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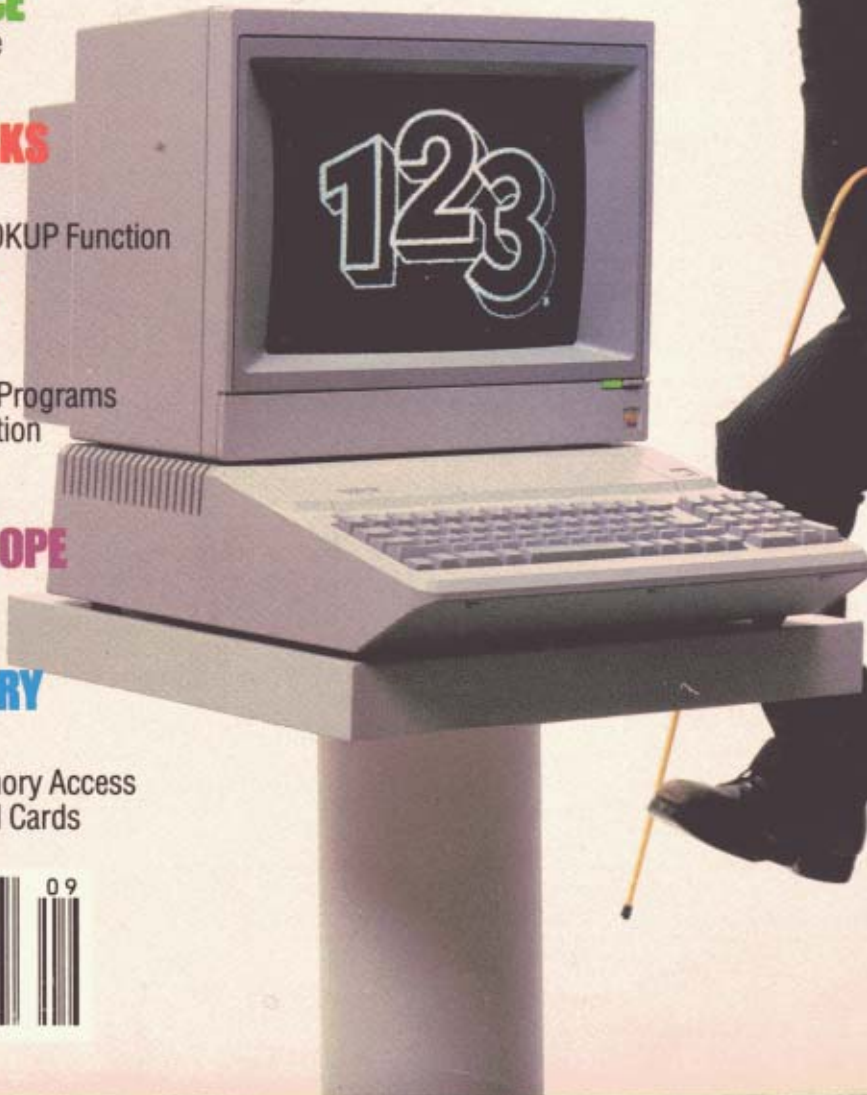
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PC Transporter

COVER STORY BY JOHN MARKOFF

An IBM-compatible coprocessor card that gives Apple II users the best of two worlds

Think of an alliance between the *Star Wars* antagonists Darth Vader and Obe Wan Kanobe. Admittedly an unlikely team, it has certain obvious advantages.

Apple Computer, Inc., and International Business Machines Corporation are the two great opposites of the personal-computer world, but a merger of the two also makes a great deal of sense. After all, the Apple II family of computers is the clear leader in educational software, whereas IBM dominates business markets.

Why not, then, have the best of both worlds? IBM compatibility can give Apple II owners access to the wealth of business software in the MS-DOS world.

