PERSONAL COMPUTER AGE

The Definitive Journal For The IBM Personal Computer User

ERIC —
GOOD LUCK WITH YOUR COMPUTER MUSEUM!
BEST WISHES, Jack Crone

A NEW AGE

Welcome to the pages of Personal Computer Age! Getting out the first issue of a new publication is an exhilarating experience. We're excited about Personal Computer Age and about the IBM Personal Computer. We are just as excited about the changes this decade will bring to personal computing and to those of us in this industry. We are living in a time of unprecedented technological advances - advances that make awesome computing power affordable at the personal level. We are seeing a fledgling industry mature and grow strong, responsible and responsive. We are seeing an increasing number of children who consider the computer a normal part of their everyday life, both at home and at school. By the end of this decade, the phrase "a computer in every home" won't be a cliche, but a reality.

Right now we are looking around the final bend in the road. We are probably entering the last explosive growth of cottage industries in the personal computer field. Within this decade the last of the skeptical consumers will see the light. The last soothsayers of doom will find their bones bleaching in the desert with those of the other false prophets. During this decade, several great truths will be universally accepted. Here are some pertinate ones. Intelligent computers will take over the world and run our lives — only in the science fiction novels. Computers are not going to create massive unemployment, they will increase our productivity, make our goods and services more reliable and make our personal lives more enjoyable. And, future historians will not place IBM as an also-ran that got into the small computer field late. Indeed it seems that IBM correctly predicted the timing of this final phase of the maturing process of this industry. IBM has introduced the right product at the right time and has established the right relationships within the computer community and with the computer user. This is a new era we are entering and the name says it all - Personal Computer - one person, one computer. Virtually overnight IBM will be the acknowledged leader in this era.

All this leads up to how we arrived at the name of our publication. We are looking at the dawn of a new age and we are doing it with the flagship of this age.

Now that we have disposed of our philosophical meanderings and crystal ball gazing let's get acquainted. Personal Computer Age is produced by CRC Publishing, a division of Crone-Reasoner Corporation. Our editorial staff consists of people with experience in the fields of hardware engineering, software engineering, publishing, law, education, medicine, manufacturing, art and real estate. In addition to our editorial duties, each of us is, and will remain, active in our respective specialty. It is our philosophy that to make a meaningful and authoritative contribution we must currently and actively participate in the discipline we discuss. In future issues we will introduce our staff so you can get to know us individually.

What is Personal Computer Age? It seems a bit too big and classy to be a newsletter and it's a bit small to be called a magazine. Our original desire was to publish a magazine; our philosophy was that it must be (as our banner states) the definitive journal in the field. Then we realized that in the beginning there wouldn't be enough truly meaningful information to fill a magazine. Another possibility was to publish four or six issues a year but, that too seemed a poor choice. The news is happening on a daily basis; a month is long enough to wait for the report.

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So we made the decision to start small but monthly, and grow with the IBM Personal Computer community. As the number of machines and users increase, the manufacturers multiply and the programmers proliferate so Personal Computer Age will grow. As the knowledge becomes available it will appear in these pages; when it is not available we won't invent it.

Usually a publication such as Personal Computer Age would be primarily concerned with new hardware, new software, applications and so forth. In time that is where our emphasis will be. In the meantime we perceive a different mission. The IBM Personal Computer has generated incredible interest in the small computer community. This has occurred long before much exists in the way of specialized hardware or software. Indeed, this interest is occurring prior to any large number of Personal Computers being available. Therefore, we see the greatest need being in the area of basic information about the machine. What it is, what it can do, and what it cannot do. Where to get it and how much it will cost.

We will be supplying the in-depth information that a prospective purchaser or new owner needs. This information will be presented in both technical and non-technical articles. These first few issues will become a reference guide that will be indispensible to someone considering the purchase of a Personal Computer. As such, CRC Publishing will make volume one available permanently.

While we have expressed our intent for this journal in general terms, the specific content will be dictated by the wishes of our readers. It is very important to us that we be responsive to your needs. Drop us a line. Let us know what you want to see. That's what you will get in the pages of Personal Computer Age.

We look forward to a long, enjoyable and exciting journey into this new era. Welcome aboard.

Jack Crone

GETTING A DISCOUNT ON YOUR IBM PERSONAL COMPUTER

Jack Crone

That's right, you can buy your IBM Personal Computer for at least 17% less than IBM wants you to pay. Now you know that supply has not caught up with demand and will not in the near future. If you have been checking out the marketplace you are also aware that: (1.) in some areas it can take a month or two to get a system, (2.) that some people are calling IBM dealers all over the country to find a system, (3.) that you could, if you had just taken delivery of a system, sell it for more than you had paid for it to someone who didn't want to wait. Knowing this, you are probably asking yourself, is this guy a magician? No, I'm merely going to show you a simple and practical way to save a substantial amount of money and maybe (no guarantees here) get a complete system in your hands just a bit sooner than using the normal route.

Here's how the plan works. IBM manufactures certain parts of the Personal Computer while other manufacturers produce the rest of the system with IBM acting as the middleman, getting these items to the user. The IBM components are competitively priced. In fact the system unit might even be considered a bargain depending on whose yardstick you were using for comparison. However, components manufactured by other companies are quite a dif-

ferent story. Prices there range from high to outrageous. It is this second group we will now discuss.

To begin our comparison we need some specifics. Let us assume that you have a need for some serious computing power, but you do not need every bell and whistle being offered. An analysis of your needs indicates that 64K of memory, two disk drives, a printer and an 80 character display should be just about right.

Table 1 shows your system straight out of the IBM and Computerland price lists. As you can see IBM is (can you believe it!) somewhat less than Computerland. The IBM prices were taken from two price lists, one from a local IBM store, one supplied by the Personal Computer headquarters in Boca Raton, Florida. Computerland prices are indicated for the store closest to us. Handy hint, shop around! It is unlikely that anyone will give you a discount from the price list they are using but they do not all use the same list.

Now, for the gospel according to Personal Computer Age. First, buy those items that are unique to IBM (or should we say place your order since it is unlikely that anything is available over the counter). The items in Table 1 marked with an asterisk are the ones we mean; the total is $2220.00.

Table 1. IBM Price

	Computerland	IBM
* System Unit	$1320.00	$1265.00
* Monochrome display	345.00	345.00
Matrix printer	825.00	755.00
* Display and printer adapter	345.00	335.00
16KB memory expansion (3)	285.00	270.00
* Diskette drive adapter	250.00	220.00
5 1/4″ diskette drive (2)	1140.00	1140.00
* Printer cable	55.00	55.00
Printer stand	55.00	55.00
System total	$4620.00	$4440.00

Next, focus your attention on the remaining items in Table 2. This, bargain shopper, is the part of your computer that IBM does not make, and these components can be purchased in single quantities from the normal distribution sources for these manufacturers (where it is probably in stock) at the prices shown. The bottom line is a saving of $778.00 or more than 17%.

The dollar saving shown here is not only very real, it is very conservative. The lower IBM prices in Table 1 were used for the expensive system. Table 2 uses only the list prices in effect when this article was written. If you have friends in the computer industry or are a resourceful shopper, you can save at least another $300.00.

At PCA, our first Personal Computer was purchased at list price. We did not have the opportunity to examine a machine prior to placing our order and it wouldn't have mattered anyway, we wanted to see exactly what IBM was selling. Our second machine was different, by then we knew what was offered and that we wanted a discount. Our total savings on unit two was over 25% (we have friends).

If you are still with me you must be interested. So, ''Where's the catch?'', you are asking. There are a few and I will lay them on you. First and most obvious is the fact that you must give up the convenience of one stop shopping.

Table 2. PCA Price

IBM supplied components	$2220.00
Epson MX-80 printer	645.00
16K memory chips (27)	67.50
Tandon TM100-1 disk drive (2)	700.00
Printer Pal printer stand	29.50
Discount price	$3662.00

Where are the sources? Most computer stores carry at least the Printer Pal and the Epson printer. Purveyors of computer parts may have the memory chips and the disk drives. Retailers in this category may be found locally and they can certainly be found in the back pages of almost any small computer magazine. If you want to be assured of factory fresh, fully guaranteed, etc., you can contact the manufacturers listed at the end of this article. They will advise you of a distributor in your area.

If shopping around doesn't bother you, perhaps esthetics will. The Printer Pal and the Epson printer do not sport IBM paint jobs. Worse yet, neither come with the IBM name. The Tandon drives have a label on the bottom that says Tandon. IBM peels this label off, you can too. The label doesn't really matter since it is out of sight. Finally the memory chips, no discernable difference here, ICs are ICs.

The plot starts to thicken. If you buy a complete system from your friendly local IBM dealer it is delivered completely assembled, checked out, etc. If you buy individual components from different sources you have to assemble and check them out yourself. The printer and stand are no problem, just follow the adequate instructions provided and plug the cable you bought from IBM into the printer. Operational and diagnostic instructions for the printer are contained in the Guide to Operations that came with your System Unit. The memory chips and the disk drives take a bit more effort.

The first thing you have to do is get inside the System Unit. Begin by placing the System Unit in the center of a table somewhat larger than the unit. Unplug all cables from the rear including the power cable. Set the keyboard, monitor, etc., well out of the way. Looking at the rear of the unit you will see a screw in each of the lower corners. Remove these screws, walk around the table to the front of the unit, grasp the cover and pull it toward you. IBM did a good job of making this easy to get into didn't they? When you are through inside, just reverse this procedure to get the cover back on. The only thing that might give you any trouble is the lips on the lower edges of the cover. Notice that they go under the corresponding lips on the chassis. Incidently, this procedure is very nicely detailed in the installation manual that comes with the 5¼'' Diskette Drive Adapter, IBM publication 6025055. If you get this component, make sure that you get the manual as well.

