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June 1988

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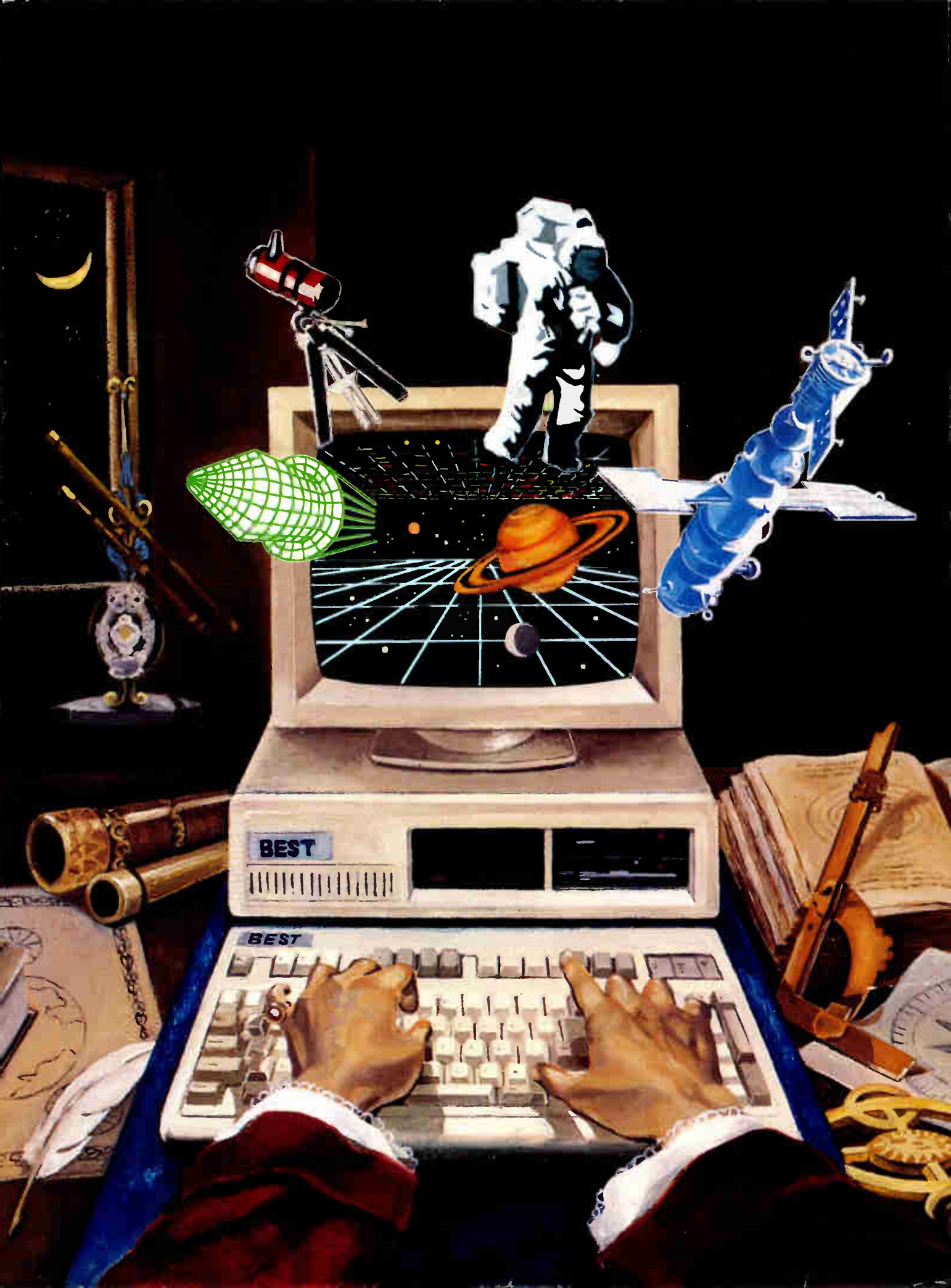
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# Electronics & Technology Today

Canada's Magazine for High-Tech Discovery

Volume 12, Number 6

June 1988



## Our Cover

The Motorola portable cellular phones illustrate our buyer's guide, and the Sony tapes highlight our review of popular cassettes; photos by Bill Markwick.

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# FOR YOUR INFORMATION

## DNA Fingerprinting

The DNA in each cell of the body has a blueprint unique to the individual, and Cellmark Diagnostics of Abingdon, UK, is offering a commercial DNA analysis service. The process can take any tissue, and from its DNA, produce a fingerprint as a track of black bands on an X-ray film. In forensic studies it can be any tissue that is studied, but the majority of cases at present start with samples of blood from individuals who wish to establish some relationships within their family.

## GaAsp!

Each month brings press releases telling of faster and faster experimental microchips. Bell Northern Research announced the development of an exploratory gallium arsenide (GaAs) circuit that can handle digital signals at 5GHz (5000MHz). The 5-gig bandwidth means that the chip, a 4 by 4 switch, can reliably move information at 2.4 gigabits per second, fast enough to transmit the 32 volumes of the Encyclopedia Britannica in one second.

## Weather Station Software

The PC Weather Pro weather station, reviewed in the December, 1987 E&TT, now has software to link the station to popular programs such as Lotus 1-2-3 and Borland's Reflex database. The new PC Weather Toolkit formats the station's data into files that are compatible with the programs; it also makes ASCII files and DIF files that are readable by other software products such as Ashton-Tate's dBase. Contact Technology Marketing Inc., 4000 Kruse Way Place, Bldg. 2, Suite 120, Lake Oswego, Oregon 97035, (503) 635-3966.

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Circle No. 4 on Reader Service Card

## DKL Sales Office

DKL Technology of Quebec has announced the opening of an office in Toronto, providing sales and service for their networking and multi-user DOS products. They're located at 50 Silver Star Blvd., Suite 217, Scarborough, Ontario M1V 3L3, (416) 321-0116.

## Unix for the Mac

Apple Canada began shipping A/UX, its implementation of the Unix operating system for the Macintosh computer. This will give Mac owners access to more than 3,000 UNIX applications. A/UX is a full implementation of AT&T System V.2.2. and has Berkeley extensions that facilitate networking capability and the ability to port applications. A/UX with an 80MB external hard drive lists at \$5,299. Contact local Apple dealers.

## But Not When They Are Red

Modern traffic signals have become increasingly intelligent, able to analyze traffic problems and independently make decisions on how to solve them. They can communicate with others to find out what is happening at nearby intersections, and work together under common control to make allowances for rush hour. But making them smarter has a price, as noted by the Georgia Tech Electronics and Computer Systems Lab. A by-product of this intelligence is that the devices are much more likely to get knocked off line or damaged by lightning, power transients or EMI. As the number of intelligent controllers increases, there is more opportunity for failure. Part of the cure includes better awareness on the part of designers of static-proofing, transient suppression and over-voltage protection.

Those who drive in Metro Toronto might also add that the traffic controller programmers ought to check into the

operation of the monster they've created. No doubt the traffic department can quote statistics that show an improvement has been made, but the fact remains that it's all too easy to get locked into a red-light cycle that you can't get out of. No matter how fast or slow you drive, the computer seems to detect you and switch all the lights in your path to red.

## Blissymbols Research

The federal government has announced a contract with the IDON Corporation of Ottawa for development and testing of a system based on Blissymbols that will allow speech-impaired people to communicate with one another and the rest of the world electronically. The objective of the \$737,000 contract, which runs for four years, include adapting the system software for additional computers, testing the system in a multi-location mode and carrying out use analysis.

## A Welcome to MKS

MKS Instruments Canada Ltd. is the newest international subsidiary of MKS Instruments of Andover, Mass. MKS is a manufacturer of high precision electronic equipment designed to monitor vacuum, pressure and gas flow in the aerospace, nuclear pharmaceutical, medical, semiconductor and power industries. They're located at 30 Concourse Gate, Nepean, Ontario K2E 7V7, (613) 723-3386.

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## High Speed 68020

The Motorola Microprocessor Products Group announces high-speed enhancements to the 68000 microprocessor series. The 32-bit 68020 is now available with a 33MHz clock speed, making it the fastest on the market. The 32-bit 68000, used in the Macintosh, and the low-power CMOS 32-bit 68HC000 are now available with 16MHz clock speeds.

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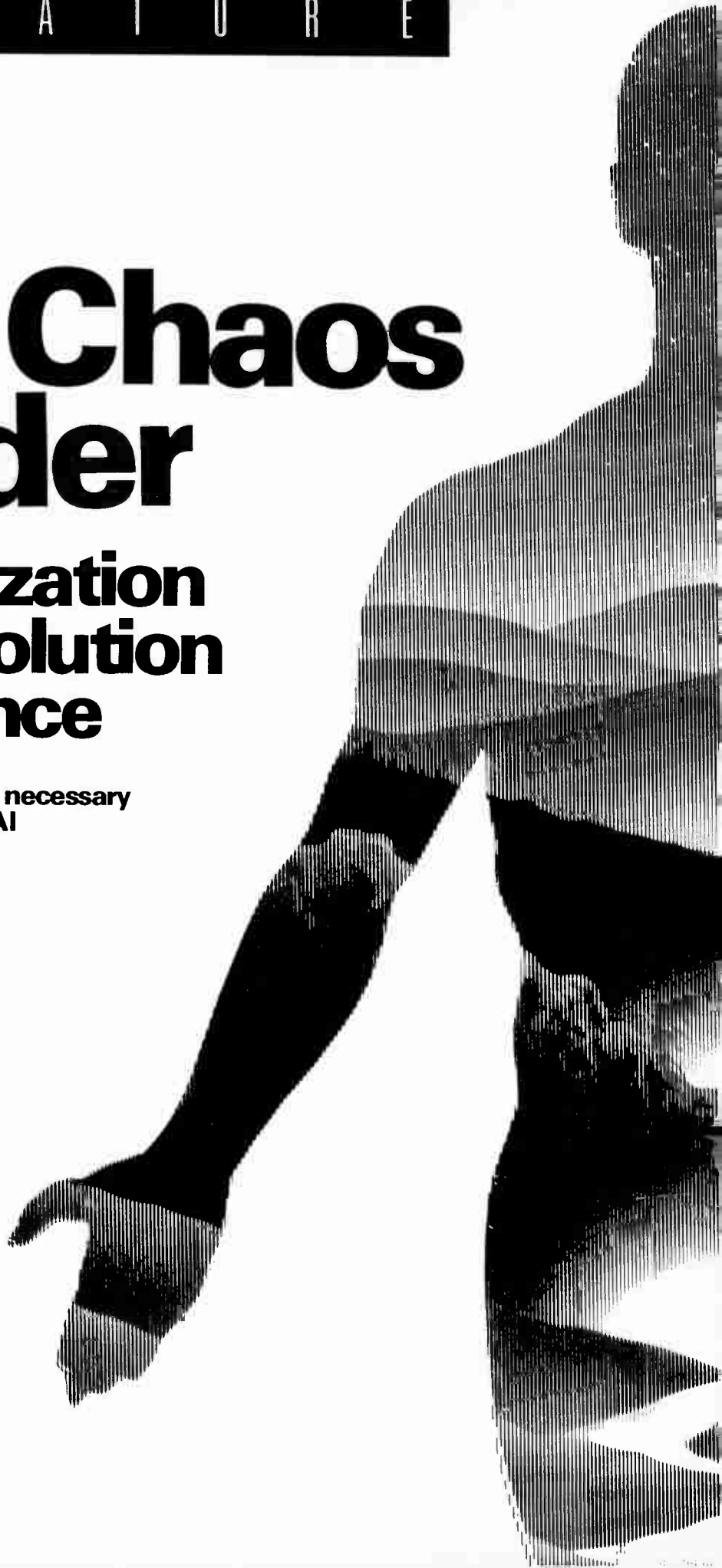


# From Chaos to Order

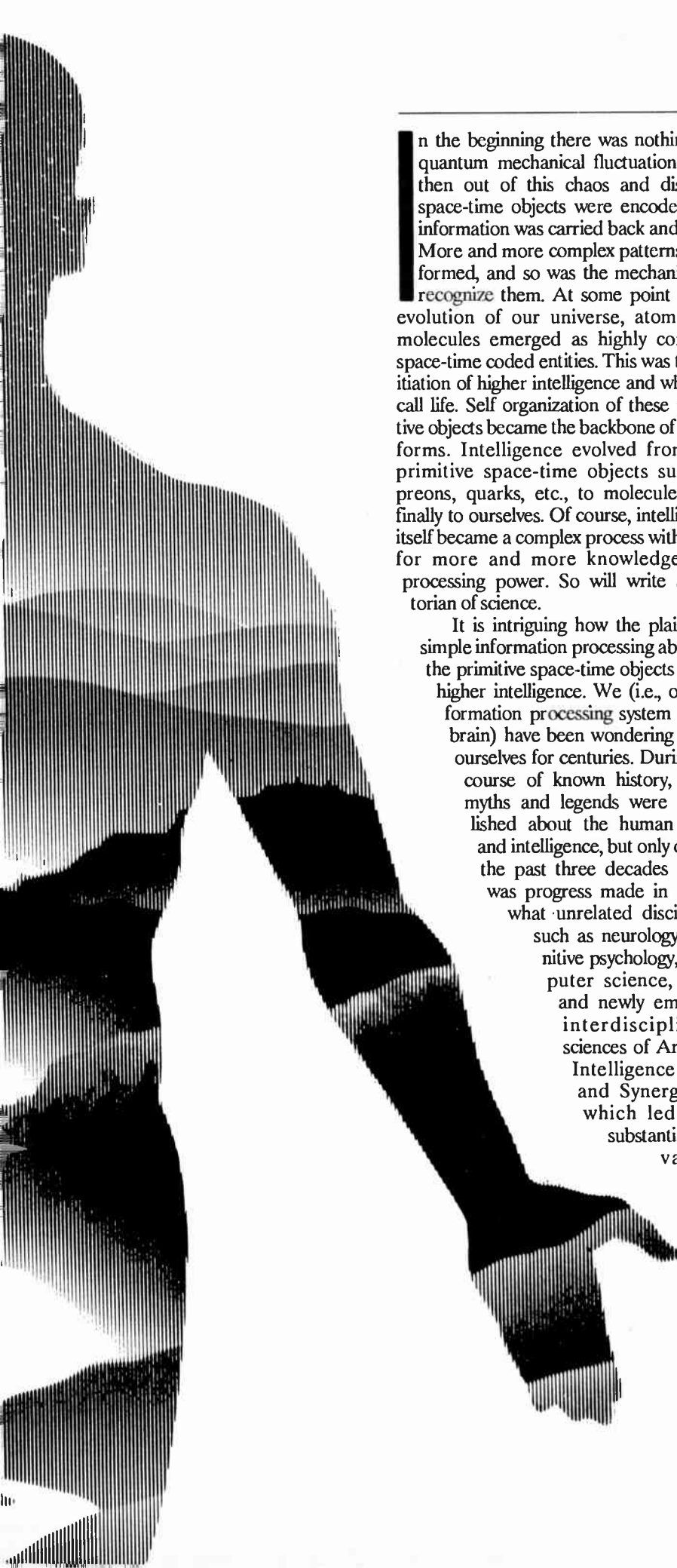
## Self Organization and the Evolution of Intelligence

Defining human intelligence is necessary  
for a better understanding of AI  
(artificial intelligence).

K. TAHIR SHAH







In the beginning there was nothing but quantum mechanical fluctuations, and then out of this chaos and disorder space-time objects were encoded and information was carried back and forth. More and more complex patterns were formed, and so was the mechanism to recognize them. At some point in the evolution of our universe, atoms and molecules emerged as highly complex space-time coded entities. This was the initiation of higher intelligence and what we call life. Self organization of these primitive objects became the backbone of all life forms. Intelligence evolved from the primitive space-time objects such as preons, quarks, etc., to molecules and finally to ourselves. Of course, intelligence itself became a complex process with need for more and more knowledge and processing power. So will write a historian of science.

It is intriguing how the plain and simple information processing ability of the primitive space-time objects led to higher intelligence. We (i.e., our information processing system called brain) have been wondering about ourselves for centuries. During the course of known history, many myths and legends were established about the human mind and intelligence, but only during the past three decades or so, was progress made in somewhat unrelated disciplines such as neurology, cognitive psychology, computer science, logic and newly emerged interdisciplinary sciences of Artificial Intelligence (AI) and Synergetics, which led to a substantial advance-

ment in our understanding of intelligence.

Artificial intelligence and Synergetics are interdisciplinary sciences. Both have emerged from a similar background. Computer scientists are not that much in touch with Synergetics as they are with Artificial Intelligence; on the other hand, physicists and applied mathematicians come across with Synergetics perhaps more often than Artificial intelligence. Recent experience with AI and researches on various models of cognition and natural intelligence has contributed to the belief that information processing, and in particular intelligence, is a cooperative phenomenon. It is a manifestation of complex patterns of correlations that exist among many parts of a system. Each subsystem behaves in a manner simpler than the whole system. A computer is a good example of the synergy where simple actions by thousands of primitive parts, known as gates (representing the Boolean operations, such as AND, OR and NAND etc.) lead towards highly complex processes/tasks such as understanding natural language, solving a differential equation and other similar demanding tasks. This cooperative behaviour is known to exist in physical and biological systems as well.

### **Synergetics**

The word "synergetics" is composed of two Greek words and means "working together", or the science of co-operative phenomenon. Professor H. Haken, the guru of Synergetics from West Germany, defines it as the "Cooperative Science" where very often the cooperation of many individual parts of a system lead to macroscopic (global) structures or processes. A researcher in Synergetics investigates how the subsystems produce these changes in an entirely self-organized manner. Basically, all investigations fall into the study of non-linear equations. Although in AI or natural intelligence no such non-linear equations have ever been discovered, in these cases we are dealing with cooperative processes. In natural intelligence the cooperation can be between many cognitive functions, for instance, ability to acquire knowledge, learning, memory and speech etc. Similarly, in machine intelligence knowledge base components, memory, inference engine, and others cooperate to cause a highly complex behavior. There is abundant evidence that not only in physical and biological systems but also in social and economic systems, global behavior is a result of cooperation amongst their subsystems. The complexity

# Introducing Microprocessors Part 4

More on system monitors, plus an assessment quiz.

MIKE TOOLEY

In Part Three we mentioned the use of a monitor program as an aid to understanding the operation of a microprocessor. We also stated that such a program can also allow us to enter, test and debug simple programs. In small microcomputer systems (of the sort used for education purposes) monitor programs are invariably provided in ROM. In other systems (such as the IBM PC and compatibles) the monitor program is resident in RAM and must be loaded from disk. Naturally, with more powerful and more modern systems, monitor programs offer a number of extended facilities. These programs (usually referred to as "debuggers") are often provided as an extension of the operating system, and their name might imply, they can be an invaluable aid for programmers and software developers. One of the most popular debuggers is that which runs under the MS-DOS operating system on the IBM PC (and compatibles). This program is DEBUG.COM.

For the purpose of this series, we shall assume that readers only have access to a fairly basic monitor and we shall discuss each of the features of a monitor with which readers should be familiar. Such a discussion will obviously be more meaningful if readers have reasonably immediate access to a microprocessor system and can try out the various monitor commands (usually single letters followed by one or more parameters) as they are introduced.

## Memory Display

A memory display facility can be used to

display the contents of a given memory address or range of addresses. The display is usually presented in hexadecimal format though systems which provide output to a TV, monitor, or VDU terminal generally also provide an ASCII representation of the data. This latter facility can be useful when the investigation contains text rather than a machine code program.

A typical memory display command would take the form:

**D 4000** (Display an 80 byte block of memory starting at address 4000 hex.)

A typical memory display (in hexadecimal and ASCII) is shown in Fig. 4.1. Note that some monitors use a Memory Pointer which must be set before the contents of a given block of memory can be displayed. A typical sequence of commands would then be:

**N 4000** (Set memory pointer to 4000 hex.)

**L** (List 80 bytes of memory starting from 4000 hex.)

Other monitors require that start and end addresses are specified as part of the command as shown in the following command which prints a 32 byte block of memory starting from hexadecimal address 4000:

**P 4000 401F** (Print 32 bytes of memory starting from 4000 hex.)

## Memory Edit

A memory edit facility can be used to change the value of a byte or bytes stored in read/write memory. Values are invariably specified in hexadecimal. A typical sequence of monitor commands to place a byte of 2A hex. into memory loca-

tion 8000 hex. would take the form:

**M 8000 4E - 2A** (Modify the byte present at 8000 hex.)

The system responds by displaying the hex. value (4E) of the byte currently present at address 8000H and the user then supplies the new value to be stored at the address. Note that there are many other variations of this command including those which preset (fill) a block of memory with a given byte value. A typical command to fill a 1K block of memory from 4000 hex. to 43FF hex. with a byte of 0F hex. would take the form:

**F 4000 43FF 0F** (Fill 1024 byte of memory starting from 4000 hex. with a byte value of 0F hex.)

## CPU Register Display

The register display facility allows users to examine the contents of the CPU registers. No parameter follows the command which is typically entered using the single letter R. A typical register display for a Z80 CPU is shown in Fig. 4.2.

## CPU Register Modify

The register modify command allows users to load the CPU registers with values prior to testing machine code routines. The command usually needs to be followed by a mnemonic for the register concerned, a typical example being:

**S BC 00FF** (Set the BC register pair to 00FF hex.)

which loads the BC register pair with the hexadecimal word. (Note that 00 appears in register B while FF hex. appears in register C). Again, there are many variations of this command.

Memory addresses (hex)	Contents (hex)	Contents (ASCII)	Contents of registers shown in hex		Contents of Flag Register shown in binary with single letters representing individual flags
0000	F3 AF 11 FF	#/..	Main set of general purpose registers	AF 0F	SZ H PNC 01010100
0004	FF-C3 CB 11	.CK.		BC 01	04
0008	2A 5D 5C 22	*J\~		DE 02	BF
000C	5F 5C 18 43	.\.C		HL 80	20
0010	C3 F2 15 FF	Cr..	Alternate set of general purpose registers	A'F' 00	SZ H PNC 00010100
0014	FF FF FF FF	....		B'C' 00	A0
0018	2A 5D 5C 7E	*J\~		D'E' 1A	0F
001C	CD 7D 00 D0	M).P		H'L' 3C	0B
0020	CD 74 00 18	Ht..	Special purpose registers	IR 3F24	
0024	F7 FF FF FF	w...		IX 03D4	
0028	C3 5B 33 FF	Cl3.		IY 5C3E	
002C	FF FF FF FF	....		SP FF7F	
0030	C5 2A 61 5C	E*a\	PC 8002		
0034	E5 C3 9E 16	eC..			
0038	F5 E5 2A 78	ue*x			
003C	5C 23 22 78	\#*x			
0040	5C 7C 85 20	\;5			
0044	03 FD 34 40	.J4@			
0048	C5 D5 CD BF	EUM?			
004C	02 D1 C1 E1	.QAa			

Fig. 4.1. (far left) Typical memory display in hexadecimal and ASCII.  
 Fig. 4.2. (below) Typical display of CPU registers in a Z80-based system.  
 Fig. 4.3. (above) Typical disassembly of memory in a z80-based system.

### Disassemble Memory

The facility to disassemble the contents of a block of memory into assembly language mnemonics can be extremely useful. A typical command would take the form:

U 0100 011F (Unassemble memory from 0100 hex to 011F hex.)

which would disassemble (unassemble) 32 bytes of memory starting from address 0100 hex. Note that some variations of this command use the second parameter as the number of bytes to disassemble rather than the end address. A typical disassembly is shown in Fig. 4.3. It is important to note that the "disassemble memory" command cannot distinguish between regions of memory in which programs are resident and those which contain text or data. The result of using the command will be meaningless in the latter case.

### Insert Breakpoints

Breakpoints are codes (usually a single byte) which are inserted into programs during testing or debugging. When a breakpoint is subsequently encountered, execution of the program is suspended and control is returned to the monitor program. This facility allows the user to examine the state of the microprocessor's registers and any relevant memory locations when a certain point is reached.

A typical command to insert a breakpoint takes the form:

B 801F (insert a Breakpoint at address 801F hex.)

which inserts a breakpoint at address 801F hex. Most monitors allow users to insert a number of breakpoints thus allowing for

Memory address (hex)	Instruction bytes (hex)	Inst
0E8B 7C	LD	A, H
0E87 0F	RRCA	
0E8A 0F	RRCA	
0E8B 0F	RRCA	
0E8C 3D	DEC	A
0E8D F650	OR	50
0E8F 67	LD	H, A
0E90 EB	EX	DE, HL
0E91 61	LD	H, C
0E92 68	LD	L, B
0E93 29	ADD	HL, HL
0E94 29	ADD	HL, HL
0E95 29	ADD	HL, HL
0E96 29	ADD	HL, HL
0E97 29	ADD	HL, HL
0E98 44	LD	B, H
0E99 4D	LD	C, L
0E9A C9	RET	

programs which use conditional branching.

### Execute a Program

This command should be self-explanatory. The command usually expects a single parameter which is the hexadecimal address from which execution is to commence. Some monitors (including DEBUG) allow further parameters which constitute addresses at which breakpoints are to be placed. A typical command would take the form:

G 8000 (Go from address 8000 hex.)

This command sets the Instruction Pointer (or Program Counter) to 8000 hex. and commences program execution from that address. Note that this command is a little dangerous as, unless breakpoints have been appropriately placed, control may not be returned to the monitor program and the user may thus effectively lose control of the system.

### Trace Program Execution

A "program trace" facility is similar to the previous command but can be used to produce a continuous display of the state of the CPU registers (as well as certain locations in memory). The display is updated as each instruction is executed. A typical command would take the form:

T 8000 801F (Trace program execution between 8000 hex. and 801F hex.) which can be used to trace program execution starting at a hexadecimal address of 8000 and ending at 801F. Note that some variations of this command use the second parameter to specify the number of instructions to be traced rather than the address at which control is to be returned to the monitor program. The trace facility is sometimes known as a "single-step" facility.

### First Written Assessment

By now, readers should also be adequately prepared for the first written assessment. This is a straightforward multiple choice test containing 22 questions, each of which is provided with four answers. Candidates should choose the answer which they think is correct and mark the Answer Sheet accordingly. Note that only ONE answer is correct in each case.

This test contains 22 multiple-choice questions. In order to pass you must answer a minimum of 16 of them correctly. The first number for each question is the test question number while the number in bracket relates to the module reference.

1. (1.1.1) A read-only memory (ROM) is best defined as

# Introducing Microprocessors, Part 4

- a. a volatile memory
  - b. a form of read/write memory
  - c. a permanently programmed memory
  - d. a memory which can only be written to.
2. (1.1.2) A VLSI integrated circuit having CPU, internal clock, RAM and I/O ports can best be described as
- a. a microprocessor
  - b. a microcomputer
  - c. a single-chip microprocessor
  - d. a single-chip microcomputer.
3. (1.2.1) The term SSI refers to integrated circuits having
- a. less than 10 devices per chip
  - b. between 10 and 100 devices per chip
  - c. between 100 and 1000 devices per chip
  - d. more than 1000 devices per chip.
4. (1.2.2) Which one of the following is FALSE?
- a. CMOS devices can operate over a wide

- range of supply voltages.
  - b. CMOS devices consume negligible current in a "standby" condition.
  - c. CMOS devices offer better noise immunity than comparable TTL devices.
  - d. The supply current consumed by a CMOS device decreases with the speed at which it is switching.
5. (1.2.3) Which one of the following gives the normally accepted upper voltage limit for a TTL low state (logic 0)?
- a. 0V
  - b. 0.8V
  - c. 2.0V
  - d. 5.0V
6. (1.3.1) Which one of the following gives the constituent elements of a computer?
- a. INPUT, MEMORY, OUTPUT
  - b. INPUT, CENTRAL PROCESSING UNIT, OUTPUT
  - c. CENTRAL PROCESSING UNIT, MEMORY, OUTPUT
  - d. INPUT, CENTRAL PROCESSING UNIT, MEMORY, OUTPUT
7. (1.3.2) The computer element responsible for permanent storage of programs and data is called the
- a. read only memory
  - b. read/write memory
  - c. arithmetic logic unit
  - d. central processing unit.
8. (1.3.3) The components of a microprocessor system are linked together by means of
- a. input/output lines
  - b. address, data path (e.g. RS-232C)
  - d. a control bus (including a CLOCK line).

- 9. (1.3.4) When a microprocessor is fetching an instruction from memory, the operation code for the instruction appears on the
  - a. address bus
  - b. control bus
  - c. data bus
  - d. I/O bus
10. (2.1.1) the block marked 'X' in Fig. 4.4 represents the
- a. data bus buffer

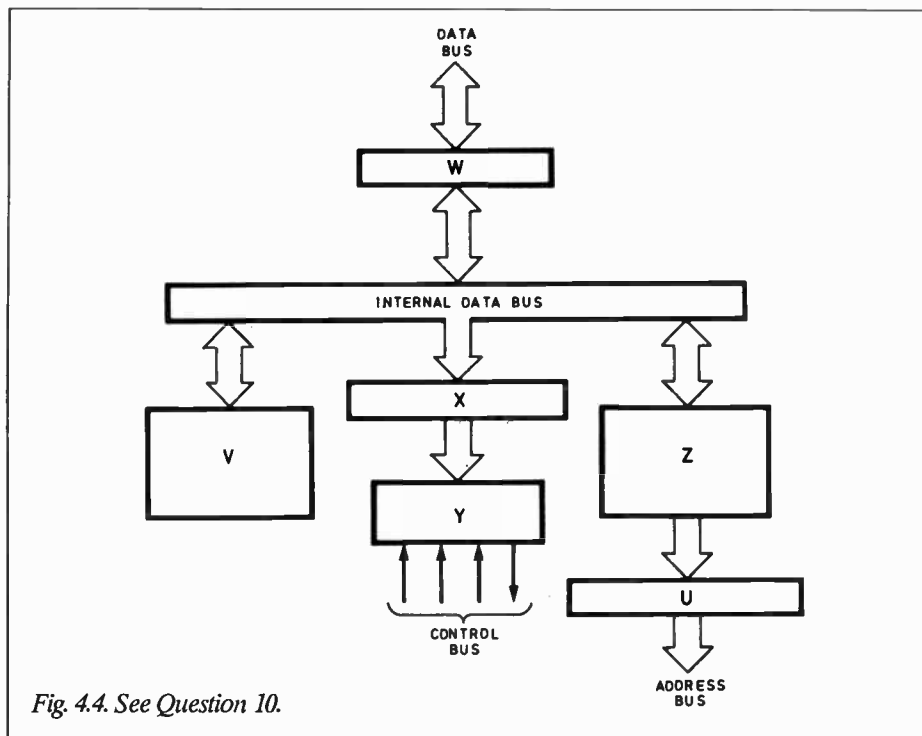


Fig. 4.4. See Question 10.

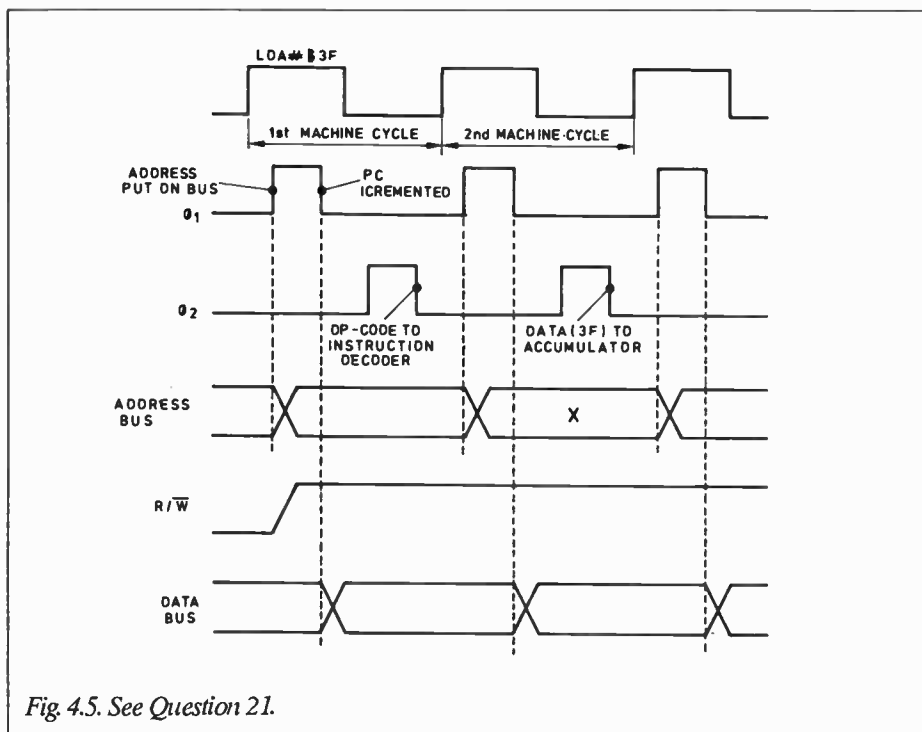


Fig. 4.5. See Question 21.

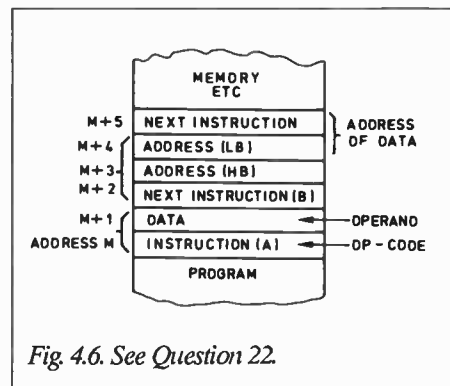


Fig. 4.6. See Question 22.



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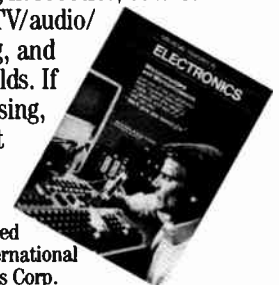
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## The Evolution of Intelligence *Continued from page 9*

of the overall system is because the global observation takes into account not only the properties of each individual subsystem but also correlations among them. Conclusively, intelligence seems to emerge as a cooperative behavior of various subsystems, such as knowledge base, inference mechanism, memory, acquisition of knowledge, and so on.

