi-directional optical fibre transmission.

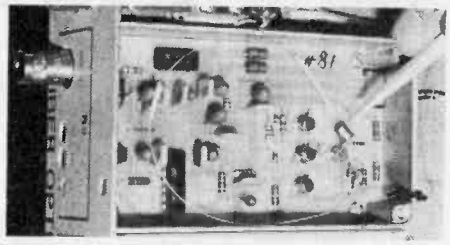
Bell are optimistic about the future of fibre optics. they suggest they will be implemented ecomically first in the inter-office environment. By the 1980 to 1982 period, the technological developments and the system economics will justify wide scale exploitation of fibre cables in transmission systems of metropolitan areas.

But it is in the introduction of fibre optics in the loop system that the most dramatic effects can be expected. A fibre optic telecommunication network could integrate telephone, television distribution, data and new broadband services in one medium for the mutual benefit of the public and service entrepreneurs such as CATV operators.

For the Yorkville Trial, Bell Canada is primarily concerned with interaction of the new techniques: the fibre optic cable, splicing closures, electro-optics and the handling of the entire system in the outside plant environment.

The optical system is largely off-the-shelf, using LEDS rather than laser sources. The optical components operate at 840 nanometers wavelength, which may not be optimum for loop-plant; but sources and detectors for longer wavelength transmission were not readily available and must await later trials for evaluation.

At the customer premises, specially designed subscriber terminals contain the optical multiplex, optical transmitter and receiver, alarm systems, analog carrier and a video converter amplifier.



Where the fibre meets the electronics at the Bell test centre.

In the operation of telephone services over the fibre optic system, the analog carrier converts the voice signal to a 76 kHz amplitude modulated carrier for transmission over fibre optics to the subscriber's terminal. Ringing appears as a 20 Hz modulation of the 76 kHz carrier. The carrier received from the distant end (subscriber) is 32 kHz amplitude modulated. Subscriber offhook condition is identified by the C.O. by the presence of 32 kHz carrier. This condition causes the analog carrier to seize the C.O. line circuit and return dial tone to the subscriber. Rotary dial pulses interrupt the 32 kHz carrier from the subscriber causing the C.O. line circuit to be pulsed at the same rate. Alternatively, in-band push-button signalling can be used.

Each individual loop facility is designed to carry one telephone channel together with the capability of a centrally switched, one-way video channel from the central office to the subscriber — and the associated low-speed data signalling channel from the subscriber to the central office for video channel selection. The latter capability will enable cable-TV or other vidio services to be added to the system at a later date if this becomes desirable. Four subscriber loops will use bi-directional transmission on a single fibre to evaluate this mode of operation, while the remaining subscriber loops will be unidirectional transmission using two fibres.

Three test lines will be used in the first phase of the trial to test and demonstrate a variety of services such as:

- Basic individual telephone service
- Conference-TV service
- Remote video surveillance
- Simulated CATV service
- Video retrieval service
- Library video retrieval service
- Video display and teleprinter data terminal on dataphone service.

Future phases of the trial will introduce a number of potential new service offerings at the test site, including videotex and similar interactive graphics systems.

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NEWS DIGEST

Engineers Wanted

The recent Technical Service Council's quarterly study of job vacancies for professionals reported increased openings for scientists and engineers, reflecting vacancies in manufacturing, mining, construction and consulting (but not governments and institutions).

Vacancies for experienced computer programmers and systems analysts reached 202, the largest number ever reported for a single occupational group. Most openings are for experience people with three to five years' experience. Opportunities for managers of data processing departments are limited.

Experienced sales engineers are usually in short supply, even when the economy is slack. The demand for such people has recently intensified, with 171 openings reported. Employers unable to interest professional engineers in sales have been hiring technologists.

Job opportunities for the 1979 university graduating classes seem best for engineers, commerce and business administration graduates. The classes in arts and general science are so large that many graduates are likely to take positions at levels which are below their expectations. Starting salaries for 1979 graduates vary with both discipline and location, but are likely to be in the range of $13,700 for arts graduates to $16,700 for engineers. Graduates whose courses are in little demand are likely to receive lower salaries if they do not secure a position by May.

The Technical Service Council is a non-profit personnel consulting service and placement firm run by industry. It was set up in 1927 to combat the brain drain to the United States. As a practical means of doing so, it operates a coast-to-coast placement service for accountants, engineers, scientists, personnel managers, data-processing staff, executives, technologists and others. The service is financed by industry and no charge is made to individuals. The TSC has offices in Montreal, Toronto, Winnipeg Calgary, Edmonton and Vancouver.

Audio Cartridge Heads

Record/playback heads developed by a British company are claimed to raise the performance of broadcast cartridge machines up to and above that of reel-to-reel machines. After small modifications to equipment, they have resolved frequencies in the range 40Hz to 15kHz at +/-1dB, against between +3.5dB and -2.5dB from other heads and between +/-2.5dB from reel-to-reel machines.

The two and three channel heads (the extra channel in each case is for control) were designed to meet the requirements of the United States National Association of Broadcasters. Mechanically they are comparable with other heads.

The standard range of fully plug-compatible heads have special profiling and lamination-core to shield-can material matching that extends life considerably beyond normal head life.

Magnetic Components Ltd., Penryn, Cornwall, TR10 8AR, UK. Tel: Penryn (0326) 72267 Telex: 45377

New ARRL Handbook

The 1979 ARRL Handbook is now out and selling at a Canadian price of $10.75. New in this edition is a section on narrow-band voice modulation, plus some rewrittten theory sections, and some new data. The section on semi-conductors is twice as big as previous ones. Add to this a stack of constructional projects, and everything else a ham could ever wish for and you have 544 pages of clean fun. Available from ARRL dealers or The American Radio Relay League, 225 Main, Newington, CT 06111, USA.

PLL Bugbook

BRS-7, the Phase-Locked Loop Reference Book with Experiments is an introduction to the implementation of Phase-locked loop integrated circuits. E & L Instruments has added this 6 x 9 inch soft cover text to the Bugbook Reference Series. It is written by Howard M. Berlin and edited by C. Titus, D. Larsen, P. Rony and J. Titus. The 270 pages cover the non-mathematical principles of the phase-locked loop, with a wide range of experiments.

The book is available from the States, priced at U.S. $8.95, E &L Instruments, Inc., 61 First St., Derby, CT 06418, U.S.A.

microfile

Intel BASIC-80

BASIC-80, a high level language and interpreter, has been announced Intel's Microcomputer Systems Division. BASIC-80 adds to the utility of Intel's Intellec Microcomputer Development Systems by providing a convenient, inexpensive facility for applications programming and problem solving, as well as an aid for microprocessor systems development.

Standard ANS 78 BASIC features provided by BASIC-80 include: string and numeric constants, variables and arrays; FOR...TO...STEP...NEXT... statements for loop execution; IF ... THEN statements for conditional execution; ON...GOTO statements for calculated branching; and GOSUB/RETURN for subroutine calls and returns. Standard ANS 78 BASIC also allows the user to define single statement functions. Its built-in scientific functions include: ABS, EXP, INT, LOG, RND, SGN, SQR, ATN, TAN, COS, and SIN.

The BASIC-80 extensions provide access to the Intellec system disk files for full sequential and random disk file input/output. They include support for the Intel single and double precision floating point standards and provide for integer and string data types with extensive string manipulation capabilities. Language extensions include direct read and write of the CPU input/output ports, direct memory read and write through PEEK and POKE functions, a formatted print statement with the PRINT USING function, and IF ... THEN statements extended with an ELSE clause.

Other BASIC-80 extensions include Boolean Operators and operation with matrices with up to 110 dimensions. To assist in debugging, Intel BASIC-80 also includes user directed error trapping and handling functions plus a program execution trace command.

BASIC-80 can be added to any of Intel's Intellec Series II or MDS-800 series microcomputer development systems with 48K bytes of RAM and at least one disk drive. It is available immediatily on single or double density diskettes; order product code MDS-320. The U.S. price is $750 for the diskettes and accompanying manuals.

NEWS DIGEST

Exorterm

Motorola Microsystems has introduced its new Exorterm 220 display terminal and console. This is a development support system for the M6800 family of microprocessors, including the MC6800, MC68A00 and MC68B00.

A basic Exorterm 220 incorporates a CRT II Module, Debug II module two 16K RAM Modules, the Resident Relocatable Macro Assembler/Linking Loader and the CRT Editor.

In addition to use as a development system, the terminal may be used as an asynchronous editing terminal through connection to a host computer (or other external device) via the serial interface (RS-232C or current loop), essentially bypassing the isolated motherboard.

The U.S. price of the Exorterm 220 Bundled System with 32K RAM, CRT Editor, Macro Assembler and Linking Loader, on MDOS Diskette is $8600. Same as above except 32K static RAM costs $9200.

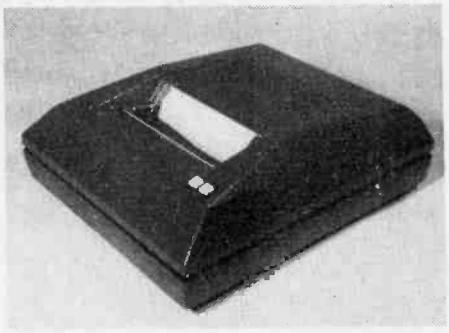
CRT Editor

Motorola Microsystems has announced a new Resident CRT Editor, the M6800 Editorm, which will allow the M6800 Exorciser or Exorterm to create and modify source programs.

The M6800 Editorm is available only on MDOS diskette and requires an Exorciser/Exorterm with 32K RAM capability.

The resident CRT editor is now available for ordering through Motorola OEM sales offices and authorized distributors. Unit U.S. price is $300. For additional information contact Motorola Microsystems, P.O. Box 20912, Phoenix, AZ 85036, or call Microsystems marketing at (602) 962-2223.

Printerm 879



Here's a low-redundancy press announcement on this new printer:

High speed bi-directional printing, 120 cps at 75 lines per minute. 9 x 7 or 9 x 9 high density matrix, with up to 4 copies. 96 character ASCII character set (upper, lower, and triple wide expanded). Operator switch selectable 80 or 132 column format. RS232 and parallel interface.

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Printer Terminals Corporation, P.O. Box 535, Ramona, CA 92065

(note: price is the U.S. price.)

8185 RAM

The 8185 1Kx8 static RAM in an 18-pin package was introduced today by Intel Corporation's Microcomputer Components Division. To permit this large, 8-bit, byte-oriented memory to fit in such a small package, the RAM features address/data multiplexing which is directly compatible with the 8085A microprocessor series.

The use of multiplexing is common for dynamic RAMs but uncommon for statics. Static memories are normally installed in smaller systems where adding multiplexed signals would become a chore. However, the 8085A is designed to provide not just address, but address and data multiplexing. This enables each device in the system to save the eight pins that would be required for independent data lines.

8080/8085 Bugbook

Bugbook VIII, 8080/8085 Software Design with 190 Software Solutions is a detailed treatment of assembly language programming for 8080 and 8085 based computers. E & L Instruments has added this 6 x 9 inch paperback to the Bugbook Series, written by Dr. Christopher A. Titus and edited by D. Larsen, P. Rony, and J. Titus and C. Titus. 288 pages of elementary and advanced instructions are analyzed and discussed.

The book is available from the U.S., priced at $9.00, from E & L Instruments, Inc. 61 First St. Derby, CT06418, U.S.A.

Audio Today

Developments in audio reviewed by Wally Parsons

ONE THING WHICH is often forgotten about noise is the variety of reactions to it. Different people find different kinds of noise more irritating, and the level seems to depend very much on the kind of noise, and the individual's particular sensitivity to a given kind. For my part, I can live with what many people would consider to be remarkably high 60 Hz hum levels, probably as a result of having started in audio with vacuum tubes. However, 120 Hz power supply hum is an entirely different matter, as is the presence of any spikeyness in the hum waveform. Even today I frequently play many of my early 78's unfiltered and somehow the surface noise doesn't bother me, yet many of the Columbia Long plays of the late 50's and early 60's sound intolerable. The generally high noise level experienced on AM radio is no problem, yet let even a little noise creeping in on FM and I start checking antenna lines and signal strength. Many people will tolerate coughing, talking and all kinds of noises at a concert, yet let one little tick appear on a recording and they write nasty letters to manufacturers and journalists complaining about defective pressings.

The methods of eliminating the different kinds of noise are about as varied as the kinds of noise and the variety of reactions to them. Recently we examined noise as it affects dynamic range, and looked at systems for extending the range itself. This month we'll have a go from the opposite direction.

UNCOMPLEMENTARY SYSTEMS

The simplest, and the oldest, system of reducing noise is to roll off system response in the range in which the noise appears. Properly used, this system is more useful than many people believe. The total noise energy increases, per octave, as frequency goes up. Thus, in a system with a bandwidth of 20 kHz, up to half the total noise energy may be in the last octave. Therefore, reducing response above 10 kHz will produce a considerable reduction in noise. "But," you say, "what about the high harmonics?". What harmonics. Even for persons with response high enough to hear the noise, we only lose the last octave. In terms of music, very little harmonic content is up this high, and even fewer programme sources actually contain it. Therefore, we are cutting off something which we rarely ever had anyway. Even FM radio cuts off at 15 kHz anyway, whether there is anything there or not. I'm not suggesting that this last octave is of no importance, but that there is little point in trying to reproduce something which isn't there, or is buried in noise.

BENEFITS

But look at what is gained by this bit of surgery. First, of course, we've cut down the noise level tremendously. In so doing the masking effect of noise has been reduced *for the octaves below cutoff.* Noise not only masks signals within the passband covered by the particular portion of the noise spectrum, under consideration, but also has some masking effect on signals *removed* from that region. The brain perceives the noise signal sent by the ears, compares it with the signals which can be distinguished then tries to ignore everything below a particular level. It is this basis which results in each of us reacting to noise differently, and it is this kind of mechanism which results in each of us hearing a little differently from each other.

FILTER SHAPE

A low pass (or high cut) filter has two characteristics of interest for our present purposes: cut-off frequency, Fo, and slope, or rate or attenuation. For a given nominal cut-off frequency, the sharper the roll-off, the more noise energy is attenuated, and the less programme energy lost. In other words the sharper the cut-off, the wider the bandwidth which can be retained for a given noise reduction. Noisy recordings especially, benefit from this treatment; all too often, the noise is the result of wear, and the very high frequencies, if they were ever there at all, have actually been gouged away, leaving noise and distortion in their place. So you trade off a little bandwidth which is not useable anyway, for a large reduction in distortion.

HOW TO

Most commercial receivers and amplifiers have a switch labeled "High Cut", "Scratch", or something similar. I have not seen many which did anything other than clutter up panel space. Usually they give a slope of 6 dB/Octave, which is pretty hopeless, and could easily be duplicated with the treble control. The best choice is either a 2nd or 3rd order Butterworth filter, which gives a flat response to the cut-off point then attenuate at 12 dB/octave or 18 dB/octave respectively. Active filter versions are shown in Fig. 1 and Fig. 2.

Fig. 1. Inverting second order Butterworth filter configuration.

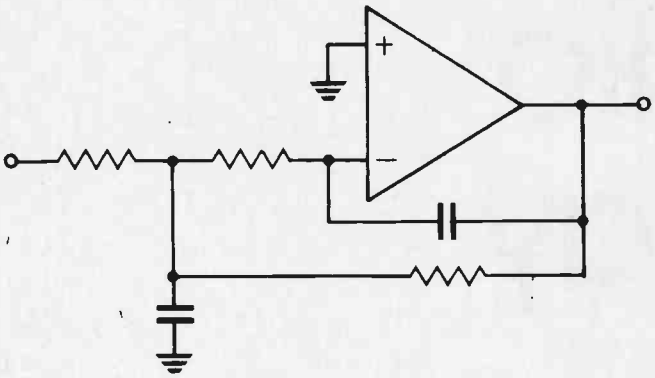
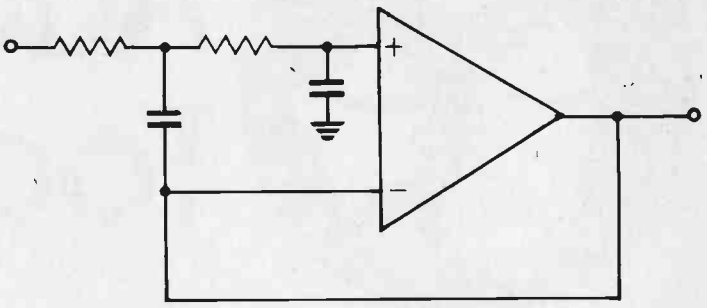


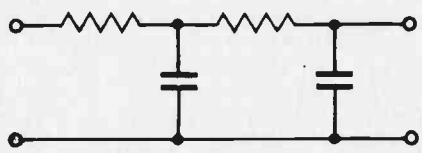
Fig. 2. Non-inverting second order Butterworth filter.



Each is a 2nd order filter, but Fig. 1 is an inverting type which Fig. 2 is non-inverting. Adding an additional RC section to the input produces a 3rd order filter. For design details, see ETI circuits, No. 1, or the National Semiconductor Linear IC handbook.

Fig. 3 is also a 2nd order filter, but this description is really only applicable to the ultimate slope of 12 dB/octave. Although simpler and cheaper to build it suffers from the disadvantage of a less sharp turnover point. If both sections are identical, the design turnover point is actually 6 dB down rather than 3 dB, and so sections should be designed as for a corner frequency 1.4 times the one desired.

Fig. 3. Second order passive filter network.



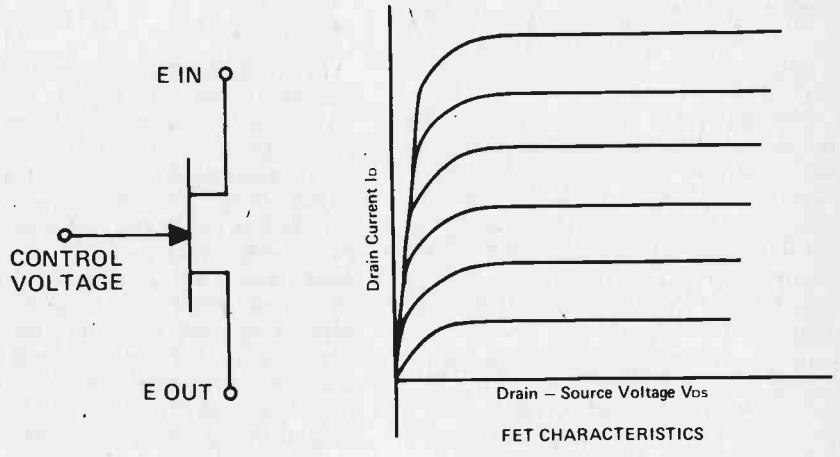
RIGIDITY

Such filters are generally useful for moderate reduction of tape hiss, surface background noise, and the like, where a cut-off of 7 kHz or higher is suitable. However, where noise problems are more acute, such filters would require a cut-off as low as 3 kHz to be effective. When programme level is fairly low and with little high frequency content, no significant signal degradation occurs. But music programme is not constant in its characteristics, and if portions of the programme contain significant high frequency content, there is a severe loss of brightness. Generally, average noise does not increase with signal, so at high levels the signal to noise ratio is actually improved, resulting in the need for less filtering. At high signal levels, the signal may easily mask the noise, so it is quite practical to raise the cut-off frequency. The obvious way to do this is to change either the resistance values or the reactance values or both. Obviously, it's not very practical to twist a knob and vary them manually, if only because dynamic peaks tend to come on too suddenly for the hand to track them. Some other method must be provided such that the signal itself provides the control.

FETS PROVIDE VCRS FOR VCFS

Figure 4 shows a J-FET connected as a variable resistance, along with a set of characteristic curves. When operated at a supply voltage above the knee, the device acts as an amplifier in that a small change in gate voltage causes a large change in source to drain current, but below the knee it operates as a variable resistor. If a FET channel is substituted for any of the resistors in Figs. 1, 2 or 3, the turnover frequency can be varied by varying the gate voltage. If this control voltage is obtained by rectifying the signal, then the signal controls the cut-off point. This is shown in Fig. 5. Figure 6 shows a variable *slope* system which appeared in ETI December 1978 as a noise limiter project. In this circuit, Q1 acts as a buffer, D1 and D2 form a rectifier, and Q2 acts as a signal controlled variable resistor in series with C4. Note that Fig. 5 requires that Q1 must have reverse bias at no signal level, and the bias is *reduced* as signal is increased. This can be accomplished by adjusting the offset of IC1. Fig. 6 is simpler in that under no-signal conditions no bias is produced and Q2 displays minimum resistance. It has the disadvantage of upsetting frequency balance at intermediate levels.

Fig. 4. Characteristics of a JFET.



One disadvantage of all such types lies in the fact that clicks and pops can trigger expansion (and "expansion" is really the principle involved). This is overcome by an RC network at the output of the rectifier, which controls the attack time. If the time constant is too long, though it will not respond to dynamic peaks. Clicks and pops can be removed by splitting the signal into two channels, one of which is a normal feed-through channel and the other, called a side-chain, is identical except that it includes a time delay line. A detector senses the very fast-rising click pulse and operates an electronic switch causing the output to switch to the delay line. The click portion is thus removed, and replaced by a portion of the programme signal a few milliseconds prior to the offending noise. When that click is detected, output is then switched back to the main channel. The use of such a device *prior* to any dynamic noise filtering will allow the filter to be set for a fast attack time.

Readers interested in a really sophisticated device which combines both functions, although the click suppressor operates somewhat differently, are referred to the Feb 1971 issue of the Journal of the Audio Engineering Society, and the description of a "Dynamic Noise Filter" by Richard S. Burwen.

Fascinating.

Fig. 5. JFET used to control filter cut-off point.

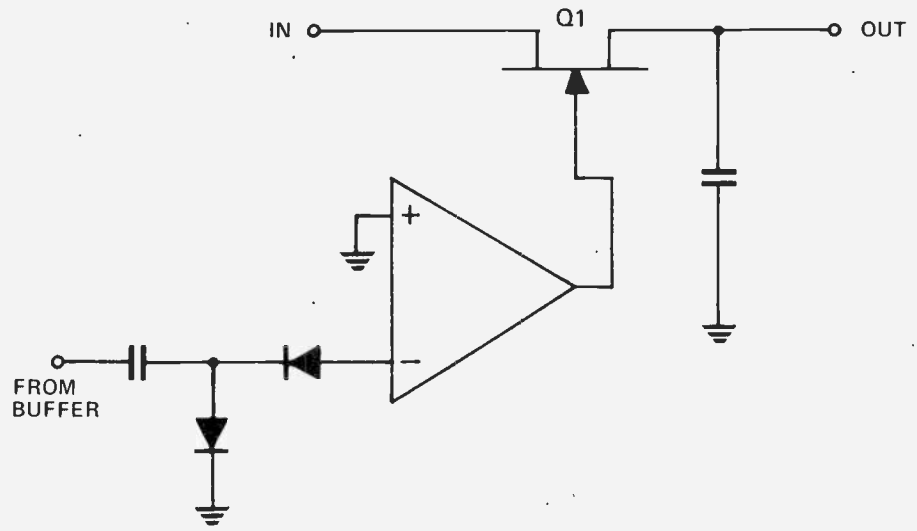
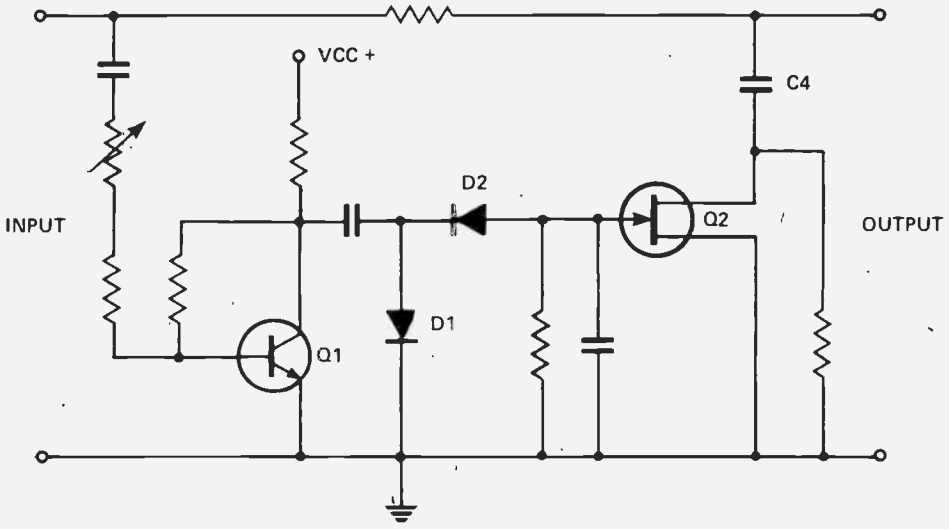


Fig. 6. In this circuit the JFET controls the slope of the filter.



Audio Today Letters

If you want to express your views or report on news write to Audio Today, ETI Magazine, Unit Six, 25 Overlea Blvd, Toronto. Ont. M4H 1B1.

ETI TUNER OFFER

Unfortunately I did not know that you would be offering a tuner identical to one I recently purchased (for a higher price, of course). Anyway, the unit works fine but I have one problem.

The output of the tuner is fairly low and though that doesn't matter with a high powered amp, it does with the 5 Watt amp that I also constructed. Do you have any suggestion for a pre-amp to boost the signal.

P.S. The 5 Watt amp works really well.

P.B., Toronto

I have purchased one of the tuners advertised in your December 1978 issue. It works very well both on AM and FM.

I should like to ask how the FM Beacon light and the mono/stereo switch are connected into the circuit. Any assistance regarding the above mentioned would be greatly appreciated.

For your information the FM portion draws 40 mA DC with a +12VDC supply and the AM section about 10 mA. The unit works well without a regulated supply. I used a Hammond 166D20 in Full Wave, 2 diode mode and a 500 uF capacitor.

Thank you for your assistance in above.

L.M., Guelph, Ont.

Do you also drive without seat-belts in Guelph? No specifications are supplied with this unit as to supply requirements, and as the parts are made in Japan for this Canadian tuner these characteristics are not immediately apparent. Although it works well without a regulated supply, a little study will show that the decoder IC

Interested in LEDs? See page 69.

is similar to type uA732. This device has a maximum rating of 15 V. Your supply is capable of delivering a peak output under zero, or very light load conditions, of 14 V with a line voltage of 117 V. This allows very little leeway for high line voltages. And if you switch B plus when going from AM to FM you will be applying very close to open circuit voltage to the FM section. Probably component tolerances will be adequate, but for a few dollars more, why not do the job right. I'm running a unit on a 12 V regulated bench supply. Operation is stable, with no drift in characteristics. Total current draw is 45 mA, 10% lower than your figure. Moreover, a regulated supply increases immunity to line borne noise and allows alignment to be tweaked for maximum sensitivity, signal-to-noise ratio, and minimum distortion.

The power supply I plan on using will be built around a Hammond type 226F and a 78L12 monolithic regulator. It will include a buffer amp similar to either Fig. 1 or Fig. 2 (this hasn't been finalized). Fig. 1 provides 20 dB gain with high slow rate and low output impedance with short circuit protection, while Fig. 2 will provide about 14 dB gain and is suitable where AM and FM functions are selected by switching B plus. This latter arrangement allows one meter to be used for signal strength measurement for both AM and FM without ambiguous readings (the metering signal from each section is passively mixed on the board).

While on the subject of metering, the meter supplied should be installed with about 50 k resistance in series if it is used for signal metering. If you wish to use one meter for AM and FM, it can be switched to terminal P20 for AM metering, where it will measure AGC voltage. It will also deflect in the opposite direction from FM thus automatically indicating which mode is in use. This is especially practical if you switch B plus.

A multi-turn dial assembly makes a great tuning dial. A digital meter would also be nice, but I haven't yet figured a way to connect one. Finding a circuit point is no problem but finding a suitable point which is also accessible is. Anyone with ideas in this area is urged to write.

The FM Beacon should be connected between the indicated terminal and B plus, with a series resistor suitable to limit current draw to 100 mA or less. An LED would be appropriate. The stereo/mono switch should connect terminal 1 to ground for mono operation. This turns off the 19 kHz amplifier thus also blanking the stereo beacon.

Returning to the preamp/buffer question, the output of this tuner is about that of a 34dB phono pre-amp with a low output pickup. A 5W amplifier will not deliver more power with a pre-amp but will give more audio sensitivity. Don't let the volume control setting fool you. Anyway, if you build the circuit I suggested, don't try to reduce the gain by increasing R3 or R2, or by decreasing R1; the LM387A is only compensated for a gain of 10 or more. If this is excessive use a volume control of about 100 K in front of C1 (DON'T connect it to pin 1 or 8 of the IC or you'll shut the device down by removing bias from the input stage).

This tuner will connect directly to a 75 Ohm TV cable with no problems.

Fig. 1. (letters) Wally's first hypothetical design.

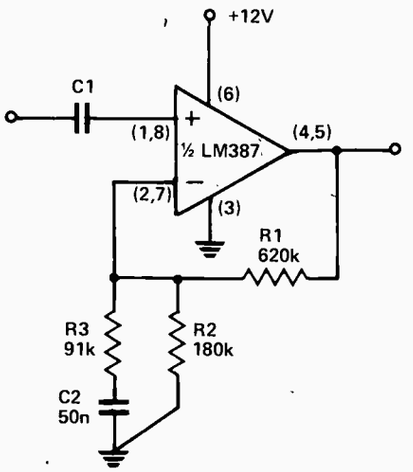
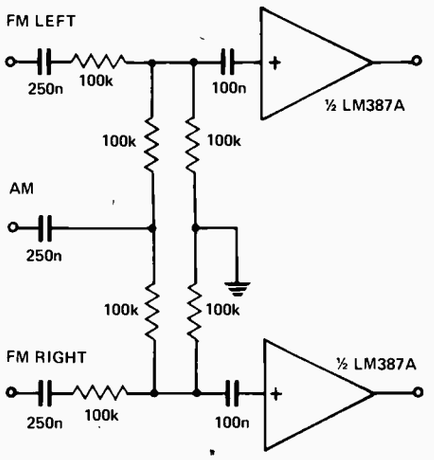


Fig. 2. (letters) Wally's second design.



AUDIO FUNDAMENTALS

I have been reading your magazine since its inception (before, actually) and I have been impressed with the quality of articles and the wealth of information that is contained in your magazine. I would like to see a little more information on hardware for ambitious projects, i.e. cabinets, transformers, etc. These are very difficult to obtain in my area. I would also like to see some good speaker designs, specifically subwoofers, of all types. The Wally Parsons articles just whet the appetite. Also how about some high power amplifiers (over 200 Watts) or high quality low power amps (but greater than 30 Watts). Still, these are minor nigglings with a good product.

Where does one find information on building speaker systems? I already have the latest Philips edition but the authors do not give general design principles.

How can hum and noise be reduced in a phono preamp? I have tried almost everything (my preamp is self-built with an LM387 chip) but listening on headphones is still excruciating.

Thanks for your time.

A.C., Windsor, Ont.

I gather you like us. I don't quite know how to take the "whet the appetite" part, but you must realize that ETI only comes out once a month, and "Audio Today" is only a year old. And despite the number of readers able to sink their teeth into some real meat, there are many others who require a greater emphasis on basics.

A case in point is your letter with its three problems. Knowing how much electronics is involved in the automotive industry, I find it hard to believe that parts would be difficult to find in a city like Windsor. Try the Yellow Pages for starters. Ask a TV repair shop. And acquire distributor's catalogues. Last year ETI published a comprehensive compendium of catalogues, and we'll probably update it sometime this year. Some of these catalogues, such as Electro Sonic's, cost money, but are worth every penny. Compared with readers in some of the small towns who write to us, you and I both have it easy, (I have to drive over 50 miles for a reasonable selection at reasonable prices).

I would recommend to you "How to Build Speaker Enclosures" by Alexis Badmaieff and Don Davis, published by Howard W. Sams, catalogue number 20520, available at most dealers. It's an excellent and detailed book suitable for beginners and hobbyists with some experience. A more advanced publication recently came out from TAB books, number 1064, "How to Design, Build, and Test Loudspeakers" by David Weems.

If your pre-amp is self-built, perhaps you should ask it to write me a letter (a little semantic humour, there). Anyway, you make no mention of noise when using loudpseakers. If you connect a sensitive headset directly across the speaker terminals you will certainly hear a lot of noise, from every stage in the amplifier. It should be padded down, not only to reduce noise but to protect the phones and your ears (I would personally like to see all headphones self-destruct at sound levels dangerous to hearing). The LM387 is quiet, and the LM387/A even quieter. But to minimize 60 Hz hum you must observe good construction practice: don't mount a power transformer too close to the devices, avoid ground loops in both the internal and external wiring, watch out for cold solder joints. 120 Hz hum can be minimized by good filtering in the power supply, although the on-chip regulator minimizes this problem provided the supply voltage is above about 12 V. Aperiodic noise, i.e. hiss, can be minimized by using good quality components. This means metal film resistors and metallized mylar capacitors or the like, not carbon composition resisitors and ceramic disc capacitors, and definitely not electrolytics in the signal or feedback paths (except for C2 in Fig. 1 which may be a tantalum type when used as a phono preamp). This device is mainly suitable for use with pickups of moderate impedances and output, such as most moving magnet types. Moving coil types will not give sufficient output or offer optimum source impedance unless a transformer is used.

How's that for solid stuff?

NOISE REDUCTION

I am considering buying a noise reduction system (not Dolby) for my Hi-fi. I have seen various sytems on the market which say they eliminate noise from tape, phono and FM sources while expanding dynamic range. Are these sytems as good as they sound, and does your project section plan to publish plans for the construction of this type of system?

G.V., Toronto

All systems are as good as they sound (oops, there we go again with the semantic humour; Second City, move over). Actually, the choice of system is more dependent on application, since they all do pretty much what they claim to do. Dolby "B" is the most useful choice in a complementary system since it is standardized and allows tapes and broadcasts to be exchanged. However, for cleaning up existing signals, nothing will touch an Autocorrelator for maximum cleaning with minimal signal degradation. Dynamic range expansion can be accomplished with one of the DBX products, or the Compander which appeared in ETI in January 1978 (back issues are still available as of January 1979). None of them should substitute for good design. The best cure for pre-amp noise is a quiet pre-amp, and the best cure for tape noise is quiet tape and recording electronics. Only when these noise sources have been reduced to a minimum should you use a noise reduction system.

By the way, did you ever build the 50 Watt amplifier (Audio Today Letters, ETI May 1978)? If so, how about writing and telling us how it worked out for you.

The Rockwell

THE FIRST FREE-FLIGHT test of the Space Shuttle, watched by 60,000 people marked the commencement of the final phase of months of testing at Edwards Air Force Base in the Mojave Desert of Southern California. At the end of January 1977 the Shuttle was moved from its assembly facility at Palmdale, along 58 km of specially widened roads to Edwards AFB, for the first Approach and Landing Test (ALT).

