A Winchester For The '89

Part One

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

Introduction

The most striking difference between an 8-bit computer and a 16-bit upstart is the speed with which the 16-bit computer can manipulate data. Having a lot of extra available memory helps, but it is the overall increase in user productivity that counts in any kind of comparison.

In the last two years, a number of important enhancements have appeared on the market that have eliminated the 64k memory restrictions of the H/Z-89. There is the 128k Silent Disk and Printer Spooler from FBE Research Co.; SPOOLDISK 89, the 256k Hi-Res Interactive Graphics Controller from SigmaSoft & Systems; the new 1MB SUPER RAM 89 from C.D.R. Systems; and the 768k-8086 CPU coprocessor from Hallock Systems Co. In combination with the '89s own memory, I now have 2MB of RAM available on this old war horse. By using these various devices as separate units, I can have MS-DOS, CP/M and HDOS files on line at any given time. The chief benefit is that I can load a large number of files into SPOOLDISK 89 and the Interactive Graphics Controller, instruct each to output data to their respective printers, reset the computer and go to work on other things.

My '89 is primarily used for word processing, and I frequently have several articles in various stages of completion, resident in the memory banks of my several peripheral boards. When I seem to run out of steam on one piece, or encounter a technical point that requires referencing, I can toggle back and forth between the articles in progress without switching disks, until it is time to call it a day and save the files.

But after watching the rapid on-screen text manipulation with one of my "silent ram disks" occur faster than the blinking of an eye, the interminable length of time it took to save a 30k byte article to my floppy disks made me impatient. The solution appeared to lie in the acquisition of a Winchester hard disk subsystem to give old Harold (my '89) a helpful boost.

Not too many years ago, the cost of a Winchester was equivalent to a King's Ransom from the viewpoint of many of us dyed-in-the-wool computer hobbyists. But the prices have been dropping steadily to a point where a hard disk subsystem has become an affordable acquisition. A 10MB subsystem can be purchased for around $1,000; a 15MB for under $1,500; and a whopping 33MB unit for $2,000.

Was it worth plunking down another $1,000 to keep old Harold zipping along like his 16-bit cousins? Or was it time to go for broke and buy a new system, tons of software and spend nonproductive months relearning the basics without any guarantee that I could transfer years of accumulated files? I wasn't really convinced that I had to trade up to a faster, sleeker machine every couple of years. Besides, I hadn't even gotten around to giving a lot of my expensive software a decent workout.

When contemplating a major computer purchase, follow Rule #1 — Ask the man who owns one. Then proceed to Rule #2 — Read every critical review you can find about the equipment.

I was able to test out Rule #1 at the college where I work. The Winchesters installed on several IBM-XT's were like whirling dervishes in a desert sandstorm. But locating product evaluations on any H/Z-89 Winchester subsystem in either REMark or SEXTANT was a futile endeavor. In fact, very little has been written about Winchester systems, in general, in any computer magazine, and I plow through at least two dozen every month.

In an attempt to correct this void, I would like to welcome all readers to the start of a new series in REMark called WINCHESTER/'89, in which I hope to enlighten you (and me) about a fascinating segment of computer technology. Having achieved a small measure of credibility with my occasional articles in REMark, I succeeded in persuading several major Heath/Zenith support firms to provide me with a desktop full of equipment and software to play with. In a spirit of cooperation, none made me swear that I would not abscond with the goods on a midnight plane to Tangiers, or imposed any conditions about how I should write about their hardware.

This introductory article will present an overview of Winchester technology and how floppy disks and hard disks compare to one another. The confusing mumbo-jumbo about the technology will be incorporated into future articles.

The second article in this series will be devoted to a discussion of the SASI and CORVUS interface cards designed by Magnolia Microsystems of Seattle, WA. Magnolia was one of the earliest manufacturers of Heath/Zenith related hardware, most of which

is quite unique, but usable for the most part only with their implementation of CP/M. Their Winchester host adaptor cards have become an industry standard, and as of this writing, every hard disk system available for the '89 uses a Magnolia interface card, because Heath's Z-89-67 was discontinued quite some time ago.

In article number three, we will evaluate the "Quikstor" subsystem developed by Quikdata, Inc. Most of you probably know that Quikdata is the parent company of H-SCOOP, a monthly newsletter devoted to Heath/Zenith computer systems, edited by the iconoclastic Henry E. Fale. The Quikstor represents a new standard by making available specially written CP/M and HDOS software created by Ray Livingston of Livingston Logic Labs and Dean Gibson of Ultimeth.

The fourth article, will be devoted to the new internally-mounted 10MB Winchester subsystem offered by Floppy Disk Services, one of the first independent suppliers of disk systems for H/Z computers. I will photograph the installation and capsulize the software documentation, and comment on the system, as well.

The primary advantage in purchasing a complete hard disk subsystem from a reputable vendor boils down to one word: SUPPORT! A malfunction on a floppy disk system is relatively easy to isolate. If you are unable to Boot a disk in drive A: (SY0:), but have no problems with drive B: (SY1:), then chances are that you have an alignment problem, which is easily remedied at any drive repair center. If the system won't Boot from any drive, then a bad IC on your controller card is suspect.

There are four main elements to contend with on a Winchester subsystem: the host-adaptor interface card, the disk controller card, the hard disk drive, and an adequate power supply and case. Because the cost of each component is high, it isn't likely that you would have spare cards and drives lying about in order to isolate the faulty piece. When the Winchester system is down, it has to go en-masse to the dealer for testing.

However, if you're a confirmed do-it-yourselfer, who casts to the winds and isn't inclined to worry about something going wrong — until it actually does — then article #5 will be just your cup of tea. I will discuss how to integrate your own hard disk subsystem; what components to buy and where to buy them; how to make your own cables; cable connection pin-outs; how to buy a hard disk drive for $100 or less; which drives are compatible with which controllers; and what to look for in power supplies.

As we get into the nuts-and-bolts of this series, I would appreciate hearing from anyone who has already built their own hard disk subsystem from scratch; what problems they may have had in getting their system up and running; or if they had conflicts with any other installed boards in their computer.

By the same token, feedback from owners of any Magnolia Microsystems, Quikdata or Floppy Disk Services hard disk subsystems would also be appreciated. If you have developed any special applications or special uses, this information would certainly be welcomed. If I receive a significant amount of pertinent data, it might be incorporated into a 6th article.

While it goes without saying that I appreciate the cooperation of Brad & Kay Gjerding of Magnolia Microsystems, Henry Fale of Quikdata, and David Hair of Floppy Disk Services, I would also like to thank the marketing staffs at Xebec Systems and Microscience International for providing me with manuals and technical data on their respective controller and drive systems.

Floppies And Hard Disks Compared

In terms of raw power and speed, a hard disk will read and write data to and from a computer's memory 10 times faster than a floppy disk. The reason is that a floppy disk rotates at 360 rpm, while a hard disk spins at 3600 rpm. The faster the disk passes under the read/write head, the faster the I/O access time. Subjecting a floppy to such rotational extremes would probably disintegrate it in short order.

Both types of disks use a magnetically coated media, much on the same principle as recorder tape. Floppies are constructed of Mylar with an Oxide coating. Early hard disks used a similar formula on their aluminum platters. Newer technology now fuses a sentitized Cobalt and Nickel coating onto hard disks, which allows for extremely dense data storage capabilities.

While floppy disks are encased in a Tyvek paper-like jacket to make them safe for handling, hard disks are hermitally sealed inside an air-tight chamber. Except for some high-end business systems with removable hard disk cartridges, the aluminum hard disk platters are mounted to a spindle which is controlled by a small precision motor.

The physical read/write format of a floppy surface in double-density format is either 8 or 9 512-byte sectors per track, with 40 tracks per side. 80-track drives use a method called half-tracking in order to achieve 320k bytes of storage per side, instead of 160k bytes of 40-track drives. Hard disks, although capable of a 512 byte sector size, are generally set up for 256 bytes. A 19.14MB Tandon TM503 5.25" hard disk drive uses 3 platters to provide 6 active data surfaces. The number of cylinders (tracks) per surface is 306 (with a track density of 345 tpi) or 1836 total cylinders on all 6 surfaces. In relation to a quad-density 96 tpi disk, the storage density is 4 times as great on a hard disk surface — or 8 times that of a 48 tpi disk.

When you close the door or latch the lever on a floppy drive, you physically bring the read/write head in contact with the exposed surface of the disk. The floppy head or heads are mounted on a geared shaft that slides back and forth as it travels from track to track. Hard disk drives, in contrast, have lever arms mounted in tandem that have the heads positioned just microns above the surface of the platter. The front of the heads are aerodynamically chamfered, so that they literally fly above the surface of the spinning disk. Since even two platters inside a hard disk means four flying heads, a Winchester subsystem is especially vulnerable to movement and vibration when operating.

Some of the new 5.25" and 3.5" hard disk drives becoming available have succeeded in overcoming the problem of crashing by incorporating into the firmware code a routine that automatically parks the heads in a neutral zone (or locks the arms) when you power down. Other head systems contain a spring mechanism that is released when the power is turned off and forces the heads toward the center of the disk.

As Winchester technology becomes smaller and more sophisticated, a few 3.5" drives from manufacturers, such as Tandon will automatically lock the drive heads for transport in a laptop computer. Carrying the technology even further, a joint venture between Plus Development and Matsushita Kotobuki Electronics has produced a 3.5" 10MB drive that is mounted on a hard disk controller card, so that it plugs directly into any PC-compatible computer, thereby eliminating the need for cables entirely,

or having to give up a floppy disk. I suspect that by the time this product is available in full production runs, someone else will have devised a similar contraption with still higher storage capabilities.

The one thing almost all 5.25" hard disk drives have in common is the controller interface. The current standard is referred to as the ST506, which references the Seagate Technology ST506 drive that sold in such high numbers that every other drive manufacturer began to adopt this interface for their own drives. While system designers admit this is a low-level of interface intelligence, allowing only a 5M-bits/sec. data transfer rate (computers are capable of a data transfer rate three times as fast), they are hard-pressed to deviate from this standard in order to provide some continuity and compatibility between manufacturers of drives and interfaces.

The ST506 standard also requires that the surface media of the drive be formatted by the end user. Thus when you see drives rated by storage capacity it is wise to determine whether the capacity is formatted or unformatted. The difference in storage capacity between the two is generally anywhere from 20-25%. A hard disk drive rated at 12.7MB unformatted will actually yield only 10MB of usable storage space. Similarly, a 19.5MB will format to 15MB, and a 40MB drive will format down to 33MB.

Part of the difference is the way the software allocates cylinders and partitions. Also, sectors within a cylinder must be encoded with information that identifies how files and data are stored on the disk and how the head will know where to position itself next when it writes or reads data from the user's input. A typical 256 byte sector will allow for a 2 byte ID field header, an ID area (physical sector address plus cylinder and head information), a 2 byte data field header, followed by the actual data. There is also a 32 byte intersector gap between sectors for servo information and time delays.

Because of the high rate of disk revolutions, sectors on a cylinder are not consecutive. They are arranged in what is called an interleave factor of six or eight. This means six or eight sectors separate logically contiguous sectors. IBM uses a 17-sector track arrangement with an interleave factor of eight to produce a track loop with this sequence:

1:16:14:12:10:8:6:4:2:17:15:13:11:9:7:5:3:

In contrast to the IBM standard, the Xebec S1410 drive controller, which has become one of the most widely used controllers for ST506 compatible drive systems, uses an interleave factor of five. [See Figure 1. for the Logical and Physical Sector mapping illustration of a track format example of 32 sectors-per-track with an interleave factor of 5.]