Similarly, in many other disciplines one finds cooperative behavior where the individual parts of a system cooperate leading to a complex macroscopic structure (e.g. orchestral music, human society, spatial patterns made by the movement of exercising athletes, etc.). In fact, one is tempted to explain any complex system in a synergetical viewpoint, be it human language, computer language or some other process or phenomenon.

Consider now computer languages, for instance, where the zeroes and ones of the computer binary code are nothing more than two states of the most primitive element. However, their patterns

represent hierarchically more and more complex structures; from symbols to words, from words to sentences, and eventually to a semantic net describing some abstract concept. In the theory of formal languages, one comes across with examples where a whole language is generated by only two primitive symbols. Of course, the grammar and the semantics are imposed on the symbolic representation of a language.

Present day research in Synergetics is focusing its attention on those situations where a structure undergoes spontaneous changes on a macroscopic scale. Thus, the science of cooperative phenomena deals with the following question: When does one structure become another structure distinct from the previous one? My own work published in the late seventies tackles this problem for types of physical systems. It was later known as "Theory of Quasi-catastrophe", because of its similarity to the Catastrophe theory by a famous French mathematician Rene

Thom. In artificial intelligence, those who are dealing with pattern recognition problems (e.g. in vision and speech recognition systems) comes across this question repeatedly.

### **Pattern Recognition**

We live in space-time. Consequently, the most common structures observed by our information processing brain are either spatial or temporal. That is, variations in the spatial or temporal values (of certain entities) produces most common patterns known to us in everyday life. Our brain has the capability to recognize both these classes of structures and others formed out of various combinations of these. Researchers in AI (especially those concerned with pattern recognition) often deal with a pertinent question. How do we recognize an object or a thought pattern? How do we distinguish one object from another, one thought pattern from another? The two issues, the occurrence and the recognition of the occurrence are respectively, the active

# Sony just extended the range of



and passive aspects of the same problem. Interestingly, while Synergetics suggests a mechanism for the formation of new structures, AI deals with problems of recognition of such changes, distinction between the old and the new structures, and their manipulation into higher order patterns by an information processing system. Not surprisingly, in nature there exists a mechanism for both occurrence and recognition. What is the relationship between the two types of processes and how fundamental is this relationship? The question is of profound importance to all; to physicists interested in elementary space-time objects, their code, and how they communicate with each other; to molecular biologists in the context of genetic code and its interpretation by cellular structures; and to computer scientists who want to understand intelligence and design intelligent systems. One would like to find at least a partial answer to this question.

So far in the above discussion intelligence is not defined and it is taken for

granted that whatever meaning we attach to it in our ordinary everyday life, it makes sense in this discussion too. The problem with such a definition is that it is too vague and ambiguous to be of any use in any rational discussion. For computer scientists it must be defined in such a way that it is possible to implement it on a computing machine based on either Turing or some other model of computation. Any intelligent behavior must be computable or else it is not useful.

Intelligence is easier to recognize than to define or measure. A recently published monograph on AI describes intelligence as a series of capabilities. It is also asserted that these attributes of intelligence are only typical of human intelligence — no less and no more. These attributes are:

- Have mental attitudes (beliefs, desires, and intentions),
- Learn (the ability to acquire new knowledge)
- Solve problems, including the ability to break complex problems into simpler

parts.

- Understand, including the ability to make sense out of ambiguous or contradictory information.

- Plan and predict the consequences of contemplated action including the ability to compare and evaluate alternatives.

- Know the limits of its knowledge and abilities.

- Draw distinctions between situations despite similarities

- Be original, synthesize new concepts and ideas, and acquire and employ analogies.

- Generalize (find a common underlying pattern in superficially distinct situations).

- Perceive and model the external world.

- Understand and use language and related symbols tools.

I strongly disagree that these attributes are typical of human intelligence. To one

*Continued on page 49*



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# Audio Cassette Test

**A test of eight brands of tape and how they compare.**

**TIMOTHY B. PALMER-BENSON**



Today's brand name cassette tapes offer a level of fidelity that few can complain about when they are used with a deck that is properly adjusted to match their formulations. To be sure, there are differences between brands, as you will see in this report, but these differences are small compared to the differences between, say, a normal bias tape and one that has a metal oxide coating.

There is so much marketing hype over cassette tapes that it is sometimes hard to discern the truth about a particular tape's capabilities. This test of eight brands of cassettes, using state-of-the-art equipment, both confirms and dispels certain myths. At the same time it should be stated that there is no clear cut winner, no best all around tape; rather there are groups of tapes that are clearly top performers in their particular category.

Except for one case, each manufacturer or distributor provided at least three different tape formulations: normal, chrome and metal. Nearly all samples were C-60s as we requested. A Revox B215 was used for all the tests. This deck has impeccable specifications and is ideally suited to cassette testing because it can be made to optimize its electronics automatically to provide the best possible performance from a tape. Another advantage is that the deck will memorize specific settings for different types of tape.

Each cassette was tested for wow and flutter, signal-to-noise ratio, frequency response and maximum output level (MOL). Measurements were made according to standard practice except that I have gone a little further in some areas such as the MOL test in order to show more detail of a tape's behaviour. Wow and flutter measurements were made because slight differences in cassette housings can influence overall performance. The B215 used in this test shows a 0.087%

unweighted wow and flutter reading, DIN standard, using a calibrated tape from Standard Labs in California. This is almost perfection in the cassette world and is the figure that should be kept in mind when evaluating the measurements.

The signal-to-noise ratio of a particular tape was measured as the difference between the signal level that caused 3% distortion (THD + N) at 400 Hz and the noise coming off virgin tape with no signal. IEC A-weighting was used according to standard practice. To evaluate frequency response in terms of amplitude, I made sinusoidal plots at Dolby level (200 nWb/m at 400Hz) using my programmable Amber 5500. This level was chosen because it is far more revealing of tape performance than sweeps at -10dB or even -20dB. At the same time, it should be remembered that Dolby level has nothing

to do with noise reduction. It merely refers to the degree of tape saturation. No noise reduction was used in any of the tests because what I wanted to test the tapes with the least signal processing possible.

High frequency MOLs for each tape were measured using the 5500 and the CCIF - IMD (Comite Consultatif International Telephonique) twin tone standard. To make these measurements, the twin tone IMD generator source (whose mean frequency is varied between 2kHz and 20kHz and with a separation of 120Hz) was automatically increased until a 3% intermodulation distortion level was measured off the tape at 24 frequency points between 2kHz and 20kHz. This level was then noted and displayed in a graph of maximum output level versus frequency.

3M provided five Scotch tape types; BX Normal type 1, CX Normal type 1, XS11 chrome type 2, and XSM 1V. The signal to noise ratio on all five types was respectable. BX measured 54.1dB, CX was 55.4dB, XS11 was

54.2dB and XSM was 52.1dB. Wow and flutter readings were 0.15% for BX and CX while XS11 and XSM 1V gave readings of 0.14%. These figures fall within the range of most of the tapes tested.

Amplitude response at Dolby level between 20Hz and 20kHz shows that BX has almost perfect response between 100Hz and 10kHz, while CX seems to suffer a gentle roll off with response down by almost 2dB at 10kHz. Scotch XS11 doesn't fare much better with response down by 1dB at 2kHz and an almost similar roll off in the high end that is similar to CX and BX. Only when we come to the XSM 1V metal tape do we see top notch performance. Note that there is no high frequency bump as there is with some other metal types. This is definitely a hi-fi enthusiast's tape with response within 2dB from 30Hz to 20kHz at Dolby level. The capabilities of

# Audio Cassette Test

this tape are also quite apparent in the MOL test.

BASF tapes gave some of the best signal-to-noise readings of all the tapes tested. BASF Ferro Extra (Type 1, or Normal bias setting) gave an S/N of 55.9dB, while Ferro Maxima 1 (also type 1, Normal bias) S/N was at 56.4dB. Chrome Extra 11, a type 2 tape, yielded a reading of 58.8dB. Wow and flutter was 0.18% for Ferro Extra 1 and Ferro Maxima 1, while Chrome Extra 11 measured 0.12%. The two former readings are a bit of a disappointment when one considers all the hoopla that BASF has made in the past over special mechanics in its cassette housings.

Ferro Maxima 1 gave the best results of the three when sinusoidal plots were recorded at Dolby level. Chrome Extra 11 is down 1dB at 2kHz and 3dB at 10kHz, while Ferro Extra seems to have an almost 2dB "suck out" in the upper midrange between 1.5kHz and 7kHz. Note that in the MOL test Ferro Maxima 1 also gave the best results. This was one of the best normal bias tapes in the test.

Three Triad tapes F-X, EM-X and MG-X gave excellent S/N ratio readings as well. F-X, a normal bias tape, measured 55.2dB while EM-X, which uses chrome bias, measured 58.1dB. The MG-X metal type was 56.8dB. Wow and flutter was 0.13% for F-X, 0.14% for EM-X and 0.16% for MG-X. Of the three types, I prefer the EM-X. It gave the smoothest trace in the Dolby level sweep and does quite well in the MOL test, though not as well as MG-X. But, while MG-X, like most metal tapes, has phenomenal high end response, it tends to be a little on the bright side when used on a good system. The 1dB of gain around 15kHz (seen clearly in the amplitude response graph) is discernible.

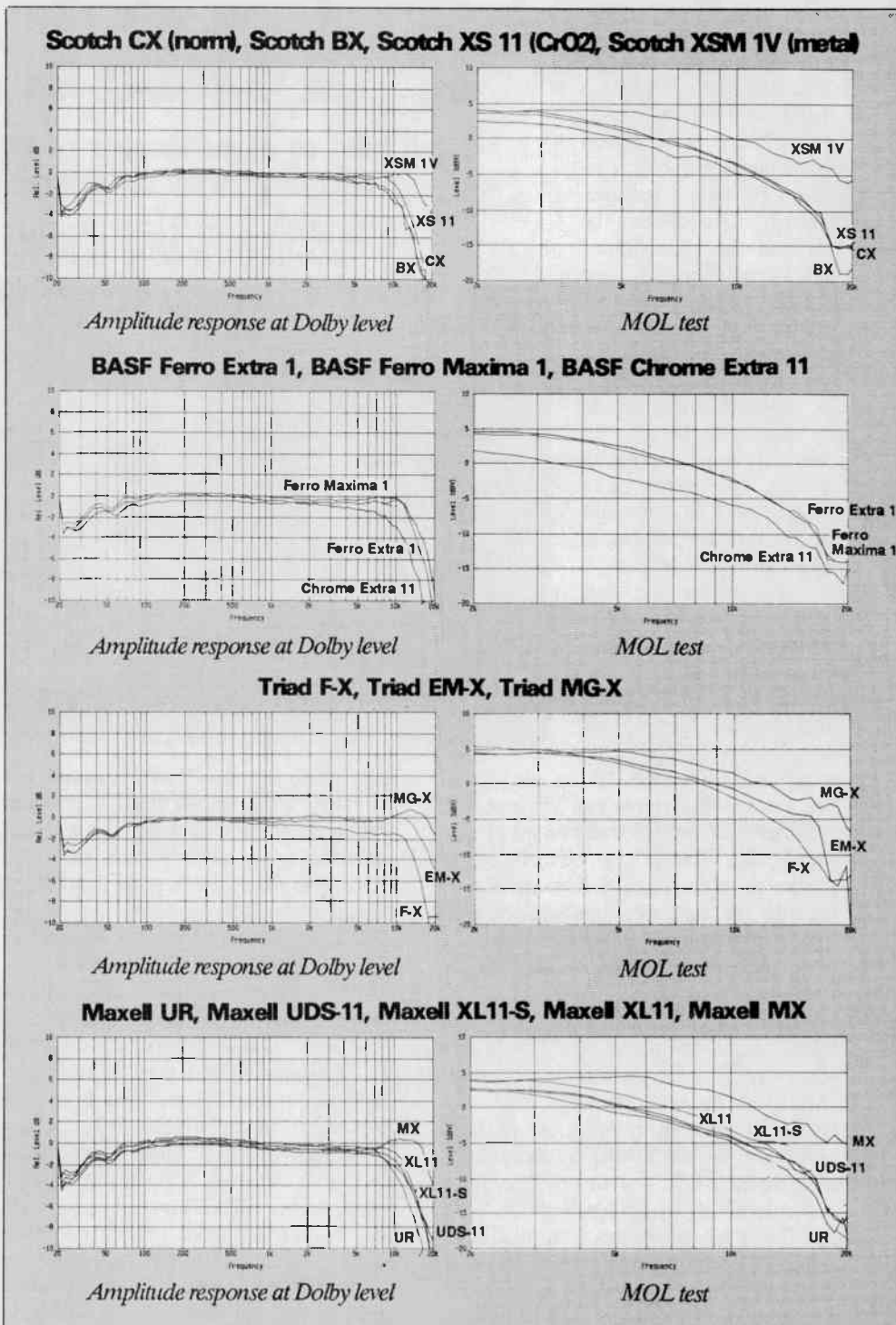
True to their reputation, Maxell tapes held their own very well in this test, both in terms of noise and extended high end frequency response. The least expensive Maxell tape in the five that I tested is Maxell UR Normal. It gave a S/N reading of 54.2dB. The remaining cassettes in the Maxell group went up from there with UDS-11 normal measuring 54.9dB, XL11 chrome 57.1dB, XL11-S chrome 55.2dB and MX metal 57.5dB. Wow and flutter readings for these cassettes were 0.17% for UR, 0.16% for UDS-11, 0.13% for XL11 and XL11-S and 0.14% for MX.

The "S" in XL11-S stands for Super, but in my comparisons with the tape it would seem to supersede, XL11, there seem to be only slight differences. In the Dolby level sweep, XL11 is down 1dB between

2kHz and 10kHz while XL11-S maintains flat output energy to about 9kHz. The two normal bias Maxells, UR and UDS-11, give the typical flat performance - between 100Hz and 5kHz with UDS-11 delivering slightly better response. The winner here is obviously the Maxell MX metal. It has the flattest and most extended response of all the tapes I tested though it does not win the MOL test.

Denon's HD8 chrome type two tape

maintained its high frequency energy better than any other chrome type tested. This tape also showed a very respectable S/N reading of 56.2dB. However, not everything is perfect. Response is down by 1dB between 2kHz and 7kHz and wow and flutter is slightly higher than other tapes at 0.18%. In contrast Denon's HD-M metal tape gives a wow and flutter reading of 0.15%, a S/N of 57.4dB and a more even response between 1kHz and



10kHz. Like other metal tapes tested there is a high frequency bump (more than 2dB at 18 kHz!) which may be a bit much for some people and a boon to others. MOL values are about average for both types.

Sony's three cassettes, HF-S, Sony UX-S and Metal-ES also showed good S/N ratios. HF-S's ratio was 55.3dB, while UX-S measured 58.3dB and Metal-ES was at 58.6dB. Wow and flutter on UX-S was less than 0.12% which is one of the best results

obtained. By contrast, HF-S was 0.19%, while Metal-ES measured 0.14%. In the Dolby level sweep UX-S beats out Metal-ES. Why Metal-ES takes a dive of more than 4dB in the high frequencies is beyond me especially when one looks at the MOL curve for this tape. It is quite respectable.

You may be somewhat astounded when you look at the Dolby and MOL traces for the five Fuji and TDK tapes tested. The behaviour of each company's metal tape is

virtually identical in the sinusoidal plots at Dolby level as well as in the MOL traces. Chrome and normal tapes are also somewhat similar.

Here is a breakdown of the two brands in terms of S/N as well as wow and flutter starting with the least expensive formulations:

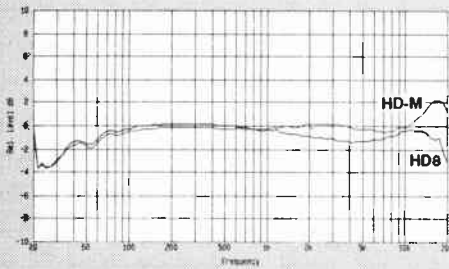
- Normal Type 1
- TDK D 54.7dB, w&f 0.16%
- Fuji DR 54.7dB, w&f 0.14%
- Normal Type 1
- TDK AD 55.5dB, w&f 0.16%
- Fuji FR-1 Super 55.2dB, w&f 0.16%
- Chrome Type 2
- TDK-SA 58.8dB, w&f 0.14%
- Fuji FR-11 58.8dB, w&f 0.17%
- Chrome Type 2
- TDK SA-XG 59.4dB, w&f 0.11%
- Fuji FR-11 Super 58.2dB, w&f 0.17%
- Metal Type 4
- TDK MA-XG 58.13dB, w&f 0.11%
- Fuji FR Metal 57.2dB, w&f 0.15%

The main differences here are in the wow and flutter readings with TDK tapes maintaining a consistently better score. S/N readings are almost exactly the same! The reason for the exemplary wow and flutter readings for TDK MA-XG and SA-XG is undoubtedly due to the special cassette housings that are used. They are very robust and about twice as heavy as other cassettes but they naturally cost a lot more.

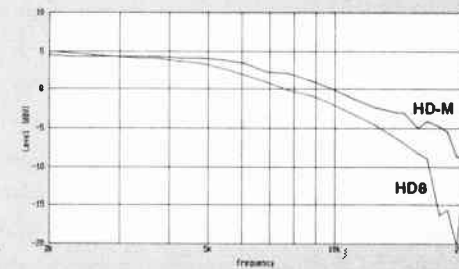
There are several conclusions to draw from this survey. The first one is that metal formulations provide the best results. You can record at a higher level, with greater signal-to-noise ratio and obtain almost perfect high end frequency response. TDK MA-XG is obviously the winner here but I also suspect it is the most expensive. Of the more popular type 2 chrome tapes, Denon's HD8, Triad's EM-X, Fuji's FR-11 Super, and Maxell's XL11-S appear to be the best. The type 1 normal bias tapes are all very much the same, although BASF's Ferro Extra 1 would appear to be the best among the premium versions. The premium normal bias types also give slightly better noise and wow and flutter measurements.

Finally, it should be noted that best results are usually ensured with a cassette deck by having it optimized for correct bias and equalization as well as lowest distortion using one particular tape. Selection of one type 1, one type 11 and one type 1V tape from any of those that did well in this test and a correct set up should guarantee good results. ■

### Denon HD8, Denon HD-M

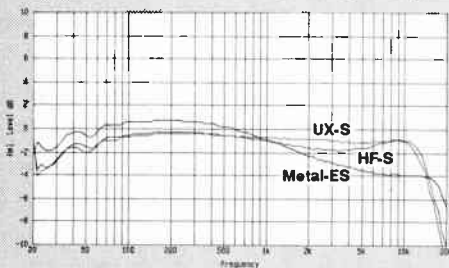


Amplitude response at Dolby level

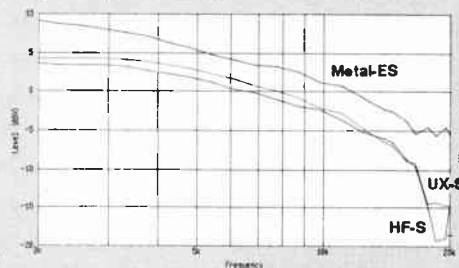


MOL test

### Sony HF-S, Sony UX-S, Sony Metal-ES

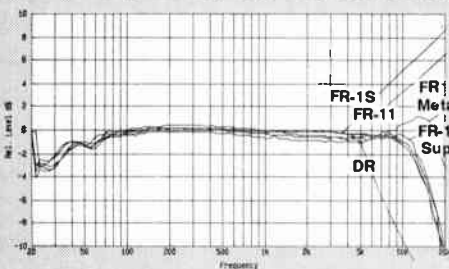


Amplitude response at Dolby level

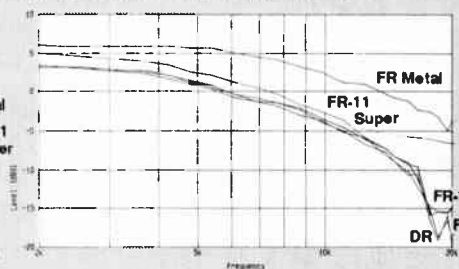


MOL test

### Fuji FR-1S, Fuji DR, Fuji FR-11 Super, Fuji FR-11, Fuji FR Metal

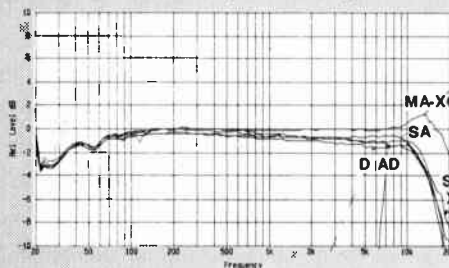


Amplitude response at Dolby level

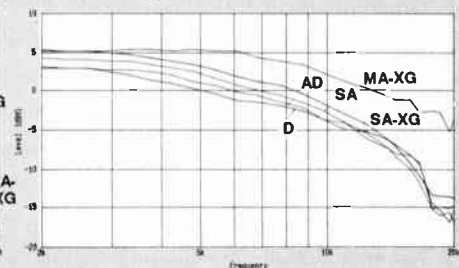


MOL test

### TDK D, TDK AD, TDK-SA, TDK SA-XG, TDK MA-XG



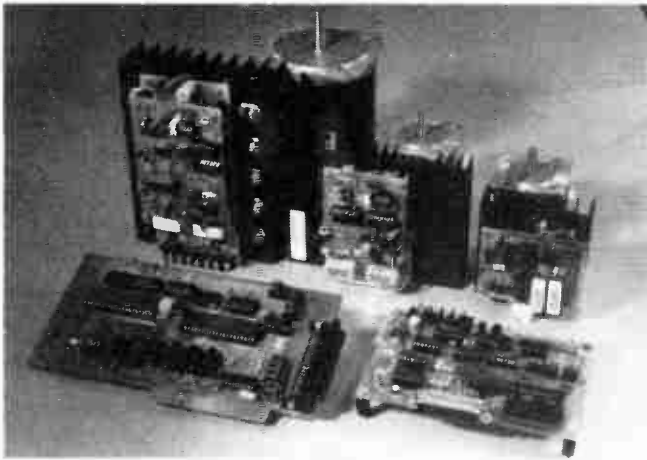
Amplitude response at Dolby level



MOL test

# MARKET PLACE

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# MARKET PLACE

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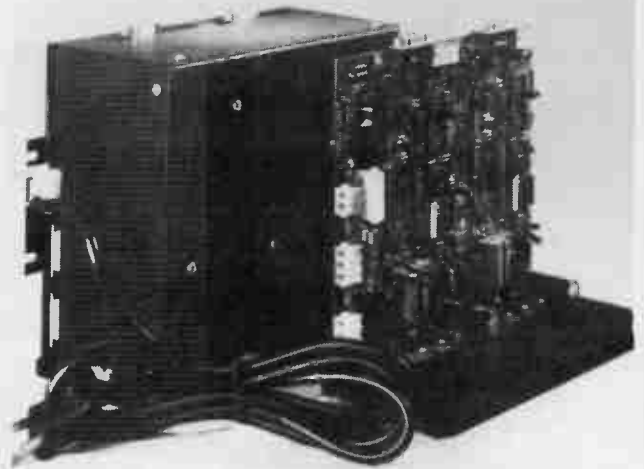
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# NEW PRODUCTS



## Servo Amplifiers

Technology 80 of Minneapolis announces the availability of their Model series 6400 Servo Amplifiers. The series contains units for both axes with or without power supplies. While usable with any servo controller having PWM and direction outputs, when coupled with the company's servo controller cards, the combination provides motor control where a high velocity servo is required, such as for robots, x-y tables and machine controls. Contact Tracan Electronics Corporation, 1200 Aerowood Drive, Units 3 and 4, Mississauga, Ontario L4W 2S7, (416) 625-7752.

Circle No. 9 on Reader Service Card



## Digital Tach

KB Electronics announces the addition of the DT series of digital tachometers to line of test equipment. The series features both touch and photo type handheld tachometers; the photo type can count from 5 to 100,000RPM, and the touch type from .5 to 10,000RPM. Accuracy is 1RPM with a 1-second sampling time. KB Electronics, 355 Iroquois Shore Rd., Oakville, Ontario, Canada, L6H 1M3, (416) 842-6888.

Circle No. 8 on Reader Service Card



## Engineering Software

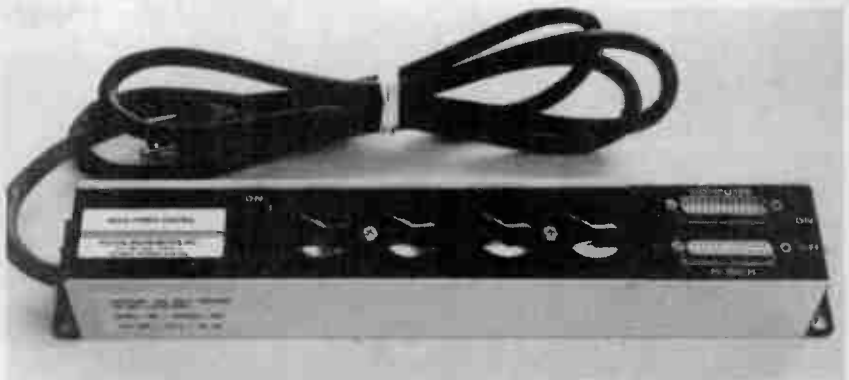
BV Engineering's 56-page catalogue describes 26 computer programs for the electronic engineer using PCs and Macintosh computers. Products are for logic simulation, filter design, microstrip design, etc. New features such as macros, Batch mode and integrated graphics are described. A tutorial on Bode stability analysis describes practical methods. It'll say "catalog" on the cover when you get it because they ran out of space. BV Engineering, 2033 Chicago Avenue, Suite B13, Riverside, CA 92507, (714) 781-0252.

Circle No. 10 on Reader Service Card

### RS232 Power Bar

If you'd like to be able to turn a remote computer's power on, the RS232 Power Bar, functioning in place of a regular power bar, powers up the attached equipment on receipt of a carrier signal. Host systems are thus powered up only for the duration of the remote access. The bar installs between the modem and the computer. The price is \$299 and it is available exclusively from Inly Systems International Ltd., 1090 Cummings Avenue, Gloucester, Ontario K1J 7S2, (613) 744-8307.

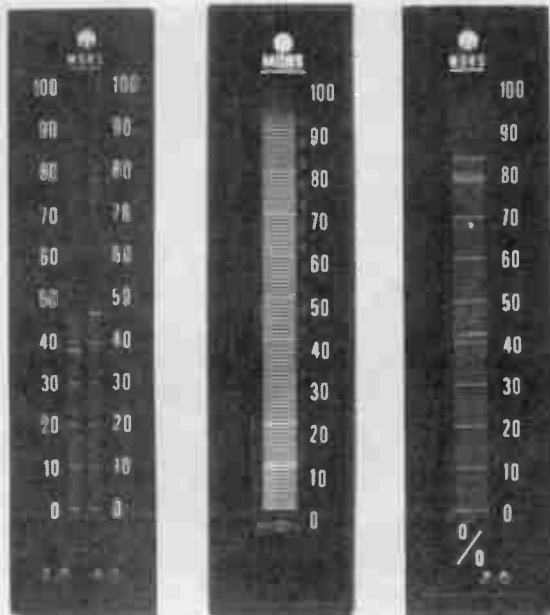
Circle No. 11 on Reader Service Card



### Peripheral Controller

Got lots of peripherals that won't play nice? They can share their computer time with the Byteway 2000, a completely automatic sharer with a buffer of up to 2MB. Parallel and serial ports make it compatible with just about any computer or printer. Conversions from one to the other are automatic. The controlling software has pop-up menus and the transfer rate is up to 38,400 baud. Protec Microsystems Inc., 3274 St. Martin Blvd W., Suite 100, Laval, Quebec H7T 1A1, (514) 682-6461.

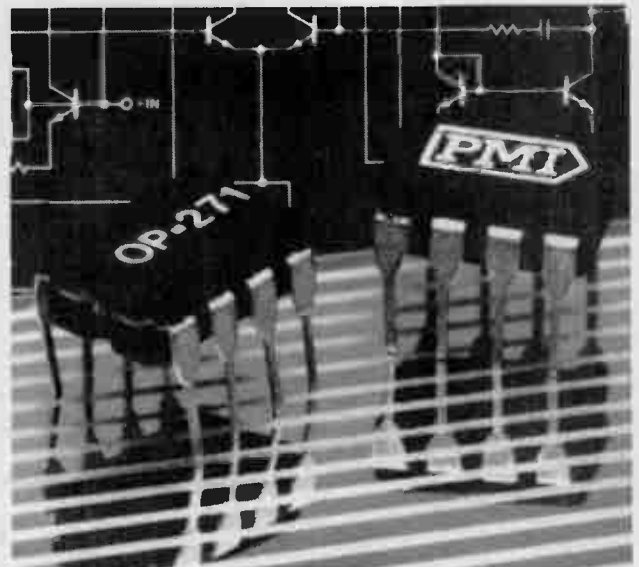
Circle No. 12 on Reader Service Card



### Bargraphs

The Mors Technologies bargraphs feature 100 segments and a scale length of 100mm, and are suited to any industrial application. The instruments include single or double channel with or without adjustable setpoints for maximum and minimum switching functions. 3-digit displays are available on some models. Mors Technologies Inc., 3430 Grifith, Ville St-Laurent, Quebec H4T 1A7, (514) 735-4411.

Circle No. 13 on Reader Service Card



### High Performance Op Amp

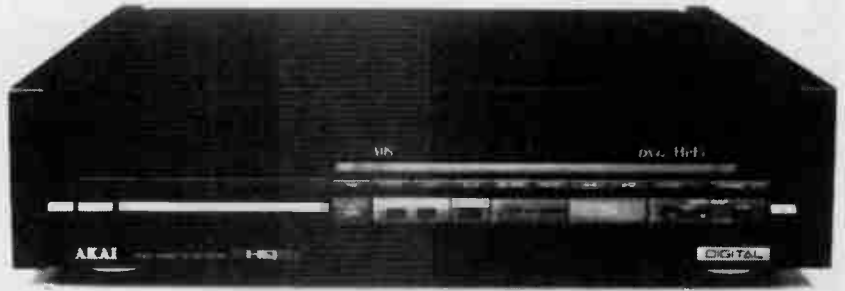
PMI has introduced the OP-271, a monolithic high performance dual op amp. It features excellent speed (8.5V/us), fast settling time (2us), a gain-bandwidth of 5MHz and stability to unity gain. The input offset voltage is typically 75uV, drift is 2uV/C, and gain is 400,000. The input bias current is 20nA. The 8-pin package is pin-compatible with the TL072, 082 LF412 and 1458 op amps. At PMI dealers, or contact Precision Monolithics Inc., 1500 Space Park Drive, PO Box 58020, Santa Clara, California 95052-8020, (408) 727-9222.

Circle No. 14 on Reader Service Card

## Akai VCR

The Akai division of Mitsubishi announces the VS-930 VCR. This top-of-the-line unit features a picture within 1.5 seconds of pushing the Play button, four heads, digital circuitry to freeze images, hifi audio, MTS stereo, a universal remote control that can memorize TV functions, a 167 channel tuner, HQ system with CCD video noise cancelling and two search systems. At Akai dealers, or contact Akai Division of Mitsubishi Electric Sales Canada Inc., 8885 Woodbine Ave., Markham, Ontario L3R 5G1, (416) 475-9804.

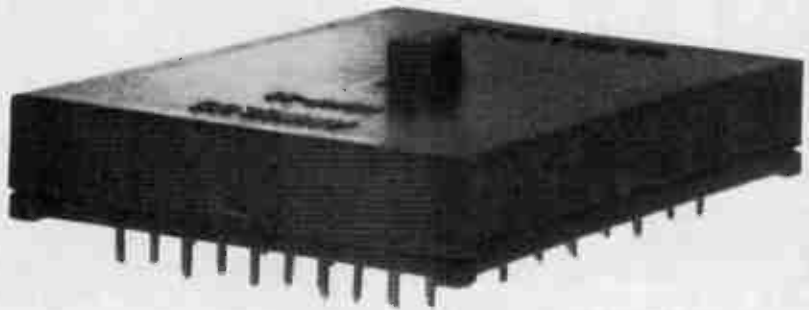
Circle No. 15 on Reader Service Card



## High Density Switch

If you're making up a test jig and need to switch a lot of data lines, or interchange various ICs, finding a mechanical switch with enough contacts can be a problem. Annulus Technical is offering a 25-pole double throw telecom grade slide switch, the HDMP-25. It actually contains 25 double throw switches in a miniature low-profile package, with PC mounting. The HDMP-25 costs \$17.50 in single quantities. An evaluation kit is available for \$29.95; it consists of a switch, a PCB, three DB-25 connectors and three 24-pin IC sockets, letting you make up a suitable jig for most test purposes. Annulus Technical Industries, Inc., 1296 Osprey Drive, PO Box 7407, Ancaster, Ontario L9G 4G4, (416) 648-8100.

Circle No. 16 on Reader Service Card



## Portable Static Meter

The Charleswater Static Surveyor™ CP911 is a handheld static meter with an analog dial and an audible/visible alarm if charges exceed 500 volts. The CP911 operates over zero to 5,000V. It requires no contact with the test object, and is powered by a rechargeable battery. It lists at \$275 (US). Charleswater Products Inc., 93 Border St., West Newton, MA 02165, (617) 964-8370.

Circle No. 17 on Reader Service Card



## Power Line Monitor

The Monitron 2000 features LEDs for indicating spikes, high voltage, low voltage, dropout and power failure. It will detect 0.5us disturbances. The five channel event recorder allows monitoring for periods of up to two months, with the time of occurrence indicated by a time track. Omnitronix Ltd., #4-1420 Dunwin Drive, Mississauga, Ontario L5L 1J9, (416) 828-6221.