Autumn
Revolution
'81

**THE
COMPUTER USERS GROUP
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FOR OWNERS OF THE
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TECHNICAL HOTLINE
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Group members will have access to the users software library.

TECHNICAL LIBRARY
Pertinent information will be indexed and catalogued.

LIBRARY CATALOGUES
Entries to the software and technical libraries will be classified and catalogued.

AUTUMN REVOLUTION '81 is an organization of owners of IBM Personal Computers. We are totally independent of International Business Machines, Corp. or any other computer manufacturing or marketing organization. Autumn Revolution '81 is dedicated to the development and application of the capabilities of this computer.

AUTUMN REVOLUTION '81 MEMBERSHIP APPLICATION

Last name   First name   **D**

Address

City   State   Zip

☐ 1 Year Membership $30
☐ 2 Year Membership $55

☐ Payment is enclosed
☐ Mastercard
☐ Visa

Card Number   Exp. date

Signature

To install the memory chips you must first remove any circuit boards that overhang the memory area on the System Board. Notice that Figure 1 shows four rows of memory chips labeled Bank 0, Bank 1, Bank 2, and Bank 3. Bank 0 is already installed, that constitutes 16K which is the minimum configuration. Banks 1 through 3 you are going to install. You must remove any boards that are in the way. This is a simple procedure, just remove the screw(s) indicated in Figure 1, grasp the board firmly and pull straight up. A little wiggling may be necessary if there are any connectors protruding through the rear opening. To reinstall just reverse this procedure.

Inserting the memory chips is a little more difficult. The pins are fragile and easily bent. The best policy is to make sure that the pins point straight down (90 degrees from the body) prior to insertion. This may require a little preliminary bending. Once the pins point down and are straight, insert the chips in the socket making sure that the notch points in the direction shown in Figure 1. When you have finished this operation you must set switch bank 1 as shown with positions three and four off. If your system was set up properly when you received it, no other switch changes will be necessary. Now reinstall any circuit boards you removed.

Installing the disk drive(s) is easier. First, and probably the hardest, remove the cover plate(s) over the openings where the drives go. The cover plates are plastic moldings held on by Tinnerman nuts. To remove the plates rotate the Tinnerman nuts 90 degrees and slide them off. Note, if you are installing only one disk drive it should go in the left hand position as viewed from the front. Once you have the cover plates out of the way slide the disk drives into place and secure them with the hardware illustrated in Figure 1. Oh yes, I forgot to mention that you would have to acquire four 6-32 by 3/8" screws from your local hardware store.

If you are clever you will have noticed that holes are provided in the bottom of the System Unit to provide further assurance that the disk drives do not get away. Don't use these holes, the official IBM assembly instructions contain an addendum that they are bad news. Probably warp the drives or the System Unit or both.

Now that the drive or drives are installed, the electrical work must be taken care of. Install the connector from the power supply. Either connector may be installed in either drive, just make sure that it is oriented as shown. Now connect the signal cable. These connectors are not interchangeable and must be installed exactly as shown in the diagram. If you are doing this you obviously have the controller board and hence should have the associated instruction manual. It is a good guide. Use it.

The final thing that must be done with the disk drive(s) is to take care of the termination and configuration. Termination is easy, just make sure that the terminator chip is plugged into drive A (the drives are shipped with this chip installed) and remove the chip in drive B. Configuration requires that you remove the jumper DIP from each drive and break six of the seven links as shown in Figure 2. The easiest way to do this is to turn the jumper DIP over, lay it on a hard surface and punch out the unwanted links with a jewelers screwdriver or similar small tool. Now, reinsert the DIP being very careful to get the remaining link in the proper position. To complete the installation set switch bank 1 as shown in the diagram. Replace the cover on the System Unit and run the diagnostic program following the instructions in the Guide to Operations.

The final complication has to do with your guarantee. If you bought all the recommended components new they are all individually guaranteed, but not by IBM. If you have problems it will be your responsibility to determine what component is in error and send that component to the proper place for service. If an IBM component needs service you must (per IBM) remove all non-IBM parts before sending the unit in for repair. If you are technically inclined the installation and warranty should not present a problem. If you are non-technical and do not have friends in the profession, you should consider the ramifications carefully prior to embarking on a project such as this. One of the reasons IBM charges the prices they do is to support their excellent service organization. If you put together a Personal Computer with components from various sources you must be prepared to do at least the diagnostic portion of the service yourself. In the near future, it seems reasonable to assume that independent service companies will be available to alleviate this problem.

If you discuss this article with an IBM Dealer he is likely to tell you that the IBM printer has certain power supply modifications and safety features that the EPSON does not possess. He is telling you the truth. The IBM Printer has a label on the bottom that warns you of high voltage inside and tells you to stay out unless you are an experienced technician (safety feature). Inside the printer there is a plastic cover over the high voltage portion of the power supply (power supply modification). This is to keep the experienced technician from hurting himself.
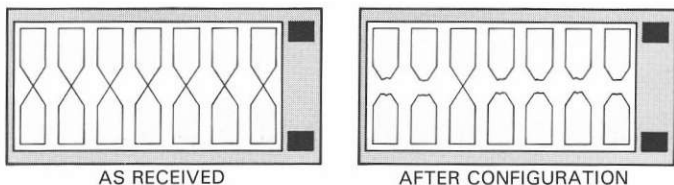
AS RECEIVED   AFTER CONFIGURATION

Figure 2. Jumper DIP

DISK DRIVE
MOUNTING SCREWS
⊗ 6-32 x 3/8'' (4)

B

JUMPER DIP

TERMINATOR
CHIP REMOVED

POWER SUPPLY
CONNECTOR

J2

SIGNAL
CABLE

POWER SUPPLY

A

JUMPER DIP

TERMINATOR
CHIP INSTALLED

POWER SUPPLY
CONNECTOR

J3

YELLOW

SW2

SW1

YELLOW

BLACK INDICATES
SWITCH TAB

BANK 3
BANK 2
BANK 1
BANK 0

J1

MEMORY
AREA

REMOVE TO WITHDRAW
CIRCUIT BOARD
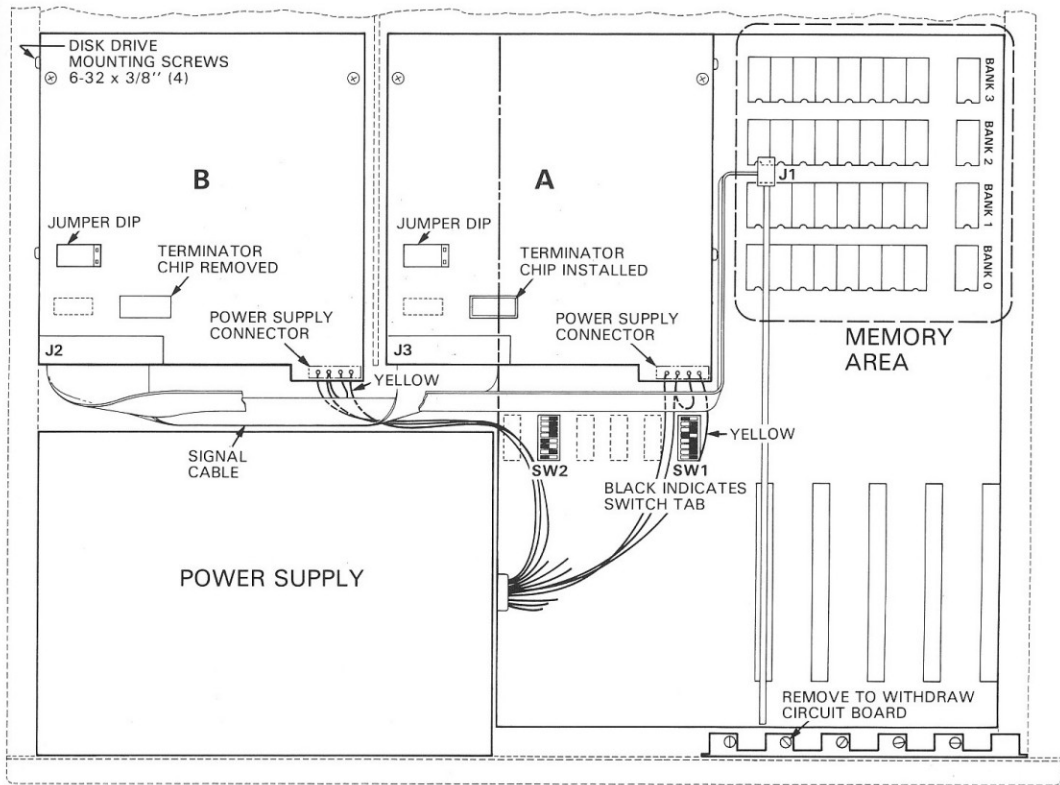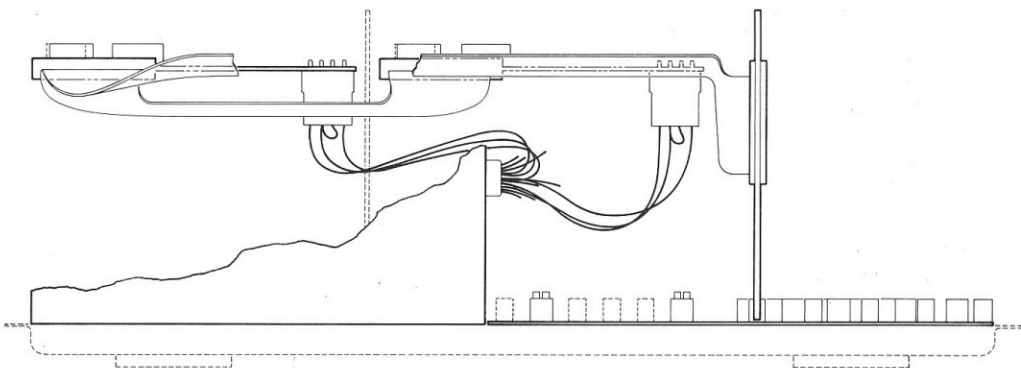
TOP VIEW

REAR VIEW
REAR PANEL AND ATTACHING
COMPONENTS REMOVED FOR CLARITY

Figure 1. System Unit

A TECHNICAL LOOK AT THE SYSTEM UNIT

Ron Reasoner

In this and the next several issues, we will present detailed descriptions of the software and hardware available for the IBM Personal Computer. This article describes the components comprising the heart of the machine — the System Unit. Future issues discuss each of the major elements identified here and expand their description to include complete hardware and programming details. Whenever possible, examples of routines demonstrating control of the peripheral components will be given.