Enter PC Transporter, an IBM-compatible coprocessor card from Applied Engineering. Designed by The Engineering Department, a Campbell, California, development group composed of key former Apple Computer engineers, PC Transporter (which was codenamed Little Blue) is a combination
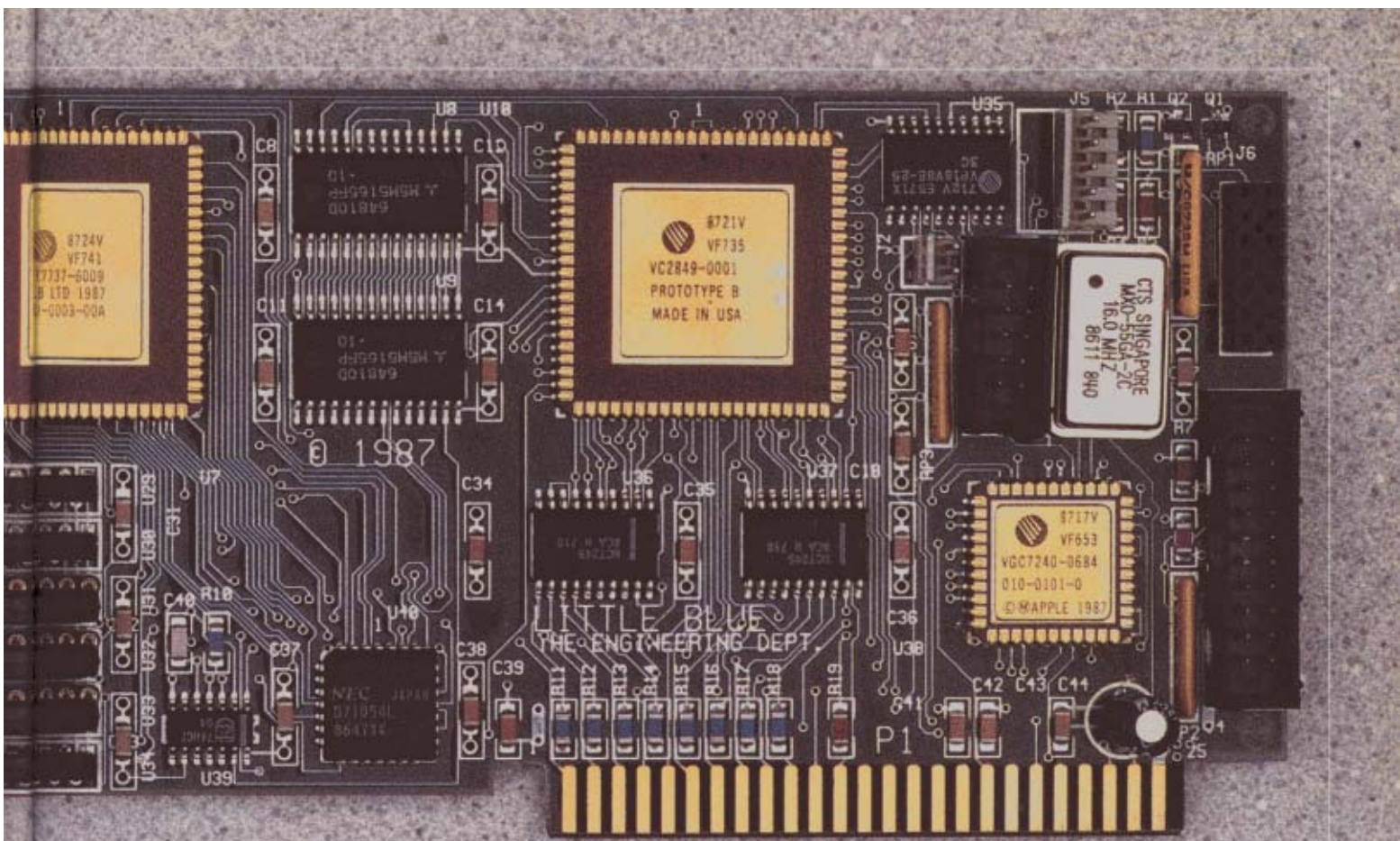
of hardware and software—including a set of utility programs—that adapts an Apple II Plus, IIe, or IIGS to the IBM PC and PC/XT world.

Plug PC Transporter into your Apple, and you have an inexpensive IBM-compatible computer that runs the major MS-DOS packages, as well as a large RAMdisk that increases the power of your Apple and a simple means of transferring program data between the IBM MS-DOS and Apple II ProDOS worlds.

Even better, an Apple II with PC Transporter runs faster than a standard IBM PC, in fact almost as fast as an IBM PC/AT. The Engineering Department has chosen a low-power-consuming, true 16-bit, CMOS, 7.2-MHz NEC V30, a chip that has more than twice the speed of the standard Intel 8088 microprocessor of the IBM PC.

I saw PC Transporter running the Norton Utilities benchmark program 3.5 times faster than a run-of-the-mill IBM PC with a 4.77-MHz Intel 8088 microprocessor. The faster processor speed,

An Apple II with PC Transporter runs faster than a standard IBM PC.

along with PC Transporter's 16-bit data bus (vs. the 8088's 8-bit bus), makes this speed possible. (Other benchmarks also show the speediness of PC Transporter. Watch for a complete performance review in an upcoming issue of *A+.*)

Besides speed, the PC Transporter has a range of other features:

The PC Transporter circuit board includes a socket for an Intel 8087 math coprocessor. The 8087 dramatically speeds operations such as recalculating spreadsheets.

Fully configured, the PC Transporter card offers a total of 768K of RAM that you can reconfigure as a RAMdisk when using PC Transporter while running Apple II software. This setup lets the Apple-Works 2.0 desktop, for instance, show 750K of work space.

With PC Transporter, you can easily translate documents between ProDOS and MS-DOS by using an MS-DOS conversion utility from The Engineering Department. It is even possible to use an Apple 3.5-inch disk drive, connected directly to the PC Transporter disk-drive port, to read from and write to specially formatted disks, which can then be directly transferred to the new breed of IBM-compatible portable computers, including the Toshiba T1100, Zenith 181, and NEC Multispeed. PC Transporter is also designed to be compatible with the 3.5-inch disk drives in IBM's new PS/2 series of computers.

Best of all, perhaps, PC Transporter allows you to retain your existing Apple II peripherals. You can use most Apple II monitors (both color and monochrome), printers, and hard-disk drives, rather than having to buy PC-compatible peripherals. To add MS-DOS compatibility, all you need is the PC Transporter package and a single floppy-disk drive that can read PC-formatted diskettes.

(You will also need an IBM-style keyboard if you have an Apple II Plus.)

Bringing together two computers as radically different as the Apple II and the IBM PC is a first-class engineering challenge. Although cloning the IBM PC is now common—hundreds of IBM-compatible models are on the market—obtaining the same functionality inside an Apple II requires a more sophisticated approach.

It also requires the expertise of engineers intimately acquainted with both Apple II and IBM hardware and software. The Engineering Department has drawn together the talents of a group of

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PC Transporter lets you retain your existing Apple II peripherals.

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veteran Apple engineers: Cliff Huston was one of Apple's earliest employees—he helped Steve Wozniak design the disk controller for the Apple II; his brother Dick joined Apple as its first full-time programmer and 25th employee and wrote the ProDOS operating system; Wendell Sander, chief Apple III designer, also designed the Integrated Woz Machine (IWM) chip; Bob Lashley designed modems and local-area networks at Apple; and Peter Quinn was the engineering project manager for the Apple IIe and IIc. It's an impressive group.