Circle No. 18 on Reader Service Card



# THE SCIENTISTS TELL ME

DAVID P. DEMPSTER

## Advanced Composites in Fighter Aircraft

Advanced composites are playing a major role in the construction of fighter aircraft these days. In the accompanying illustrations we are introduced to the construction of graphite tall systems for the U.S. Navy F-18 Hornet strike fighters and flying high in the sky is Sweden's future combat fighter, the supersonic JAS-39 Gripen, also employing large areas of graphite composite in its construction.

The new Swedish fighter is the sixth generation of jet fighters developed in Sweden. Claimed to be the first aircraft ever designed to perform — in one version — intercept, attack and reconnaissance missions, the JAS 39 is adapted to the specific Swedish profile in air defence, which is characterized by the use of ordinary highways for air strips. As well, the airforce depends on the use of ordinary conscripts to handle simple maintenance, including turnaround service.

The JAS 39 aerodynamic configuration uses a delta wing combined with a nose-wing. The forward edge of the delta wing has a so-called sawtooth to give superior maneuverability. About 30 percent of the airframe, including the wing structure, consists of carbon-fibre composites. The first wings were produced at British Aerospace in Great Britain but production will ultimately be transferred to Sweden.

The engine is a joint development of Volvo Flygmotor of Sweden and General Electric in

United States. It is a version of the G.E. F404, especially adapted to Swedish needs. It has been renamed the RM12.

A large portion of the aircraft's advanced electronics was developed by Ericsson Radio Systems, also of Sweden. Before final acceptance, the various systems employed in the aircraft underwent stringent tests in nearly a dozen different test rigs and simulators.

## Using Plastic ice to Keep Aircraft Aloft

Are you a nail biter when you have to fly during winter storms? Take heart — research is underway in a number of locations to reduce the problems associated with winter flying.

At Ohio State University aeronautical engineer Michael Bragg spends much of his time turning plastic and wood into artificial ice. The reason — to discover ways of keeping airplanes safer in freezing weather. It's part of a long-running research project at Ohio State aimed at designing airplane wings and helicopter rotors to better resist the accumulation of ice while in flight.

Ice build-up on wing and rotor surfaces decreases the lift and increases drag on aircraft. That lessens the plane's ability to glide and increases the energy needed to keep it flying.

Most of the work done on aircraft icing has depended on studies using wind tunnels — huge machines designed to simulate the effects of air rushing past an aircraft in flight. And although Bragg continues to use such tech-

niques to reproduce these icing conditions, he also relies heavily on a computer to replace the wind tunnel and fake ice to mimic the real thing.

Small propeller-driven aircraft, because of their lack of size and power, often encounter problems in preventing ice buildup, says Bragg, an assistant professor of aeronautical and aeronautical engineering. Most aren't properly equipped, and icing is frequently a major headache for airplane companies.

Bragg models the shape and texture of actual ice deposits found on wings by using wood, foam, fiberglass and resin. The models are tested under wind that is provided by a tunnel generating speeds up to 140 miles per hour. Pressure sensors and velocity probes are attached to the various airfoils. The devices measure how the simulated ice shapes disturb the flow of air over the airfoil, and potential effects on its performance.

Bragg and his team were the first to use computers to simulate the developments of "rime" ice and its aerodynamic effects on various airfoils. Rime ice forms at very low temperatures, creating a "very streamlined, easy to measure" shape on the wing or rotor surface. This kind of icing often occurs at extremely low temperatures; microscopic water droplets come in contact with the airfoil surface and freeze.

Most ice formation occurs between the ground and 10,000 ft. The prime altitudes — 5000-7000 ft. — are the levels at which most aircraft tend to fly. Most commercial jets rarely have icing difficul-

ties, he says, since they fly at heights of over 30,000 ft.

Bragg's computer programs attempt to predict where — and under what conditions — the droplets will contact the airfoil, the particular ice pattern that can form, and its possible effects.

There is another kind of ice known as 'glaze' that forms at slightly warmer temperatures, though still below freezing. This 'glaze' creates mushroom-like patterns on the airfoil surface.

Bragg's work now concentrates on simulating the formation and effects of glaze ice, which can cut an airfoil's lift up to 50 percent and increase its drag by as much as 300-400 percent. The uneven shape and patterns of glaze ice are potentially more dangerous to the aircraft involved, and present a greater challenge to model.

The work, done in conjunction with researchers at NASA's Lewis Research Centre in Cleveland, may lead to the first complete computer simulation of glaze ice conditions.

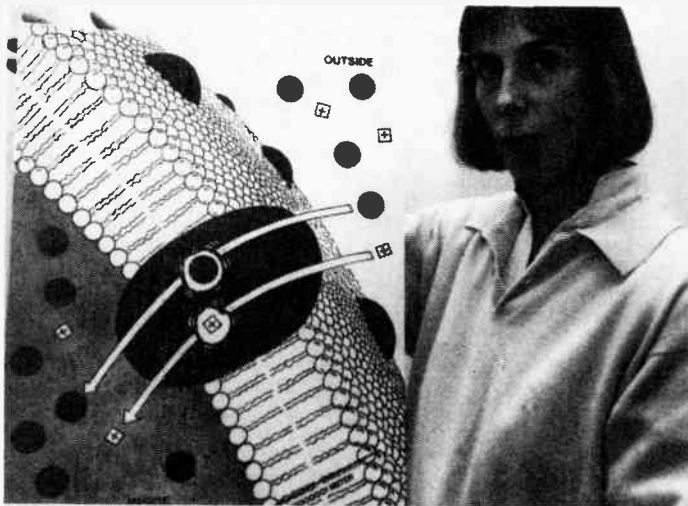
At NASA Lewis, a refrigerated air tunnel allows actual ice buildup to be studied. But Bragg and his colleagues prefer to use other materials to simulate the shape and roughness of ice.

"We've found that we are able to get good agreement in the aerodynamic properties with the different models and the actual ice accumulation shown in the NASA tunnel," he notes.

They have developed techniques to cast the ice in a mold. After ice forms on the airfoil, a silicone rubber compound is applied. This hardens to form a mold of the shape, from which a solid



The model shows the JAS-39, Sweden's sixth generation of Swedish-developed fighters. It employs large areas of graphic composition in its airframe.



Dr Janet Wood of the University of Guelph is trying to solve the mysteries of microscopic blobs that she and other researchers believe are the key to problems like diabetes and Western Canada's soil salinity crisis.

copy in plastic resin can be cast.

Bragg says that the various ice patterns that develop change the flow of air around the airfoil and the craft in a number of different ways, and in turn, affect the accumulation of further ice.

We don't think we can ever precisely predict what the ice (buildup) will be like until we understand all these details." But when this is accomplished, says Bragg, then it should be possible to develop a more effective ice protection system, and airfoils that are less susceptible to icing.

## This Blob is called a Biological Wonder

Science fiction movie fans remember "The Blob" as a lumbering mountain of jelly, bent on destroying the world. But University of Guelph biochemist Dr. Janet Wood thinks the "blob" she's studying is the key to a mystifying array of biological problems, from diseases like diabetes to Western Canada's billion-dollar soil salinity crisis, she and another University of Guelph scientist, Dr. Peter Pauls, have applied for a Natural Sciences and Engineering Research Council Grant to unravel the riddle of "the blob."

Wood's "blobs" are actually minute protein molecules. Even through a powerful electron microscope, they're visible only as tiny dots. They occupy about one percent of the area of the wall surrounding every living cell, and are seated among millions of smaller molecules that form a barrier between the cell and its external environment.

Researchers have discovered that these protein "blobs" have an essential function: they're like

miniature pumps or transporters, responsible for the passage of essential substances like sugars and amino acids between the inside and outside of the cell.

"They're really intricate little machines whose moving parts are atoms," says Woods.

By applying new genetic and biochemical techniques, scientists have achieved a breakthrough in understanding what the pumping mechanism does. The challenge now facing Woods and her colleagues is to deduce how, on the cell's behalf, the "blobs" select substances for uptake and release, how they transport the selected substances through the cell wall and how the cell regulates their activities.

"Besides being a fascinating area of basic, fundamental research, it's economically worthwhile to understand how these transporters work," says Wood, associate professor in the Department of Chemistry and Biochemistry since 1982.

One of the most dramatic problems that might be solved through more knowledge of the pumps and how their actions are controlled, she says, is the \$80-million a year loss prairie farmers suffer from salt-laden or "saline" soil. In the early 1980s, it was estimated this affliction has already lowered farmland values by \$3 billion.

Crop production is dramatically reduced by high salt levels, which dehydrate cells by the process of osmosis. Related studies by Wood and others have shown that to protect themselves from dehydration, bacterial cells either synthesize a new substance internally or accumulate an available innocuous substance from their external environment.

In either case, transporters

("blobs") are used to keep newly-created substances in, or to select the best external substance to admit. "We suspect that the survival of plants in saline soils is also enhanced through the efforts of these molecular pumps," says Wood. "If they're not helping to adequately balance the cell contents, the plant can't cope with its saline environment, and production is either cut sharply or the plant dies.

Wood also wants to study how these protein pumps can be manipulated to make plants less vulnerable to the ravages of saline soil. According to Dr. Larry Milligan, dean of research, "This type of basic, fundamental research is critical to scientists in industry, universities and government who are developing salt-tolerant plants to aid farmers anywhere that saline soil is a problem."

Understanding how "blobs" work is also an area of great medical interest, especially to diabetes researchers. Diabetes occurs when there's a lack of production of the hormone insulin, which controls the transport or uptake of glucose from the blood into cells.

Cells use glucose as an energy source; in its absence, they're starved. Understanding how the transporters select and move the glucose from the outside to the inside of the cell and how a hormone like insulin controls these

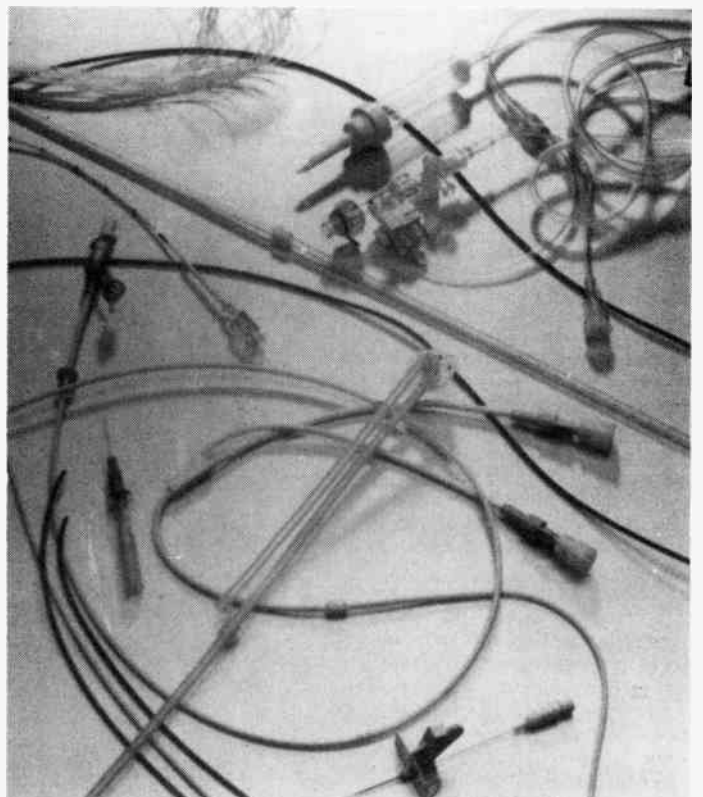
transporters is important for the control of diabetes.

## Long-term Implants Made From Polyurethane Elastomer

Here's a story about another plastic lifesaver. This one is based on polyurethane chemistry and is used to produce tubes, catheters and other devices which are designed for long-term implanting in the human body. The purpose — to test, explore, diagnose, monitor and treat organs and blood vessels.

The material is an aliphatic (light-stable) thermoplastic polyurethane elastomer which was developed by Thermedics, Inc., of Woburn, Massachusetts. The rubberlike material is also used in infection-resistant skin buttons, or semipermanent ports, which provide access to implanted devices used in treating patients with diseases of the heart, kidneys of genitourinary organs. And on an experimental basis, the resin has been used successfully in components for implanted temporary heart-assist devices.

Devices made from the material are said to provide excellent biocompatibility with the strength and processibility needed in medical devices. The material is not affected by nor does it affect body fluids and tissues. ■



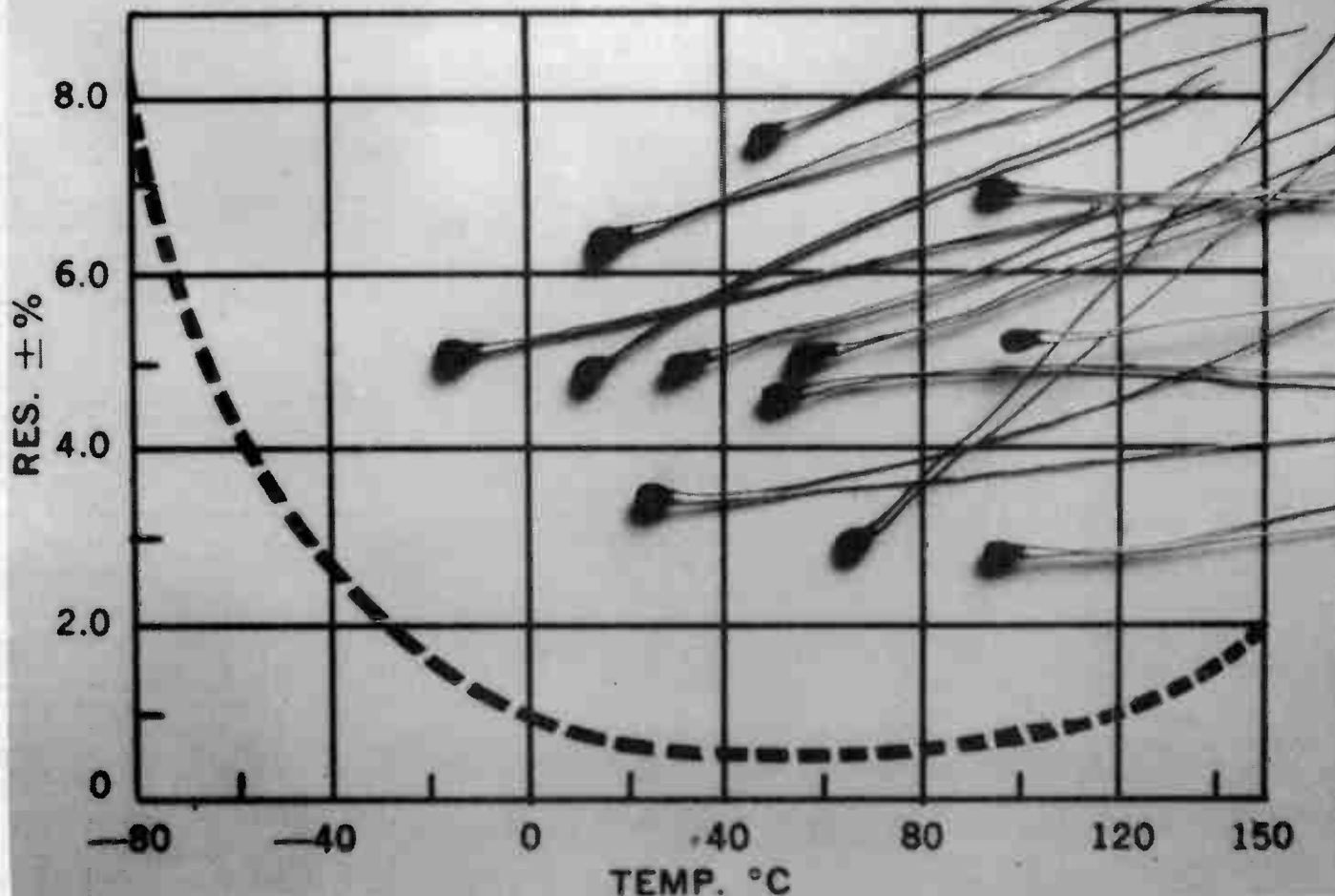
Polyurethane chemistry is used to produce tubes, catheters and other devices which are designed for long-term implantation into the human body.

# The Thermistor

Resistors that vary with temperature are versatile control devices for a wide variety of applications.

DR. H. VIRANI

## RESISTANCE TOLERANCE



**C**eramic positive temperature coefficient thermistors are temperature-dependent resistors that can be used in a wide field of applications in electrical engineering and electronics. The characteristic of a positive temperature coefficient thermistor is that in the "cold" state it is a relatively good conductor of electric current and, at a particular temperature, it increases its resistance suddenly.

Depending on the design of the positive temperature coefficient thermistor, and with an appropriate shape, it is used for measuring temperature, compensating for

temperature-dependence, as non-destructive fusing elements and for delayed switching and stabilization tasks. Further more, it is increasingly used as a heavy-duty self-limiting heating element. Applications include electronics, telecommunications, electrical engineering, motor vehicles, and household appliances.

### Overload protections

In this application, the positive temperature coefficient thermistor is connected in series with the load to be protected. An operation of the load under rated conditions, the positive temperature coefficient thermistor remains at a low resistance, and a low voltage is then applied to the device.

In event of an overcurrent during a fault conditions, the positive temperature coefficient (PTC) thermistor becomes heated to a level greater than its reference temperature and suddenly changes to a high resistance. The current flowing through the load is reduced simultaneously to an acceptable level, i.e. a few MA.

When the supply voltage has been switched off, the positive temperature coefficient (PTC) thermistor cools and becomes operational once again.

When the equipment is started, it again assumes its protective function.

### Delayed Switching

If the PTC thermistor is subjected to cur-

# The Thermistor

rent or voltage in order to heat it beyond the reference temperature, the time taken to reach the reference temperature and the high-resistance state depends on the initial power. The "Switching time" ( $t_s$ ) can be varied within wide limits by selecting the voltage (current), series resistance, size of the PTC thermistor, reference temperature and thermal capacitance.

## Measurement and control

The steep slope of the resistance/temperature characteristic of a PTC thermistor indicates the special advantage of this component as a temperature sensor, e.g. in monitoring - specified temperature limits. It can be used for measurements and control tasks with few associated components, where it is in thermal contact with the body or medium to be monitored.

Special design types such as disks, pellets with or without leads, and screw-type versions were developed to the following examples of applications. There is also a wide range of applications for these devices in combination with triacs, thyristors and LEDs.

## Motor and machine protection

Special types of PTC thermistors for motor protection have been developed for this specific application. They are manufactured in the form of small pellets with leads, coated with lacquer and shrink-sleeve insulated against high-voltage so that they can be fitted directly in the winding of the motor or of the machine. The threshold temperature is chosen so that the PTC thermistor operates in the steep slope of its resistance/temperature characteristic, when the maximum permissible operating temperature of the motor is exceeded. Fig. 1 shows the typical resistance/temperature curve of a sensor for motor protection.

These specially developed sensors can be used to provide full protection of heavy-duty motors which are subject to severe thermal stress, for thermal monitoring of sleeve bearings, and for temperature monitoring of heat sinks in power semiconductor.

## Heating elements and thermostats

Positive temperature coefficient (PTC) thermistors can be used in the design of self-regulating heating systems which require no additional auxiliary elements.

If a positive temperature coefficient (PTC) thermistor is subjected to a voltage, which is sufficient to heat the device to a temperature above the reference tempera-

ture, a sudden change of resistance takes place. This results in a balanced state in which the dissipated heat is equal to the electrical power applied. The stabilization temperature does not depend on the ambient temperature. As a result of the positive temperature coefficient of the PTC thermistor material, the power drawn rises as the temperature drops and decreases as the temperature rises.

Heat transfer is ensured by clamping, bonding or soldering the PTC thermistor to the system to be heated; care should be taken to achieve a symmetrical heat dissipation (dissipation from both surfaces of the thermistor).

Low-voltage positive temperature coefficient (PTC) thermistors are suitable for clamping, bonding and soldering with suitable solders consisting of a minimum 3% silver. It is important to ensure that the PTC thermistor is not subjected to thermal shock, and pre heating is therefore necessary. Low-voltage version which are only suitable for clamp contacting are also available.

## Special applications

Positive temperature coefficient (PTC) thermistors can also be employed in a variety of special uses, including applications in television servicing for degaussing the shadow mask in colour picture tubes, and as a starting resistance in switched-mode power supplies. Another use is as delayed switching elements for overcurrent protection at high operating voltages, to suppress input peak currents, for motor starting and soft starting.

## Negative temperature coefficient (NTC) thermistor

Negative temperature coefficient thermistors are temperature dependent semiconductor resistors with a negative temperature coefficient between 3% and 5% K and are produced from carefully selected and tested raw materials. The starting materials are different oxides of metals such as manganese, iron, cobalt, nickel, copper and zinc, to which in-part stabilizing oxides are added to achieve better reproducibility and stability for a thermistor's characteristics.

NTC thermistors have many ad-

vantages including: high sensitivity; good reproducibility thanks to mechanical thermal, and electrical influences; long life; compact design; and favorable price/performance ratio.

They have been used for many years in a broad range of applications in the field of electronic circuitry. Owing to their ease of handling and high reliability NTC thermistors can be used for a wide variety of measuring, controlling monitoring and similar tasks.

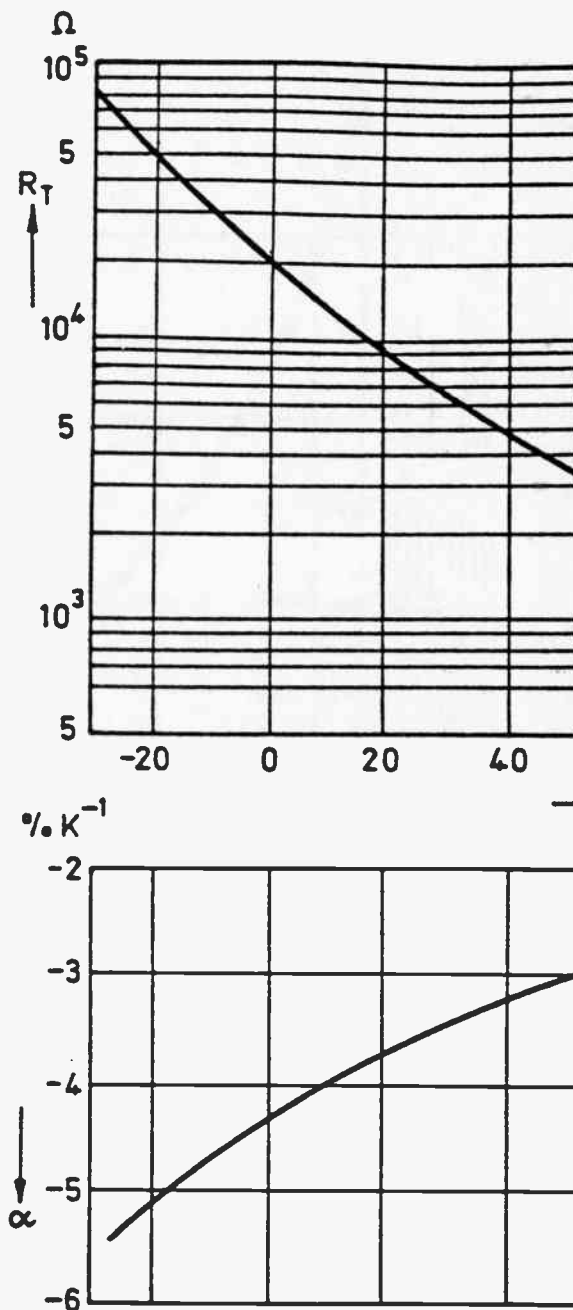
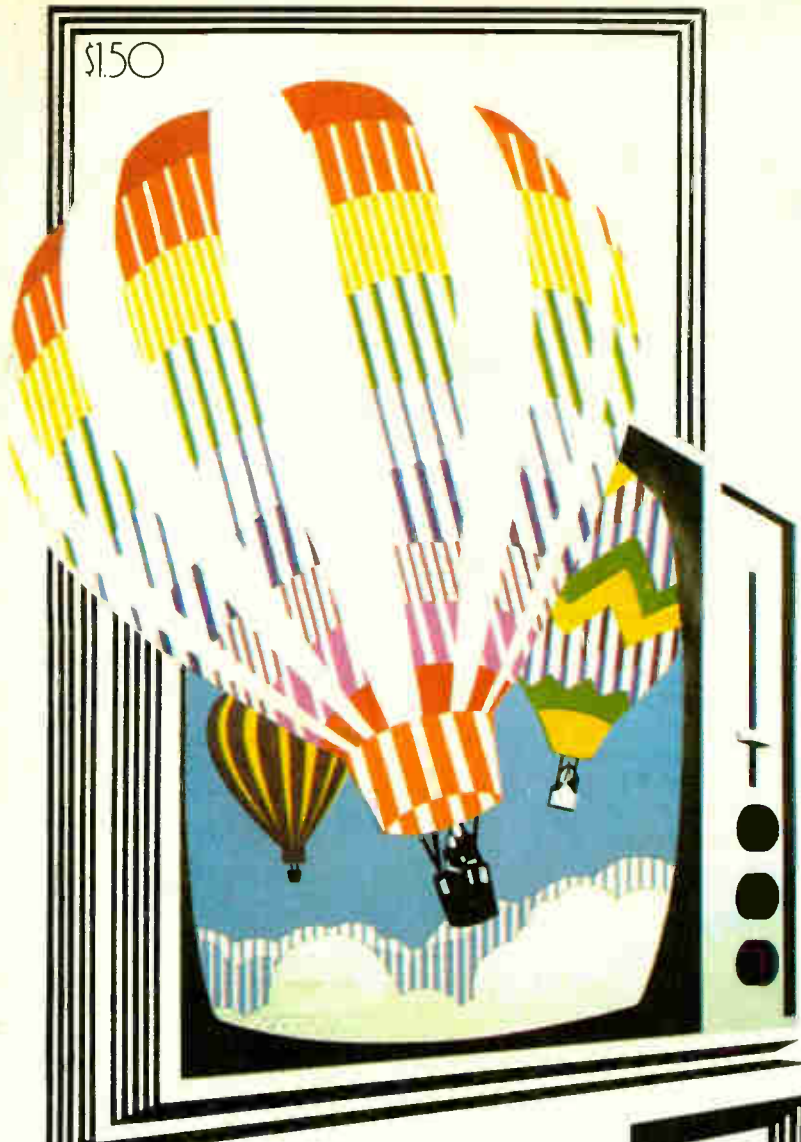


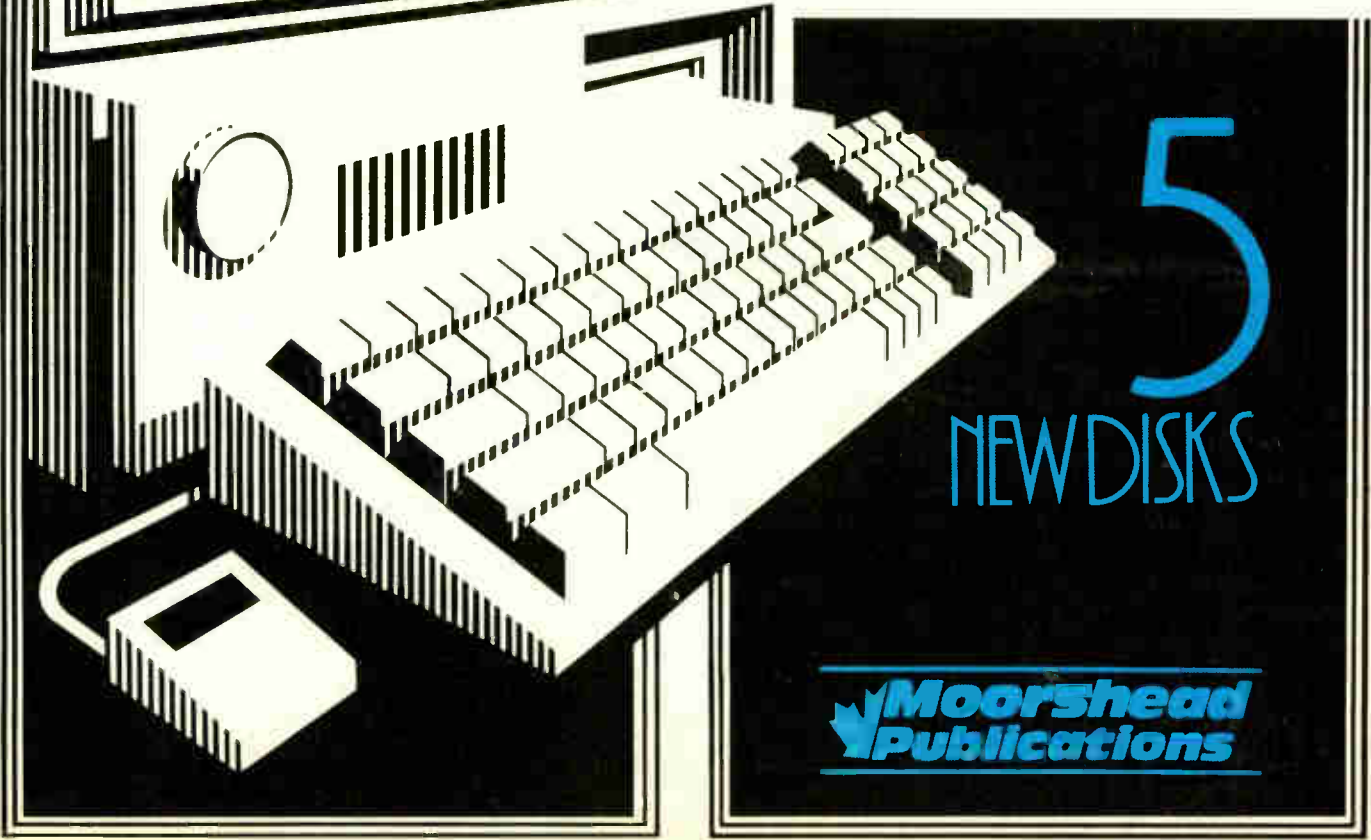
Fig. 1. The relationship between temperature and the resistance



\$1.50



# SOFTWARE CATALOGUE SUMMER 1988 REVISED EDITION

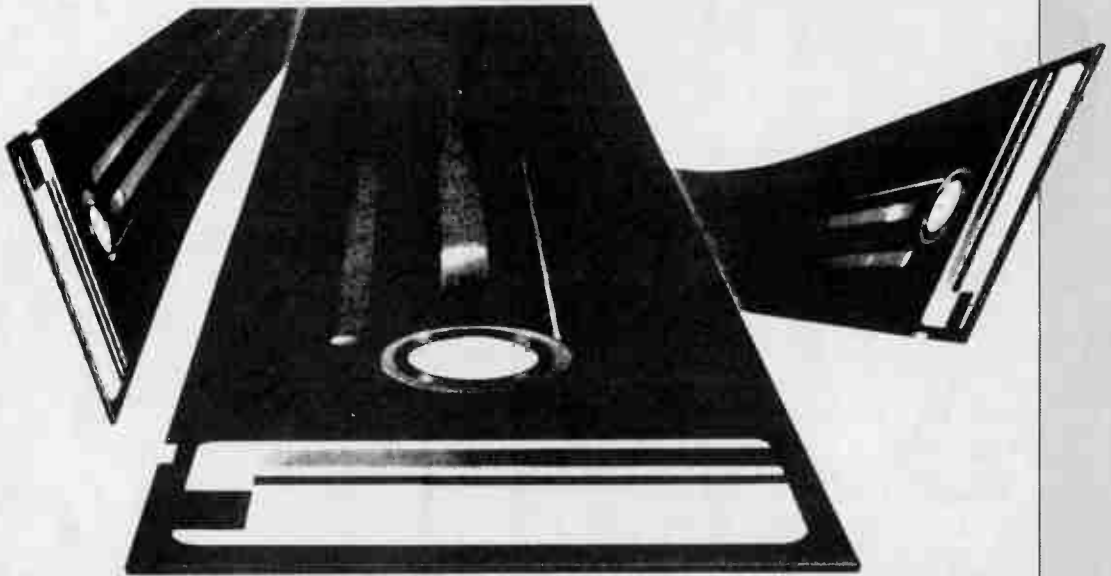


5

NEW DISKS

**Moorshead  
Publications**

# The Almost Free PC Software Disk of the Month Club



We have often been asked if a subscriber to one of the magazines of The Moorshead Group could arrange to receive each new PC disk automatically. Not only will this save on long distance telephone calls and postage, it will also save time. Because YOU asked us, we are pleased to introduce the **Almost Free Software Disk of the Month Club**. While the name may be hard to say, the Club is easy to join. Here's how it works:

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Software Disk the day we put it in the mail to you. There will be approximately one new disk each month.

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# SOFTWARE FOR THE PC

## VOLUME 1

**PC-WRITE** An earlier, compact version of this well-known word processor — perfect for program editing. PC-Write boasts features such as user-definable help screens and a 'printer ruler file' which can be customized to work with virtually any printer.

**SOLFE** is a small BASIC program that plays baroque music. While it has little practical use, it's a lot of fun. It's also a fabulous tutorial on how to use BASICA's sound statements.

**PC-TALK** A high-power telecommunications program for a low-power price. It does file transfers in both ASCII dump and MODEM7/XMODEM protocols. And, it comes with a large documentation file.

**SD** This sorted directory produces displays which are a lot more readable than those spewed out by typing DIR.

**FORTH** This is a small FORTII, written in Microsoft BASIC. A good tool for teaching the ideas and concepts of this esoteric, but useful language.

**LIFE** This is an implementation of the classic ecology game written in 8088 assembler code.

**MAGDALEN** This is another BASIC music program.

**CASHACC** is a fairly sophisticated cash acquisition and limited accounting package written in BASIC. It isn't exactly BPI, but it's a lot less expensive and suitable for many small business applications.

**DATAFILE** is a simple data base manager, written in Microsoft BASIC.

**UNWS** Convert WordStar documents to standard ASCII files.

**HOST2** This program includes BASIC source and documentation files to allow users with SmartModems to access their PC's remotely.

**\$19.95**

## VOLUME 2

**SWEEP** is a disk utility which virtually replaces the DOS COPY, REN, TYPE and DEL commands.

**WORLDMAP** is a sophisticated graphics program which draws a very detailed map of the world. It can display its wares on your monitor, or send them out to a dot-matrix printer. CGA required.