Without accessories, two items comprise the IBM Personal Computer; a System Unit and a keyboard. The keyboard is connected to the System Unit via a six foot coiled cable.

The System Unit is a beige, steel enclosure that houses a 15" x 19" x 5" chassis. The system power supply and the main circuit board (this board is referred to as the System Board in the Technical Reference manual) are both mounted on the steel chassis. The power supply is a switching regulator and provides four output voltages with the following specifications:

Voltage (volts)	Current Capacity (amps)
5.0 ± 0.25	7.0
12.0 ± 0.6	2.0
- 5.0 ± 0.5	0.3
-12.0 ± 1.2	0.25

Figure 1 indicates the major features of the System Board. The significant components are:

1. Intel 8284 clock generator
2. Intel 8088 eight bit microprocessor (CPU)
3. Intel 8288 bus controller
4. 8259A programmable interrupt controller (PIC)
5. Intel 8237A-5 programmable direct memory access (DMA) controller
6. Intel 8253-5 programmable interval timer
7. Intel 8255A-5 programmable peripherial interface (PPI)
8. 8K System Function ROM (Bootstrap and BIOS)
9. 32K ROM BASIC
10. 16K bytes RAM
11. Five card expansion area
12. Keyboard logic
13. Speaker controls
14. Cassette recorder interface

Additionally, a socket is provided for the installation of an Intel 8087 numeric data processor.

CLOCK GENERATOR

The 8284A clock generator oscillates at a crystal controlled frequency of 14.31818 MHz. This frequency is exactly (and conveniently) four times the standard chrominance subcarrier frequency (3.579454 MHz) used in commercial television. In fact, the 14.31818 MHz is used on the optional Color/Graphics Monitor Adapter to generate 3.579454 MHz. A variable capacitor provided near the oscillator enables fine tuning and subsequently adjustment of the colors generated by the color board.

The 8284A also contains a divide by three and a divide by six circuit. The output of the divide by three circuit (4.77272 MHz) is the basic system clock, with a period of about 210 nanoseconds. The divide by six circuit (2.38636 MHz) is used by the 8253-5 programmable interval timer that will be described later. The phase of the 2.38636 MHz can be monitored via one port of the 8255A programmable peripheral interface.

CPU/NDP

The 8088 microprosessor presently offers the most computing power of all available eight bit microprocessors (see "Eight Bit Microcomputer Benchmark Test Review" in the February issue of this newsletter). The 8088 supports an eight bit data path and twenty bits of address (twenty address lines translate to 1,048,576 bytes, roughly one megabyte).

Although the Intel 8087 Numerics Data Processor (NDP) chip is not supplied with the Personal Computer (a forty pin socket is supplied for later installation), a few comments on number crunching are in order. The 8088 supports fixed point (integer) add, subtract, multiply, and divide. The 8087, however, supports floating point (up to 64 bit) add, subtract, multiply, divide, compare, square root, tangent, exponentiation, and data type moves (stores and loads). According to the manufacturer, the 8087 increases floating point number crunching speed by a factor of about 100 over the 8088. As of this writing the 8087 is not available in 100% functional form, but should (according to Intel) be available in the first quarter of 1982.
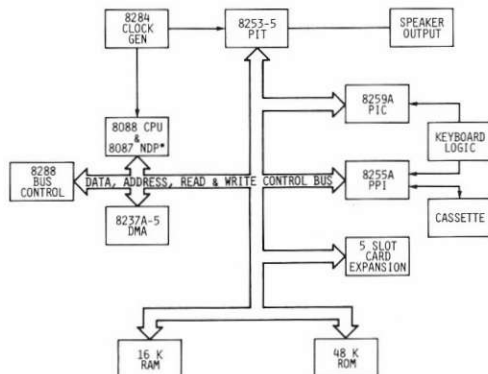
*8087 NOT INSTALLED ON SYSTEMS BOARD AS DELIVERED

Figure 1. System Board Features

BUS CONTROLLER

The 8088 is capable of operating in either a stand alone minimum mode (for small systems) or with an 8288 bus controller in a maximum mode. In the IBM Personal Computer, the maximum mode is utilized. Used in this manner, the 8288 decodes signals from the 8088 to generate the following system controls:

1. Memory read/write requests
2. I/O read/write requests
3. Address latching (address and data lines are time multiplexed in the 8088)
4. Data transfer direction control (since data input and output occur on the same eight lines of the 8088)
5. Interrupt acknowledgement to the 8259A programmable interrupt controller
6. System control arbitration with the 8237A-2 programmable direct memory access controller

A complete description of the System Board and card expansion timing (including dynamic RAM refreshing will be in the March, 1982 issue of Personal Computer Age.

PROGRAMMABLE INTERRUPT CONTROLLER

The 8259A programmable interrupt controller (PIC) enables the IBM Personal Computer to handle eight levels of software controllable interrupts. Two of the interrupt levels are dedicated to the System Board. Interrupt level 0 is tied to the 8253-5 programmable interval timer and provides a means of tracking time under software control. Interrupt level 1 is triggered when a byte of data has been transferred to an eight bit shift register from the keyboard. Interrupt levels 2 through 7 are not generated on the System Board, but are bussed through the five expansion card slots. The interrupt levels shown in the following table are reserved for specific cards and may be used in the expansion slots.

Interrupt Level	Card
7	Parallel printer adapter
6	5 ¼" Diskette drive adapter
4	Asynchronous Communications Adapter

PROGRAMMABLE INTERVAL TIMER

The 8253-5 programmable interval timer (PIT) contains three separate dividers programmable under software control. All three of the timers utilize a 1.19318 MHz signal derived by dividing the 2.38636 MHz signal by two. Channel 0 is used to trip interrupt level 0, thus providing time information to software. Further timing information is available by reading the state of the PIT counter in real time (between interrupts) to determine how many of the 1.19318 MHz pulses have occurred since the last level 0 interrupt.

Channel 1 of the PIT is initialized when power is turned on. The output of this channel is derived by dividing the input by 18. This results in a frequency of 66.28778 KHz (a period of 15,08618 microseconds). Each time this pulse occurs, a flip-flop is set that requests a data transfer via channel 0 of the 8237A-5 programmable direct memory ac-

cess controller. Each time the DMA is granted control of the system by a channel 0 DMA request, a channel 0 DMA acknowledge occurs. That forces the dynamic memory devices to refresh.

Channel 2 of the PIT can be used for two functions: generating musical tones to be output to the internal speaker, or generating data to be output to the cassette recorder. This signal can be read back on one of the 8255A-5 programmable peripheral interface ports.

PROGRAMMABLE DIRECT MEMORY ACCESS

The 8237A-5 programmable direct memory access (DMA) controller contains four independent channels that may be used to input or output data from blocks of memory. Channel 0 is reserved for refreshing the dynamic RAM devices. The other three channels not in use on the System Board are available at the five slot expansion card bus. If a 5 ¼" diskette drive adapter is inserted into an expansion slot it will use channel 2 of the DMA. DMA channels 1 and 3 are not used on any of the cards currently available from IBM.

The 8237A-5 contains all the functional elements required to support a 16 bit memory address. The additional 4 bits needed to generate a 20 bit DMA (to cover the range of the 8088 CPU) are provided by a 74LS670 integrated circuit (this is a 4 bit by 4 bit register file).

PROGRAMMABLE PERIPHERAL INTERFACE

The 8255A-5 programmable peripheral interface (PPI) contains 24 programmable I/O pins. These I/O pins are identified as PA0 through PA7, PB0 through PB7, and PC0 through PC7. Each of the twenty-four pins may be read or written under software control. Pin function depends upon the state of some of the other pins in the system, enabling the inputs to be multiplexed under software control. The signals associated with these pins are listed in the following table. Read implies an input from the 8255A-5 pins, and bits that are set will have been set by writing to the chip.

8255A-5 I/O Pin	Function
PA0 to PA7	If PB7 is low (0), read a byte from the keyboard
	If PB7 is high (1), read the system configuration switches on SW1
PB0	Enable channel 2 of the (PIT) if high (1)
PB1	Enable the speaker output when high (1)
PB2	If high, enable system configuration switches SW1 through SW4 at SW2 to be read at PC0 through PC3. If low, enable SW5 at SW2 to be read at PC0
PB3	If low (0), turn cassette motor on. Otherwise, turn cassette motor off.
PB4	If low (0), enable non-maskable interrupts if system board memory parity errors occur. If high, disable system board parity errors.
PB5	If low, enable non-maskable interrupts to occur if problems exist in the expansion card buss. If high, disable NMI due to expansion card problems.
PB6	If low (0), disable the keyboard clock, and hence the keyboard. If high, enable the keyboard clock.
PB7	If high, enable configuration switches at SW1 to be read at PA0 through PA7. If low, enable keyboard data to be read at PA0 through PA7, and also clear keyboard interrupts (level 1).
PC0 to PC3	If PB2 is low, read configuration switches SW1 through SW4 located at SW2. If PB2 is high, enable SW5 located at SW2 to be read at PC0.
PC4	Cassette input data
PC5	PIT channel 2 level
PC6	If PC6 is high, a non-maskable interrupt occurred due to an error in the expansion card buss.
PC7	If PC7 is high, a non-maskable interrupt occurred due to a parity error in the system board memory.