Silicon Valley is the best place in the world to undertake a project as complex as creating PC Transporter. Not only is it possible to find engineers who understand the fundamentals of PC design, but the most advanced semiconductor-design houses are here as well. The members of the Engineering Department team have taken circuitry that originally required dozens of separate off-the-shelf chips and squeezed it down so that it now fits comfortably on a single plug-in board (see "PC Transporter Gets Small," this page). The hardware they couldn't fit on the board they have imitated
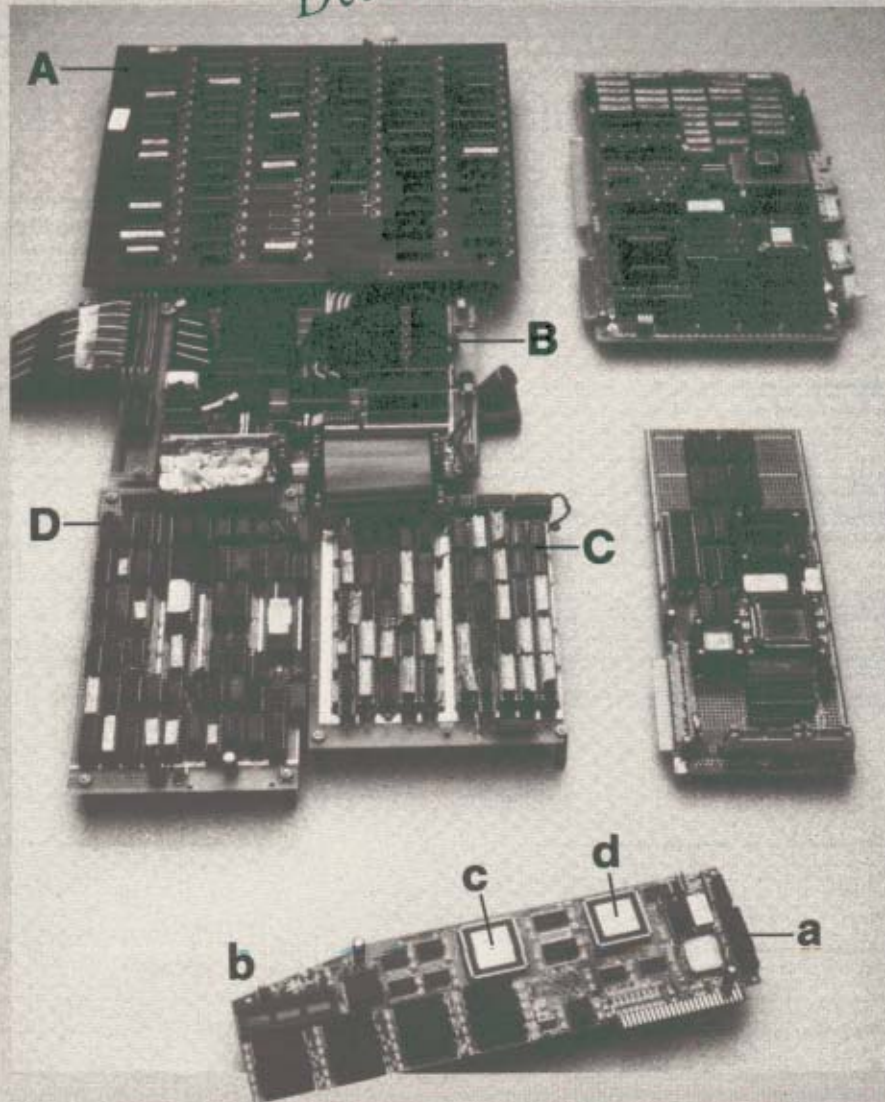
PC TRANSPORTER GETS SMALL

Like any other circuit board, PC Transporter started out large and got small. The photograph above shows PC Transporter in several stages of development, starting at the upper left and moving clockwise to the bottommost board—the finished product. On the left are four subboards (*A–D*) that were built in the late summer of '86 and linked together to form this early prototype. (The original prototype, not shown here, was built a year earlier to test the product concept.)

A is an early version of the disk controller, which has since been scaled down to the pint-size controller chip (*a*) on the finished board. *B* is the motherboard that contains the RAM, CPU, and math coprocessor, as well as the logic that buffers between the IBM and Apple worlds; it corresponds to *b* on the completed PC Transporter. *C* is the ancestor of the "glue" chip (*c*) that combines the miscellaneous circuitry from the two systems. And *D* is what eventually became the custom video chip (*d*).

In the upper right-hand corner is the first "wire-wrap" version of PC Transporter, meaning the first incarnation of the product in which all the various components reside on the same board. The Engineering Department came up with this board in early 1987.

Midway down the right-hand side is the next iteration of PC Transporter, which came into the world in the spring of this year. If you look closely, you'll notice that it has drastically fewer chips than does its immediate predecessor.

—*Lisa Raleigh*

in software that runs simultaneously on the Apple II's 6502 microprocessor.

To mimic the IBM PC, The Engineering Department has chosen to shrink most of that computer's functions onto three custom chips. First, a video chip allows PC Transporter to send IBM Color Graphics Adapter (CGA) graphics to either an Apple II monochrome or an analog RGB monitor, or directly to an IBM-compatible digital RGB monitor. (The IBM monochrome monitor doesn't work with PC Transporter.)

Second, a powerful, custom, single-chip disk controller includes the functions of the Apple IWM chip (used in the Apple IIe, IIGS, and Macintosh) plus the ability to read from and write to IBM-compatible drives. The disk-controller chip allows you to connect several

You can daisy-chain up to four drives off PC Transporter.

types of disk drives to PC Transporter. It is perhaps the most flexible personal-computer disk controller ever designed. You can daisy-chain up to four drives off PC Transporter—as many as two IBM drives and two IIGS-style 3.5-inch drives (officially called Apple 3.5 Drives). The older Apple UniDisk 3.5 drives can't be connected to PC Transporter. The IBM drives may be in either 5¼- or 3.5-inch format.

Finally, a third, custom, "glue" chip concentrates all the miscellaneous circuitry that normally requires several dozen chips on an IBM PC motherboard. All the custom chips are attached to the PC Transporter board via a technique called surface-mount technology. The advantage to surface-mount is that it creates very reliable products, but the downside is that if the products fail, they are quite costly to repair.