**ANITRA** plays Anitra's Dance by Edward Grieg. A beautiful addition to your computer music collection.

**RAMDISK** is one of the most useful utilities you'll ever plug into your PC. Once installed, it creates a virtual drive in memory on your PC.

**ALIEN** Plays a bizarre adventure game and will lead you into some of the most exotic spots in the universe.

**FOS** is a well designed personal finance manager which will do much to help you tame your cheque books.

**JUKEBOX** represents yet another PC music system. This one comes with a host of songs and some really electric graphics.

**ASMGEM** is one of the best text disassemblers we've come across. It takes any executable COM or EXE file and produces an assembler listing. It's surprisingly good at distinguishing between code and embedded data or text.

**STRUCT** will appeal to the rapid programmer in everyone. It enables MASM to be used to assemble a higher level language. Included also is a test file to illustrate the syntax.

**PRTSC** replaces the internal PC screen dump code with something more suited to reality. It allows one to hit the PrtSc\* key and then select the print quality from a menu. It supports a number of popular printers.

**BREAKOUT** plays a PC version of the popular game. It will accept input from either a joystick or the keyboard. The graphics are good and the action is adjustable from a beginner's level right up to 'fast and nasty'.

**UTIL** is a collection system utilities which can be accessed from a single menu. Among its many talents are a sorted directory, keyboard redefinition and the facility for scrolling through text files.

**\$19.95**

## VOLUME 3

**WRT** DOS allows files to have a 'read only' flag, but it lacks a way of manipulating them. This pair of utilities allows you to set and unset this flag, protecting important files from accidental erasure.

**BROWSE** is a timesaving program which provides a useful alternative to the DOS 'TYPE' command. BROWSE allows you to easily scroll through text files in order to have a quick look at a text file.

**CAT** If the DIR display is too dull for your taste, CAT may be just what you need. It will tell you everything you could possibly want to know about the files on your disks.

**CGCLOCK** is a simple little program which displays the running time in the upper right hand corner of your screen. Works with CGA displays.

**CURSOR** A tiny twenty-four byte program which displays a large cursor on your monitor.

**CMP** This program does a very elaborate comparison of two files and reports their differences.

**JUMPJOE** A bit like "Miner 2049'er", this game is certain to damage your mind. You get to be the janitor of a space station and must deal with berserk robots and other weirdness.

**CASTLE** Wander through a deserted

castle collecting treasures... but mind you don't get killed by the nasties. A solution is included should frustration set in.

**78INT** This small BASIC program calculates interest using the rule of seventy-eight.

**MOON** is one of the nicest lunar lander games we've come across. This version uses high resolution graphics and startling sound effects to hurl you to your doom in style.

**PERTCHT** is a BASIC program which prints PERT charts. It should interest anyone involved in project management and scheduling.

**DATNOIDS** is one of the strangest games ever put on a disk. In fact, mere words don't serve to describe it: you'll have to try it for yourself.

**NUK-NY** This is one of the nastiest bits of software we've ever seen. It produces a full color high resolution simulation of a nuclear attack on New York City.

**\$19.95**

## VOLUME 4

**BACKSCROLL** Perhaps one of the cleverest DOS utilities, BACKSCROLL hooks itself into the PC and buffers whatever scrolls by. Using a well-thought out command structure, it allows one to scroll through text which has already scrolled off the screen into oblivion.

**BIGCAL** is a BASIC program which performs calculations on extremely large numbers.

**BUGS** is an off the wall ASCII game in which a player uses the cursor pad keys to move a 'nuclear fly swatter'



around the screen blowing up a long crawling bug.

**CRYPTO** is a BASIC program which unscrambles cryptograms. It's an interesting study for puzzle enthusiasts.

**DEFRAG** is a utility that lets you "defragment" your disks to make your applications run faster. The utility reorganizes a disk, connecting up the fragments of files created by DOS.

**DOSEEDIT** enhances the command line facility of MS-DOS by creating a command stack. Instead of merely

being able to recall a command with the F3 key, DOSEEDIT lets you use the cursor arrow keys to scroll through a whole stack of previously entered commands, re-executing the ones you need.

**DUMP** is a utility program designed to produce Hex dumps of object files.

**FREE** is a tiny file which tells you how much space is left on a disk... without having to view an entire directory listing.

**KBFX** displays the status of the keyboard lock keys on the screen and expands the size of the keyboard character buffer to avoid losing bytes.

**LABEL** changes the labels on disk drive volumes. It's a simple utility, but useful if you use volume labels to keep track of your disks.

**LIST** is an improved version of the DOSTYPE command which shows you the contents of a file page by page.

**MEMBRAIN** is the most sophisticated RAM disk program we've seen yet. It lets users install variable sized disks and provides control over several other parameters.

**MONOCLOCK** is a screen clock display program, designed specifically to work with monochrome displays.

**MOVE** is a disk utility which moves and optionally erases disk files. Using wild cards, the user can ensure that specific types of files are not MOVED by the program.

**NEWBELL** is a tiny program which performs the lowly task of changing the sound of the PC's control G beep.

**NUSQ** is a file un-squeezer. Its a useful utility for people who download compressed files from bulletin board systems.

**PARCHK** is a trap which prevents the system from 'freezing' when a "parity error" is encountered.

**PURGEDUP** is an intelligent little program which cleans up obsolete backup files. Very useful on a hard drive.

**PX** is a cross reference generator for assembler programs. It helps you keep track of where you put procedures in large files.

**QS** is a DOS patch which eliminates some of the wait encountered when DOS is booted while it performs a

# SOFTWARE FOR THE PC

number of system checks. The program is not compatible with all software, but is still handy to have.

**SDIR** is an improved sorted directory program.

**SP** is a clever print spooler which lets you 'print' files into a RAM buffer, leaving the user free to move on to other tasks using the computer.

**SPACE INVADERS** A fast variation of this popular arcade game. The graphics are superb.

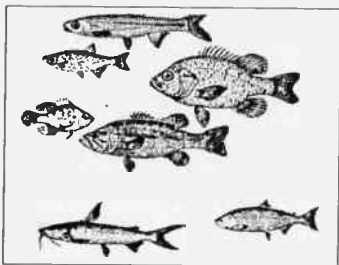
**SPEED** is a simple program which changes some of the PC's floppy disk parameters and effectively speeds up disk accesses for some applications.

**VDEL** is a multiple deletion program that queries the user prior to erasing each entry. Similar to MOVE, but much smaller.

**WHEREIS** will locate a file on a disk even if it lurks in a subdirectory. Most useful on hard disk systems.

**WIZARDS** is an adventure game in the classic style, except that it ranks as one of the most sarcastic programs in creation. The program is vast... you can wander about its darkened corridors for hours.

**\$19.95**



## VOLUME 5

**AREACODE** is a useful tool if you use the telephone a lot. Give it an area code and it will match it with the city in which the code is used.

**D** in another sorted directory program. This one emulates the CP/M style D, which is arguably more useful for most applications.

**FRACTALS** An amazing implementation of the Mandelbrot Microscope, which generates unearthly images on your screen.

**HIDE** is a set of utilities which let you create, enter and remove invisible DOS directories. An inexpensive security strategy.

**LAR** is a library utility that allows you to concatenate several small files into a library to save on disk overhead.

**MAIL1** is a mailing label utility written in BASIC.

**MORERAM** This is an assembler program. It lets you alter the memory setting on the PC's motherboard to enable it to use more than 640K RAM.

MASM & LINK Required.

**MORTGAGE** generates amortization charts.

**MXSET** lets you control the parameters of Epson printers from the DOS command line.

**PARCHK** is an assembler program which requires MASM and LINK to work. It installs a trap for parity errors in your computer.

**VDEL** is a Delete with Verify program.

**WHEREIS** finds files in a complex hard disk system.

**ZAXXONPC** This is an incredible implementation of one of the most popular micro games ever created.

**\$19.95**

## VOLUME 6

**3-DEMON** is one of the most interesting variations on Pac-Man in the known universe. Instead of simply looking at a map of a maze, this program shows you a three dimensional view of it.

**DU** allows you to see what the tracks and sectors on your disks look like, recover erased or damaged files, and meddle with the system tracks.

**GENERAL LEDGER** This is a complete general ledger accounting program. Written in BASIC, the program possesses most of the features found in commercial packages. Documentation included.

**PC-CHESS** is a slick chess program which makes good use of the PC's colour graphics abilities and boasts a running chess clock.

**RAMDISK** is the assembler source code for a memory disk program. A great learning tool for budding assembler programmers.

**VFILER** is a file management utility which lets you view files in a directory and allows you to COPY, TYPE and even run programs... in short, it does almost everything DOS does but it's user-friendly.

**QMODEM** is a sophisticated telecommunications program that includes windowing, multiple protocols, and definable function keys.

**ARC** is a clever file archiving program which stores multiple files in single library files.

**ZAPLOAD** is a utility for programmers to handle Intel standard HEX files. Very fast and well documented.

**SOPWITH** Using superb graphics, SOPWITH lets you pilot a World War I biplane on dangerous bombing missions.

**JSB** Another BASIC music program for your collection. This one plays a soothing sonata.

**STAR** is one of a growing breed of small... somewhat silly... novelty programs. This one, as you might guess, draws stars.

**SURFACE** demonstrates the complexity of the "hat" function by graphing it.

**OP** is the operator program from the November '85 issue of Computing Now!

**(2 Disk Set) \$24.95**



## VOLUME 7

**BLACKJACK** is a BASIC implementation of this popular card game.

**EDSCR** is a screen editor which can be used with virtually any programming language from assembler to dBase III.

**FK** allows you to make the function keys of your PC do more useful things under DOS.

**FXMASTER** is a printer program for the popular Epson FX Series and compatible printers. It uses a full screen menu to enable you to easily change printer settings and modes.

**INDEX** allows you to generate indexes from WordStar documents... or text files from any other text editor.

**KEYCLICK** is a memory co-resident program which will make your keys click.

**PCBW** is a small utility which makes colour screen displays show up in monochrome video. Great for users with colour graphics cards and monochrome monitors.

**PINBALL** is a pinball simulation that is easily worth the cost of this disk all by itself.

**QUICKGRAF** is a powerful business graphics package which generates complex bar, line and scatter charts in medium and high resolution. An Epson with GrafTrax or compatible printer is necessary to produce hardcopy.

**SERPENT** is a variation on the classic snake game. Written in BASIC, this one is weird, but very fast.

**SHOWCLK** is yet another clock program... its the smallest one yet, and it beeps to chime the hour.

**VTREE** is a graphic TREE program that shows you how the subdirectories are set up on your disk... in a fashion more easily understood than the MS-DOS TREE utility.

**WORLD** is a remarkable program which incorporates a world map. It al-

lows you to zoom in on specific areas of the globe, locate major cities and perform a number of useful calculations.

**\$19.95**

## VOLUME 8

**DDCAL** is a very clever perpetual calendar and desk diary. It keeps track of your appointments and performs several other functions.

**PC-KEY DRAW** is a remarkable public domain paintbox program which compares favorably with many commercial applications. It'll handle multiple screen images, business graphics and superb computer art — all in full colour.

**CPU** is a tiny program which tells you the effective speed of your system.

**XRAY** is a remarkable co-resident utility which monitors what a program is doing while it's busy doing it. It allows you to interrupt the execution of your code and have a look inside.

**GAME** — well, there are no words for this program, or, at least, none that are printable. This program does use some suggestive language, and we recommend that young or sensitive users not boot it.

**TUNE** is a very small music generator which makes noises from within batch files.

**CHASM**, or cheap assembler, is just the thing if you want to get into assembly language programming but don't want to spring for the Microsoft macro assembler package.

**GETDIR** is a resident directory utility. It allows you to see what files are on your disks, even if you're in the middle of doing something else.

**COPYPC**, not to be confused with the commercial Copy II PC, is a quick disk backup utility.

**LOOKIT** is a full screen browsing program which lets you scroll forward and backwards through text files — sort of like a tiny word processor with no editing features.

**SYSLOCK** is a security device for hard disk users. By running this utility on your XT or compatible, access to your computer will only be granted to users with a valid password.

**\$24.95 (two disk set)**

## VOLUME 9

**SMALL C** is a restricted implementation of C, producing code which is compatible with Microsoft's MASM and LINK programs — you'll need these to get it going.

**MAP** is an interesting little utility which will check how DOS is situated in the memory of your computer and tell you a number of things about it.

**NOTE** is the source file for the memory resident note pad which ap-



# SOFTWARE FOR THE PC

peared in the March 1986 edition of Computing Now! It requires MASM and LINK to use.

**PANGO** is one of the wildest games we've come across for the PC. While its premise is a bit improbable, it's fast and weird — hours of fun.

**PC-SPELL** is a spelling checker written in BASIC. It's fast, accurate and easy to use. It can be listed if you want to see how it works, and comes with a large dictionary file and a utility to assist you in customizing it.

**PEACOCK** is a memory resident program which allows you to change the colours of your screen with alternate function keys.

**RECOVER** is a file recovery utility. It lets you look at your files one sector at a time in order to put the pieces back together.

**SDB** is a small relational database. It isn't dBASE III, but it also doesn't cost quite as much.

**TALLY** is a program which accurately counts the number of characters, words and lines in a file — all within your lifetime.

**XENO** edits the tracks and sectors of your disks in a user friendly format — or, at least, one that doesn't lunge for your throat every time you boot it.

\$19.95

## VOLUME 10

**MONOPOLY** A good implementation of the classic board game. Great graphics and sound. Slightly sarcastic play.

**D20** is the latest version of Steve's sorted directory program. This one uses DOS two calls and handles subdirectories.

**EDIT** is a lightning fast full screen editor, ideal for editing program source files, dBASE stuff or other ASCII phenomena.

**BANNER** takes mere text and prints it sideways on your printer — in gargantuan block letters that can be read from miles away if you have a good set of binoculars.

**MORTGAGE** is one of the nicest mortgage programs we've seen so far — lifelong debt and ruination has never been so well formatted.

**QUICK** speeds up your PC quite a bit by improving video response.

**SPEECH** is a rather remarkable little germ of code. It talks through the PC's internal squeaker speaker. The voice isn't exactly human, but it's understandable on most machines.

**PC-AR** is an accounts receivable package for the PC. It will take care of the records for a small or medium sized business quite well.

\$19.95

## VOLUME 11

**PAC GIRL** is, predictably, a variation on the almost mythical Pacman game. This one moves fast, and plays much like the arcade version.

**MENU** lets you create a menu-driven tree-structured environment that is friendlier and more manageable than is DOS.

**Z80MU** is one of the most brilliant pieces of software we've ever encountered — free or not. It actually emulates a Z80-based computer running CP/M on the PC with no additional hardware — you don't even need a V20. It will run almost all CP/M software, including old favourites like WordStar and dBase and includes features lacking in both CPM and MS-DOS.

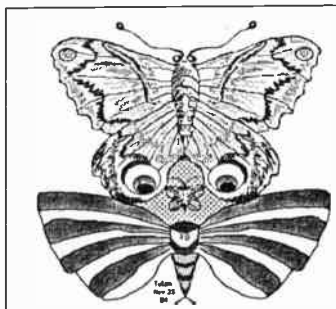
**SERIO** is the assembler file from the July edition of Computing Now! that implements an interrupt-driven terminal in higher level languages such as C. It's also suitable for use with compiled BASIC. Both MASM and Link are required to use SERIO.

**BREAKDOWN** is a peculiar program which takes meaningful text, analyzes it and generates meaningless, but profound-sounding prose from it. If you've been wondering if your co-workers really read your office memos and reports, try filtering your prose through this program. The effects will be astounding.

**XMODEM** is a C language implementation of the XMODEM file transfer protocol, from the July 1986 edition of Computing Now!. It can be integrated into other programs to allow easy access to telecommunications facilities. This code requires SERIO (see above) and version three Lattice C.

**GRABIT** is the screen grab program from the July 1986 edition of Computing Now!. It will make a useable text file from the contents of ones screen at the touch of a key. MASM and Link are required.

\$19.95



## VOLUME 12

**CV** is a small utility for changing the volume name on disks.

**BREAKOUT BOX** is an assembly language program that hides in memory and shows you what your serial ports are doing. It's a valuable trouble-shoot-

ing utility for pin pointing serial printer and modem problems.

**ICON MAKER** allows you to generate sophisticated bit-mapped images. It's easy to use and extremely colourful, producing data that can be incorporated into other programs.

**SHELL** is another DOS menu program. This one is very fast, free of 'snow', and provides easy access to virtually all DOS features.

**STRIKER** is an experience. It's a brilliantly written helicopter game in the style of Choplifter, complete with professional high resolution graphics and running spies.

**RAMSET** is a RAM expansion program from the July 1986 edition of Computing Now!. It allows you exceed the PC's 640K memory limit. Ramset also lets you bypass the PC's time-consuming memory check.

**TRAP** is the high-resolution Gemini patch program from the May edition of Computing Now!. It makes the Gemini 10x suitable for use with Personal Composer, but is easily modified to fix most bit-mapped printing problems. MASM and Link are required to assemble the program.

\$19.95

## VOLUME 14

**CUT AND PASTE** is a memory resident program that allows you to grab text from the screen of any application and paste it into any other application that accepts characters for input.

**INT13** will help you unravel the copy protection schemes of your software so you can make archive copies — just in case the cat takes a fancy to your masters. It prints a log of direct disk accesses and where they're called from so you can check out the code that's going after specific tracks, the heart of most protection systems.

**PMAP** tells you what's living in the memory of your system — and where. It will help you to find the resident utilities you have loaded and, more important, is great for sorting out peculiar interactions between multiple resident programs.

**SOFT TOUCH** is a keyboard macro program not unlike ProKey. It allows you to store up to twenty five thousand key strokes, has a built in screen blanker and great wandering herds of other features.

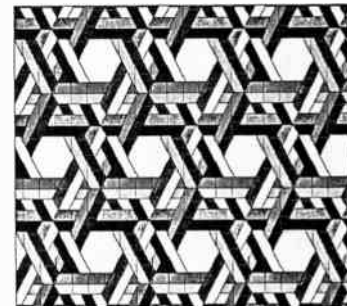
**SUB CHASE** is a first rate graphics arcade game. One sails across the clear blue sea — or green sea, depending on what sort of monitor you have — heaving depth charges off the stern to blow up subs. Requires a colour graphics card.

**TheDRAW** is an ANSI screen editor. It allows you to create and edit full colour screens of text and graphics which can be displayed from DOS — in full colour — or integrated into programs. Requires DOS two or better, ANSYS and is more fun with a colour monitor.

**TREK** is the best Star Trek game yet devised for the PC. The graphics are stunning, the complexity is intense and the action scoots along at warp nine as soon as the program gets going. Requires a colour card.

**CROSSWORD** is a utility which translates text files from one application to another. It supports several popular word processors, including WordStar, WordStar 2000, Multimate, XYwrite, SideKick and standard ASCII.

\$19.95



## VOLUME 15

**ALTAMIRA** This is one of the nicest public domain paint box programs available for the PC. It does first rate pictures. Colour graphics card required.

**FRACTAL** This is the C source code for the fractal generator that first appeared in the August 1986 issue of Computing Now!. Requires a C compiler and a colour graphics card.

**NEMON** This is a really weird game. You get stuck in the catacombs of king Nemon with nothing more than your wits and a flashlight. You have to find some keys, some treasures and, hopefully, a way around a host of arcade game nasties.

**THOR** used to be the god of thunder. Now he appears to be the world's most sophisticated desk calendar program for keeping track of appointments.

**ROUND 42** This is bizarre variation on the theme of space invaders. One of the best computer games in creation. Requires a colour graphics card.

**V20** is a CP/M emulator for users of the NEC V20 chip. Replace your existing 8088 with a V20, score this little program and most CP/M software will run on your system as if someone had stolen half the bits out of your PC. Regular MS-DOS isn't affected. Requires a V20 chip.

\$19.95

## VOLUME 16

**ARCDIR** The archive file compression system is the most efficient way to store large files in a small space. This simple ARC directory utility was featured in the November 1986 edition of Computing Now!. It includes both a COM file and the source code so you can see how it works. Requires a C compiler if you want to meddle with it.



# SOFTWARE FOR THE PC

**BRICKS** The "Little Brick Out" game is one of the classic programs for microcomputers. This splendid version will get you turned onto simple games all over again.

**DX** This is a small DX-7 voice librarian, as found in the Book of Computer Music. It includes both a COM file and the assembler source code.

**MOREROOM** If you have a hard drive system you may have noticed that it's extremely inefficient with small files. Here's a collection of tricks to get substantially more space on your disk.

**E88** is a tiny — but powerful — text editor. Neat and compact it is perfect for programming.

**EXPERT** Commercial Expert Systems software is still in its technological infancy. If you're interested in learning about expert systems and how they relate to your computing needs, you should try this simple program.

**FULLDOS** A DOS enhancement program that makes the DOS user interface behave in a rather more friendly manner. It creates a command stack and lets you re-execute previous commands.

**K9** This is yet another resident keyboard enhancer — with a difference. Aside from expanding the keyboard buffer, installing a screen timeout and so on, it makes a number of the alternate keys 'hot', giving you dozens of unique functions.

**InstantMENU** This is the code for the Instant Menus article which appeared in the November 1986 Computing Now!. With it, you can create elaborate batch file menus without programming. Menus can be easily altered with a text editor or word processor. Source code is included.

**PALERT** We've all occasionally run out of disk space while inside an application and discover that we've been dumped back to DOS unexpectedly. This program warns you of an impending full disk.

**\$19.95**

## VOLUME 17

**ARC512** This is the latest version of the de facto standard PC file compression and archiving utility. It will create, maintain and crack unpack ARC files. See the November 1986 edition of Computing Now! for more about this.

**ATC** ATC stands for "Air Traffic Controller". In this colourful simulation of the rigors of managing the planes at a busy airport may, among other things, renew your interest in train travel.

**DRAW POKER** This is a really slick little poker machine simulation. The graphics are good, the play is fast and the machine doesn't always win. It's a shame it won't spew silver dollars out of your disk drives.

**HercBIOS** This set of routines will allow you to display text on a Hercules card when it's in one of its graphics modes — just as you can with a colour

card. It will intercept the 10H interrupt vector so that anything that normally tries to print to the colour card will also work for the Hercules card.

**HotDOS** If you've ever found yourself wanting to run a second program without quitting your first application, then HotDos was made for you! Hit its control key combination from within most popular programs and it will give you a DOS prompt to run any other program at.

**KBD** This is a very tiny keyboard buffer extender. It's a useful few bytes to have around, and extremely tiny.

**LinkFOUR** A simulation of "Connect Four", this is a deceptively simple game. The graphics and sound effects are particularly good.

**MONEY** Yet another Canadian mortgage program, this easy-to-use program is surprisingly most colourful. It will also calculate charts for a variety of financial situations.

**PCWINDOW** This is a resident utility which lets you call up a number of useful "windows". These include an elaborate event timer, a note pad, an ASCII code chart and so on. It's well done, fast, and fairly small.

**PD** This program redirects the output of one's system from the printer port to a disk file. It lets you to use things that normally insist on having a printer on line even if you don't own one, or don't want hard copy.

**\$19.95**

## VOLUME 18

**BRADFORD** A fancy printing program for Epson and Gemini dot-matrix printers.

**CARD** This is the draw poker machine program from the December 1986 edition of Computing Now!. It's included here both as an executable COM file and as source code in C.

**DIVERT** This is a tiny program which doubles the effective screen printing speed of most programs which print through DOS.

**DONKEY KONG** This is a pretty snappy public domain implementation of the classic arcade game. Getting squashed by oil drums is more fun than anything. Requires a colour card.

**MASTERKEY** is a public domain disk manipulation program that offers track and sector editing, unerasing files, and all the general low level fiddling that the expensive programs do.

**PRINTER** This is the PRINTER.BAS program from the December 1986 edition of Computing Now!. It reprograms the high end characters of an Epson FX-80 (or compatible) printer to make them print IBM PC screen block graphics.

**QUICKEY** This little program speeds up keyboard action.

**ZOARRE** This is another dungeon game, but terrifically well done and very

intricate. It displays a picture of the room you're in, zaps you with various monsters and generally tries its very best to kill you. If you liked Castle you'll freak over this one.

**\$19.95**

## VOLUME 19

**BOTH** is a small utility which can slash your paper bill by allowing you to print long files on both sides of the paper.

**DIAGS** Written by the author of Z80MU, this collection of tools will be nirvana for the experienced PC programmer. It does things like generate an annotated list of all the interrupt vectors in your PC, let you meddle with the 6845 registers, test most of the ins and outs of your system and so on. It's a brilliant bit of work.

**GRCP** Graphic cut and paste is a memory resident tool that allows you to scoop things from a PC high resolution graphic screen and pop them into other applications.

**LOCKERUP** This tiny microbe of code sleeps in your system until you have to leave your PC for a while. Then it enables you to irrevocably lock up your keyboard until you come back to restart it. It's perfect for offices where there are more fingers than hands to contain them.

**MEGAPEDE** Just when you thought that it was safe to play ASCII games again... This one is a sophisticated variation of the classic "snake" programs and it plays with the speed of a boa constrictor. Don't count on winning for a while.

**MURPHY** Sort of an iconoclast in a can, this program will print a random selection of several hundred of murphy's laws, corollaries and commentaries thereon each time it's run. If you put it in your AUTOEXEC file it will say something clever each time you start your computer.

**QUEBERT** This fast PC implementation of the classic arcade game is every bit as exciting as the real thing but lacks a coin slot. Jump down the mountain, avoid the snake and try not to get clobbered with fresh fruit. Sounds like real life...

**SAT** This is a powerful, menu driven satellite data downlink terminal, as discussed in the December 1986 edition of Computing Now!.

**SCAV** This is a great program for people who buy economical floppy disks and just about everyone else who can't afford a clean room for their PCs. It cruises through one's disks locking out bad sectors and restores previously 'fried' disks to usefulness.

**SimCGA** The utility does an astoundingly good job of making a Hercules graphics card behave like a colour graphics adapter. It will let you run most CGA software.

**STUFFIT** Stuffit is a disk management utility which stuffs files into the inner tracks of a floppy disk, allowing

the outer tracks to be used for work space. This improves the disk access times and the reliability of mostly full disks considerably.

**\$19.95**

## VOLUME 20

**ARTIFICIAL ART** generates an ever changing graphic image on your PC — with accompanying sound. While it may seem a bit pedestrian, it's a gas to watch. Requires a colour graphics adapter.

**AsEasy** This is a public domain spreadsheet package, very similar in its abilities to the more popular functions of Lotus 1-2-3. Unlike Lotus, it doesn't cost anything and it isn't copy protected.

**ASYNCR** This is an assembler file which creates a device driver to make the PC's serial ports behave as they should, with interrupt driven buffered inputs and outputs. This is a programmer's delight. Requires MASM to use.

**ChessII** This is one of the best chess programs yet devised for the PC. Aside from being small and fast, it lets you physically pick up the pieces and move them rather than entering board coordinates. Plays an evil game, too.

**HAUNT** This is a haunted house adventure game. You wander around looking for the mysterious pumpkin man while picking up things, encountering ghosts and, if you're not careful, getting busted for shoplifting.

**LPTX** The most flexible printer redirection program imaginable, this thing lets you set up virtual printers, that is, disk files to capture the output of things that think they're printing. Includes both executable and source files.

**PITFALL** This is a supremely clever ASCII game. Aside from being an absolutely superb game in itself, it's a clever use of the PC's screen. You get to pilot a spaceship down a winding, rather nasty pit. More fun than being beamed into a supermova.

**RAMDISK** Once you've installed a normal RAM disk, it's there for the duration. This one allows you to change the size of the disk on the fly, or blow it away all together, without having to reboot anything.

**ZAPDRAW** This is the C source code for the Graphics in C article from the January 1986 edition of Computing Now!. It creates a general purpose high speed PC graphics library, suitable for use on both the colour card and the Hercules board. Requires Lattice C or something similar.

**\$19.95**

Our Public Domain Software Collections are an economical way to obtain powerful business and exciting leisure software...

# SOFTWARE FOR THE PC

## VOLUME 21

**CACHE** A disk cache program allows one to vastly speed up the disk access of a PC by stashing frequently used sectors in memory. This public domain cache program is extremely fast and fairly intelligent about which bits of oxide it retains.

**COREWARS** Perhaps the first program to truly embody the spirit of the phrase "computer game", Corewars pits two programs against each other. The object of the game is to crash the other code.

**EMACS** This is the latest word in well-executed programmer's text editors. It has multiple windows, macros and will even create a DOS shell for you so that you can skip out for a while to execute another task. Requires NANSI.SYS (see below).

**MTS** lets you run two applications, flipping back and forth between them at the stab of a key. This is the first one of these things we've seen that's bug-free.

**VIEW** This is the fastest full screen file browser in creation. It allows you to page back and forth through a file — it's much slicker than the DOS "TYPE" command. Requires NANSI.SYS (see below).

**NANSI.SYS** A replacement of ANSI.SYS, the improvements in the performance of your system that NANSI can produce are almost godlike. It includes a high speed screen driver and additional escape sequence screen handlers.

**MIDIzap** Figuring out the secret codes that drive some of the more sophisticated MIDI instruments is a lot easier if you have something to send and receive them with. This little MIDI debugger runs with the popular Roland MPU-401.

**SHELL** This is a command.com replacement that implements a UNIX-like environment. It supports many features that DOS would like to have, and a much tighter command structure.

**MUSIC SYSTEM** This is a pair of programs which allow you to edit and play three voice music on the PC. These programs are not compatible with PC/ATs.

**DEV** This is a tiny utility that will locate the device drivers in your system's memory. It includes the assembly language source code.

\$19.95

## VOLUME 22

**CALENDAR** This program prints up a calendar for any month in the twentieth century. It's very useful if you want to know which days people were being idle on in 1921, for example.

**DFA** This is a strange disk accelerator program which attempts to anticipate which sectors your software will call for and fetch them when the computer isn't busy. It can speed up some programs

quite noticeably.

**FSDEBUG** lets you scroll forward and backward through a disassembly, set breakpoints, trace code and so on, all with a full-screen display.

**GRABASM** This is the source code for the graphics grab program from the March 1987 issue of Computing Now! Requires MASM to assemble.

**SCROLL** This is a resident scroll lock key enhancement. It's not all that exciting, but, then at 247 bytes, it's not all that big either.

**SIDEWAYS** This program lets you print awkward-sized documents sideways on an Epson printer.

**PLAYSONG** This is the source code for the linkable interrupt driven music playing package from the March 1987 issue of Computing Now! It also includes the MUSIC.C demonstration program. Requires MASM to assemble and a C compiler to deal with the demo.

**ZAPDRAW2** This is the C language source file and updated header file for the text and graphics module from the February 1987 edition of Computing Now! It embodies several significant enhancements over the published version, including a writing speed increase of about 10 times. Requires ZAP 1.C from our Volume 20 disk and a C compiler.

**PINBALL2** If you wasted a meaningful part of your life on the pinball game on our Volume 7 disk, this one will help you ruin what's left of it. It's the fastest, most colourful, weirdest pinball program to date.

**MACSHOW** This program allows you to look at Macintosh MacPaint image files on a PC. It will also print them and convert them to PC compatible bit maps. Several sample pictures are included. Requires a colour card.

**WILLY THE WORM** This is a fast graphic game in which you try to get Willy the Worm home. It's extremely strange.

\$19.95

## VOLUME 23

**ARCE** A really tiny archive utility, this thing will extract members from ARC files without tying up half a disk for itself.

**BABY** An extremely warped game, this thing is engaging and fairly challenging none the less. It involves catching babies who are leaping out of a burning building.

**CHMOD** This is a useful utility for reading and changing the bits in a DOS mode flag.

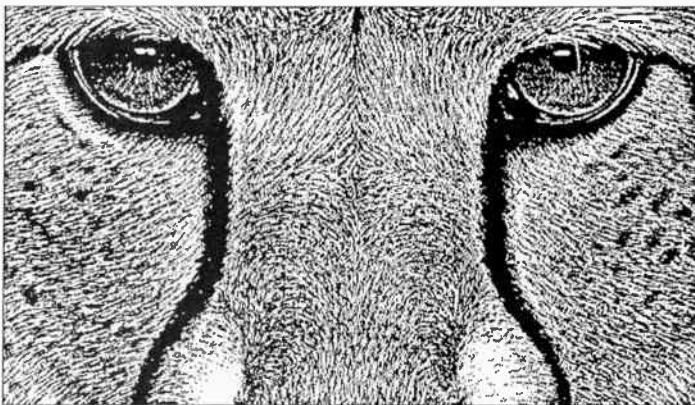
**CITYDESK** This is an elegant fancy printing program that allows you to do some desktop publishing functions with a dot matrix printer.

**DOG** A disk organizer, Dog will defragment the files on your disks to make them quicker to access.

**FPR** This is a printing program written in C. It's not compiled — you can change it to meet your needs. Requires a C compiler.

**THRILL** There is little to say about this program. It's a beautiful example of high resolution PC graphics, and was too good to ignore, even if it was wholly useless. It's also a bit naughty.

**MIDI-IO** This is the source file for the interrupt driven MIDI communication module from the April 1987 edition of Computing Now! Requires MASM to assemble and a language compiler to use — preferably C.



**PC-WRITE** The latest version of this phenomenal word processor, this thing is enough to turn you off any other word processing package on the planet.

**EDWIN** This is a decent windowing program editor written in Turbo Pascal. It's not terribly fancy, but it's fast and very much like WordStar.

\$29.95 (2 disk set)

## VOLUME 24

**AC** This is a small area code program — give it a three digit area code and it will tell you where it is.

**ASC** This is a memory resident utility that pops up a window with an ASCII character chart.

**ATTR** This utility lets you meddle with the attribute bit of your files.

**BAC** This is a disk backup utility that is much less frightening than the one that comes with DOS.

**BACKSRL** This recalls stuff that has scrolled off your screen. It's neat if you can't seem to reach the NumLock key in time.