ROM

The 8K system function ROM resides between memory address FE000 and FFFFF. This block of code contains the routine used to control the major I/O devices in the System Unit and to provide a means of accessing system services. Parameters are transferred to and from the BIOS (basic I/O system) through the 8088 registers, and the actual calling of the specific function is done by triggering 8088 software interrupts. See the April issue for detailed information on using the ROM BIOS.

RAM

The System Board without memory expansion contains 16K bytes of dynamic RAM, and includes a ninth bit of storage for parity checking. The devices used are 16K by one bit, with a 250 nanosecond access time. Additionally, sockets are provided to increase the System Board Memory to 64K bytes in 16K byte increments.

KEYBOARD LOGIC

The keyboard logic area receives the signals from the keyboard by a five pin DIN type connector located at the rear of the System Unit. Eight bits of data are shifted into a register, after which an interrupt is generated. The data is then read through the PA0 through the PA7 bits of the 8255A-5 PPI. The keyboard, which contains an Intel 8048 eight bit microcomputer, will be discussed in a future article.

SPEAKER OUTPUT

Audio output is provided by a 2¼'' speaker mounted on the System Unit chassis. The speaker output circuit is capable of supplying about 0.5 watts of power. The output tones may be generated from either of the following sources: channel two of the 8253-5 PIT or the PB0 bit of the 8255A-5 PPI. Channel two of the PIT can be programmed to divide the 1.19 MHz by any number from 1 to 65536 (sixteen bit programmability). Furthermore, the PIT can be frequency modulated and gated off and on. The other source of audio (PPI) can be turned on and off rapidly to generate audio. In this mode, tones may be generated based on period, rather than frequency.

CASSETTE RECORDER INTERFACE

The System Board provides the hardware necessary to interface with a cassette recorder. The Personal Computer Technical Reference manual indicated that any "good quality audio cassette" is adequate.

The cassette connects to a five pin DIN connector located at the rear of the System Unit. A relay contact is provided that allows remote control of the cassette motor through the DIN connector. The output to the recorder is generated by channel two of the PIT chip. An attenuator is provided on the System Board to generate a level appropriate for either the microphone or the auxiliary input to the recorder (the level is selected by moving a jumper on the System Board). The recorder output is amplified and clipped, fed into pin PC4 of the 8255A-5 PPI, where it is monitored under software control. The cassette circuit features an output to the recorder that may be monitored by the recorder input to verify proper cassette recorder interface operation. However, this manuever may not be done while the recorder is operational.

The baud rate of the cassette recorder interface varies between 1000 baud and 2000 baud (125 to 250 bytes per second). The actual rate is data dependent since the bit duration is different for a logic 1 than for a logic 0. The ROM software, which may be used to drive the cassette interface, verifies data transfer integrity by generating and checking with a Cyclic Redundancy Check (CRC) algorithm.

ON THE CREATION AND MANIPULATION OF TEXT ...

Jack Crone

This space was originally designated for an objective review of EasyWriter - the lone entry in the word processing arena for the IBM Personal Computer. Instead, it will consist of a subjective and brief 'non-review' of EasyWriter followed by some rambling narrative about what I think is necessary to aid in the creation of the written word.

Perhaps you have already noticed that I am a bit annoyed. You're right, I am, and, since everyone at the office is tired of hearing me expound on this topic, I want to share my tale of woe and frustration with you.

The story began when we at PCA realized that the Personal Computer was destined to become one of the most significant computer products introduced in recent years. We really got excited! We wanted to be part of the revolution the machine was going to trigger. We wanted to use them, to play with them, to make money with them.

At last, the computer we dreamed about was here! Powerful enough to handle most jobs in a reasonable period of time yet simple enough so that anyone could learn how to use it, small enough to fit anywhere, attractive enough to be part of any decor and sufficiently inexpensive so any one could have one.

We are still excited about the Personal Computer. As a new machine it is entitled to have some problems, amazingly few exist. Its initial software support is far stronger than would normally be expected. The problem with the system is its lack of word processing software.

Oh, I know about EasyWriter. Let me tell you about EasyWriter. When we received our first machine in October, we were told about a bug in EasyWriter, and, to our chagrin, learned it would not be available for a couple of weeks. As luck would have it, the waiting time was closer to two months, quite a long wait for us since

we turn out a lot of text. The bottom line is that EasyWriter still has a lot of bugs. I can't imagine what it was like before it was 'fixed'.

At this point I could tell you what EasyWriter does and does not do according to the manual, or I could tell you what it really does (which is not always in agreement with the manual). I could tell you about its maddeningly slow operation (it allows you to type at about ten words a minute on long insertions). I could tell you what experienced WP users say after giving it a try, "I'll do without before I use this thing." I could tell you about the case of the disappearing text, or the system crashes that can be recovered only by rebooting (meanwhile losing all your work in the process).

I could discuss all these points at length, but I won't. Instead, in the interest of fair play, I am going to tell you that I have never used EasyWriter with another computer but I have read favorable reviews about this experience. It is entirely possible that in another environment EasyWriter is a good product. Where the Personal Computer is concerned, EasyWriter is simply not ready for release.

This appears to be IBM's only major mistake to date. The company should have selected a more powerful word processing package in the first place (this in no way casts stones at EasyWriter, the price is commensurate with the claimed performance). They then should have made sure that the software could be ready on schedule. When they knew the product was not ready for release, they should have held up production until the bugs had been worked out completely. Many people are likely to buy a Personal Computer for the primary purpose of word processing. If their experience is anything like mine they are likely to have bad feelings toward IBM and

the Personal Computer.

If and when EasyWriter gets sorted out Personal Computer Age will print an accurate and objective review written by someone who hopefully never used one of the early releases.

So far I have managed to do a very commendable job of biting my tongue (keyboard and anything else available), refraining from describing Easy(?)Writer with the litigation provoking terms I would prefer to use. So, let us move on to more cheerful subjects; namely the prospect of a good word processor for the Personal Computer.

I would have preferred to see IBM give their corporate blessing to a high powered, high priced (you get what you pay for), professional word processing package and leave the less sophisticated efforts to the independents for later introduction. Since it didn't happen that way the burden now falls on the entrepreneurial types to order a few more barrels of midnight oil and get a top notch progam on the market, preferably yesterday. Shouldn't take much urging to get this group moving. An extremely conservative estimate indicates at least 10,000 Personal Computer's will be sold this year to people who will purchase the best WP package available. At $500.00 each that's a five million dollar market for 1982 alone.

I have listed my personal preferences for a word processing package. My desires are simple: keep it small, keep the cost down, increase the reliability and get it on the market sooner. Some are the features I need and some are conveniences that would be nice.

First, the program should work with standard DOS ASCII files. This accomplishes two important things. From the programmers point of view it can greatly reduce the development time because it is not necessary to provide an editor. A powerful, sophisticated editor can require at least as much development effort as a comparable text formatting package. The present situation is this, we have a simple editor (EDLIN) and a simple word processor

(EasyWriter). The editor works, the word processor doesn't. Give us a good text formatter now and bring out your good editor later!

From the users point of view, standard ASCII files are advantageous. We can use the editor of our choice and then massage the text with the word processor we prefer. In the future, when several editors are available, I will probably use more than one in order to best match the capabilities of the editor to the requirements of the particular job. Finally, on the subject of standard files, if a product is introduced that, like EasyWriter, uses a non-standard file system, this product must provide utilities to convert standard files to its format and vice versa.

On the subject of simplicity (and the separation of editing and WP functions), I do not find it necessary to have an interactive word processor at all. Nice at times, but not necessary. I view a word processor as a very simple to operate utility that takes text that I have prepared on an editor (any editor) and sends the reformatted text to a printer, another disk file for later printing, or the console display for visual checking of the result. I need one interactive command, the ability to stop the process if the results coming out are not what I want.

The last comment implies that all WP commands should be embedded. There is good reason for this. If I produce a document such as a form letter that will get repeated use I want to be able to just run the program every time I want another copy. I do not want to have to enter margin, page numbering, printer, etc. commands for each run. An exception (not desired, but perhaps acceptable) would be to use DOS batch files for these commands. In the case of EasyWriter, the ⅔#$! thing doesn't run under DOS so I don't even have that option. For special or 'what if' situations, interactive commands that override the embedded commands would be a desirable option.

Batch files are a very desirable feature. For example, consider all the articles that will be written for this journal. I want to see all the rough drafts printed in a consistant format on the same printer. With a sophisticated WP program this could entail quite a few command lines at the beginning of each file, not an insurmountable problem, merely a nuisance. Instead, if I could put these commands in a common file capable of setting up all the parameters and printing the desired article(s) I would save time and perhaps eliminate the need to put embedded commands in the text files.

A good word processing program should be able to accomodate any printer and that includes taking advantage of any special features the printer might possess. Obviously the originators of the program cannot be aware of all the printers in existence, not to mention the ones that will be introduced in the future. Therefore the program must make provisions for the user to define the characteristics of any printer. This process should not require the services of an experienced systems programmer.