As impressive as PC Transporter's custom very-large-scale integrated-circuit (VLSI) hardware is, the secret of the coprocessor board is the role the Apple II 6502 microprocessor plays in emulating all the hardware ports that normally provide I/O for an IBM PC. While running MS-DOS software, the 6502 operates in the background under the ProDOS operating system.

Every time the PC Transporter coprocessor asks for data from one of its own ports, the 6502 supplies it. The Apple emulates the functions of standard IBM chips and devices such as the 8237A DMA controller, 8259A interrupt controller, 8255A PPI (keyboard, speaker, and switches), game control (through the Apple's game port), parallel interfaces (printers), asynchronous communications (modems), and a hard disk (as a ProDOS volume or file that appears as an MS-DOS volume to PC Transporter). Perhaps most impressive is PC Transporter's emulation of the NEC 765 disk controller; without this emulation, PC Transporter would have a tough time running copy-protected IBM software. A master control program running on the Apple II translates between PC Transporter and various Apple peripherals.

You as a user see only a maximum of 640K out of PC Transporter's total 768K of RAM, because PC Transporter uses the rest of memory for programs that help emulate a PC, as well as for the menu-driven software that helps you configure the system. For example, the Basic Input/Output System (BIOS) takes up 10K of memory, and an extension for the PC/XT fills another 10K. In a PC, the BIOS (a set of low-level software programs that mediate between application programs and the computer hard-

ADDRESSING THE DISK-DRIVE DILEMMA

When you buy PC Transporter, you must also acquire an IBM-style disk drive in order to run IBM software or to load IBM programs and transfer them to an Apple 3.5 drive. To make life easier for its PC Transporter customers, then, Applied Engineering is also selling IBM-compatible drives. These are not just off-the-shelf IBM-type disk drives; they are specially modified to work in an Apple/IBM setup.

The Applied Engineering drives come in a box that's the same size as that of the older Apple Disk II. You can get one or two half-height drives in a single box. The drives come with their own power supply, which relieves the Apple II power supply from the extra load, and also have a little circuit board built in that protects your Apple in case you shut it off but forget to turn the power off on the drives.

The most critical feature, though, is the arrangement of the cable connectors. A standard IBM-style drive comes with a 34-pin connector with which you're supposed to hook up the drive to the computer. Unfortu-

nately, that's not the right pin configuration to connect with PC Transporter, which was designed to let you connect either IBM-style or Apple GS-style drives to it. Thus, PC Transporter favors the Apple pin configuration and has a DB-19 (19-pin) connector for disk drives—and so does the disk-drive set from Applied Engineering.

The back of the drive box also has a DB-19 connector for daisy-chaining Apple 3.5 drives. The drives' internal circuitry has daisy-chain logic built in so that it knows how to handle up to four disk drives.

Of course, you can wire your own cables and connectors for hooking an IBM-type drive to PC Transporter, but you run the risk of blowing the disk-controller chip on the PC Transporter board if you get the wiring wrong. The price for all this equipment is not especially cheap: $239 for a one-drive box and $349 for two. If the functionality of PC Transporter appeals to you, though, the price is probably worth the headaches you'll avoid.

—*Lisa Raleigh*

ware) permanently resides in read-only memory (ROM). BIOS resides in RAM to save cost and enhance flexibility. Since you load it from disk, rather than burning it into ROM, the task of updating BIOS in the future is simplified.

Starting PC Transporter

To start PC Transporter, you must first load the ProDOS operating system and then run the PC Transporter program on the Apple from the same disk. The PC Transporter program initiates a sequence that begins with a simple series of menus for configuration (see below). Once you set up PC Transporter to match your system software, the special driver programs load into Apple II memory, and then the BIOS from the disk loads into PC Transporter's own RAM memory.

You configure PC Transporter by using a program that you can also access any time PC Transporter is running by holding down the Shift key and pressing Caps Lock twice. It is a ProDOS application running on the Apple II that lets you select items such as printers and printer interfaces, video displays, and communications equipment; set PC Transporter's ports to match standard ports on a PC; adjust settings similar to those set by switches in a PC; set memory configurations; and configure disk-drive arrangements. This "control panel" consists of menus that allow you to load specific drivers, which are ProDOS control programs that govern the devices attached to PC Transporter. Once you set up your configuration, you can save it to your boot disk, which PC Transporter subsequently reads every time you start it. There is also an auto-configure option.

The most challenging aspect of using PC Transporter may be the actual task of installing it in your Apple. Part of the task is straightforward. You can put the PC Transporter card into any of your Apple II's expansion slots (the higher-numbered the better), except the auxiliary slot on the IIe, the memory-expansion slot on the IIGS, or slot 0 on the II Plus. After you've installed the card, the more ardu-

ous task is connecting it to its life-support system through a series of cables and connectors. Separate cable kits are available for the Apple IIe and IIGS. (At press time, Applied Engineering said it would probably bundle these cables with the PC Transporter card as well as provide them separately.) You need an additional cable to connect a II Plus to an IBM-compatible keyboard.

For the IIe, the connections include a speaker connector and an optional keyboard connector that lets you add an IBM keyboard. If you don't opt for the latter, you must connect your IIe keyboard cable to the PC Transporter card. In

> *The engineering feat of PC Transporter's designers is impressive.*

addition, there's a composite video jumper that you need if you are using an Apple monochrome composite monitor, plus a 19-pin disk-drive port and an optional analog RGB connector port. The II Plus setup is similar, except that you must add an IBM-style keyboard to use PC Transporter because the II Plus keyboard doesn't have enough possible key combinations to simulate an IBM keyboard. With the IIGS, you don't need to worry about the keyboard, speaker, and video-jumper connections, but you must use a video converter that translates PC Transporter's digital video signal into analog for the IIGS's RGB monitor.