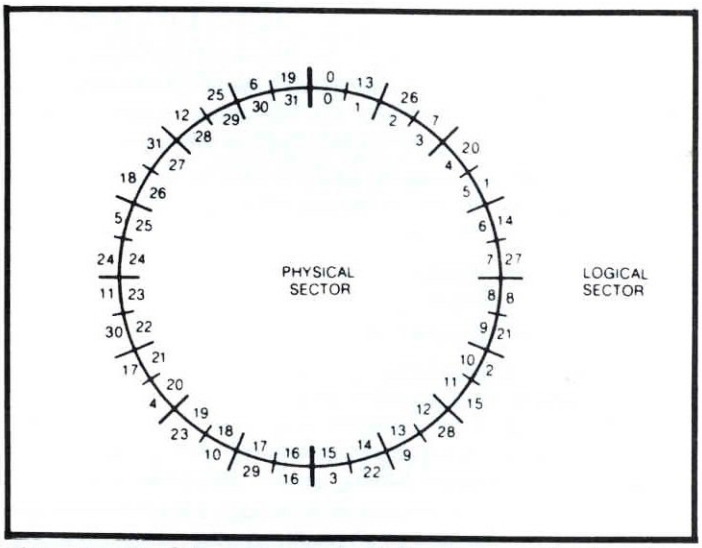


Figure 1 — Track format example of 32 sectors-per-track with an interleave factor of 5.

The Xebec S1410 is also capable of variable interleaving, which is described on page 33 of the manual as follows:

"Variable sector interleaving is supported by the S1410 disk controller. When any format command is issued, any interleave value up to the number of sectors-per-track minus one, may be passed in the Device Control Block (DCB byte 4). The interleave factor may be adjusted for maximum system performance. Interleaving allows logical contiguous sectors or data on a given track to be mapped onto non-adjacent physical sectors. An interleave factor of five, for instance, means that every fifth physical sector is transferred as the next contiguous logical sector of data. It does not mean that five sectors of data are transferred in one revolution. If the operation is read and the interleave factor is five, then a sector of data is read into the sector buffer, and during the time that the heads are passing over the next four physical sectors of the disk, the data is being transferred to the host. If the host cannot transfer the full sector of data during the four sector times available, then the controller has to wait a full revolution before the next logical sector can be read from the disk. If this happens, the interleave factor is too low and should be increased until an increase in operating system speed is noticed. In order to take full advantage of the interleaving feature of the controller, the operating system should perform multiple sector data transfers. If single sector transfers are employed, the difference in speed

with various interleave factors may not be dramatic."

Floppy disks can only be formatted for a single operating system, because the track and sector initialization is specific to that DOS. On the other hand, hard disk drives are capable of containing more than one Operating System through a unique feature called Partitioning. Partitioning allows the user to physically map the size of each partition during the set-up procedure, so that he can allocate the vast storage capabilities of the drive in a manner best suited for his own purposes.

All hard drives must be partitioned in one way or another, because the software does have limits on the number of directory entries it will handle. If your operating system allows you to have 256 directory entries on a 640k quad-density floppy disk, you certainly would not want to be limited to that on a 10MB Winchester. Once the 256 entries have been recorded on the hard disk, you would be informed that there is no more free space on the media, even if your entries consume less than 1MB of storage space.

You, therefore, allocate manageable chunks of space (partitions) within the boundaries and limitations of your operating system and hard disk driver software. The maximum number of partitions available will, again, depend on the software, which in relation to the drive's capacity, can be from 4 to 15 partitions. We will cover specific details on how to allocate partitions in a later article.

H/Z-89 owners, depending on the hard disk driver software they use, can have both CP/M and HDOS partitions resident on the same drive. Each partition is then Formatted (or Initialized) and Sysgened to make each Partition a separately allocated device on the drive. Depending on what your needs are, you can then select each partition for a specific work area: word processing, database management, modem communication, programming languages, spreadsheets, billing, etc. — all of which are now "on-line" and ready to be accessed through a Boot menu without having to constantly change floppy disks and rebooting the system.

However, a hard disk is not an island onto itself. Without the support of floppy disks to back up the data you so prodigiously worked to accrue, you simply can't take a hard disk out of service once all the partitions are full and plug in another hard disk. The cost is too high. Accepted procedure recommends that you periodically back up your data in the event of a system failure. Waiting until the hard disk is full is not a wise course either. Even a modest 10MB hard disk can hold the equivalent amount of data on 15 quad-density (640k) disks or 30 (320k) disks. Backing up this large volume of data would probably require several evenings of lost computer time.

Hard disk subsystems for 16-bit computers range from cheap to pricey. IBM-PC and compatible computers have a variety of combination host adaptor/controller cards available that are produced in such quantity that the competition has lowered their price to around $200. Other 16-bit computers, such as the Z-100 series require a host adaptor and controller card set that cost around $1000 to which you must still add the price of the drive.

By comparison, host adaptor and controller cards for the H-89 will cost only about $550. And this would include the CP/M software by Magnolia Microsystems. For another $195 you can purchase the Quikstor software from Quikdata Computer Services, which is compatible with all versions of the Heath implementation of CP/M, plus HDOS software, as well. It is also faster than the Magnolia software and allows for a greater number of partitions to be allocated on the disk.

The host adaptor card that mounts in the computer has what is referred to as an SASI interface. This design concept provides for an uncomplicated method of data transfer to and from the computer, and was the brainchild of the Shugart Drive Division of the Xerox Corporation. The letters stand for Shugart Associates System Interface, and it is easily adapted to almost any computer bus structure by means of a few ICs. (It is ironic to note that Shugart, responsible for so many innovations and standards, was recently sold to the Japanese manufacturing giant, Matsushita.)

To give you some idea of how the host adaptor, controller card and hard disk drive interact with one another, see Figure 2 for a simplified block diagram of the functional organization of the controller. The main elements are:

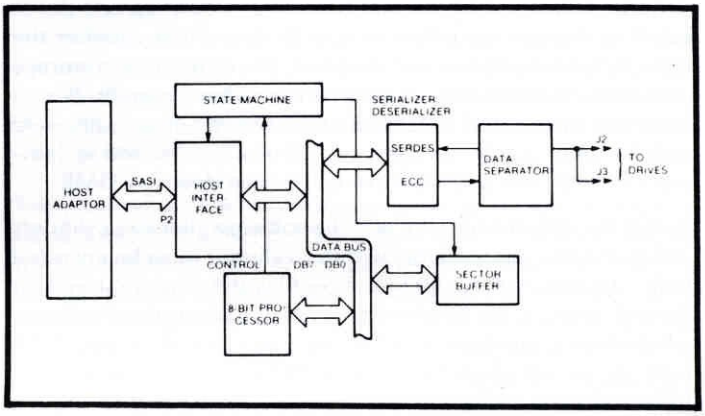


Figure 2 — S1410 Controller, Functional Organization

Host Interface. The host interface connects the internal data bus of the host adaptor. The state machine controls the movement of data and commands through the host interface.

Processor. The eight-bit processor is the intelligence of the controller. It monitors and controls the operation of the controller.

State Machine. The state machine controls and synchronizes the operation of the host adaptor, SERDES, and sector buffer.

SERDES. The serializer/deserializer (SERDES) converts parallel data from the internal data bus to serial data for transfer to a selected disk drive. It converts serial data from the selected disk drive to parallel data which it places on the internal data bus.

Data Separator. The data separator converts serial NRZ data to MFM for transfer to the selected disk drive. It converts MFM data coming from the selected disk drive to serial NRZ data for the SERDES.

Sector Buffer. The sector buffer stages data transfers between the disk and host adaptor to prevent data overruns.

* * *

When Heath/Zenith finally got around to producing a double-density disk controller card for the H-8 (which had already been taken out of production), they included an SASI interface to enable owners to connect a hard disk controller card and a Winchester drive. For the H/Z-89, which lacked the expansion card capabilities of the H-8, owners had to be content with a separate card called the Z-89-67.

According to Bob Harris, Senior Consultant at Heath's Technical Consultation Department: "This system consisted of an interface card that installed inside the H-89 Computer and communicated with the controller board inside the Z-67 Cabinet. This controller board was manufactured by Data Technology Corporation and was their model number MRX-101. This board is designed exclusively for controlling the Memorex 101 8-inch Winchester Drive."

In a subsequent letter, Mr. Harris informed me that the CP/M support package for the Z-67 Winchester subsystem was specifically written for this controller/drive combination and that he did not feel it would be transportable to other equipment. When Heath/Zenith phased out the Z-67, most of the H/Z retail centers began to offer pre-packaged subsystems from Magnolia, or put together their own subsystems using the host adaptor cards and software from Magnolia.

The significant point here is that the Z-67, although it used an SASI Interface, was part of the 8" Winchester drive era when controller cards were specifically designed to handle certain drives. There were numerous standards: the Corvus, which was actually designed by IMI, the Shugart SA1000 and SA4000, and others that faded as quickly as they appeared.

But none of these standards became as universally adopted as the emerging ST506 interface for 5.25 hard disk drives. What made the ST506 interface so popular and cost effective was partly the result of the development of the Xebec S1410 Winchester drive controller cards that could be integrated with many different drives and computer systems because the on-board firmware and the microprocessors could be programmed to talk to the drive: i.e., how many heads, cylinders, etc. Eight-inch Winchester controller cards weren't programmable in the same respect. They used only discrete components and firmware in ROM that relayed information on a particular drive to the computer. This did change slightly when drive manufacturers, such as Quantum finally adopted the Shugart SA1000 standard suitable for 5MB and 10MB drives, and SA4000 standard for 20MB and 40MB drives. These subsystems were massive and reposed on a desktop like a steamer trunk. In terms of reliability, they were solid performers that seemed to last forever.

Most 8" drives, like the Shugart SA1002 5MB (which used the Western Digital WD1001-85 hard disk controller, were ultimately dumped to electronic wholesalers and computer dealers at prices far below their original manufacturing cost. Many can still be obtained in original factory sealed cartons. Others were snapped up by system integrators and are now peddled at very attractive prices.

The quest for the maximum amount of storage in the smallest package possible still continues. Drive manufacturing firms like Siemens are already boasting 5.25" 7-platter drives holding 300MB, with 500MB systems in final stages of development. Already 20MB 3.5" drives for portables are available for OEM use. Most of us don't have the need to store the entire Encyclopedia Britannica on a hard disk, but the reality of owning a 5, 10 or 20MB unit is with us now — at a price the hobbyist can afford.

Put one in your H/Z-89 and you will be hard put to describe the blinding speed with which database programs are sorted and programs compiled. They can make a computer operating at 2 MHz as fast as any 16-bit upstart on the market. And possibly even faster, because 8-bit code is much more efficient. Perhaps not in relation to a true 16-bit CPU like the Intel 8086 or 80286, but certainly in relation to the hybrid 8088 which uses 16-bit address lines with an 8-bit data path. In this context an H/Z-89 with a Winchester becomes a very capable and formidable contender.

Although I have occasionally been accused of sneering at 16-bit computers, I don't deny that the production volume of these units has directly influenced the lower prices we now see on hard disk components. The PC-compatible market uses the same ST506 standard drives that are used on the H-89 and other 8-bit computer systems.

Having now used several Winchester hard disk systems on my H-89, these past few months, has convinced me that they're not only a cost-effective storage media, but they provide a significant improvement in the overall operating speed and productivity of my computer. *

A Winchester For The '89

Part Two

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

The Magnolia Connection

Magnolia Microsystems of Seattle, WA is probably responsible for more sophisticated enhancements for the H-89 computer than any other independent supplier — and that includes Heath/Zenith. In fact, Magnolia (which was founded in 1976) actually predates both Heath Company and Zenith Data Systems.

They began as a retail operation selling CP/M computers, such as the Altos, and were the first operation of this kind in the Seattle area. When Heath launched the H-89 in 1979 as a small, relatively low-cost computer that the market needed, Magnolia initiated an evaluation of the unit in relation to their customers' needs. The H-89 lacked a standard Operating System (it came with HDOS), so Magnolia implemented ORG-0 CP/M and introduced it at the West Coast Computer Faire in 1980.

Seeing that the '89 had a far-reaching sales potential beyond the hobbyist market, Heath/Zenith rushed to complete their own version of CP/M in 1981. Unfortunately, the accompanying documentation package did not do credit to their usually high standards; and it took them another two years to provide the updated version 2.2.04 (which provided support for the Z-89-11 Multi I/O card) and a manual that was a model of clarity and detail.