The actual parameters that the program can operate on should include:

Center
Footnotes
Indentation
Index
Justification
Line length
Lines per page, total & printed
Line spacing
Link to next file
Margins
Page eject
Page numbering
Paragraph
Print index
Printer commands
Printer pause
Skip lines
Special characters
Subtitle
Tabs
Title
Underline
User defined commands
Word count (display on screen)

This list is not all inclusive. But, if implemented with considerable flexibility and power for each listed parameter, should adequately serve the needs of most users. Finally, the ability to merge a document with a mailing list program and produce form letters is a very desirable feature. This particular feature could also be implemented as a separate program with no loss in flexibility.

With these remarks I rest my case. I would be very interested in obtaining your comments on this subject. Do you agree with me? Disagree? What do you need that I haven't mentioned? Write me with your comments. All correspondence of a shopping list nature will be distilled into a common data base of word processor features and will be made available to any requesting software house. Let's get some software written the way we users want it! Programmers take note, I am willing to provide any assistance I can if you want to tackle this project.

Next month I'll have a few comments on text editors.

FINDING DEBUG

Have you ever wondered how the term "debug" crept into the language of computers? While most computer jargon is acronymic or of mathematical origin, "debugging" had a modest beginning in 1944 at the U.S. Naval Bureau in Washington, D.C. The bureau was using the first electromechanical computer, the Mark I, when it ran into operating difficulties. The technicians looked over the many relays used to open and close circuits and found a moth caught in one of them. They removed the moth and jokingly recorded the incident in their log as a "debugging" of their system. Today the word has wormed its way into common usage to signify the discovery of a programming error or problem in the hardware.

THE LEGAL LOOK

Sheridan Foster

Are you in love with computers but can't for the life of you figure a way to afford one? Do you drive by computer stores on your way to work every day? Do you dream in living color about having a personal computer for your very own, but in reality can't justify the expenditure?

Well, you have come to the right source. I am going to tell you just how to afford the computer in those dreams--the IBM Personal Computer.

Many owners of small businesses do not know that owning a personal computer is not only a business necessity in this day and age, but a significant tax deduction as well.

The Federal Government has provided some incentives for your capital investment through the Economic Recovery Tax Act of 1981 (ERTA). As with all major tax reform packages, we will undoubtedly see technical corrections acts and other legislation to refine and define ERTA. However, an overview of portions of ERTA indicates positive ramifications for the personal computer purchaser.

The overriding purpose of ERTA is to provide investment stimulus essential for economic expansion. Spiraling inflation has reduced the real value of depreciation deductions to the business taxpayer and discourages replacement of equipment. This article discusses two provisions that intended to stimulate equipment purchase: restructuring of depreciation for a faster and complete write-off and providing a new capital cost recovery system through a complete cost write-off in one tax year.

ACCELERATED COST RECOVERY SYSTEM describes the new optional method of depreciation. Former law permitted allocation of the cost of an item over the period of time the piece of equipment was used to generate income, limited however by the salvage value of the equip-

ment. ERTA provides full cost recovery of an item otherwise subject to depreciation, without the salvage value limitation. The personal computer would fall into a 5-year cost recovery class, or possibly a 3-year class if it can be catagorized as research and development equipment. Under the 5-year cost recovery system, the first year of depreciation/cost recovery is 15% of cost; the second year, 22%; and 21% for each of the remaining three years.

This system of cost recovery is available for equipment purchased from 1981 through 1986. However, different annual cost percentages apply for 1985 and 1986 purchases.

The Accelerated Cost Recovery System may not be available to some businesses because of losses or other tax deductions. In that event, the business taxpayer may elect to use a method based upon a more conventional, but never-the-less altered straight line deduction. This election must include all equipment in that

class placed in service during that year and may not be revoked. However, different elections may be made for property in the same class, but purchased in different tax years.

The cost recovery system of depreciation may be used by those who lease personal computers. The IRS guidelines and various court decisions have clouded the issue of whether a transaction is a lease or just a method of financing equipment. ERTA attempts to narrow this controversy for purposes of cost recovery (and investment tax credits) by prescribing that the parties must elect to treat the lessor as the owner of the property. The lessee may not acquire ownership of the property at any time for the duration of the lease. The lessor must be a corporation, other than a Subchapter S or closely held one; other conditions state that the lease term cannot exceed the midpoint life of the property, the equipment must be new and lessor must have a minimum "at risk" investment of not less than 10%. As lessors will have advantages of accelerated cost recovery, lessees may likely reap benefits through reduced rental charges.

EXPENSING refers to a full write-off of the purchase price of the equipment during the year of purchase and is a major benefit conferred by ERTA for the personal computer buyer. In order to qualify for expensing, the equipment must be purchased for use in a trade of business and not for the sole purpose of generating income for the business; i.e., the computer must be used at least in part for the operation of the business itself. Up to $5,000 of such qualified property purchased in 1982 or 1983 may be deducted on that year's return. During 1984 and 1985, the first $7,500 of equipment purchased may be deducted; and after 1985, a $10,000 deduction applies.

Although no investment credit would be permitted for purchases where the taxpayer elects expensing, the benefit of the immediate write-off would usually be of greater benefit to the taxpayer, especially a small business owner.

Where the cost of the personal computer exceeds the yearly allowable expensing deduction, the amount over the permitted expensing would be subject to the accelerated cost recovery method of depreciation.

Partnerships and a controlled group of corporations (using a 50% control test) are treated as a single taxpayer for the purposes of utilizing expensing. A married couple filing separate returns would be limited to one-half of the annual expensing deduction on each of their returns.

Upon disposing of the equipment, any part of the cost that has been expensed is treated as a depreciation for the purpose of recapture rules. Therefore, any gain recognized upon disposition is treated as ordinary income to the amount expensed and depreciated.

Expensing would not be available to a lessor of the small computer, as the equipment must be used in actual operation of the business attempting to expense.

Between accelerated cost recovery and expensing, a business taxpayer is encouraged to replace obsolete equipment, thus making new investments. So you see, now is the time to get the personal computer you really want and realize short-term and immediate tax benefits.

WAIT A SECOND

As the operating speed of today's computers increases, the time necessary to perform calculations decreases. This requires the identification and labeling of smaller fractions of a second.

Millisecond = one-thousandth of a second (0.001)

Microsecond = one-millionth of a second (0.000001)

Nanosecond = one-billionth of a second (.000000001)

Picosecond = one-trillionth of a second (0.000000000001)

The Personal Computer can add two 16 bit numbers in 630 nanoseconds (register to register).

THE EDUCATED COMPUTER

Leigh Zeitz

With this issue we begin a monthly column on the use of computers in education. Although the emphasis is supposed to be on the IBM Personal Computer it is so new that its educational use in the classroom is extremely limited. I have decided therefore, to spend my first few columns investigating the impact computers have made on the classroom. If any of you have had experience with computers (especially the IBM Personal Computer) in your classroom, I am anxious to hear from you.

The main question educators and the public alike have pondered is Why? Why should we introduce computers into the classroom? Textbooks, blackboards, and teacher lectures have been effective for centuries. Perhaps we should ask a more significant question. How effective have the conventional methods of teaching been recently?

It may be true that our nation was built on one-room school houses and a minimum of educational frills but why is it that the nationwide test scores have been dropping consistently for the past two decades? The answer lies in the changing needs of our students. Unfortunately, the educational process hasn't kept up with this change. Computerized education may prove to be the teaching medium needed to succeed with the "New Age" student.

The most important reason for introducing computers into education is to prepare our students for the advanced world in which they live. Computers appear more frequently in daily life and the trend will continue. Trips to the bank and supermarket have become computer operations. Technology is changing the world so rapidly that by 1990 (eight years from now), anyone unable to use a computer may be considered functionally illiterate.

It is essential that our children learn to use computers at a young age. Not that third graders need to be computer programmers (although this goal has some merit too), but they must become acquainted with a computer through constant use, so they begin to think of it as a tool rather than a threat.

But how will computers change actual education in the classroom? They will increase classroom efficiency. They can remove much of the administrative and routine teaching work to free the teacher to do what he/she was trained to do—TEACH. Ask any teacher about the most tedious task in teaching and the answer will be paperwork. The attendance records, grade keeping, report cards and classroom inventories have always been time-consuming but necessary tasks. The recent increase in governmental aid and teacher ac-

countability has quadrupled the mounds of paperwork. The teacher is left less time for teaching.

Computers are able to take much of the burden off the shoulders of the teachers. Already there are numerous programs designed to help the teacher with attendance and record keeping. Considering the high rate of transient students today, a computerized rollbook which will present a daily alphabetical listing of students without having to be rewritten by hand is a wonder that only teachers can appreciate. The gradebook software will not only keep an accurate account of student grades but will also average the grades at semester's end. In some cases, the computer can actually print out the report card.

At the instructional level, a computer can provide an additional teacher/tutor. With class enrollments reaching 35-40 students, it is difficult for a single teacher to give any type of individualized instruction. CAI (Computer-Assisted Instruction) can tailor learning to each student's individual needs and allow him/her to learn at his/her own rate. It is a low-threat situation which is safe from ridicule by one's peers and comes complete with an eternally patient tutor which will give praise when earned and additional instruction when needed.

Computerized education will also provide a unique learning media. No other teaching media in the classroom today, aside from a living and breathing teacher or aide, provides the amount of interaction with a student and immediate reinforcement possible with a computer. Many times I've heard other teachers lament having to compete with television. Children are so used to the visual bombardment of television that to watch a teacher at a blackboard is, as they so often label it, "Boring!" Let's face it, with the

average child watching 6 hours of television a day, how can the classroom teacher rival the multi-million dollar productions seen on the boob tube. Educators need to try meeting their students on a middle ground. What's that old saying? If Mohammed won't come to the mountain,. . .