The Monitor

PC Transporter works with one out of three graphics-hardware devices that IBM PC-compatible computers use. Currently the most popular Personal Computer graphics standards are the monochrome text-only mode (Monochrome Display Adapter), high-resolution color (Enhanced Graphics Adapter), and low-resolution color (Color Graphics Adapter).

Although EGA is considered the optimal mode in the IBM world, PC Transporter uses CGA because it is a lowest common denomina-

tor. Still, it provides adequate resolution with a good monitor. If you have a standard Apple II composite monitor such as the Apple Monitor III or Monitor II, programs running on PC Transporter will appear in the Color Graphics Adapter mode. In this case, a simple gray scale is mapped onto the color output, meaning that you get a monochrome image.

You can also use PC Transporter with a PC-compatible digital RGB monitor. If you have an Apple RGB monitor, you can also use it, but you need a special converter to let PC Transporter work with an analog RGB monitor. If you have two video displays connected when you're using PC Transporter, you can switch back and forth between monitors.

Disk Drives

PC Transporter's design elegance is evident in the single-chip form of the disk controller, which normally takes up an entire expansion card in most PC-compatible computers. The engineering feat of PC Transporter's designers is particularly impressive because PC-compatible disk drives and Apple disk drives use two entirely different recording methods to store information on diskettes.

PC-compatibles employ a method called Modified Frequency Modulation (MFM), whereas Apple-compatible drives use a different technique called Group Code Recording (GCR). Another complication is that the ProDOS and MS-

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PC Transporter makes a great deal of sense for practical reasons.

DOS operating systems have very different internal structures. To surmount these obstacles, The Engineering Department had to design an extremely flexible disk controller.

As a result, you can simultaneously connect up to four floppy drives directly to PC Transporter: up to two PC-compatible 5¼- or 3.5-inch drives and up to two Apple "Unified" disk drives (meaning the "universal" drives that can work with both the IIGS and the Macintosh). Additionally, you can use a PC-compatible drive as a ProDOS volume when running in the Apple II mode and similarly use a 143K Apple 5¼-inch drive as an MS-DOS volume.

You can also transfer MS-DOS files from ProDOS in order to move data between the Apple II and PC worlds. A special MS-DOS utility program permits you to transfer MS-DOS files on disk drives connected to PC Transporter to and from ProDOS files. File formats are a limiting factor, but AS-CII (text) files are easy to transmit from one environment to another.

PC Transporter permits you to access an Apple-compatible hard-disk drive as a PC-formatted hard-

disk drive for use by PC-compatible programs. To do so, you first need to prepare the Apple disk by using a selection from the setup menu, which allows you to set aside space on the hard-disk drive, actually creating a special ProDOS file on the disk. To PC Transporter, the file looks like a hard-disk MS-DOS volume on which you can then format and store data. Disk performance is not comparable to the performance of the fastest hard-disk drives available for PC-compatible computers, but using this setup is significantly faster and more convenient than using floppy drives.

The Keyboard

If you have an Apple IIe or a IIGS, you can use the Apple keyboard and emulate a standard IBM PC keyboard through keystroke combinations. If you have an Apple II Plus, you will need an attached IBM PC-compatible keyboard. The PC Transporter card has a special port that can connect to a separate IBM-type keyboard. The problem, of course, lies in the fact that the Apple has fewer keys than the IBM PC. Consequently, PC Transporter interprets Apple key combinations as IBM keystrokes (such as the equivalent of function keys) by requiring you to press certain key combinations that are as easy to use as possible. The PC Transporter card has a jumper connection to the Apple II keyboard-controller chip. The jumper provides separate status for keys, such as the Control key, that are not reported as separate keys through the usual Apple software interface.

Having It Both Ways

PC Transporter is a new alternative for those who have been tempted by the IBM software "standard" but who feel their heart still remains with Apple. It also makes a great deal of sense for practical reasons. It's faster than a PC, it costs less than most clones, and it provides the convenience of easily moving data between the Apple II and IBM formats. Also, consider that buying another computer would take up more than twice the desk space.

When I saw PC Transporter ear-lier this year, it was still in prototype form, so I could not tell if it would be 100% compatible with the PC world. Its developers aim to make PC Transporter capable of running 99% of all programs written for the IBM PC class of computers, however. Watch for *A+*'s upcoming performance-and-compatibility review to see how well it measures up.   ✛

John Markoff has been an editor for both Byte *and* InfoWorld. *He is now a technology reporter for* The San Francisco Examiner.

An overview of operating systems

COVER STORY *BY CHARLES RUBIN*

Moving Over
to MS-DOS

O wning a PC Transporter board means having the ability to run MS-DOS software. You can bring Lotus 1-2-3 or Multimate files home from the office and run them with your Apple IIe or IIGS, or move your old CP/M files up to more advanced versions of WordStar or dBASE. But running MS-DOS software means dealing with the MS-DOS operating system, so let's take a look at what's in store for IIe or IIGS users running MS-DOS. First, we'll compare the features and feel of MS-DOS with other IIe and IIGS operating systems, and then we'll look at each operating system in ac-

tion. Little of your specific knowledge about Apple operating systems will carry over to MS-DOS, so be prepared to do some homework if you're new to MS-DOS.

DOS 3.3

DOS 3.3 is the last version of the original Apple Disk Operating System that debuted in 1978 with the Disk II floppy-disk drive. Originally designed to work with an Apple II with 16K of RAM, DOS is a compact and simple, yet fairly convenient, operating system. It provides direct access to up to 64K of memory, but it recognizes storage volumes up to only 143K in size. The small volumes force hard-disk users to create a series of phantom 143K volumes for data storage.

The major ease-of-use feature of DOS 3.3 comes from Apple's philosophy about how it distributes its operating systems. Apple supplies DOS 3.3 and ProDOS for free, so the operating system is included on the majority of Apple II program disks. You can simply insert the disk and turn on the computer, and the software boots automatically. (In contrast, CP/M and MS-DOS users must first load the DOS from a separate disk and then type the name of a program's start-up file to run it.)