Magnolia was also responsible for yet another first: the implementation of a Winchester hard disk system for the '89 as early as 1980 — a full two years before Heath/Zenith offered the Z-67 subsystem — with the 77313 Corvus host adaptor. The Corvus interface (actually designed by IMI, whose 8" drives and controllers Corvus used) predates the Shugart SASI-bus. It was contemporaneous with the 8" SA1000 interface from Shugart, but at a different functional level — IMI put the controller inside the drive itself. Shugart competed by developing a controller using their own (SASI) bus (which went on to become an industry standard and, eventually, an IEEE (SCSI) standard). Along the way, IMI also designed 5" drives with their own (non-ST506) interface, with an "IMI-bus" controller which Corvus also used.

The Magnolia Corvus Winchester interface appeared shortly after their release of CP/M. All at once, the H-89 had gone from a computer system primarily designed for the hobbyist, to a full-blown business machine capable of holding its own among its peers.

In 1981, when Heath/Zenith was taking "forever" in releasing their Z-89-47 interface and Z-47 8" drive subsystem, Magnolia updated their Corvus hard disk interface by adding the Remex intelligent floppy I/O to their 77313 board, which now came to be called the 77314, and beat Heath to the market by several months.

This was quickly followed by their 77315 (CAMEO) and 77317 (XCOMP) interfaces, which are still available from stock, but no longer actively promoted. The XCOMP controller was designed for both the SA1000 and ST506 drives. The CAMEO controller supported one of the early Winchester monster units — a 14" 5+5 MB Cartridge Subsystem. The one truly outstanding feature of these early Magnolia hard disk interface cards was the addition of their own proprietary bus expansion technique.

As the abilities of the H-89 grew, several shortcomings in the design became more obvious. Aside from only having a 90 watt power supply, it did not support direct memory access, and it only had three expansion ports available. Due to internal space limitations, expansion cards were greatly restricted in size, which in turn limited the number of I/O ports the computer could have resident at any given time.

By enhancing the BIOS of their CP/M implementation, writing new software driver utilities, as well as preparing a variety of BOOT ROMS, Magnolia was able to open up a whole new world of I/O expansion for the '89. This wasn't done at the expense of the I/O ports Heath/Zenith had built into the computer. They remained intact, especially the disk I/O port slots at P504 and P506. Instead, Magnolia's proprietary expansion bus confined itself to the center slot (P505), through which they implemented their hard disk interfaces, as well as the 3-Serial I/O ports that otherwise would have been lost with the removal of the H-88-3

Serial card. This explains why Magnolia expansion cards always resemble an aerial view of an overcrowded parking lot. Brad Gjerding and his designers had a knack for stuffing four functions into a space ideally suited for only one.

I suppose its reasonable to ask — if a small firm with a handful of employees and relatively modest resources could do so much to enhance the usefulness of the '89, why didn't Heath/Zenith with its overwhelming engineering staff and financial clout do more than it did to expand the '89? At best, their efforts appeared more to patronize a loyal band of customers than a consummate desire to sophisticate their product. As soon as the '89 hit the streets, they were hard at work on the next generation of computers, incorporating the latest advances in board design and IC technology, and assembly-line automation that would result in a faster, more powerful computer at a lower cost. The big profits were in selling systems — not add-on cards.

When Heath/Zenith introduced their Z-89-67 SASI interface card and the Z-67 Winchester subsystem in 1982, Magnolia had their own SASI interface card in the final stages of development — the 77320. Since the SASI standard is a hardware specification, the Z-89-67 and the 77320 cards are compatible with each other as is their respective software. That is, Z-67 software will work with the 77320.

When I asked Brad Gjerding if he could recall any limitations the 77320 board had, he replied: "We've come to regret not including an option to use one of our expanded I/O addresses, so people could have the 77320 board in their computer together with both Z-17 and Z-89-37 controllers. But, that's 20-20 hindsight. However, we did include the standard Heath serial ports at the bottom of the card. Things got a little crowded and we had to tack one of the three serial port connectors on the back of the card."

When you install any Magnolia Winchester host adaptor card in the '89, you can only have one floppy disk controller resident at the same time. In practical terms, however, once you've upgraded to the Z-37 disk controller, there really isn't much point in tolerating the limited storage abilities of the hard sector controller. And, with a Winchester, you seldom use even your Z-37 controller, except to transfer programs to the Winchester and to perform periodic back-ups of your hard disk files. In daily use over the last four months, I can't recall having turned on my quad-density drives more than a dozen times. You're spoiled quite easily when you install a Winchester on the '89. You can BOOT from any of the partitions you have set up in an average of 12 seconds, as opposed to nearly 45 seconds from a floppy drive.

Five years have elapsed since Magnolia implemented CP/M and the first Winchester hard disk system for the '89. During this intervening period, Heath's hard disk subsystem was a viable product for only two years, because the emergence of their 16-bit system relegated the 8-bit '89 to secondary status. And, as this article is being written (September 1985), the '89 has been discontinued after a six-year reign. This has placed Magnolia Microsystems in the enviable position of being the only manufacturer of hard disk host adaptor cards. Unquestionably, their biggest seller was the Corvus 77314 interface, because the Constellation multiplexer allowed several computers to share one rather expensive hard-disk drive — a system they supplied to many companies around the country.

Magnolia's 77320 SASI interface competed quite well with Heath's Z-89-67 host adaptor because their implementation of

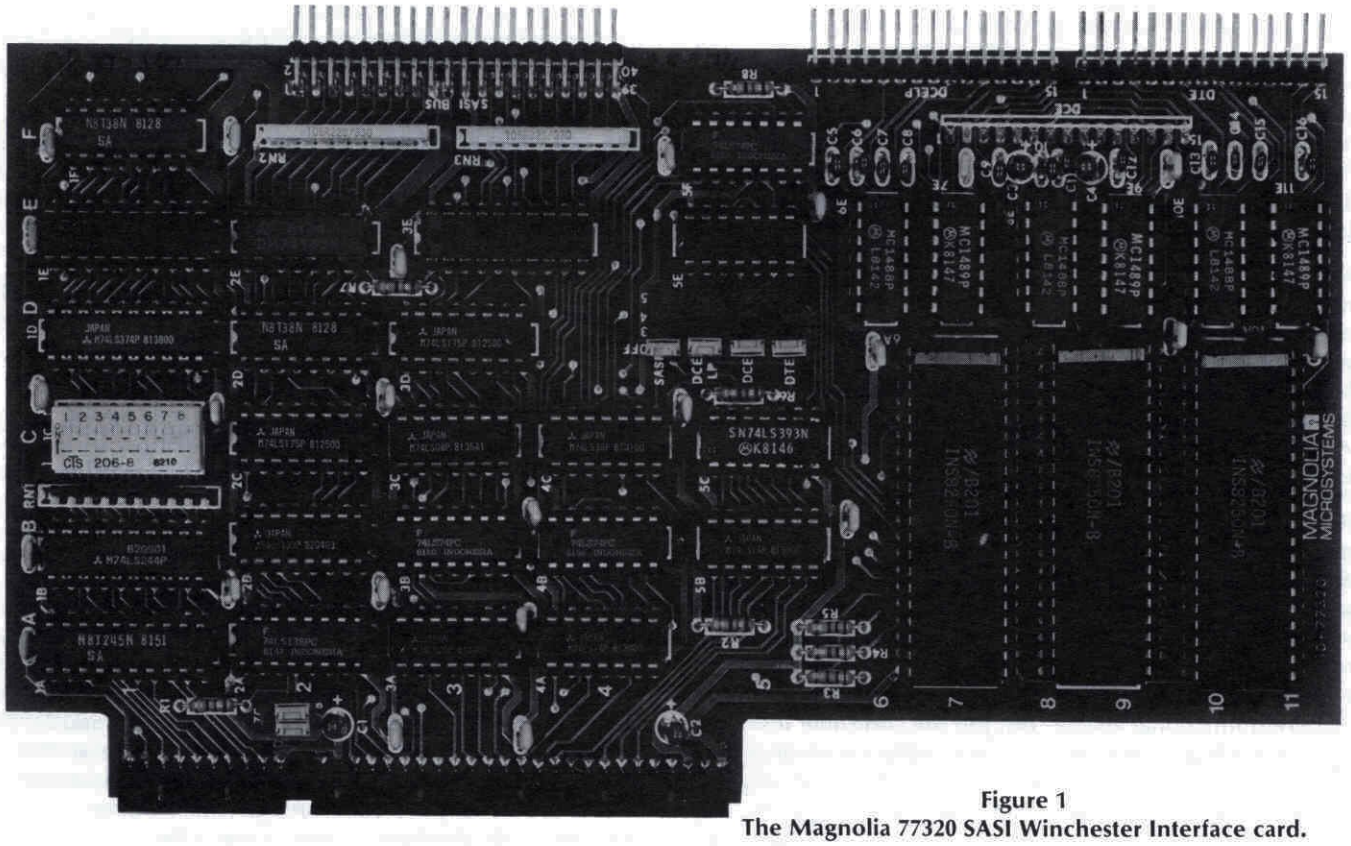


Figure 1
The Magnolia 77320 SASI Winchester Interface card.

CP/M allowed greater flexibility in hard disk drive selection, whereas Heath's would only support the mammoth Memorex 101 8-inch Winchester I discussed in Part One of this series. Also, Heath's Winchester BIOS was sold as a separate software package. It would have been nice if they had incorporated the Winchester BIOS into CP/M 2.2.04 rather than consigning it to the old products heap. So, we are left with the 77320 SASI interface as the universal communicator between the '89 and a hard disk drive.

I had hoped to obtain schematics and other technical data for this article, but I was informed this information was not available. "We support our products at the 'functional interface' (black box-to-black box) level, complete with system software, and customers don't need to worry about technical details, such as actual cable pinouts. If you have a Corvus drive, it works with the '314 and our software. If you don't, it won't . . ."

In correspondence around the country, I have learned that Magnolia has come to rely more heavily on their dealers to provide the necessary technical support required by the user, because these dealers quite often are their own hard disk system integrators and Magnolia isn't in a position to know what drives and controller combinations are being offered in a subsystem. If you purchase a complete system from Magnolia, it behooves them to provide you with the help you need to get it operational. But if you merely purchase the SASI host adaptor and the CP/M software (which comes free with the SASI), and scout around for the rest of your system at the lowest possible price, Magnolia can't afford to spend a lot of time holding your hand.

Magnolia's SASI host adaptor and CP/M is optimized for the Xebex S1410 and the newer low-power S1410a hard disk controller card. I am told it will work with other hard disk controllers which I hope to test out in one of the forthcoming articles in this series. On the hard disk drive level, any ST506 standard drive is usable. But this doesn't mean that you should grab any surplus bargain you see advertised.

A primary rule you should remember is to purchase only a drive for which documentation is available. In order to use Magnolia CP/M on a Winchester subsystem, you must create a BIOS and LINK it into your system volume which contains important information about the drive you're going to use — specifically, the number of read/write heads, number of cylinders, tracks per cylinder, etc. Without this information, you cannot partition the hard disk drive and then Sysgen it as a bootable device.

The one negative feature of the Magnolia CP/M Winchester utilities is that you are only allowed two partions on a Corvus system. I think that when this standard was established, most Corvus drives available were in the 5-10 MB range. The 77320 SASI interface will allow up to four partitions on a drive, which offers the user somewhat more flexibility in the number and types of programs he can have resident on a single drive, especially when you are using a drive with 20 MB or more of storage capability.

On the positive side, Magnolia's 77320 SASI utilities will support eight hard disk controllers, each of which (if you are using the Xebec) can handle two Winchester drives. Simple mathematical extensions will deduce that you could, conceivably, run sixteen Winchester drives off one '89, if you're willing to spend a small fortune in the process. Most 16-bit computers aren't capable of a hard disk network of this magnitude. I wonder if Magnolia realized the ultimate power they had made available to the H-89 computerist when they developed their SASI utilities. No doubt they had a multi-user office environment in mind, because they were the first and only firm to develop a controller network that catapulted the '89 into the business world.