**CAT** This is a collection of disk utilities in one program.

**CLOCK** One of the nicest clocks we've seen, this has a built in alarm function among other things.

**COVER** This is a sorted disk directory that prints out all the files on a floppy in a form suitable for sticking to the sleeve.

**CWEEP** This is a menu driven file mover — saves typing the word COPY

over and over again.

**DDIR** Yet another directory utility, this does a two column directory similar to the regular single column DOS version.

**DELZ** This wipes out files so they can never come back — kills the sectors as well as the directory entry.

**DISKCAN** This one checks your disks for bad sectors — get 'em before they get you.

**DOORS** This lets you flip between multiple monitors without rebooting your system.

**EQUIP** This program tells you what hardware you system thinks it has — very often providing you with the answer to all sorts of software problems.

**FASTDISK** If your floppies seem a bit tedious, you might want to zap 'em with this speed up program.

**FDATE** This changes the date stamps of files.

**FLIP** This one sets a number of otherwise tedious parameters under DOS.

**FREE** This returns the amount of free space on a disk without having to watch the whole directory scroll by.

**GERM** This is a memory resident interrupt driven communications terminal.

**IBMSHELL** This allows you to fool your system into loading COMMAND.COM from other places.

**KBBUFF** This is a keyboard buffer extender. No home should be without one.

**KEYFAKE** This allows you to "stuff" keyboard characters into an application to get past tedious introductory screens and menus.

**LC** This counts the number of lines in a text file.

**LOCATE** This scans through sub-directories, checking all the files for specific text strings.

**LOCK** This is a file encryptor. Also includes UNLOCK.

**MOVE** This moves files between sub-directories with less typing than COPY would entail.

**NDOSEDIT** An updated version of regular DOSEDIT, this is a resident DOS command line editor that actually makes DOS decent to work with. Indispensable.

**NO** This is a strange little wild card exception thing. It allows you to create more complex file specifications than does DOS all by itself.

**NPAD** This is a simple memory resident node pad.

**PCUTIL** This is a collection of additions to DOS.

**PINHEAD** This is the tiny printing press program from the June 1987 edition of Computing Now! It can get up to 16 kilobytes of text on a single page. Includes the C source code. — works with Epson compatible printers.

**POPCAL** This is a memory resident utility which will bring up any month of any year you like.

**PR** This is a handy formatted printing utility.

**PUSHDIR** Primarily used in batch files, this allows you to change subdirectories, do something and then return to the previous directory.

**REBEEP** A replacement for PAUSE, this is a noisy batch file utility to attract attention when a task has been completed.

**RENDIR** This renames subdirectories.

**SCRN** This is a screen saver — it blanks all the monitors attached to your system after a specified period of inactivity to keep your phosphor from getting fried.

**SETPRN** This allows you to painlessly set up your printer from DOS.

**SETUP** This is a memory resident utility that will allow you to set up an Epson compatible printer from within any application.

**SIZE** This returns the number of allocation clusters a file occupies on the disk.

**SOUND** This makes weird noises to attract attention from within a batch file.

**SP** This is a really nice little print spooler.

**SWEEP** This allows you to execute a command in every subdirectory on your disk.

**UNDEL** This recovers accidentally deleted files. You may not need it now but you sure will sooner or later.

**VDL** This requests verification before it deletes files so you won't need UNDEL quite as often.

**VOLSER** Changes the volume name of a disk.

**WAITN** This pauses for a specified time while executing a batch file.

**WHEREIS** This finds files in subdirectories. It includes the C source

code from the June 1987 edition of Computing Now!

**XDEL** This is a menu-driven file deletion utility.

**\$19.95**

## VOLUME 25

**VMAC4** This little program allows PC users with Hercules compatible cards — or ATI multiple monitor boards — to look at MacPaint pictures. The Hercules card has a more usable aspect ratio than the colour card, and the images look pretty slick.

**PINBALL3** The weirdest pinball game we've encountered thus far, this thing will zap your brain if you play it late at night.

**MAXHEAD** This is a MacPaint picture of Max Headroom for VMAC4, above. There are several more — rather more exotic — pictures on Volume 24, which will also work with VMAC4. Likewise, this file will work with the MacShow colour card program on the disk, which can be used to convert it for use in other PC graphic software.

**SPKR** A device driver, this little beast allows you to make the PC's speaker play music in a very elegant, program independent way. It's suitable for use with BASIC, C, Turbo Pascal, assembler and even just from DOS.

**RESQ** can recover erased files and, more important, it can find text that you've lost in memory due to a software crash and get it back into a file. It's indispensable.

**IT** The "Ideal Terminal" is a telecommunications terminal package which emulates several professional mainframe style hardware terminals. It also handles XMODEM and KERMIT file transfers, making it a much less freaky replacement for the likes of QMODEM and CrossTalk.

**RIGHT HAND MAN** is a sort of enhanced public domain SideKick. It provides all sorts of pop-up utilities including an ASCII table, a really powerful calculator, a DOS shell and several note pads. It also handles keyboard macros.

**SLOWDOWN** A lot of software — mostly games — which has been written to run normally on a PC switches into maximum overdrive on an AT or even a fast PC. This usually makes it useless. The slowdown program allows you to bring the speed of such a machine back down to sublight levels for these occasions.

**\$19.95**

## VOLUME 26

**AWS** Programs that turn WordStar into ASCII abound, but this one turns ASCII back into WordStar. Let those high bits roll.

**BADCLUST** This program finds the bad clusters on cheap disks, preventing

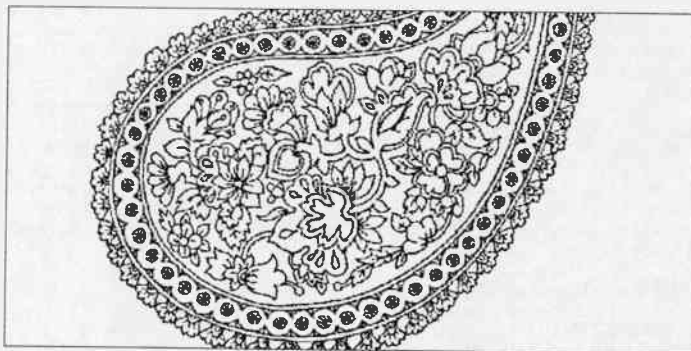
them from killing your data. If you must use low rent oxide, use it carefully.

**CHEAPFMT** Like BADCLUST, above, this program makes your life less freaky if you use cheap disks. It formats them very carefully, looking for unusable sectors.

**CCC** A C language programmer's dream, this is a "pretty print" program, that actually draws nesting loop and structure diagrams beside the source code it lists. It makes spotting even subtle bugs effortless.

**CTP** Something of a mutated fusion between snake and space invaders, this is a ruthlessly fast arcade game in first rate high resolution graphics. Requires a colour card or HGC, below, and a Hercules board.

**HGC** This is the first colour card simulator for a Hercules board that really seems to have its act together for the majority of colour card graphics software. Run it and your Hercules card will display colour card high resolution graphics as if it was designed for the task.



**BIGPRINT** This program prints text files in very large characters. It requires an Epson compatible printer.

**MBS** This is one of the nicer fractal programs we've encountered, as well as being one of the faster ones. It runs on a colour card, or on a Hercules board with HGC, above.

**MOUSE** This is the source code for the linkable MOUSE driver, as seen in the July 1987 edition of Computing Now! It requires MASM to assemble and a C compiler to use.

**PCRR** This is one of the most interesting programs we've yet encountered. It simulates a railroad in high resolution graphics. You can lay out your railroad, equip it with multiple trains and make the whole party go. Requires a colour card or HGC, above and a Hercules board.

**TASKER** This is the most elaborate multitasking system yet devised for the PC. Install up to nine variable sized partitions, with a program running in each, and pop between them instantly.

**WINDOW** This is the source code for the C language window manager from the July 1987 edition of Computing Now! Written in Lattice C.

**\$19.95**

**DECEIVE** This is a resident program to be used if your boss likes to creep up behind you when you're supposed to be working. At the touch of a key your PacMan screen can be replaced by WordStar, Lotus or any other serious application until the powers that be are satisfied and play can resume.

**DPATH** Allows the opening and creating of files to be handled with a path, just as the running of programs is under DOS with the PATH command. This is the gift of the gods to programs that can't find their overlays and configuration files.

**HXC** A sophisticated hexadecimal calculator, this program will keep you from damaging your hands by trying to glue on four extra fingers.

**IOMON** This is a resident utility which monitors the disk I/O of your system and lets you see what the drives are doing. It's great for spotting the causes of system errors.

**TREECOPY** This is the best... and fastest... tree copy utility we've encountered to date. It will copy an entire subdirectory and all of its included subdirectories into another tree.

**TREEDL** This program will wipe out a whole subdirectory and any subdirectories in it with one command. Mass slaughter... what fun!

**TREESIZE** This program will tell you how much space is occupied by the aggregate contents of a subdirectory.

**VRAM** This is an amazing bit of work for people with programs that want to see a Lotus-Intel AboveBoard memory card... if they lack one. It allows up to eight megabytes of hard drive space to pretend to be extended memory... sort of a RAM drive in reverse.

**LQPRINT** is a nice print enhancement utility that works with many word processors and printers. It includes a wide selection of very well done fonts.

**ZANSI** Another replacement for ANSLSYS, this one increases your console printing speed by almost fifty percent without sacrificing any of the commonly used ANSLSYS functions.

**CYLON** This makes your cursor go strange... deliberately. Requires an EGA card.

# SOFTWARE ORDER FORM

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# SOFTWARE FOR THE PC

**EGAROIDS** The best asteroids game ever written for the PC... when those rocks come at you start praying to the cosmic gods. Requires an EGA card.

**KC-PAL** An EGA palette editor and librarian. Comes with lots of support utilities and toys. Not surprisingly, it requires an EGA card.

**NEWFONT** Replace the austere, depressingly corporate IBM font of your PC with damn near anything you can think of. Several fonts are included. The screen interface is seamless, and the results can be extremely pleasing. Requires an EGA card.

\$19.95

## VOLUME 28

**ASTROLAB** This is a very sophisticated program for working out the conjunction of the planets for any day in history. It's not much use if you believe in a flat earth, but handy for horoscopes.

**BASERES** Yet another resident utility, this thing will accept numbers in any base and show them to you in all the other commonly used notations. In other words, it will convert decimal to hex and back again—great for people with only ten fingers.

**BREAKON** This is a utility to make just about any program exitable with control-break. It has multiple levels of urgency—three hits gets you out of anything short of the end of civilization as we know it. Assembler source included.

**CROSSWRD** If you've ever wanted to generate your own crossword puzzles, this is the code for you. Fill it full of words and it finds places for them—keeps track of the clues, too.

**DIMMER** The smallest screen blanker yet—two hundred and seventy one bytes.

**EPSONISM** Even people with laser printers occasionally have to deal with plebes. This program is a DOS filter to make a PostScript printer behave like an Epson.

**FASTBIOS** This is a pair of programs which will extend your keyboard buffer—without hanging your system—and increase the speed of your screen dramatically.

**FREERAM** This will tell you the truth about how much useable memory is available to your programs.

**LASERGRID** This is an ASCII game, but a rather good one. Place your bets and hope the aliens leave you alone.

**VMUSIC** This is a small three voice music player which handles its scores in BASIC music notation. Comes with several songs, and you can easily create your own tunes with a text editor.

**IDCKEYS** This is an assembly language program to set up the function key redefinitions under ANSLSYS. It's great if you like to have keyboard

macros under DOS without a keyboard redefinition program installed. Requires an assembler to use.

**IDCKILL** This will go through an entire hard drive—including all your subdirectories—and kill files that match a given specification. A bit nasty if you use it improperly, but great, say, for snuffing BAK files.

**LW86** This is an extensive pop up reference card for assembly language programmers. It includes explanations of the op codes, what the assembler directives do and so on, all at the touch of control shift.

**SPACE** Find out how much useable space is on your hard drive instantly. Includes assembly language source.

**YESNO** A really useful thing to create complex interactive batch files, this little program returns an error level code basic on the ASCII value of a key press. Assembly source included.

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## VOLUME 29

**INSTACALC** is a memory resident spreadsheet. It may not be Lotus or Excel, but it's amazingly powerful considering that it lives in an alternate key combination. Includes a sophisticated macro facility.

**ALTER** allows you to change the attributes of a file... including the time and the date.

**CALENDAR** is a sophisticated desk calendar which can be made memory resident if you want it to be. It uses data files which allow you to have it remind you of things.

**COVER** prints disk directories suitable for sticking into the sleeves of your disks... the nicest such program we've encountered. Requires an Epson compatible printer, patchable with DEBUG for other printers.

**DISKLITE** is a tiny bit of code which shows you when one of your drives is running. Not much use for floppies, this, but great for RAM disks and AT style internal hard drives.

**DISKUTIL** is a poor man's Norton utility. It will walk you through simple disk level functions, including FAT table fix ups and file uneraser.

**MELT** clears the screen... dramatical-

ly.

**MONSTER** a memory resident DOS monitor. Check out what your programs do one INT 21 call at a time.

**THEGRIN** is the most sophisticated MacPaint picture viewer yet. It allows you to stretch and compress images, zoom in and out and generally hack their bits to bits. It also prints them.

**TMAP** is a clever TSR program mapper which is itself memory resident. It's superb for finding gorges caused by interacting resident programs.

**VARISLOW** is a variable speed control for AT type computers. It lets you crank the clock down to play games at their normal speeds. However, you can do it interactively, rather than from a command line.

**WATERFALL** is a fabulous MacPaint picture of an Escher drawing, suitable for use with THEGRIN or any other MacPaint reader.

**CHINASEA** is a James Clavell novel in a disk file. In this game you get to be a trader in the far east. Try to prosper without getting knifed.

**TURBO CPATCHIES** is a collection of patches to fix some of the bugs in the early releases of Borland's Turbo C. If you're going to compile at warp speed you'd better have one of these.

## VOLUME 30

**386BUG** Some 80386 chips don't work quite right. They have problems with integer multiplication, which can cause some software to behave unpredictably. This Little program spots the duds... it's essential if you're thinking about buying a 386 machine. Includes source code.

**MASM-MAC** This is a collection of MASM assembler macros to make BIOS, DOS and 8087 interfacing a lot easier. Requires MASM to use.

**8X6** installs a really tiny screen font on an EGA card. You can get about four times the usual amount of text on your screen with this if you run applications which support it.

**AT** is a little time bomb program. It will hide in memory and run applications at specific times and dates without any attention. Allows for queuing up several tasks.

**BACHMIN** is a three part Bach minuet in BASIC... quite the trick.

**CAT** is a small sorted directory program. While hardly high tech, it is a useful replacement for DIR.

**CAVERNS** is a fast graphic arcade game. It looks a bit simplistic but it will surprise you when you get into it. Wants a CGA card.

**CMOS** is a pair of simple programs which read the contents of an AT's CMOS memory into a disk file and then restore it. This is great for changing batteries, of course, and also for those sys-

tems with funky memory which require frequent setting up.

**DIRNOTES** allows you to attach short, one line comments to the directory entries on your disks.

**PRTSCEGA** is a program to make the PrtSc function work properly for EGA cards, allowing you to once again dump screens to your printer. Versions are included for a stock Epson FX-80 and for the Tandy DMP200. In addition, the source code comes with it, so you can hack a driver up for your specific printer.

**EDISK** allows you to put a RAM disk in the space between your normal system memory and your screen buffer, using this otherwise wasted space for something practical. It requires that you have memory in there, of course... many RAM cards will address this area.

**EMC** is an extended memory cache. It allows you to use LIM memory for a disk cache, speeding up your disk accesses without robbing your system of any main memory.

**GDIR** is a sorted directory program with uses the Hercules card's graphics mode to put forty-three lines of listings on the tube at once. It's very slick.

**HELP** is a slick little DOS help program which can be called up any time you need something about the PC explained to you.

**THRASHER** is a splendid system to find out the optimum setting for the BUFFERS line in your CONFIG.SYS file. It can speed up your disk accesses while actually freeing up a bit of memory.

**MCSCOOP** is the executable version of the MacPaint file reader in the January 1988 edition of Computing Now. It also prints picture files... to PostScript, LaserJet+ and Epson printers.

**LDRES** is a system to make somewhat standard COM files into memory resident utilities, or TSRs. Please note that while full documentation is included with this thing, it's still a bit technical and you'll have to be a moderately decent hacker to make something come of it.

**NOREBOOT** will disable the Ctrl-Alt-Del reboot of your system. Source code is included.

**RES86** is a transliteration of the redoubtable CP/M RESOURCE machine language disassembler. Source code is included. This program requires an extensive understanding of machine level programming to be useful.

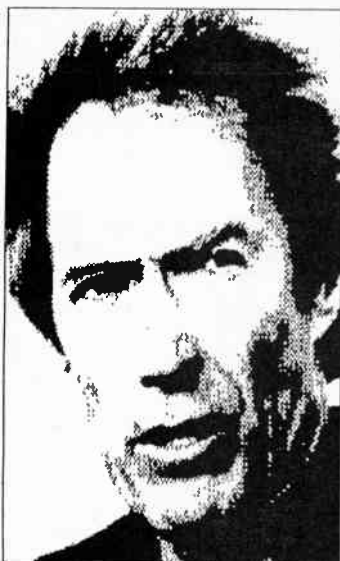
**RS232** will show you the status of your serial port on your screen. It's handy for debugging, and to see what you're modem is up to if you have one that lives inside your PC.

**WFU** is one of the nicest DOS shell managers we've yet encountered. It handles tagging, copying, deleting, renaming and generally manipulating files just as you would with the command line... but it does so in a convenient, menu driven environment.

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# SOFTWARE FOR THE PC



## VOLUME 32

**ARCTOOLS** is a front-end menu utility for the popular PKXARC-/PKARC archiving utility (available on SuperDisk 1). ARCTOOLS makes it easy to view and extract archived files.

**CMPDIR** is a simple utility that simplifies comparing files in different subdirectories and drives. CMPDIR can be a real timesaver when you need to identify files with the same name and different date/time stamps.

**FCU** is a financial calculator. Use it to quickly calculate interest, rates of return, loan amortizations and many other common financial calculations.

**CARSIGN** is a silly program that lets you create diamond-shaped "carsigns". Requires an Epson FX/MX or IBM Graphics compatible printer.

**INDEXER** is a flexible index generator. Create a text file with all keywords required in the index and indexer will generate an index file containing all keywords and page numbers.

**VACINE** is a utility designed to prevent "virus" software from infecting your hard drive and DOS disks. VACINE can tell you if the COMMAND.COM and DOS system files have been tampered with.

**FREE** is a memory utility which reports on how much RAM is available in your system. This one will also report on Extended Memory (above 1024K).

**PRUFREAD** is a specialized file browser designed to speed proofreading. A highlighted bar remains stationary in the middle of the text screen, making it easy to focus on one line at a time in the text.

**FKEYMAP** is a utility for printing Function Key templates (for keyboards with function keys vertically oriented on the left-hand side) Great for new users. FKEYMAP includes templates for Word Perfect and Lotus 1-2-3 version 1A.

**APRIL** is one of the strangest "April Fools" software pranks ever created. Slip it into a friend's AUTOEXEC.BAT file and see what happens. Completely harmless fun. Colour graphics card or compatible required. Also works with SIMCGA CGA simulation utility.

**DVICEMAP** is the most comprehensive utility yet devised to map memory locations of DOS system devices. This one also shows the order in which devices have been loaded, attribute words and interrupt locations.

**\$19.95**

## VOLUME 33

**READRITE** is a co-resident "readability checker". Based on a formula developed by Rudolph Flesch, READRITE can be called up to analyze text. It will provide a readability index that relates syllables per word and words per sentence.

**\$19.95**

**SPACEWAR** is a fantastic space battle simulation. It comes in both CGA and Hercules versions and has stunning graphics and fast play. Loads of options!

**MFRAC** is a simple fractal generator that can display an endless variety of "mountain" fractals. CGA required.

**MRORGAN** is an unusual co-resident utility that turns your keyboard into a mini organ. It will really jazz up your favourite word processor. Great for office concerts!

**FREEBYTE** is a small and fast utility that tells you how much free space remains on your hard drives. Yes drives. It's smart enough to check space on large capacity drives with multiple partitions.

**CHESS2** is a small chess game that works with Microsoft Windows (version 2). Great graphics, but it's for two players only. MS Windows required.

**DIGICLOCK** is a handy digital clock for Microsoft Window (version 2). Windows required.

**FREEEMM** is a simple Windows



utility that shows the amount of Expanded RAM installed in your system. It will also show you how much RAM is left for applications. Requires Windows.

**DBWP** is a dBase III to Word Perfect Mail Merge conversion program. It can be a real time saver.

**TCKILL** is a file deletion program with a twist. After files have been OK'ed for deletion TCKILL will toss them into the trash!

**TETRIS** is a wonderful game! This is the original version that was created in Russia. It is best described as an "action puzzle" and it will challenge your imagination and your reflexes for hours at

a time.

**TOGGLE** is a useful little utility that lets you control the status of your keyboards NUMLOCK, CAPS LOCK and SCROLL LOCK keys from DOS.

**STOPCLOCK** is a handy little stopwatch that prints a huge digital display one your screen. Just the thing for the office olympics or for the occasional impromptu benchmark.

**LIFE** is a new version of a classic computer game. This one comes with complete on-line instructions and includes a detailed history of the game.

**BUFFIT** is a nice DOS buffer utility that lets you scroll through DOS screens that have disappeared from view.

**ELTYPE** is a simple typing test program for training and evaluating keyboard virtuosos. It provides real-time statistics on speed and accuracy.

**\$19.95**

## BUSINESS

Our Almost Free Business Package will add power and versatility to your business applications.

**MA.BAS** The Micro Accountant is a complete, working accounting and check register program, with a 25K documentation file. Requires BASIC.

**PCWINDW22** A "Sidekick"-like co-resident window utility. Pop-up window functions include ASCII table, stopwatch, alarm, printer setup utility and notepad.

**PSHIFT** A time saving and convenient 'memory partition' utility. Lets you define up to nine memory areas. Load programs such as dBase II and WordStar into separate partitions and 'flip' between them instantly with simple keystrokes.

**PC-TOUCH.BAS** Increase typing speed and accuracy with this easy-to-use typing tutor. Requires GWBASIC.

**PCYEARBK** Appointments and reminder program to help you keep track of your time.

**TASKPLAN.BAS** Project management software which lets you track up to 50 tasks during 50 time periods (days, weeks or months). Requires GWBASIC.

**NOCOLOR** A handy little utility for users with monochrome monitors and colour software.

**MAXIT** A simple but subtle game for two human opponents, or one player and the computer. Hours of fun!

**PERTCHT** A sophisticated project management tool using the Program Evaluation Review Technique.

**PLUS** More utilities to help organize maintain and copy your files, including a "monitor saving" program which blanks out your screen when it is not in use.

**\$19.95**

## VOLUME 31

**NINJA** is a fast martial arts game that lets you pit your skill against a never-ending supply of well trained adversaries. Colour Graphics Card, EGA or compatible display required.

**DDUP** DDUP will find and let you delete duplicates of file you never new you had!

**DIRLABEL** is a simple utility that saves users from having to hand-write disk labels. Feed standard 1 X 3 1/2 inch labels through your printer and start DIRLABELing your floppies.

**MADNESS** If you thought you were going crazy, you haven't played Madness. MADNESS is an adventure game for the mind. Enter a land of shadows and mirrors, a land where reality is little more than a hazy concept.

**PM** is a handy co-resident phone message utility. Just pop PM onto your screen and enter the particulars of each call. PM inserts the correct date and time and appends each message to an ASCII text file that can be printed later.

**RUSHHR** is one of the strangest games ever created. Play traffic computer by juggling the timing of a series of traffic lights in a busy downtown core. You control the number of cars that are able to get through each light.

**SPEED** performs a detailed system speed test - similar to the "SI" test provided on the Norton Utilities, only better. SPEED shows you speed statistics for a host of register and memory operations such as arithmetic calculations and block memory reads and writes.

**FREECELL** This is an unusual solitaire game. Great graphics!

**HDSENTRY** is a resident utility that intercepts destructive calls to hard drives. Run HDSENTRY before trying out public domain software of dubious origin. It tries to prevent Trojan software from destroying the data on your hard drive.

# SOFTWARE FOR THE PC

## HD Survival Kit

If you have a hard drive you can have all sorts of powerful utilities and programs installed in your system to make your use of it more efficient and productive. We've collected the best of these utilities on a single disk to help new PC users get the most from their hard drive systems. Please note that these programs are included in our other almost free software disks. Descriptions of them are provided elsewhere in this catalog.

- |          |                                   |
|----------|-----------------------------------|
| HGC      | Colour card emulator for Hercules |
| ADDRESS  | Resident envelope addresser       |
| WHEREIS  | Hard drive file finder            |
| SIZE     | File size finder                  |
| SETUP    | Resident Epson printer setup      |
| RENDIR   | Sub-directory renamer             |
| POPCAL   | Resident perpetual calendar       |
| CLOCK    | Screen clock                      |
| EDV:IN   | WordStar like editor              |
| NANSI    | Screen driver                     |
| CACHE    | Disk cache                        |
| RAMDISK  | RAM disk program                  |
| LPTX     | Printer redirection               |
| MURPHY   | Foolishness and wisdom            |
| LOCKERUP | Security system                   |
| BOTH     | Printer paper saver               |
| PCWINDOW | Resident grab bag                 |
| PINPRESS | Prints things very small          |
| NOTEPAD  | Resident notepad                  |
| FREE     | Free space finder                 |
| HOTDOS   | Multiple tasker                   |
| BLANK    | Screen blanker                    |
| K9       | Another resident grab bag         |
| LAZY     | Menu generator                    |
| UNWS     | WordStar converter                |
| MORTGAGE | Measure of your indenture         |
| LOOK     | File viewer                       |
| PCBW     | Colour killer                     |
| VFREE    | Hard disk map                     |
| VFILER   | File manager                      |
| POPCALC  | Resident calculator               |
| DOSEDT   | Command line editor               |

\$19.95

## SuperDisk 1

**EBL** This is the latest version of the Extended Batch Language, an easy-to-use program that lets you customize hard disk and floppy disk systems for less experienced users. Create custom menus and make your system idiot-proof — without the need for a complicated DOS shell program.

**TIRED** You may want to save this one for April 1st. Sneak it into a friend's BATCH file, or run it from DOS (while your friend is at the coffee urn). Spectacular, but harmless results.

**BREAKON** Ever need to exit from a program in a hurry? Or do you get frustrated when your computer hangs up because of a software problem. You could press the RESET button, or try running BREAKON. This little beauty works with many popular programs.

**PKARC** If you want to keep archive copies of important, but rarely needed data files or programs, an archiving program is an inexpensive alternative to buying more floppy disks. Archive files with PKARC and extract them with PKXARC. These utilities are fast and accurate — and they'll help you save on disks.

**DSIZ** DSIZ is a simple utility that will provide information on the size of the various directories on a hard disk system.

**CONVER** An easy-to-use unit conversion utility. This provides imperial, metric and U.S. conversions for all common units of measurement — and many uncommon ones as well. Provides well over 200 conversions.

**CUTE TIME** Friendlier than a clock program, but not as accurate, running QT gives on an English approximation of the time. "It's about half past two", for example.

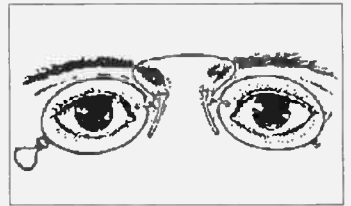
**DRAIN** Another April Fool's program. Run DRAIN to remove the water from your disk drive. Keep 'em rolling in the aisles.

**XEQ** This utility is designed to let you manage those small but useful programs that tend to clutter up disks. Files can be added, removed and run from XEQ.

**ORDER** Use ORDER to change the order in which files appear in the directory on your disks. This utility will create order out of chaos in large directories. Great for hard disks.

**TSR** For SideKick, ProKey and SuperKey users — or anyone who uses co-resident software. This utility lets you remove co-resident programs (such as those mentioned above) from memory — without rebooting your computer! You'll wonder how you ever managed without it.

\$19.95



## SuperDisk 2

**BLOCKADE** Play with up to two human and five computer players. This territorial game will generate hours of excitement. This version lets you select a number of game parameters such as strategy and speed. Win by blocking the paths of your opponents in order to gain territory.

**DALEKS** A game of skill and logic based on the Dr. Who television series. Use your talents to rid the universe of the dreaded Daleks.

**RLOGIC** Save the world from nuclear annihilation. This one is trickier than you might expect.

**CAVERNS OF GINK** A strange name for a strange game. Explore the Caverns and see what you'll find.

**LET FALL** A great way to learn touch typing and to have fun too. This one lets you work on tricky key combinations — and it will report on your

## ClipArt for PC and Macintosh

If you have begun using the popular Ventura desktop publishing software package, you'll know how much graphics can dress up your documents. However, unless you have a scanner and

a ready source of hard copy clip art at your disposal... or a paint box program and a great deal of time... it's very nearly impossible to find spot illustrations in picture files. At least, it used to be. Al-

most free Ventura clip art picture collections are disks full of image files. They will work with Ventura 1.1, and we include a utility to make them suitable for use with the original 1.1 release or

the patched one. Each disk has a variety of pictures, both for spot illustrations and full page pictures. They're suitable for reproduction on any output device. Only \$19.95 each.



### VOLUME 1

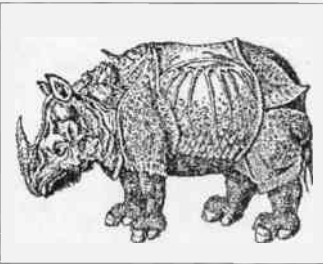
- BABY
- BELVEDERE
- BLUES BROTHERS
- BLUENUN
- BUGS
- CHEETAH
- CLIPART
- FISHES
- GIRLWING
- KNOT
- KOALA
- LETTER A
- HEARTS
- WOMAN
- RELATIVITY
- SCAN
- ESCHER WATERFALL

\$19.95

### VOLUME 2

- AIRCRAFT
- BUTTERFLY
- CAR LOGOS
- COLLECTORS CARS
- MORE CLIP ART
- CUBE
- DANCERS
- DRAGON
- GLASSES
- GREYHOUND
- HANDS
- MORE KNOTS
- LEATHER GODDESS
- MINOTAUR
- SKELETON
- TIGER
- ANOTHER WORLD
- ZEBRA GIRL

\$19.95



### VOLUME 3

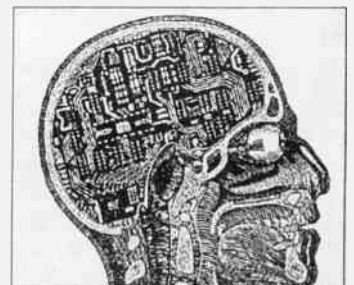
- BADNEWS
- DRAGONS
- DREAM
- KIDS1
- MEN1
- WOMEN1
- MONALISA
- CAT
- RHINO
- TRIANGLE
- OLDMAN
- SHELL
- BEACH
- FLOWER
- PAISLEY

\$19.95

### VOLUME 4

- BUDBRAIN
- DRAGON2
- SKULLS
- KIDS2
- MEN2
- WOMEN2
- PERSUIT
- SUNDIAL
- PORCHE
- EASTWOOD
- VANGOGH
- IBM WARS
- STELLA
- QUADRANT
- YAWN

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# SOFTWARE FOR THE PC

progress.

**WIMPS** Maneuver your spaceship and blast away at the marauding wimps. A great zero gravity simulation.

**FLIGHTMARE** As an Omegan jet fighter ace, your job is to protect Omegan factories from hordes of desert vandals.

**PYRAMID** Hop on each triangle in the pyramid and score points, but watch out for the snakes!

**HI** Just run Hi from DOS or from within a BATCH file and be prepared for a daily dose of inspired wit and wisdom. From Confucius to Murphy, this program has it all.

**\$19.95**

## SuperDisk 3

**DSCAR** This is the "dBase Source Code Analyzer and Reporter", a utility that lets you pretty up and document your dBase programs. This program is very flexible in how it analyzes your files. You can even edit the reserved word list so that it will work with future updates of dBase III as well as with dBase compilers such as Nantucket's Clipper.

**SET COLOUR** A simple, but well written routine that can be called from within any dBase program. This one lets you install screen colours.

**DB-CHECK** Check the logical flow of your dBase programs and have this handy utility indent your programs so that they are more easily read — and debugged. This one is very fast!



**FLOW** A quick program flow checker that matches up DO's and ENDDO's, IF's and ENDIF's and DO CASE's and ENDCASE's. It makes those hard to find errors easy to find.

**DB3TOPAS** Not your everyday utility, DB3TOPAS creates Turbo Pascal routines that can access dBase III files.

**LBARGEN** This is a simple dBase III Light Bar menu generator. Just enter the options for your application and LBARGEN will generate a .PRG file, saving you the time and energy required to do it yourself.

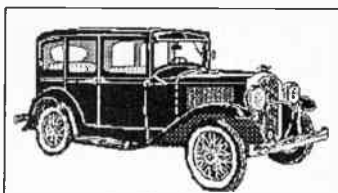
**DL1B** This is a shareware Clipper library which can be linked with any Clipper program. There are all sorts of great routines in this library — every-

thing from screen handling functions to financial formulae and a phone dialer for modem users. A powerful addition for all dBase/Clipper programmers.

**BEEPER** Another Clipper utility. Assemble with MASM and link BEEPER with any Clipper program and you'll gain control over the PC's speaker. Alter pitch and duration and add sound to your programs.

**HELP** There are many good books on how to use dBASE III, but these 7 text files provide dozens of "power user" tips that are often overlooked. These files contain a host of information on using dBase with Lotus 123, backing up large data files, printing, indexing and generating labels. Just use the DOS TYPE command or any ASCII word processor to read these files.

**\$19.95**



## SuperDisk 4

**TREND** is an easy-to-use program that lets you make projections based on past historical data which the user enters. The program can display both line and bar-graphs.