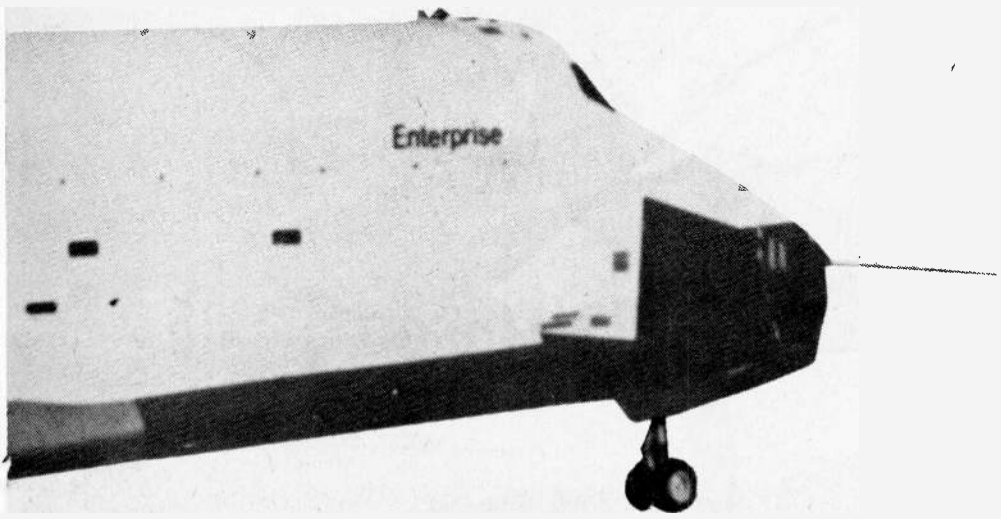
The Space Shuttle is the first of a new breed of spacecraft which is designed to be reused. Previously, the technology available meant that each spacecraft could be used only once, but for any long-term program of space research this is extremely wasteful. Everything was built to the highest standards and then used only once. The Space Shuttle changes this. The Space Shuttle Orbiter vehicle is designed to land intact in the same manner as an aircraft, and the solid rocket boosters used to provide the enormous thrust at takeoff are also reusable. In fact, a Space Shuttle can be launched as quickly as 160 hours after landing from the previous mission, although a two-week ground turnaround is the goal in actual use.

UP UP AND. . .

The Shuttle is launched vertically, attached to an external tank which contains the ascent fuel burnt by the Orbiter's main engines, and two solid rocket boosters. At lift-off all the engines fire in parallel, the SRB's each generating 11,800,000 Newtons of thrust and the three Orbiter engines each generating 2,100,000 N. The two SRB's are jettisoned once they burn out and are recovered after a parachute descent. The external tank is jettisoned before the Orbiter attains orbit.

Space Shuttle

The Space Shuttle has had a relatively low profile after the exciting Apollo missions. Here's a look at what it's been up to.



The orbital manoeuvring system is used to make any adjustments to the orbit or any manoeuvres that may be required during the mission. The jets for this system are mounted near the nose and in pods on the upper rear of the fuselage. These jets can pitch, roll or yaw the Orbiter.

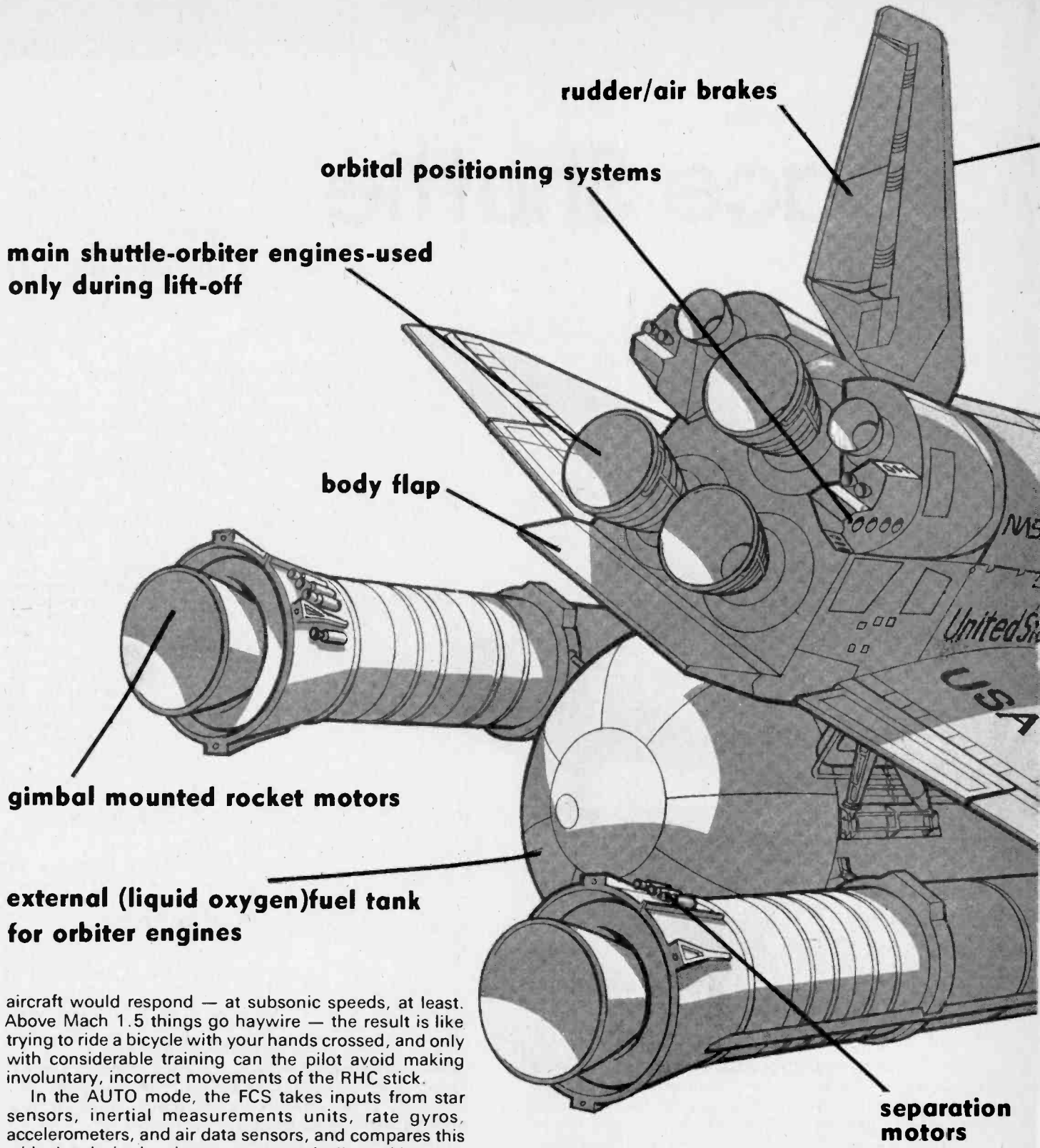
The Orbiter is designed to carry a crew of seven (early missions call for four), including scientific and technical personnel and a payload up to 18 m long and 5 m in diameter. Because of the low g forces at launch, only 3g and less than 1.5g on re-entry, space flight is no longer limited to intensively physically trained astronauts — now experienced scientists and technicians can have access to zero g, vacuum conditions.

Payloads up to 29,500 kg can be placed into orbit. These can range from small satellites to fully equpped scientific laboratories, and not only can the Space Shuttle launch payloads into orbit, it can also retrieve and return them, and service or refurbish satellites in space. The versatility of the Shuttle's cargo opens up whole new areas, i.e. space manufacturing.

DOWN

Upon completion of the various mission duties, the crew will prepare the Orbiter for re-entry — this is when the Space Shuttle really flies. The Orbiter, since it moves in the two media of air and vacuum, has two separate manoeuvring systems. One is the orbital manoeuvring system referred to above, and the other is a set of aerodynamic control surfaces that act in much the same way as conventional aircraft.

There are seven aerodynamic control surfaces on the



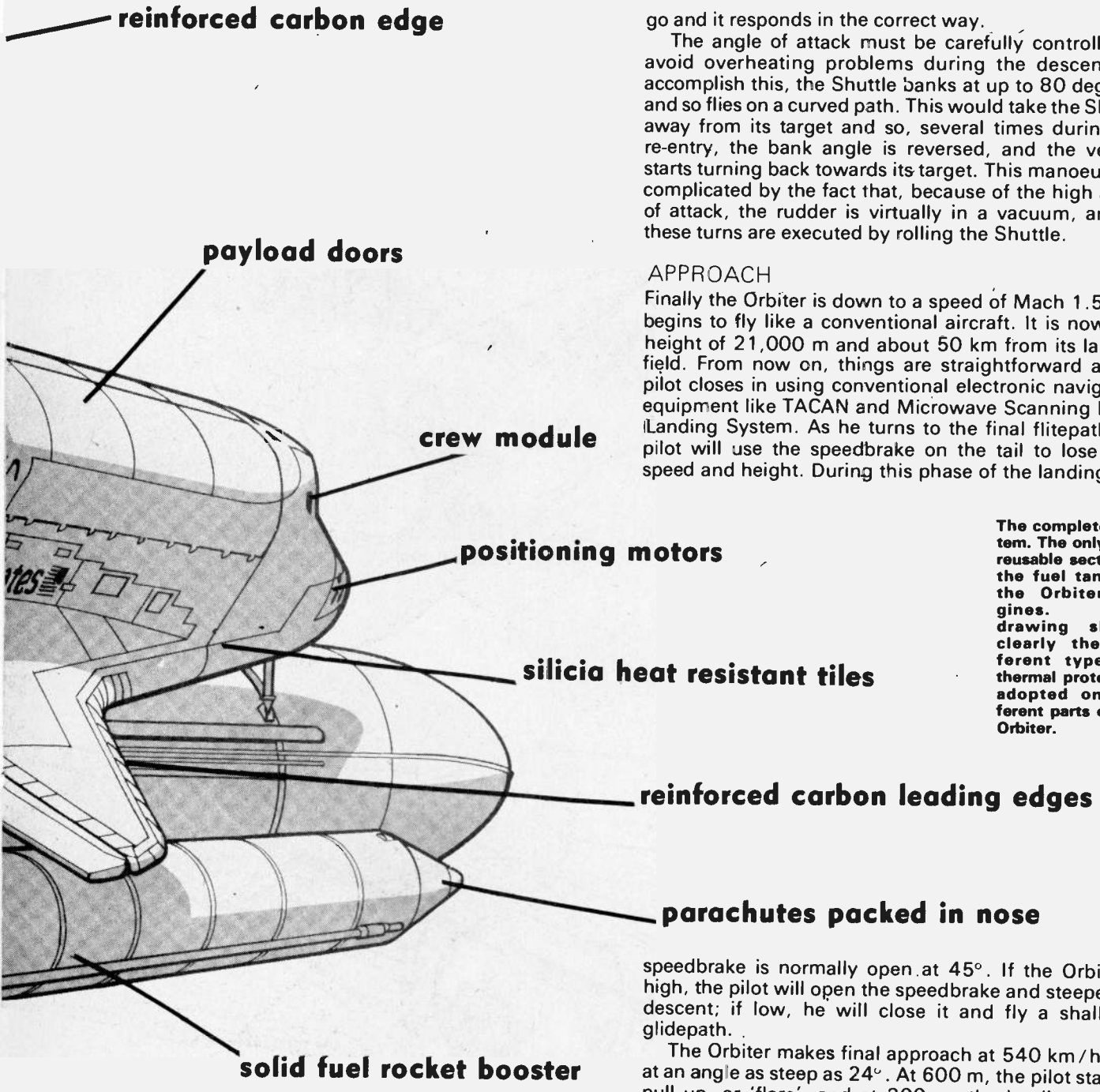
aircraft would respond — at subsonic speeds, at least. Above Mach 1.5 things go haywire — the result is like trying to ride a bicycle with your hands crossed, and only with considerable training can the pilot avoid making involuntary, incorrect movements of the RHC stick.

In the AUTO mode, the FCS takes inputs from star sensors, inertial measurements units, rate gyros, accelerometers, and air data sensors, and compares this with the desired trajectory, automatically making corrections to keep on the path. In fact, the Orbiter can land itself from orbit completely automatically, with the only pilot intervention required being landing gear extension and operating the brakes on the runway!

In the CSS mode, the Flight Control System interprets between the pilot and the control surfaces. The pilot uses the Rotational Hand Controller and pedals, but the FCS accepts these inputs as rate commands in pitch, roll or yaw — in other words, the way the pilot wants the Orbiter to move. These commands are compared with inputs from the rate gyros and accelerometers, and generates control signals to implement the pilot's commands. In this mode the FCS automatically takes account of the reverse effects produced by the aerodynamic surfaces at high airspeeds.

RE-ENTRY

The Orbiter starts re-entry at a high angle of attack, around 30 to 40 degrees, so that the bottom of the wing and fuselage are exposed to the airstream. The under surface is covered with a high-temperature structure of reinforced carbon-carbon on the leading edges and



The complete system. The only non-reusable section is the fuel tank for the Orbiter engines. This drawing shows clearly the different types of thermal protection adopted on different parts of the Orbiter.

special silica tiles over most of the other surfaces to maintain the airframe within acceptable temperature limits.

Unfortunately, because of the high angle of attack, moving the RHC to the left in the DIR mode causes the Orbiter to roll to the right. This is because the right elevon is deflected downward, but this causes drag, and turns the vehicle to the right. This increases the lift on the left wing, so it lifts, causing the right roll. In the Control Stick Steering mode, though, this problem is taken care of by the Flight Control System, and the pilot simply moves the stick the way he wants the vehicle to go and it responds in the correct way.

The angle of attack must be carefully controlled to avoid overheating problems during the descent. To accomplish this, the Shuttle banks at up to 80 degrees, and so flies on a curved path. This would take the Shuttle away from its target and so, several times during the re-entry, the bank angle is reversed, and the vehicle starts turning back towards its target. This manoeuvre is complicated by the fact that, because of the high angle of attack, the rudder is virtually in a vacuum, and so these turns are executed by rolling the Shuttle.

APPROACH

Finally the Orbiter is down to a speed of Mach 1.5, and begins to fly like a conventional aircraft. It is now at a height of 21,000 m and about 50 km from its landing field. From now on, things are straightforward as the pilot closes in using conventional electronic navigation equipment like TACAN and Microwave Scanning Beam Landing System. As he turns to the final flitepath, the pilot will use the speedbrake on the tail to lose both speed and height. During this phase of the landing, the speedbrake is normally open at 45°. If the Orbiter is high, the pilot will open the speedbrake and steepen his descent; if low, he will close it and fly a shallower glidepath.

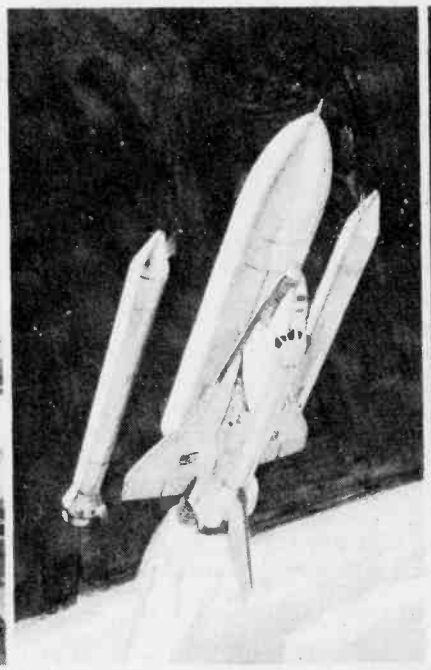
The Orbiter makes final approach at 540 km/hr and at an angle as steep as 24°. At 600 m, the pilot starts to pull up, or 'flare', and at 300 m, the landing gear is dropped. The vehicle touches down at 350 km/hr; at this point it is losing 9 km/hr of speed every second and stalls at 280 km/hr, which is why the landing is at such high speed.

The Approach and Landing Test were designed to check out the performance of the Shuttle during this phase of the mission. They were also designed to check the performance of that now-famous 747/Space Shuttle combination which will continue to fly, delivering Orbiters to the launch site from the production line and landing sites.

FIRST FLIGHTS

The first flight of the Space Shuttle took place on 12th August last year. At 8 am, the 747 Shuttle Carrier

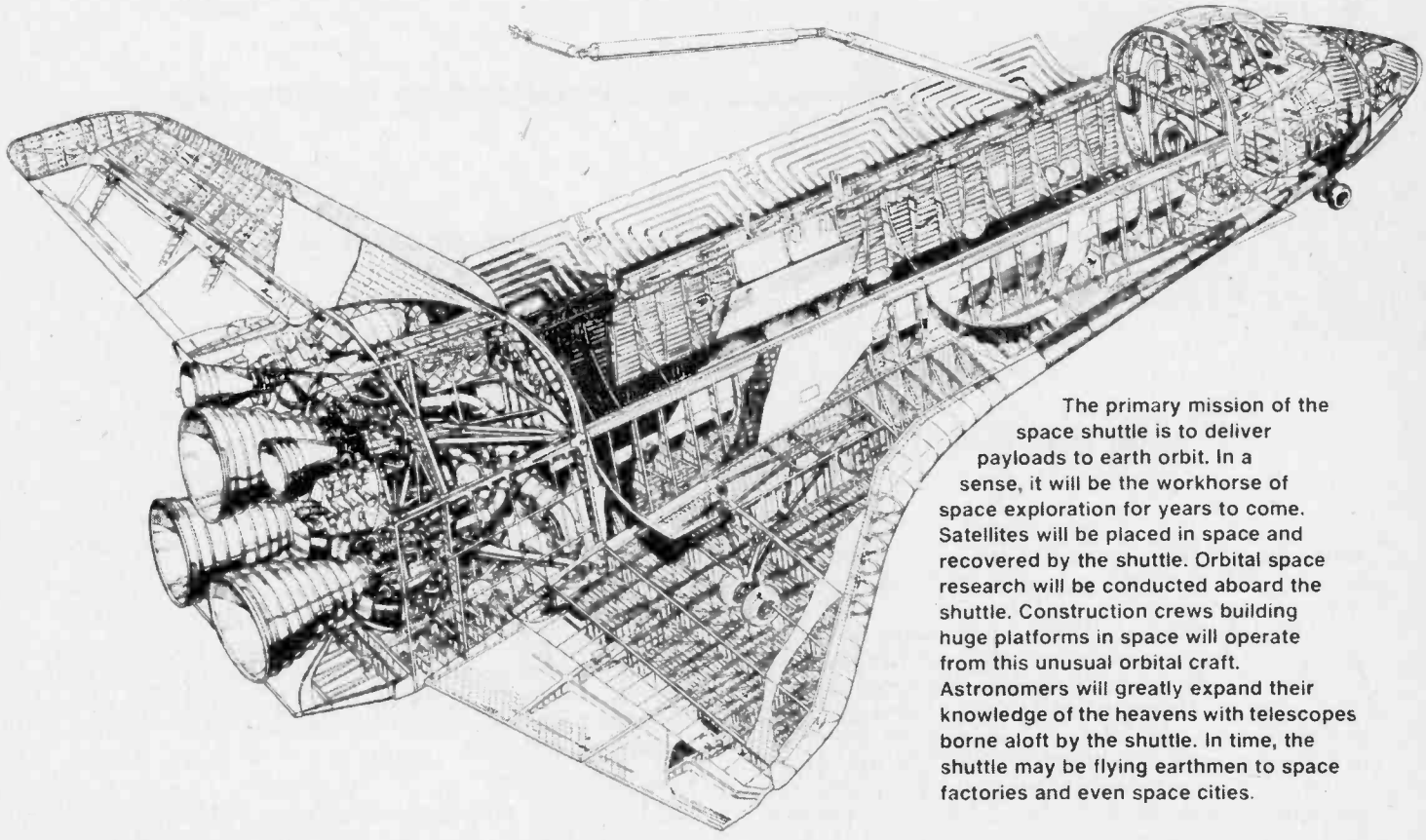
LAUNCH



SEPARATION OF SOLID-ROCKET BOOSTERS
HEIGHT: 46 kilometers
(28 miles)
VELOCITY: 5008 km/hr
(3112 mph)

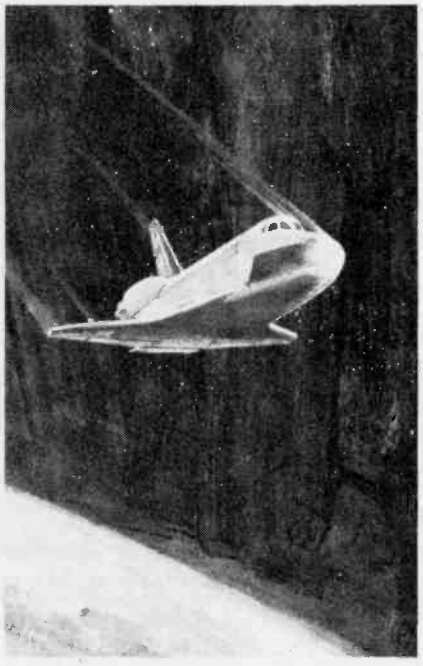
SEPARATION OF EXTERNAL TANK

ORBIT INSERTION AND CIRCULARIZATION
HEIGHT: 185 kilometers
(115 miles, typical)
VELOCITY: 28,300 km/hr
(17,600 mph)



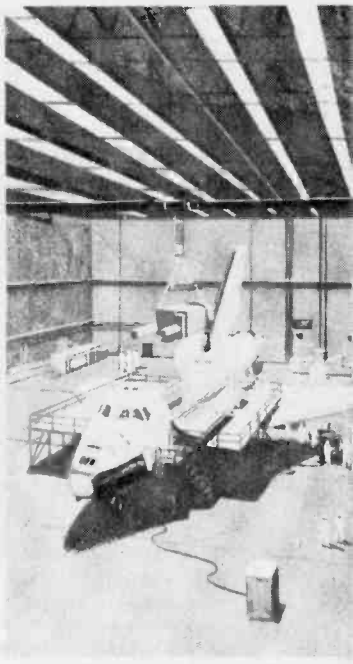
The primary mission of the space shuttle is to deliver payloads to earth orbit. In a sense, it will be the workhorse of space exploration for years to come. Satellites will be placed in space and recovered by the shuttle. Orbital space research will be conducted aboard the shuttle. Construction crews building huge platforms in space will operate from this unusual orbital craft. Astronomers will greatly expand their knowledge of the heavens with telescopes borne aloft by the shuttle. In time, the shuttle may be flying earthmen to space factories and even space cities.

ORBITAL OPERATIONS
HEIGHT: 161-966 kilometers (100-600 miles)
DURATION: 7-30 days

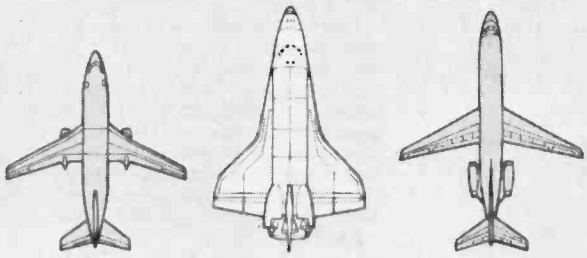


ATMOSPHERIC ENTRY
HEIGHT: 122 kilometers (76 miles)
VELOCITY: 26,765 km/hr (16,633 mph)

LANDING
CROSSRANGE: ±2011 kilometers (±1250 miles) (from entry path)
VELOCITY: 335 km/hr (208 mph)



SERVICING FOR RELAUNCH



BOEING 737 SHUTTLE ORBITER DOUGLAS DC-9

Orbiter. Four of these are on the rear of the wings and are called 'elevons' — they combine the effects of elevators and ailerons. The fifth surface is at the bottom rear of the fuselage between the wings, and assists the elevons in controlling the pitch of the craft. It also protects the rocket engine nozzles from buffeting in the airstream during re-entry. The two remaining panels are on the rear of the vertical tail and can be used as a rudder or spread apart to form a 'speedbrake' by increasing the drag. This is used to limit the airspeed during landing.

At low speeds these surfaces act in a conventional manner. However, at supersonic speeds above Mach 1.5, the effect of some of the control surfaces is reversed, or not the expected one, which makes flying in a conventional manner impossible! To get round this problem, the Space Shuttle, unlike most aircraft, which use mechanical or hydraulic links between pilot and controls, uses a digital 'fly-by-wire' Flight Control System. This is based on three on-board IBM System/4 Pi AP-101 computers which monitor their own operation to provide a measure of fail-safe redundancy.

SHUTTLE CHARACTERISTICS
(values are approximate)

LENGTH
SYSTEM: 56.1 meters (184 feet)
ORBITER: 37.1 meters (122 feet)

HEIGHT
SYSTEM: 23.1 meters (76 feet)
ORBITER: 17.4 meters (57 feet)

WINGSPAN
ORBITER: 23.8 meters (78 feet)

WEIGHT
GROSS LIFT-OFF:
1.99 million kilograms (4.4 million pounds)
ORBITER LANDING:
84.8 thousand kilograms (187 thousand pounds)

THRUST
SOLID-ROCKET BOOSTERS (2):
11.6 million newtons (2.6 million pounds) of thrust each
ORBITER MAIN ENGINES (3):
2.1 million newtons (470 thousand pounds) of thrust each

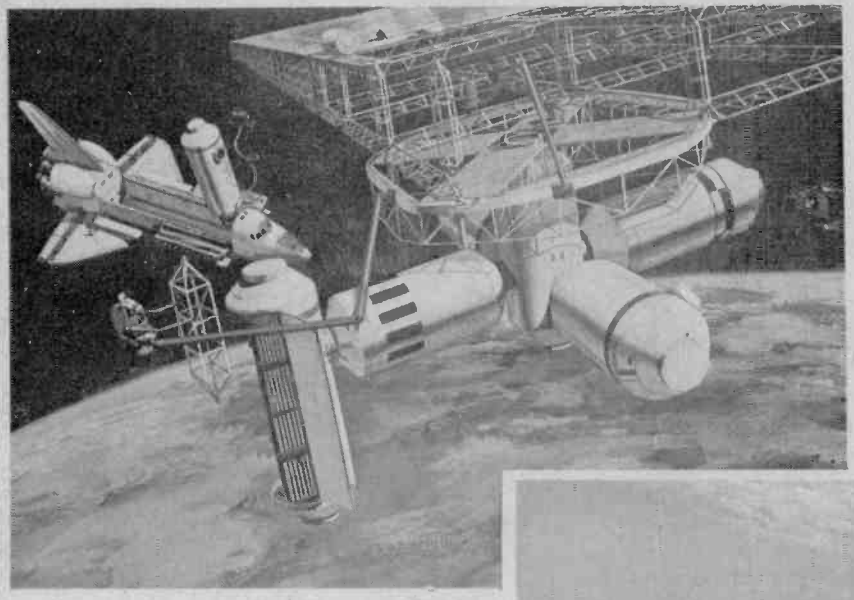
CARGO BAY
DIMENSIONS:
18.3 meters (60 feet) long, 4.6 meters (15 feet) in diameter
ACCOMMODATIONS:
Unmanned spacecraft to fully equipped scientific laboratories

FLIGHTS MODES

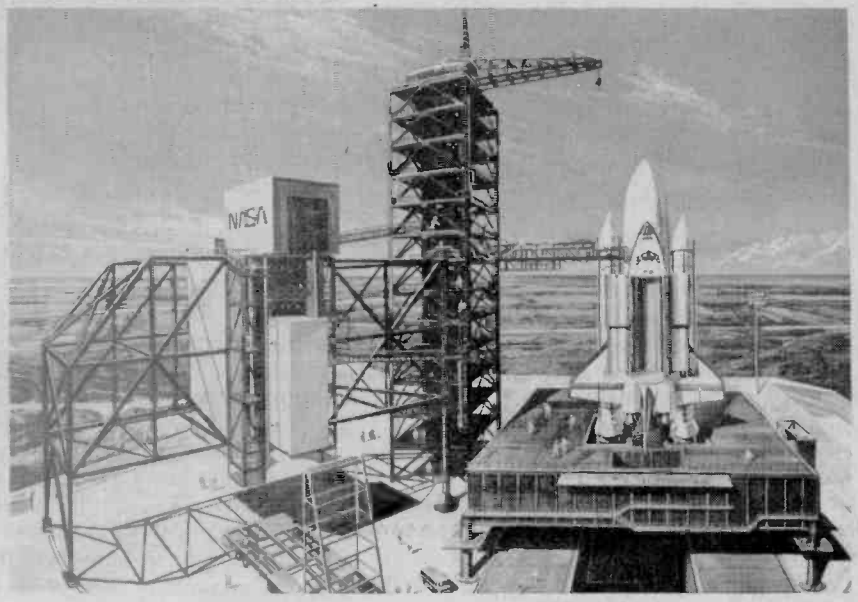
The Flight Control System (FCS) can be operated in three modes: Direct (DIR), Control Stick Steering (CSS) and AUTO. The mode can be selected separately for pitch, roll/yaw, speedbrake and body flap controls.

In DIR mode, the pilot grips a small stick called the Rotational Hand Controller and ordinary pedals. Movements of these inputs to the FCS produce movements of the control surfaces in the same way as a conventional

Space Shuttle Orbiter 101 rides "piggyback" atop NASA's 747 Carrier Aircraft in the first series of captive approach and landing tests conducted at NASA's Dryden Flight Research Center at Edwards Air Force Base in California. With the Orbiter unmanned and its systems inactive, the highly successful first tests verified the safe operation of the combined vehicle configuration, Photo was taken at about 16,000 ft. above the California desert.



Space Shuttle can deliver both the materials and the machinery required to build large space structures, such as this demonstration satellite solar power station. After being fabricated and assembled in low earth orbit, a power station would be transferred to its permanent place in geosynchronous orbit (about 22,000 miles out in space). There it would beam a continuous stream of microwave energy to earth receivers, which would convert the energy to electricity. When completed the station would be 1000 feet square and 25 feet thick.



The Shuttle orbiter cargo bay — which is larger (60 by 15 feet) than most freight cars — will accommodate a great variety of payload combinations. Payloads can be installed or removed while the orbiter is either horizontal or in the vertical position on the launch pad, as shown here, which greatly enhances operational flexibility. The payload "changeout" room is located in the white structure on the left.

Aircraft with its piggyback Orbiter took off on time — the only problem had been a fault in one of the AP101 computers, but that unit was quickly replaced.

At 8.47 the pair were at 8,539 m, and the Boeing started a 7° dive. At a speed of 280 kts, and a height of 7.346 m, the Boeing pilot informed the Shuttle crew that they were ready for separation. The crew, Haise and Fullerton, fired the separation bolts and lifted away, rolling to the left while the 747 dropped to the right. Following a pair of right and left rolls to put some distance between the two craft, Haise tried a practice flare and some banking manoeuvres. This gave the computers at Johnson Space Centre the opportunity to calculate any deviation from the predicted lift/drag ratios, information which would allow a more accurate landing. In fact, the JSC ground controllers muffed it by assuming that the Orbiter was in level flight, whereas it was actually climbing, so they concluded that the lift/drag ratio was lower than predicted.

Haise could not open the speedbrake beyond 45°; this was a mission constraint to avoid steep glideslope angles. Performing a flare at 270m, Haise touched down 600m beyond the expected touch down point at a speed just over 360 km/hr. The overshoot was no problem, as runway 17 at Edwards AFB is 11 km long, but with the wheels on the ground, Haise opened the speedbrake to 90° and the nose wheel came down. The flight had lasted just 5 min 23 sec.

The first three flights were made with a streamlined tail fairing covering the dummy rocket engines at the tail. The fourth flight, on 12th October, was made with the fairing removed, giving a slightly reduced lift/drag ratio. Otherwise, the vechicle did not behave significantly differently.

NEXT COMES NOTHING

With all the approach and landing tests completed, the Shuttle programme moves into its next phase which takes it into space. In the middle of 1979 the Orbiter will be lifted from Cape Kennedy for its first real flight. At present the projected date is sometime in June, but this may well change.

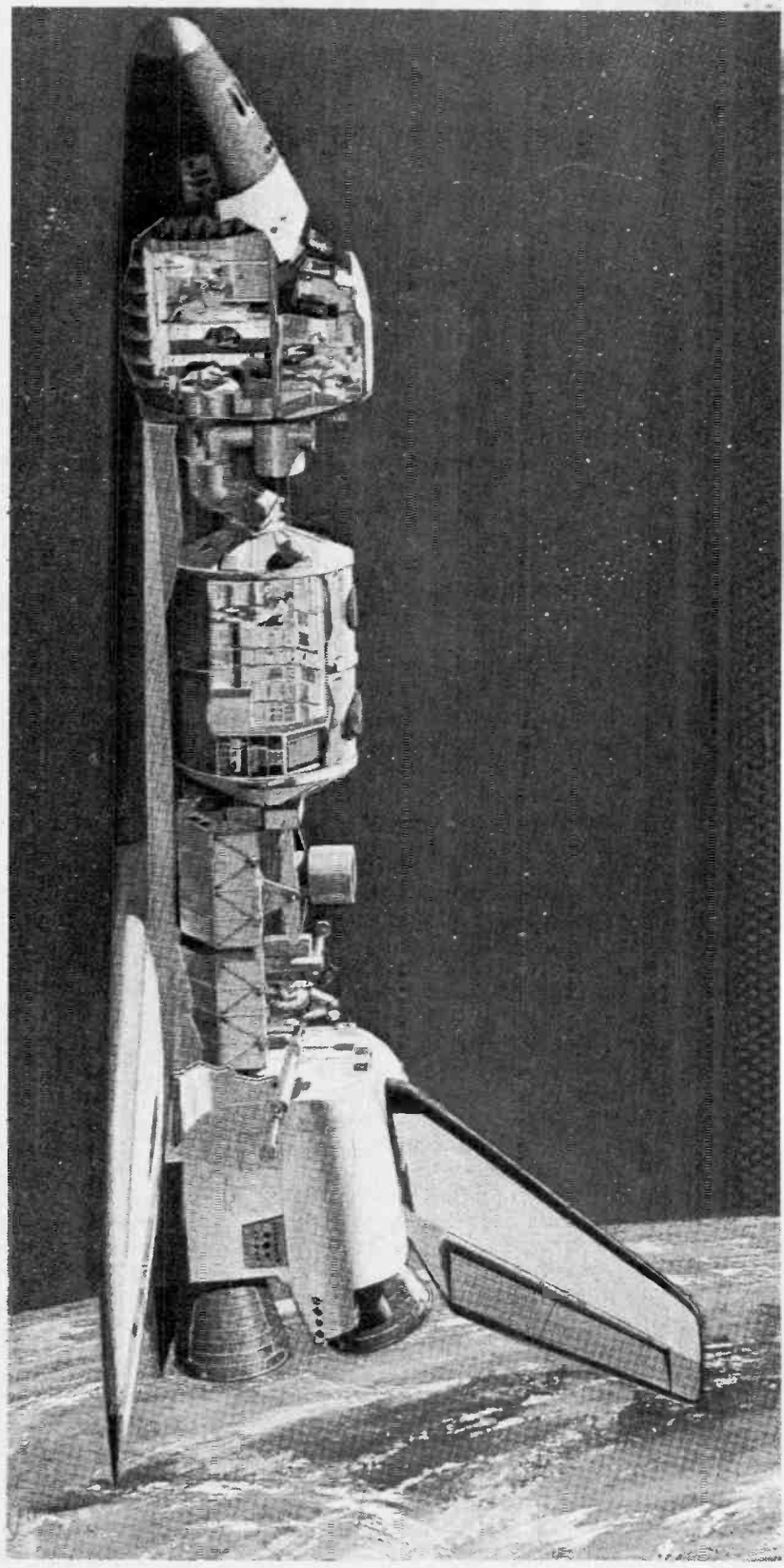
Rockwell are already selling space in the cargo bays — and doing very well too. One of the first payloads will be the Euro Space Lab, which will use the Orbiter's ability to stay put in space for up to a month or more. Cargos are being accepted from commercial firms too — so if you fancy sending a package into space this is your chance. Move quickly though because space in space(!) is hard to get and bookings stretch out a few years into the future.