B ecause of its original 16K memory constraints, DOS is largely a command-driven operating system. You use such commands as INIT, CATALOG, LOCK, and UNLOCK to work with files. The exceptions are the COPY, FID, and MUFFIN programs, which require loading from
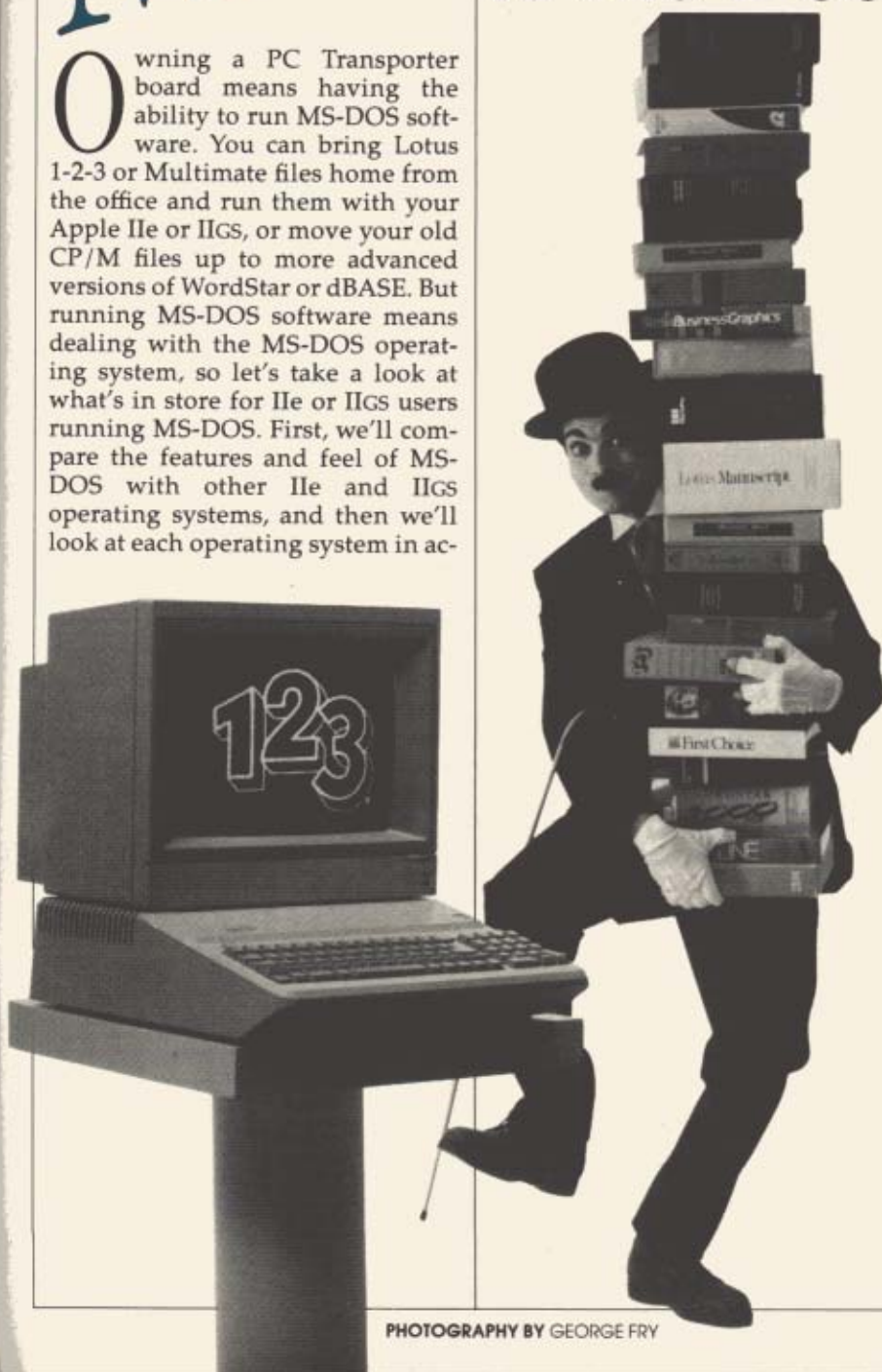
disk and offer menus that step you through the process of copying or converting disks or files. DOS 3.3 accepts filenames up to 30 characters long, which allows descriptive monikers.

DOS 3.3 lets you chain files together and monitor the output of a file on the screen as it is being written to disk. You can also create small programs that automatically enter a string of DOS commands, by using the EXEC command. You must manually tell your Apple to run such programs—they can't start themselves automatically.

CP/M

Although not available for the Apple II Plus until 1980, when Microsoft introduced the Softcard, CP/M is the oldest operating system in this group. It dates back to the mid-1970s and was the standard operating system for microcomputers used in business. By the time the Softcard had been out a couple of years, more CP/M users had Apple II, II Plus, and IIe machines than any other brand of computer.

Overall, CP/M is a more complex, more powerful operating system that is somewhat harder to learn than DOS 3.3. Users get little help from the CP/M manual, which is a classic example of poor documentation. CP/M recognizes up to 64K of memory directly and can work with storage volumes of up to 16 megabytes, so it is far better suited to systems with hard-disk drives than is DOS 3.3. Filenames can be only eight characters long, with a three-character extension. Instead of identifying storage devices as Drive 1 or 2 (as with DOS 3.3), CP/M uses A, B, C, and so on as drive specifiers.

CP/M was initially designed to fit into 4K of memory, so it is an entirely command-driven operating system that loads most of its functions from files on disk as you request them. To copy a file, for example, you type the name of the copy program, called PIP, on the CP/M disk, and PIP loads. You then use commands to tell PIP what to do.

Unlike DOS 3.3, CP/M has to be loaded into your computer first.