Getting Started Under Magnolia CP/M

My first encounter with Magnolia CP/M was caution mixed with fear. I had been told that it was the "only way to go" and "once you've used Magnolia's CP/M, no other version on the market would ever be satisfactory." As I'm usually suspect of broad statements about a product's superiority, I wasn't quite certain what to expect when my software package arrived.

The documentation is handsomely prepared and stuffed into a fat, gray binder. Depending on the type of hard disk system you are planning to install, several supporting booklets pertaining to the hardware installation, the Monitor ROM and the software utilities you will be working with are also supplied. You will also receive a functional replacement for the standard Heath/Zenith MTR90 4k Boot ROM, as well as new I/O Port Decoder ROMs replacing part numbers 444-61 and 444-83. There are "a", "b" and "c" versions of all these ICs, covering all of Magnolia's Winchester options.

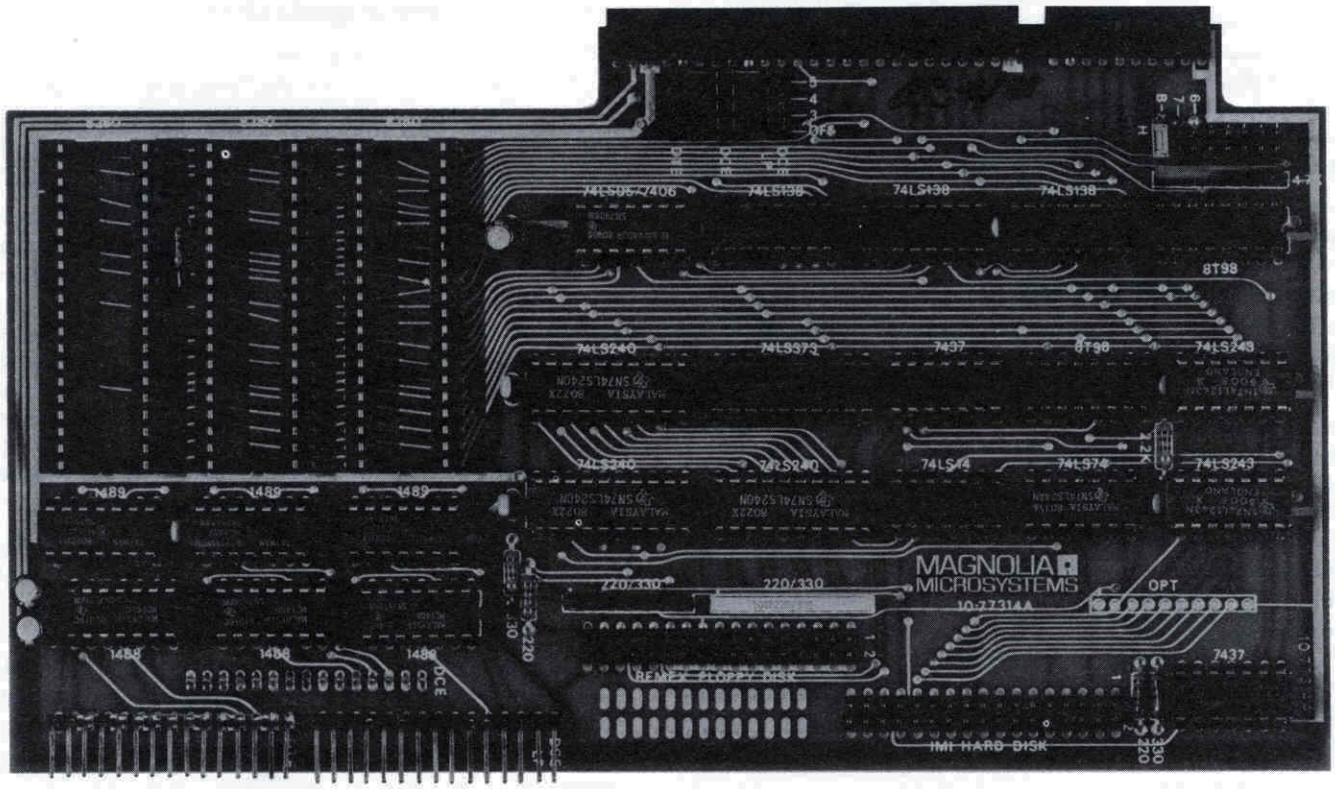
None of these will affect the operation of the standard Heath/Zenith version of CP/M or even HDOS. You will not be able to use your Winchester with H/Z Operating Systems, but you can certainly Boot these from your floppy drives — with a minor change. That is, the symbolic representations of the SY: and DK: floppy disk devices under HDOS and the alpha designations of CP/M have been converted to a numerical format.

Depending on how you have set up the switches on S501 on the '89s CPU board to designate the primary Boot drives, the procedure with Magnolia CP/M requires that you specify the assigned number of the drive you wish to Boot from. According to Magnolia's very elaborate scheme, device numbers have been assigned to cover the Heath/Zenith Z-37 soft-sector controller and H-17 hard-sector controller, the Z-47 and Z-67 subsystems, Magnolia's own 5"/8" double-density controller, their 128k RAM card, and their Cameo, Xcomp, Corvus and SASI interfaces.

We shall ignore the basic setting up procedures for a CP/M System Volume disk, because of the similarities to Heath/Zenith's CP/M. But I shall mention that you will now be able to add a fourth drive to your Z-37 controller and increase the amount of physical data you can store on your 48 or 96 tpi double-density disks because of the way the track/sector format has been allocated. Also, the FORMAT procedure offers a screen display as each track is formatted, and these are automatically verified so that you can instantly spot a bad disk. Most of the set-up procedures are handled by screen menus, and you use your cursor and special function keys to move around the menu and to configure the associated hardware you have on-line.

I think it is appropriate to mention to those '89 owners who are not familiar with both the Heath/Zenith and Magnolia CP/M version that data and program files from either version cannot be transferred to the other because MMS and H/Z handle the logical-physical head positioning of double-sided disks in different ways. In simplistic terms, Magnolia CP/M writes to one side of a disk first, then the other side, with side two offset by about 4 tracks. Track 0 on side one begins at the outside edge of the disk and writes to the center hub. Side two begins to write (and read) from the center hub to the outside edge. This was done for compatibility between Magnolia's 5"/8" double-density controller and the H-17 single-density controller. However, the Z-37 double-density controller follows an alternating side method of

Figure 2
The Magnolia 77314 Corvus (IMI) Winchester Interface card.



read/write: First track 0 on side one, then track 0 on side two, and so forth.

Those who are contemplating switching from Heath/Zenith CP/M to Magnolia and wish to place their working files to a Winchester drive, should first transfer their files to an MMS CP/M formatted floppy disk via a conversion utility program before loading them onto a hard disk. One such program is called EMULATE, which is distributed by Analytical Products, 20663 Ave. 352, Wood Lake, CA 93286. This utility will read and write to more than 4 different CP/M formats and is worth investigating.

Now, before I wander too far afield from the intended scope of this article, we will now go through the procedure for setting up a hard disk using the Magnolia CP/M, 77320 SASI interface, and the Xebec hard disk controller. The hard disk data listed below is for both the Microscience HH-612 and Shugart SA-712, which are new half-height, low-power 10 MB Winchester drives. Part of the set-up procedure has been condensed from a booklet published by Floppy Disk Services (39 Everett Dr., Bldg. D, Lawrenceville, NJ 08646) and entitled INSTRUCTION MANUAL FOR INTERNAL AND EXTERNAL HARD DISK SYSTEMS FOR THE H/Z-89. It is one of the best idiot-proof manuals I have ever read, and it will be discussed in Part Four of this series when I will examine their internal hard disk system for the '89.

1. Turn on the '89. It should beep twice and the hard disk will begin to wind up. The LED on the hard disk may or may not flicker or be lit for the first 30 seconds. The Boot Syntax is Boot 0 for H/Z-17, Boot 46 for Z-37 or Boot 33 for MMS double-density.

2. Format and Sysgen a blank disk in drive B:. Copy all the utilities from your Master MMS CP/M disk. Reset the '89, insert the System Volume you have just made and PIP the files from the SASI diskette to it.

3. Reboot your disk and run DEFSASI3.COM. After the program has loaded, the cursor will position itself at the first line titled SUBSYSTEM DATA. Hit the Return key and enter the following data:

```
Controller number     : 0
Controller mfg.       : Xebec   (enter #1 to get this)
Model                 : S1410   (enter #1)
Version               : 104683  (enter #2)
Logical unit number   : 0       (enter #0)
Drive mfg.            : MSCI    (enter #1 and type in MSCI)
                                (or Shugart if applicable)
Model                 : HH-612  (enter #1 and type in HH-612)
                                (or SA-712 if applicable)
Physical sector size  : 256     (enter 256
```

Now hit the BLUE key on the '89 to save this info and return to the main menu.

4. Move the cursor to the DRIVE CHARACTERISTICS section using the up/down arrows on the keypad and hit the Return key. Using the guide below, enter the data as given:

```
Logical unit number       : 0
Type of media             : F
Number of cylinders       : 306
Number of heads           : 4
Sectors per track         : 32
Control byte              : 14 (use 17 for SA-712)
Interleave factor         : 32
Expected format time      : 30
Exp. disk test time       : 10

Reduced write cyl.        : 0
Write precomp cyl.        : 0
ECC data burst length     : 11
```

Hit the BLUE key to save the data and return to the main menu.

5. Position the cursor to the UPDATE DEFSASI3.DAT and hit return to save the data to the disk.

6. Position cursor to DRIVE INITIALIZATION and hit return. The cursor will position itself in the desired starting location. Hit return for each item. Some of the functions are instant. Others will take a few minutes. All tests must finish with NO ERRORS. When complete, hit the BLUE key to exit to the main menu.

7. Move cursor to the WRITE M320F210.HEX file and hit return to create this file on the disk.

8. Then move cursor to EXIT TO CP/M and hit return.

9. Now we must tell the system to recognize that the hard disk is present. This is accomplished by linking the new hex module as follows:

```
A>LINK M320F210 MOVCPM <ret>
```

10. When the link is complete, immediately run MOVCPM. Then run SYSGEN. Since the new system is already in memory, it isn't necessary to "get" the system, only put it. In other words "RETURN" for source and "A" for destination. And since you have just re-sysgened drive A, you must SHIFT-RESET and reboot.

11. Now run the program DRIVES. This program may take several seconds to complete. Look for 2 devices, 50 and 51 in brackets. These are the numbers assigned to your new hard disk system. Make a note of the "letters" (not the numbers). They will be used in the next few steps. These numbers and letters will vary depending on the options in your particular system. If all goes well, the system reboots, the new hard disk will appear as the letter I: (eye). REMEMBER! The letter may be different on your system. In our examples, we will use the letters "I" and "J".

12. Type the following: SCAN I:<ret>. Then, follow the directions on the screen. You will only have to hit return once for this operation. It may take from 5 to 15 minutes to perform this operation.

13. When this function is complete, and no errors have been encountered, you must now SCAN J:<ret>. This will not take as long as I: since this partition is smaller than the other. Remember that the default partition is 8.1 MB for the first partition, and 1.5 MB for the second as CP/M can only address 8.1 MB maximum under this system. If you wish to partition the hard disk in a different way, refer to the Magnolia Manuals. If everything has gone well, both partitions should not show any error. Now you may PIP all files (*.*) to the hard disk by typing PIP I:=A:*.* (during this operation any bad sectors found will be "mapped" out).

14. In order to boot directly from the hard disk, we must set up the system to do so. Since you have just copied all the files from your master to the hard disk, log onto the first partition, I:<ret>, per the examples in the two previous sections. Remember that your assignment letters may vary.