HOPEFUL SIGN

Of course the Shuttle gives us the capability to build space stations at last, with all that implies — solar power, weather control, observatories and starships. It may be a long time before Man does reach for the stars, but at least we've taken the first step.

Our thanks to Rockwell International — Space Division — for their assistance in the preparation of this article.

A key Shuttle payload is Spacelab, center, a multipurpose laboratory that will enable scientists to conduct experiments in the gravity-free environment of space. The lab is being produced by the European Space Agency (ESA), a consortium of European nations, in cooperation with the National Aeronautics and Space Administration.



APL: Good For The Brain

A Programming Language has been around for many years, yet it is fast becoming THE new language. This exciting development in small computing systems is something that we think will be good for all of us.

IT HAS BEEN observed that not only does a language (English, French etc!) provide a means of expressing thoughts, it also tends to limit thoughts, to those expressible in the language whether to others, or to one's self. Just as a road provides a path for transportation, if you get used to travelling by car you kind of have to stick to the road, and the surrounding terrain remains undiscovered.

So it is with computer languages. Iverson Notation was developed for humans to use, to advance their ability to think and solve problems. APL grew from this, and is probably the only language to pick up an already developed notation, as opposed to acting as a compromise between English and machine code.

Thus while other languages tend frequently to constrict one in trying to solve a problem, learning and using APL tends to help one to handle the problem. In fact with experience one seems to be able to write an APL program while thinking up the method of solution. Other languages usually require an intermediate block diagram or flow chart stage for a similar problem. The proof of this lies in the absolutely fanatical following for APL, and the well attended and highly regarded APL conferences which take place to discuss applications and possible new features for the language.

We think APL is great for the mind and body, and that it's about to arrive in a big way. This article deals with what it is, where it's been, and a look at when it should be used, and where it's going.

WHAT IT'S LIKE

In as much as APL is quite different from other computer languages, has vastly different qualities, and has fanatical supporters, it is very useful to know something about the language itself.

APL having originally evolved from Iverson Notation, it is most helpful to start with those features which are actually part of the notation.

IVERSON NOTATION

The first step to getting a grasp on Iverson Notation is to be familiar with a few 'buzz-concepts' essential to the topic.

Essentially Iverson Notation is a mathematical notation which permits expressions to be written in very compact and condensed forms. The idea is that by giving a lot of the most used functions single symbol names (instead of just + − x and ÷) the user can not only more easily write his ideas down, but even learn to think on a higher level. A good example of this is a sorting operation, for example putting a list of names in alphabetical order. Iverson Notation gives you the concepts of how to think of the list of names, and then allows you to write down, using just a couple of symbols, the method used to do it. Example later.

DATA TYPE

In a mathematical expression, one may have a variety of different types

APL Applied

APL's big strength stems from the ability of a person familiar with the language to write a program as fast as thinking of the method. In fact one even tends to think of the solution in APL form. The other influential feature is that APL is an interactive language.

These two combine to produce an ideal way to use a computer for applications where the programs need to be ready fast, and where the applications area may be new (and hence the program is experimental and may require much revision). This is not to say that in other applications APL is not suitable, but until recently APL has been thought of as expensive in terms of execution time and memory use, or even simply to obtain access. In addition compared to other languages there are relatively few experienced APL programmers, the number familiar with the language will of course grow.

One estimate holds that an APL programmer can produce a program on the order of 25 times the speed of a COBOL programmer, (including debugging) and that the result is of course a far more compact listing.

One point to watch, however, is that while almost anyone can plough though a BASIC, FORTRAN or COBOL program (with enough patience), it is possible to program in APL in such a dense and tricky manner as to make the program virtually impossible to decipher by other persons. Programmers who do this also enjoy reducing 100 line FORTRAN programs to an APL one-liner. (There seems to be some special attraction to the 'one-line' challenge!)

However, if a program is written with reading also in mind, with a bit of descriptive documentation, there is no problem.

What APL Looks Like

SCALAR DYADIC FUNCTIONS

X+Y		X plus Y
X-Y		X minus Y
X×Y		X times Y
X÷Y		X divided by Y
X*Y		X to the Y-th power
X⌈Y		Maximum of X and Y
X⌊Y		Minimum of X and Y
X|Y		X-residue of Y
X⍟Y		Base-X logarithm of Y
X!Y		Binomial coefficient: Y items taken X at a time
X○Y		See trigonometric functions
X<Y	*	X less than Y
X≤Y	*	X less than or equal to Y
X=Y	*	X equal to Y
X≥Y	*	X greater than or equal to Y
X>Y	*	X greater than Y
X≠Y	*	X not equal to Y
X∧Y		X and Y
X∨Y		X or Y
X⍲Y		Not both X and Y
X⍱Y		Neither X nor Y

TRIGONOMETRIC FUNCTIONS

R←X○Y

(Y in radians)		(R in radians)	
X	R	X	R
0	(1-Y*2)*.5		
1	Sine Y	¯1	Arcsin Y
2	Cosine Y	¯2	Arccos Y
3	Tangent Y	¯3	Arctan Y
4	(1+Y*2)*.5	¯4	(¯1+Y*2)*.5
5	Sinh Y	¯5	Arcsinh Y
6	Cosh Y	¯6	Arccosh Y
7	Tanh Y	¯7	Arctanh Y

SCALAR MONADIC FUNCTIONS

+Y		Y
-Y		0-Y
×Y		Signum Y
÷Y		Reciprocal of Y
*Y		e to the Y-th power
⌈Y	*	Ceiling of Y
⌊Y	*	Floor of Y
|Y		Absolute value of Y
⍟Y		Natural logarithm of Y
!Y		Factorial Y; Gamma Y+1
○Y		Pi times Y
?Y	#	A random number from ⍳Y
~Y		Not Y

* ⎕CT dependent
\# ⎕IO dependent

SYMBOLS

( )	Parentheses for nesting
[ ]	Brackets for indexing
⎕	Quad for input-output
⍞	Quote-quad for character input
'	Quote delimits character literals
⍝	Lamp indicates comment
¯	Negative sign
E	Exponential notation
∆	Delta. Trace (T∆) and stop (S∆) control
⍪	I-beam for system functions
.	Decimal point
^	Caret locates errors
;	Semicolon separates list elements
⋄	Diamond used as statement separator
→	Branch
:	Colon delimits labels and locks
⍞	Squish-quad display of non-printable characters

The following characters are available as graphics:

```
⍎ ⍺ ⌈ ⊢ ⊂ ∩ ¨
⍕ ⍵ ⌊ ⊣ ⊃ ∪ ⍣
```

FUNCTION DEFINITION

Function definition is opened or closed by ∇.
Use of ∇ at the close will lock the function.
The following are valid with open definition.

[⎕]	Display entire function
[n⎕]	Display line n
[⎕n]	Display from line n to the end
[n⎕p]	Display line n and position at p prior to editing
[n⎕0]	Display line n and position at right-hand end of line
[n]	(Re)define line n

MIXED FUNCTIONS

X⍴Y	Reshape Y to have dimensions of X
⍴Y	Dimensions of Y
X[Y]	#Y-th elements of X
X⍳Y	*#First locations of Y within vector X
⍳Y	#Y consecutive integers from origin (0 or 1)
X∈Y	* Membership of X in Y
X⊤Y	Representation of Y in number system X
X⊥Y	Value of the representation Y in number system X
X?Y	#X integers selected randomly without repetition from ⍳Y
X⌽[Z]Y	Rotation by X along the Z-th dimension of Y
⌽[Z]Y	Reversal along the Z-th dimension of Y
X⍉Y	#Transpose of Y according to X
⍉Y	Transpose of Y (⌽⍳⍴⍴Y)⍉Y
X,[Z]Y	Catenate or laminate Y to X along Z-th dimension
,Y	Ravel of Y (makes Y a vector)
X↑Y	Take first or last X elements of Y as X is + or -
X↓Y	Drop first or last X elements of Y as X is + or -
X←Y	X is assigned the value of Y
⍋Y	#Index vector such that Y[⍋Y] is in ascending order
⍒Y	#Index vector such that Y[⍒Y] is in descending order
X/[Z]Y	X (logical) compressing along the Z-th dimension of Y
X\[Z]Y	X (logical) expanding along the Z-th dimension of Y
R←X⌹Y	Matrix divide. X approximates R+.×Y
⌹Y	Generalized matrix inverse of Y
⍎Y	Executes the character string Y
⍕Y	Character representation of Y
X⍕Y	Numeric expression Y is converted to character according to numeric format control vector X

● below denotes any scalar dyadic function

●\[Z]Y	● applied cumulatively along the Z-th dimension of Y
●/[Z]Y	The ● reduction along the Z-th dimension of Y
X∘.●Y	Generalized outer product of X and Y
X●.●Y	Generalized inner product of X and Y e.g. X+.×Y is ordinary matrix product of X and Y
⊖	⌽ applied to first dimension (reverse or rotate)
⌿	/ applied to first dimension (compress or reduce)
⍀	\ applied to first dimension (expand or scan)

If the expression [Z] is omitted, the operation applies to the last dimension of the argument array Y. The expression [Z] is ⎕IO dependent.

* ⎕CT dependent
\# ⎕IO dependent

SYSTEM COMMANDS

Note: Bracketed words are optional.

) [n]	Allow editing of immediate execution line at position n
)nnnnnnn [:lock]	Sign-on - invalid sign-on acts as)BLOT
)BLOT	Print a mask for typing secure information
)CLEAR	Clear the active workspace
)CONTINUE [HOLD] [:lock]	Terminate a session and store the active workspace in CONTINUE
)COPY name [:lock] [list]	Copy objects from a workspace
)DROP name [:lock]	Delete a stored workspace
)ERASE list	Erase objects
)FNS [letters]	List names of functions
)GROUP name list	Define a group
)GROUP name	Disperse a group
)GRP name	List members of a group
)GRPS [letters]	List names of groups
)KEYB LOCK	Lock keyboard (to receive messages)
)KEYB NOMSG	Suppress incoming messages
)KEYB	Return keyboard to normal state
)LIB [nnn]	List names of workspaces in library
)LOAD name [:lock]	Activate a copy of a stored workspace
)MSG taskid text	Send message to designated terminal
)MSGN taskid text	Send message to designated terminal without locking sender's keyboard to receive reply
)OFF [HOLD] [:lock]	Terminate a work session
)OPR text	Send message to SHARP APL operator
)OPRN text	Send message to SHARP APL operator without locking sender's keyboard to receive reply
)PCOPY name [:lock] [list]	As)COPY, but protect contents of active WS from being overwritten.
)PORTS aaa	List port number and task-ID of user aaa
)PORTS nnnnnnn	List port number and task-ID of user nnnnnnn
)RESET	Clear the)SI stack
)SAVE [name] [:lock]	Store a copy of the active workspace
)SEAL	Lock all functions in the workspace, prevent dispersal of contents
)SI	Display the state indicator
)SIV	Display state indicator and names of local variables
)SYMBOLS [n]	Display/set symbol table size
)TERM [name]	Display/set terminal type. See WS ≤ TERM for current list of names
)VARS [letters]	List names of variables
)WSID [name]	Display/set workspace name

Fig. 1. I. P. Sharp Associates provide a handy reference card for programmers using their systems. It is just about all you would ever need to remember or take with you to a desert island equipped with only an APL computer, on a scant 224 square inches of card. No more heavy manuals to lug around! Most of the information in this exerpt is general, we have included the section on system commands to give an idea of what is typical. The special characters shown here are those produced on an impact kind of typewriter terminal.

of data. Most people are familiar with integers and real numbers, but also letters, words, collections of characters can be data.

Do not confuse, however, character data with names for variables. For example, in the ordinary algebraic expression A=2xB, A and B are variables while 2 is a constant. On the other hand, in a computer context it would be quite permissible for C='ABCD', ie 'ABCD' is the 'value' of variable C.

RANK

In ordinary algebra we mostly use variables of a single 'element', known as scalars (eg a=2). Sometimes vectors are used, really a list of numbers known by one variable name (eg a=3, 7, 2, -1, or a(1)=3, a(2)=7, a(3)=2 and a(4)=-1). 'Matrices' are expecially popular for such applications as solution of complicated equations, and have two 'subscripts'.

Example:

```
a =  1  3  0
     7  5  4
     8 -7  2
```

or a(1,1) = 1, a(2,1) = 7, a(3,3) = 2, etc.

The concept of using subscripts can be extended on and on to any number of 'dimensions'. The general term for all such variables is 'array'. The number of dimensions or subscripts, it has is known as its 'rank'. Hence a (b,c,d) has rank of 3, a 2 dimensional matrix has a rank of 2, a vector rank 1, and a scalar has rank 0.

FUNCTIONS

APL has a large number of characters which denote functions (examples are the familiar + − x ÷ but there are many more exciting ones! A couple of useful words to know here are 'monadic' and 'dyadic' which mean 'having one argument' and 'having two arguments' respectively. Note that each argument may be an array. Thus A+B may yield a scalar if A and B are scalar , but if they are arrays of the same size and shape, each element of A is added to the corresponding element of B to make the corresponding element of the resulting array.

CONSISTENCY AND EXECUTION ORDER

One of the great virtues of Iverson Notation is its consistency. All monadic

```
      ∇ACCUM[⎕]∇
    ∇ Z←ACCUM A;B;L
[1]   ⍝ IMPROVED
[2]     A←A[⍋A[;1];]
[3]     B←A[;1]
[4]     L←(1↓B)≠¯1↓B
[5]     L←L,1
[6]     B←L/B
[7]     A←L/+\A[;2]
[8]     A←A-0,¯1↓A
[9]     Z←B,[1.5] A
    ∇


      ∇CHARS[⎕]∇
    ∇ Z←CHARS X;A
[1]   ⍝ RETURNS A LIST OF CHARACTERS IN (X),
[2]   ⍝ SORTED ACCORDING TO THEIR POSITION IN ΔAV
[3]     A←' ',ΔCHAR
[4]     Z←A⍷X
[5]     Z←Z/A
[6]     X←((X\X)=\⍳⍴X)/X←(~X⍷A)/X
[7]     X←ΔAV\X,Z
[8]     Z←ΔAV[X[⍋X]]
    ∇
      ∇DEB[⎕]∇
    ∇ Z←DEB X
[1]   ⍝ DELETE LEADING, TRAILING AND EXTRA 1↑0⍴X IN (X)
[2]     Z←1↑0⍴X
[3]     →(1=⍴⍴X)⍴L1
[4]     X←,X
[5]   L1:Z←(-~Z←¯1↑Z)↓X←(Zv0,¯1↓Z←X≠Z)/X
    ∇
      ∇DLBDTB[⎕]∇
    ∇ Z←DLBDTB X
[1]   ⍝ REMOVES LEADING AND TRAILING BLANKS FROM TEXT INPUT (X)
[2]     Z←((v\Z)^⌽v\⌽Z←X≠' ')/X←,X
    ∇


      ∇COMPRESSNAME[⎕]∇
    ∇ Z←COMPRESSNAME NAME;L
[1]   ⍝ AN ALGORITHM FOR NAME COMPRESSION
[2]   ⍝    [1] DELETE SECOND ELEMENT OF REPEATED CONSONANT PAIR
[3]   ⍝    [2] DELETE 'AEIOUY' EXCEPT WHEN FIRST LETTER IN NAME
[4]   ⍝ 1ST STATEMENT IS NOT ABSOLUTELY REQUIRED
[5]   ⍝
[6]     →(⍴NAME←DEB NAME)↓⍴Z←''
[7]     Z←~L←NAME⍷'AEIOUY'
[8]     L←(0,1↓L)∨NAME=1↓NAME,' '
[9]     Z←L/NAME
    ∇
```

Fig. 2. Another example of what APL looks like, this printout from a DEC dot matrix terminal. The resolution is not quite as good, nor the resulting characters so exotic looking, but the terminal is faster and quieter.

functions are written with the one function symbol to the left of the argument, such as !F which means the factorial of F, ÷X which is the reciprocal of X, or ?Y, a random selection from the first Y integers, while |A means absolute value of A. And remember F,X,Y and A could be arrays! In fact, the APL user tends to think that the basic data form is the array, which occassionally 'happens' to be a scalar or vector.

Similarly, all dyadic functions are written with the symbol between the two arguments.

Finally, execution order is right to left, regardless of functions (ie x does not take precedence over +). The order may be changed using brackets. This order is consistent with the normal use of functions such as sin, log, d/dx etc.

THE APL CHARACTER SET

In order to write all functions compactly, a large collection of new symbols was designed, which is now fossilized in the type elements of various impact type terminals. These usually have all the upper case letters, plus numbers and punctuation and so forth, and of course quite a selection of not normally found symbols. Even more symbols are made by backspacing and over striking a second symbol on the first. (eg A, □ and ÷ to make ⌸ etc).

Before non-APL fans get turned off by all this new symbology, it must be said that learning these symbols is extraordinarily easy, as many of them remind you of their meaning by their shape.

Two important notes to make: the use of the proper multiply sign (rather than an asterisk for multiply as in many languages) and ← instead of =. This is a logical choice since A←A+1 really means 'A is assigned the value A+1', rather than 0=1. (By the way, APLers often say 'gets' rather than 'is assigned the value').

In Fig. 1 is a listing of APL symbols and their meanings, while Fig. 2 shows what a typical output looks like and there are more annotated examples in Fig. 3.

ENVIRONMENT

The implementation of Iverson Notation as a computer language brought real muscle to the elegant notation. As a computer language it is used interactively, that is to say you sit at a terminal (or at your personal APL machine!) and communicate directly and immediately with the computer.

You have the option of typing a statement and obtaining its result on the spot (immediate execution mode), writing a function or program (function definition mode), and executing such a function or program (again — immediate execution mode). Various editing and line numbering facilities are provided for function writing, and diagnostics and error messages help to debug functions.

THE WORKSPACE

On 'big systems', each APL user has a 'workspace', a fenced-off piece of memory, as it were, of some arbitrary size, say 50k bytes, where all his work is stored, all variables functions and programs, and in which the programs are executed. On completion of a session the user can store his workspace, even including partially executed programs, as complete state information is contained in the workspace. This storing process is usually onto disk, and is done in a relatively fool proof way as the user signs off. The workspace then sits in suspended animation, awaiting the user's continued efforts next time.

A user may also copy functions from another workspace into his own,

(if so permitted) which of course gives access to alot of useful software which others on the same system have developed.

OTHER BIG SYSTEM APL FEATURES

Just as a user may copy information from another workspace, so can he access system 'libraries' where large volumes of software are typically found, such as routines for plotting, various engineering, statistical, and work processing packages, and of course games.

Additionally, extensive file systems (usually disk) are generally available for storing large amounts of program code or data.

APL CHARACTERS ON EXISTING MACHINES

How do you put APL on a machine which has no APL character set? While new machines will be able to display the characters, and new character generator ROMs may satisfy a few other ways around the problem are possible.

One is to use three to five letter keywords instead of symbols, such that a single key could signify the function, and the whole keyword pops onto the screen. This doesn't provide an elegant looking display, but it does give you APL with only a small sacrifice.

IMPLEMENTATION ON MICROS

The workspace, library and file concepts are more system dependent than the Iverson Notation part of APL. They are also likely to be seen only in limited form at first on small systems. For instance, one workspace is likely to be almost the entire memory of a micro-based machine, so there will be only one user at a time. A disk unit will be essential, for storing workspace(s) and files, and one will presumably be able to create one's own libraries, or buy library disks with various useful packages on them.

'Virtual Workspace' schemes are already being worked on, wherein the user thinks he has a large amount of memory available, when in fact the machine has only a small amount, but swaps portions of the workspace on and off a disk as they are needed. This requires some fancy memory management to accomplish effectively.

```
     ∇ ENTRY
[1]    B←10↑□
[2]    A←A,B
[3]    →1↑B≠'*'
     ∇
```

ENTRY allows the user to enter a list of names, one at a time, alloting ten characters to each name, and filling any unused positions with blanks. ENTRY stops if the user types a single "*". The resulting vector is A.

```
     ∇ RESHAPE
[1]    C←((⍴A)÷10),10
[2]    D←C⍴A
     ∇
```

RESHAPE changes the list of names from a vector to an array with one name per row.

```
     ∇ ORDER
[1]    E←ALPHA⍳D
[2]    L←1↑C
[3]    F←E,⍳L
[4]    N←10
[5]    F←F[⍋F[;N];]
[6]    N←N-1
[7]    →5+3×N=0
[8]    D←D[F[;11];]
     ∇
```

ORDER takes the array D, makes a numerical array E whose entries represent the letters in D, according to ALPHA. E is sorted by row, and the new order is then imposed on D. Job finished!

Below, the functions in action.

```
      ALPHA
ABCDEFGHIJKLMNOPQRSTUVWXYZ
```

ALPHA is the vector variable to which we assigned the desired organizing sequence. It's value is the character "blank" followed by the alphabet. Other orders or characters could have been chosen instead.

```
      ENTRY
JOHN
FRED
ANDY
*
```

User types "ENTRY", the the function waits for the users entries, until it encounters the "*".

```
      A
JOHN      FRED      ANDY      *
      B
*
```

The resulting A and B values after ENTRY.

```
      RESHAPE
      C
4  10
```

RESHAPE, and the resulting C and D values.

```
      D
JOHN
FRED
ANDY
*
      ORDER
      E
 11  16   9  15   1   1   1   1   1   1
  7  19   6   5   1   1   1   1   1   1
  2  15   5  26   1   1   1   1   1   1
 28   1   1   1   1   1   1   1   1   1
      L
4
      F
  2  15   5  26   1   1   1   1   1   1   3
  7  19   6   5   1   1   1   1   1   1   2
 11  16   9  15   1   1   1   1   1   1   1
 28   1   1   1   1   1   1   1   1   1   4
      D
ANDY
FRED
JOHN
*
```

User executes the function ORDER, and the resulting values of E, L, F, and finally what we were waiting for . . . D, now in order.

```
     ∇ EXAMPLE
[1]    A←''
[2]    ENTRY
[3]    RESHAPE
[4]    ORDER
[5]    □←D
     ∇
```

EXAMPLE is a function which ties these three functions together into one, and then prints the result out.

Fig. 3. An example of how to sort a list of names. The 3 functions are listed at the top. Below is a series showing what the user did (indented), and what the machine's response was. (Yes, we know it could be done in one line or less).

Want to read more about electronics? See card facing page 3.

Fig. 4. The caption originally read: "This historic photograph was taken in the hospitality suite at the recent APL users meeting. From left to right are Dick Lathwell, Ken Iverson, Roger Moore, Adin Falkoff, Phil Abrams and Larry Breed. It is believed to be the first time that all six 'originators of APL' have been in the same place at the same time, it is probably the first time that all six have worn jackets and ties simultaneously and the first time that Ken and Adin have been observed to smile simultaneously." Reproduced by kind permission from The I. P. Sharp Newsletter.

Where has APL Been?

Not hiding, just expensive?

It was in the late 1950's that Kenneth Iverson, a Canadian, at that time a professor at Harvard University, developed his notation system. Iverson Notation was intended for analyzing and communicating problems in information processing which he and his students were involved with.

Iverson and IBM joined forces in 1960, and there, with the help of those fellows in Fig. 4, IBM's APL interpreter resulted.

For a long time, APL was only available to those with access to large computers, which made it expensive to get into, but the enthusiasm of those who could use it was extrordinary. So much so, in fact, that I. P. Sharp Associates now provide addicts in Europe, North America, Scandinavia and Australia with access to APL on their Toronto systems via a vast communications network.

What was needed was a stand-alone type machine which was inexpensive, in order for APL to be worthwhile for the smaller user, or even as an educational tool. Steps in that way were taken with IBM's 5100 series (a dedicated APL machine which pretended to be a 360 cpu and thus could run the 360 APL interpreter unchanged, including bugs!), also machines from Hewlett Packard and DEC.

THE MCM MACHINE

In what might seem like attempting to win the Indianapolis 500 on roller skates, MCM Computers, (a Canadian company!) in 1974 introduced the MCM70 a desktop APL computer with one line alphanumeric display, keyboard, dual cassettes and was based on the 8008! It might be obvious these days that microprocessors are the way to go but at the time development started on that MCM machine people were skeptical of seeing any kind of high level language on a micro, let alone APL, and especially on the 8008! More on this in 'The MCM Story'.

RECENT MICRO MOVES

Until recently there hasn't been much stiring in the way of APL for the microcomputer system, in the way BASIC has been available for every microcomputer around.

Now, suddenly there appears to be a terrific battle brewing, as the race is on to feed APL to what is expected to be an open-mouthed market. Judging by the almost astounding enthusiasm of current APL users, each new user will be spreading the word far more quickly than was true with BASIC, that is if he

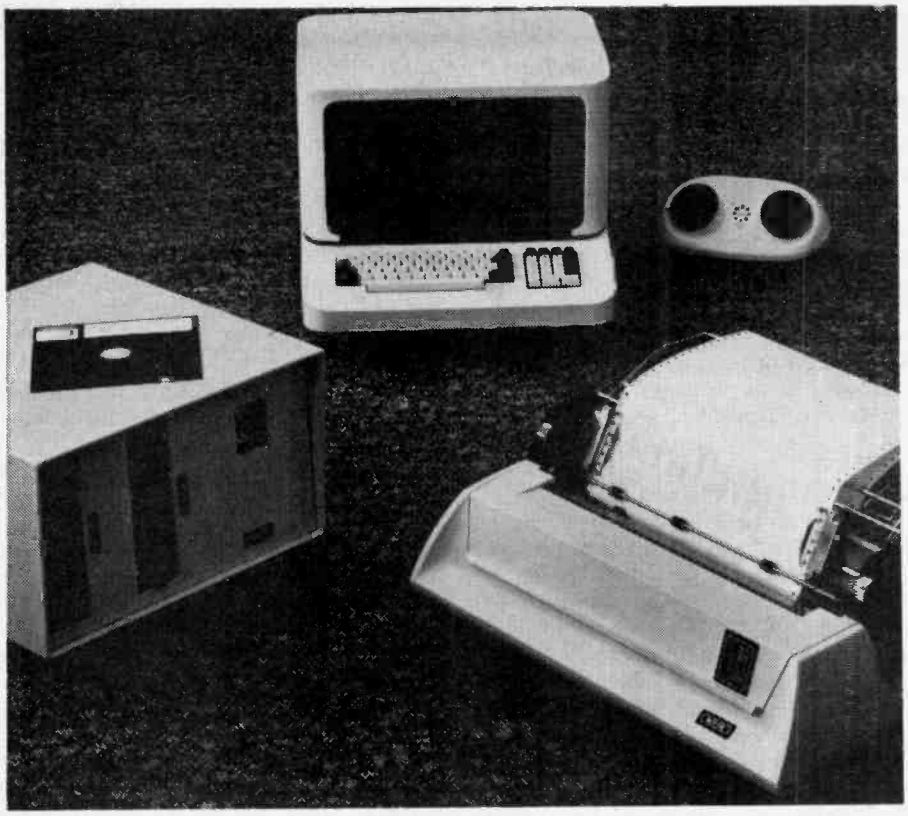


Fig. 5. Here's what the MCM 900 system looks like. This collection costs around $20,000. The keyboard-display unit contains the guts. The display itself is a 12 inch screen with 21 lines by 96 characters.

can tear himself away from the console!

VIDEOBRAIN

First out with APL appears to be Umtech with their F8 based Video Brain. Fitting into 13k - worth of ROM-in-a-cartridge, APL/S is a subset of 'full APL', although there is no standard APL. While a standard for APL is being worked on, big machine versions provide a reference which differs only slightly from one to another, and then only in housekeeping facilities rather than in the basic notation.

Z80 AND VANGUARD

Vanguard Systems Corp. have announced an APL interpreter on floppy disk for Z80, and of course all companies with Z80 based machines are eagerly waiting for it. It is reported to be 27K.

MICROSOFT

Meanwhile, over at Microsoft, much brain work is going into the development of APL interpreters for all kinds of processors, past present and future, ie 8080, Z80 and the 16 bit micros 8086, Z8000, and 68000. Bill Gates, president and APL Product Manager at Microsoft figures fall '79 will be the time his 8080 and Z80 interpreters will be ready with the 16 bit versions in early 1980. Vanguard are hoping to manage the same feat.

IT'S COMING!

Well, it's almost here. It appears that the development of APL on a 16 bit microprocessor will make the first really comfortable implementation of APL for personal, home, business or educational use. Because of this general purpose nature most new APL machines will be easy to use and hence either contain APL on ROM (fool proof) or on disk (most machines will have a disk or two anyhow).

Where Is APL Going?

Microsoft's Bill Gates has a bit to say.

Microsoft is a name in the microcomputer software field regarded with a great deal of awe. The US trade magazine 'Electronics' describes Microsoft as a 'small...software house', but with customers like Radio Shack and Commodore (TRS-80 Level II and PET BASICs) who are the leaders in consumerized home computing, and a huge list of other microcomputer companies, Microsoft has to be *the* major 'force' in micro software.

Bill Gates is the president of the company, and the APL job is largely his baby. So we asked him for his views on the micro APL scene.

NEAR FUTURE

What is about to happen in the way of micro APL?

'APL will see an incredible increase in popularity because it will be exposed to so many new people. To date, it has been an expensive language to use and is almost never introduced to first time computer users. APL's strengths assure that a significant percentage of personal computer users will adopt it as "the language". However it is not the ideal first time language and has some limitations of its own. BASIC will continue to dominate in this role, although specialized languages will be supported by personal computer manufacturers. Microsoft will introduce APL on the TRS-80, Exidy Sorcerer, Interact One, Nascom and NEC TK-80 in 1979.

Also the old time APL users will enjoy the low cost and ease of access to the low priced machines. These old

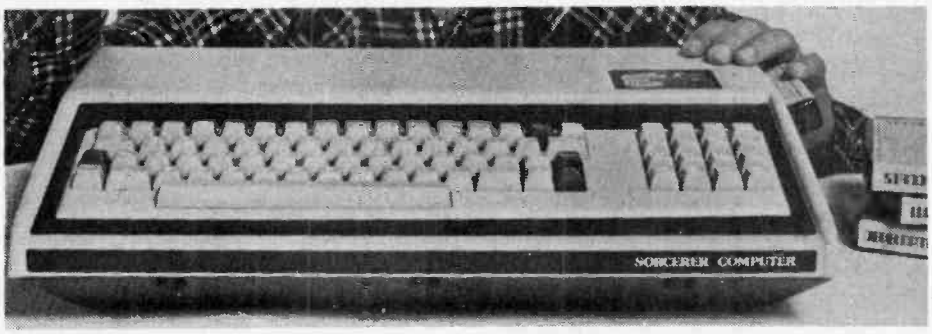


Fig. 6. This is the Exidy Sorcerer, which currently runs BASIC language. Plug in ROM-PACs, just visible to the right, will allow the use of other languages, with APL to be ready in the fall.

time users will be key in generating new converts. New tutorial material making APL seem less mathematical and not forcing the user to see the utility of all the operators will be required. The statistical, accounting, and model type applications that APL is excellent at will be key ones for the new small business computers. With APL's following, IBM's support of it and its strength, our OEMs have decided they can't ignore it. Our response on the product to date has been incredible.'

FIRST VERSION

Details of the 8080/Z80 version:

'Our 8080/Z80 version (long awaited) will be out in April running under CP/M. Other versions such as the virtual workspace one will follow.... Equivalence with the 5100 was my goal — and I met that with 24K of code.

We will license our APL to most of our existing OEMs.'

PERFORMANCE

What kind of performance is expected from micro APL?

'Microsoft APL has all the features of IBM APL/SV (360/370) APL except that the I/O and shared variables are handled differently and the math will not be totally the same since we use binary exponents where IBM uses hex. Our APL is twice as fast as the 5100 which is very adequate and often better than remote APL timesharing systems. Our 8086 and Z-8000 APLs will be at least five times faster and will be available in early 1980. This APL will outperform APL on most minis.

The string search and block transfer are an advantage that our Z-80 version will use. In specific cases this could cause a 2:1 speed difference, but overall the Z-80 to 8080 difference will be less than 15% at equal clock speeds. More important are the design techniques which allow a 32K byte work space to be equivalent to almost twice that much workspace on the 5100 through more efficient management and special representations.'

FAR FUTURE

Looking forward about a year Gates sees some of the following features being offered:

Workspaces upto 40K with virtual workspace to follow.

Libraries on disk.

Unlimited number of dimensions for arrays.

16 digit computation (floating point)

Availability of all primitives normally found.

Sophisticated system commands, error messages.

Initially only SAVE and LOAD workspace 'file' operations, but later random access I/O on arbitrary objects.

Later on Gates thinks 16 bit APL will have up to 10 meg workspaces, same library facilities as I.P. Sharp. Significantly, he comments that many language extensions may be persued, something he feels IBM has stifled. 'APL should not be allowed to stagnate. It is very weak in control structures. General lists should be added.'

AN EXCITING NEW COMPANY

Starting a new company can be a thrill, and it sounds like Microsoft is an example:

'Paul Allen and I started Microsoft in November 1974. The incredible potential for the microprocessor when combined with good software presented a unique opportunity for us to start on our own. The conventional languages and our enhancements of them (BASIC, FORTRAN and COBOL) have kept us extremely busy and delayed our introduction of APL for over 18 months. Providing these packages for the 16 bit processors as well as our new 8-bit products: a BASIC compiler, a Data base manager, a PASCAL based systems programming language and of course APL, will be our primary emphasis in 1979.

The APL project was started in January 1976. At one time people had doubted the ability of microprocessors to support high level languages. After BASIC had disproven this, APL seemed like a great follow-on product. APL provided a new challenge because of its complexity and requirement for lots of memory. However, FORTRAN got higher priority and only one person was left on APL after November 1976. FORTRAN was introduced in June 1977. COBOL was introduced in June 1978.

Microsoft now employs 14 full time technical people and has moved to new and bigger offices in Seattle, Washington, as well as purchasing a DEC 2020 for in house development.'

THE MCM STORY

This company, based in Toronto and Kingston Ontaio, has had a very interesting past, and a unique part in the development of APL machines.

In late 1971, early 72, two fellows by the names of Mers Kutt and Gord Ramer started the company. Their first product was the MCM 70 desktop APL computer, which was based on the 8008 the first 8 bit microprocessor. This model was quickly superceded by the MCM 700 which was a slightly modified version. This machine had dual cassette drives, and one line alphanumeric display. 32K of ROM contained the interpreter, with 2K RAM provided, expandable to 8K.The 700 even came with battery power, enough for the APL addict to get his fix anywhere! This machine was offered for about $8000 in 1974.

Kutt left the company in mid 74, and in the spring of 75 Ted Berg became it's president.

In mid 76 the company's second model, the MCM 800 was introduced. Because the APL interpreter already developed was so good, but the 8008 a little slow, the 800 was centred on a CPU board built with a couple of ALUs and other supporting chips imitating the 8008. This resulted in a computation power improvement of around 10 over the 700. The 800 is generally used in a system with dual floppy disks, with perhaps a printer. About $9,000 could get you the 800 itself, which incorporated a VDU and single cassette, and came with 8K RAM.

In mid '78, Berg moved to take on MCM's US distributor Interactive Computer Systems Inc. The company's new president, Chuck Williams explains that with MCM's third generation machine, the MCM 900, the marketing strategy can now be more solidly aimed at a wide market of business applications. The 900 is based again on an 'imitation' high speed 8008, using a pair of 2901 4 bit slice processors, giving an increased performance of 5—10 over the 800 according to John Koiste, General Manager of MCM's Kingston R & D and production facility. Williams likens this improvement from 800 to 900 to the production of automobiles with top speeds of 60 and 80 miles an hour. While the performance improvement is relatively small, and the first car will accomplish transportation, there is a certain threshold level at which the product becomes widely acceptable. This, Williams feels, has happened with their 900, which strongly competes with timesharing and other more expensive models. The 900 itself is priced around $10,000, but is really intended for use with a dual disk and printer. Essentially it is part of an $18 — 20,000 business problem solving package.