**EE2** is a handy "Environment Editor" that lets you make quick changes to DOS PATH and SET commands. The few simple commands needed to run this utility are explained in a small help screen. Requires DOS 3.1 or higher.

**PCSTYLE** A public domain program which tests your prose and provides a quick test for readability. While not a substitute for a competent English teacher, PCSTYLE can help you improve your writing style by providing statistics on word length, sentence length, percentage of action verbs, etc.

**PLANIT** is an interesting appointment reminder program. By keeping all of your important dates in a text file (created with your word processor), PLANIT will check the file and tell you if you have any important engagements. A host of options enable you to set up messages which repeat weekly, monthly and yearly. It can even warn you of important dates before they arrive!

**CPU2** is a speed checker/benchmark program. It measures the speed of your IBM PC compatible system against a standard IBM XT configuration. The assembly language source code is included, in case you want to see how it is done.

**EXPENDIT** is good expenditure tracking program. Designed primarily for personal use, EXPENDIT lets you set up various categories for your monthly expenses to help you see where all the money goes. A variety of printed reports can also be generated.

**MAKEREAD** is a simple, and somewhat strange utility that converts text files into programs. When one of these programs is run, it prints the text contained in it on your screen. An odd program, but it could be useful for generating help short messages for inexperienced users.

**REMINDER** is a good on-screen clock/reminder utility. Press ALT-R to see the time. You can also enter daily appointments and REMINDER will chime when the time is at hand.

**FORTUNE** is a complete text simulation of one of TV's most popular game shows. All that's missing is Vanna and the commercials.

**FIRE** is a great little game which simulates a forest fire. You devise complex strategies using water bombers, etc. in order to quench the flames.

**BLORTII** is a fast-paced colour graphics game. You have to be quick with this one!

**\$19.95**

## SuperDisk 5

**DR.COM** Need to look at a file, or copy it - fast! Call the DR! DR.COM is a small assembly language program that lets you quickly call up the files in a directory. You can display files in order by name, date or size. Files can be viewed, copied, renamed, or deleted with a little help from the DR.



**SIMCGA** is the newest version of an indispensable utility for users with Hercules-type graphics cards. This one lets you flip back and forth between Hercules and Colour Graphics programs with two tiny utilities which can be run from DOS or Batch files. Yes, you can run CGA games with your Hercules card!

**DATASCAN** is a shareware program which is designed to give scientists, statisticians and business users a quick overview of the relationships between the variables in their data. When you load a data file, DATASCAN plots an array of small scatter-graphs, show-

ing the various relationships of up to nine variables. The user can "zoom in" on any graph for more detailed information. You can extract a variety of statistical information such as correlation coefficients, and plot linear regression lines. DATASCAN is not intended to replace any of the more powerful statistical programs such as SAS, but it is powerful enough to enable you to detect statistical correlations within your data. This will pace the way for more indepth study. Requires a Colour Graphics Display. DATASCAN also works with EGA displays and Hercules compatible graphics cards using the SIMCGA utility included on this disk. Graphs can be printed on most dot-matrix printers if GRAPHICS.COM or replace graphics driver has been loaded. DATASCAN works with Lotus 1-2-3 .PRN files, or you can enter data directly.



**ZENCALC** is a small but powerful spreadsheet program which performs many of the mathematical operations available with commercial spreadsheets. Extensive on-line help is available by pressing the "?" key. ZENCALC is perfect for fast number-crunching.

**PC-FLOW** Flowcharting as a planning tool is often under used, simply because the use of templates can be very tedious. PC-FLOW is a flow chart designing program which makes flowcharting easy and fast. PC-FLOW lets you manipulate a variety of symbols and lines using either a mouse or the keyboard. Requires a color graphics card. A special file has been included that will let you PC-FLOW with a Mouse Systems Mouse.

**19.95**

## SuperDisk 6

**YAHTZEE** This is a great implementation of a classic game. Pit your wits against several other players, including the computer. Keeps track of high scores and has a good on-line help screen.

**MAROONED** — High adventure in space. Your ship has crashed on an alien planet and you must escape.

**BLACKJACK** — Lots of excitement and nothing to lose, this game plays a strong, but honest hand. Learn the strategy behind this diversion.

**MAYAKDM2** is an enlightening text (with ASCII graphics) adventure game. You need a creative soul and a search-

# SOFTWARE FOR THE PC

ing intelligence to escape the materialistic — and deadly — Mayan Kingdom. But greater and more meaningful pleasures can be yours if you can cross the ocean to freedom.

**3DTICTAC** Just like the name says, this is a 3- dimensional Tic-Tac-Toe game. And a mean game it is too! Just you and your computer in an all out battle of wits.

**ICBM** Save a city from nuclear annihilation. Blast those ICBMs before they blast you. Requires a colour graphics (CGA) card or equivalent.

**CRSWRD** is nice little program which lets you create your own crossword puzzles. It lets you enter words and clues, edit them, save them — and print them.

**ROBOT** is a clever game of strategy in which you maneuver a small creature around the computer screen. A number of robots will try to attack you. If the converge on you, the game ends. With careful maneuvering, you can cause the robots to destroy each other. There is also a teleport key — just to add a little more excitement.

19.95

## SuperDisk 7

**ASTRO** is a great astronomy simulation program which graphically demonstrates planetary motion around the sun. It will also perform a number of calculations such as lunar phases, sunrise and sunset times. Requires an EGA display.

**TOFHANOI** This is a nice implementation of a classic logic problem. The object of the game is simple - move a tower of disks from one platform to another. But you can't place larger disks on top of smaller disks. Requires an EGA display and a logical mind.

**TICK** is a classic Space Invaders-type game - with a frightening twist. Maneuver a tank at the bottom of your screen and try to eliminate the giant bugs that are trying to get you. Just to keep things interesting, you can also take aim at the occasional rat. Requires a CGA display and fast reflexes.

**SOPWITH2** lets you battle the Red Baron in a vintage World War I airplane. The program has realistic flight simulation - it will even stall and crash if you fly too high or too slowly. Requires a CGA display.

**GOMOKU** is an easy game to play, but a difficult game to win. Enter coordinates from the keyboard to place an Xs on the screen and try to place 5 Xs in a row. The computer will try to stop you - and you must use your brains to keep the computer from winning.

**FOOTBALL** is a nice NFL football simulation. It is very complete, allows you to choose any two teams you like and even includes details such as a coin toss to see which side kicks off first. Choose each play from a huge "play book" and "make one for the Gipper".

**HIQ** is brilliant computerized version of a classic peg-jumping game. On a

cross-shaped board you try to eliminate all of the "checker pieces" by jumping over them. The object is to clear all but one piece from the board. No special hardware requirements.

**KILLER** is a well-executed graphics-based game that lets you shoot down the "killer bees". You have to be fast on the draw to win this one. Requires a CGA display.

\$19.95



## SuperDisk 8

**HAVE** is a nice little system information utility that will provide you with information such as the number of installed serial ports, parallel ports, type of graphics adapter, number of floppy and hard drives and amount of memory. **HAVE** even draws a picture of your computer with extended ASCII characters, complete with printer, monitor and keyboard. Its a nice touch.

**HANDLES** is a small utility that shows you how many files DOS will allow open at the same time. The assembly source code is included to in case you want to see how it is run.

**WCD** is a nice little program that calculates flying times between world cities. Select any two international airports and you get a display showing their longitudes and latitudes and an estimated flying time. Distances in Miles and Kilometres are also shown. Handy for frequent flyers.

**HLPURSLF** is a resident help screen system. A series of HLP and MNU files are included to help you set up your own custom Help system. A great way to help new users learn about their computers.

**UNIX** has absolutely nothing to do with the operating system of the same name. This **UNIX** is a fast and furious pinball game. It does a great simulation of the real thing. Saves on quarters too.

**VDE** is a small full-screen text editor

that could make a great programming editor. It's also good for "quick and dirty" text editing for BATCH files, etc. It only needs 11K of RAM, but it still boasts WordStar compatible commands and comes with an installation program to it can be customized for your own needs.

**EP** is a PATH editor which lets you quickly add or remove paths from your PATH statement. Small and fast, EP's program screen incorporates a complete list of editing commands to make altering your PATH statement quick and easy.

**TAO** is, well TAO just is, that's all. Based on the TAO of Programming, this program displays a random gem of wisdom from the Master Programmer every time you run it. More food for your AUTOEXEC file.

\$19.95

## SuperDisk 9

**TAX87ONT** is a comprehensive Lotus worksheet (version 1.X) for Ontario tax returns (unfortunately, we could not locate a similar worksheet for other provinces). **TAX87ONT** is an elegant worksheet which even includes all tax schedules. A split screen window lets you see whether you owe tax or vice versa. It's simple and easy to use.

**BANKRUPT** is a good worksheet for investors and potential investors. It lets you calculate the likelihood of a publicly traded corporation going bankrupt using "The Bankruptcy Predictor Formula", a formula was devised by Edward I. Altman, a financial economist at New York University's Graduate School of Business.

**LOTUSX** is proof that computers have been taken over by practical jokers. Run **LOTUSX** and an innocent looking worksheet is displayed. Press any key and the worksheet will actually "crumble" before your eyes! Slip it into a colleagues AUTOEXEC.BAT file.

**HANGMAN** is a competent version of the Hangman word guessing game written as a 1-2-3 worksheet! It comes complete with simple ASCII graphics.

**OIL** is a simple worksheet which forecasts oil prices from a number of historical factors.

**I23LEARN** is a menu-driven macro creation worksheet. Using Version 2.00 or higher, you can use **I23LEARN** to record keystrokes in order to create complex macros.

**CHKBKC2** is a personal finance management worksheet which lets you balance monthly income and expenditures. You can customize it to suit your specific needs.

**TMPDOOM** is a series of mystery adventure games created as a series of 1-2-3 worksheets. Because of the medium, **TMPDOOM** is not as extensive as most dedicated, commercial adventure games, but it is fun! Solve the mysteries by using your skill with Lotus commands. A great teaching tool.

\$19.95

## Mac VOLUME 1

**ASTEROIDS** This is a splendid implementation of one of the most popular arcade games of all time. The graphics and sound effects are amazing.

**RED RYDER** Telecommunication on the Mac has never been this easy. **RED RYDER** includes XMODEM and Kermit protocols and many other features.

**BINHEX** is a utility for **RED RYDER** which converts applications files to binary files and back again to allow them to be transferred over phones lines.

**LIFE** is one of the classic computer programs, and this version is exceedingly well done.

**VIEW PAINT** Ever wanted to look at a MacPaint drawing without getting into MacPaint. This utility lets you sneak peeks at your drawing files without fussing about.

**MacCLONE** Many users have found the Mac's disk copy routine to be less than perfect. This is a vast improvement. It even defeats a number of copy protection schemes.

**RESOURCE EDITOR** Macintosh icons and other resource items just cry out to be personalized. This little tool will help you make your Mac look its best for you.

**SCREEN MAKER** Moving text from MacWrite to MacPaint can be a bit disappointing... something gets lost in the clipboard. This utility helps your words make the trip unscathed.

**FONT EDITOR** For those longing to make their own fonts... and for those who just want to adjust the ones they have... this editor lets you shuffle fat bits to your heart's content.

**MENU EDITOR** A handy utility for editing the words in Macintosh application menus.

\$24.95





# SOFTWARE FOR THE MACINTOSH

## Mac VOLUME 2

**FONT LIBRARIAN** A splendid alternative to the Macintosh system font mover, this utility makes it easy to create custom collections of Macintosh fonts.

**WIZARD'S FIRE** This is a lively game which comes with still more lively games tucked away in the desk accessories. Get the magic rays before they get you!

**SWITCHER** Multitasking on a Mac? Why not. SWITCHER lets you run up to four applications concurrently on a 512K "Fat Mac".

**RAMSTART** Creates a RAM disk of any size on a fat Mac, and effectively increases the speed of most applications several times over.

**MADONNA** A MacPaint picture of the popular pop star.

**MOCK CHART** A desk accessory to handle the creation and printing of small business charts.

**DAM** A Desk Accessory Manager for setting up the Apple menu on your Macintosh the way you want it.

**MOCK TERMINAL** A desk accessory for telecommunication functions from within another application.

**HP CALC** Add a simulated Hewlett-Packard calculator to your Mac.

**REdit** A slick resource editor. See the December 1985 issue of Computing Now! for an in depth look at this esoteric art form.



**ORION** This one is worth the price of the disk all by itself. It simulates a star ship cruising around the galaxy at the speed of light. Stars fly past like white lines on the highway ... with or without star names fluttering like celestial flags. The heavens are accurately mapped and the star ship handles like any other warp drive star Chevy.

\$24.99

## Mac VOLUME 3

**ICON COLLECTOR** is a peculiar program that allows you to locate icons in applications and capture them to disk for use in other programs.

**BILLIARD PARLOR** is worth the cost of this disk all by itself. It's an excellent simulation of a billiard table. It will play most of the usual variations of pool and billiards, and simulates the movement of the balls with unspeakable realism.

**MANDELZOOM** is the nicest Macintosh fractal generator we've come across. It's surprisingly fast, considering the nature of the Mac's floating point library.

**RED RYDER** This is the latest version of this popular communications program. It runs perfectly, giving you a sophisticated terminal with download facilities, macros and dozens of other features.

**PACKIT** — not to be confused with PackIt will compress and uncompress PZT libraries which have been downloaded from bulletin boards. An essential utility for telecommunications.

**BINHEX5** is a file manipulation utility which allows Mac files to be sent over a modem.

**EDIT** is the most sophisticated text editor available for the Mac. Operating similar to MacWrite, it allows you to edit documents in multiple windows. Ideal for program editing, Edit produces clean text files which can be compiled.

\$24.95

## Mac VOLUME 4

One of the most interesting aspects of the Macintosh is its ability to use software-based character sets. While there are a number of commercial font packages for the Mac, we feel that this collection of public domain fonts ranks among the best.

This disk is filled — to the last byte — with thirty-eight unique fonts. We've selected a variety of body copy and display typefaces, spanning traditional and avant garde designs, along with a number of special purpose sets. Bid fairwell to the placid exterior of Chicago, the mild amusement of Geneva, the unadventurous disposition of Athens and plug your Mac into this typesetter's pipe dream.

A powerful font librarian is also included to assist in adding the fonts you want to your system.

\$24.95

## Mac VOLUME 5

The Apple Macintosh has available for it a whole universe of exciting public domain stuff. Aside from just software there are font files, desk accessories, music files, init resources, paint files and buckets of other things. In this collection we've tried to really overfill a disk with bits. In fact, there is so much software on these disks that it is impossible to describe all of it here. All of this software has been compressed into PIT files to allow us to get more things on the disk, and it fills all but about thirty two kilobytes of a standard eight hundred kilobytes double sided floppy. The PackIt extraction utility is included, and is very easy to use. Software has been tested on an enhanced Mac with one hundred and twenty eight kilobyte ROMs, a megabyte of memory and a Rodime hard drive. Some older Macintosh systems may have trouble with some of these files, particularly the hundred and twenty eight kilobyte "thin" Mac, which will not be able to use some of the software, the INIT resources and a minority of the desk accessories.

### APPLICATIONS

**AutoBlack** a screen blanker INIT resource.

**Bounce Me** is a bouncing ball demo, a la Amiga.

**Brickles** Little brick out in style.

**Clim** An MS-DOS/unix style command line interpreter, replacing the mouse, icons and finder. Includes batch files and lost of commands... good for program development or when you get sick of rodentia.

**Cursor Wrap** An INIT resource that makes your cursor travel around the back of your screen when you reach an edge.

**FaceLift** Globally reformat the text in MacWrite files.

**Font DA/Mover** Install and remove fonts and desk accessories in your System file. Works with all the fonts and accessories in this collection.

**Global Search** Find files anywhere on a hard drive using the HFS file system.

**Jclock** This is an INIT resource which puts a clock up in the right corner of your screen.

**IconEdit** is the source code for the Pascal program in the December 1987 edition of Computing Now!

**MicroFinder** A very tiny... and fast... Finder replacement. No bells, no whistles, just blinding speed.

**RDecompiler** Decompiles the resources in existing applications down to source code and use them in your own programs. Works on about three quarters of all applications. Great little icon swiper.

**Screen Maker** Converts a MacPaint file to a StartupScreen to replace the boot message of your Mac. Consider being welcomed by

the leather goddess of phobos each morning.

**Sequencer** Batch processing for the Mac.

**Set File** Change the attributes of any file on your disks. Includes, type, creator and all the bit flags.

**Sampler** Try out desk accessories without having to install them. Works with all the desk accessories in this collection.

### DESK ACCESSORIES

There are over 14 Desk Accessories included with Volume 5. These include: 3DITT A three dimensional tic tac toe game; Sleep, a manual screen blanker and tube saver; Camera, a screen capture utility with a timer; Change font; Choose Scrap; ConCode, a big 68000 machine language help screen system. Many more DA's are also included on this disk. Whether you need a VT52 terminal emulator, an Icon maker, or a speaker control utility, you'll probably find it on this disk.

### MACPAINT FILES

Pictures include: Aircraft • Blues Brothers • Car Logos • Escher Waterfall • Leather Goddess of Phobos • Pascale • Cars • The Letter A • Zebra girl (some files contain nude images)

### MUSIC FILES

Songs include: Sheep look up • Three part invention in G minor • Allemand • Almost persuaded • Brandenburg concertos three and five • Gigue • Malaguena • March in G • Messiah overture • Minuette • Mozart's clarinet concerto • Periludium • Polonaise • Sinfonia • Study • Amen chorus • plus several studies and inventions of dubious origins. (includes JukeBox music playing software)

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\$19.95 (800K disk)

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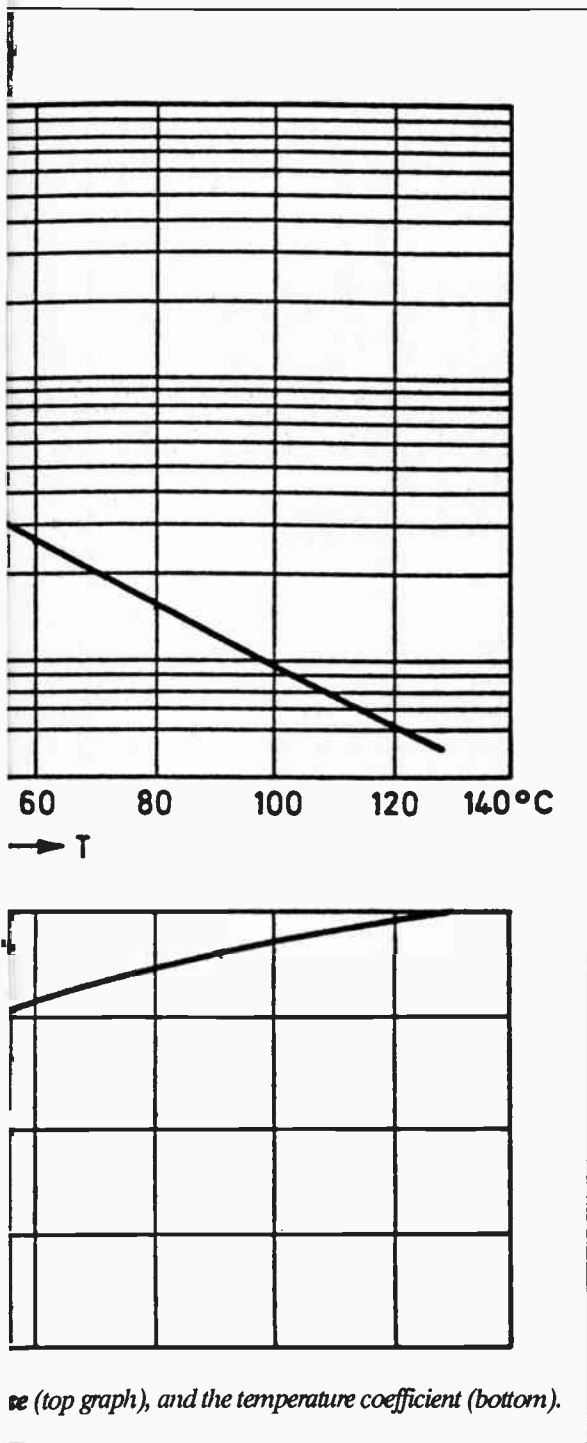
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The interrelationship between resistance value and temperature is expressed by the R/T characteristic Curve or by the temperature coefficient, as shown in Fig. 1.

### Temperature measurement

Compared to other temperature sensors, thermistors present considerable advantages in many applications. First, the high resistance makes the ohmic effect of leads negligible, and thus compensation of the lead resistances can be omitted.



Second, close resistance tolerances implying high accuracy in measuring temperature can be achieved with little effort.

Thirdly, the high temperature coefficient of 3% to 5% K makes it possible to reliably detect temperature difference of 10-4K with few additional components. Fourthly, the small dimensions enable temperature sensors with very small time constants to be designed, which can be used in the tightest measuring locations and respond very fast.

Because of the more attractive price, the greater ruggedness and the higher measurement accuracy that can be achieved, disk thermistors are preferred for temperature measurement. Thermistors used for temperature measurement should have a low electric load, so that no significant heating occurs and the resistance of the thermistor is determined only by the ambient temperature. Bread negative temperature coefficient (NTC) thermistors, are particularly suitable for applications requiring high temperature resistance (operating range up to 450°) and short response time. Equally suitable for high temperature are NTC thermistors in glass diode design, where the thermistor disk is sealed in a glass tube and thus protected from environmental influences. Such devices are suitable for host of temperature measurement applications in automobile vehicles, household appliances, heating, airconditioning and medicine.

### Temperature compensation

Virtually all semiconductor and the circuits that are made up of them exhibit a temperature coefficient, just like the copper coils of measuring instrumentation or the focusing coils of TV sets. For the compensation of this generally-undesirable temperature response, thermistors are particularly suitable owing to their high temperature coefficient. By using series and parallel resistors and appropriate voltage-divider and bridge circuit, it is possible, with simple means, to produce temperature-dependent resistances and voltages that will compensate for any temperature response. It is important that the compensating thermistor should have the same temperature, as far as possible, as the device causing the

temperature response. Among the thermistors that are suitable for temperature compensation there are, in addition to the conventional types with leads, thermistors in packages with a screw of attachment to cooling fins and heat sinks, and a chip form for surface mounting by automatic placement machinery.

Negative temperature coefficient (NTC) thermistors can be used for temperature compensation in entertainment and industrial electronics and household appliances.

### Inrush current limiting and relay delay

Many kinds of equipment, like switched-made power supplies, electric motors or transformers, exhibit excessive current when they are switched on, meaning that other components can be damaged or fuses can be tripped. With thermistors it is possible to effectively limit these currents, at attractive cost, by connecting a thermistor in series with the unit concerned. The thermistors specially developed for this application limit the current at switch-on by their relatively high cold resistance. As a result of the current load, the thermistor ten reduces its resistance by a factor of 10 to 50 and the power that it draws reduces accordingly, thus continuous currents of up to 7.5A are possible.

What is important in selecting the appropriate thermistor is the continuous current that is required, the permissible continuous current determining the cold resistance of the thermistor.

It is not possible to connect two or more thermistors in parallel, because the thermistor with the smaller resistance receives the larger portion of the currents and heats to a greater degree and thus its resistance decreases further. Finally, this thermistor receives the entire current and parallel thermistor remains cold.

Certain thermistors are particularly suitable for relay delay. Such devices permit relay operation delay times of 0.1 s to several seconds. A series connection of thermistor and relay coil is used to delay relay operation, while a parallel connection or relay coil and thermistor is used to delay relay release.

Negative temperature coefficient (NTC) thermistors can be used in switched-mode power supplies for computer terminals, personal computers, TV sets, and as soft-start devices for vacuum cleaner motors. Other uses include the limiting of inrush currents in fluorescent, projection and halogen lamps. ■

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This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

**BP222: SOLID STATE SHORT WAVE RECEIVER FOR BEGINNERS R.A. Penfold \$7.80**

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R.A. Penfold Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category.

The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuxx Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser-Units, Tremelo Generator etc.

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In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the shortcomings of this simple machine will be discussed and the reader is shown how these can be overcome. A glossary of microprocessor terms is at the end of the book.

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The aim of this book is to enable the reader to simply and inexpensively construct and examine the operation of a number of basic computer circuit elements and it is hoped gain a fuller understanding of how the mysterious computer "chip" works.

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**BP140: DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS \$15.00**

Shows equivalents and pin connections of a popular user orientated selection of Digital Integrated Circuits. Includes European, American and Japanese devices.

**BP131: MICRO INTERFACING CIRCUITS-BOOK 2 \$9.00**

intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature and optical sensors, and motor controls are discussed using practical circuit descriptions.

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This is a book for the person who has just, or is about to buy or rent some video equipment but is not sure what it is all about.

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This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

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**BP141: LINEAR IC EQUIVALENTS AND PIN CONNECTIONS \$23.80**

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The powerful Sinclair QL microcomputer has some outstanding capabilities in terms of its internal structure. With a 32-bit architecture, the QL has a large address range, advanced instructions which include multiplication and division. These features give the budding machine code programmer a good start at advanced programming methods. This book assumes no previous knowledge of either the 68008 or machine code programming.

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Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter.

**BP49: POPULAR ELECTRONIC PROJECTS** \$10.00

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Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

**BP84: DIGITAL IC PROJECTS** \$7.80

F.G. RAYER, T.Eng (CEI), Assoc. IERE  
This book contains both simple and more advanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be built and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

**BP90: MINI - MATRIX BOARD PROJECTS** \$7.60

R.A. PENFOLD  
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**BP103: MULTI-CIRCUIT BOARD PROJECTS** \$7.80

R.A. PENFOLD  
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

**BP107: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 1** \$9.00

R.A. PENFOLD  
A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects featured in this book have been specially designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components it is possible to build, in turn, every project shown.

**BP127: HOW TO DESIGN ELECTRONIC PROJECTS** \$9.00

Although information on stand circuit blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

**BP122: AUDIO AMPLIFIER CONSTRUCTION** \$6.75

A wide circuit is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities for even those with limited experience.

**BP106: MODERN ON AMP PROJECTS** \$7.80

R.A. PENFOLD  
Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

**BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2** \$8.00

R.A. PENFOLD  
70 plus circuits based on modern components aimed at those with some experience.

**BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS**

The main stumbling block to the would-be robot builder is the electronics which are required to control the robot to do the things which are the purpose of this hobby. This book explains and provides some of the very simple electronic circuits which bridge the gap.

**BP32: HOW TO BUILD YOUR METAL & TREASURE LOCATOR**

Several fascinating projects with complete plans and practical details. Simple, and inexpensive construction of Heterodyne Locators.

**BP108:** \$7.00

Cross-references European American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDs, Diacs, Triacs, SCRs, OCIs, photodiodes and display diodes.

**BP88: HOW TO USE OP AMPS** \$11.80

E.A. PARR  
A designer's guide covering several op amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made as nonmathematical as possible.

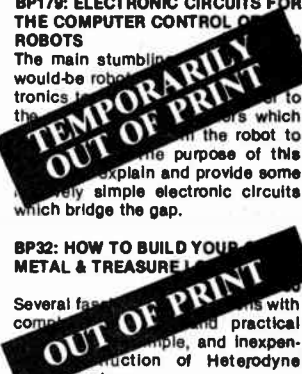
**BP65: SINGLE IC PROJECTS** \$6.00

R.A. PENFOLD  
There is now a vast range of ICs available to the amateur market, the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

**BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - BOOK 2** \$7.80

R.A. PENFOLD  
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

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# Programmable Thermostat

Build your own versatile controller.

TREVOR COX

Most people turn down the thermostat at night to save on heating bills and to sleep better. Most people now and then also forget to turn it down. And no one likes to wake up to a cold house in the morning. Offices and multi-user buildings such as meeting halls stand to save even more by turning down the heat when no one is using the building. Yet more often than not, it is impossible to give that responsibility to one person, with the result that the building will be kept heated for no reason. If the thermostat itself knew that everyone went home at 5:00, or that it should have the gymnasium warmed up for the aerobics class in the morning, energy would be saved and life would seem just that little bit easier. In this age where we can program our telephones, TVs, ovens, lamps, computers, and compact disc players, why not program our thermostats as well?

Let's look at what sort of electronics is necessary to make a Programmable Thermostat. It needs a switched output to tell the furnace or heater to turn on and off. Some way of sensing the room temperature is required. A keyboard to enter the time, to program it, and to manually change the temperature setting should be provided, and hopefully these things could be done simply. Of course it needs a display to show the room temperature and the temperature setting, and maybe act as a clock as well. But there is a lot more to this than just those things. All the temperature settings with the corresponding time they come into effect must be stored somewhere.



Hysteresis (the difference between the temperature the room is allowed to drop before the heat comes on, and the temperature it rises to before the heat shuts off) must be taken into account. The circuit has to see when it is time to change the thermostat setting and then change it. In short, this is a very complex task, and we would like it to fit in a compact case which can mount unobtrusively on a wall, and because we may want to build one as a hobbyist project, it should not be too complicated or expensive.

## The Design

If you are trying to visualize this thermostat circuitry made in a conventional way, you may be thinking of a very complex digital design. To build this project from standard logic gate ICs would not meet our criteria, as it would be large, complicated and expensive. If we were making these by the thousands, we could decide to have a custom-designed IC built. Usually commercial designs for devices like this take that route, custom chips called Application Specific Integrated Circuits (ASICs) are designed that put almost all of the necessary circuitry on a single chip. But our budget is not quite that large here so we will have to come up with another idea.

## Programmable Circuitry

It may have crossed your mind that a computer would have no trouble with this task. It would have no trouble keeping track of the time, displaying the temperature and other information on its screen, and all of the other functions. While we would not want to hook up an IBM XT to the furnace, perhaps we could build



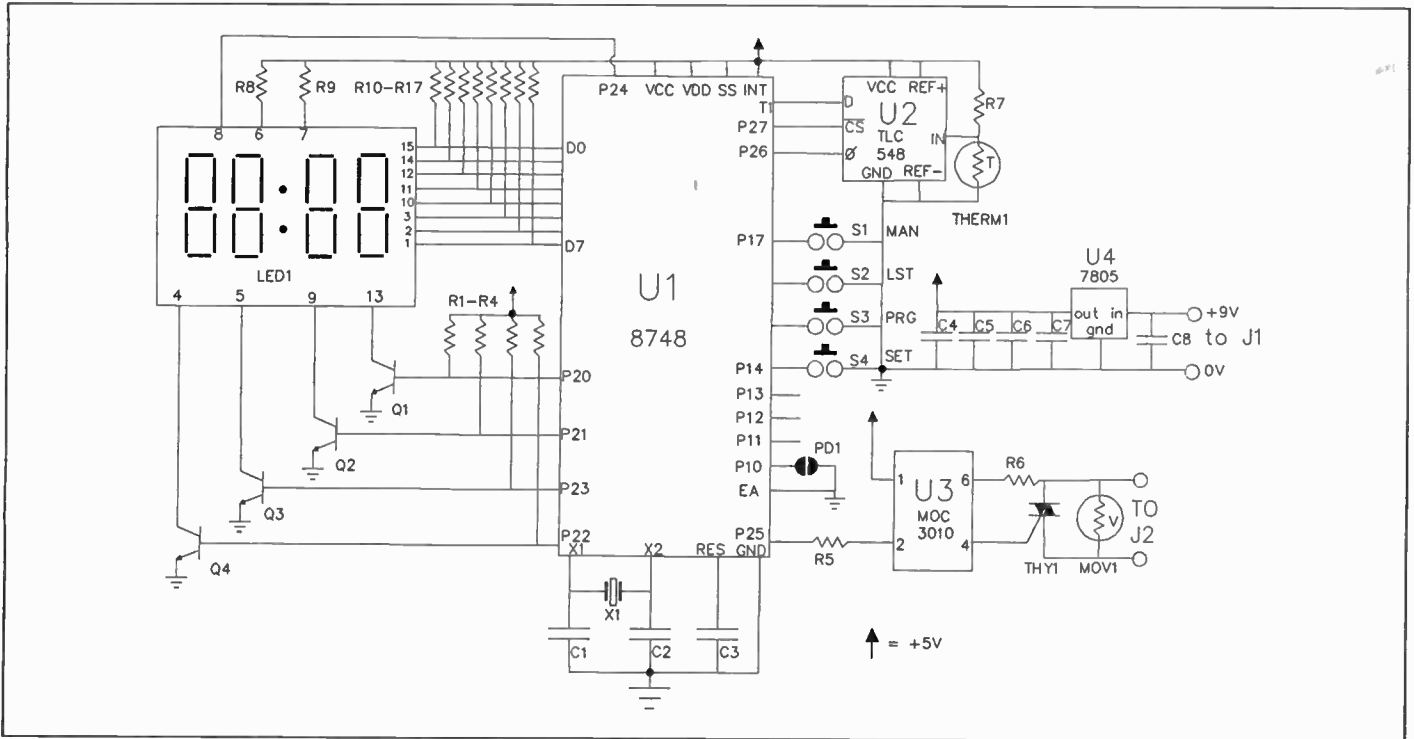


Fig. 1. The schematic for the Programmable Thermostat.

a simple computer into the thermostat. It would require a microprocessor IC, one chip for data storage, another for program storage, a couple ICs to interface to the digital display, another to interface to the temperature sensor, and maybe one or two more that would be necessary to keep it all working together. While this would do the job, it would not fit in a small case very well, it is rather complex, and it is still a bit pricey.

Fortunately, there is another alternative, a chip that combines almost all of that circuitry in one. Single-chip microcontrollers are economical, easy to use, and the one we will use in this project includes program memory, data memory, input and output capabilities, and a timer, all on a single 40 pin IC. It is programmed in its own assembly language, not too different from the lowest level programming language for any computer. (Some microcontrollers even have a built-in BASIC interpreter.) Intel Corporation's 8748 contains a built-in EPROM, so that it may be programmed with a special PROM programmer (these are widely available) and then erased by exposing the clear window on the top of the IC to ultraviolet light, in order to revise the program.