15. Run the SETUP.COM program and select the Logical/Physical Drive Assignments. Hit return.

16. Under MMS CP/M, the first 5.25" drive (using the MMS controller) is designated as 33, then 34, 35, 36. If this is the case, the screen will display number 33 in parentheses. If you're using the Z-37 controller, the numbers would be 46, 47, 48, 49. In order to make the hard disk the first and second logical drives, enter 50 when the A: designator is on the screen. Then move the cursor down one and enter 51. Then down again and enter number 33, 34, etc., or 46, 47, etc., for the controller you are using. If you see any error messages at this time, simply ignore them. If your system is different from our examples, consult the Magnolia manual for assistance.

17. Now press the "f3" key. This will clear any error codes. Then hit the BLUE key to update and exit to CP/M. To link the new boot module onto the hard disk, proceed as follows:

    While logged on I:, type:

```
I >LINK B320 MOVCOM <ret>
```

    When the link is completed, run MOVCPM. Then Sysgen and put the system from memory to drive I: Remember that the system is in memory, so just hit "return" for the question "Get system".

18. Your new hard disk is now ready to boot. Hit SHIFT/RESET and enter "B" at the MMS: prompt, followed by the letter "E". This will echo as two letters — "EE". Hit return and your new hard disk should boot up.

A final note of importance: When you first install your MMS 77320 SASI controller and the appropriate ROMs that come with this interface package, you must alter the dip switches on S501 on the CPU board according to the documentation.

And, as mentioned earlier, obtaining the manufacturer's documentation for the hard disk drive you plan to purchase is of the utmost importance. The set-up parameters are vital, if you are to link them to your system volume. Without this information you will be unable to communicate with the hard disk.

If possible, obtain a copy of the Xebec S1410 Owner's Manual. Many system integrators don't always supply this when you order the controller either separately or as part of a complete subsystem. Some, I've learned, don't have them to sell. They can be purchased from Xebec, P.O. Box 512, 432 Lakeside Drive, Sunnyvale, CA 94086. It provides a valuable source of information pertaining to pin-outs, error messages, SASI interface schematics, programming data, parameter information on some two dozen different ST506 compatible drives, and much more.

In one of the future articles in this series, we will attempt to explain the significance of the hard disk parameters that your software looks for during set-up.

For further information on the many Magnolia CP/M software products and fully operational Winchester subsystems MMS has to offer, write to:

MAGNOLIA MICROSYSTEMS, INC.
4039 - 21st Avenue West
Seattle, WA 98199

Our next installment will look at the Quikstor Winchester from Quikdata and the new standard Heath/Zenith CP/M and HDOS hard disk software they now have available. I welcome any comments and suggestions on this series. Please enclose a stamped reply envelope if I can assist you with any specific or technical information relating to your H-89 Winchester. *

A Winchester For The '89 Part Three

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

Quick Watson, The QuikStor

Quikstor isn't so much a hard disk subsystem as it is a unique Winchester operating system for the H-89 and H-8 computers, boasting both CP/M and HDOS software. In fact, it is, as of this writing, the only program that supports HDOS. I've noticed in the Annual BUSS Directory that several firms offer HDOS drivers for the Z-67 board, but all requests for information have fallen on deaf ears. This leads me to the conclusion that these are not viable products and certainly not worth investigating further.

Quikstor is the brainchild of Henry Fale of Quikdata Computer Services, Inc., which is also the parent company of H-SCOOP, the popular monthly newsletter for the Heath/Zenith community. Although Quikdata has been a Zenith Data Systems distributor for many years, and a distributor for Magnolia Microsystems, Inc., they were concerned about the limited amount of Winchester software support and the lack of good documentation available to H-89 (and H-8) owners. They also knew that there was a sizable block of H-89 and H-8 computer owners who would welcome a Winchester software package that included HDOS, and set out to fill this void in 1982.

After many months of discussions to establish a framework for the scope of the software, Quikdata contracted with Dean Gibson of Ultimeth Corp. to write the HDOS partition and Ray Livingston of Livingston Logic Labs to write the CP/M partition software. Both men were among the very early independent hardware, firmware and software supporters of the H-89 and H-8, and understood the potentials and limitations, of these machines.

The primary ground rule was that the Quikstor Winchester Software would support only the Heath/Zenith implementation of CP/M and HDOS, including the MTR90 Monitor ROM and the equivalent ROMs from Magnolia, because the Quikstor package used both the Heath/Zenith Z-67 and Magnolia 77320 SASI host adaptors. The Quikstor software package was bundled as a complete subsystem with the Xebec S1410 hard disk controller, and Tandon TM 503 Winchester drive in a heavy-duty case with a switching power supply, fan and built-in line filter, and demonstrated for the first time at HUGCON II, in 1983.

It was an appropriate time for launching such a product because the prices of Winchester drives had been steadily dropping to the point where the serious computerist, as well as the hobbyist could afford to purchase a high-speed, high storage hard disk system. But a number of H-89/H-8/H-19 owners encountered problems using the Quikstor. They had acquired various enhancements in terms of upgraded Terminal Logic ROMs and enhanced Monitor ROMs in conjunction with assorted hardware from various vendors, and Quikstor would not work with many of them. Some of these TLB ROMs stripped out the ANSI code which was detrimental to the successful operation of the Quikstor hardware/software package.

The original authors and Quikdata issued several minor revisions to the software over the next year to compensate for some of the different firmware on the market. Finally, in the fall of 1984, Quikdata initiated a complete rewriting of the software to incorporate the following features:

- Support of multiple Winchesters and multiple sizes
- Continued support for HDOS 2.0
- Continued 2/4 MHz support
- CP/M 2.2.03 and 2.2.04 with and without ZCPR for all standard H/Z drives
- New improved partition and test utilities
- Up to four active CP/M partitions on line at one time
- Support for some TLB ROMs without ANSI code (some still don't work and Quikdata should be consulted on the compatibility of the substitute TLB ROMs you may have).
- Support for the H/Z-29 terminal (which needs all the help it can get because it promised H-19 compatibility, but didn't fulfill this obligation and required software handshaking which the H-19 did not).
- Allow user selection of drive sizes and types

Considering that the Quikstor has followed a three-year enhancement evolution, it is safe to believe that the final version

(Revision 5) published in May of 1985, will be the definitive execution of this software. One of the considerations in rewriting the software was to allow the user to select hard disk drives of different sizes and types because many Quikdata customers expressed the expertise and interest in being their own integrators.

The current revision became a nightmare of coordinating and testing because both Dean Gibson and Ray Livingston had sold their H-89 and H-8 equipment. Dean went IBM and Ray acquired a Zenith 150. Thus, the burden of testing and debugging fell on Henry Fale and the staff at Quikdata. Chief obstacles in rewriting the code centered on the inclusion of the Z-29 as an alternate terminal, and making the software compatible with some popular TLB ROMs, even though the ANSI code had been stripped out or modified. Based on some of the background information supplied to me, I suspect that the current revision was probably more expensive to produce than the original version. Some debugging was so extensive that equipment had to be supplied to both Ray and Dean, and then tested and checked out during marathon long-distance phone sessions using an H-8 front panel for debugging.

The incompatibility among many TLB ROMs stifled a fair amount of new hardware and software development for the H-89 because the respective vendors could not (or would not) cooperate among themselves to adhere to a common standard. I recall reading in either H-SCOOP or BUSS a few years ago that one major Heath/Zenith support vendor offered to act as a clearing-house for the establishment of hardware and software standards so that related products would work in all systems. Had some of these firms banded together they might have had greater success with their products or possibly avoided going under from the costly expense of technical support.

Compatible ROMs

In order to use the Quikstor Winchester software, you must have the Heath/Zenith MTR90 Monitor ROM (444-84 or 444-142) at U518 and the secondary address decoder (444-83) at U516. The only equivalent Monitor ROMs supported by Quikdata are the -

Ultimeth	MTR-4K
Magnolia	444-84B
Kres	KMR-100

because they are fully functional with all Heath/Zenith CP/M and HDOS software. If you purchased the Z-37 double-density controller, the upgraded ROMS will have been included in your kit.

The Terminal Logic Board requires the installation of the original Heath/Zenith ROMS. On the older H-19/H-89, these are located at U422 and U430. On the newer H-19A/H-89A, they're to be found U437 and U445. Sorry, the Watzman/HUG ROM set will not work with Quikstor, as I found out when I tried to boot the Quikstor subsystem and software for the first time. Early releases of Quikstor would not, as I mentioned earlier, support any replacement TLB ROM that either stripped out the ANSI code or modified it. The current version supports both ANSI and Heath codes and will "automatically switch to the code that the terminal can handle by polling the terminal upon activating and sensing its needs." This means that the UltraROM and the SUPER19 ROM may work with Quikstor, but Quikdata will not support any ROMS other than Heath's.

On the related hardware side, the software will function with the D-G Super 89 replacement CPU board. It will also work with an H-8 computer system that has a Z-80 CPU card and any Trionyx or D-G boards. If your '89 has been modified for 2MHz/4MHz operation, the software will Boot at 4MHz. But you must have a Monitor ROM capable of booting at 4MHz, such as the Kres KMR-100 or the Ultimeth MTR-4K. Based on testing and experience, Quikdata insists that the only "technically sound" 2/4MHz hardware modification is the Kres module. There are some reliable 8MHz modifications available for the H-8, and the Quikstor software will boot at this speed without changing the software. However, Quikdata will not provide technical assistance for any speed modifications not specifically listed in their manual.

Partitioning

Two standard subsystems were recently offered by Quikdata: a 15 MB system using the Tandon TM503 19.14 MB (unformatted) drive; and a 31 MB system with the Rodime 203E 40 MB (unformatted) drive. While this series was in preparation, I learned that Quikdata was phasing out the 15 MB Tandon system because the manufacturer had discontinued production of this drive. It has been around for a few years and is one of the full-height 5.25" drives that requires a larger case and a hefty power supply. It is being replaced by Seagate ST225 half-height drive offering 20 MB of formatted storage for the same price as the original 15 MB subsystem, and in a smaller cabinet.

The nice feature of the Quikstor software is that it was designed to have both CP/M and HDOS resident on the same drive. Each partition can be FORMATted or INITialized and then SYSGENed so that you can Boot from any partition. You are allowed a total of 15 user-selected partitions. The default partition assignments as shipped by Quikdata, unless the purchaser specifies otherwise, are:

For the QS15 System —

PARTITION #	NAME	SIZE MEGS
0	CP/M 0	5.0 MB
1	CP/M 1	5.0 MB
2	HDOS 0	1.2 MB
3	HDOS 1	1.2 MB
4	HDOS 2	1.2 MB
5	HDOS 3	1.2 MB

For the QS31 System —

0	CPM0	8.0 MB
1	CPM1	8.0 MB
2	CPM2	4.0 MB
3	CPM3	4.0 MB
4	HDOS0	1.2 MB
5	HDOS1	1.2 MB
6	HDOS2	1.2 MB
7	HDOS3	1.2 MB
8	HDOS4	1.2 MB
9	HDOS5	1.2 MB

For the QS20 System —

0	CPM0	8.0 MB
1	CPM1	8.0 MB
2	HDOS0	1.2 MB
3	HDOS1	1.2 MB
4	HDOS2	1.2 MB
5	HDOS3	1.0 MB

In order to get their customers on line with a minimum of effort, Quikdata PARTITIONS and FORMATS all drives, so that the user merely has to SYSGEN each respective partition. Under HDOS this procedure takes about 5 minutes. The setting up of CP/M BIOS will take about 30 minutes. In a few moments, we will devote some space to the partitioning procedure and walk you through the Menu Screens. The reason for this is to give you an overview and some familiarity of how Quikstor works should you ever decide to repartition the drive. If you don't, all you will ever work with is the Main Menu Screen.

The QS15 can hold a staggering amount of data, when you consider that a 1.2 MB HDOS partition is the equivalent of two 96-tpi quad-density disks. During the 90-day period, I worked with the QS15 subsystem, I threw every working file onto the drive and didn't succeed in even filling one HDOS partition. The remaining storage on my CP/M partition paled the amount of data I put on it. It is conceivable that, under strenuous use, your floppy drives could be idle for months on end.