As for the future, Koiste admits that MCM has gone about as far as it can with using the 8008 interpreter

and will have to develop new software around 'more up-to-date technology'. This we take to mean they are looking at 16 bit microprocessors. Meanwhile, Williams says he isn't worried about competition from the hobby computer manufacturers, even as they pursue APL on 8 and 16 bit machines. He feels his personnel and their experience are the company's strengths, and that they will stay ahead of the game in the business market, where they have seven more years of experience than the newcomers.

I. P. SHARP

An interesting story came to our attention recently in connection with micro APL. I.P. Sharp Associates, known worldwide for their APL communications network and software expertise, were apparently working on a micro based APL consumer product! Sharp's Steve Kohalmi described the project. A major Canadian manufacturer of entertainment products went to Sharp with the idea, and developed the hardware prototype while Sharp worked on the software. The product was based on a GI 1600 microprocessor, and was to have floppy disk(s) and some colour graphics capability. The APL interpreter, which was developed on a PDP11/34 simulating GI code, has dynamic workspace management, floating point numbers, but only one dimensional arrays. 16K of 16 bit words was required. Unfortunately the whole combination was never tested as interest in further development has appeared to lapse. Anybody want to take over an almost debugged GI 1600 APL? Call Sharp.

ACKNOWLEDGEMENTS

Our thanks to the following people who were very helpful in the preparation of this article:

Bill Gates, Microsoft;
Chuck Williams, John Koiste, MCM Computers;
Steve Kohalmi, I. P. Sharp Associates;
I. P. Sharp Newsletter

SUGGESTED BOOKS

Kenneth E. Iverson: "Elementary Analysis"; APL Press, 1976.

The APL Press has available a comprehensive collection of publications on APL, the interested reader should write for a complete list.

Leonard Gilman and Allen J. Rose: "APL An Interactive Approach"; John Wiley and Sons Inc, 1974.

A. D. Falkoff, and K. E. Iverson, "APL Language", IBM Corp, 1975 (Form No. GC26-3847)

ADDRESSES

APL Press, Box 378, Pleasantville NY 10570.

Exidy Inc., 969 West Maude Ave., Sunnyvale, CA 94086.

MCM Computers Limited, 6700 Finch Ave. West, Suite 600, Rexdale, Ont., M9W 5P5.

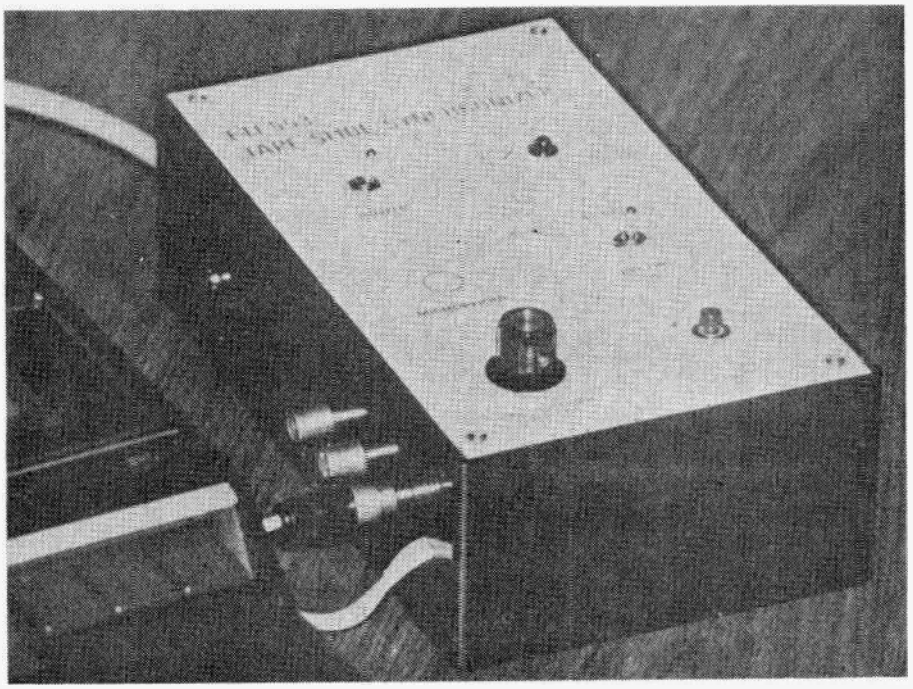
Tape Slide Synchronizer

This unit will let you tape record a commentary for your slide show, so you can even give a talk without being there. . .

WHEN PUTTING ON a slide show for your friends or a business meeting, it is usually necessary to have some commentary with it. If it is a one-time presentation this is no problem, but if the show is to be repeated or if you simply want to be able to recall good memories a couple of years later then a tape recording of the commentary is ideal. The problem now is to keep the slides changing in synchronization with the commentary, without having to record that obtrusive phrase 'change slide now' onto the tape.

This unit allows a control tone (120 Hz) to be recorded on the tape along with the normal voice recording; when replayed the tone will activate a relay which will change the slide while a notch filter removes the tone so it is not heard through the speaker.

An earlier design recorded the tone on the second channel of a stereo recorder. While this worked well, a stereo recorder is not always available, and this design allows an economical mono recorder to be used.

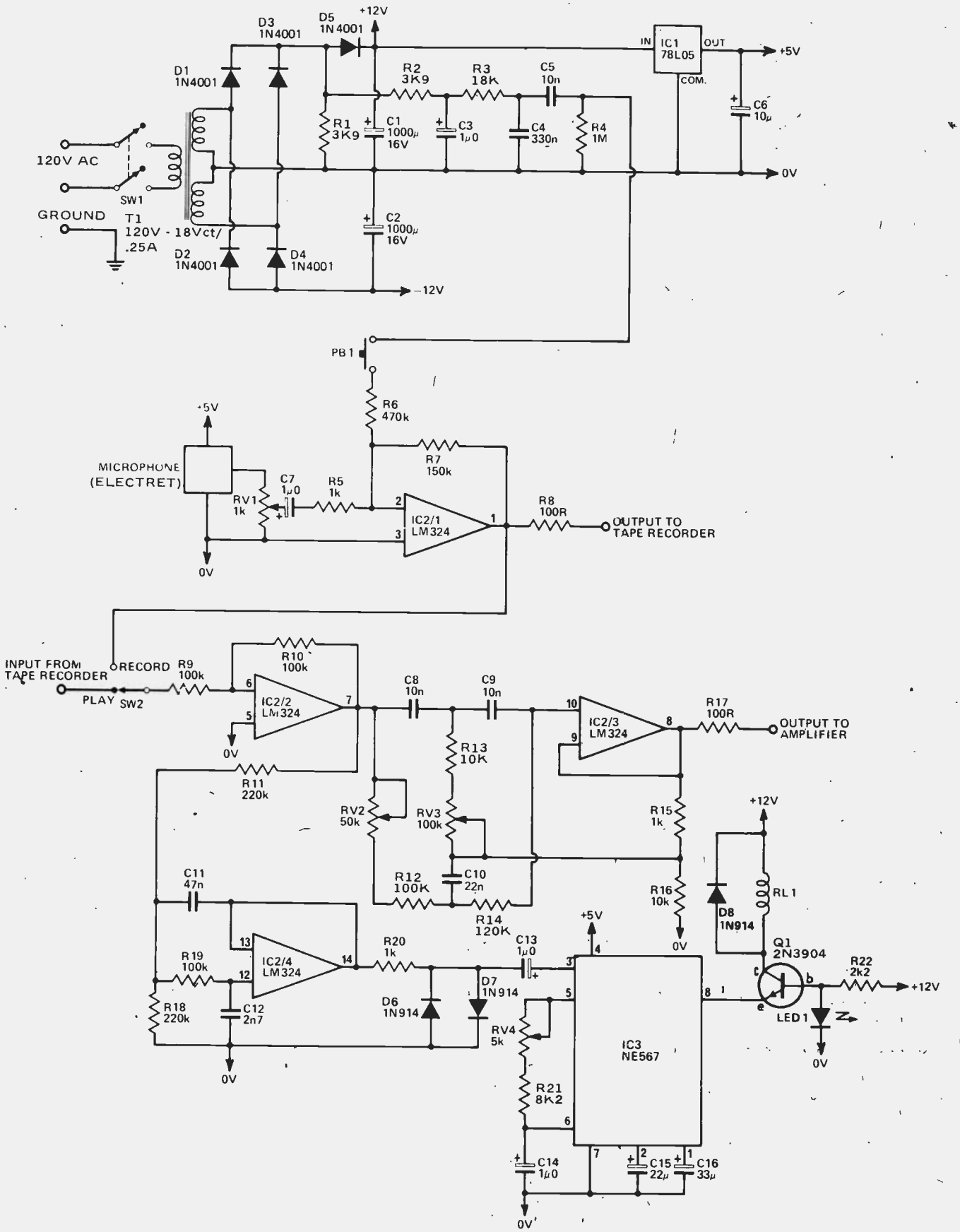


CONSTRUCTION

Assemble the pc board with the aid of the component overlay in Fig. 1. With the 120V wiring it is better not to use pc pins but solder the wires directly onto the pcb. A covering of epoxy glue over the tracks leading to the transformer will help to prevent accidental contact.

If you cannot find an appropriate pc. mounting transformer, you can of course use a chassis mount type and omit the end of the pcb.

We built the prototype into a large plastic box with the controls on the front panel and the tape recorder/amplifier connections on the side. The wiring of the front panel is given in Fig. 3. We used an electret microphone insert mounted just behind the front panel. Thin adhesive vinyl was used to cover this panel, with a 25 mm dia. hole behind to allow the panel to vibrate and transmit the sound to the microphone. However the noise of the relay operating could be heard on the tape and therefore an external microphone is recommended. A socket can be mounted on the front panel in the microphone position.


D3 1N4001
D5 1N4001
+12V
IN
IC1 78L05
OUT
+5V
COM.
D1 1N4001
R2 3K9
R3 18K
C5 10n
C6 10µ
120V AC
SW1
R1 3K9
C1 1000µ 16V
C3 1µ0
C4 330n
R4 1M
0V
GROUND
T1 120V - 18Vct/ .25A
C2 1000µ 16V
D2 1N4001
D4 1N4001
-12V
PB1
R6 470k
+5V
MICROPHONE (ELECTRET)
C7 1µ0
R5 1k
RV1 1k
R7 150k
IC2/1 LM324
R8 100R
OUTPUT TO TAPE RECORDER
0V
INPUT FROM TAPE RECORDER
RECORD
R9 100k
PLAY
SW2
R10 100k
IC2/2 LM324
C8 10n
C9 10n
IC2/3 LM324
R17 100R
OUTPUT TO AMPLIFIER
R13 10K
R11 220k
RV2 50k
RV3 100k
R15 1k
+12V
C11 47n
R12 100K
C10 22n
R16 10k
RL1
D8 1N914
R14 120K
+5V
R19 100k
IC2/4 LM324
R20 1k
C13 1µ0
Q1 2N3904
R22 2k2
+12V
D7 1N914
D6 1N914
R18 220k
C12 2n7
RV4 5k
IC3 NE567
LED1
R21 8K2
C14 1µ0
C15 22µ
C16 33µ
0V

HOW IT WORKS

With this unit, unlike our previous design, we record a 120 Hz tone burst on the same channel as the speech whenever we require a slide to be changed. The tone is derived by full wave rectifying the output of the transformer and filtering out the harmonics by R2,3/C3,4.

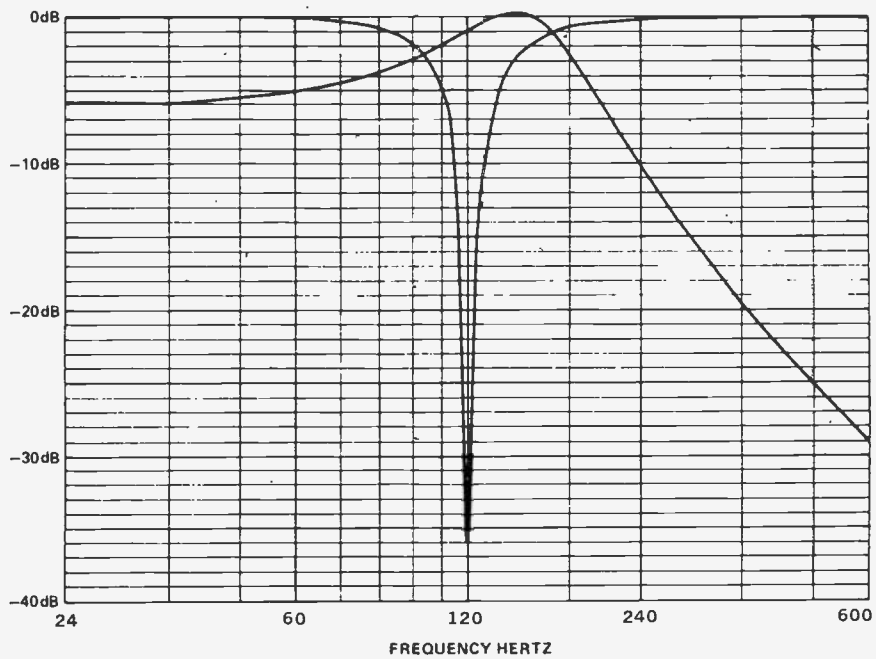
Pressing the slide change button mixes this tone with the output from the microphone which is amplified by IC2/1. This combined output is recorded on the tape.

In the record mode SW2 connects the output of IC2/1 to the buffer amplifier IC2/2. In the playback mode it connects the output from the tape recorder to the amplifier. The output of this amplifier is split into two paths. One of these is through a 120 Hz notch filter to IC2/3 effectively removing the 120 Hz tone without much change to the rest of the spectrum. This is used to drive an amplifier/speaker system.

The other path for the signal after IC2/2 is via a low pass filter IC2/4. This removes frequencies above 150 Hz and has a response as shown in fig. 3. When the 120 Hz tone occurs, this filter passes it, rejecting speech frequencies, and it is passed to IC3. This is a phase locked loop tone decoder and its output on pin 8 turns on when the correct frequency tone is received. The output stage of this IC is an open collector npn transistor which can sink but not source current. With no incoming tone this transistor will be off, preventing any emitter current in Q1, hence turning it off also. The voltage on the base of Q1 in this case will be set at 1.6 V by LED1. When a tone occurs the output of the IC will saturate to about 0.6 V, forward biasing Q1, turning it on, and closing the relay. The current in R22 is now bypassed into the base of Q1, giving about 1.2 V on the base. This is too low for the LED to conduct and it will go out.

The power supply is simply full wave rectified and filtered for IC2, and a 5 V regulator is used for the PLL IC and the microphone amp.

The pcb for this project is available from Spectrum Electronics, 38 Audubon St., S. Hamilton Ontario L8J 1J7 and from B & R Electronics, PO Box 6326F, Hamilton L9C 6L9.



ADJUSTMENTS

Set the unit up to record and with all trimpots at the centre of their travel and the microphone level at minimum, hold the slide change button down. Probably some 120 Hz signal will be heard on the output of the amplifier. Alternately adjust RV2 and RV3 to minimise this signal. It should be necessary to wind up the volume of the amplifier to finally adjust for a minimum level.

The other adjustment is of the phase locked loop centre frequency. With the push button pressed slowly rotate RV4 until the relay either opens or closes. If it closes, continue to rotate it until it drops out then bring the pot back to the half way point. If the relay opened, reverse the rotation to find the other point at which it opens and leave RV4 midway between these two points.

Check the operation of the relay when pressing the button. There should be about half a second delay before it closes.

USING THE UNIT

With this unit a separate amplifier/speaker system is needed. Also the slide projector must have a remote change button using normally open contacts. Connection has to be made between these contacts and the relay in the unit. Check that these wires are isolated from the 120V line and if not be very careful with the connections.

Connect the unit to the tape recorder and projector, assemble the slides in the correct order and switch on. With the record/playback switch in the record position and the recorder set to record, commence the commentary, changing slides with the button on the unit. The high level input on the recorder should be used and the microphone level pot set to give the correct recording level.

When playing back simply set the record/playback switch to playback and replay the tape.

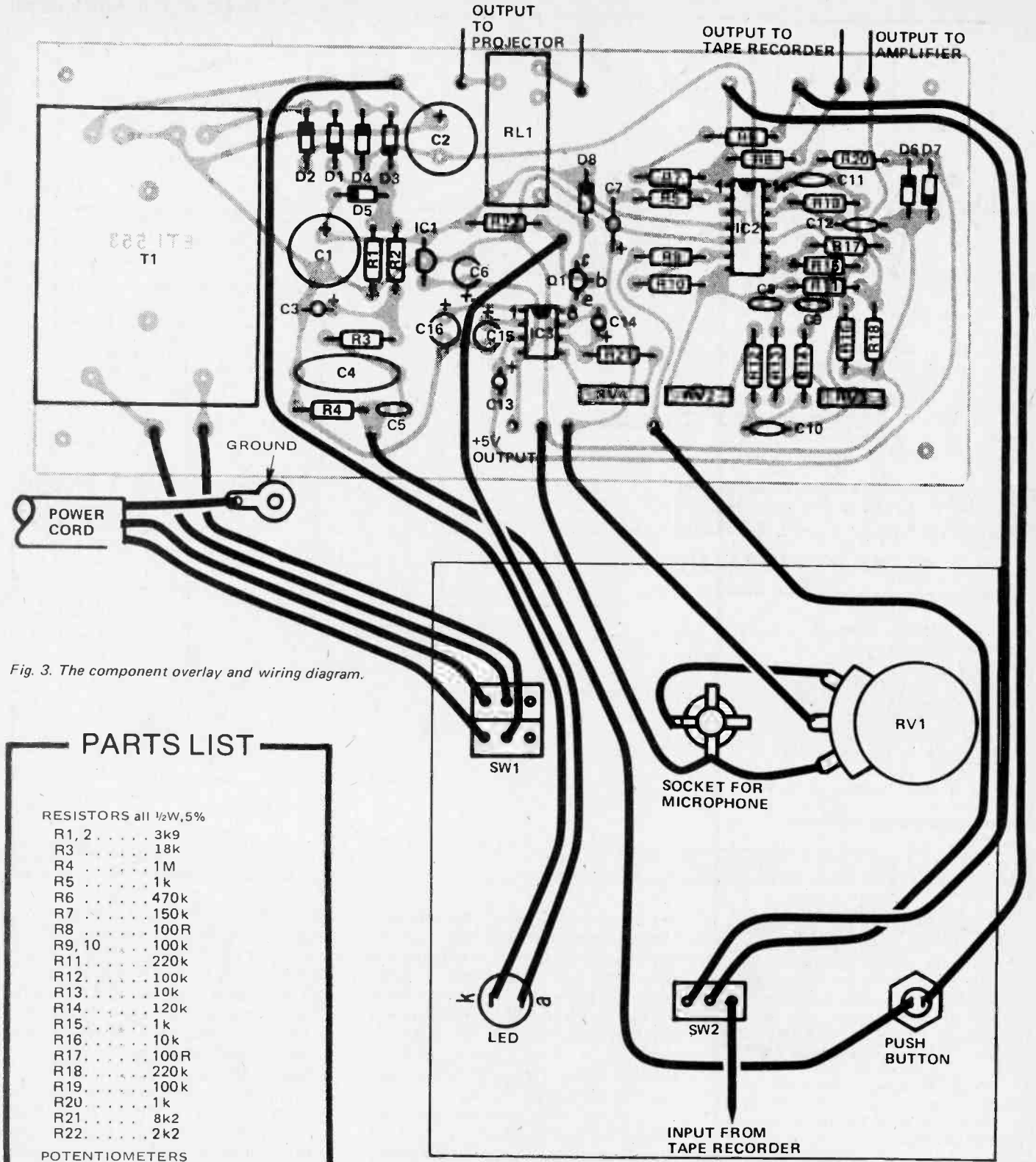


Fig. 3. The component overlay and wiring diagram.

PARTS LIST

RESISTORS all ½W,5%

R1, 2	3k9
R3	18k
R4	1M
R5	1k
R6	470k
R7	150k
R8	100R
R9, 10	100k
R11	220k
R12	100k
R13	10k
R14	120k
R15	1k
R16	10k
R17	100R
R18	220k
R19	100k
R20	1k
R21	8k2
R22	2k2

POTENTIOMETERS

RV1	1k log rotary
RV2	50k trim
RV3	100k trim
RV4	5k trim

CAPACITORS

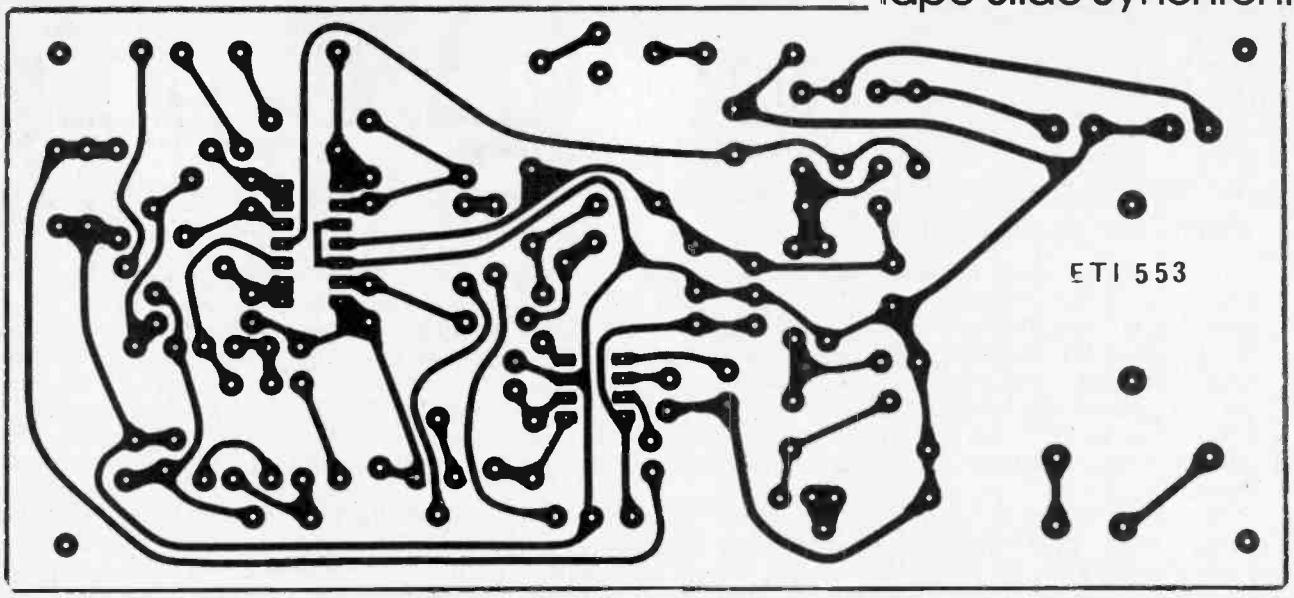
C1, 2	1000µ 16V electro
C3	1µ0 25V electro
C4	330n polyester
C5	10n polyester
C6	10µ 25V electro
C7	1µ0 25V electro
C8, 9	10n polyester
C10	22n polyester
C11	47n polyester
C12	2n7 polyester
C13, 14	1µ0 25V electro
C15	22µ 10V electro
C16	33µ 10V electro

SEMICONDUCTORS

IC1	78L05
IC2	LM324
IC3	NE567 (8 pin)
Q1	2N3904
D1–D5	1N4001
D6–D8	1N914
LED	

MISCELLANEOUS

- PC board ETI 553
- Relay 12V 280Ω
- Transformer 120V - 18Vct/.25A
- Two toggle switches
- One push button switch N/O
- Box to suit
- 3 wire line cord
- Output sockets etc.



A CLOUDY, SNOWY midday it is, and the feeling of pressure in the air is so thick you could cut it with a pair of wire snippers . . . .

. . . although not really the kind which are actually mostly intended as wire strippers and are quite thin and flimsy, you would probably have to resort to quite a chunky pair to make a dent on it. The reader is usually not aware of what goes on behind the scenes at a magazine, so I'll tell you. "Next month in ETI" is the last thing we normally do on the magazine. The last piece of the puzzle. We are all tired, after the end-of-issue rush, and thinking about what we have to do *next* month doesn't fill us with enthusiasm. In fact, we just want to go over to the plaza for a sandwich at the deli. Except I'm going to have a fish-on-a-bun, and Mark wants a milkshake from the ice cream shop. Gail will probably go to the other deli for a soup, and when she gets back she will be furious with the deli counter lady for not attaching the soup lid tight enough so that the soup will all leak into the paper bag and then onto the carpet at the office.

Meanwhile Sharon is buried under mounds of typing, and Senga is valiantly trying to figure out where the extra penny went. Bebe is pacifying a subscriber on the phone who wants to know *why* the post office still has his copy, and *please* don't cut off his subscription just because it has expired, since he has been in Brazil for the last three weeks and has been unable to renew; and with the other hand she is mediating/fighting with the magazine mailers and post office to try and get them to talk to each other and agree on how to mail magazines. In the next office Steve is encouraging the printers to move faster, and generally making sure the ETI crew don't go berserk by looking into the possibility of more S-P-A-C-E for the workers. There's also the continuing debate over glossy paper for the magazine, (what will the readers think, well?) . . .

. . . . all in all, a potentially explosive situation. All it would take to set things off would be a phone call from Wally . . . .

By the way, next month we've got a bit about solar power for heating house or pool, how it's done, and a project to build the essential electronic portion of the system, the ETI Solar Differential Temperature Controller. There's also an Audio Compressor project, and Wheel of Fortune with sound effects. Learn about Designing Audio Amps, and about RF Chokes (more than just a bit of wire you know!).

And, oh yes, next month is . . . April . . .

Electronic Dual Dice

A fine excuse to gamble and have some electronic fun too.

IT SEEMS THAT LEDs and games just naturally go together, and they are always popular to build and amuse people with. Half the fun is showing it off to your friends, the neighbours' kids, etc. and this dual dice project should fill this requirement nicely, since it can be used with hundreds of board games and gambling passtimes. This must almost classify it as useful!

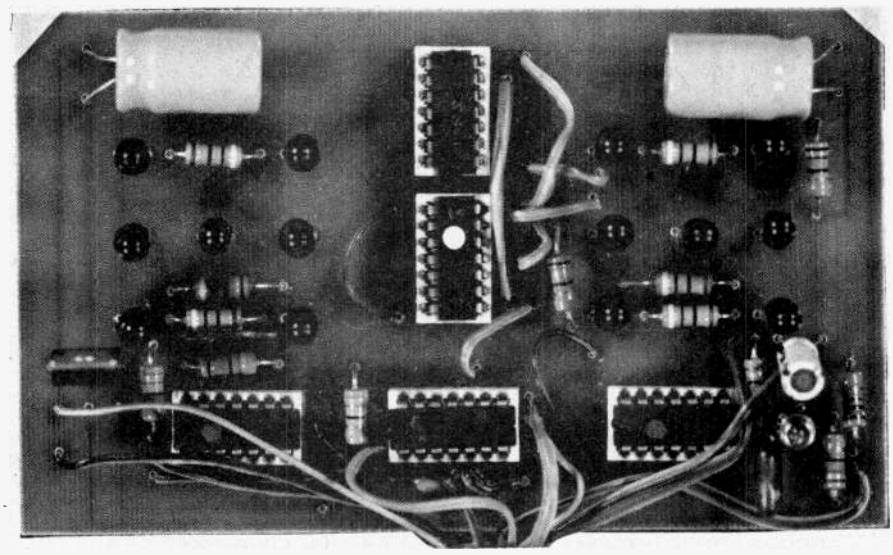
FEATURES

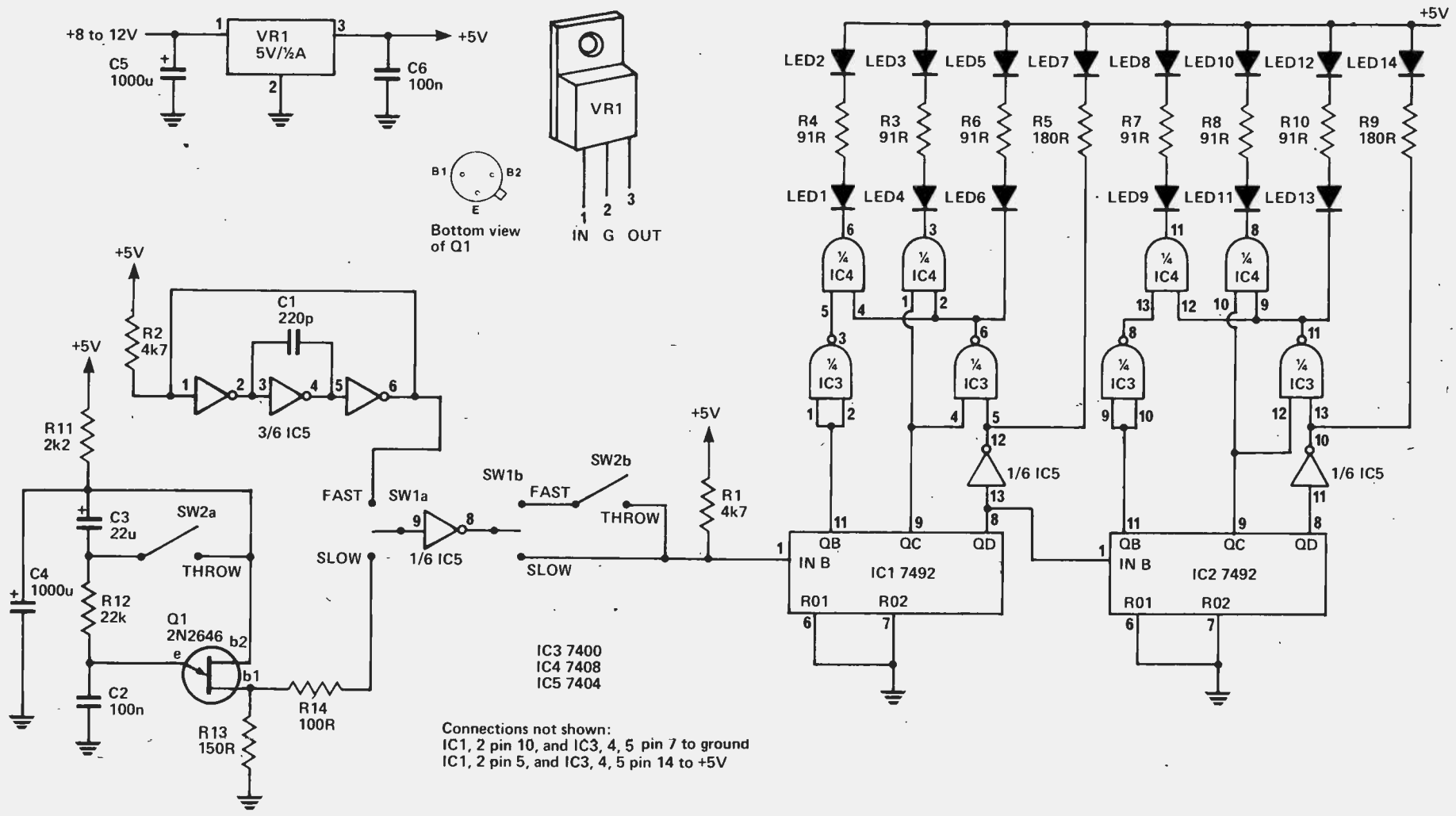
The operation of this unit is very straightforward to anyone familiar with the normal dice. Two sets of seven leds represent the faces of two dice, and at the push of the "throw" button the electronics decides which pattern of leds to illuminate to provide a "random" display. The second switch has a "fast" and "slow" position. When set to "fast", the display stabilises instantly when the "throw" button is released, while in the "slow" position the display gradually slows to a stop, imitating the rolling of actual dice.

CONSTRUCTION

Building the project is quite easy, with or without the pcb, however the pcb definitely makes things easier once it has been made or obtained. We built our unit with the leds mounted on the board, but they could have been mounted remotely if a different display arrangement was desired.

As is commonly known, positioning red leds behind ruby red plexiglass improves the contrast immensely (look at calculators). If this material is hard to get, then here's another suggestion. Printers use a sheet film material known as "ruby lith", in huge quantities too, and they're always throwing it away. This material is sturdy enough to make a display panel cover of reasonable size, or may be strengthened by sticking it to some clear plexiglass or even glass. Check out your local community newspaper printer, ask for the guy who does the "stripping", buy him a coffee and he'll probably give you more than you could use in several decades. What he thinks of as "used" is quite suitable for panel purposes. (No, stripping isn't at all risque!).





HOW IT WORKS

The best place to start understanding the workings of the dual dice is with the counter-display section, specifically IC1. Supposing there is a continuous stream of pulses being fed into pin 1 "IN B", the 7492 will count upwards, the count being available in binary form on outputs QD, QC, QB (in order of decreasing significance). Naturally, since a die has 6 possible displays we would like the counter to cycle through 6 "states". This it does as follows: QD, each is equal in the final outcome.

IC2 and its leds are connected identically, although its input pulses come from the last stage of IC1. Hence, every time IC1 ticks over from 110 to 000, IC2 increases by one count. In a sense then, IC1 and 2 together form a 2 digit base six counter, with very odd counting sequence.

As long as the pulses keep on coming into IC1 the display keeps changing. When they stop, that's where the noise on the power supply line from one die circuit affecting the other, reducing the randomness.

With SW1 in the "slow" position, the pulses come from the "relaxation" oscillator involving Q1. With the "throw" button depressed, the circuit operates as follows: C2 charges up due to current through R12. At a certain voltage the e–b1 junction of Q1 suddenly conducts, somewhat discharging C2, while feeding current through R13,

PARTS LIST

RESISTORS

R1,2	4k7
R3,4,6,7,8,10	91R
R5,9	180R
R11	2k2
R12	22k
R13	150R
R14	100R

QC,QB= 000, 001, 010, 100, 101, 110. (Note that 011 is missing from the normal counting sequence — but that's just how the 7492 counts. There is also an additional 1 bit binary counter in this IC which is not used.)

The gates of IC3 and IC4 combine the outputs of IC1 to turn on the 7 leds to form dice displays for each digit. Notice that as the counter counts from 000 through to 110, the die display reads 2, 4, 6, 3, 5, 1. The order is not important so long as the probability of rapidly for the eye to follow. When the "throw" button is released the display stops apparently randomly.

The reason for IC2 counting off IC1's output, rather than a separate oscillator, was to avoid the problem of display stops. With SW1 in the "fast" position, and the "throw" button pressed, the pulses will come from the three sections of IC5 which are connected in a loop to act as an oscillator. This runs at about one million pulses per second, and hence the display changes too and hence making a short voltage pulse across it, as Q1 quickly turns off again. Now the cycle starts over.

This oscillator operates normally at a high rate. However when SW2 is released, C3 slowly charges, reducing the voltage "at the top" of R12, gradually reducing the rate at which C2 charges. The overall effect is to gradually slow the pulses, and hence the display, to a stop.

The power supply can be any source of 8-12VDC, which is fed into a three terminal regulator, whose output is 5V as required by the TTL ICs. C5 provides supply input smoothing, while C6 is to reduce any high frequency noise on the power supply line.