Educational television was promoted and utilized with reasonable success in the seventies. It definitely caught the students' interest but, due to the nature of the beast, it was only a one-way teaching medium with no interaction except the teacher-student discussion at the end of the presentation. Many educators tuned-out to this type of teaching because they saw it as only adding time to television viewing.

Computerized education provides the best of all worlds. It supplies the students with an electronic medium to stimulate interest and an interactive process to induce learning. It's like a book that talks back to you after you have read it to discover how much you have learned. And it can be used for everything from drilling addition facts to simulations of senate hearings to teach social studies. At present, the greatest use for computers in the classroom is drill and practice but this is not the extent of their capabilities. As software is developed, the computer's abilities to facilitate the learning of logic, creative thinking, and problem solving are being expanded.

How effective is computer teaching? Motivationally, computers are the greatest thing to happen to education since the invention of recess. Nationwide, classes that are using computers report a dramatic increase in attendance. This helps teachers provide a greater continuity in education and the school boosts greater ADA (state funding for the school for Average Daily Attendance). Educationally, 20-40% less learning time is needed when material is computerized, and retention of material has been shown to be equal to, if not greater than, that of the conventional method.

Will the computer ever replace the teacher? Unequivocably, NO! It may redefine the role of a teacher to the level for which he/she was trained. It is estimated that 70% of a teacher's day is spent in repetitious drill and practice teaching. Computerized education will free the teacher to spend time in social skills, problem solving, and creative work such as art and music. And even in the most complex teaching, whether it's using a textbook or a computer, a trained professional is necessary to manage the proper placement of each child and monitor that child's progress.

Finally I would like to state that IBM must be as aware of these pricing discrepancies as I am and now you are. IBM has expressed a desire to see independent venders support the Personal Computer. This is a very obvious invitation to participate.

Disk drives:
Tandon Corporation
20320 Prairie Street
Chatsworth, CA 91311
(213) 993-6644
Part number: TM100-1

Printer stand:
FMJ, Inc.
23520 Telo Ave.
Torrance, CA 90505
(213) 325-1900
Model: Printer Pal

Printer:
Epson America, Inc.
3415 Kashiwa Street
Torrance, CA 90505
(213) 539-9140
Model: MX-80

Memory chips:
NEC Microcomputers, Inc.
173 Worchester Street
Wellesley, MA 02181
(617) 237-1910
Part number: uPD416C-2

Advanced Micro Devices, Inc.
901 Thompson Place
Sunnyvale, CA 94086
Part number: Am9016DPC

Note: These are but two of the many semiconductor manufacturers that make this chip.

THE GENERATION GAP — BY JAN REASONER

WHAT'S THIS WORLD COMING TO?

YEAH, FIRST THE MINI.

THEN PERSONAL T.V. DISPLAYS, FUN AND GAMES

I HEARD THEY ARE EVEN STARTING TO TALK BACK

AND NOW THIS!

WHAT'S A COMPUTER, TO DO?
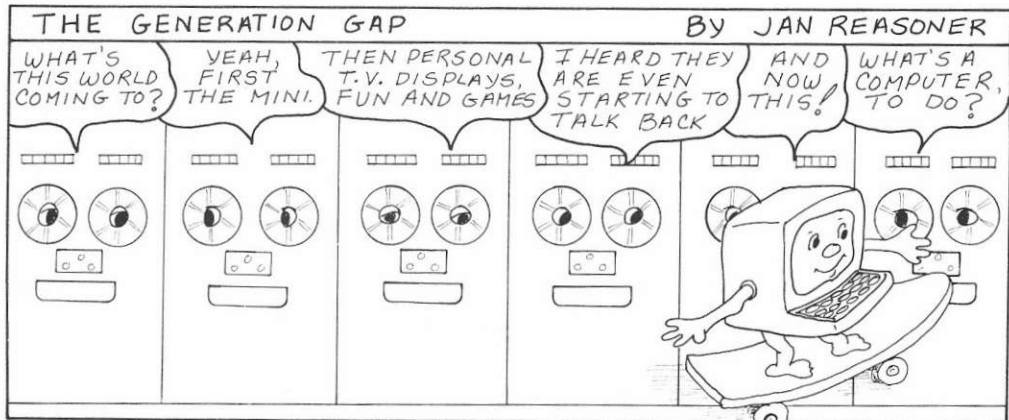
EDUCATIONAL SOFTWARE RELEASED

IBM has introduced four new software products as the debut of its Education Program Series. They include TYPING TUTOR, an interactive touch-typing instruction and drill program; FACT TRACK, a basic arithmetic skills builder; and ARITHMETIC GAMES (Set 1 and 2), a group of games. PCA has reviewed these products and is pleased to discover a high level of quality which we hope is indicative of future releases by IBM. These releases were developed by third-party sources, Microsoft developed TYPING TUTOR and Science Research Associates developed the other three.

After spending a few minutes with a demo disk of Microsoft's TYPING TUTOR, I realized that I had found an exciting alternative to those tedious hours spent in typing class long ago. Although Microsoft's uses an approach similar to the one used in schools for decades, the computer capability has made learning how to type enjoyable.

Instead of a typing book the computer displays a 9-character example for the student to copy. The cursor begins directly below the first letter of the example and guides the student while he types an identical string of letters underneath the example line. At the completion of the lesson the computer displays the number of errors and the rate of speed directly on the screen; i.e., 1 error at 35 words per minute. This immediate feedback makes typing a challenge rather than a drudgery. The added motivation provided should reduce learning time.

At the outset of the program the student is presented with three columns: Fast; Lesson Keys; and Slow. All of the letters are displayed in the Slow column. The letters which are being learned are in the Lesson Keys column. As the letters are mastered by the student (high accuracy at 30 wpm or better) they are transferred to the Fast column.

After ten lessons have been completed, a menu appears:

1. Continue Lesson
2. Build More Speed
3. Learn More Keys
4. Practice Paragraph
5. Typing Test
6. Progress Report

At this point that the student may change the direction of his lesson if he wishes. Chosing "Continue Lesson" results in the presentation of an additional ten lessons at the same level of difficulty. "Build More Speed" increases the speed necessary for a word to be considered mastered and listed in the "Fast" column. "Learn More Keys" increases the number of keys to be learned at one time. "Practice Paragraph" provides a paragraph for practicing the previously introduced keys. "Typing Test" introduces a teacher-written test paragraph. "Progress Report" provides a comprehensive overview of the student's work: Keys learned to date; Average number of words per minute; Average accuracy of typing; Average corrected speed; and Highest corrected speed to date.

An impressive characteristic of this program is its ability to handle the individual records for up to 39 students. The Teacher Mode allows a teacher to access these records at will for monitoring student progress. A secret password, known only to the teacher (hopefully), is needed to enter the Teacher Mode. Once entered, a teacher may display records, delete records of students are no longer using the program, and insert testing paragraphs.

There are two potential problems with Typing Tutor. The first one concerns format. The structure of the lessons requires the student to match the text by typing directly below each line of text. This doesn't develop the eye control needed when transcribing from printed copy. A more accurate format would be to split the screen vertically and display the test paragraph on the upper half while the typist's copy appears on the lower half. The second problem is in the determination of errors in the test paragraphs. If a student's copy fails to fall directly below the corresponding letters in the example because he has added or forgotten a letter, all of the letters that are out of correspondence are considered mistakes even if they are spelled correctly. This is a failure in the programming of the lessons and can be easily remedied.

Typing Tutor runs either on an IBM Personal Computer with one diskette drive, 48k bytes of user memory and the DOS or on a Personal Computer with a cassette recorder and 32k bytes of user memory. It is presently available for $25.

FACT TRACK will be reviewed in the February issue of Personal Computer Age.

SO YOU WANT TO BE A
ROCK AND ROLL STAR!

Ron Reasoner

Well, if you've got an IBM Personal Computer, you're on your way. Tone generation is included in the computer's hardware, and I'll give you a few lines of code (in cassette BASIC) so you can write the first gold record of 1982.

The Personal Computer can generate tones by either or both of the following methods. First, one of the bits in the programmable peripheral interface (PPI) can be toggled (on-off-on-off...). Alternatively, channel two of the programmable interval timer (PIT) can be set up to generate a fixed frequency. These two signals are gated together to create a frequency output to the 2¼" speaker.

If you're ambitious enough, you can dig up the device addresses and programming requirements for the PIT and PPI and generate music by moving ones and zeroes around in the hardware. Those of you who are lazy don't despair, the tones can be created by simple BASIC language instructions.

Two BASIC statements can be used to generate tones: SOUND and PLAY. The SOUND statement is available to systems with cassette, disk or advanced BASIC, while the PLAY statement is only available to systems with advanced BASIC. The SOUND statement, as you might expect, is somewhat less elegant that the PLAY statement. Here's the way it works.