You then type the name of the start-up file for the program you want to run. You can copy the CP/M software onto the same disk as a program and then patch the boot track on the disk so the program automatically loads when you boot the disk, but doing so requires the use of the CP/M debugger—a feat beyond the capabilities or desires of many users.

Although it is more difficult to learn than DOS 3.3, CP/M is much more powerful. You can use passwords to protect files from unwanted access. You can date- and time-stamp files, and you can cre-

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CP/M is a more complex, more powerful operating system than DOS 3.3.

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ate files that automatically enter strings of CP/M commands, much as with the EXEC command in DOS 3.3. Because CP/M loads many of its utility programs from disk, those utilities tend to be much more powerful than similar functions under DOS 3.3. CP/M also comes with a line editor, a debugger, and a macro assembler, whereas DOS 3.3 doesn't.

ProDOS 8 and ProDOS 16

ProDOS, later called ProDOS 8, made its debut in March 1984. ProDOS 16 appeared in September 1986, with the introduction of the Apple IIGS. ProDOS is six times faster at loading and saving files than is DOS 3.3. ProDOS 8 recognizes only 64K of RAM, but it can work with storage devices of up to 32 megabytes. ProDOS 16 can recognize up to 16 megabytes of RAM and works with the AppleTalk network but is otherwise similar to ProDOS 8.

Like DOS 3.3, ProDOS comes on every program disk, so programs load automatically when you boot the disk. It allows filenames up to 15 characters long. Unlike DOS 3.3 and CP/M, ProDOS uses a hierarchical filing system that lets you create subdirectories to better organize files on hard-disk or high-capacity floppy-disk drives. ProDOS uses pathnames to track locations of files. These pathnames can in-

clude directory and subdirectory names as well as filenames. The advantage to pathnames is that ProDOS can find a file you specify, no matter which disk drive it resides on. ProDOS recognizes disks or hard-disk volumes by names you assign them, but you can also refer to floppy disks by the number of the disk drive they occupy.

ProDOS was designed for systems with a minimum of 64K of RAM, and its relatively large size makes it an extremely easy operating system to learn. You select most of its commands from a series of menus, and you receive prompts for each step of each command. Many fail-safe messages warn you when you are about to format a hard disk or if you are about to erase existing files on a diskette when you format it.

As far as power is concerned, ProDOS goes beyond CP/M with its hierarchical filing system but is otherwise somewhere between CP/M and DOS 3.3. ProDOS surveys the slots in your Apple II Plus, IIe, or IIGS and determines what types of interface cards or other devices are present. It time- and date-stamps files in its disk directories. It automatically loads files with the suffix .SYS, so if you're using a hard-disk drive, you can easily rename a certain program on the disk with the .SYS suffix so it automatically loads when you boot from a disk. Other than with the .SYS suffix, however, you can't create files directly with ProDOS that automatically execute commands.

MS-DOS

MS-DOS began life as a knock-off of CP/M that was designed to fit into 40K of RAM. Current versions of MS-DOS occupy about 55K. MS-DOS recognizes up to 640K of RAM and can work with storage devices of up to 32 megabytes. The commands and operating style of MS-DOS were deliberately designed to be familiar to CP/M users, to simplify migration from CP/M to MS-DOS. It is therefore an exclusively command-driven system: not much for ease of use but very powerful. Like CP/M, MS-DOS is sold to developers for a fee, so all MS-DOS programs must

be loaded separately after you've loaded the operating system itself.

Like ProDOS, MS-DOS uses a hierarchical filing system that lets you use subdirectories to organize files on a disk. It uses A, B, C, and so on as disk-drive specifiers. It time- and date-stamps files, and it lets you create batch files that automatically execute a series of DOS

> *MS-DOS makes no advances over CP/M in ease of use.*

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commands. You can set batch files to run an application program automatically when you boot a disk, and the batch files can respond to user input and perform many other marvels. MS-DOS also has a built-in line editor and debugger.

Overall, MS-DOS gives you much more control over your computer system and peripherals, but it makes no advances whatever over CP/M in ease of use. You can easily erase the contents of a hard disk with one command, and MS-DOS won't warn you. MS-DOS presents error messages when you do something wrong, but it does little to explain what you've done wrong.

I could go into much more detail about features of these operating systems, but a quick way to get a better feel for them is to compare how they act in the real world. Formatting a disk, copying a disk, and copying a file are three tasks that almost every computer user has to perform from time to time.

Formatting a Disk

DOS 3.3—Type INIT HELLO, Volume, Slot, Drive. To initialize a diskette in disk drive 1, for example, you type INIT HELLO V254, S6, D2 (the V254 is optional).

CP/M—Type FORMAT Drive Specifier. To format a disk in drive A, for example, you type FORMAT A:. Next, the formatting program loads from disk and prompts you to insert a blank diskette into the appropriate drive. Once you've done that, you press the Return key. Each CP/M system has a slightly

BY GARY LITTLE

OPERATING-SYSTEM COMMAND COMPARISON

Here's a quick cheat-sheet of operating-system commands for MS-DOS, ProDOS, Apple DOS 3.3, and CP/M. You'll notice that to perform certain operations in ProDOS, you must go into the FILER utility program, whereas in MS-DOS you simply type in the command at the system prompt. Similarly, you must use the FID and COPYA program in Apple DOS 3.3 to perform the equivalent of certain MS-DOS commands. Some commands have no equivalents in other operating systems. Some MS-DOS commands are loaded into memory from disk when you enter the command. A command that the computer loads into memory from disk when you issue it is known as a transient command, because it is deleted from the computer's memory after you finish using it.