### The Circuit

Once you have the programmed microcontroller, all that remains is to add the few associated parts and put them

together on a printed circuit board. The thermostat program was written with the PC board design in mind, to make it as simple as possible. Although more expensive microcontrollers are available which include an analog to digital converter (ADC) on chip, this design uses an separate ADC chip. The ADC takes the voltage at the thermistor which is proportional to the temperature, and converts this to a binary number. This number is then sent serially into the microcontroller to reduce the number of necessary wires (see Radio Shack's data sheet for how this is done).

Also, to conserve wires and reduce current requirements, the LED display is multiplexed. This means that only one digit is on at a time, but the digits are scanned so fast that it looks like they are all on. U3 in the schematic diagram is an opto-isolator, used to isolate the current switched by THY1 from the low voltage used by the electronics.

### The Components

Because most readers will not have access to an 8748 programmer, an 8748 is available from the supplier in the parts list with the thermostat program already programmed in. This program is about 600 instructions long, so a discussion of it is beyond the scope of this article. Use a triac such as Radio Shack's 276-1000, unless you are using the project in a high

power application (this is discussed further when we talk about installation). The value for MOV1 (metal-oxide varistor) also depends on the application, it used to protect the triac from voltage spikes. Try to find one rated for the voltage the triac has to switch (24V for a standard furnace). If one is not available use a varistor rated for a higher voltage. X1 may be either a 1.8432MHz or 3.6864MHz crystal. The AC adapter need not be the one specified in the parts list; however, it must provide at least six volts and 300 milliamperes. The thermistor used must be exactly the same as the Radio Shack device specified. This lack of flexibility is the reason that no calibration is required.

### Building It

A PC board pattern (single-sided) is included here; you can make your own or order from the supplier in the parts list. Sockets must be used with U1 and U2 as they are especially sensitive to heat and ESD (static electricity). If possible, use a grounded IC insertion tool when putting these two chips into their sockets. The first step is to short the copper pads labelled PD1 with a solder bridge if you are using a 1.8432MHz crystal for X1.

Then, follow this sequence in building the project: Wire links (there are five), IC sockets, switches, resistors, capacitors, transistors, crystal, display module (connect to PCB with 15 pieces of short, solid

# Programmable Thermostat

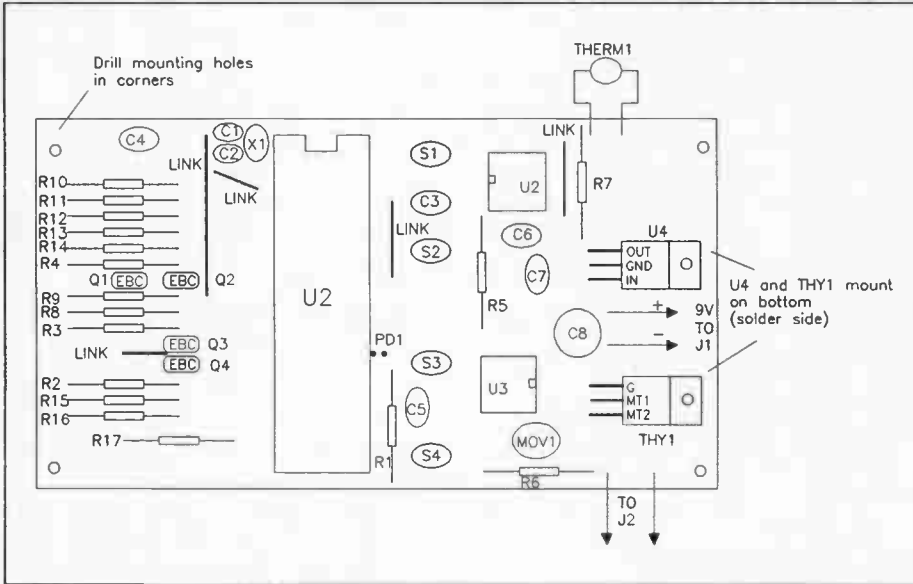


Fig. 2. The parts location for the Programmable Thermostat printed circuit board (not to scale). PD1 (pin 27 on the foil side) is shorted for the 1.8432 crystal, open for the 3.6864 crystal.

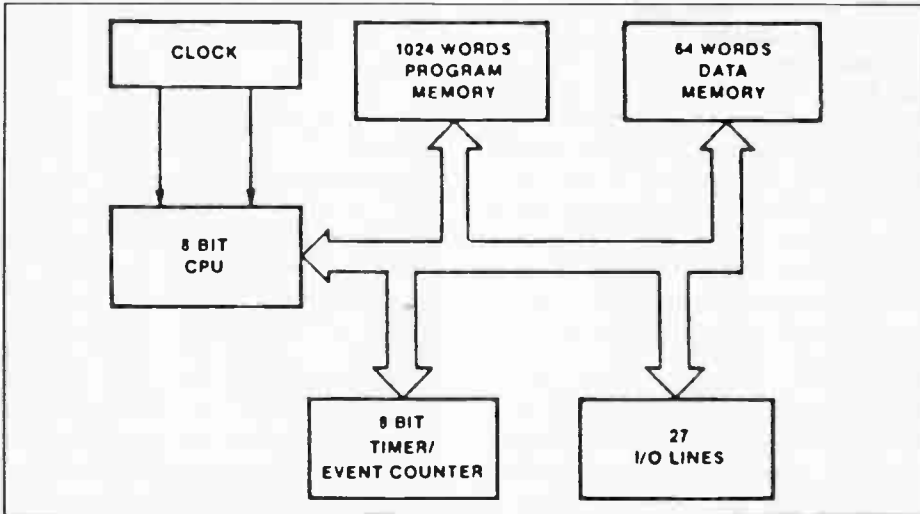


Fig. 3. The organization of the processor buss.

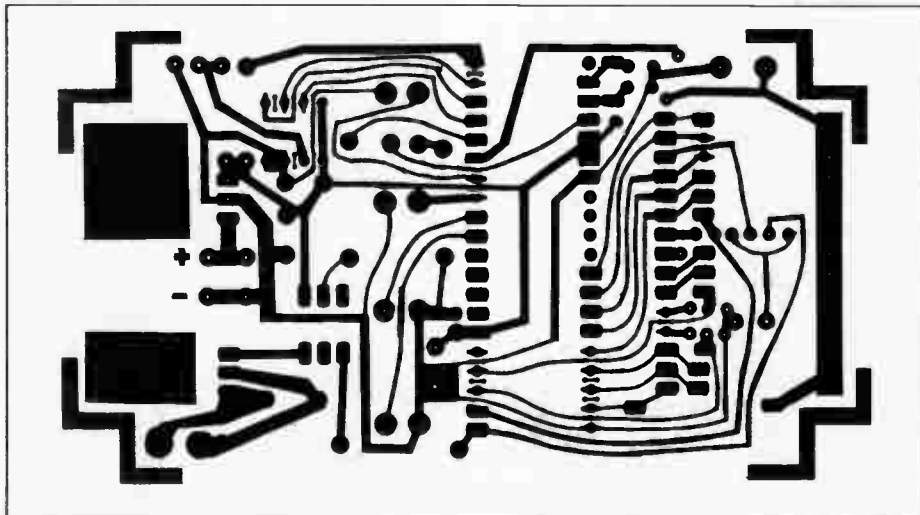


Fig. 4. The printed foil side.

hook-up wire), triac, thermistor (leave long leads on this device), U4, U3, and the wires to the connectors. Do not insert U1 and U2 yet. U4 and the Triac must be bent over and bolted to the PCB. It is a good idea to put heat sink grease between the metal surfaces here.

## Checking It Out

Now is the time to find any mistakes. Check all the polarized components; transistors, electrolytic capacitors, ICs, and the Triac. Examine the PC board for breaks and your soldering for bridges. After you check that the power adapter connector is the correct polarity, connect the AC adapter and plug it in. All of the LEDs should light up, including the PM indicator and the colon.

Using a voltmeter or logic probe, check the power supply pins of each chip. All of the positive supply pins should be 5 volts; if not, disconnect power and check out the 7805 regulator and its associated circuitry. If all is well, disconnect the adapter and insert U1 and U2. Make sure they are in the right way. Reconnect power, and 12:00 should flash on the display. At this point you can try programming it and setting the time, an ohmmeter connected across the output will indicate if the furnace would be on or off.

## Putting It Together

The PC board should be mounted to the front of the cabinet using bolts with spacers. Because the components which require holes in the case are mounted on the PC board, the hole locations can be worked out from the PCB layout. Drill four holes for the bolts and four holes for the pushbuttons in the cabinet face. The pushbuttons with their mounting nuts will also help hold the PCB in place. The length of the spacers and bolts depends on the height of the pushbuttons. Drill a small hole for the thermistor in the side of the case (the thermistor must be largely outside of the case in order to be accurately at room temperature).

A rectangular opening for the display must be cut and filed smooth. For improved visibility, a red filter should be epoxied in place behind this opening. If you made the wires to the display the correct length, the display will be touching the filter when the PCB is bolted in. It may be epoxied in place to the filter. The connector for the thermostat output should be mounted to the back of the case if you want to make this connection in the wall. Mount the AC adapter connector on the

back or side of the case depending on how you plan to install the project. The Programmable Thermostat is now ready for final testing.

### Wiring It In

So far it has been assumed that the Programmable Thermostat will be used to replace a low-voltage furnace thermostat. The thermostat in most central heating systems switches a 24 volt circuit. If you wish to use this project with a baseboard heater or any system where the thermostat must directly switch the power to the heater, you will have to use a larger Triac and a large heatsink. If you do this, make sure that the Triac is rated for a load a little larger than you expect the heater to be, and that U3 and R8 are appropriate for driving the Triac's gate. You must also use a larger varistor for MOV1. Alternatively, you could use the Triac to drive a large relay.

Follow all safety precautions if you install the project yourself. Determine which wires were switched by the old thermostat, either by looking at a wiring diagram or examining the circuit. If you are unsure about how the wiring works, consult the Electrical Code or a book on do-it-yourself heating installation. The two wires which will turn on the furnace when they are shorted must be connected to the two screw terminals on the back of the Programmable Thermostat. After drilling appropriate holes in the case, it can be screwed to the electrical box of the old thermostat. The AC adapter should be plugged into a nearby outlet. The wire from it can be run neatly up the wall or you may wish to have it enter the wall near the outlet and connect to the thermostat inside the electrical box.

### Going Further

Microcontrollers are a great way to simplify complicated projects. They are easy to design with once you learn to program in assembly language. You can get someone else to burn in the program or buy a EPROM programmer yourself. The author started programming microcontrollers using a very simple (two ICs) homemade EPROM programmer which plugged into a Commodore VIC-20 computer. If you like programming and experimenting with electronics, microcontrollers are the perfect way to combine the two. If you would like more information on microcontrollers, you can contact the company mentioned in the parts list.

### Using the Thermostat

If you have just plugged in the thermostat, "12:00" will be flashing on the display. Otherwise, it will be in its normal display mode, alternating between the clock and thermometer displays. Using the thermostat is similar to setting a digital watch.

1) To set the clock:

— Press SET/ADV. The hour digits will flash.

— Press SET/ADV to advance the hour display. The dot in the top left corner of the display indicates PM.

— Press any other button when the hour is correct. The minute digits will now flash.

— Use SET/ADV again to set the minutes, then any other key to return to the normal display.

2) To program the thermostat:

— Press PRG/CLR to tell the thermostat you wish to add a program. If there are already eight settings entered, your request will be ignored.

— Advance the hours and minutes the same way you did to set the clock.

— A two digit number will now flash on the display. This is the temperature setting you would like to come into effect at the time you just set. Use the SET/ADV button to change this setting.

— Press any button other than SET/ADV to return to the normal display mode.

— Every day when the clock display reaches the time you just set, the thermostat setting will automatically change to the programmed one.

3) To list the programmed settings:

— Press LST. If there are no programmed settings, your request will be ignored. Otherwise, a setting will be displayed on the display, alternating between time and temperature.

— Press LST again to go on to the next setting. The settings will not be displayed in any particular order. If there are no more settings to be listed, it will return to the normal display.

4) To erase (clear) a setting:

— While the setting you wish to erase is being displayed (see LST instructions above) press the SET/CLR button. That setting will then be lost from the memory.

5) To manually change the thermostat setting:

— Press MAN. It is now just like a standard thermostat. The "S" in the leftmost digit indicates that the display is the current thermostat setting. Pressing SET/ADV will change this setting.

— Press MAN again to return to the normal display mode. ■

## PARTS LIST

### Resistors (1/4 W, 5% unless stated)

R1-4.....	1.5K
R5.....	330R
R6.....	180R
R7.....	10K
R8-17.....	220R

### Capacitors:

C1.....	5pF
C2.....	20pF
C3.....	1uF
C4,5,6,7.....	0.1uF
C8.....	10uF radial

### Semiconductors:

LED1 NSM4005A 4 digit LED (see below)

Q1,2,3,4 MPS2222A

THY1 Triac (See Text)

U1 8748 (see below)

U2 TLC548 (Radio Shack #276-1796)

U3 MOC3010 (Radio Shack #276-134)

U4 7805 5V regulator

### Miscellaneous:

MOV1 Metal Oxide Varistor (see text)

Thermistor 10K at 25 degrees (Radio Shack #271-110)

X1 Crystal (1.8432 or 3.6864 MHz)

J1 To match AC adapter plug

J2 2 position barrier strip

AC adapter 9 volt, 300 mA

Case 112 x 62 x 27mm (eg. Hammond 1591B)

**Note:** The following are available from Canin Electronics, Box 342, Kaleden, BC, V0H 1K0:

#8748ETT-PT (8748 with required program) \$21.50

#4005ETT-PT (LED display) \$ 1.50

#PCB-ETT-PT (PC board, etched & drilled) \$12.00

#KIT-ETT-PT (All parts, case, PCB, instructions,

copy of program source code) \$69.50

All orders add \$2.00 for postage. BC residents add 6% sales tax.

Money order or cheque only, please.

# The Tecmar VGA Adapter

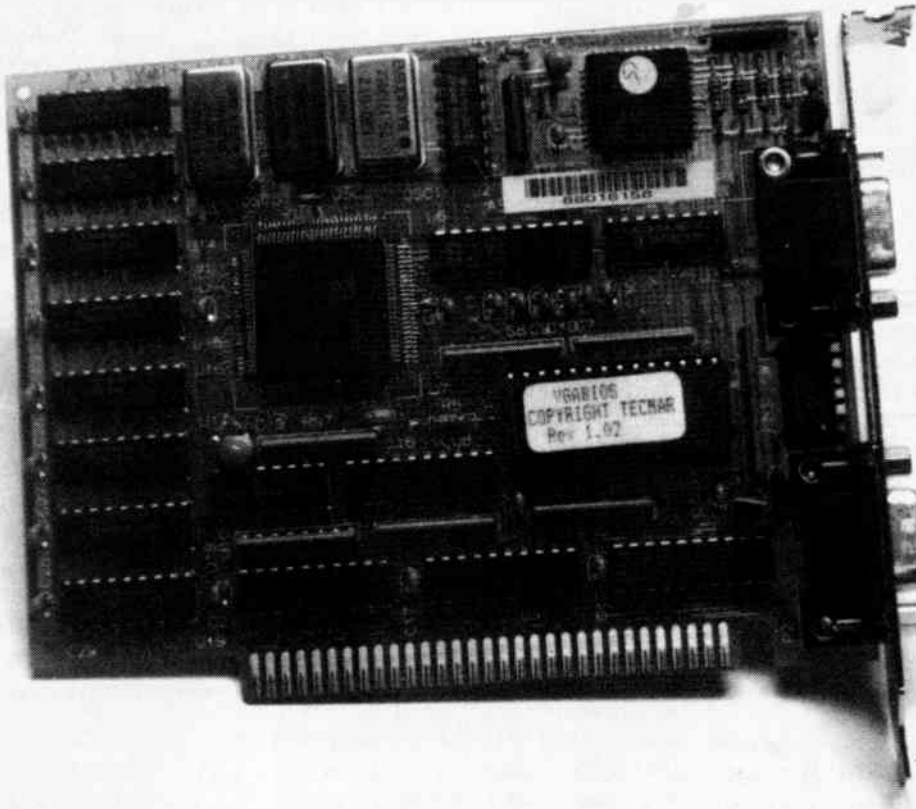
Upgrade to the latest high-resolution computer video standard.

BILL MARKWICK

For years, owners of IBM PCs or compatibles had a choice between looking at hi-res monochrome, such as the Hercules video adapter, or the standard Color Graphics Adapter (CGA). The CGA wasn't bad, with its resolution of 640 by 200 (with two colours), but it was a bit coarse for text. If you had to stare at a word processor all day, a monochrome was better. When used for paint programs or CAD, it suffered from the "jaggies"; the limited resolution caused angled lines to look like little staircases.

The next improvement was the EGA card with 640 by 350 resolution and more colors. This is probably the most popular high-performance video card of recent years. Naturally it was only a matter of time until the next upgrade was announced. This turned out to be the Video Graphics Array from IBM, the VGA card. It provides 640 by 480 color and 720 by 400 monochrome text, and allows 256 colors from a palette of 262,144.

It wasn't long until third-party manufacturers produced plug-in cards that would



let any PC owner upgrade to the VGA standard. The Tecmar VGA Display Adapter is just such a card, and an impressive one at that.

## Specs and Features

The Tecmar card has the VGA standards mentioned above, but in addition can also do 640 by 350 256-color graphics, 132-column text display, 800 by 600 16-color

graphics and more. 256K of video memory is on-board and the card has both digital and analog outputs, as well as a DIP switch to suit most monitor types. The two floppy disks shipped with the card contain drivers for most popular software, as well as the resident Tecmar program that lets you configure the card via a menu.

Should your software be incompatible with the VGA mode, the menu will let you instantly reconfigure the Tecmar into an EGA emulator. If the program you're running doesn't support EGA, you can turn the Tecmar into a CGA, and if *this* doesn't work, it will become Hercules monochrome compatible.

## Installation

It looks as if all you have to do is fit the card into a slot and run the software. Ah, but no; you're about to become a VGA pioneer, and pioneers have a lot of experimenting to do before the leading-edge is comfortable. First, you need a better monitor. While it's true that the VGA

*Continued on page 42*

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# Combo Lock

A six-key electronic lock for security or other purposes.

CHUNG YIU KO



Neighbourhood Watch schemes cover the land. Security in the home has a higher profile today than ever before and a simple electronic locking device could be worth its weight in missing cufflinks.

The circuit detects correct sequence input and provides a relay output suitable to trigger an electronic lock. Its main beauty is that it uses no ICs and keeps things simple and cheap. The correct combination is hardwired rather than programmed and the lock could be used to protect door openers, burglar alarms, car ignitions — the applications are limited only by your imagination. The circuit diagram is shown in Fig. 1.

The heart of the circuit is the sequential detector which interprets the correct sequence inputs from the key switches, turns the output on and activates a relay. An indicator (LED1) indicates that the correct number sequence has been entered. If the right numbers are entered but in the

wrong order than the sequence detector is reset and the entire sequence must be repeated.

Alarm circuitry is incorporated in the design and this is activated if the digits not appearing in the combination are pushed.

## How It Works

The sequence sensing circuit is constructed around Q1 to Q6, the key switches and the relay.

Initially Q1 to Q6 are non-conducting. As soon as key 1 is keyed Q2 is forward biased, collector current flows through R4 and the base and emitter of Q1. Q1 charges via R3 and R4 which provides sufficient bias to turn Q1 on. The voltage drop developed across R2 (due to Q1 collector current) briefly holds Q2 on and a constant current source is now available at the emitter of Q1, forming the power source for the remaining stages of the emitter follower.

The functions of Q3 and Q4, Q5 and Q6 are a similar except that the loading of

the final stage is a relay coil and LED indicator. Obviously the keys must be keyed in correct sequence (1, 6 then 8 as shown in Fig. 1), otherwise there will be no power source available from one stage to another and the relay will never energize.

The incorporation of the keypad or key board enables the user to select any three digits of any combination number he chooses while the remaining keys are connected the reset/alarm mode input.

Whenever the unselected keys are pressed the circuit is reset by pulling Q1 base to negative (via D1 in alarm mode) and at the same time discharging C1. Q1 is biased off turning off Q2. At this stage the entire sequence must be repeated. The second half of the circuit is alarm warning circuitry. Whenever a reset/alarm key is keyed (except the actual reset key Q) the alarm will sound for a short duration.

Q7 and Q8 form a basic astable multivibrator circuit. Initially the oscillator is inoperative, because Q8 is biased off via resistors R14 and R11 to the positive

# Combo Lock

supply. As soon as a reset/alarm key is keyed, capacitors C4 charges via R16 with the polarity shown. Q8 becomes forward biased and the oscillation starts for a duration determined by the R11 and C-4 network.

Gradually C4 discharges across R11 to cut Q8 off and the oscillator stops.

Q9 is a simple direct-coupling emitter-output power amplifier. The circuit will operate well on 12V DC and draws a maximum standby current of 20mA. The maximum current is 400mA with the alarm and relay energized. This makes the device ideal for 12V car system or an AC derived supply.

## Construction

Though stripboard could be used with care, the PCB is recommended and the overlay is shown in Fig. 2. The relay will fit directly onto the PCB. It is possible to use any relay having a 12V 300R or higher resistance coil, but it may be necessary to redesign the printed circuit layout or mount the relay off board.

The key switches are of push-to-make momentary action type and any switches of this type can be used. However a low profile keypad or keyboard is more desirable for ease of construction. After inspecting of the PCB for short circuits, broken tracks and any damage, the resistor should be soldered onto the board, followed by the capacitors, then the diode and transistors (care being taken with polarity of these components).

Once all the components are securely fitted onto the board, connect the corresponding wirings to the desired sequence and reset key switches.

In Fig. 1 the sequence number is shown as 1-6-8. Zero is for reset and the remaining unselected invalid keys are connected

to parallel to the reset/alarm warning circuitry input. The PCB is purposely small so that it can be mated back-to-back with the key pad by two spacers, and tuck away in any suitable front panel. For door opener applications the unit can be fitted in a metal blanking plate (as used in house wiring) and mounted in the door frame, with the speaker wired remotely indoors.

For automotive applications a small module case with metal front panel is most suitable. The base of the case can be secured onto the dashboard, with the metal front panel used to mount the complete unit.

The alarm in the circuit shown is not going to wake the street; in its present configuration it is more of a loud indication that the incorrect sequence has been entered. It would not be difficult to fit a second relay into the alarm section of the circuit which could trigger a bell alarm, or a flashing neon arrow with "Burglar" written on it, or even to release an enormous weight from the second floor onto the burglar... ■



Fig. 3. The printed circuit board

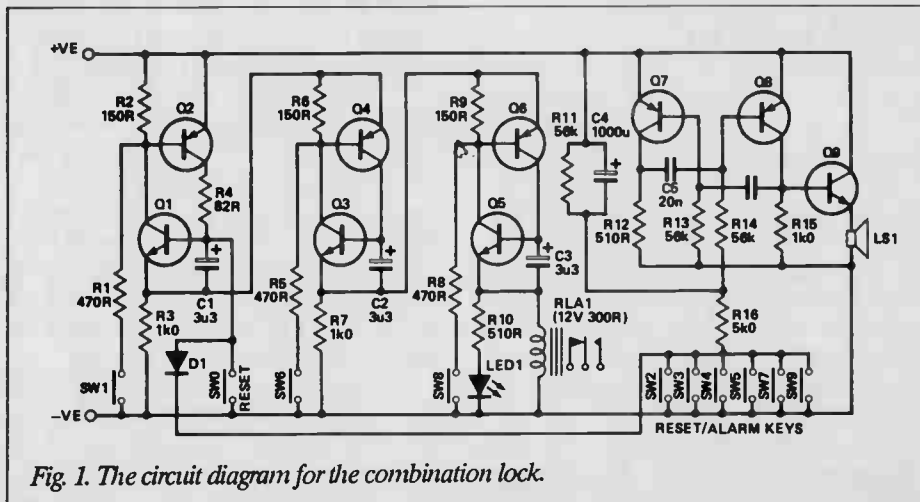


Fig. 1. The circuit diagram for the combination lock.

## PARTS LIST

**Resistors (all 1/4W 5%)**

R 1, 5, 8 .....	470R
R2, 6, 9 .....	150R
R3, 7, 15 .....	1K0
R4 .....	82R
R10, 12 .....	510R
R11, 13, 14 .....	56K
R16 .....	5K0

**Capacitors**

C1, 2, 3 .....	3u3 12V electro.
C4 .....	100u 12V electrolytic
C5, 6 .....	20n ceramic

**Semiconductors**

Q1,3,5	MPS3904 (Radio Shack 276-2009)
Q2,4,6,7,8	MPS2907 (RS 276-2023)
Q9....	TIP3055 (RS 27-2020)
D1	1N4001
LED .....	red LED

**Miscellaneous**

RLA1	12V relay 300R or higher
Keypad or push-to-make switches	
PCB, PCB pins (16), wire, nuts and bolts.	

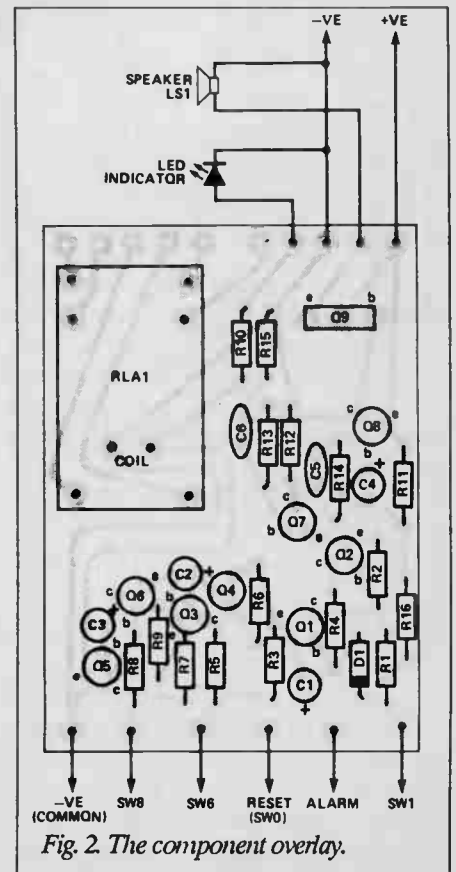


Fig. 2. The component overlay.

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# The Tecmar VGA Adapter *Continued from page 36*

adapter works splendidly with an EGA color monitor, it doesn't reach the dizzying heights it's capable of unless you have an analog monitor with very high bandwidth. For instance, we tried a Tatung 1293 VisualPro, a 12" analog monitor. Paint programs looked wonderful on it, with a palette of colors such as you've never seen before. However, when we tried reconfiguring the Ventura desktop publisher for the maximum 800 by 600 resolution, the image flickered so badly it was unusable. The cure was to step up to a higher bandwidth monitor, the Sony 1302. This made Ventura as sharp and as clear as if you were holding a typeset page in your hand.

But this created a new problem. The Sony has both digital and analog inputs, and our only available cable did not have the special analog connector. This meant that we couldn't get the wide palette of colors in the highest resolution mode (you need analog to get the 256 colors).

Further, the Tecmar VGA driver for AutoCAD was for the new Release 9 and

wouldn't work with our older Version 2.62, so we could only see AutoCAD in the EGA mode (which was beautiful, I must admit).

Lastly, we had some sort of a hardware conflict with our Best computers, preventing booting, though the Tecmar worked well in other compatibles.

Lest I give the wrong impression, I have to say that both Tecmar of Ohio and EMJ, the Canadian distributor, bent over backwards to see that we received the monitors, software and hardware that we needed. It's unfortunate that as we went to press, we couldn't get the AutoCAD VGA and the Best compatibility problem solved in time, but no doubt the cures will be in hand by the time you read this.

## And so...

If you want the current best in video displays, the VGA is the one to have. However, not all software has VGA drivers, so you'll need a card that's downward compatible with EGA and CGA, and in that case, the Tecmar is a superbly engineered

device, giving you color images that are just *dazzling*, plus a well-designed software interface for changing modes. And, rarity of rarities, it comes with an excellent manual.

If you're buying VGA to enhance a particular piece of software, be sure that (a) it supports VGA, or that Tecmar can supply a VGA driver, (b) that you choose a proper monitor, and (c) that you obtain the proper cables. EMJ is more than helpful in guiding you in the selection.

At present, you can get a Tecmar card and a VisualPro monitor for \$1295; the card and the Sony 1302 is \$1995. There are several other options in between. If you can't locate a dealer who stocks the EMJ/Tecmar package, EMJ has the following branches:

Guelph: (519) 837-2444  
 Vancouver: (604) 875-9344  
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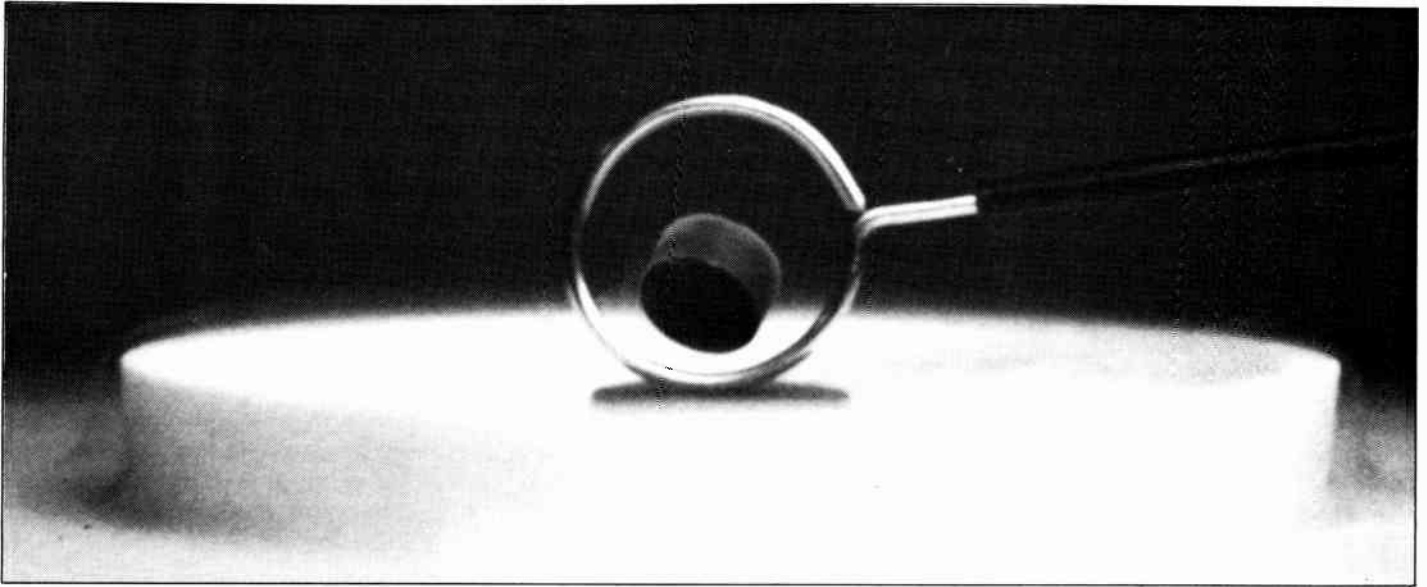
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# A Superconductor Kit

Watch a superconductor in action right before your eyes.

BILL MARKWICK



Not long ago, the superconductor existed only in major laboratories. The drop to zero of electrical resistance had only been observed at temperatures colder than 23°K (23 degrees above absolute zero), a temperature that could only be maintained with liquid helium. However, it was predicted that materials research would turn up a substance that would exhibit superconductivity at much higher and more manageable temperatures. In 1986, IBM's Zurich Research Laboratory announced a ceramic oxide which exhibited a  $T_c$  (temperature of superconductivity) of 35°K. In early 1987, the University of Houston produced a material made from yttrium, barium and copper oxide with a  $T_c$  of 93°K. This allowed superconductivity using liquid nitrogen with a boiling point of 77°K.

Today, CS Technologies, a company in Kanata, Ontario, is selling a superconductor kit that can demonstrate the effect to anyone with access to a flask of liquid nitrogen, which is not that difficult to locate from science labs, gas product companies or welding suppliers. The kit consists of a ceramic disk of the superconductor (yttrium oxide, barium carbonate and copper oxide), an insulated stand, a magnet, a small hoop and a pair of tweezers.

We took the kit over to Marc Garneau

Collegiate in Don Mills, where the science department could demonstrate the kit to some of the students. A cryogenic flask of liquid nitrogen was kindly donated by the Ontario Science Centre, and we donned safety glasses and gloves as a precaution against spills. It may be warmer than helium, but it can instantly turn your fingers to Popsicles...

The superconductor pellet is placed on the stand and the tiny magnet placed on top of it. When a little liquid nitrogen is poured over them, the magnet suddenly jumps about 5mm into the air and hovers there, twisting this way and that in the air currents. The hoop can be used to demonstrate to scoffers that they're actually looking at genuine levitation. Occasionally the magnet might slip out of range, or even freeze from condensed water vapour; the tweezers are for setting it in place without getting too close to the liquid nitrogen.

The reason the levitation occurs is that the magnet is inducing an equal magnetic field in the resistance-less superconductor. The equal fields repel; should the magnetic move in relation to the superconductor, the magnetic fields alter together, keeping the magnet in balance. You can even set it spinning in the air, with a very slow decay rate.

The potential for this new technology is

enormous. The loss is power transmission would be greatly reduced, though it's unlikely the cost of replacing the existing grid would be justified. Semiconductor junctions could become faster by several orders of magnitude, and electric motors could be much smaller and more efficient for the same power.

CS Technologies will soon be introducing the world's first commercially available superconducting motor. This experimental motor places 24 electromagnets around the circumference of a rotating 8.5" aluminum plate. As these iron-cored electromagnets pass close to the two superconducting disks placed below the plate, they induce mirror magnetic fields in the superconductors that repel the electromagnets, resulting in rotation of the aluminum plate at about 50RPM.

You can order a semiconductor disk (part 87001) for \$30, the entire kit (part 87002) for \$50, and a fabrication kit is available for about \$200, which includes the chemicals, crucible and die required for making your own. Facilities required, such as a 1000°C kiln and a large vise, should be available in most school labs. Please note that prices do not include taxes or shipping.