CAPACITORS

C1	220p
C2	100n
C3	22u/16V electrolytic
C4,5	1000u/16V electr
C6	100n

SEMICONDUCTORS

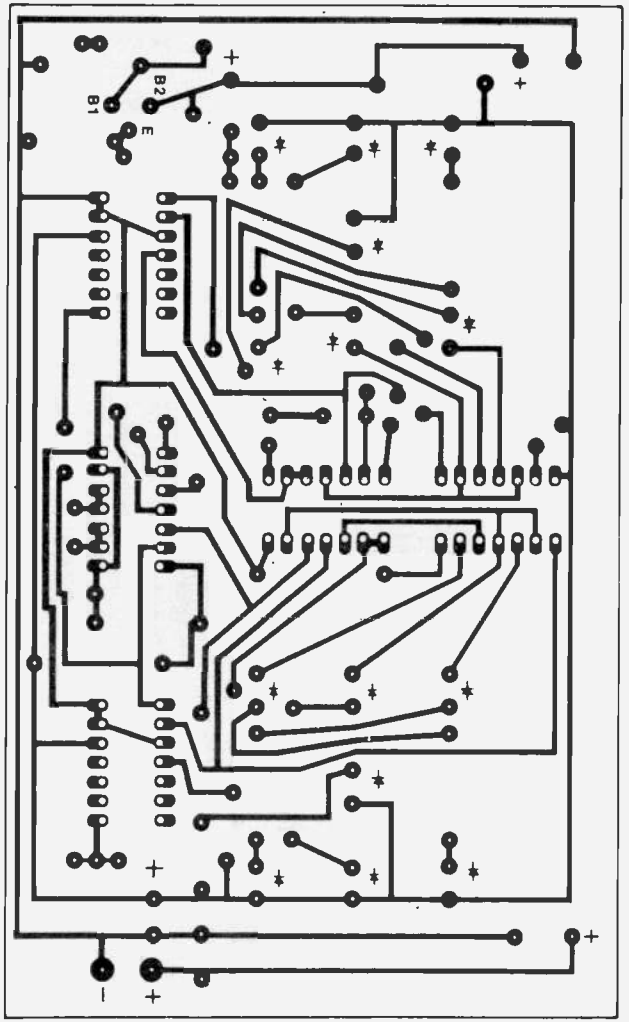
IC1,2	7492
IC3	7400
IC4	7408
IC5	7404
VR1	7805 5V/½A
Q1	2N2646
LED1-14	Red, to suit

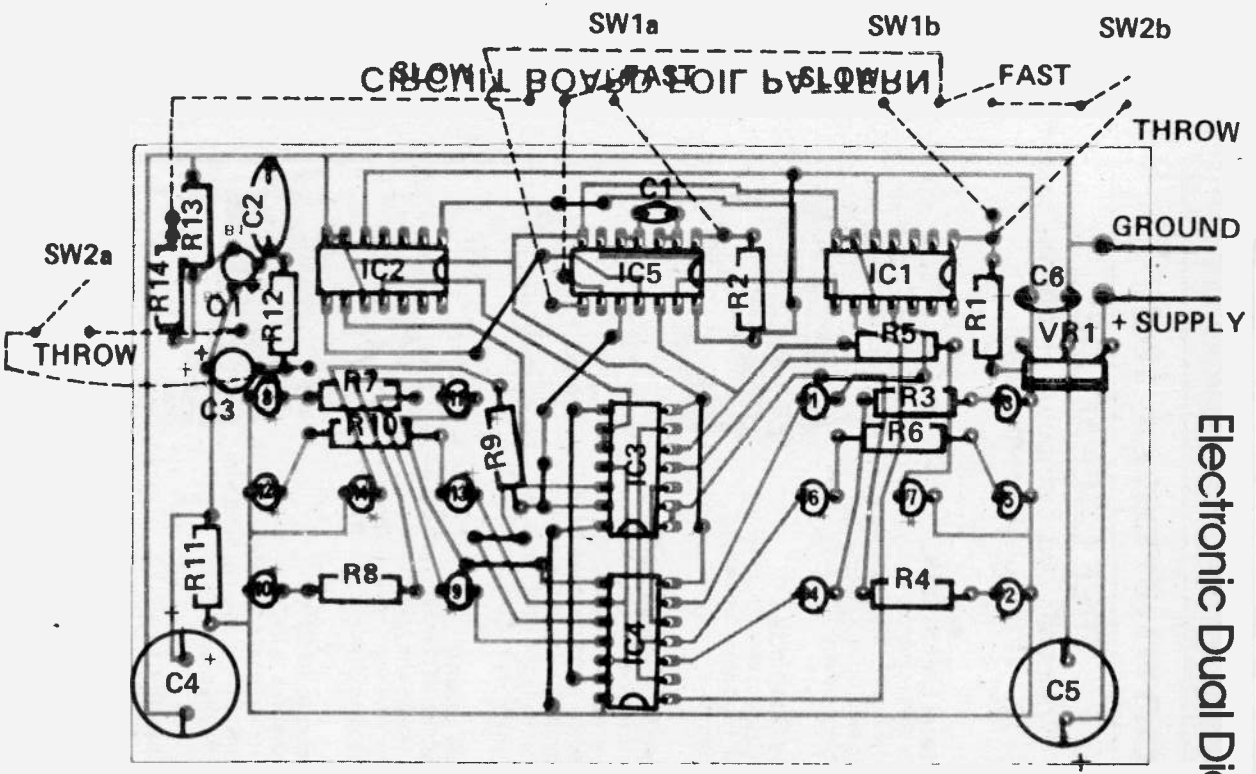
MISCELLANEOUS

SW1	DPDT Slide
SW2	DPDT spring return

Wire, IC sockets, battery connectors etc.

Kits for this project are available from Jana. See their advertisement in this issue for addresses of dealers.



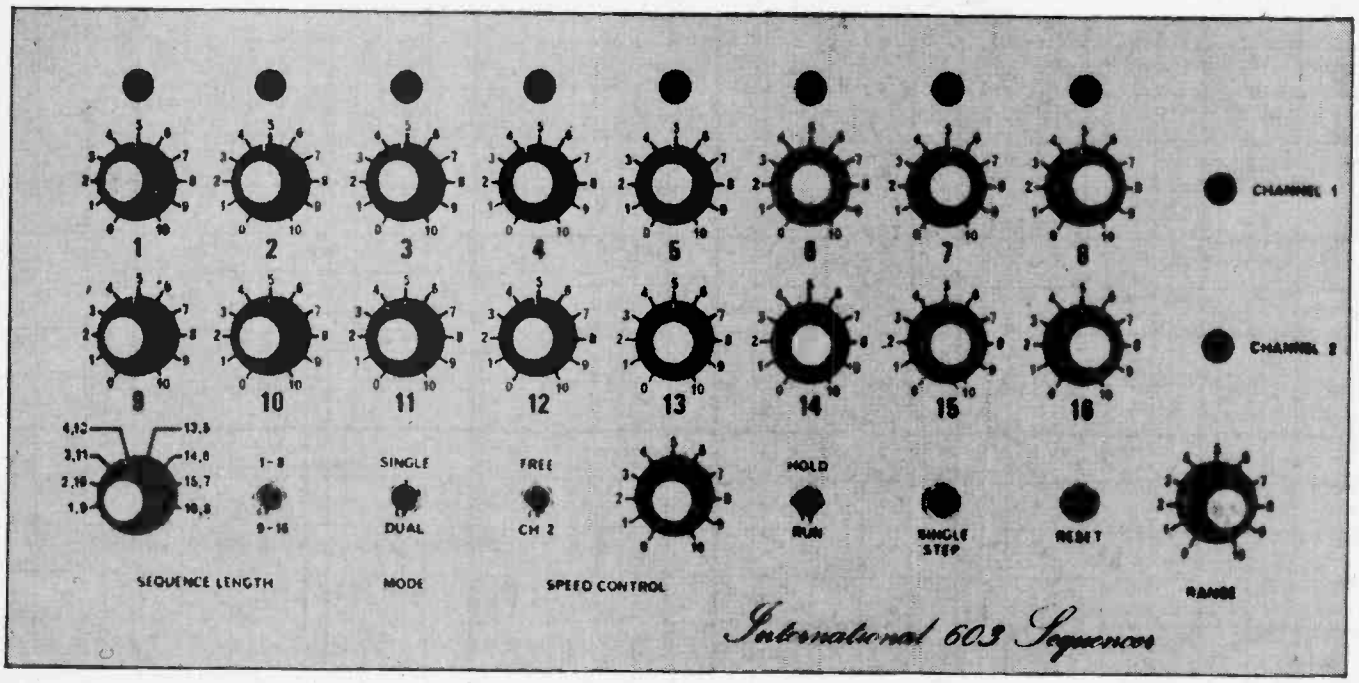


COMPONENT LAYOUT

Electronic Dual Dice

Synthesizer Sequencer

This unit demonstrates the principles of generating a sequence of analog voltages of varying time lengths, for use with music synthesizers or industrial and other controls.



ONE OF THE accessories most requested for use with a synthesizer is a sequencer, which allows a rhythm to be played using spare VCO's and envelope generators, etc., in the synthesizer while playing the melody with the keyboard.

In addition, a number of other problems arise in other areas, such as industrial controls, were a sequence of analog voltages would be useful.

This unit is capable of replaying up to 16 individual notes at a regular beat or up to eight steps where the beat is variable as well as the pitch. If a regular beat is used, two separate channels are available, provided the length is limited to eight notes or less.

This unit could of course be expanded up to any length of sequence that your budget would allow, using the same principles.

SPECIFICATIONS

Number of steps	**2 – 16 single output** **2 – 8 dual output**
Output voltage	**0 – 5 Volts**
Speed	**10 ms – 1 s per step**
Output impedance	**<1 Ohm**
Load resistance	**> 500 Ohms**
Trigger pulse	**2 ms negative pulse**
Power supply	**8 – 15 V dc**

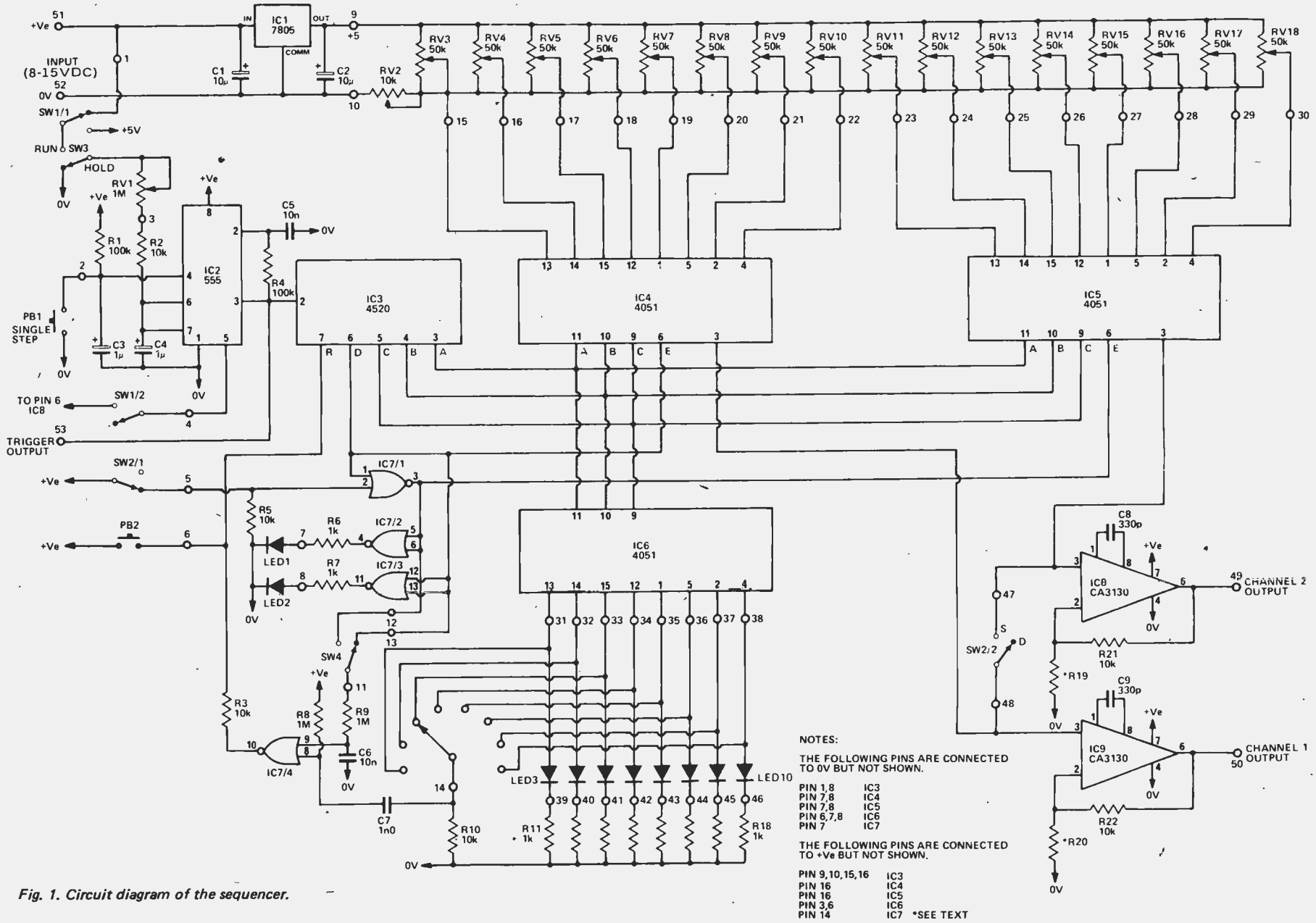


Fig. 1. Circuit diagram of the sequencer.

NOTES:

THE FOLLOWING PINS ARE CONNECTED TO 0V BUT NOT SHOWN.

PIN 1,8	IC3
PIN 7,8	IC4
PIN 7,8	IC5
PIN 6,7,8	IC6
PIN 7	IC7

THE FOLLOWING PINS ARE CONNECTED TO +Ve BUT NOT SHOWN.

PIN 9,10,15,16	IC3
PIN 16	IC4
PIN 16	IC5
PIN 3,6	IC6
PIN 14	IC7

*SEE TEXT

HOW IT WORKS

The sweep time of the sequencer is controlled by IC2 which is a 555 timer. It clocks IC3, a four-bit binary counter, which gives the 16 steps required. The output however is in four-bit binary form.

The individual levels in the sequence are set on the potentiometers RV3 to RV18 which have a fixed supply voltage across them. One side is at +5 V as set by IC1 and the other side is variable from 0V to about 3.8 V by the range control RV2. This reduces the range over which the synthesizer VCO can be varied, making set-up easier.

These 16 output voltages are connected to the inputs of IC4 and IC5 which are eight-input analogue multiplexers, the selected input depending on the binary code presented to the control inputs. The enable line is used as a control line to allow full 16 input operation. The outputs from IC4 and IC5 both are buffered by IC8 and IC9 to prevent loading the potentiometers.

In the single mode the multiplexers are selected alternately and their outputs are connected so that both buffers have identical outputs. In the dual mode both multiplexers are active, the connection between the outputs is open and the buffer IC9 corresponds to the output of IC4 (RV3 to RV10) and IC8 to that of IC5 (RV11 to RV18). In this mode the sequence is only eight steps long.

Control of sequence length and the position indicator LED's is done by IC6 and IC7. IC6 decodes the lower three bits of the binary code and drives the eight LED's indicating which column is active. The upper bit is inverted by IC7/1 and this output plus the normal output are buffered by IC7/2 and IC7/3 which drive LED's 1 and 2 which are the row indicators.

The output of IC6 is also connected to SW5 which is the sequence length selector. When the sequencer is on the length selected, the voltage on R9 is near the supply rail. When the next step occurs, this voltage falls to zero and C7 connects this pulse onto one input of IC7/4, which resets IC3 back to the start of the sequence, (provided the other input is on zero).

The second input to IC7/4 determines the row and is selected by SW4. The resistor R8 and capacitor C6 provide a slight delay to give correct operation when lengths of 8 or 16 notes are selected.

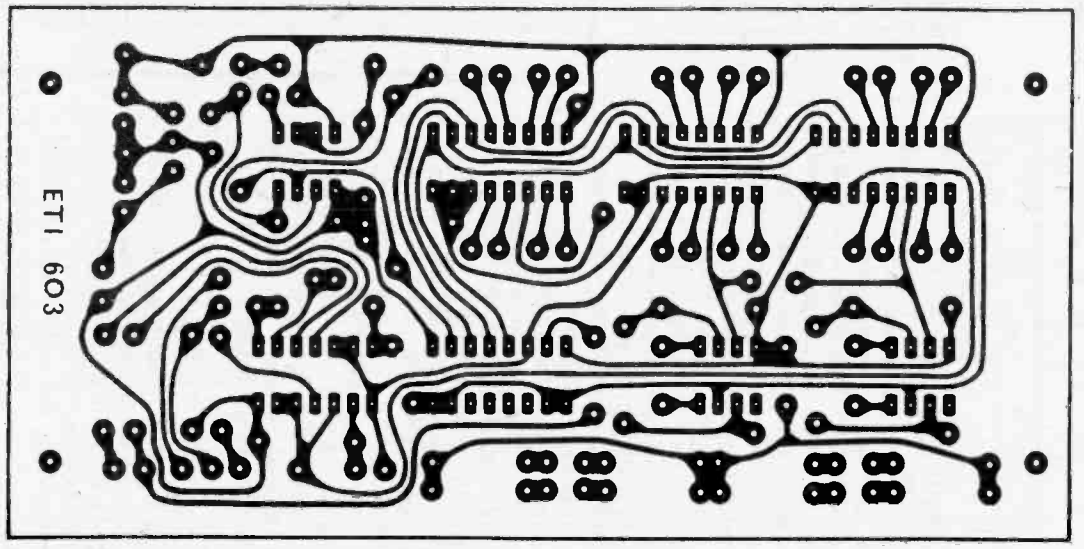


Fig. 2. Printed circuit layout. Full size 140 x 70 mm.

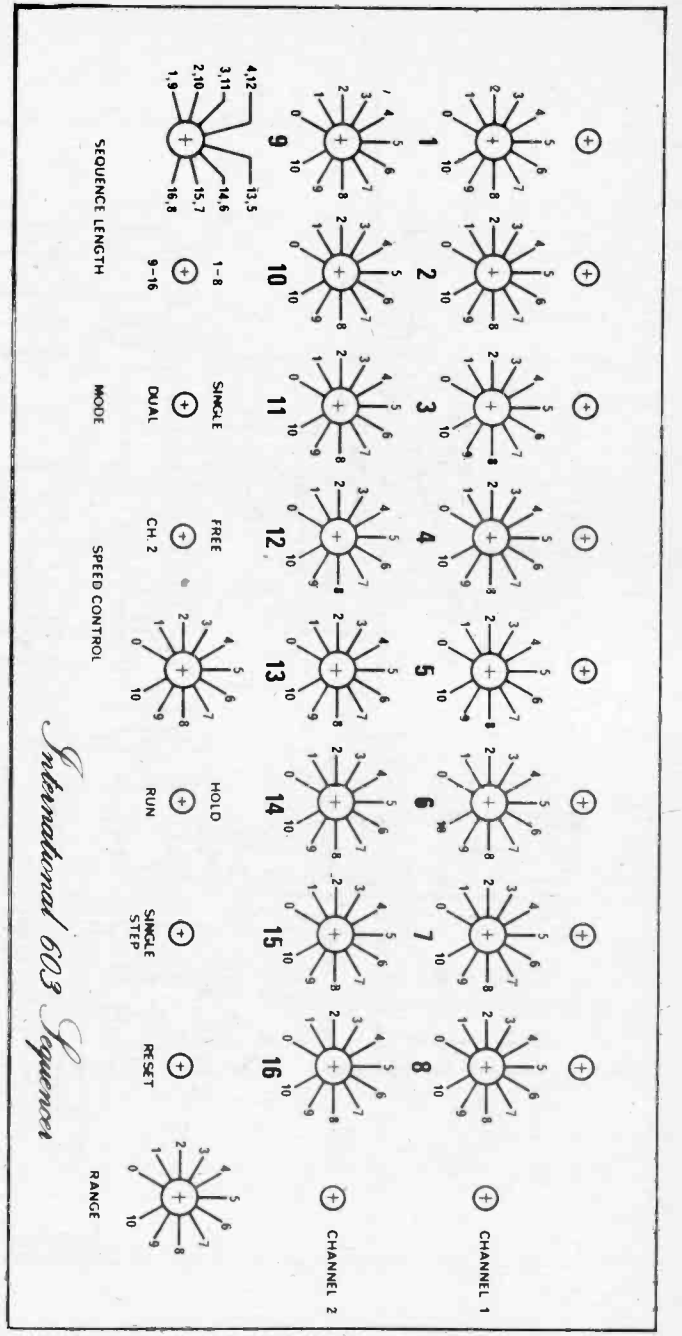


Fig. 3. Front panel artwork. See Fig. 7 for dimensions.

See page 40 for a collection of projects for beginners.

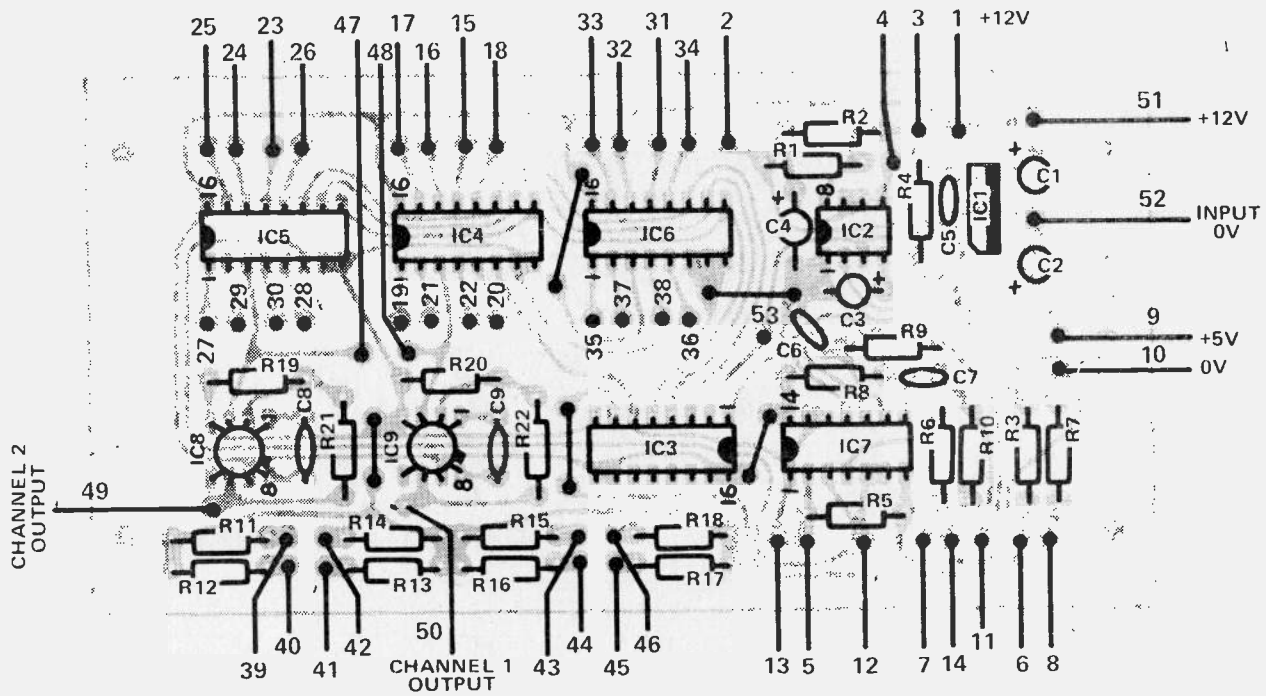


Fig. 4. Component overlay of the sequencer.

DESIGN FEATURES

When initially looking at this unit we had to decide between two different approaches. The first, which is presented here, is to use a heap of potentiometers on which the individual voltages are manually set up and a large multiplexer to select the potentiometers sequentially.

This system is economical up to about sixteen steps. Beyond this, the cost of the hardware, i.e. potentiometers, knobs, panel space, etc., is far more than the cost of the electronics involved.

In the second system, the tune is entered 'live' through the keyboard and the individual notes, the key depression times, and the intervals between notes are sorted in a memory. Long strings of notes or more could be stored in this way and then replayed as a rhythm (or melody!).

This system is obviously much more flexible but it is more expensive and complex if a short sequence is all that is required. However, cost does not rise much for longer lengths.

CONSTRUCTION

The PC board should be assembled as shown on the overlay diagram (Fig. 4). The CMOS IC's should be installed last and the power supply pins (7 and 14 or 8 and 16) should be soldered first to allow the internal protection diodes to work.

The front panel can be assembled as shown in Fig.5 and interwired to the PC board using the numbers on the wires for reference. Due to the large number of wires it is recommended that 'rainbow' cable be used for neatness. When connecting the LED's note that the shorter lead or the lead nearest the notch or flat on the body is the negative side (cathode).

The mechanical construction we have used need not be followed if the unit has to fit into an existing space and none of the wiring is critical as regards length or layout. We didn't use a power switch as the module was used on the synthesizer power supply.

The output of the unit is in the range of 0V to +5V if R19 and R20 are not

PARTS LIST

RESISTORS (all ½ W 5%)

R1	100k
R2,3	10k
R4	100k
R5	10k
R6,7	1k
R8,9	1M
R10	10k
R11–R18	1k
R19,20	see text
R21,22	10k

POTENTIOMETERS

RV1	1M lin rotary
RV2	10k lin rotary
RV3 – RV18	50k lin rotary

CAPACITORS

C1, 2	10µ 16V electro
C3, 4	1µ0 16V electro
C5,6	10n polyester
C7	1n0 polyester
C8, 9	330p ceramic

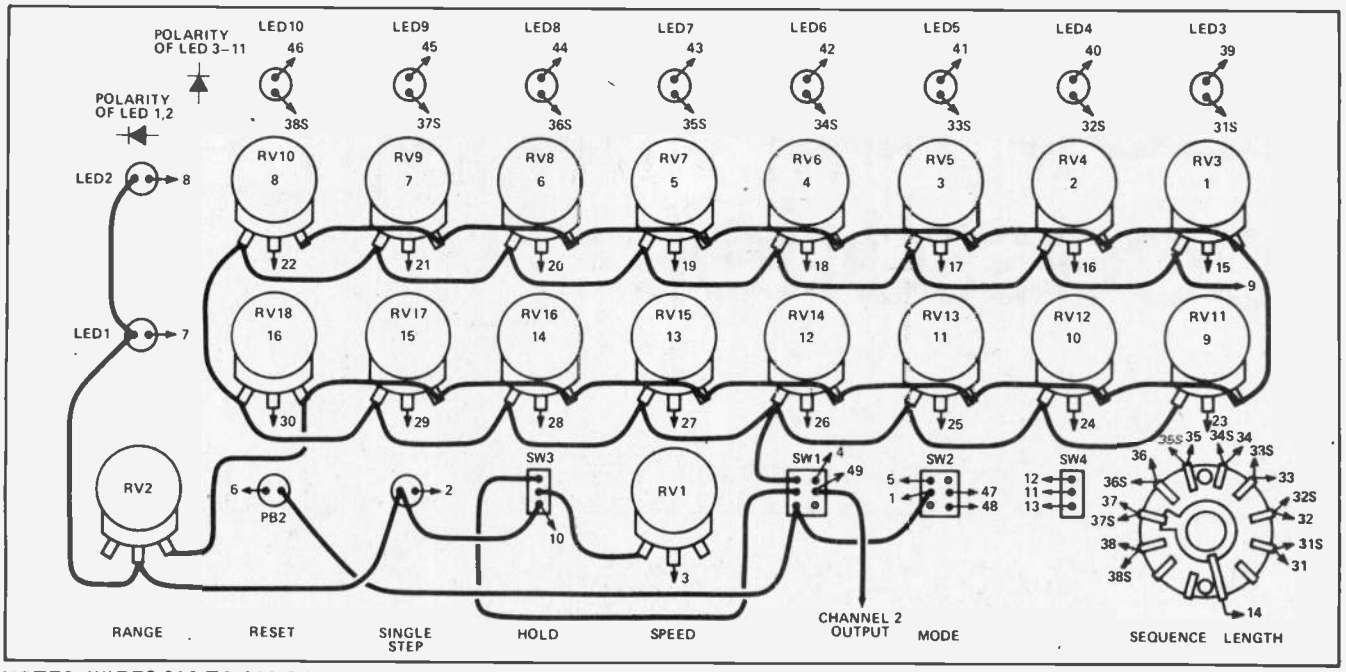
SEMICONDUCTORS

IC1	78L05 or 7805 regulator
IC2	555 timer
IC3	4520 dual binary counter
IC4 – IC6	4051 8-bit data selector
IC7	4001 quad 2-input NOR
IC8, 9	CA3130 op-amp
LED1 – LED10	Red LED with mounting clip

MISCELLANEOUS

PC board	ETI 603
SW1, 2	DPDT toggle
SW3, 4	SPDT toggle
SW5	single pole, 8 or 11 position
PB1, 2	single make pushbuttons

Front panel to Fig. 7
Bracket to Fig. 6
The pcb for this project is available from Spectrum Electronics, 38 Audubon St., S. Hamilton Ontario L8J 1J7 and from B & R Electronics, PO Box 6326F, Hamilton L9C 6L9.



NOTES: WIRES 31S TO 38S GO BETWEEN SWITCH AND LEDS.

Fig. 5. Wiring of the front panel.

used. If a higher voltage is required the value of R19 and R20 can be calculated as follows,

$$R19,20 = \left(\frac{V\ max.}{5} - 1\right) \times 10000 \text{ ohms}$$

INTERCONNECTION

While most synthesizers use some form of voltage control scheme for their oscillators and filters, it would be wise to find out exactly the requirements and capabilities of your particular unit before embarking upon, or modifying this project.

Fig. 6. Details of the small bracket which supports the PC board.

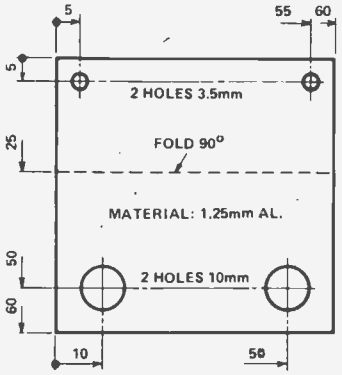
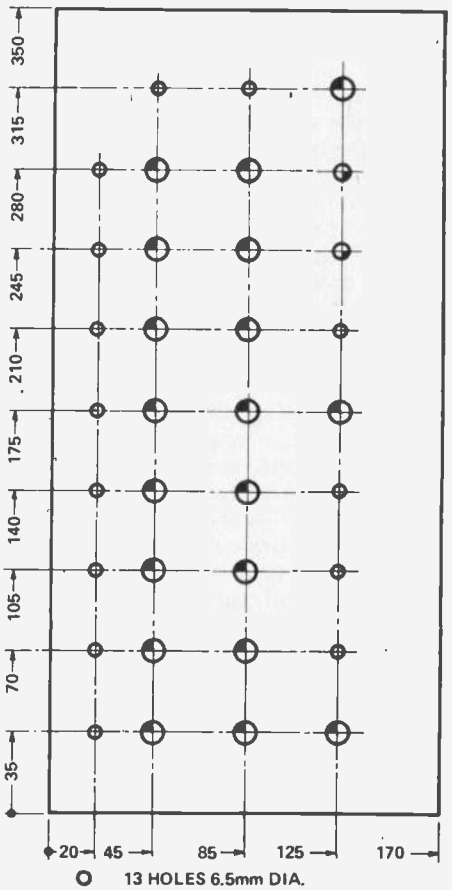
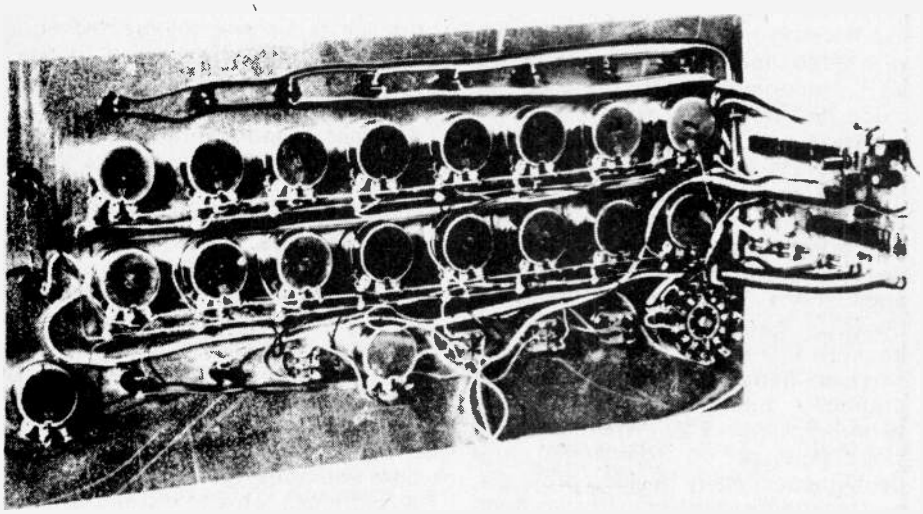


Fig. 7. Details of the front panel metalwork.





Video Tape and Accessories

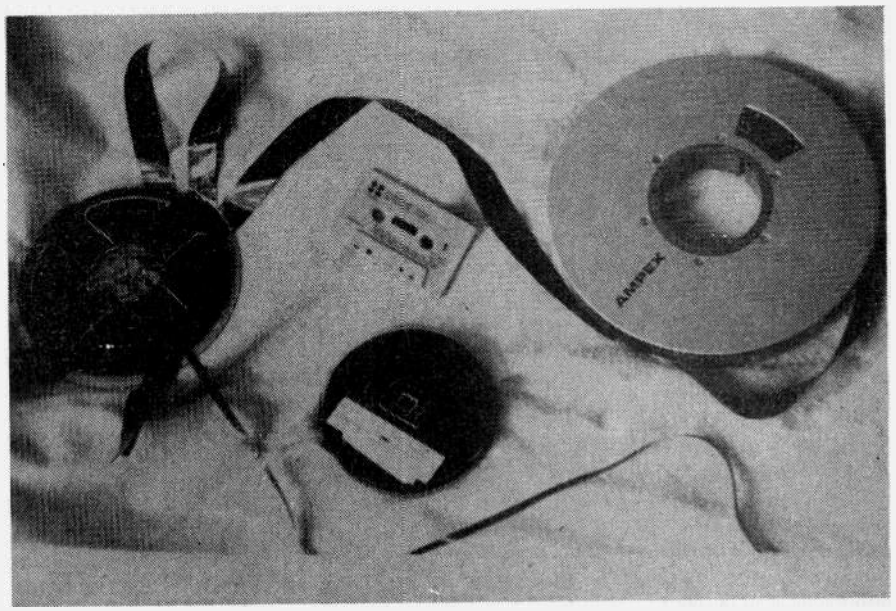
Steve Rimmer discusses add-ons in Part 4 of Getting Into Video.

VIDEO TAPES . . . A NEW MYSTERY

The "secret" of video recording is the tape: it is only with the formulation of a recording medium capable of surviving the rigors of the helical scan tape transport and at the same time record and play back the "difficult" video signals involved that all of the technology of video tape recording is possible. Whereas with audio recording the tape can be considered to be secondary, "any ol' tape that'll fit on th' machine'll do fine", with video the choice of what tape to use is of the utmost importance.