Command Description	Microsoft MS-DOS[1]	Apple ProDOS	Apple DOS 3.3	CP/M
Changes the active directory	CHDIR	PREFIX	(2)	USER[3]
Checks disk and reports status	CHKDSK	Use FILER	Use FID	STAT
Compares two files	COMP	Use FILER	(4)	(4)
Copies a file	COPY	Use FILER	Use FID	PIP
Displays/changes the date	DATE	(8)	(5)	(5)
Lists filenames in a directory	DIR	CATALOG	CATALOG	DIR
Copies a disk	DISKCOPY	Use FILER	Use COPYA	PIP
Deletes a file	ERASE	DELETE	DELETE	ERA
Formats a disk	FORMAT	Use FILER	INIT	FORMAT
Renames a disk volume	LABEL	RENAME	(7)	(7)
Creates a disk directory	MKDIR	CREATE	(2)	(3)
Renames a file	RENAME	RENAME	RENAME	REN
Removes a disk directory	RMDIR	DELETE	(2)	(3)
Displays/changes the time	TIME	(8)	(5)	(5)
Displays contents of a text file	TYPE	(6)	(4)	TYPE
Verifies integrity of a file	VERIFY	VERIFY	VERIFY	(4)

1. Versions 2.0 or higher
2. Apple DOS 3.3 does not have commands such as CHDIR, MKDIR, and RMDIR because it uses only one directory.
3. CP/M has multiple user areas within a single directory. It does not have a hierarchical directory structure like that of MS-DOS or ProDOS.
4. No standard command
5. Apple DOS 3.3 and CP/M do not time- and date-stamp files.
6. It is possible to add a TYPE command to ProDOS when Applesoft is active. See "A TYPE Command for ProDOS," *Softalk*, June 1984, pp. 157–165, and "Adding a TYPE Command to ProDOS,"

Call-A.P.P.L.E., May 1984, pp. 42–49.
7. Apple DOS 3.3 and CP/M do not use volume names.
8. ProDOS does time- and date-stamp files, but it has no standard commands for setting the time and date.

different formatting procedure, so the foregoing may not be the exact commands on your system.

ProDOS 8/16—Type V (Volume Commands) from the Main Menu; choose F (Format a Volume) from the Volume Commands menu, type the slot and drive numbers or accept the defaults; then type the volume name or accept the default.

MS-DOS—Type FORMAT Drive Specifier. To format a disk in drive A, for example, you type FORMAT A:, just as you would with CP/M.

Copying a Disk

DOS 3.3—Type RUN COPYA; then type the slot and drive numbers or accept defaults by pressing the Return key. DOS 3.3 automatically formats the destination disk before copying onto it. It can automatically overwrite any existing information on the destination disk without warning.

CP/M—Type PIP B:=A: * . *. You must format the destination disk before issuing the PIP command.

ProDOS 8/16—Type V (Volume Commands) at the Main Menu, type C (Copy a Volume) from the Volume Commands Menu, type the slot and drive numbers or accept the defaults by pressing the Return key, and then type the new volume name or accept the default by pressing the Return key. ProDOS automatically formats the destination disk and warns you if the destination disk isn't blank. You can then choose to format it or use another disk.

MS-DOS—Type Diskcopy A: B:.

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You must format the destination diskette with a separate FORMAT command before copying.

File Copying

DOS 3.3—Type BRUN FID to load FID, type 1 to choose Copy files, type the source and destination slot and drive numbers or accept the defaults, and then type the source file name. You can use wild cards to copy several files or all the files on a disk. DOS 3.3 warns you if a file with the source name already exists on the destination disk and asks if you want to replace it or use a new filename.

> *You won't have to worry about translating from one disk format to another.*

CP/M—Type PIP B:=A:Filename. This command replaces any existing file with the same name without warning.

ProDOS 8/16—Type F (File Commands) from the main menu, Type C (Copy Files) from the File Commands menu, and then type the source and destination pathnames. You can use wild cards to copy more than one file or have ProDOS stop and ask if you want to copy each file on a disk as you come to it. ProDOS also tells you if a file already exists on the destination disk and lets you rename it or replace it.

MS-DOS—Type Copy Filename Drive Specifier. To copy the file Letter from drive A to drive B, for example, you type COPY Letter B:.

As you can see, CP/M and MS-DOS have much more economical commands, whereas the Apple operating systems offer more help and safeguards for users. If you know all the commands for MS-DOS, you can probably perform operations with it much faster than with ProDOS or DOS 3.3 (which require you to step through menus), but learning MS-DOS commands is much harder in the first place.

Moving Files into MS-DOS

One of the key issues for would-be users of PC Transporter is whether you can transfer files from your older Apple II Plus or IIe programs and other operating systems into the MS-DOS world. We have two separate issues here: file formats and disk formats. The file format is the specific recording method each program uses to store files. AppleWorks files have a different format from Apple Writer files, for example. The disk format is the way disk files are identified and organized on a disk under different operating systems; ProDOS, DOS 3.3, CP/M, and MS-DOS all use different disk formats.

Fortunately, PC Transporter has a built-in, "transparent" utility that automatically translates Pro-DOS disk formats into MS-DOS disk formats. (ProDOS itself has a utility to translate files or disks with the DOS 3.3 format into the ProDOS format, and third-party utilities already exist for translating CP/M-format disks into MS-DOS-format disks.) With a utility like this, you won't have to worry about translating from one disk format to another, and you can move files from one operating system to another by using standard file formats such as ASCII or DIF.

In the absence of such a utility, moving files from one operating system to another is a little more complex. If you are transferring from CP/M to MS-DOS, you can use one of the existing third-party utilities for translating disk formats. Once you have a CP/M file in the MS-DOS format, then you can either load it directly with some programs (such as WordStar, dBASE II, or SuperCalc), or you can use the ASCII or DIF file formats to move files between programs.

Eventually, Applied Engineering or some other developer will probably offer software that does specific file-format translations between popular programs such as AppleWorks and Lotus 1-2-3. When that day arrives, you can skip the step of fussing with ASCII and DIF file formats to move data between your Apple II and MS-DOS.   ✦

Contributing Editor Charles Rubin is the author of five books about personal computing, the latest of which is Mi-crosoft Works from Microsoft Press.