SOUND (Cassette, disk, or advanced BASIC)

To use the SOUND statement, do this:

SOUND parameter 1,parameter 2

followed by a carriage return and line feed (cr/lf). Parameter 1 is the desired frequency in Hz, and must be in the range of 37 to 32767 Hz. Parameter 2 is the duration of the tone, given in the number of ticks of an internal clock (each tick is 55 milliseconds). Suppose, for example, you wanted 2000 Hz for 2 seconds, and 1000 Hz for 1.4 seconds. Parameter 1 is easy, since SOUND accepts the frequency in Hz. To get parameter 2 for 2 seconds, divide 2 seconds by 55 milliseconds (to get 36.4 ticks, rounded to 36). Likewise for 1.5 seconds, parameter 2 would be 1.5/0.55 = 27.3 ticks, or rounded off to 27. Then your program would look like:

```
10'
20'     Cassette Basic program demonstration of the
        SOUND statement
30'
40'     Generate 2000 Hz for 2 seconds, then 1000 Hz
        for 1.5 seconds
50'
60'
70'     SOUND 2000, 36      '2000 Hz for 36 ticks
80'     SOUND 1000, 27      '1000 Hz for 27 ticks
90'     END
```

PLAY (Advanced BASIC only)

The PLAY statement interprets a string expression. The string contains music information in what the IBM BASIC manual calls a "tune definition language". This enables the composer to write his tune in a pseudo-musical language. This command is formatted as follows: PLAY string variable. The string variable can contain any of the following strings:

String	PLAY interpretation
A thru G	Musical notes A,B,C,D,E,F,G
A# thru G#	Musical notes A#, B#, C#, D#, E#, F#, G#
A+ thru G+	Same as A# thru G#
A− thru G−	Musical notes Ab, Bb, Cb, Db, Eb, Fb, Gb
Ln	Set note length. L1 = whole, L4 = 1/4...L64 = 1/64
MF	Music foreground. Will not go on to next instruction until this note completed.
MB	Music Background. Generates a buffer of length 32 maximum which stores the notes to be played. The rest of the program can then be executed while background music is played from this buffer.
MN	Music normal. Actual duration of the notes will be 7/8 of that specified by the Ln string
ML	Music Legato. Each note will play the actual duration specified by the Ln string.
MS	Music staccato. Each note will last only 3/4 of the duration specified by the Ln string
Nn	This string is used to generate tones by the numbers. Of the 7 octave range (with 12 notes per octave), there are 84 notes. These can be specified numerically as N3N6N0. N0 means rest - one beat with no note.
On	Set the octave number. This is used in conjunction with the individual notes. There are 7 octaves, so this string can range from 00 to 06.
Pn	Pause. This generates a silent delay in the same manner Ln generates the length of notes (1, 1/2, 14,...,1/64).
Tn	Tempo. This enables you to change the number of quarter notes in one second from the default value of 120. The range is 32 to 255.

So you see, there is a lot of variety in the PLAY command. If you have a disk system and advanced BASIC available, you can write music in string serial fashion. Suppose you wanted to generate the following tune: a quarter note of A# above middle C, wait a whole note, then a half note of Dd two octaves above middle C. One possible string to do this would be: "L4O3A#P1L204D-". You read this as follows: set length of notes to ¼ - set octave number to 3 (octave 3 begins with middle C) - sound an A# - pause one whole note - set the octave number to 5 (2 above middle C) - sound a Db.

This is all well and good if you have advanced BASIC. But what about the ROM based cassette BASIC users? Well, I've dug up the actual frequency of the notes in chromatic scale and put them in a dimensioned BASIC array that enables you to use the SOUND statement to generate music with variables that look like the note you want to play. And, there are no restrictions on the number of octaves available (within the frequency range of the SOUND command). It's easier to enter your tune with this method than using either the SOUND or PLAY statement.

CASSETTE BASED MUSIC LANGUAGE (CBML)

Take a look at the accompanying listing. An entire octave is stored in a two dimensional array called FREQ (for frequency). All the sharps and flats are included, too. The rest of the program is dedicated to interpreting your input and converting it to the appropriate frequency and duration. All you have to do is learn CBML.

This program reads tunes from DATA statements which must be loaded into the program. The format for the music it will generate is note, duration, note, duration,...,note, duration,x. The x (either upper or lower case) indicates the end of the tune. Enter this after the last note you want to play.

Look again at the listing. An example of a "tune" is listed between lines 1620 and 1700 and between 1760 to 1840. This particular tune plays all the notes within the range of the SOUND statement, first in ascending order (using the sharps) and then in descending order (using the flats). Notes are created by writing the sequence, note, duration over and over, and the notes are defined by the following sequence: note attribute octave, where attribute is sharp or flat.

For example if you wanted to generate A sharp in octave 3, you would specify in your DATA statement:A#3 (the # is used for sharps). Similarly, if you wanted to generate G flat in octave 6, you would specify: Gb6 (lower case b is used to indicate flats). The duration of the note is specified by a number following the note (don't forget the comma separating the note and duration). A quarter note is specified by 4, an eighth note by 8, a sixteenth note by 16, and so on. An interesting outgrowth of this approach is that fifth, seventh, third, or any duration you want may be specified.

You might wish to know where these octave numbers are in relation to some known instrument. In this program, middle C on the piano occurs at octave 4 (this note would be C4). Octaves defined in CBML range from Ab

through G#, and over nine octaves may be ranged in your tune (good luck above octave 9 — my hearing goes out at about A9).

A comment of dynamic range of CBML is in order here. The SOUND statement only has a range of 37 Hz to 32767 Hz. Therefore, the lowest note you can play is D in octave 1, and the highest note you can play is B in octave 10. Also, if you enter a duration that is 0, you get an overflow (duration 0 means play this note forever).

If you want to insert spaces (soundless areas) to your tune, specify note H, with the usual duration. For example, a quarter note dead spot would be: H4.

There is one more feature in this program. In statement 1070, there is a variable called TEMPO which is set to 1. You can scale the speed at which the program will play by changing TEMPO. Making TEMPO larger slows the program down, making it smaller speeds it up. You can therefore modify the duration of all your notes with one program change.

MAKING YOUR OWN CBML SEED

I suggest that you enter the program as listed so that you get the comments and at least one set of notes that will run, then save it on a cassette or disk. After working with this program for a while, make another version without the DATA statements or comments. Now all you have to do is enter your notes as described, using DATA statements. Don't forget to use the x as the last note in your program.

AN EXAMPLE FROM SCRATCH

I happen to remember that the first four notes of "Yankee Doodle" are C,C,D,E all in quarter notes. In this example, I will insert a duration of 1/32 note between each note to give it what I think is a better sound. Since these notes are middle C and above, the notes will be in octave 4. Then with a duration of 4, we have:

DATA   C4,4,H,32,C4,4,H,32,D4,4,H,32,E4,4,x

and that's all there is to it.

Now, a few words about program length. As written, including comments and the original program (of about 210 notes), this program requires about 7284 bytes of RAM. The dimensioning of the variable tone in statement 1090 allows for up to 300 individual notes (including delays using H). If you want to increase the size of tune this program will handle, and you have sufficient RAM, simply increase the size of the array. For example, if you dimension TONE(500,2), you will have room in the array for 500 notes. Each increase in the size of the array requires 6 additional bytes, so if you have 1000 notes, your array would be 1000 notes long and would require 6000 bytes for the array alone. Knowing this and the size of your RAM, you can estimate the longest tune you can play.

Reference:

John Backus, The Acoustical Foundations of Music, W. W. Norton and Company, Inc., New York, 1969, pp 132-134.

```
1000 '
1010 '
1020 '
1030 '      MUSICAL INSTRUMENT IN ROM BASIC
1040 '
1050 '
1060 '
1070 CLS: KEY OFF: TEMPO = 1
1080 LOCATE 5,5: PRINT "CASSETE BASIC MUSIC GENERATOR"
1090 DIM FREQ(8,3),TONE(300,2)
1100 FREQ(1,1) = 27.5: FREQ(1,2) = 29.135: FREQ(1,3) = 25.957
1110 FREQ(2,1) = 30.868: FREQ(2,3) = 29.135
1120 FREQ(3,1) = 32.703: FREQ(3,2) = 34.648
1130 FREQ(4,1) = 36.708: FREQ(4,2) = 38.891: FREQ(4,3) = 34.648
1140 FREQ(5,1) = 41.203: FREQ(5,3) = 38.891
1150 FREQ(6,1) = 43.65401: FREQ(6,2) = 46.249
1160 FREQ(7,1) = 48.999: FREQ(7,2) = 51.913: FREQ(7,3) = 46.249
1170 FREQ(8,1) = 25000
1180 I = 0
1190 READ NOTE$: IF NOTE$ = "X"  THEN GOTO 1320
1200 IF NOTE$ = "x" THEN GOTO 1320
1210 READ DURATION$: IF DURATION$ = "X" THEN GOTO 1320
1220 IF NOTE$ = "x" THEN GOTO 1320
1230 M1 = ASC(LEFT$(NOTE$,1)) - 64
1240 M2 = 1: IF MID$(NOTE$,2,1) = "#" THEN M2 = 2
1250 IF MID$(NOTE$,2,1) = "b" THEN M2 = 3
1260 IF M2 > 1 THEN MM = 3 ELSE MM = 2
1270 M3 = VAL(MID$(NOTE$,MM))
1280 L = 18.2*TEMPO/(VAL(DURATION$))
1290 TONE(I,1) = FREQ(M1,M2)*EXP(M3*LOG(2)): TONE(I,2) = L
1300 I = I + 1: GOTO 1190
1310 TONE(J,1) = FREQ(M1,M2)*EXP(M3*LOG(2)): TONE(J,2) = L
1320 FOR J = 0 TO I -1  : SOUND TONE(J,1), TONE(J,2): NEXT J
1330 '
1340 '
1350 '      ENTER YOUR TUNE IN HERE AS A DATA STATEMENT
1360 '
1370 '      EXAMPLE:
1380 '            DATA  A9#,2,B6b,4,C3,6,X
1390 '
1400 '      THIS DATA STATEMENT WILL PLAT A# (NINTH OCTAVE) FOR 1/2 NOTE
1410 '      THEN A Bb (SIXTH OCTAVE) FOR A QUARTER NOTE THEN A C (THIRD
1420 '      OCTAVE) FOR AN EIGHT NOTE.  THE X IS USED TO TELL THE PROGRAM
1430 '      THE STRING ENDS.
1440 '
1450 '
1460 '            HAVE FUN !!!
1470 '
1480 '            INCLUDED BELOW IS THE RANGE OF NOTES FOR WHICH THE
1490 '            PROGRAM WILL FUNCTION.  ANY OTHER NOTES ARE OUT OF
1500 '            THE RANGE OF THE "SOUND  FREQUENCY, DURATION" STATEMENT.
1510 '
1520 '            THE ENTIRE RANGE IS SCALED FROM THE BOTTOM UP USING
1530 '            SHARPS, AND THEN FROM THE TOP DOWN USING FLATS.
1540 '
1550 '
1560 '
1570 '
1580 '
1590 '            FIRST, USING SHARPS AND ASCENDING SCALE
1600 '
1610 '
1620 DATA D1,4,D#1,4,E1,4,F1,4,F#1,4,G1,4,G#1,4,A2,4,A#2,4,B2,4,C2,4,C#2,4
1630 DATA D2,4,D#2,4,E2,4,F2,4,F#2,4,G2,4,G#2,4,A3,4,A#3,4,B3,4,C3,4,C#3,4
1640 DATA D3,4,D#3,4,E3,4,F3,4,F#3,4,G3,4,G#3,4,A4,4,A#4,4,B4,4,C4,4,C#4,4
1650 DATA D4,4,D#4,4,E4,4,F4,4,F#4,4,G4,4,G#4,4,A5,4,A#5,4,B5,4,C5,4,C#5,4
1660 DATA D5,4,D#5,4,E5,4,F5,4,F#5,4,G5,4,G#5,4,A6,4,A#6,4,B6,4,C6,4,C#6,4
1670 DATA D6,4,D#6,4,E6,4,F6,4,F#6,4,G6,4,G#6,4,A7,4,A#7,4,B7,4,C7,4,C#7,4
1680 DATA D7,4,D#7,4,E7,4,F7,4,F#7,4,G7,4,G#7,4,A8,4,A#8,4,B8,4,C8,4,C#8,4
1690 DATA D8,4,D#8,4,E8,4,F8,4,F#8,4,G8,4,G#8,4,A9,4,A#9,4,B9,4,C9,4,C#9,4
1700 DATA D9,4,D#9,4,E9,4,F9,4,F#9,4,G9,4,G#9,4,A10,4,A#10,4,B10,4
1710 '
1720 '
1730 '            SECOND, USING FLATS AND DESCENDING SCALE
1740 '
1750 '
1760 DATA Bb10,4,A10,4,Ab10,4,G9,4,Gb9,4,F9,4,E9,4,Eb9,4,D9,4,Db9,4,C9,4,B9,4
1770 DATA Bb9,4,A9,4,Ab9,4,G8,4,Gb8,4,F8,4,E8,4,Eb8,4,D8,4,Db8,4,C8,4,B8,4
1780 DATA Bb8,4,A8,4,Ab8,4,G7,4,Gb7,4,F7,4,E7,4,Eb7,4,D7,4,Db7,4,C7,4,B7,4
1790 DATA Bb7,4,A7,4,Ab7,4,G6,4,Gb6,4,F6,4,E6,4,Eb6,4,D6,4,Db6,4,C6,4,B6,4
1800 DATA Bb6,4,A6,4,Ab6,4,G5,4,Gb5,4,F5,4,E5,4,Eb5,4,D5,4,Db5,4,C5,4,B5,4
1810 DATA Bb5,4,A5,4,Ab5,4,G4,4,Gb4,4,F4,4,E4,4,Eb4,4,D4,4,Db4,4,C4,4,B4,4
1820 DATA Bb4,4,A4,4,Ab4,4,G3,4,Gb3,4,F3,4,E3,4,Eb3,4,D3,4,Db3,4,C3,4,B3,4
1830 DATA Bb3,4,A3,4,Ab3,4,G2,4,Gb2,4,F2,4,E2,4,Eb2,4,D2,4,Db2,4,C2,4,B2,4
1840 DATA Bb2,4,A2,4,Ab2,4,G1,4,Gb1,4,F1,4,E1,4,Eb1,4,D1,4,x
```

As a regular monthly feature Personal Computer Age will present a list of known or suspected problems with the Personal Computer and its associated software. In most cases we have personally observed the abnormality. In a few instances we have accepted an unconfirmed report from someone we consider to be an objective authority. In all cases we solicit reader feedback. If we are incorrect in a report let us know so we can set the record straight. If you have a solution for a problem, share it. And, of course, you are going to find new bugs on your own. Tell us about them, if we can confirm it we will print it. The first person to report a problem will get ten dollars for their trouble.

Editing in BASIC

This problem is not too well documented but has been observed on several occasions. There are two editing activities that seem to give trouble. To observe the first try editing several lines in a BASIC program but do not use the enter key. Then position the cursor in some obscure place on the right side of the screen where there are no program lines and press enter. All the corrections you made may go away.

The other problem involves long insertions that cause a displayed line to wrap on the screen. This can produce lines with two line numbers. Further editing will be then be required to sort things out.

Finally, we have gotten syntax errors when there was nothing observably incorrect with the line. Retyping the line solved the problem. Apparently an unprintable character had snuck in.

Is there recovery after parity error?

It appears that IBM has gone to the trouble of implementing parity in RAM and then providing no recovery from errors. Any parity error forces the system to display an error message and then hang. Rebooting is the only means of recovery which implies a loss of the data being protected! This topic will be discussed at length in a future issue.

Mismatched character sets.

The line drawing graphics characters on the CRT display do not match the block graphics characters on the printer. This is not a problem, per se, in that the differences are clearly pointed out in IBM publications. It is, however, a nuisance to produce a nice form on the screen, want a print of it, and get something out of the printer that looks like a childs building blocks.

Printer jams.

The matrix printer is very sensitive to binding in the paper path. Anything less than completely free feeding paper from the supply can cause the sprocket holes to tear out and all your printing to occur on one line. Places where the paper can bind include: (1.) The wire paper handler on top the printer being bent or misaligned. (2.) The signal cable from the computer contacting the paper. (3.) The stack of paper under the printer stand being too high.

Monochrome monitor display blooming.

If a very bright display (screen just about all green) is flashed on and off the display will grow and shrink in size, a phnomenon known as blooming. This condition could occur in some games. This is probably caused by poor high voltage regulation in the monitor

Hardware dependent software.

Certain software packages are sensitive to the I/O devices they are controlling. We have seen software refuse to function in a system with the Color/Graphics Adapter and work normally on a system with the Monochrome Display Adapter. We have also seen the reverse situation with other software packages. In both cases the software was intended to work with either display board. We have heard reports that Visicalc may not work with printers other than the IBM Matrix Printer. It is our understanding that these problems are being corrected, nonetheless, it would be advisable to try software on your configuration before committing to it.

Short cables.

If you have occasion to operate your Personal Computer with the Monochrome Display in other than its intended location on the System Unit, you will find the cables inconveniently short.

Power supply delay.

If the Personal Computer is powered up immediately after being turned off it will refuse to come to life. The power supply needs five seconds without power to regain its composure. this is documented in IBM literature but many users may not be aware of this idiosyncracy and may assume the system has malfunctioned when the power switch is used for rebooting (see the next anomaly).

Ctrl-Alt-Del = reset, usually.

Certain system crashes refuse to respond to this key combination requiring the use of the power switch to reboot the system. Be sure to leave the power off for at least five seconds.

BASIC files.

An attempt was made to SAVE a BASIC file with the /A (ASCII) format. An error message "too many files" was returned. This was a small program and the disk was nearly empty. Repeated tries returned the same result for that session. The problem was never observed again.

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If you represent a company, club or other organization that should be listed here we want to hear from you. Just give us the name, address, phone number and a brief description of what you are all about. We'll do the rest. There is no charge for this service.

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Dedicated to presenting sophisticated material in an easy-to-understand manner, these five editors provide expertise in computer technology and publishing with superior writing skill in each issue of PERSONAL COMPUTER AGE. They consistently combine editorial leadership with the highest caliber of coverage of IBM PC applications, configurations, programs and programming techniques.
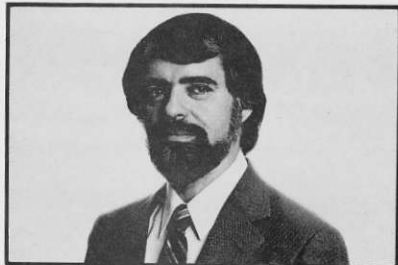
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ROBERT EMBRY Managing Editor

Bob has a B.A. degree in journalism and more than 10 years background in writing and publishing. Experienced as a technical writer/editor for a computer manufacturer as well as Jet Propulsion Laboratories, his skill provides PC AGE with outstanding editorial quality recognized throughout the industry. Bob's energetic administrative abilities coordinate the complex functions of magazine production.

MICHAEL DURR Associate Editor

Mike has a B.A. in business and technical communications and an M.A. in communications. In addition to technical articles, he has authored several textbooks, including one for IBM Corporation's Science Research Associates (SRA). Prior to joining PC AGE, Mike was an editor for Petersen Publishing. His expertise includes computer applications in editorial production and communications research.

PETE MOULTON Communications Editor

Pete has a B.S. in math and an M.A. in industrial management, and contributes over 14 years of experience in the computer field to the readers of PC AGE. As an independent consultant, he was a pioneer advocate of balanced computing in corporate environments. His expertise is strengthened by his continued consulting activities in data communications and personal computers. Pete is also in demand as a lecturer throughout the world on these subjects.

LEIGH ZEITZ Education Editor

Currently working on his masters in computer education/curriculum development, Leigh is an experienced journalist for both educational and microcomputer publications. He was recently appointed as the Coordinator of Computer Activities for a local Los Angeles school district. In this capacity, Leigh is able to combine his professional background in education with his dedication to computer literacy to promote effective and extended use of computers. He is also a popular speaker on the use of the IBM PC at various "hands-on" seminars.

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