First of all, the tape must be video tape. This statement is not as erudite as it sounds. One of the temptations which sooner or later inspires most home experimenters is the bonanza of the data processing industry; computer tape. Largely made obsolete by narrower gauge tape and disc stroage systems, "fantastic, originally cost $300 a roll" one inch tape can often be had for less than the price of the reel it comes on. However, if you do manage to get it respooled and run it through your machine it will munch your three hundred buck video head in less than an hour, . . . besides producing a very disappointing picture, if any at all.

The problem with computer tape is that, just as is video tape, it has been formulated especially for its application. Data processing tape drives have stationary heads and vacuum tape guides such that the head and tape are always very slightly separated, and do not actually come in contact with one another. Thus, computer tape can be much more abrasive, and the recording surface need not be attached nearly as firmly to the backing material as is necessary with video tape. The rotating head of a VTR would very quickly grind up the oxide, and in so doing, wear itself down to a frazzle.



There are several other manifestations of one inch tape around, data (instrument) recording tape, audio mastering tape and so on, none of which are usually suitable for video applications. This, in effect, rules out buying "bargain" surplus tapes, because there is no way to figure out what an unmarked reel of tape was originally intended for, short of imperiling your VTR. When you buy video tape, do so from some party dealing specifically in video products, and make sure that it is clearly designed "video" tape.

The third hassle with video tape is that all tapes are not created equal. Each machine is designed to use a specific type of tape, and very often the tapes supplied for machines of a different manufacture will not work satisfactorily. They probably will not harm your VTR; they simply will not yield a picture. This can be rather confusing, as sound and sync will usually come out just fine.

The difference between tapes is largely in the thickness of the backing material. It seems that thick tapes used on thin tape machines cannot get enough surface area over the head to effect a reasonable transfer of energy.

The last point regarding tape is its care and housing: it is easily damaged by extremes of heat, cold and humidity. The recording surface may be

degraded by any one of a number of agents, the most common of which is fingerprints. It should not be exposed to dust, which can get ground into the oxide and later act to abrade the recording head. To this end, it should never be left threaded through the machine when not in use, wherein it is susceptible to all sorts of foreign matter floating around. It should always be stored in its box away from the aforementioned bad influences. Even the boxes warrant some consideration: the blue and white plastic containers supplied with 3M tapes, (which can actually be sealed when not in use, may be decidely better than the cardboard containers used by other tape manufacturers, or the plastic ones that Sony makes (which are not sealable), especially if your tapes are to be stored in a particularly dusty environment. Lastly, make sure that the reels that hold your video tapes are not warped, as this may fray the edges of the tape, eventually rendering it unusable.

ACCESSORIES

No system would be complete without the need for some accessories to render it incomplete as it stands. With the VTR, the range of accessories is limited only by the size of the user's workshop. Just to get your imagination going, here is a brief rundown of some of the other things you can hook into a video system to expand its versatility. I hope to elaborate on them in future writings.

The most obvious departure from simply recording and playing back broadcasted signal is to generate some of your own, and the medium which first comes to mind is the television camera. A simple vidicon unit will suffice quite nicely, and these can occasionally be found surplus for less than a hundred dollars. They can be built by the home experimenter with the ubiquitous "well stocked junk drawer" for even less. With a TV camera it becomes possible to produce one's own shows and to experiment with the television medium as a tool for creativity.

The capabilities of the resulting entity, the telvision studio (even if it is only your living room), can be further enhanced by the addition of a second camera and a method of selecting between the two. This can be a simple toggle switch, but it can also be expanded into effects boards which produce split screens, wipes, fades, dissolves and all the other various devices familiar to television viewers. The resulting "switcher-fader", as it is called, is a topic all in itself.

Video signals can also be obtained from several other sources. One of these is called the "tele-cine chain" and is used to produce television pictures from motion picture film or from still slides. In its simplest form, the tele-cine chain consists merely of a projector coupled to a camera. However, for the home experimenter who may not wish to tie up a camera in such a system, similar results can be obtained with a flying spot scanner. In this circuit, a small cathode ray tube with a blank television raster is placed before a photo tube. A slide is interposed between the two. As the beam of the CRT scans and excites the phosphor on its screen, it produces, at any given instant, a single spot of light, which is applied to the photo tube and converted back into an electrical impulse. The amplitude of the impulse is directly proportional to the intensity of the light falling on the tube's photo-cathode. The intensity of the light, in turn, is governed by the density of the slide at that particular point where the light passes through it. Thus, moving beam scans the slide and produces, at the photo tube, a video signal. Sync signals are added afterwards.

The flying spot scanner can also be adapted for use with a movie projector by replacing the projector's bulb with the photo-tube and focusing the lens on the CRT. In order to get the film to come out the right way 'round, it may be necessary to reverse the polarity of the CRT's horizontal yoke so as to make the scan go backwards.

Several circuits for flying spot scanners have been published in ham radio magazines. An afternoon in the archives of your local library should produce one or two good designs.

Your VTR can record video from any source, including some of the more recently introduced television-associated devices, such as TV typewriters, bio-feedback machines and the like. "Pong" afficionados can even use the VTR to record their matches and analyze their strategies.

Aside from things to feed into the video, you will also want to put some sound on the tape and this is done in the conventional manner. Most electronics experimenters will be familiar with the various sound components now available; mixers, equalizers, synthesizers, and so forth, and a detailed description of what can be done in this area will probably not be necessary. Suffice it to say that any audio component that is compatible with your stereo system should work equally as well with your VTR (except that the VTR is, of course, monaural: you may want an adapter to mix the two channels down to one).

There are further refinements to the system, such as effects generators, keys, video feedback loops, sync time base comparator-correctors, editing systems, and so forth which also fall into the scope of the expanding video system, but are a bit complicated to get into here. When you get the system as it stands now, together and working, these refinements can be added and the versatility of the whole mess expanded still further.

STAYIN' ALIVE

Despite the plethora of meters, belts, pulleys, gears, solenoids, relays and infernal whizbangs that make your VTR go, the routine maintenance which you must lavish upon it is relatively minimal and, in fact, will probably not prove much more troublesome than the maintenance of an audio recorder. Still, it must be observed carefully in order to keep your machine operating at peak efficiency.

The first concern of VTR maintenance is the care of the video head. Considering what this part is subjected to, it is not difficult to understand that its operating life is much shorter than that of a typical audio head. One manufacturer, for instance, cites a pessimistic 500 hours between head changes. However, the life of the head is largely determined by how it is used and maintained.

When the head is whizzing around during normal operation it develops a cushion of air between itself and the tape, several molecules thick, which negates the abrasive characteristics of the tape surface. This cushion, however cannot be maintained when the head is travelling at speeds substantially slower than those at which it is intended to run when in normal use. Thus, the major part of head wear takes place when the head is accelerating or decelerating, conditions which occur when the tape is started and stopped. Thus, multiple short recordings should be avoided in the interest of prolonging head life.

Head life is also reduced by producing "stop action" pictures, that is, by turning off the reel drive motors while the head is spinning and manually tightening the tape until a single frame is displayed on the screen.

The head must be cleaned frequently. For complete details of how and how often this procedure is to be carried out, it is advisable to consult the literature of the manufacturer of your machine, as different types of heads

require different cleaning techniques. The head is usually cleaned with a camel's hair brush, an aerosol spray or a Q Tip soaked in alcohol or a special cleaning fluid. In those cases where a liquid cleaning agent is used, avoid applying an excessive amount such that some of it drips into the workings of the machine. Many of the synthetic rubber and plastic parts used in VTRs are soluble in the chemicals commonly found in some head cleaning solutions.

The tape guides, pinch rollers, tape gates and the erase, audio and control track heads also require periodic cleaning. Once again, it is best to consult the manual for your machine for the details of this procedure. Usually alcohol on a Q Tip or a clean camel's hair brush is used.

If your machine uses slip rings to transfer video signals to and from the spinning head, your manual will also provide instructions on the cleaning of these parts.

TRAILER

Video Tape Recorders are a fascinating and complex subject, one well suited to the advanced experimenter, especially with the current availability of equipment. Hopefully, this article provided enough information and ideas to get you started in this field; there are several good books on the subject kicking around and, perhaps, if the response is favorable, there will be further video articles appearing in ETI in the near future.

Stay tuned.

With thanks, for help with the machines and the series, Barry Kushin at Philips, Emil Adamyk at Comad Communications, Bob McEwen at McEwen Photo and Joy.

Five books on page 69.

Home Climate Control Principles

The concepts are straightforward, and it's something you can play with.
From Stephen MacLellan, Senior Engineer with Canadian Thermostats and Controls.

During the last few decades we have become more aware of the demands that modern society places on energy reserves. As our desire for a better way of life sees fulfilment in more television and radio entertainment, improved telephone services, homes with central heating and air conditioning, automobiles with luxurious options, and easy access by air travel to most parts of the world, we overlook our increasing consumption of energy. The very way of life we have come to take for granted has a pretty big price tag, called energy, and we are only just starting to be able to weigh the things we want against an energy value that is going up with increasing demand.

With recent fuel shortages experienced in the Western world, we have become more aware of conserving energy, by increasing and restricting the price and availability of automobile fuel, and by increasing the cost of fuel oil used for domestic heating. The additional action taken by government to increase taxes on larger cars, and applying a special tax for automotive air conditioning, has also helped generally to cut down on a percentage of the overall energy consumption. Media ads to turn down the furnace at night, keep your car tuned up, shut off the refrigerator and air conditioner while away, and turn off unused lighting has had it's effect as well. We have managed to reduce a portion of the energy wastage that was occurring. We have also become aware that there is a lot more that we can still do to reduce and possibly eliminate unnecessary energy losses.

At present, many approaches are being taken to preserve our energy reserves, as well as developing new energy resources. Coal is being re-evaluated as a viable substitute for oil in thermal electric power generating plants, and for domestic heating purposes. Researchers are hard at work exploring solar energy conversion systems, wind turbines, tidal power projects, and fusion reactors. Engineers are pushing our technology to the limit to develop more efficient motors and generators, and to reduce the amount of power consumed by the equipment that is essential in our society (computers, communication systems, and transportation systems).

Electronics is playing an ever increasing role of importance in society. Computers and communications are obvious areas where this is so. The not so obvious areas are just as significant. Modern medicine relies heavily on electronics for investigation, diagnosis, and treatment. Many machinery operations have been turned over to electronic control, and combinations of LASERs and computers fabricate components to tolerances that mechanical machining can't come close to. What is most important in all this is these improvements are actually reducing the amount of energy consumed, yet productivity and quality are better.

The "key" to energy conservation is intelligent use of science and technology. When we accomplish this, we will open wide the doors to a very promising future.

CONCEPTS OF THERMAL ENERGY CONTROL

ANCIENT CIVILIZATIONS MADE use of the materials at hand to help them harness the sun, wind and rain to improve their environment. They had no outside help, or magic incantations, they simply put into use what they observed around them. They used common sense and basic observations of natural phenomena when they built their homes and irrigation systems. Through the centuries we have somehow managed to lose that ability. Maybe we have allowed ourselves to be caught up in the wonders of technology. Whatever the reason, it is time we all take a good look around us, and observe this world we live in. It has a lot of surprises in store for us. If we were to take the basic knowledge and common sense those ancestors of ours used a couple of thousand years ago, and combine it with the technology of today, we would have an interesting world. Can you imagine what kind of world we can have if we add our modern scientific knowledge to the other two? Fascinating, isn't it.?

The unfortunate fact is that our society as a whole has learned to accept what is, without asking why it is. Even engineers and technologists have generally stopped asking why things are the way they are around us, and yet they are the very people who work in a vocation the nature of which is to ask "WHY?".

In this article, I am going to get you not only to ask WHY, but WHAT, HOW and most importantly, WHY NOT. I am going to do this by appealing to something that in this day and age is very important to all of us, our spending money.

CONSERVATION

The field of energy conservation is vast, virtually everything you can think of consumes energy in some way, and conservation of that energy saves each of us real money.

The way in which we come closest to energy conservation is our own home heating and cooling system. Most

people think of a furnace as some sort of big black box hidden away somewhere in the dingy depths of the basement, amongst the spiders and other bugs. In other words, people are generally uninformed about their heating systems. This situation isn't helped by the service industry either. For whatever reasons, servicemen have managed to terrify more housewives with thoughts of a furnace gone berserk than Alfred Hitchcock ever dreamed of with his movies.

FEELING HEAT

I have already made a very brief reference to the use of the sun, wind, and rain in making a domicile more habitable. We all know how warm the sun can be, even on a cold winter day. I've been living in Montreal for the past few years, and I found out that it can get cool here in the winter. There have been days that not even a Brass Monkey would go outside, yet the sun shining through the livingroom window has pushed the room temperature up over 90° (32° C, I still tend to think in F°). As for wind and water, ask anyone who has lived on the coasts about that. I've walked along the shores of St. Margaret's Bay, near Halifax, with my favorite lady on a day with the temperature in the mid seventies, and actually felt cool, while friends a few miles away in downtown Halifax were complaining about the heat. Temperature and humidity were the same, but while we were exposed to a gentle sea breeze, our friends were "becalmed" as the saying goes. In the winter this combination of wind and humidity can make life miserable. For those of us with fond memories of sailing out of Halifax Harbour on a winter dawn, trying to get warm again is an exercise in frustration. That cold sea air cut through the RCN weather jackets and into your bones, and there it stayed. It isn't only temperature that we feel, it is the combinatin of temperature, humidity and wind that gives us a comfortable feeling.

The funny thing is, very few of us consider these three phenomena as related when we try to heat and cool our homes to any degree of comfort. The whole trick here is to look at the heating and cooling problems of a home as a "thermal system". Being more aware of the inter-related effects of temperature, humidity and wind is primarily a matter of experience, but most of us know that we feel comfortable when the temperature is around 70°, the humidity somewhere around 50%, and a gentle circulation of air. These values will vary depending on individual tastes, but it is the combination of the three in the right ratios that will do the job.

My intention is to give a working understanding of the concepts of thermal energy control, and I am going to do that by introducing the reader to the "tools of the trade", and then going through the application of these tools on a conventional home heating and cooling system.

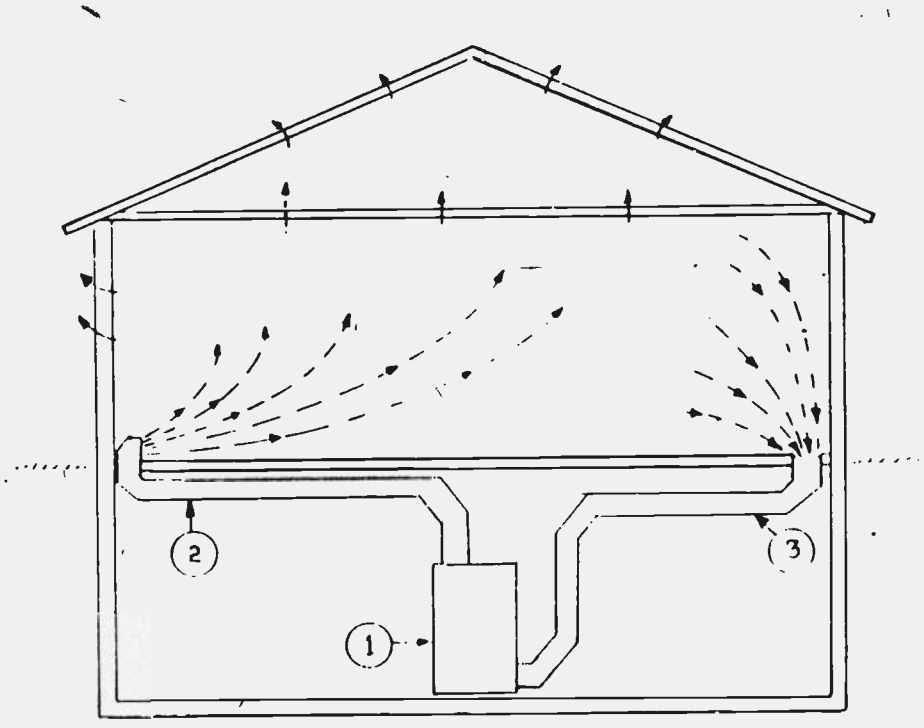


Fig. 1. In a conventional home heating system, hot air, heated by the furnace (1), is forced through the hot air ducts (2), and dissipates throughout the home, with some of the heat being lost through the roof and outside walls (as indicated by the small arrows). As the air cools down, it sinks towards the floor and is circulated back to the furnace via the cold air return ducts (3).

A surprising amount of hot air is actually trapped into the attic, and represents even in well insulated homes a fair portion of the heating costs lost since it is not circulated downwards.

TOOLS

In thermal energy systems, the "tools of the trade" are not something to hold in awe, nor is there any "black magic" or two hundred years of study before you are allowed to gaze upon the OFF/ON switch. All that is required is common sense, a little reading, and a lot of work.

Risking accusations of becoming technical, lets look at each of the tools in turn to find out what they are, how they differ, and how and why they are applied in the system. These "tools" are the temperature sensor, the temperature control, the unit being controlled (the furnace or air conditioner), the environment being controlled (the interior of a home or a greenhouse), and the thermal feedback loop. Together they form a thermal control system, and unless each individual part is considered in context with the entire system, reductions in operating performance and efficiency result.

THERMAL SENSORS

The temperature sensor is probably the most improperly used part of a thermal system. They can be as basic as a bi-metal switch, or as exotic as a Molybdenum/Rhenium sheathed Platinum/Rhodium thermocouple (used for temperature measurements up to 3000°F). Each temperature sensor has an application and temperature range it is best suited for. Table 1 gives a brief listing of some temperature sensor types broken into three main categories, with a general description of the characteristics and application areas for each type.

Some thermal sensors are also controls. Primarily this refers to the bi-metallic types used for heating and cooling thermostats in home environments, where they directly control electrical power applied to heating elements, furnaces, and air conditioners. The significant advantage with these units are their low cost and simplicity, and with the bi-metal spring types described previously in this article, offer reasonably high sensitivity and low hysteresis allowing relatively stable temperature control at any given setting. However they do have a relatively long thermal time constant (the time it takes to respond to a temperature change) and as a result can have a fairly long settling time (the time that is required for the area being controlled to stabilize at the desired temperature). The other types of sensors require some form of electronic control circuitry, but offer faster thermal response times and more stable operation while sacrificing the significant cost advantage that bi-metal devices offer.

For most residential applications however, the bi-metal devices presently available, if properly utilized, will adequately handle the requirements.

Temperature controls are devices which interface between a sensor and the heating or cooling plant. One basic type of device which I have not mentioned previously is, like bi-metal devices, inherently a temperature sensor and control. This is the Bourdon tube and expansion bellows which are usually incorporated with an electrical switch and finds its primary uses as the temperature control in a refigerator. Although these units are fairly sensitive to temperature variations, they are also more subject to mechanical failure problems since the active material is a pressurised gas within the tube that is subjected to bends and flexing during installation and maintenance periods. The tube material is usually copper, and will crystalize, becoming pourous, or actually break, if flexed too sharply or too often. For this reason, its use is restricted to minimum mantainance systems, where the tube, once installed, is not subject to flexing or mechanical damage.

Other temperature controls are electronic devices which actively transform the sensor characteristic from a semi-linear to linear response, and provide means to allow adjustment to a desired control temperature and causing an output device to turn on or off, or convert the sensors readings into a visual display of the temperature being sensed. Electronic controls of this nature are inherently stable, very accurate, and can be made to compensate for sensor aging or variation. They can also be made to be programmable, varying termperature settings with time, or sensing several independent sensors to maintain large areas or several small areas at independently set temperatures.

Their capabilities and applications are limited only by the designers imagination, but like any good thing of its nature, the more you want it to do, the more expensive it is, and unless there are individuals out there who are into gadgetry, and will gladly pay a few thousand dollars for a temperature control that will control the stereo system throughout the home as well as maintaining temperature, humidity, and air velocity in every room, and keep tabs on where junior is, most electronic temperature controls are really a little expensive and unnecessary for home environmental systems.

THE "CONTROLLEE"

The unit being controlled is almost self-explanatory. The reason I say almost is that since these units are so basic, a lot of people overlook them with a simple observation that they either work or they don't. Although it is true that furnace either works or it doesn't, it is also true that a furnace can work efficiently, or inefficiently, and still work. The point I am trying to get at here is simply that any device used for heating or cooling purposes has an efficient or inefficient way of being used, and sometimes inefficient use can make a unit look incapable of doing the job required of it. Heating and cooling units (air conditioners and furnaces) are rated in BTU's (British Thermal Units, a measure of the heat required to raise one pound of water one degree Farenheit, which is 251.98 Calories). This figure relates to the temperature change capacity the unit has, and is usually given in units per hour. What this means is that if a furnace has a BTU rating of 25,000 per

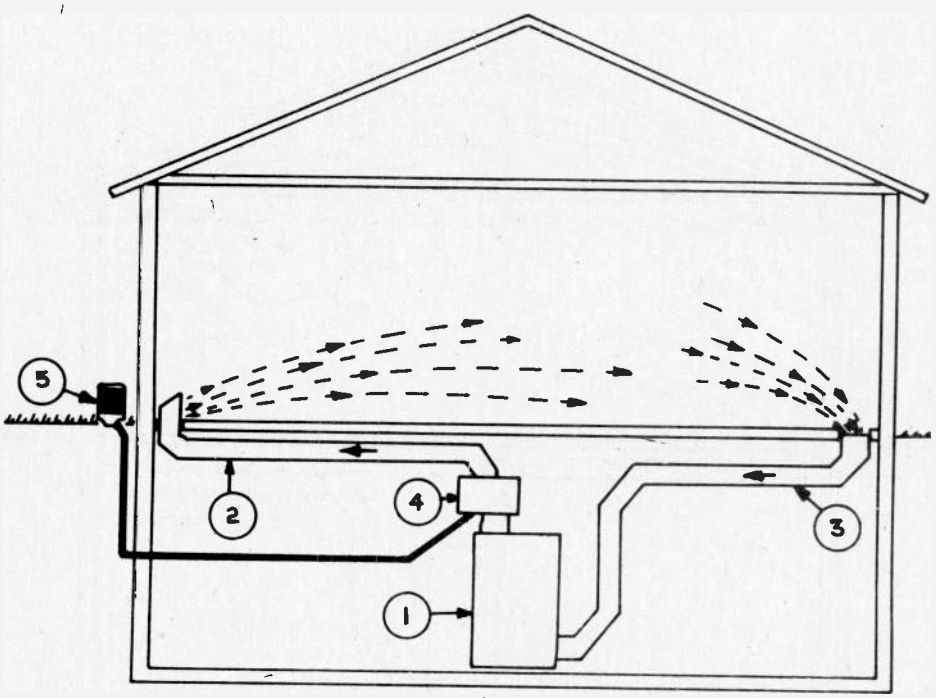


Fig. 2. When an air conditioning system is added to a conventional heating system, the cooling coils are usually installed in the portion of the existing heating ducts that are used to supply hot air to the home. The cooling coil, (4), lowers thetemperature of the air flow provided by the furnace fans (1), and is forced out into the room. But since the air is cool it tends to stay near the floor, and is drawn back into the furnace's cold air duct (3), and recirculated before significant cooling of the room takes place, which results in a layer of warmer air remaining at the ceiling. Item (5) is the heat exchanger unit of the basic central air conditioning in popular use today.

hour, and the rate of heat loss of the system it is used in is a little less than 25,000 BTU's per hour, then the furnace will just barely be able to maintain temperature stability. If however, the sytem losses are greater than 25,000 BTU's per hour, the temperature will decrease to a value considerably below the required amount, giving the impression that the furnace is not working. In fact, the furnace is working, but does not have enough output, since the requirements of the system are above the capacity of the furnace. Even if the requirements of the system equal that of the capacity of the furnace, the system will not be operating effectively, since there are additional losses in any system that are momentary or transient in nature. It is also not practical to select a furnace with considerably higher capacity than the system requires, since this approach generally causes a system to overshoot the desired control temperature, will consume more fuel than is actually necessary, and will cost considerably more than a furnace with lower capacity. Most residential heating systems are installed with furnaces or electric heating that has been matched to the requirements of that basic home type, and certain assumptions are made by the installer as to the volume being heated, and the rate of heat loss through outside walls and roof surfaces when standard insulation practices are used. In many cases however, the basic home type is "modified" over a period of time (a recreation room, enclosed garage, a second floor, etc), and these changes drastically effect the heating load that the furnace "sees", with the end result that certain rooms are colder, and other rooms are hotter unless careful attention has been paid to normal air flow through the new additions, and allowances made to reduce heat losses in new additions. Air conditioning systems are the inverse of heating systems, and their capacities, if central air conditioning is being considered, will equal the furnace's capacity under ideal conditions.

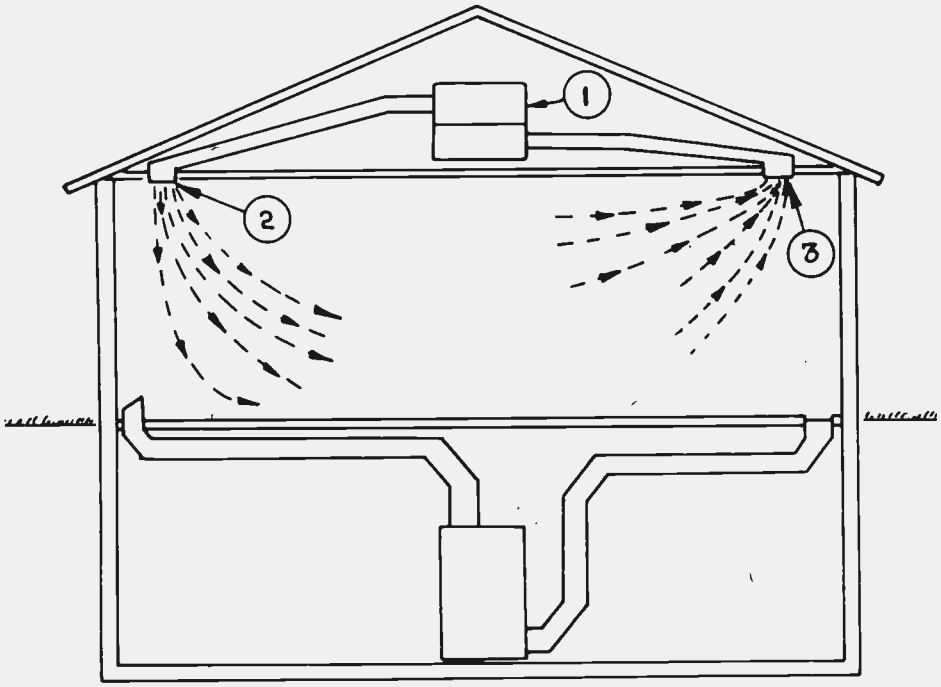


Fig. 3. A more thermally efficient air conditioning system would place the cooling coils and fan assembly in the attic (1) with the heat exchanger portion on an outside wall. Cooled air would flow naturally through the cold air ducting (2) with a minimum amount of blower energy, and sink towards the floor. As the air becomes warmer, it would rise and be collected by the warm air return (3) and then to the cooling coils. The heating functions of the furnace are completely independent, and are as in Fig. 1.

LOBSTERS AND DUCTS

Although we have actually started discussing the environment being controlled, the paragraph above mentions the environment as an aspect of the heating and cooling plants. In reality, these two portions of the thermal system are very much inter-related, since it is not just the capacity of the heating or cooling plant, but how that capacity is applied to the system or environment in question. How many times have you been sitting in a room, feet freezing, while from the waist up you feel like a well done lobster? The furnace is obviously working well, but what is wrong is that no attention has been paid to the natural phenomenon that cold air, being heavier than warm air, sinks to the floor. If some method for removing the colder air is not provided, it lies there, and creates the cold feet/hot head effect. It is a peculiar observation, but I have rarely seen cold air return ducts in newer homes. The house I grew up in many years ago in Hamilton had a cold air return duct in every downstairs room, built into the furnace. I remember them for the sole reason of the number of times my brother and I had to clean them. That house was a warm house though.

In any thermal system there will be a natural flow of heat energy from a warmer surface to a colder one. If the thermal system encloses a volume of space (a house) then this heat flow sets up a mild air flow as well, usually in a vertical direction. This process is called convection, and if taken advantage of can greatly increase the efficiency of the heating system of a home. How many roofs have you looked at in the winter that have snow around the edges, but most of the roof is bare? Have you ever stopped to consider how much lost heat energy that bare roof represents? If that heat had been recirculated back into the house from the attic, can you imagine what savings that would cause to the fuel bill? The real shame of it all is that we pay for that energy, utilize only a small portion of it; and generally let the rest escape out through the roof.

THERMOSTAT LOCATION

The thermal system in a home is a combination of the heating system, the forced-air circulation system, a convection circulating system, and the temperature sensor and control system. They form a loop that is dependent on the inter-relationship of each part. This is why in a properly installed heating system the thermostat

is situated in what at first may seem to be an odd spot. The location of the furnace is usually on the lowest floor, with the cold air return (if there is one) being provided from either the area it is located in, or from the floor directly above it. This is to take advantage of natural convection air flow to aid the forced air system in distribution of heated air throughout the home. Air conditioning systems should be just about the opposite, but you usually see air conditioning systems installed as an integral part of the existing heating system so that they can both use the same ducting with a minimum of renovation and expense. For single floor dwellings this approach is acceptable, but for multiple floor dwellings the operating efficiency is reduced considerably, since the forced air system has to move the cold air against the natural convection flow. Also, for optimum efficiency, a cold air inlet into a room should be near the ceiling, along with the warm air exhaust, taking advantage of convection flow (the cold air inlet and the warm air exhaust should also be on the opposite sides of the room). With the heating and cooling systems installed and the combinations of both the natural convection air flow and the forced air flow taken into consideration, the ideal location of the thermostat starts to become apparent. What also must be taken into consideration is which room is of primary importance as far as the temperature stability is concerned. You can rule out the kitchen immediately, since the additional heat loads in a conventional kitchen, (stove, refrigerator, freezer, toaster and lights) will, in the winter provide almost all of the heat required for that room. In the summer, its another story. That heat has to be disposed of, otherwise wife cooks before the meal she is preparing. Bathrooms are momentary use facilities, so temperature stability is not necessary (I agree it is nice, especially when stepping out of a hot shower into a cold bathroom). Since it is preferable to keep bedrooms slightly cooler (we seem to sleep better in a cool room), we are left with the dining, livingroom, and recreation room. Since most recreation rooms are located in an area adjacent to the heating system, hot air inlets into the room will be quite warm, and considering that this room also tends to be irregularly used, the stability of the room temperature is not that important. I personally feel that the most important room to keep at a stable temperature is the dining room, since I enjoy eating, and cold or hot drafts can be annoying while trying to enjoy a well prepared feast. Also, dining and living rooms are where most of us do spend our time at home, and it tends to be the area in which we entertain our guests, so it becomes the logical choice for me to select these two areas for temperature stability. The location of the thermostat within this area has to take into consideration the air flow through the room. Basically, the thermostat should be located away from the hot and cold air inlets to the room, and away from obvious drafts also. The height at which it is mounted on the wall should take into consideration the length of your children's arms versus age ratio. If they are not old enough to understand how the system works, keep the control out of reach, or put a locking cover over the thermostat. These covers are readily available from electrical suppliers, are transparent, look nice, and install in minutes. It is surprising what a reduction in fuel consumption occurs when the thermostat is left at a particular temperature.

HOW TO *NOT* ADJUST THE THERMOSTAT

The primary reason that thermostats are constantly being adjusted is due to someone finding another room either too hot or too cold. A much more effective way to correct this problem is to increase or decrease the flow of air to the room in question. This is accomplished by simply going over to the furnace, locating the duct that leads to the room in question, and adjusting the duct "flapper" until the desired results are achieved. Remember that when you are doing this, it will take a while for the change to be felt, so be patient.

Another simple but very effective method of improving the efficiency of a residential heating and cooling system is to install a fan in the attic. In the winter this fan should force hot attic air into the basement or into the cold air intake of the furnace. This would be recycling air already heated, so the furnace would not have to work as hard, and fuel consumption will be cut considerably. In the summer this same fan would be used to exhaust the hot attic air to the outside, keeping the attic cooler, and therefore upstairs rooms too, while also reducing the risk of fire in the attic due to the high temperatures created in the attic from sunshine on the roof. Air circulation in attics is also important in the prevention of "dry rot" in the support members of the roof structure.

These hints given here are very basic. But then, the intention of this article is to get us started on thinking of other ways our existing heating and cooling systems can be made to operate more efficiently. Installation of automatic thermostats (that will decrease the control temperature at night), additional insulation where required (or more insulation if the old insulation has settled, leaving open space), small fans to aid air flow throughout the home (stirring up the room air to get rid of the cold feet/hot head effect), covering outside windows with semi-reflective mylar film (reflecting heat back into the rooms), locating the thermostat in the most effective spot, and leaving it set at one temperature, are all things we can do now.

NON-AIR HEATING

Most of the above discussion has been slanted towards hot air heating systems. A little thinking will allow transferring these concepts to hot water heating systems, and independent electrical heating systems. In both of these systems, moving the hot air from the attic down into the basement will recirculate warm air, reducing the heating load required of the hot water system or the electrical heaters.

For those of you lucky few who have open fire places, several improvements have been made that not only make a fireplace more luxurious, but a lot more efficient as well. For example, the "Physicist's Fireplace" holds the burning logs so that they assist in the radiation of heat into the room, while another burning log holder allows air to flow through the support tubes where it is heated by the burning wood, and flows out into the room. Several fireplace designs circulate room air around the firebox and back into the room. If a person were to combine these three independent ideas, he would have an efficient fireplace indeed. If a heat exchanger radiator were mounted along the inside of the chimney, then an additional inexpensive source of hot water is created also.

Earlier I briefly mentioned ancient uses of sun, wind, and rain for environmental control of a domicile. We now have the capability of utilizing these effects much more efficiently, especially when modern materials and technology are taken into consideration. Use one way reflective glass to allow sunshine to enter a room, and at the same time, reflect the heat back into the room (for winter) or reflect heat away from a room (in summer). The use

Do not read page 36.

of plants in a room will help to refresh the air, humidify it and actually help to control the temperature somewhat. Ever noticed how a plant lover's home, although filled with plants, always seems fresh and comfortable? It takes a lot of plants to have a significant effect; but they are efficient and inexpensive to operate.

Uses of sun, wind and rain are detailed in many articles. For reference reading, and scavenging of ideas (after all, a little honest plagerism is beneficial), I recommend the following publications.

Published by Instrument Society of America, 1973, Pittsburgh Pa.

There are many other texts available on this field, but I find the above mentioned ones to be the most referred to in my library. If you visit our local library you will find books on virtually every conceivable aspect of temperature measurement and control, and through those books you will, like I have done, open your eyes to what we can do now with the materials at hand to make our homes more comfortable and a lot less expensive to keep them that way.

BIBLIOGRAPHY

Semiconducting Temperature Sensors and their Applications (Herbert B. Sachse)
Published by John Wiley & Sons, Inc. 1975.

Temperature Measurement Handbook 1978 (Omega Engineering, Inc)
Published by Omega Engineering Inc. PO Box 4047, Stamford CT, 06907

The Solar Decision Book (R H Montgomery)
Published by Dow Corning Corp, Midland, Michigan.

Thermoelectric Handbook, Second Edition
Published by Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge, Mass. 02138.

Decision Making in Solar Energy System Design
Published by Design Product News, Nov 1978.