Partitioning is accomplished by the SASIX utility. There are CP/M and HDOS versions (they function identically) and separate versions for CP/M 2.2.03 and 2.2.04. As I explained in the first part of this series, a partitioning utility takes the available hard disk storage and divides it into manageable chunks of space that are practical to work with. Anywhere from 20-25% of space is lost in this process because of ID headers that are used to identify the various cylinders on the drive.

Depending on the size of the partitions, you must be cognizant of the "minimum size" that a file will occupy. Under HDOS this is known as a "cluster". A cluster is a group of sectors which is the smallest size available for a file. On an SSDD 100k disk, the cluster size is 2k. On a large partition, the cluster size could be more than 20 sectors. This means, if you have a one sector file that physically occupies only one sector on the partition, the directory will log it as 20 sectors. This will explain, in part, why the HDOS partitions on the foregoing charts were prepared for 1.2 MB each, rather than a larger size. A 2.5 MB HDOS partition has a cluster size of 38 sectors, while a 5.0 MB HDOS partition's cluster size is a whopping 76 sectors. Thus, a 1.2 MB HDOS partition makes reasonably efficient use of directory space without being too wasteful.

CP/M also has limitations on the maximum number of directory entries which depend on the size of the partition. Quikstor allows for a maximum of 8 MB per partition, which is the CP/M limit (not true for CP/M+). The cluster sizes for CP/M are as follows:

0 to 256k = 1k minimum per file
256k to 2 MB = 2k minimum per file
2 MB to 8 MB = 4k minimum per file

0 to 256k partition = 64 maximum directory entries
256k to 512k partition = 128 max. directory entries
512k to 2 MB partition = 256 max. directory entries
2 MB to 8 MB partition = 512 max. directory entries

If you want to calculate the partition size from the number of allocated cylinders, note that in the case of the 15 MB Tandon, 1 cylinder = 6 tracks. Each track can hold 8k of storage, or 48k for 1 cylinder. The default CP/M partitions of 100 cylinders yield 48000k storage, or 4.8 Megabytes.

For the default HDOS partitions of 25 cylinders, you get 1200k of storage, or 1.2 MB. For estimating purposes, 20 cylinders is equal to 1 MB. Calculating the sector/cluster size of HDOS partitions is accomplished by the following formula:

```
((# CYLINDERS) * (# HEADS))/8
```

Take this value, round it up to the next highest even integer value, and that is the number of sectors taken by each cluster, which is the minimum sector size for any file. Quikstor's standard partitions are set up with a size of 25 cylinders, which results in a "cluster" size of 20, per the following example based on the above formula:

```
((25) * (6))/8 = 150/8 = 18.75, rounded up to 20.
```

Setting Up The Quikstor Partition

There are two sections in the Quikstor Manual that may cause temporary hyperventilation when you first encounter them. The first is the running of the Partition Utility and then setting up the Quikstor BIOS on your CP/M partitions. The primary rule to remember, if you purchase the Quikstor software for installation on your own Winchester subsystem, is that you can't expect a lot of hand-holding from Quikdata, as you are no longer paying them to be the system integrator. Simply put, you are on your own.

For all the fear that I may have conveyed by the previous paragraph, I assure you that it's not as dreaded as it sounds, because Dean Gibson of Ultimeth Corp. has created an ingenious series of menu-driven screens to walk you through the entire Partitioning program. Furthermore, so much care has gone into the preparation of the manual, that you'll feel like an expert when you're through.

Take any bootable CP/M system disk and transfer the SASIX-.COM file from the Quikstor CP/M distribution disk and type SASIX.

The first screen comes up on the CRT and you are requested to provide data on your I/O Port, the Drive, the Controller card, and a couple of other irritating details the software finds quite important. You shift from field to field using an on-screen menu that explains how to use your cursor and editing keys to move around the screen. When you have entered the appropriate data, you can check that the SASI Controller card is working properly by pressing the #5 key. Then press the #6 key to proceed to the next screen.

This is considered to be the Main Screen, because it is here that you will not only establish the size of each of the partitions, but also enter some technical data about the hard disk drive you are using, such as:

Number of Heads
Number of Cylinders
Write Precompensation starting cylinder number
Write Reduce current starting cylinder number
Seek Type
Error Len

Quikdata provides all the necessary data on the hard disk drives they offer in their packaged system. If you have your own drive, make certain that you obtain a manual and enter the correct data.

When you're finished setting up this screen, you can press key #4 and the software can now check to see if your drive is functioning properly by reading one sector on each track of the hard disk drive. This Check Drive feature also has a hidden benefit in that it allows you to park the read/write heads at the inside track if you plan to relocate or ship your drive.

When you are in this screen, you are also able to generate the Magnolia Microsystem's partition table from the Ultimeth partition table. The MMS partition table is different from Ultimeth's, and invoking this function will cause a different set of data to be recorded on the boot track. This section must be used with great care if you are planning to install both the Heath/Zenith and MMS CP/M implementations on different partitions. This is not supported by Quikdata.

Screen Three shows the formatting options and an action code to format specific partitions or the entire disk. Obviously, you will select to format specific partitions which you established while in Screen Two. You can also elect to format an alternate boot track (either track 1, 2 or 3) in the event track 0 ever becomes defective, so that you will be able to boot successfully from any partition. It is worth mentioning that this feature is unique. No other hard disk system integration offers an alternate boot track (including those from the Blue Plague of Boca Raton). If Track 0 goes bad with other systems, the Winchester is unusable.

To set up your HDOS partitions is somewhat simpler, because this is accomplished through the SASIX.ABS program and two drivers: DVDDKGEN.ABS (which is used to set the number of partitions or logical drives on your Winchester hard disk) and DKSASXV3.DVD (which will become the actual device driver to access the partitions. This is a breeze, because it follows all HDOS conventions in establishing and setting up a device through the SET option. You set your number of drives DK0: to DK7: (yes, you can have up to eight HDOS partitions with Quikstor), then SHIFT/RESET the computer so that when you boot up again, the system will recognize the existence of the DK: devices.

If your HDOS system volume has a DK.DVD driver already on it, you must delete it. Then, copy the DKSASXV.3.DVD driver from the Quikstor HDOS distribution disk to your system volume and rename it DK.DVD. Your new DK.DVD device driver must now be set by typing BYE and rebooting the system. Now, you invoke your SET DK: HELP command and SET your Port Address, Drive Number (if it's the first Winchester on your system, this is 0), the Controller number and, finally, the Partition Category (meaning the number of HDOS partitions you have allowed on this drive). This will allow you in the future to SET additional drives and controllers if you plan on paving the road to Wallet Depletion by daisy chaining multiple drives and controllers from the host adaptor card.

Now you can INIT and SYSGEN each partition separately and load any application programs you plan to work with. I should point out, before I get too far afield, that the SASIX.COM utility under CP/M and SASIX.ABS under HDOS are not only exactly alike, but can be used interchangeably.

In contrast to the simplicity of HDOS, the CP/M section takes on an ominous glow, because you must create a new BIOS and you must exercise care by following the instructions very carefully. The Quikstor CP/M Winchester software distribution disk is chock-full of files with BIOS.SYS files covering all the possible floppy drive combinations that will be used in combination with the Winchester (H-17, Z-37, H-47) under both the 2.2.03 and 2.2.04 version.

Take a blank disk. Format and Sysgen it from a CP/M system volume, making certain that the BIOS.SYS is on the disk. Run MOVCPMxx, which you will have PIPed from your particular version of the original CP/M distribution software. This will become your QSBIOS System Disk. Now boot from this disk and transfer the appropriate INSTLxx.SUB file from the Quikstor distribution disk. Also, copy the QSPUTSYS.GEN, EX14.COM and CFGPATCH.COM.

Quikdata and Ray Livingston were exceedingly foresighted by including several important Public Domain utilities on the Quikstor CP/M distribution disk:

XDIR.COM — An enhanced directory listing program which displays an alphabetically sorted directory listing complete with the size of each file.

FBAD.COM — A non-destructive disk test and bad blocks lockout utility.

ZCPR — A CCP (Console Common Processor) replacement which provides several new and useful system commands, as well as enhancing the user interface.

EX14.COM — Replacement for the Digital Research SUBMIT and XSUB batch processors, providing useful enhancements.

So, if you want ZCPR automatically installed on your QSBIOS Disk, copy the ZCPR.COD and ZCPR.REL files to this disk at this time.

Also, copy the DDT.COM, MOVCPM37.COM and CONFIGUR.COM files from the original CP/M distribution software. Now, we will run the installation program on the QSBIOS system disk by typing EX14 INSTL0x (where x is 3 or 4, depending on your CP/M version. When this function has been fully executed by the computer, QSPUTSYS.GEN, MOVCPM37.COM, CFGPATCH .COM, CONFIGURE.COM, ZCPR.COD and ZCPR.REL will be gone. In their place, you will now find QSPUTSYS.COM and QSCONFIG.COM.

Now, you will copy the appropriate BIOS0xxx.SYS to the QSBIOS system disk. For example, the Z-37 version under CP/M 2.2.04 would be BIOS0437.SYS, which you will then rename as BIOS .SYS. Then, you will run QSPUTSYS by typing QSPUTSYS A:BIOS .SYS. No specifier is used. When this program has finished, you will have a bootable Quikstor CP/M disk.

RESET and reBOOT your '89. Configure your system by running QSCONFIG, and make the proper changes to represent your system floppies, printers, terminals, etc. Reset and reboot your system, and place any other important CP/M utilities on your new Quikstor CP/M system volume that you normally use. Now, you can FORMAT and SYSGEN each Winchester partition you set up earlier.

The balance of the Quikstor CP/M documentation provides an explanation of all Error Messages, as well as an explanation of the utility programs on the distribution disk.

When all is said and done, you have a fully operational monster capable of devouring (storing) vast chunks of your work, which, with a little bit of luck on your part, will keep you away from the family for even longer periods of time.

Now — when you first turn on your '89 and you see the familiar H: or MMS: prompts, you type B for Boot and a boot menu appears on the screen. You will stare at this with great fascination, while the blinking cursor awaits your command to enter the partition of your choice. For the first few times it's kind of like an "Open Sesame" experience.

Backing Up Your Winchester Drive

One thing you will have to be concerned with on a periodic basis is the backing up of your Quikstor Winchester files. This can be

an onerous chore at best, especially if you wait until your partitions are at the bulging point.

HDOS partitions do not present too much of a problem because their individual size are the equivalent of two 96-tpi quad-density drives. It's the 4 MB or 8 MB CP/M partitions that can cause grief. Quikdata offers an interesting support package from Stock Software, Inc. called BACKREST, which can do the dirty work for you.

While there isn't sufficient space in this article to give you a full-blown rundown of the BACKREST features, it is worth every penny in terms of time saved. It is an intelligent hard disk to floppy backup and restore utility that can be modified to the user's needs. (Maybe we'll get to a full evaluation later in this series.)

It has the ability to only backup those files that were created or modified since the previous backup. This greatly reduces the number of floppy disks required for each scheduled backup. If you have a multi-user system or a single system that is used by several people, you can code your files in a manner to designate each user and backup a single user's files.

You can intruct BACKREST to ignore certain delineators so that it skips them in a backup procedure, such as *.$$$ files, *.TXT files, etc. Very long files that are too large to fit on a destination disk are split and automatically merged when restored. It can create a management report of what it has done for a permanent record. BACKREST will also serialize all floppy disks that it uses for back-up. So, it knows where it put what.

It is a clever utility that does your thinking for you, as well as forgives you when you goof. The documentation is excellent, and I do recommend that you invest in this utility if you use your Winchester extensively.

Conclusion

I cannot equate the Quikstor against the Magnolia CP/M Winchester software on an apples-to-apples basis, because the former utilizes the Heath/Zenith version of CP/M. There are numerous differences that are a matter of personal preference. I had hoped to include some observations on the Z-67 Winchester software in this series, but Heath's marketing division told me the package was dead and buried. I am hopeful, however, that some kindly soul at Heath will read this and will make an evaluation package available so that I can report on it before this series is concluded.