For more information, contact: CS Technologies, 21 Sumner St., Kanata, Ontario K2L 2P3, (613) 836-4617. ■

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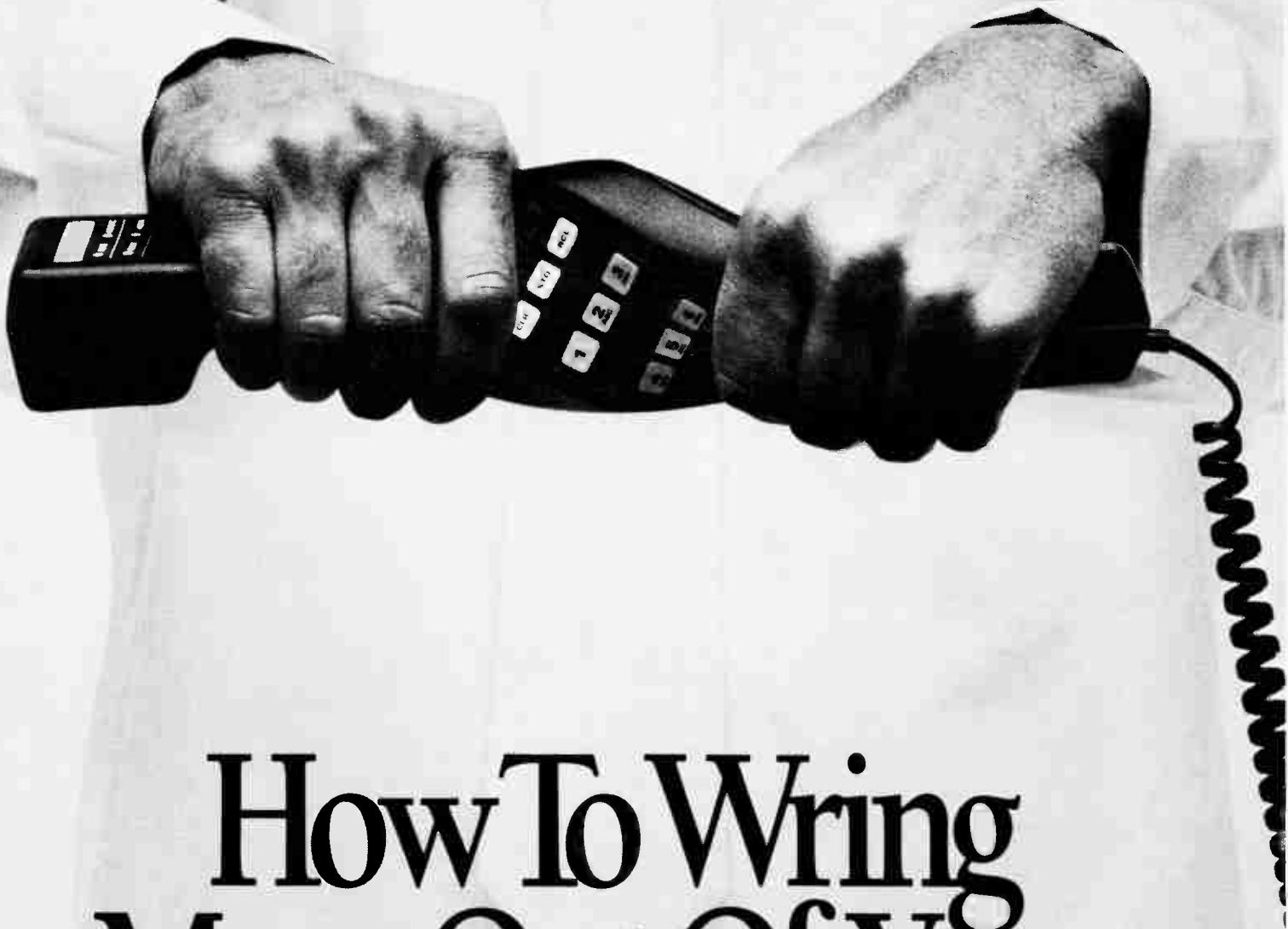
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# How To Wring More Out Of Your Cellular Service.

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# A Guide to Cellular Phones

Helpful facts if you're looking into the convenience of the go-anywhere telephone

BILL MARKWICK

Once upon a time, and not very long ago, a mobile telephone was such a complicated and expensive undertaking that it was reserved for situations where a company just had to have one (or for the well-heeled with the stretch limo). Besides the cost, the radio-telephone was at the mercy of reception quality from a single transmitter tower.

As you've no doubt noticed from the prevalent advertising, and from getting calls from people in cars ("Do you have the figures on that?" "Uh, not right now, I'm in my car."), the radio-telephone has come of age. The shrinking cost and size of computer circuitry has allowed the use of multiple send/receive towers (cells). The main computer measures your signal, and if it drops below a preset level, a search is made to see if reception would be better using another nearby cell. If so, your phone receives a coded command to switch to the new cell frequency (the handoff). The computer also controls the channel frequencies, slotting your phone into the first available channel to prevent interference from other cellular phone users in the same area.

The result of all the computer switching is that you rarely have the noise and fading problems associated with mobile radio reception. Furthermore, the number of cells is expanding all over North America, with most busy corridors now serving the cellular phone user by means of reciprocal agreements between service companies (roaming). Chances are good that you could sit in the cottage or canoe and talk on the phone, if you don't mind bringing that much of the city to the cottage with you.

And how far has all this technology brought the phone? It's probably safe to say that the phone in your car has far more features than the one in your home.



## A Quick Tour

For the purposes of this article, we raided the advertising department and stole two of their "transportable" cellular phones and one portable. Transportable means the same thing in phones as it does in computers: you can move it around all right, but it's big and heavy enough that you wouldn't put it in your briefcase, say. The two Motorola transportable phones appear on the cover.

We tried them out under a number of conditions. The first thing you have to do with two phones, of course, is make a phone call to the person standing right beside you. Small thrills aside, this is a fairly rigorous test: the signal from the small antenna has to exit through a steel-roofed office building, find the cellular system and return to the second phone through that same building. For the most part, the phones worked flawlessly, though there was the occasional sputter and noise intrusion.

The next test was to have one phone in the office and the other in a car going down the Don Valley Parkway. When it comes to radio reception, Toronto drivers will confirm that the DVP's sides and surrounding tall buildings make a symphony orchestra sound like small-arms fire in a newscast. Surprisingly, there was very little noise or interruption when calling the second transportable, and none at all when calling the office switchboard. I assume that the broadcasting pattern of the various cells is designed to take geography into account. It's a remarkable bit of engineering when a battery-operated radio transmitting from the centre of a steel car can reach another battery unit in the centre of a steel building with only occasional noise. Proper external antennas would have improved the reception tremendously.

# A Guide to Cellular Phones



As for ease of use, I'd rate the transportables as so-so. If you've borrowed a company phone that doesn't have your favorite phone numbers in its memory, you'll have to dial (push buttons, actually), and this is best done when the car isn't moving. If you have a manual gearshift, you'll want to hold the phone on your left, and this is made awkward by the coiled cord heading over to the battery pack on the right. The cures? Either a permanent installation with a hands-free microphone and speaker (which is also available as an option with most transportables), or a fully portable unit such as the Motorola 8000X. The true portables fit in a briefcase or even a pocket, but they're top dollar.

The transportables give you two hours of continuous use with the internal batteries (or continuous with the car battery). They'll charge in eight hours with the AC plugpack or three hours when plugged into the car's cigar lighter socket. On the model we tested, the keyboard was illuminated from underneath, nice at night but a battery drainer.

Incidentally, if the power is off, your phone is out of service, and callers will receive a recorded announcement to that effect.

## Security

You might wonder what would happen if someone broke into your car and started running up long-distance charges on your cellular phone. The answer is that this is isn't likely to happen if you use the Lock feature included with the phones. This

prevents operation until you key in a 3-digit code to unlock the circuitry.

If the fate of the free world is in your hands and you need strict telephone privacy, the cellular network is not the place to be. Anyone with a commercially available VHF/UHF scanner can listen in on the cellular frequencies.

## Phone Features

The hazards of dialing can be eliminated with the built-in dialer fitted to the phones. Some of the portables have 40, some of the transportables 99. At least four keystrokes are required: Recall, the two digits and Send. The memory registers will usually hold enough digits for long-distance codes as well.

The features and options available vary a great deal with the make and model. The Radio Shack CT-300, for example, is a true portable with 600mW of power, a weight of 28 ounces, a 40-number memory, 1 1/2 hours of operating time, and one-hour charge time. Options include a mobile mounting kit which holds the telephone and charger in your car, and a hands-free unit that also includes a data interface for connecting laptop computers (more on this later). The basic telephone's catalog price is \$2495. Their transportable, the CT-200, lists for \$1995 and has options such as horn alert, extension handsets and computer data cables. The least expensive way to go cellular is to buy one of the full-size units, in which the electronics chassis mounts under the seat or in the trunk. Their CT-100 is such a unit, includes hands-free operation, and lists for \$1399.

Motorola's Dyna T-A-C 6000X is another example of an in-car cellular phone. It has features such as a quick-connect handset so you don't have to leave it in the car, a speakerphone, call timers, memory scrolling of the 99 stored numbers, auto redial and incoming-call screening, which can transfer callers to another number. It can also receive calls with the ignition off, and CALL will appear in the display if a call came in when you weren't there (you then contact the operating company's message centre).

All of the phones available have a host of features made possible by the microchip: speed dialling, last-number recall, security lock and so on. Probably the best option for the driver is hands-free operation. This is usually accomplished by mounting a small microphone (on the sun visor, perhaps) and a small speaker. Another thing to check would be the availability of the horn-alert option to let you know a call is coming in when you're out of the car, but nearby.

If you have the need to send computer data back to the office, or you want facts and figures sent to you, the cellular line can be used just like any telephone line. A computer is connected to the cellular phone by means of a modem, and you're set. As far as quality of reception goes, it's probably best if the car is parked. There may be a slight interruption if you drive past buildings or powerlines, or as you pass from one cell to another. The interruption would probably be unnoticeable to the ear, but the computer might see it as missing or corrupt bytes.

If you're interested in the data transmission possibilities, check to see that the phone of your choice can be fitted with an interface for connecting a modem.

Another aspect of data transmission: portable FAX machines are now coming on the market, so you could send and receive photofax copies from your car. Instant drawings and data. It wasn't all that long ago that this sort of thing was pure science-fiction.

In our next issue, we'll cover cellular data transmission in more depth, and hope to have a portable FAX test for you.

### Pricing

In Ontario, there are two companies supplying the radio network for cellular phone users, Bell Cellular and Cantel. The same situation may apply to other areas, or you may find that cellular service is supplied by the local telephone company. These companies, incidentally, have formed an association called CellNet Canada. Through CellNet, companies with cellular mobile telephone service needs in several provinces are provided with a standard rate package, single-office contact and dedicated local support across the country. In other words, you'll find cellular service in all major areas from sea to shining sea. If you need facts about specific coverage around the country, you can contact CellNet Canada at 10 Carlson Court, Rexdale, Ontario M9W 6L2, (416) 674-8186.

There are two ways to go cellular: you can buy the entire package from a cellular service company, or you can buy the telephone itself from a third-party supplier and then lease a network line from the cellular companies.

The Radio Shack prices quoted previously are pretty much representative of hardware costs. The in-car permanent installations are the lowest cost at about \$1300, the transportables are about \$2000 and the top-of-the-line portables with all the bells and whistles about \$2500-3000.

The cost of the service from the cellular companies can get quite complicated because of the package deals available. The package deals include your basic monthly service charge and various amounts of air time depending on the cost.

If you went for the basic service that would get you on the air, you can expect to pay \$15 monthly to Cantel, and \$9.95 to Bell (plus \$4.95 for the Message Centre feature, which you'll want). There's a one-time \$40 service connection charge, plus the system licensing charge, though this may be included in package deals. The

hardware cost is in the same range as mentioned above, and installation, if any, is included.

Now you're on the air. Each call will cost you 55 cents a minute for the first 120 minutes and 35 cents a minute for 121-240 minutes during peak rates. The off-peak rates are one-third off (Bell cellular rates — Cantel has similar packages). You'll also pay the usual toll charges if you call long-distance. If you plan to use the phone a lot, it's worth asking your local suppliers about the packages, which will reduce your cost-per-call.

### Installation

There isn't much to installation, really. The permanent in-car phones require wiring to the electronics and the fitting of an antenna. According to a technical bulletin from Bell Cellular, the choices for antennas are, in order of preference: a roofmount in the centre of a metal roof, a corner mount away from the passenger area, and a glassmount window antenna. The glassmount antennas, incidentally, don't require any holes to be drilled; capacitance passes the signal through the glass nicely.

A bracket is usually fitted to hold the handset. If you get the hands-free option, the microphone and speaker have to be wired in.

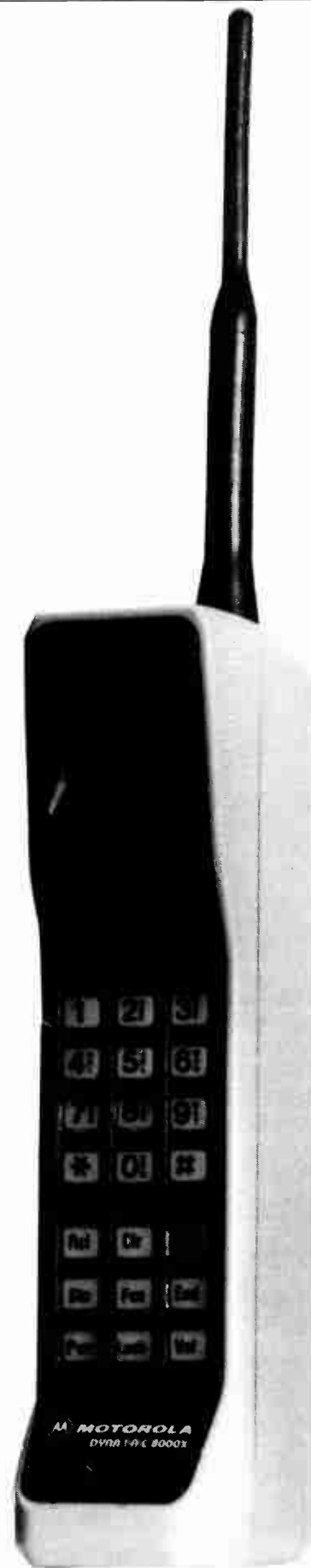
### Roaming

The charming name of *roaming* means that you can drive anywhere where's a cellular system and send or receive calls from any other cellular system. You could make a call from your car in Florida, say, to another car in BC. How's *that* for science-fiction?

If you're within the range of the cellular company that you subscribe to (for example, Ontario and Quebec for Bell), you make calls normally: seven digits for locals, eleven for other area codes. People calling you do the same thing.

People who want to call you when you're outside the home service area have to call the roaming number at the local cellular company; on receiving a second dial tone, they enter your area code and number.

Those are the basics of getting on the air with this convenient service (ever try to find a phone booth plus parking space in a busy downtown area?). It's simple to install and even simpler to use, with excellent reliability. Next month, we'll be looking at the mobile office (your car or van), made possible by cellular's data transmission capability. ■





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## Microprocessors, Part 4 *Continued from page 12*

- b. instruction decoder  
c. instruction register  
d. CPU registers (including Instruction Pointer).
11. (2.1.2) The instruction Register provides a means of
- a. locating the next instruction in memory
  - b. locating the start address of a program in memory
  - c. storing an instruction while it is being decoded
  - d. storing the result produced when an instruction is executed.
12. (2.1.3) Which one of the following statements is TRUE?
- a. Both RAM and ROM devices are connected to the address bus
  - b. neither RAM nor ROM devices are connected to the address bus
  - c. RAM devices are connected to the address bus while ROM devices are not connected to the address bus
  - d. ROM devices are connected to the address bus while RAM devices are not connected to the address bus.
13. (2.1.4) The clock in a microprocessor system provides
- a. a common time reference
  - b. a control signal for read/write memory
  - c. a signal used within the address decoder
  - d. a means of determining the execution time of a program.
14. (2.1.5) The clock input to a microprocessor comprises
- a. a sine wave signal of typically 1kHz to 4kHz
  - b. a square wave signal of typically 1kHz to 4kHz
  - c. a sine wave signal of typically 1MHz to 4MHz
  - d. a square wave signal of typically 1MHz to 4MHz.
15. (2.2.1) Which one of the following is an essential part of any microprocessor instruction?
- a. Label
  - b. Address
  - c. Operand
  - d. Operation code.
16. (2.2.2) The first byte of a three-byte instruction comprises
- a. a label
  - b. an address
  - c. an operand
  - d. an operation code.
17. (2.2.3) Which one of the following does NOT represent a data transfer instruction?
- a. JMP
  - b. LDA
  - c. MOV
  - d. STA.
18. (2.2.4) In which one of the following addressing modes are there no data or address bytes present within an instruction?
- a. Absolute
  - b. Extended
  - c. Implied
  - d. Immediate
19. (2.3.1) Which one of the following gives the correct sequence of events within the fetch-execute cycle of an instruction which loads the accumulator with an immediate data byte?
- A = Decode the Operation Code  
B = Increment the Instruction Pointer  
C = Fetch Operand  
D = Latch Operand into Accumulator  
E = Fetch Operation Code
- a. A E B C D
  - b. A B E D C
  - c. E B A C D
  - d. E C B A D
20. (2.3.2) Which one of the following gives the action which takes place in the instruction Pointer during the fetch-execute cycle?
- a. Set to zero and then incremented as each instruction byte is fetched hence counting the total bytes in a program.
  - b. Set to the first address of the program and maintained constant so that the program can be restarted when a system RESET occurs.
  - c. Incremented during the fetch-execute cycle so that it eventually holds the address of the next instruction to be fetched.
  - d. Contains first the operation code and then each operand byte in strict sequence this allowing the instruction to be decoded.
21. (2.3.3.) The feature marked X in Fig. 4.5 represents
- a. the address of the data byte
  - b. the data byte present on the bus
  - c. the address of the operation code
  - d. the operation code present on the bus
22. (2.3.4.) Fig. 4.6 shows two instructions (A and B) located within the memory of a microprocessor system. During the FIRST fetch cycle
- a. the address M + 1 is loaded with the operand
  - b. the address M is loaded with the operation code
  - c. the Instruction Pointer is loaded with the operand
  - d. the Instruction Pointer is loaded with the operation code.

### Test Answers

1. d 2. d 3. a 4. d 5. b. 6. d 7. d 8. b 9. c  
10. c 11. c 12. a 13. a 14. d 15. d 16. d  
17. a 18. c 19. c 20. c 21. a 22. d ■

extent or the other, many of these attributes are now established for animals, such as primates and some aquatic species.

The difficulty with any definition of intelligence is due to the following question. When does a "simple" information processing system become intelligent? Instead of answering this question, I will use the notion of intelligence only, but grade it into a hierarchy. I would like thus to extend the notion of intelligence to "lower classes" of information processing systems, e.g., primates, higher animals, cells and giant molecules, etc. To understand this viewpoint, one should look into the evolution process. How did intelligence evolve?

## Evolution of Intelligence

The Earth and the solar system came into existence some four and half billion years ago. Let us look how life evolved once chemical compounds were already formed. The primitive Earth was a difficult

place to live by any standard. At first it was too hot, but it started to cool down and the Earth's crust was formed. Then rains started. For centuries it rained and rained, until oceans and seas were filled with water. All kinds of chemical compounds were dissolved and a primitive "life soup" was ready to give birth to life. The formation of elements inside the star core gave rise to favorable structures, such as the valency of atomic Carbon, the hydrogen bonding, and other elements which were soluble in water and other which used water as their carrier. The external environment was also making its contribution such as volcanic activity, variation in temperature, electrostatic discharges from the water clouds, radiation bombardment, the sun light and all possible moving and shaking by the earth quarks. Could anyone have imagined that intelligent life forms could be created out of this soup? Indeed they were!

Chemical molecules were formed and broken down due to harsh environment.

Those which survived were able to stand the harsh treatment of radiation, vibration and terrifying lightning. At first amino acids were formed which could stand the test of the earth's primitive environment. They represented whatever could survive. More molecules were formed: giant ones, only those which would not break into smaller and simpler molecules due to environmental bashing. They started to grow into compounds, carrying their history in the form of chemical structure. Today, we call this chemical structure the genetic code. But it is this structure which has survived and "learned" to replicate itself. The basic genetic message is simple enough — only a particular combination can exist. Whatever was breakable is gone for ever.

Some chemicals needed sun light so they remained near the surface of the water. Had they stayed far deeper, they would have destroyed themselves. New chemical structures were added, those which by using their chemical energy

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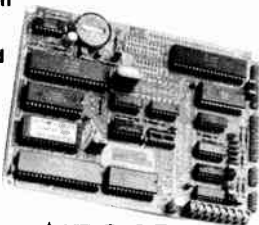
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# The Evolution of Intelligence

propelled themselves towards the sun light. They developed chemical sensors to find where light is. This was the development of a primitive vision system. There was a need to compute distance, direction, and avoid destructive encounters with other objects. How to do it? More molecules joined together, their purpose being to evaluate distance and to look for dangerous elements in the environment. This was the initiation of chemical intelligence. The more complex a system became, the more the number of subsystems it acquired. One for this, the other for that, and so on.

## Intelligence Hierarchies

My point of view is that intelligence exists at many possible levels of hierarchy — from our own electrochemical intelligence to primitive space-time objects, but of course, with decreasing complexity. There are many reasons why one would want to define intelligence hierarchically. The first and foremost reason is that the so called

“level of intelligence” is very much knowledge dependent, i.e., an increase in knowledge implies a higher level of intelligence if you take for granted the capabilities mentioned above. Thus it becomes dependent on the ability to acquire knowledge, store it in a fashion so that it can be retrieved, manipulated and new knowledge can be created.

As we know, this ability depends very much on memory storage facility and input - output mechanisms, and the efficiency and reliability of hardware, as well as the life time of the hardware (i.e., the intelligent being). It is known that biologists equate very often the brain size of an animal with its stage of evolution. At the bottom of this hierarchy where only a code for the recognition of a fixed set of simple objects and their pre-coded interaction is required, intelligence manifests itself as an elementary particle interaction. At a little higher level, it manifests itself as intercellular communication to achieve well defined objectives. If we compare this

stratification with the hierarchy of the computer language, we find that from the machine code and assembler to the fourth and fifth generation computer languages a similar (pyramid) structure exists. Again, in both cases the cooperation of simple parts leads to a complex macroscopic behavior. For the sake of discussion, consider the following hierarchy of intelligent systems:

1. Humans
2. Primates
3. Higher animals
4. Lower animals
5. Bacteria, Virus, etc. (giant molecules)
6. Simple molecular and atomic structure
7. Elementary particles (quarks and leptons)
8. Most elementary space-time objects not yet known.

Lower level animals have relatively less memory due to their smaller brain size. Such a brain is not big enough to accumulate large amounts of knowledge as in

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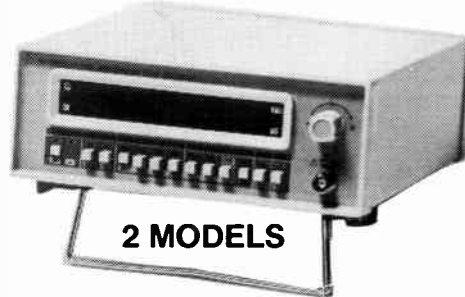
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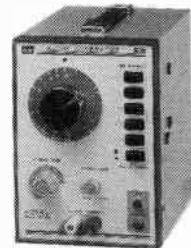
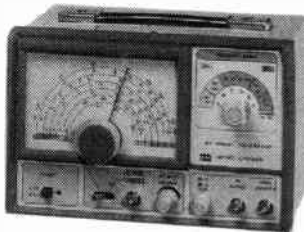
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humans. From bacteria and virus downwards, intelligence consists only of recognition ability of certain classes of chemical molecules; or at the very end of the spectrum, as in elementary particles, it is only the ability to recognize other space-time objects and communicate with them in a pre-coded way. The interaction is pre-coded because it is always the same and predictable. To get further insight into the hierarchical model of intelligence, consider the following facts:

a. All human beings are capable of recognizing patterns in space-time and complex abstract concepts.

b. All lower animals do have relatively lower levels of intelligence, but enough to survive and continue their species. They are generally capable of recognizing each other, other material objects and "understand" their external environment.

c. Bacteria, virus and other simple biological entities can recognize other bacteria, virus etc. and behave in a particular way as to ignore each other's presence or destroy other species.

d. At further lower levels there exist elementary particles which can recognize each other and certain aspects of their environment. They can discriminate one class of objects against the objects of another class. They preserve not only their own identity but interact in a prescribed manner such that the final products are always the same under similar circumstances.

What is common to all these structures is the information processing ability. But the complexity of processing and the "hardware" which does it varies from structure to structure. Even the most primitive one can "send" and "receive" information through certain "messenger" entities. These messenger entities exist at all levels of intelligence and information communication is a fundamental mechanism. For us, it is the symbolic representation of our thoughts in written or spoken form; in genetics it is the messenger RNA; and photons and other so-called intermediate particles are in elementary particle interactions.

### Computer AI

Let us go back to the computer as a synergetical system. Here, like in physical and biological systems, there are two main subsystems, the hardware and the software. The basic hardware parts are the transistors, while basic software "parts" are their on and off states. At the next level of hierarchy, this evolved into logical gates (operations of Boolean Algebra) as the

basic active elements of computing machines. Moreover, certain manipulation procedures used repetitively were given mnemonics and the so called assembler languages were developed.

From assembler onwards, more and more complex languages were evolved but at the machine level, it is always binary on/off which are the basic events. The functional success of binary state Turing - Von Neumann machines (i.e., our computers) put them among the list of good examples of synergetical systems. It is completely clear in this case, starting from two primitive symbols, how one can represent highly complex structures.

Consider for instance, at a given time  $t_1$ , the status of all active elements as a sequence of binary states and let it represent concept A. Similarly, at a time  $t_2$  another state

$A = (1011\dots)$   $B = (0110\dots)$

different from A, representing a concept B. When we say concept A and B, these are perceptions of simple or complex patterns of our external world. A machine recognition of structures external to itself is based on comparison/ matching with its internal structure (a sequence of 0's and 1's) and 1-1 map between internal representation and the external world. Thus occurrence and recognition are related through what we may call a semantic map. Continuing the example of machine intelligence, we know that intelligent behavior requires:

- Knowledge of a given domain
- Ability to manipulate knowledge by reasoning and other methods

Fundamentally, knowledge and the manipulation of knowledge is required for the purposes of solving a problem or any other intelligent behavior listed above. A detailed analysis shows that one can divide further an intelligent system into subsystems such as:

- Knowledge base and its components
- Organizer of knowledge base
- Knowledge acquisition sub system
- Inference manipulator
- Language in which program is written
- compilers/interpreters (From higher language to lower)
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Each system in itself is not an intelligent system but their overall cooperation produces intelligent behavior. In this scheme as we move higher and higher into the hierarchy of subsystems, we move towards higher and higher intelligence. ■

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**Cloners Beware**

By cloners, we mean the science-fiction kind, the ones who make human bodies in a lab by decoding the DNA secrets of the cell. The amount of information encoded into each and every human cell is said to be, by a remarkable coincidence, the same as the information in the 32 volumes of the

Encyclopedia Britannica, and there are 10 trillion cells (give or take a dozen).

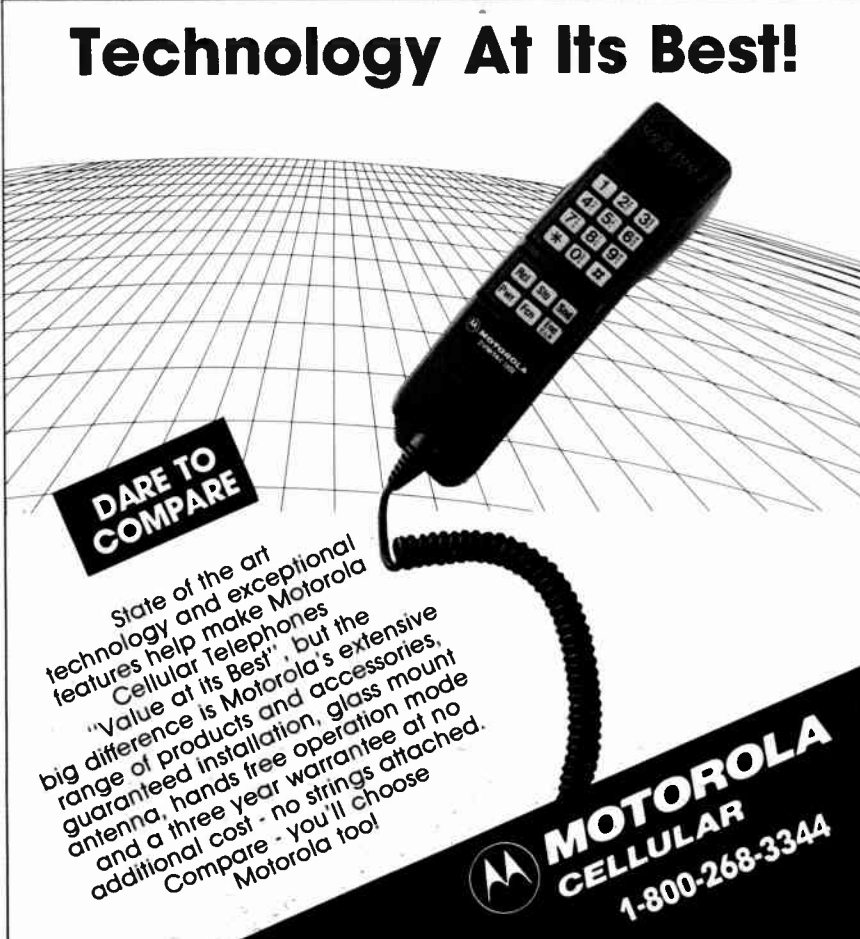
This means that encoding all the human body's cell information into a computer using the Bell Northern chip mentioned above would require 10 trillion seconds, or 115,741 years. If you allow that most of the cells are duplicates of each other and divide by 1000, you're still looking at 115 years of computer time. "Igor, forget the arms and legs. We're running out of computer tape."

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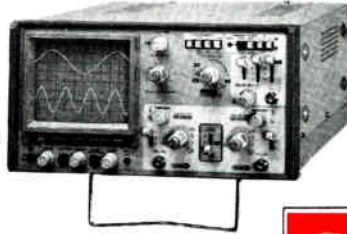
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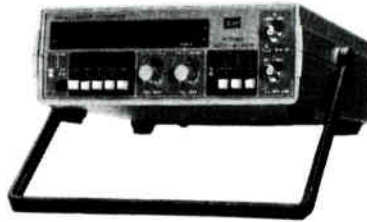
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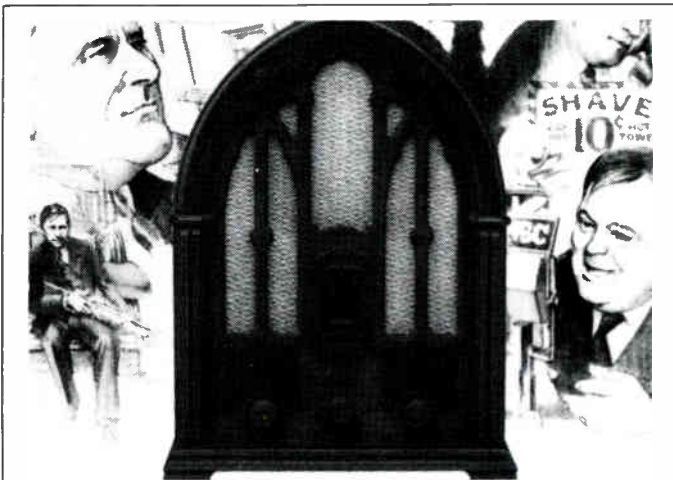


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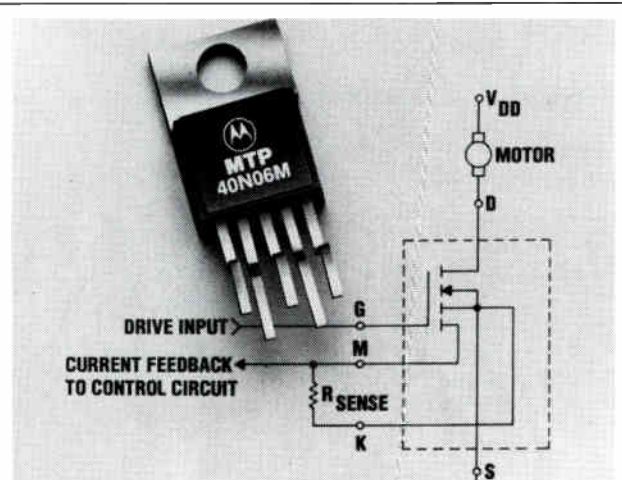
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### A 1932 Classic

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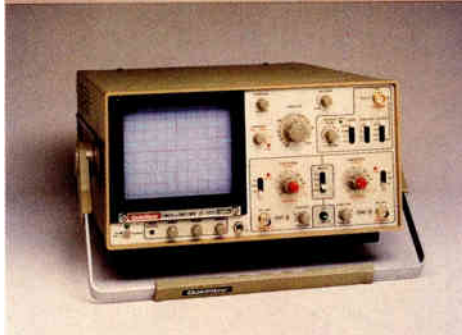
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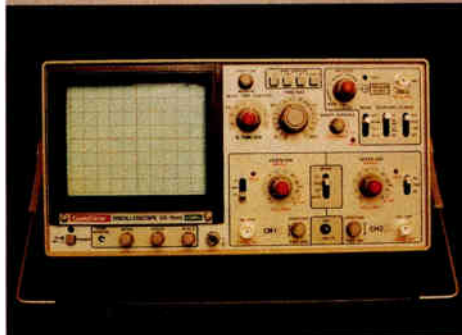
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