Temperature — It's Measurement and Control in Science and Industry, Vol 1 to 4

DEVICE TYPE	CHARACTERISTICS	APPLICATIONS
SWITCHES Bi-metal switches Mercury Switch/ Bi-metal coil combinations. Thermal Fuses	Gives a mechanical contact opening or closing at a specific temperature, with an inherent hysteresis of 10C degrees or more. (for most bi-metal switches) The thermal response time is quite slow.	Used in low cost thermal protection for electric motors, transformers, heating elements, consumer appliances, refrigerators, automotive and industrial machinery. The combination of Mercury switch with bimetal coil finds primary use as a thermostat in home environments. (Covers 0C to 200C)
SEMI-LINEAR Thick Film Thermistors Thin Film Thermistors Thermocouples Semiconductor Devices IC Temperature Transducers	Generally exhibit a semi-linear impedance change versus temperature plot, (some devices give a volt/temp characteristic) Devices generally exhibit very fast thermal response times, excellent stability, and high reliability.	Used with support electronics for a variety of temperature monitoring and precise temp measurement and control in the industrial and scientific fields. (Used from -250C to 4500C)
TRANSITIONAL Thick Film Pos. Temp. Coef. Thin Film PTCs Thick Film Neg. TCs Thin Film NTCs	Exhibit an abrupt change o f impedance at a specific temp point. Generally have a very fast thermal response time, excellent operational stability, and precise repeatability of transition point.	Primary uses in the thermal protection of semiconductor devices, ICs and in specialized "expanded scale" temperature monitors and controls. The NTCs are finding increased useage in the IC fabrication industry as on-board thermal protection. (Presently these devices cover from 10C to 140C)

Table 1. Characteristics of various thermal sensors, and their applications.

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News on Zenith, Electrohome, GTE Sylvania and keeping a small business afloat.

HI! JANUARY 8 and 9 the Zenith Radio Corporation held the first of their 1979 shows in Toronto. The event seemed to be well attended and according to the company management it was a very successful one. Since I no longer have to concern myself with possible future sales, what to buy, and so on and so forth, and seeing no great change in the receivers on display, I spent most of my time in the parts and service sections. A very effective active flea market was run by the service and warehouse personnel and there were some extremely good buys available for those people who arrived on the Monday. An old friend of mine (G. & G. Electronics) was having a fine time. He is opening a new branch of his very well established service/sales operation, which is going to be a retail parts outlet. George (the boss) informed me that though the new department was primarily intended for the hobbyist, he would be delighted to offer a reasonable discount to all professional servicemen requiring such parts as transistors, triplers, flybacks, rebuilt tuners etc. This operation is not to be confused with the established wholesalers, but more in the nature of a convenience for local technicians who need a part in a hurry. To assist in the stocking of this new enterprise he was purchasing everything in sight that looked like a good buy. He certainly took advantage of the old adage, the early bird gets the worm. By the time he moved on to the B. & K. exhibition the stock in the flea market has been considerably reduced. (Any serviceman seeking some of the older Zenith replacement speakers, flybacks, etc., contact G. & G. Electronics.)

ZENITH CHASSIS AND SEMINARS

I had a long conversatioh with Mr. Glen Andrews, the national service manager, and he reaffirmed to me that the System 3 chassis was performing satisfactorily as expected. No bugs had developed and the general public's acceptance of this new chassis was extremely gratifying.

Mr. Andrews apologized for the fact that the new schedule of cross-country seminars had not yet been completed, but promised to let me have this as soon as possible. However since the time now is early January and this will not reach the newsstands until March, it may be in some instances too late to be of any real use to interested technicians. However I would suggest that all technicians interested in attending the seminars should immediately contact their local Zenith representative with a view to finding out exact times and locations for their area.

Thanks to Zenith for a fine day.

ELECTROHOME

Reading some previous columns of mine I came across the November issue and was reminded of Service Electrohome's expansion into other manufacturer's products. I decided to visit Electrohome's large service centre on Idema Road to see what, if anything, was transpiring, and was greeted most cordially by Mr. Hoffer and Mr. Bertin, and we sat down to discuss how things were going. It was not surprising to me to find Mr. Hoffer talking about still further diversification, closed circuit TV being one of their latest additions. He obviously is very much on the ball in seeking still further electronic servicing. With some little reluctance he let me into the main workshop area, and I was quite surprised to find no evidence at all of other brands awaiting service. The service reception area was inundated with sets (stereo and TV) and many black and white and colour TV portables, but looking carefully around the racks I saw nothing other than Electrohome products. It may be that since it was Friday all finished work was on delivery. Mr. Hoffer did point out that the amount of non-Electrohome service has not yet reached an appreciable percentage of their complete work load.

SMALL BUSINESS

An old friend of mine who has been a domestic electronic technician for many years recently came to see me, and after a period of reminiscing I asked him, as a one man operation, how his own small business was standing up to present day competition. He sounded off at some length about manufacturers' intrusion into the service field and was not very happy about either R.C.A. or Electrohome, however he finally calmed down and had to admit that in reality his business still continued to give him a reasonable standard of living. He told me that although he did not consider himself to be a brilliant technician, he had by hard work and often extremely long hours, managed to survive when other technicians of his acquaintance had come and gone. He told me that when solid state first began to make its mark he was quite concerned about his ability to service this new development. However he assured me that by dint of considerable studying and knowing where to go for advice, and if necessary to sub-contract a chassis out, he was able to maintain his operation satisfactorily. In passing I would like to say that this man has been in business for over 20 years and operates from a small shop in North Toronto. He did not start with a large amount of capital, and yet by tenacity and perseverance he had amassed a not inconsiderable number of extremely staisfied clients. Best of luck, J!

Service News

Before closing I would like to point out to our readers that I unfortunately know very little about service problems outside Metropolitan Toronto..I would very much like to hear from service persons across Canada on any matters, large or small, pertaining to our industry. Please write me care of Electronics Today.

Belatedly, my I wish you all a Happy and Prosperous New Year.

Best of luck, Richard Cartwright.

LATE NEWS . . .GTE SYLVANIA TO HOLD SEMINARS. Here's what you'll learn about, when and where.
E48 and E49 feature a VIR module that provides automatic tint and colour control cicuitry.
E49 is now available with a remote control digital tuner.
A buffet or Smorgasbord lunch will be provided.
Meetings will start at 9:30 a.m. at:
Barrie: Wed Feb 14, Continental Inn 395 Dunlop St., W.
Toronto: Tues & Wed Feb 20, 21 Holiday Inn at Warden and 401
Kingston: Tues Feb 27 Holiday Inn 1 Princess St.
Chatham: Tues Mar 6 Holiday Inn 25 Keil Dr.
London: Thurs Mar 8 Lamplighter Inn 591 Wellington
Jordan: Wed Mar 14 Beacon Motor Hotel, Q. E. W. & Jordan Rd.
Belleville: Wed Mar 21, Four Seasons Hotel, 11 Baybridge Rd.
Cambridge: Wed Mar 28 Holiday Inn 401 and 24 N.

QRM QRM

LATE NEWS!!!!!
The world's highest 2m FM repeater-attached-to-the-ground-by-a-building was tested in mid January. The TFM club proudly operated VE3TWR, their CN Tower based unit. In on 449.4 and out on 444.4 MHz, its estimated range is 70 km, favouring the north side of the tower, on which side the antenna is mounted. Paul Edgely VE3PQ, and Andy Betterton G8FNF are responsible. Details: TFM Communications Society, Box 427, Willowdale Ont. M2N 5T1.

Bill Johnson, VE3APZ, figures cleanliness is next to keeping Canada's repeaters repeating. He also draws some fire from the RSO.

WE'RE VERY LUCKY here in Canada. Our Southern neighbours have reams and reams of regulations pertaining to amateur operation. Just about every condition you could possibly think of has been — and there is a regulation to cover it. The most prolific regulations are those covering VHF and repeater operations. The way in which a repeater station can be operated and must be maintained is spelled out explicitly. One would think from the degree of complexity of the regulations that safety of life at sea, for example, was totally dependent on the proper operation of an amateur repeater station. It is not my purpose to elucidate the entire regulations in this column, but a few points may serve as words to the wise in Canada. One of the most recent effects of the tight regulations down south has been the shutting down of all fully-automatic phone patches (autopatches) unless a central operator is on duty.

A central operator is a duly licensed amateur designated by the licensee of a repeater to have control over the repeater by using touchtone, usually on secret 450 MHz inputs. The central operator's job is to monitor the repeater and shut it down if any technical malfunction or operator's abuse (usually the latter) occurs. He has to sit there hour after hour listening to the absolute drivel that sometimes goes on on two metres and is personally responsible for any breach of the regulations that goes unnoticed and is allowed to continue. The number of central operators is usually limited to two or three, and the job is further made difficult by the fact that you cannot perform this function from your car due to an interpretation of a regulation which says users of remote base stations have to be fixed stations themselves.

This makes being a central operator a pretty lonely and boring job, yet there are plenty of people willing to do it — just goes to show how dedicated some amateurs are.

IN CANADA

What's this got to do with us safely above the border you say? Plenty. Since America is ten times the size of Canada, then it follows that they will have ten times the problems, right? The problem (let's take autopatch abuse, for example) that is not big enough yet to raise an eyebrow at the D.O.C. has probably already caused the regulation — writers in America to sharpen their pens. So when we see regulations being put into effect in America then we should start taking a good hard look at the way we are doing things here, and possibly mend our ways before it is too late. In a way, you could say we almost have a crystal ball.

TFM CASE

Last year, at a directors meeting of the Toronto FM Communications Society Inc., we decided that we should take all the operating cautions, notes and hints that we have published in our bulletin over the ten year life of the Society and formulate them into a set of rules for the use of our four repeaters. We went through several directors' ideas of drafts, weeded out the bad ones, amplified, re-wrote and explained, and ended up with two pages of strict 'guidelines', to be followed by everybody using our repeaters. We changed all our repeater access codes because they had been broken and passed around over the years, and only gave them out to fully paid up members who had read the rules and signed a form to say they had read them and would follow them. To the majority of people, this appeared to be a very good idea, and many said so. There were a few individuals, however, who complained bitterly at having to sign, saying we were taking away their rights and freedoms etc etc., but they signed, because they wanted the codes, and they didn't want to be labelled as dissenters.

As I said before, we are very lucky in Canada. For example, there are no specific regulations on how a repeater is to be run. There are some 'guidelines' however, which basically state a repeater should have an identifier, a timer, and the licensees should be able to control it by physical or remote means possibly assisted by two or three people whom he may designate in writing to the department. This is the way it is, and THIS IS THE WAY IT WILL STAY, as long as the people that make the rules see that we can regulate ourselves and behave in a mature and sober way with a minimum of supervision. Two metre FM is a very good example of this, and one to which most amateurs can relate, but is spreads into every facet, every subdivision of our hobby. As long as we obey the rules we have, and don't try to stretch them to suite our selfish wants then we won't have to worry about having our privileges taken away — 'the squeaky wheel gets the oil'. 73 till next month

QRM LETTERS

The January QRM column contained comment on the RSO's proposed repeater. Following its publication, I received a phone call from one of the Vice Presidents of RSO Repeater Inc., who says I only gave half the story. He has since written to me and his letter appears on the following page. Others on the RSO executive have also written, their views will be aired in future issues.

Several people have written in asking how they may become an amateur.

For Mr. Saik Teewatctah of tent 13, Cheegaboogoo Reservation, Southern Northwest Territories, I can only advise a good book and lots of self-study. (Not the kind Gurus peddle). Those who live in the larger population centres will usually (almost always) find a radio club within driving or bussing distance of their home. There are several ways of contacting these clubs:—

1. Beg, borrow, steal, or, as a last resort, buy a copy of the 'Radio Amateur's Licensing Handbook' by Jim Kitchin VE7KN, published and distributed by ALH distributors, P.O. Box 27, Vancouver, B.C. As well as being a valuable text for study, it also lists Canadian Amateurs, province by province. Look through the list and find one close to you. Get his number from the phone book and give him a call. Tell him you want to learn how to be a ham and don't know where to start. He'll probably invite you over to his shack to see what it's all about. He'll at least be able to tell you where the nearest club meets, and probably be able to put you in touch with the person who runs it.

2. Canada has two national organizations for amateur radio.

a) The American Radio Relay League Canadian Division, P.O. Box 418, SACKVILLE, N.B., E0A 3C0 (506) 536–1208.

b) Canadian Amateur Radio Federation Inc., P.O. Box 356, Kingston, Ontario, K7L 4W2.

Both of these organizations have lists of clubs to whom they can refer you. Most clubs have very inexpensive training classes weekly starting in the fall and going until spring.

3. You can get a book called 'From five Watts To A Thousand' at your local Radio Shack store.

The standard study guide for begining amateurs is 'Ham Handbook for Beginners' by Glen Emo, VE3EME, published by Arta Publishing, Box 571 Don Mills, Ontario M3C 2T6. Don't buy this if you plan to join a club course — they quite often buy them all together and get a discount.

RSO REPEATER COMMENTS

I would like to express my profound disappointment with the tone and context of your article on the RSO Repeater Project in the January issue.

My involvement with VHF FM began in 1963 when I worked on mobile radio equipment and repeater stations eight years commercially. In 1969, with some assistance from other amateurs, I built VE3KSR which was, as far as we are aware the first repeater in Canada to be licenced to a club and the first to use touch tone for contol.

In 1969, a group of us who were involved with repeaters formed what is now the Western New York and Southern Ontario Repeater Council. In 1970, I was involved with the development and testing on the Multi-Channel boards for VHF FM which was published in the VHF Repeater Manual by ARRL. In 1976, we helped develop the now famous KSR power supplies for amateurs to use with their surplus mobile equipment released from a communications company which our club distributed to amateurs all over Ontario. That same year, VE3WFM repeater went on the air in Waterloo which was built and owned by myself. The Kitchener Waterloo Amateur Radio Club honoured me with the "Amateur of the Year" award in 1977.

As you can see from the above paragraphs, I too have been "intimately involved in 2m FM for ten years." I'm therefore very concerned with the negative connotations which I feel you would leave with readers of your article.

Let me back-track just a little. After listening to several busy repeaters, including VE3KSR, it occured to me that much of the time that the repeaters were on the air, they were being used in a frivolous manner. A NEW CONSTRUCTIVE use that they could be put to would be for CODE PRACTICE. This code practice on a DAILY BASIS would assist new people to get into amateur radio. They would simply tune into the LOCAL REPEATER on a readily available public service band receiver. Thus, they would not have to invest in a communications receiver to pick up W1AW. I proposed this idea to the VE3KSR group, and they approved the system.

Lloyd Ferns, VE3BZF, of the Orangeville area, started to work on a teletype system of generating Morse. On December 9, 1975, he went on VE3KSR with about 150 sessions of code practice at 15, 10, 7½, and 5 words per minute. The following year, he conducted 187 nightly sessions on VE3TTY and VE3KSR. In 1977, he went on the air with a 200 foot tower and 6dB antenna to feed code practice to 6 repeaters simultaneously on 147.990. The full story of his efforts appeared in the April 1978 issue of the Ontario Amateur. This year, Lloyd was awarded the Clifford Marsh Memorial Trophy, "Amateur of the Year" for his self sacrificial assistance to others in pioneering a system to transmit code practice high in quality, reliable, inexpensive to use, and never before available to would-be amateurs.

Lloyd and I discussed the idea of establishing a repeater at his house so others could originate code practice and feed it out on the network. Should we once again scrounge and build to produce a repeater for this project, or should we solicit donations and purchase the best, most reliable repeater available? The answer to that question for me was clear after having built two repeaters and spending hundreds of hours in the process: let's for once put on a super reliable commercial quality repeater for this demanding job of code practice.

I presented the idea to the Kitchener Stratford FM Association Inc. in May 1979. They agreed that we should proceed with the project and since a group in London had obtained a Wintario Grant to establish a repeater, we agreed to apply for a grant as well.

The next question to consider was whether this project for ALL AMATEURS of Ontario should be sponsored by a local Kitchener area group, or whether a large organization such as RSO should become involved. Harold Braun and I presented the idea to the RSO executive and they thought it was a fine project, and agreed to help us get it going. A new incorporated company, the VE3RSO Repeater Assn. Inc. was formed with Harold Braun as President, and George Davis and myself as Vice Presidents.

This repeater will be on the air in the spring of 1979 and will have battery backup supply designed to run for 3 days in the case of a major disaster. It will have a micro-processor for the code generation, storage, and other "tricks" for Morse code only. Keith Bently, VE3DHL, is the engineer in charge of this area of the project. While morse code is the primary function of this repeater and it is the largest and most costly repeater ever planned in this area, it will be a real asset to the amateur fraternity. We are awaiting approval from Wintario and as you are probably not aware, the total budget represents one third cash on hand one third Wintario grant, and one third donated labour.

Recently I have been appointed to head the VHF-UHF Advisory Committee of the RSO and the Frequency Study Committee of the Western New

Continued on page 66.

SWLs and QSLs

John Garner describes the fascinating hobby of collecting QSLs and tells how to go about getting them.

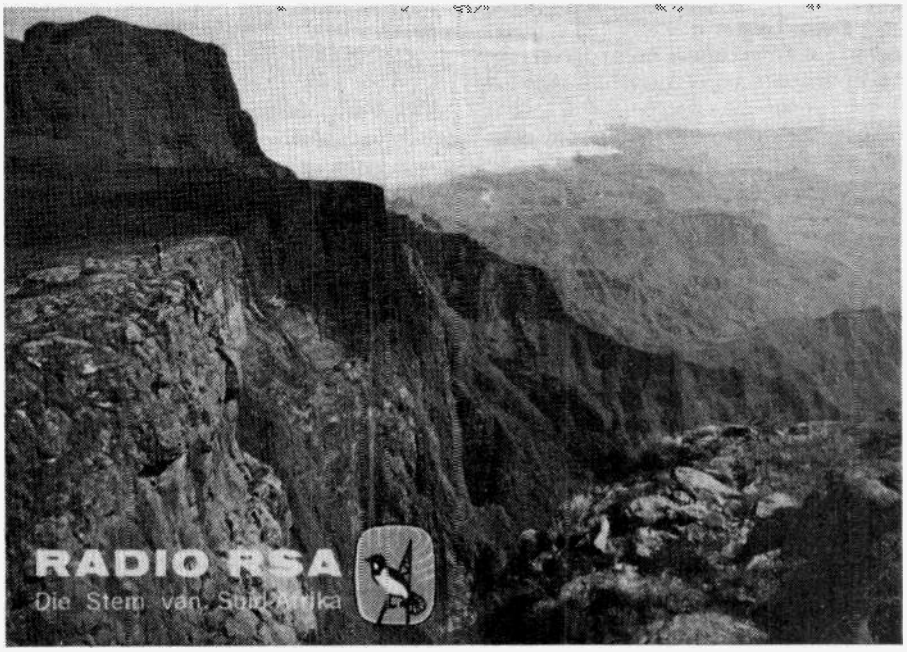
SINCE THE VERY early days of radio broadcasting, listeners have been sending reception reports to far away radio stations which they have heard. Perhaps the first request for reports from a station occured on Christmas Eve, 1906 when the first radio voice transmission went out to ships owned by the United Fruit Company from the Company's office in Brant Rock, near Boston, Mass. The host of that program which included Christmas greetings and music for the occasion, was Reginald Fessenden, the Canadian who invented radio as we know it today. That particular program was the first time radio was used to carry the human voice and also the first time music went out over the airwaves.

A good reception report contains the following: Technical details which will enable the station's engineering department to evaluate the quality of the signal being sent out to a particular area of the world; Personal comments which help the producers to improve the contents of their programs to suit the needs and wishes of their listening audience; Details from programs heard in order to make verification possible.

WHAT TO SAY

Stations receive many reception reports every day so it is very important to make your report easy to read and understand. Many clubs issue printed forms for this purpose. If possible your report should be typewritten — otherwise printed or written very clearly.

The language you use to write your report should be in the same language as the program heard or the language of the country broadcasting the program heard. English may be used for your report if it is going to one of the major international broadcasters but in most cases will be of little use when writing to most of the smaller domestic stations



Thank you for your report on the reception of our transmission from the

H. F. Verwoerd Shortwave Station

DATE: 13-11-78 TIME (GMT) 2230

FREQUENCY: 9585 kHz

RADIO RSA
The Voice of South Africa
Box 4559, 2000 Johannesburg, South Africa

DRAKENSBERG South Africa
Tugela Falls and the superb view from atop "The Amphitheatre" - in the Royal Natal National Park.

DRAKENSBERG Suid-Afrika
Tugela-waterval en die pragtige uitsig van "Die Amfiteater" af - in die Royal Natal-Nasionale Park.

Mr. J.J. Garner,
980 Georgina Bay,
Thunder Bay,
Ontario
CANADA P7E 3H7

where English may not be understood.

Personal comments should be on an enclosed letter separate from the technical portion of the report. In this way the technical section of your report can be passed on to the engineering department while your comments will be directed to the program producer.

When writing a reception report to a station, probably the first thing that you should do would be to clearly print your name and address at the top of the page (as well as at the top of each additional page). Many SWLs have criticised stations for not QSLing when in fact the station's staff were unable to read the name and address or it was completely missing from the report.

While listening to a program on the short wave bands it is always a good idea to jot down a few notes to enable you to prepare your report later on. A tape recorder is also very useful in this respect to help you later on with program details.

Mention the name of the station heard at the beginning of your report. State the frequency in kilohertz as exactly as you can. The date and time of reception (in GMT) should be given next. Your local time is of no use to a station on the other side of the world so GMT (or Coordinated Universal Time, which is really the same as GMT) should always be used for international broadcasting stations.

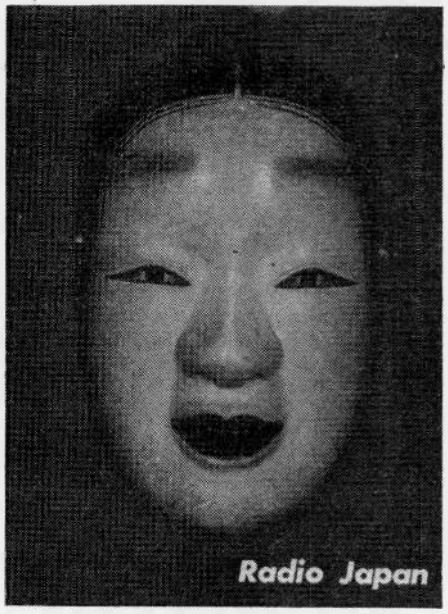
If you live in a small community, explain the location of your town by telling the station the distance and direction from a large, well-known city.

Five or six details about the program heard over a period of at least fifteen minutes (preferably longer) should be sufficient to prove that you did indeed hear the program that you are reporting. Some typical details might include the name of the program, the name of the host or announcer, the name and/or composer of a piece of music, the names of any products being advertised, the subject of a commentary or discussion. It is also a good idea to list the time (in GMT) of each item you report.

RECEPTION QUALITY

This is, of course the main purpose of the report — to let the station's staff know how well their efforts are getting out to their target areas as well as elsewhere in the world.

For the major international broadcasters the SINPO code of reporting is preferred. This code is explained in Chart 1 and the following paragraphs.



Signal Strength If your receiver has a built-in S-meter you can use it to determine signal strength. If the S-meter shows between 1 and 3, the S (for signal strength) will be listed as 1; between 4 and 7, S = 2; between 8 and 9, S = 3; between 9 and 9 plus 20 db, S = 4; and over 9 plus 20 db, S = 5.

If you do not have an S-meter on your receiver then you can judge the signal strength from the amount the volume control has to be turned up from zero. A signal strength of 5 would only be used for stations that are coming in as strong as a local station on your medium wave radio.

Interference All stations are very interested in knowing if they are being interfered with, especially when they start transmitting on a new frequency. If you can identify an interfering station the station is appreciative of this information. Also it is important to let them know if the interference is on the same frequency or on a higher or lower frequency. If a station is being jammed, this information should also be noted along with the type of jamming as well as you can determine it.

Noise Atmospheric noise from electrical storms and polar light is included here. The source of the noise may be thousands of kilometres away and may just show up as a high noise level in your receiver. Man made electrical interference, such as vacuum cleaners, hair dryers, etc, are not included in the code.

Propagation This could better be described for most as fading. A 5 for this portion of the SINPO code would indicate a stable volume throughout the recorded logging period, while a 1 would indicate that the program was fading completely away at times.

Overall Merit This is a measurement of the readability of the station's signal. The station would appreciate a comparison of their reception with other stations on the same continent and broadcasting in the same bands.

Your local weather conditions are of no use to the station since radio propagation is mainly influenced by ionospheric conditions and not by weather in the lower atmosphere.

Tell the station what type of receiver and antenna you are using. You might mention the number of transistors and/or tubes in your receiver and the year in which it was manufactured. The antenna length and height above ground should be stated in metres since the metric system is in use in almost all parts of the world. Be sure to indicate whether you use an indoor or outdoor antenna.

I will continue this discussion about reception reporting and the resulting QSL cards that you may expect in return for your reports, in next month's column.

SHORTWAVE WORLD MAILBAG

Andre Renes writes to say that he is interested in converting a TV tuner for VHF reception. If anyone has any information on such conversions drop us a line and we will pass it on to other interested hobbyists.

Andre continues "I have also experimented with adding a variable condenser to the existing one in my Heathkit RX1 receiver. This allows me now to tune in not only to the amateur bands but also to regular shortwave

broadcasts in the 16—49 metre bands. I have already listened to some very interesting broadcasts from Egypt, Australia, India, Israel, Netherlands and many more . . . I am also interested in what is necessary to receive Amateur TV (Slow scan) — I suppose a TV receiver could be rewired for this purpose."

Since this column is meant for shortwave listening, it is very nice to know you are enjoying broadcasts from some of the major shortwave broadcasters. In regard to your question about amateur TV reception, perhaps this should be directed to the Ham column in ETI. One manufacturer of Amateur slow scan TV equipment is Robot Research Inc., 7591 Convoy Court, San Diego, CA 92111, USA. Good luck, Andre, in your conversions.

I'd like to take this opportunity to thank those who have enjoyed this column and taken the time out to write and let me know. If you have any questions about short wave radio write to Shortwave World, P.O. Box 142, Thunder Bay, Ontario, P7C 4V5.

EQUIPMENT REVIEW

A name well-known in the home entertainment field in Canada is the Sony Corporation. Sony introduced the world's first pocket sized transistor radio. They also produced the world's first AM/FM transistor radio, the world's first medium wave/short wave transistor radio and the world's first radio using integrated circuits (ICs). With a record like this in the radio field you can be assured of sound quality from Sony.

Sony manufactures seven portable receivers that include the short wave bands. These range in price from $150 to $2150.

ICF-5800L — This is a compact five band portable which features AM, FM, and LW (longwave) as well as two short wave bands covering the frequencies between 1.6 and 12 MHz. It has a large dynamic speaker, separate bass and treble controls and a telescopic antenna. A built-in timer turns the radio on or off automatically. It is supplied with an earphone and carrying strap and operates off 4 'C' size batteries or on house current with the optional AC adapter. The ICF-5800L measures 208 mm wide, 228 mm high and 84 mm deep and weighs 2 Kg with batteries. The Canadian list price is $149.95.

TFM-8000W — This receiver features AM, FM, PSB (Public Service band) and three shortwave bands covering the frequencies from 1.6 to 26 MHz. It has a built-in AC power cord or it can be operated on 4 'D' cells. A tuning meter and fine-tuning bandspread are included for shortwave. Also featured are an automatic AC/Battery switching circuit and a convenient battery check button. The TFM-8000W measures 210 mm high, 290 mm wide and 105 mm deep and weighs 3.2 Kg with batteries. The list price in Canada is $199.95.

ICF-5900W — This set has the AM and FM bands as well as three short wave bands which cover the frequencies from 1.6 to 30 MHz. The precision tuning along with a built-in crystal marker provides accuracy to within 5 kHz on the shortwave bands. SSB and CW reception are also possible with this receiver's BFO switched on. The ICF-5900W also has a battery check and tuning meter. Operation is by three 'D' cells or on AC with the AC adapter supplied with the set. This radio measures 235 mm high, 222 mm wide and 102 mm deep and weighs 2 Kg. The Canadian list price is $239.95.

CRF-5100 — "Earth Orbiter" — This portable has the AM, FM, LW, PSB, and aviation bands as well as five shortwave bands covering the frequencies between 1.6 and 26 MHz. There is precise tuning on all 10 bands with LED tuning indicator, tuning meter and fine tuning bandspread for SW. The BFO signal generator allows reception of SSB and CW signals and the PSB and aviation bands have a squelch control. The CRF-5100 has a built-in AC power cord but may also be operated on 8 'D' cells. A World Time Zone reference chart is built into the case to allow the user to determine the best SW reception times of countries and cities throughout the world. Measurements of the CRF-5100 are 230 mm high, 340 mm wide and 160 mm deep and it weighs 6.4 Kg. The list price in Canada is $499.95.

Next month's equipment review will feature the other three Sony shortwave receivers — the ICF-6700W, ICF-6800W and the CRF-320. So until then 73 and good listening.

Number	Signal Strength	Interference	Noise	Propogation	Overall Merit
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely Audible	Extreme	Extreme	Extreme	Unusable

Chart 1. The SINPO code.

ICF 5900

CRF 5100

Calculator Hangman

Use your calculator for word games. By Rick Campbell of London Ontario.

THIS PROGRAM is a calculator version of the popular game "Hangman". The object of the game is to guess a hidden word which has been entered by your opponent. Guesses are made by entering a letter from the alphabet which the player believes is contained in the hidden word. Because calculators only accept numerical data the letters are represented by number combinations, with 00 being "A", up to 25 being "Z".

After a guess has been made a response will appear on the display. If the letter guessed is not contained in the word, the display will indicate a zero. If the letter guessed is contained in the word the calculator display will show the position of the letter in the word.

Example: The hidden word is "LOUD" The player's guess is "O" (14). The display indicates a 3, the third position from the right.

If the word contains more than one of the letters guessed, the display will indicate the position of all the correct letters.

Example: The hidden word is "STRUT". The guess is "T". The display will indicate a 41, fourth and first positions.

SAMPLE GAME
For TI SR 56.

Step 1. The word is selected and entered by the opponent. In this case we will use "TEST".

ENTER:
RST
19041819
R/S

Step 2. The word length is entered by the opponent.

ENTER:
4
R/S

Step 3. The player enters a guess.

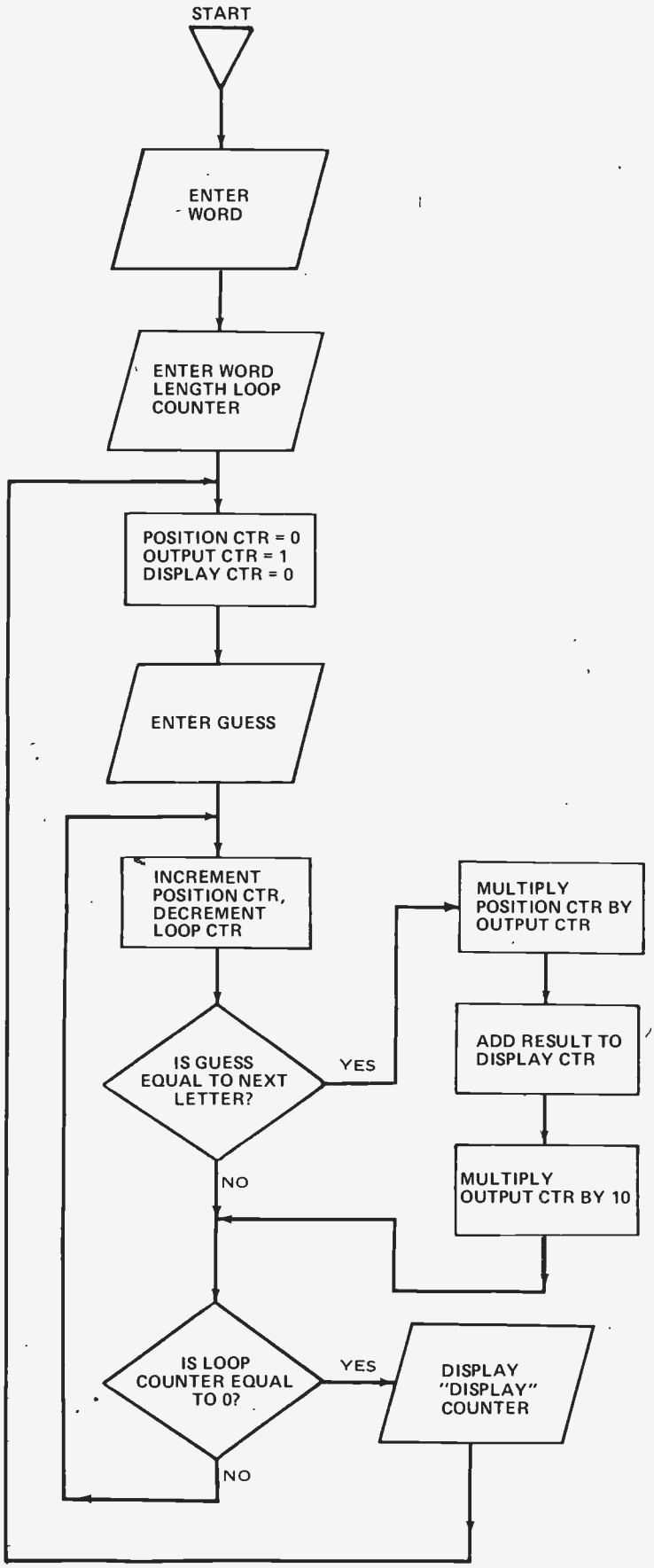
The resulting game is shown in Fig. 1.

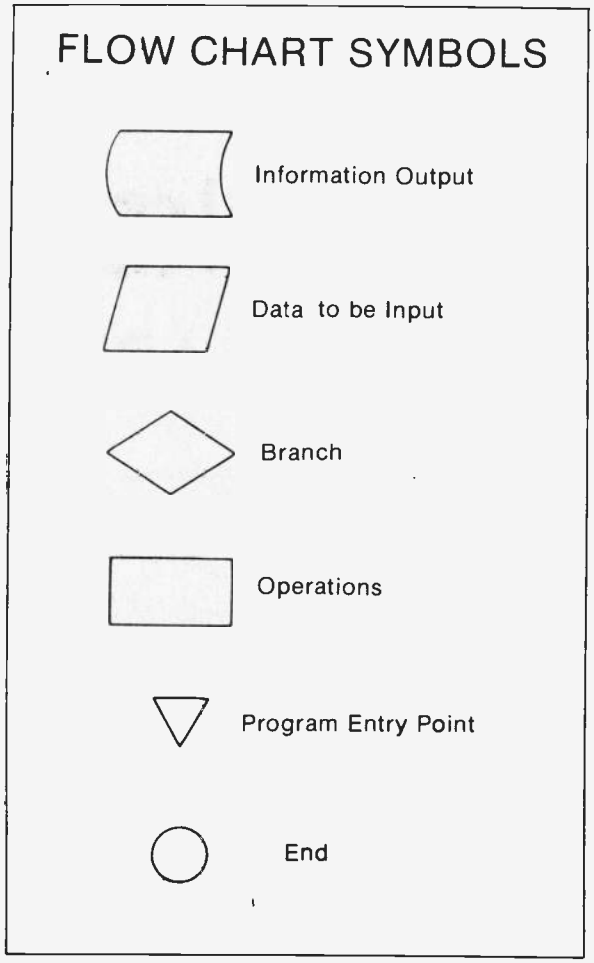
ENTER	GUESS	DISPLAY	LETTERS USED	WORD
00 R/S	A	0	A	****
04 R/S	E	3	AE	*E**
08 R/S	I	0	AEI	*E**
19 R/S	T	41	AEIT	TE*T
18 R/S	S	2	AEITS	TEST

Fig. 1. Sample game.