I liked Quikstor for many reasons. The Operation Manual is well laid out and it includes a smattering of technical info for those who prefer to put together their own subsystem. It also includes technical information on all the drives supported by Quikdata, as well as "questions" and "answers" that the uninitiated person is likely to ask. I didn't try the system at 4MHz because I haven't bothered to speed up my old '89. I'm not as impatient as I used to be.

I liked Quikstor because it supported HDOS. As clumsy as HDOS is, I am fond of it, and it will do things that CP/M doesn't. Unfortunately, all the professional software is in CP/M.

Both Dean Gibson and Ray Livingston have done an outstanding job with the software. Their final salvo to the life of the '89 (and the H-8) is probably their best. Henry Fale and the staff at Quikdata must have sweated countless hours in laying out and writing the documentation. The Quikstor manual is superb. All set-up procedures are presented in a logical sequence that is easily understood. It is probably the only manual I have ever encountered that didn't talk down to me.

Basic pricing information at the time this was prepared is: The QS20 (or QS15 if available) system of Winchester drive, Xebec controller, case with power supply and all cables, is $995. A second "slave" drive without the Xebec is $795. The QS31 system is $1695, and a "slave" drive is $1495. The Magnolia 77320 SASI host adaptor card and ROMS is $225. The Quikstor CP/M and HDOS hard disk driver software is $149 ($195 if you buy it without the system). BACKREST is $95. For more information, write to:

QUIKDATA COMPUTER SYSTEMS, INC.
2618 Penn Circle
Sheboygan, WI 53081
(414) 452-4172

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A Winchester For The '89

Part Four

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

Hide A Winchester In Your '89

As a departure from the Winchester operating systems we've discussed in the last two installments of this series, I'm going to take you on a guided tour this month on how to stuff a hard disk in your '89. While it's also a splendid way of disguising a new computer acquisition without prompting a host of nagging questions from your wife, I have some reservations about the practicality of this concept over periods of extended use.

As Winchester drives diminished in size and made use of the latest chip designs, their reduced demand on power supplies has made it practical for system integrators to dispense with the costly case and power supply and offer an affordable package to the hobbyist. However, even most IBM-PCs and a host of the compatibles on the market are unable to accept an internally mounted hard disk drive without a new 135-watt power supply to replace the standard 65-watt unit. And herein lies the problem with the '89.

Mounting a hard disk drive in the '89 was the brainchild of Floppy Disk Services, Inc. FDS has made a specialty of selling disk drives and subsystems and was one of the earliest supporters of the '89. In recent years, when some firms have phased out their support of the '89 in favor of other computer systems (need we name names?), FDS has continued to adapt new hardware for the '89 and are obviously successful in doing so.

Late in the summer of 1984, when Microscience International launched the first of several half-height Winchester drives — the 10-megabyte HH-612 — FDS obtained production samples to test with the second generation SASI controller card from Xebec called S1410a. The S1410a had all the features of the S1410 but only half the chip count, improved diagnostic firmware, which increased the reliability while lowering the power requirements.

Full-height drives and S1410 SASI card combinations needed a switching power supply capable of delivering +5 volts at 5 amps and +12 volts at 4 amps. This is rather hefty when you consider that the '89s +5 volt rating is 5 amps for the entire computer. This made it impractical to mount a Winchester in the '89. The +12 volts in a hard disk drive is required by the motor to spin several rigid metal platters at 3600 rpm, and the biggest demand occurs when the drive is first turned on. After 10–20 seconds the drive attains its rotational velocity and the +12 volt requirement usually drops in half.

Being a die-hard H-89 enthusiast, I had to get my hands on one as soon as I could. My FDS system contained the Shugart SA712 equivalent of the Microscience HH-612. The Xebec S1410a drive controller was mounted with spacers to a metal shield in order to deflect RFI emissions from inside the computer. All cables were supplied, and the package was bundled with the Magnolia Microsystems 77320 SASI host adaptor, the MMS ROM set and CP/M manual. The cost? A little under a thousand dollars. The drive has a full-height bezel with a drive indicator light on the front. The mounting hardware is quite simply the same mounting bracket used by Heath/Zenith for their H-17 drive, except that a few extra holes have been added to accommodate the Xebec card and the position of the Winchester drive's mounting screws.

The entire installation process takes less than one hour. You remove your existing internal drive and all mounting hardware. Lift the CPU board out of the mounting frame after removing all plug-in cards and cables, replace the Monitor and Secondary Address Decoder ROMs with the Magnolia equivalents supplied with the kit. Set S501 switches 1, 4 and 5 to the left; all others to the right. If your system doesn't already have the MTR90 4k ROM, install the small jumper cable from top jumper block near U518 to pin 14 on any of the three lower left-hand expansion sockets (P507, P508 or P509). Set the jumper on the MMS 77320 to 78H if you plan to retain your hard-sector controller, or 7CH if you plan to use only the soft-sector controller. There is also a DIP Switch on the 77320 host adaptor card. Make sure all switches are turned to ON.

Replace the CPU board and plug in your boards and cables. Take the drive mounting bracket and secure it to front panel. Mount

the Xebec controller, slide in the Winchester, connect your cables and power up.

This is a simplified overview of the installation, but it does illustrate the ease with which the entire unit is assembled in your '89. Most half-height Winchester drives are about a half-inch longer than their full-height floppy counterparts, so when you slide the drive through the opening, you are likely to encounter blockage from the heatsink fins on the power supply distribution board. Simply bend them close to the metal shield they're mounted on (it won't hurt) and push the drive home.

Floppy Disk Services has prepared an excellent assembly and software installation manual that holds your hand through every step. Nothing has been left to chance. FDS claims to have written the manual step-by-step during an actual hardware and software installation procedure, and I don't doubt it. The manual is profusely illustrated and check-off boxes are supplied for each step so that you don't lose track of your installation steps in the event you're interrupted. Those of you who are accustomed to climbing in and out of your '89 every so often, will probably dispense with the manual after a quick reading.

Is There Enough Power?

My big concern prior to installing the FDS internal Winchester was the '89s power supply. My unit has had periodic power supply problems that I touched on briefly in an article in the April 1985 REMark. When I investigated the power supply problems further with the Heath Consultation Group and various H/Z support vendors around the country, I proceeded to compile a list of available plug-in boards and hardware enhancements for the '89 and the +5 volt power consumption of each board (including Heath's). I had planned an article around this information, but felt this guide would be more useful if included in an evaluation of an internal hard disk subsystem. It is appended to the end of this article.

If your '89 has the upgraded +5 and +12-volt regulators installed (which are supplied with the Z-37 controller kit), your system may be able to handle this internal Winchester installation. If yours is an older model, you should upgrade your +5 volt regulator to a UF78HO5SC or MC78TO5 (Heath part number 442-651) and install it at U101 with a multi-finned heat sink. Heatsinks should also be installed at U102 and U103. Since the Xebec SASI card and the hard disk will generate a significant amount of heat, I would also recommend that you reverse your fan to blow cold air into the computer, and leave the cover unlatched to increase ventilation.

A further modification recommended to me by Leon Cray, a Senior Technical Consultant at Heath, was to remove the yellow wires from P101 of the power distribution board and cut away the orange wires that go from P103 to the bridge rectifier. Then install the yellow wires on the bridge rectifier in place of the orange wires. "Any system configuration," Mr. Cray wrote, "that draws more than 4 Amps should have this modification made on that unit . . . the effect of eliminating these four connections within the plug and sockets is to decrease the overall circuit resistance on the primary side of the bridge rectifier. By reducing the amount of resistance within the primary circuit, we are also eliminating potential sources of heat generation . . . This wiring change was incorporated into all units produced or serviced since the latter half of 1982."

The Xebec S1410a hard disk controller will consume about 1.0 amp of +5 voltage and about 3 to 6 milliamps of +12 voltage, which is quite insignificant. The Microscience HH-612 will draw .9 amps at +5 volts and a +12 volt drain of .9 amps after a brief surge of 2.0 amps as the drive motor starts up. This occurs when you first power up your computer. By the time your system prompt appears on screen the entire power supply will have stabilized.

If your system has all three right-hand slots occupied, plus the standard 16k RAM expansion board on the left, as well as a parallel board, your unit (together with the Winchester drive and controller) will probably be drawing more than the 5 amps the +5 volt regulator can supply. This could lead to system shutdown. Since the Magnolia 77320 card also provides the standard serial ports, all other cards should be removed. The system shut down is usually related to the over-heating of some wires on the power distribution board, as these pins are only rated for 5 Amps.

My first try at this installation resulted in my blowing both the +5 and +12 volt regulators. I hadn't bothered to check into the power specifications of the Shugart SA712 drive prior to installation. After they were replaced, I removed all of my boards except the Z-37 floppy controller, and the system did run as advertised. However, there was a suspect build-up of heat within the computer that I felt might be detrimental to the long term reliability of the computer. ICs have a tendency to deteriorate faster in a hot environment than in a cool one.

If you subscribe to COMPUTER SHOPPER, you will be aware of the many supply houses that sell new, but surplus, computer power supplies at bargain prices, and you have a choice of dozens of units in the $25-50 range that can provide enough amperage for a Winchester drive and controller card. Stuff one of these into a cheap case and run the power cables directly to the "Y" connector on the drive and controller. The effect of this combination will allow the '89's power supply to run cooler and you will be able to fill all your expansion slots with your favorite I/O cards.

Another precautionary measure would be to mount a second fan on the top left of the cover to blow cool air to the CPU, TLB and plug-in boards. This can be wired to the AC lines leading to the internal fan, or to an external line cord to be plugged into an outlet. It's not elegant, but it works.

If you are inclined to leave your '89 "as-is" for extended periods of time, then your internal Winchester will be housed in a stable environment. But if you tinker around, I would recommend securing the FDS hard disk unit in an external cabinet. Although most of the current crop of Winchesters are relatively immune to casual handling, it isn't wise to risk damaging an expensive investment.

Considering all the high-storage Winchester options coming available on the market, perhaps it's time for some Heath/Zenith support vendor to design a replacement power supply board and heatsink assembly that is capable of providing enough reserve power for an internal hard disk drive. The practicality of having a Winchester in your '89 can help to minimize the clutter peripheral equipment creates on your desk.

Though it isn't widely advertised, Technical Micro Systems, Inc. (PO Box 7227, Ann Arbor, MI 48107) has a replacement heat-sink assembly available for about $30 that mounts the voltage regulators away from the CPU/TLB support bracket and allows the fan to be mounted on it. TMSI also has several kits available at reasonable prices that replace a number of heat-generating TTL ICs

with low-power CMOS chips. These modifications should be considered if mounting a Winchester in your '89 is in your future plans.

The Quikstor CP/M and HDOS system evaluated in the previous installment of this series will work quite nicely with this system, too, if you want the option of using your favorite HDOS programs.

Floppy Disk Services has created an interesting piece of system integration by mating the latest high storage technology and proven software with a well-documented installation manual. Unfortunately, it lacks related information on power supply limitations that I feel prospective customers should be made aware of so they can compensate by removing unnecessary boards from their system.

For more information, write to:

FLOPPY DISK SERVICES, INC.
39 Everett Drive, Bldg. D
Lawrenceville, NJ 08648
(609) 799-4440

[The 5th article in this series was originally scheduled to be a guide on how to build your own Winchester subsystem by taking advantage of some of the close-out bargains currently available from a variety of dealers. As I am still collecting and correlating a lot of research, this article will be pushed back one installment, in order to present a new product from C.D.R. Systems, Inc. called SUPER RAM 89. This ingenious enhancement sports a Direct Memory Access controller, 1-Megabyte of RAM, a non-volatile Clock and an SCSI hard disk interface. SCSI stands for Small Computer Systems Interface, and is an evolved upgrade of the SASI standard that most Winchester and Controller manufacturers are adopting in an industry-wide effort to create a greater interchange of hardware.

In addition, other high-storage options are coming available for the '89 which we will include in a future article in this series, as well as some interesting "quick and dirty" hard disk integrations suggested by readers of this series.]