Progam for TI SR 56

LOC	CODE	KEY						
00	38	CMS		01	1		04	4
	33	STO		35	SUM		64	x
	01	1	30	04	4		34	RCL
	33	STO		34	RCL		05	5
	02	2		01	1	60	94	=
	01	1		54	÷		35	SUM
	33	STO		01	1		06	6
	05	5		00	0		27	dsz
	41	R/S		00	0		02	2
	33	STO		94	=		08	8
10	00	0		33	STO		34	RCL
	33	STO		07	7		02	2
	03	3	40	29	INT		33	STO
	41	R/S		33	STO		01	1
	54	÷		01	1	70	34	RCL
	01	1		34	RCL		03	3
	00	0		07	7		33	STO
	00	0		12	INV		00	0
	94	=		29	INT		34	RCL
	32	x → y		12	INV		06	6
20	01	1		37	x = y		54	÷
	33	STO		06	6		01	1
	05	5	50	03	3		00	0
	00	5		01	1		94	=
	33	STO		00	0	80	41	R/S
	04	4		30	Prod		22	GTO
	33	STO		05	5		01	1
	06	6		34	RCL		04	4





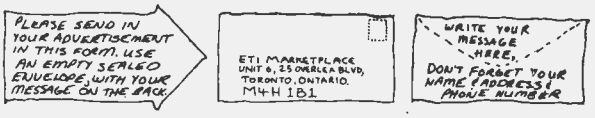
SOFTSPOT is ETI's programmable calculator software department. We know there are many of you who have gone to a lot of effort to write routines for your machines — how about sharing the fun. Send us a copy of your pet program, preferably with flow chart. To make things interesting we will restrict our choices to only those programs making use of loops or conditionals.

All programs we publish will be paid for.

Mail to: ETI Softspot
Unit 6, 25 Overlea Blvd.,
TORONTO, Ontario
M4H 1B1

Don't forget to mention what kind of calculator you use — and we'd also be interested to know where you bought it.

ETI MARKET PLACE



★★★★FREE ADVERTISING★★★★

OLD TUBES FOR SALE: 024A-42-80-89Y-6D6-1642. EICO 625 TUBE TESTER. EICO 232 VTVM. A. BOISVERT, 4830 DES PERVENCHES, ORSAINVILLE, QUEBEC 7, QUE. G1G 1R7.

CLEARING OUT ELECTRONIC SHOP. SEND ME YOUR NAME AND ADDRESS-FOR FREE LIST. FRANCIS LECLERC, C.P. 1554, GASPE, QUE. P0C 1R0.

FOR SALE! COSMAC ELF. ALL PARTS NECESSARY FOR BASIC ELF. NOT ASSEMBLED. INCLUDES 14"x 8"x 4" CABINET WITH ASSEMBLED FRONT PANEL, TOGGLE SW. ADDRESS, DATA AND STATUS LEDS, SPRING-LOADED TOGGLE SW. ARE USED FOR INPUT, SINGLE-STEP AND ADDRESS LOAD. ALSO INCLUDED IS 8 VOLT 7 AMP POWER SUPPLY, ASKING $100. HENRY NING, 21 LAURIER CRES. KAPUSKASING,ONT P5N 2P7. (705) 335-5097.

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WANTED: HEATHKIT HW-101 H.F. TRANSCEIVER IN GOOD CONDITION. ALSO INTERESTED IN ACCESSORIES. IF REPLYING, STATE PHONE NO. BERNIE MAC INTYRE, MARSHFIELD, P.E.I. C1A 7J7, 902-892-3236.

FOR SALE: SENCORE CB ANALYZER CB42 CB PERFORMANCE TESTER CB41. PRICE: $1,290.00 WITH ALL ACCESSORIES, LIKE NEW. ANDY CHAN (465-2889) 330 DIXON, APT. 704, WESTON ONT., M9R 1S9.

FOR SALE: BINATONE MICRO-CASSETTE RECORDER WITH VINYL CARRY CASE. $30.00. :MULTI-SOUND EFFECTS GENERATOR— USES SN76477 CHIP-LIMITLESS POSSIBILITIES— W/SPKR. AND INSTRUCTIONS— $25.00 ASSEMBLED. :T1 20 SWITCH KEYBOARD-1-9,0,00,+,-,%,ETC. $5.00. :ASSORTED IC'S, AND SUPPORT COMPONENTS— NEW AND USED— ASK FOR IT! PLEASE WRITE AHEAD BEFORE ORDERING! B.J. PALMER, 1303-96TH AVE. S.W. CALGARY, ALTA., T2V-0Y2— (403) 252-3031.

Continued from page 60.

York and Southern Ontario Repeater Council. In your article, you stated that "Provincial Organizations were not interested in it." I presume you are excluding RSO since I remember many fine articles in the Ontario Amateur by Jim McCullough, VE3CSO, who is indeed an expert in VHF FM.

Bill in your article, you missed entirely the reason for our new repeater and proceed to condemn RSO. ETI Canada magazine is very likely to be picked by a great many people who would be interested in becoming an amateur. Do you think your article of January 1979 would help them to become interested in Amateur Radio??

We in the RSO are interested in doing the best job for the Amateurs of Ontario and we would greatly appreciate your support in ETI. Would you consider doing an article on our code practice scheme in a future issue? I would be pleased to assist.

Newcomers to our hobby will then find out some helpful ways to learn Morse Code which of course is a primary requirement.

73, J. Riddell, VE3AMZ.

Clever, easy-to-make, inexpensive jana kits

dice game

Produces more random numbers than Las Vegas!

True randomness is hard to achieve in any kind of mathematics. But Jana Dice Game can keep the numbers more unpredictable and 'honest' than old-fashioned real dice, once they are even slightly worn.

Friends who are unfamiliar with the powers of electronics will be most impressed with your Jana Dice Game's never-failing ability to reproduce faithfully the patterns of dice. The easy-to-follow Jana plans show you how to program your Dice Game so that the dots light up invariably in true dice configurations.

Like most Jana kits (see list), Dice Game comes complete with detailed plans, all parts except battery, and the container converts to case. If you enjoy putting electronics together, here is your chance to harness mathematics and make something new and different of every dice-throwing game from Monopoly to Craps.

Jana kits for many useful and entertaining purposes.

1. Automatic Headlight Reminder
2. Battery Operated Fluorescent Light
3. Bug Shoo
4. Code Oscillator
5. Crystal Radio
7. Curiosity Box II
8. Dally Lighter
9. Decision Maker
10. Fish Caller
11. Hi Power 12V DC Flasher
12. Photo Electric Night Light
13. 6V Power Supply
14. 9V Power Supply
15. O-20V Power Supply
16. Single Channel Color Organ
17. Electronic Siren
18. Shimmer Strobe Light
19. Tone Generator
20. 5 Transistor 1 Watt Amplifier
21. Tube Continuity Checker
22. Xenon Strobe
23. LJ 12016A Color Organ
24. Loudmouth Siren
25. Roulette Wheel
26. Electronic Sheet Game
27. Electronic Dice
28. Super Roulette
29. FM Mini Broadcaster

Jana Electronic Projects are available through Cam Gard Supply and other distributors across Canada (partial list on facing page).

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Saskatoon • Winnipeg • Halifax • Fredericton • Moncton

For institutional inquiry contact:
Mr. D. Mann
Jana Electronics Limited

jana ELECTRONICS LTD.

P.O. BOX 489, WINNIPEG, MANITOBA R3C 2J3

ETI Data Sheet

CMOS 555!

One of the few exciting updates for the 555, a CMOS version from Intersil.

The 7555 is in most cases a direct replacement for the 555 timer. Because the 7555 does not produce large crowbar currents in the output driver, it is not necessary to decouple the supply lines with a large capacitor close to the device. Secondly the control voltage decoupling capacitors are not necessary. Thus for many applications two capacitors can be saved by using the 7555.
The output driver is a CMOS inverter capable of driving two TTL loads.

MONOSTABLE OPERATION

Initially the external capacitor (C) is held discharged. Upon application of a negative trigger pulse to pin 2, the voltage across the capacitor increases exponentially. When the voltage across the capacitor equals 2/3 $(V^+ - V^-)$, the comparator resets which discharges the capacitor rapidly and drives the output to its low state.

CONTROL VOLTAGE

The CONTROL VOLTAGE terminal permits the two trip voltages for the THRESHOLD and TRIGGER internal comparators to be controlled. This provides the possibility of oscillation, frequency modulation in the astable mode or even inhibition of oscillation, depending on the applied voltage. In the monostable mode, delay times can be changed by varying the applied voltage to the CONTROL VOLTAGE pin.

RESET

The RESET terminal is designed to have essentially the same trip voltage as the standard bipolar 555/6, i.e. 0.6 to 0.7 volts. It presents an extremely high input impedance. The mode of operation of the RESET function is, however, much improved over the standard bipolar 555/6 in that it controls simultaneously the state of the OUTPUT and DISCHARGE pins.

ASTABLE OPERATION

The circuit can be connected as a multivibrator. The external capacitor charges through R_A and R_B and discharges through R_B only. Thus the duty cycle may be precisely set by the ratio of these two resistors. In this mode of operation, the capacitor charges and discharges between 1/3 and 2/3 $(V^+ - V^-)$. As in the triggered mode, the charge and discharge times, and therefore the frequency, are essentially independent of the supply voltage.
The frequency of oscillation is given by:

$$f = \frac{1}{t} = \frac{1.46}{(R_A + R_B)C}$$

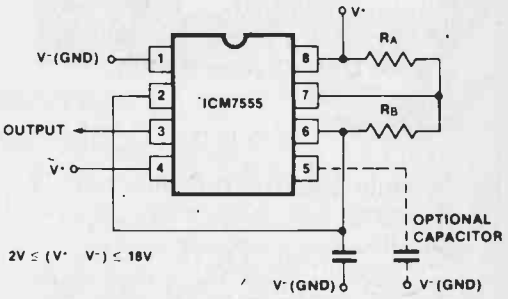


Fig. 3. Astable operation.

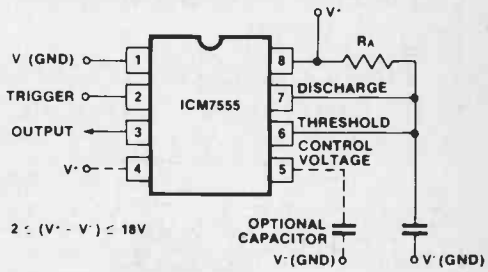


Fig. 4. Monostable operation.

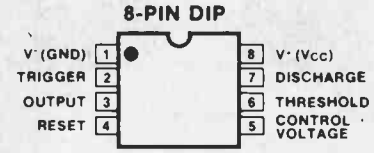


Fig. 1. Pinout of the 7555 is identical to that of the NE555.

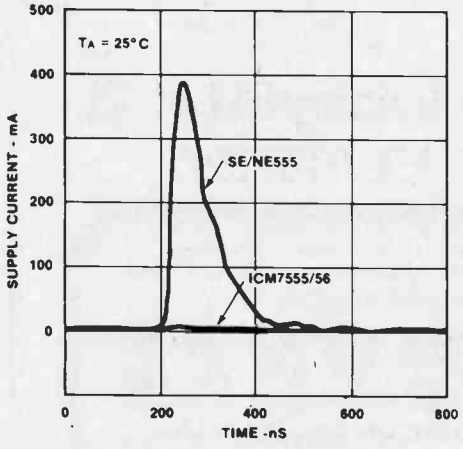


Fig. 2. Power supply transients of the 555 and 7555 compared.

OPERATING CHARACTERISTICS (T_A = 25°C, V^+-V^- = +2 to +15 Volts unless other specified)

PARAMETER	TEST CONDITIONS			VALUE MIN	VALUE TYP	VALUE MAX	UNITS
Supply Voltage	−20°C ≤ T_A ≤ +70°C −55°C ≤ T_A ≤ +125°C			2 3		18 16	V V
Supply Current (Note 4)	ICM7555	V^+-V^- = 2V V^+-V^- = 18V			60 120	200 300	µA µA
Supply Current (Note 4)	ICM7556	V^+-V^- = 2V V^+-V^- = 18V			120 240	400 600	µA µA
Timing Error (Note 5) Initial Accuracy Drift with Temperature Drift with Supply Voltage	R_A, R_B = 1k to 100k C = 0.1µF V^+-V^- = 5V				2.0 50 1.0		% ppm/°C %/Volt
Threshold Voltage					2/3		X(V^+-V^-)
Trigger Voltage					1/3		X(V^+-V^-)
Trigger Current	V^+-V^- = 18V V^+-V^- = 5V V^+-V^- = 2V				50 10 1		pA pA pA
Threshold Current	V^+-V^- = 18V V^+-V^- = 5V V^+-V^- = 2V				50 10 1		pA pA pA
Reset Current	V_{RESET} = V^-	V^+-V^- = 18V V^+-V^- = 5V V^+-V^- = 2V			100 20 2		pA pA pA
Reset Voltage	V^+-V^- = 18V V^+-V^- = 2V			0.4 0.4	0.7 0.7	1.0 1.0	V V
Control Voltage Lead					2/3		X(V^+-V^-)
Output Voltage Drop	Output Lo	V^+-V^- = 18V V^+-V^- = 5V	I_{SINK} = 3.2mA I_{SINK} = 3.2mA		0.1 0.15	0.4 0.4	V V
	Output Hi	V^+-V^- = 18V V^+-V^- = 5V	I_{SOURCE} = 1.0mA I_{SOURCE} = 1.0mA	17.8 4.0	17.25 4.5		V V
Rise Time of Output	R_L = 10Mohms	C_L = 7pF	V^+-V^- = 5V		40.0		nS
Fall Time of Output	R_L = 10Mohms	C_L = 7pF	V^+-V^- = 5V		40.0		nS
Guaranteed Max Osc Freq	Astable Operation			500			kHz

Interested in LEDs? See page 69.

5 New Paperbacks

These five books are advertised here for the first time in ETI. More details will be published in future issues. The books are in stock now. All 7 1/8 X 4 1/4 inches.

Radio Circuits Using ICs by Brian Dance
Published May 1978. 125 pages.
$4.50 + 30¢ postage & handling.

Mobile Discotheque Handbook
by Colin Carson.
Published May 1978. 127 pages.
$4.50 + 30¢ postage & handling.

Popular Electronic Projects by R.A. Penfold
Published July 1978. 135 pages.
$4.80 + 30¢ postage & handling.

IC LM3900 Projects by H. Kybett.
Published August 1978. 119 pages.
$4.50 + 30¢ postage & handling.

Electronic Music and Creative Tape Recording
by M.K. Berry.
Published July 1978. 87 pages.
$4.20 + 30¢ postage & handling.

Please use the card to order.

50 Simple LED Circuits

By R.N. Soar
64 pages
Published December 1977

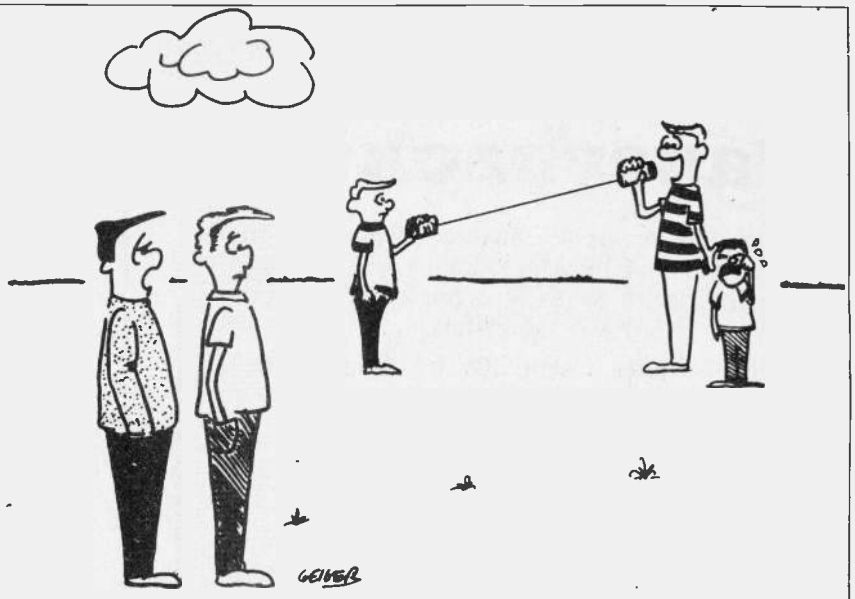
It is suprising how many of our readers do not understand these remarkable little devices. This book tells you

- how to use LEDs
- how to choose the value of the series resistor
- how to make a zero-beat indicator
- make a constant-current charger
- all kinds of testers, for voltage, current, transistor good/bad, etc.
- noiseless volume control
- signalling circuit
- much more

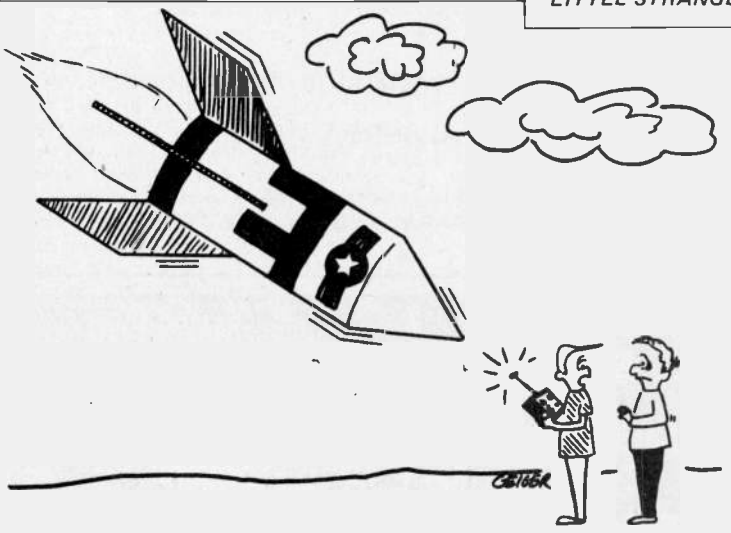
$2.75 + 30¢ postage.

Please use the card to order.

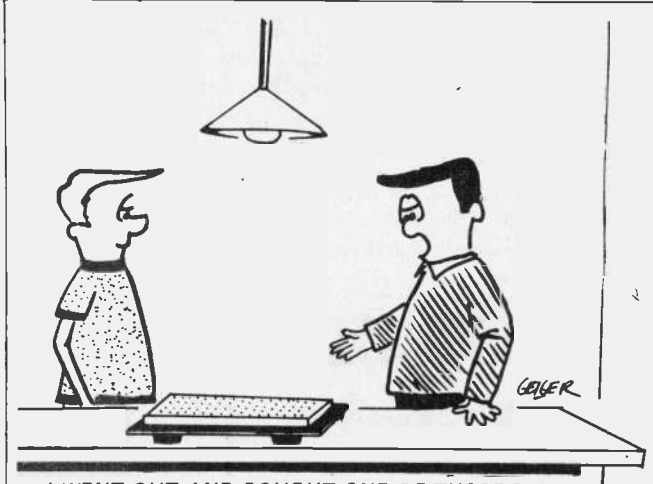
The Fun of Electronics



EVER SINCE HE HAD HIS CB LICENSE REVOKED, HARRY'S BEEN ACTING A LITTLE STRANGELY...

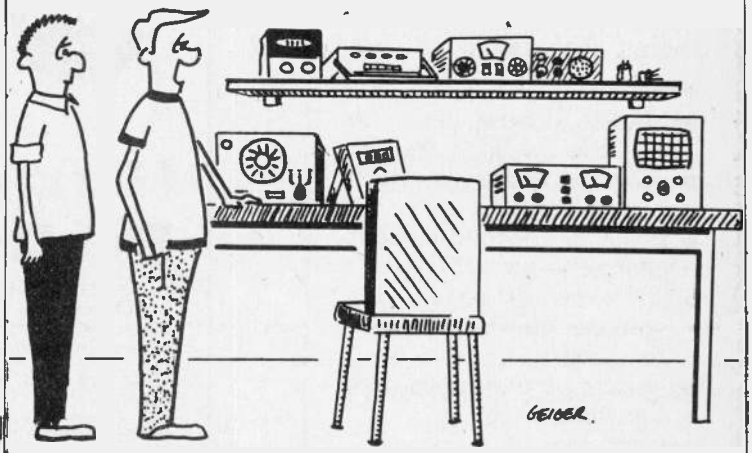


I THINK I'VE GOTTEN MY SIGNALS CROSSED WITH NASA – AND IF I'M RIGHT, MY SCALE MODEL BIPLANE IS RIGHT THIS MOMENT TOUCHING DOWN ON VENUS.



I WENT OUT AND BOUGHT ONE OF THOSE SOLDERLESS BREADBOARDS, FRANK, AND IT'S A REAL TIME-SAVER – IT NOW ONLY TAKES ME HALF AS LONG TO MAKE A WIRING ERROR AND BLOW UP EXPENSIVE PARTS!

THESE NEW PLUG-IN MODULES ARE A GREAT BOON TO THE SERVICEMAN, SAM, NOW INSTEAD OF CHARGING A CUSTOMER TO REPLACE A 98¢ TRANSISTOR, WE CAN CHARGE THEM $35 FOR A WHOLE NEW MODULE!



YESSIREE, JIM, GONE ARE THE OLD DAYS WHEN I USED TO BURN OUT A $10 METER ABOUT TWICE A WEEK – NOW I'M A SOPHISTICATED EXPERIMENTER, AND I ONLY BURN OUT DELICATE EQUIPMENT COSTING HUNDREDS OF DOLLARS.

Have you seen page 30 yet? Right after page 29.

CLASSIFIED

You can write for Eti

75 cents per word

ETI's new classified advertising section allows you to reach 30,000 readers nation-wide. For as little as $15 (there's a 20 word minimum) you can promote your business from coast to coast.

WHAT DO YOU DO?

Send us your typewritten or clearly printed words, your permanent address and telephone number, and your money (no cash please). Make your cheque or money order payable to 'ETI Magazine'. We're at Unit 6, 25 Overlea Blvd., Toronto, Ontario M4H 1B1.

WHAT DO WE DO?

We typeset your words (and put the first word and your company name in bold capital letters).

If we get your message by the 14th of the month, it will appear in ETI 1½ months later. For example, if we receive it by November 14th, you (and thousands more) will see it in the January issue.

EQUALIZER Phaser, many other kits; quality components; send 25¢ for 1979 catalogue.
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ETI Project File

Updates, news, information, ETI gives you project support

PARTS PARTS PARTS

We are continually beseiged with letters from readers asking where they can get parts in their area. Since we can't take a country-wide tour to check where all the elctronics parts-places are, how about sending us a note on any stores you have found useful, what they are good for (if you own the place you can contribute too!) and so on. At some time in the future we would like to help out the "lost" readers by publishing a rundown of where to get what.

PROJECT FILE is our department dealing with information regarding ETI Projects. Each month we will publish the Project Chart, any Project Notes which arise, general Project Constructor's Information, and some Reader's Letters and Questions relating to projects.

PROJECT NOTES

Since this magazine is largely put together by humans, the occasional error manages to slip by us into print. In addition variations in component characteristics and availability occur, and many readers write to us about their experiences in building our projects. This gives us information which could be helpful to other readers. Such information will be published in Project File under Project Notes. (Prior to May 78 it was to be found at the end of News Digest.)

Should you find that there are notes you wish to read for which you do not have the issue, you may obtain them in one of two ways. You can buy the back issue from us (refer to Project Chart for date of issue and see also Reader Service Information on ordering). Alternatively you may obtain a photocopy of the note free of charge, so long as your request includes a self addressed stamped envelope for us to mail it back to you. Requests without SASE will not be answered.

PROJECT CONSTRUCTOR'S INFORMATION

Useful information on the terminology and notation will be published each month in Project File.

ISSUE DATE	ARTICLE
Feb 78	Tachomonitor
Apr 78	Neg.
Feb 78	LCD Panel Meter
Apr 78	Note: C
Apr 78	Neg.
Feb 78	CB Power Supply
Apr 78	Neg.
May 78	Note: N
Feb 78	Freezer Alarm
Apr 78	Neg.
Mar 78	Hammer Throw
June 78	Neg.
Feb 79	Note:C,D
Mar 78	True RMS Meter
Apr 78	Neg.
Jan 79	Note:N
Feb 79	Note:N
Mar 78	Home Burglar Alarm
Apr 78	Computer PSU & Neg.
Apr 78	Audio Delay Line & Neg.
Apr 78	Gas Alarm & Neg.
May 78	White Line Follower
June 78	Neg.
May 78	Acoustic Feedback Eliminator
June 78	Neg.
May 78	Add-on FM Tuner
June 78	Neg.
June 78	Audio Analyser
June 78	Ultrasonic Switch & Neg.
June 78	Phone Bell Extender & Neg.
July 78	Proximity Switch
Aug 78	Neg.
July 78	Real Time Analyser MK II (LED)
Aug 78	Neg.
July 78	Acc. Beat Metronome.
Aug 78	Neg.
July 78	Race Track
Aug 78	Neg.

ISSUE DATE	ARTICLE
Aug 78	Sound Meter & Neg.
Dec 78	Note: N
Aug 78	Porch Light & Neg.
Aug 78	IB Metal Locater & Neg.
Aug 78	Two Chip Siren & Neg.
Sept 78	Audio Oscillator
Nov 78	Neg.
Sept 78	Shutter Timer
Nov 78	Neg.
Sept 78	Rain Alarm
Oct 78	CCD Phaser
Nov 78	Neg.
Oct 78	UFO Detector
Nov 78	Neg.
Oct 78	Strobe Idea
Nov 78	Cap Meter &Neg.
Nov 78	Stars & Dots
Nov 78	CMOS Preamp & Neg.
Dec 78	Digital Anemometer
Feb 79	Neg
Mar 79	Note:C. D
Dec 78	Tape Noise Elim
Feb 79	Neg
Dec 78	EPROM Programmer
Feb 79	Neg
Jan 79	Log Exp Convert.
Feb 79	Neg
Jan 79	Digital Tach.
Feb 79	Neg
Jan 79	FM Transmitter
Feb 79	Neg
Feb 79	Phasemeter & Neg
Feb 79	SW Radio
Feb 79	Light Chaser & Neg
Mar 79	Tape-Slide Synch
Mar 79	Synth. Sequ..
Mar 79	Dual Dice

ETI Project Chart

Canadian Projects Book

Audio Limiter	Metal Locator
5W Stereo	Heart-Rate Monitor
Overled	GSR Monitor
Bass Enhancer	Phaser
Modular Disco	Fuzz Box
G P Preamp	Touch Organ
Bal. Mic. Preamp	Mastermind
Ceramic Cartridge Preamp	Double Dice
Mixer & PSU	Reaction Tester
VU Meter Circuit	Sound-Light Flash
Headphone Amp	Burglar Alarm
50W-100W Amp	Injector-Tracer.
Note: N Apr. 78	Digital Voltmeter

Key to Project Notes
C:- PCB or component layout
D:- Circuit diagram
N:- Parts Numbers, Specs
Neg:- Negative of PCB pattern printed
O:- Other
S:- Parts Supply
T:- Text
U:- Update, Improvement, Mods
***:- Notes for this project of complicated nature, write for details (enclose S.A.S.E., see text)

PROJECT CHART

This chart is an index to all information available relating to each project we have published in the preceding year. It guides you to where you will find the article itself, and keeps you informed on any notes that come up on a particular project you are interested in. It also gives you an idea of the importance of the notes, in case you do not have the issue refered to on hand.

Every few months we print a pull out section in the magazine which may be used as a photographic negative for making printed circuit boards (as described in our January 78 issue). Each edition of this sheet contains projects from the preceding few issues. Information on where to find which negative is included in the chart.

Write to: Project File
Electronics Today International
Unit 6, 25 Overlea Blvd.,
TORONTO, Ontario
M4H 1B1

Component Notations and Units

We normally specify components using an international standard. Many readers will be unfamiliar with this but it's simple, less likely to lead to error and will be widely used sooner or later. ETI has opted for sooner!

Firstly decimal points are dropped and substituted with the multiplier, thus 4.7uF is written 4u7. Capacitors also use the multiplier nano (one nanofarad is 1000pF). Thus 0.1uF is 100n, 5600pF is 5n6. Other examples are 5.6pF = 5p6, 0.5pF = 0p5.

Resistors are treated similarly: 1.8M ohms is 1M8, 56k ohms is 56k, 4.7k ohms is 4k7, 100 ohms is 100R, 5.6 ohms is 5R6.

Kits, PCBs, and Parts

We do not supply parts for our projects, these must be obtained from component suppliers. However, in order to make things easier we co-operate with various companies to enable them to promptly supply kits, printed circuit boards and unusual or hard-to-find parts. Prospective builders should consult the advertisements in ETI for suppliers for current and past projects.

Any company interested in participating in the supply of kits, pcbs or parts should write to us on their letterhead for complete information.

READER'S LETTERS AND QUESTIONS

We obviously cannot troubleshoot the individual reader's projects, by letter or in person, so if you have a query we can only answer it to the extent of clearing up ambiguities, and providing Project Notes where appropriate. If you desire a reply to your letter it must be accompanied by a self addressed stamped envelope.

Digital Anemometer

This project appeared in our December 1978 issue. The printed circuit board is correct where there are two errors in the circuit diagram. Pin 16 of DSP 1 (connected to pin 11, DSP 2) should be labeled pin 6, and pin 7 DSP1 should be shown connected to pin 9 of DSP 2. Gail would like everyone to know that it was not her fault.

Please mention ETI when responding to advertisements.

Reader Service Information

Editorial Queries

Written queries can only be answered when accompanied by a self-addressed, stamped enveloped, and the reply can take up to three weeks. These must relate to recent articles and not involve ETI staff in any research. Mark your letter ETI Query.

Projects, Components, Notation

For information on these subjects please see our Project File section.

Sell ETI

ETI is available for resale by component stores. We can offer a good discount and quite a big bonus, the chances are customers buying the magazine will come back to you to buy their components. Readers having trouble getting their copy of ETI could suggest to their component store manager that he should stock the magazine.

Back Issues and Photocopies

Previous issues of ETI-Canada are available direct from our office for $2.00 each. Please specify issue by the month, not by the features you require. The following back issues are still available for sale.

1977	1978	1979
February	January	January
May	February	February
June	March	
July	~~April~~	
September	May	
November	June	
	July	
	August	
	September	
	October	
	November	
	December	

We can supply photocopies of any article published in ETI-Canada, for which the charge is $1.00 per article, regardless of length. Please specify issue and article. (A special consideration applies to errata for projects, see Project File.)

Advertisers' Index

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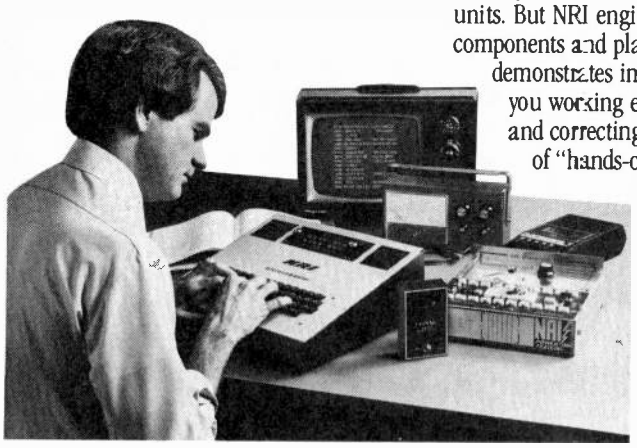

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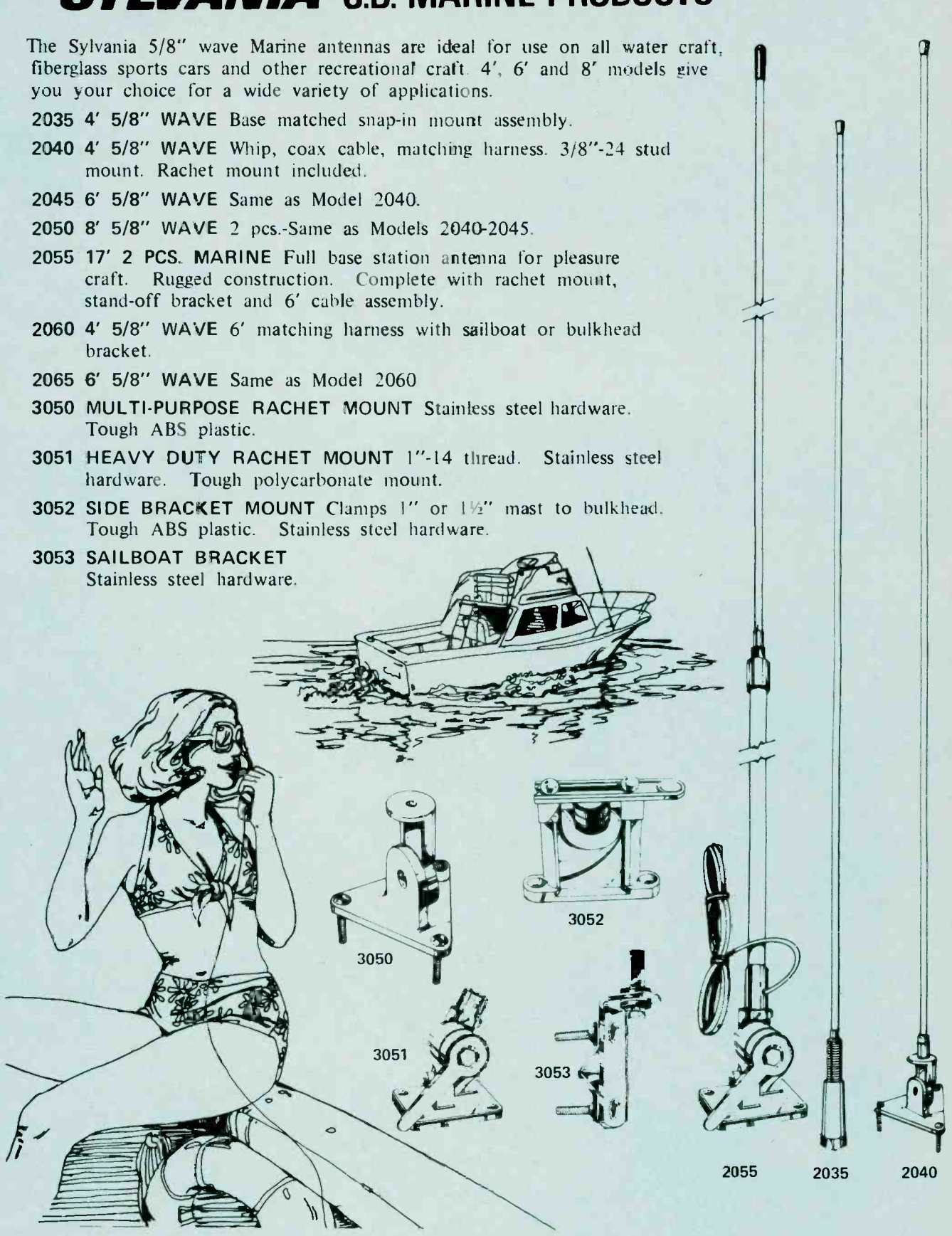

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