H-89/90 +5-Volt Power Consumption Chart

CPU And Replacement Boards		
Heath Co.	CPU Logic Board w/48k	.94 A
Heath Co.	Terminal Logic Board	1.17 A
Technical Micro Systems	H-1000 Replacement CPU Board (Z80 & 8086 CPU's) w/1024k	1.30 A
D-G Development	Super 89 CPU Replacement Board	
	w/128k	1.10 A
	w/256k	1.15 A
	w/256k & AM9511 Math IC	1.19 A
Floppy Disk Controller Boards		
Heath Co.	H-88-1 5.25" Hard Sector Disk Controller Board	.20 A
Heath Co.	Z-89-37 5.25" Soft Sector Disk Controller Board	.50 A
Heath Co.	Z-89-47 8" Disk Controller Board	.50 A
Bit Zero	Livingston Logic Labs FDC89 8" Disk Controller Board	.21 A
C.D.R.	FDC-880H 5.25"/8" Disk Controller Board	.35 A
Magnolia Microsystems	XM-316 5.25"/8" Dble Density Disk Controller Board	.57 A
Hard Disk Controller Boards		
Heath Co.	Z-89-67 SASI Hard Disk Interface	.50 A
Magnolia Microsystems	MX-320 SASI Winchester Bus Interface	.64 A
Magnolia Microsystems	XM-314 Corvus Winchester Interface	.62 A
C.D.R. Systems	DMA SASI Hard Disk Interface (add-on for SuperRAM 89)	.35 A
Serial And Parallel I/O Boards		
Heath Co.	HA-88-3 3-Port Serial Card	.15 A
Heath Co.	Z-89-11 Multi I/O Board	.35 A
Technical Advisors	Parallel Multi-Port I/O Board (based on number of I/O lines)	.40-.60 A
SigmaSoft & Systems	Universal Parallel Card	.15 A
FBE Research Co.	H89PIP - 2-Port Parallel Card	.05 A
FBE Research Co.	H89UTI Utility Card w/Clock	
	w/No Serial ICs	.24 A
	w/2-Serial ICs	.37 A
	w/AM9511 Math IC	+.05A
FBE Research Co.	H89CTI-a/b/c Parallel Printer Interfaces	.10 A
Kres Engineering	PPT330/3-Port Parallel I/O Board	.18 A
Graphic Boards		
Cleveland Codonics	Imaginator Graphics Board w/Tektronix 4000/4014 Emulation	.50 A
Northwest Digital	Graphics Plus	.90 A
SigmaSoft & Systems	Interractive Graphics Controller (has separate power supply)	- 0 -
New Orleans General Data Systems	HA-89-3 Color Board	1.0 A
RAM Expansion Boards		
Heath Co.	WH-88-16/16k Ram Expansion Board	.05 A
Micro Research	16k Ram Expansion Board	.05 A
FBE Research Co.	16k Ram Expansion Board	- 0 -
FBE Research Co.	Spooldisk 89 / 128k Ram Expansion & Printer Spooler	.60 A
Magnolia Microsystems	XM-311 / 16k Ram Expansion Board	.01 A
Magnolia Microsystems	XM-318/128k Ram Expansion Board	.15 A
Magnolia Microsystems	XM-422-64 / 64K Magnet Network Controller Board	1.1 A
Magnolia Microsystems	XM-422-256 / 256k Magnet Network Controller Board (Consult the Notes section below)	
C.D.R. Systems	SuperRAM 89 Board w/256k	.50 A
	w/512k	.51 A
	w/768k	.53 A
	w/1024k	.54 A
Clock Board		
Bit Zero	Real Time Clock	.06 A
Analytical Products	TIM2 Real Time Clock	.02 A

C.D.R. Systems	Real Time Clock w/Battery B/U (add-on for SuperRAM 89)	.10 A
Miscellaneous Boards		
Analytical Products	REP2 Auto Repeat Key Board	10 uA
Mako Data Products	PSG X 2 Sound Board	.06 A
Magnolia Microsystems	Composite Video Generator	- 0 -
Kres Engineering	DSM240 Dual Speed Module	.13 A
Slot Expanders		
FBE Research Co.	SLOT 4	none
Mako Data Products	MH89+3 Expansion Board	.04 A
Microflash Co.	M-89 Interface Card for M-89 Expansion Box	.01 A
Kres Engineering	7-Slot Expansion Board	.20 A

Notes:

1. You must also allow for the +5-volt power consumption of an internally mounted drive. The standard Heath/Zenith single-sided 48-tpi Siemens drive is rated as:

   .40 A when idle
   .55 A when active

   Double-sided 48-tpi and 96-tpi half-height drives are generally rated as low power, but this statement isn't always true. The QumeTrack 142 is rated at .60 Amps. The Teac FD55B and the Shugart SA455, which is also known as the Panasonic or National JA-551-2, are rated at .38 Amps. While the Teac FD55F (96-tpi) drive is rated at .70 Amps. This disparity should be watched for when you install new drives inside the '89.
2. As of 9/85, the production rights of the Z-37 soft-sector controller were acquired by Technical Micro Systems, Inc., manufacturers of the H-1000.
3. If the Magnolia XM-422-64 Magnet Network Controller board is installed in the '89, the internal drive must be removed or disconnected because the board draws its power from the floppy drive's +5/+12 connector.
4. The Magnolia MX-422-256 Magnet Network Controller has such high power requirements that it must be installed in an external case with a separate power supply.

*

A Winchester For The '89

Part Five

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

C.D.R.'s Super RAM 89 (I)

Just when you think that everything ever destined to be designed for the old H/Z-89 has already been done (in some cases, once too often) a product appears and creates a whole new set of standards. I was well under way in researching this series when C.D.R.'s Super RAM 89 slid into view. There was none of the hoopla that accompanied the impending arrival of the D.E.L. "Gemini" or UCI PC-Emulator Boards for the Z-100; nor reams of media hype of will-it-won't-it-where-is-it-send-check-now-and-hold-your-breath nonsense that kept anxious users waiting for for nearly a year before the products were ready for release.

C.D.R. (better known as Controlled Data Recording Systems, Inc., of San Diego, CA) is not a firm noted for multitude H/Z-89 enhancements. When they feel they've created a worthwhile product, they try to perfect it as much as possible and then release it. Since they're also a Zenith Data Systems dealer, they are in a position to provide good support for their customers.

The firm was launched in 1978 when Marc Brooks graduated from the University of Hawaii with a B.S. in Computer Sciences and started the company with his father Herm Brooks and Bill Martin, who had worked with Herm at his previous corporate assignment. A year later, it was just Marc and Herm Brooks as the principles of Controlled Data Recording Systems.

The newly-founded venture had its main interest in developing data retrieval and harsh environment instrumentation, remote data acquisition systems, test instrumentation and industrial controllers. They used Heath computer systems almost from the beginning and adapted the H-89 to some of their industrial data acquisition systems. The main thrust behind C.D.R. is Herm Brooks, who has been in electronics research and development divisions of major corporations for over 30 years. He holds seven patents. As with most C.D.R. products, Herm Brooks does the engineering and design work, with the assistance of their resident technician, Steve Devlin. Marc Brooks develops the in-house software.

Since C.D.R. has used Heath/Zenith computers exclusively for all software development, they branched out and became a Zenith Data Distributor and also began to design product enhancements for the H/Z-89 and H/Z-100 — including disk controllers, speed modules, power supply modifications, and special software packages.

Super RAM 89 created more than a minor flurry when it was released. Only CP/M was provided, and C.D.R. received an unexpected deluge of requests for HDOS software, which was completed about five months after the release of SR-89. The initial SASISOFT hard disk software drivers were configured around the Adaptec ACB-4000 hard disk controller, a unit they feel is more sophisticated than the popular Xebec S1410. However, a large percentage of '89 owners who had Winchester subsystems on line, used the Xebec controller, and this meant they had to develop an alternate software package.

To ease the technical correspondence load and to minimize the expense to both C.D.R. and the User in obtaining software updates, C.D.R. has created a Bulletin Board in cooperation with the San Diego Heath Users' Group. C.D.R. has provided all the equipment and telephone lines; San Diego HUG, the software and board maintenance. When a C.D.R. product is purchased, the new user receives a password to get on the BBS. From there he can download new technical data, ask for help, and receive free software updates (saving himself the nominal update charge). San Diego HUG members have access to other portions of the BBS designed to benefit their group and associated members.

Super RAM 89 is a complex product that incorporates the latest innovations in chip technology. Eighteen-months ago this product would not have been financially possible for a computer system slated for extinction in the marketplace. Now it's not only

affordable, but will turn the H/Z-89 into an entirely new system capable of holding its own in the high-speed world of 16-bit computers.

Because there is a lot of territory to cover, we are going to present the Super RAM 89 story in two parts. This segment will cover the hardware and the H/Z-89's entry into the new SCSI standard for hard disk interfacing and multi-user applications. The second part will delve into all the software for RAMdisk, Clock Board and Winchester drive usage.

What Is Super RAM 89?

There are many features to Super RAM 89. First and foremost, it is a RAMdisk, containing a full Megabyte of RAM in the form of 32-256k Dynamic RAM ICs. Load your favorite Database or Spreadsheet program and then dump the contents of a 96-tpi disk (640k), and you'll be stunned by the manipulative speed when you assemble, sort or calculate directly in RAM.

Had C.D.R. created Super RAM 89 with just the RAMdisk, it would have been a welcome add-on for the H/Z-89. But they weren't content. They included a programmable clock with a back-up battery to automatically keep track of the date and time and an 8237 Direct Memory Access Controller. (A DMA controller is a dedicated high-logic circuit that can operate faster than the microprocessors.) For direct memory access, the DMA controller takes over the CPU's memory. It contains a set of programmable registers that specify a starting memory address, the number of bytes to be transferred, and the direction of transfer (to or from memory). In a sense, it is a slave CPU, sitting idly by until an associated peripheral device has some data to be transferred. Registers inside the DMA controller are downloaded by the CPU, and when the controller has finished the job, it signals the CPU via an interrupt or control flag. As a result, data is transferred at a higher throughput, because the device communicates directly with RAM instead of disturbing the CPU.

As a coup de grace, C.D.R. added an SCSI hard disk interface via an NCR 5380 SCSI controller chip. This has several advantages for the '89. It doesn't steal a valuable expansion slot from the right-hand bus, and it enables the '89 to access high storage media — primarily hard disk drives capable of 50-144 Megabytes of storage. The older SASI interface from Magnolia Microsystems and the MMS implementation of CP/M (this includes the Quikstor Winchester software from Quikdata Computer Services) limit the user to hard disk drives with 40-Megabytes.

The SCSI interface will also allow the '89 to use the new Bernoulli Box — a removable cartridge device that is immune from head crashing, but outrageously priced; and the hard disk drives incorporating the new voice-coil technology and capable of 30ms data transfer rates. But we're getting ahead of ourselves.

The affordability aspect of Super RAM 89 is a boon for those of us who would like to add on without the painful side effects. Each component, the basic Interface Card, the Piggy-Back Expansion Board, the RAM, the Clock circuitry, the SCSI interface, the HDOS software (CP/M comes with SR-89), hard disk software for either the Adaptec or Xebec Winchester controllers, can be purchased one step at a time, like a building block.

The Hardware

A fully configured Super RAM 89 is contained on 2 piggy-back boards approximately 4" × 6". The primary interface board plugs into P501 — the first expansion slot on the left-side. It can be stuffed with 16-256k chips for a total of 512k RAM — or an equal number of 64k chips for 128k of RAM. The expansion piggy-back board contains another 512k RAM plus all the good stuff — the Clock circuitry, battery, DMA controller and SCSI interface. The two boards are mated at three points. It is a tight fit and they butt against each other without so much as an air space between them. The piggy-back board is .05" longer on top to allow for the 50-pin right angle header for the SCSI cable.

The installation is simple. Remove the CPU board and lay it down on a clear space on your desk. If you have the 16k RAM expansion board installed at P503, remove it and pack it away. You can also remove the 48k of 4116 ICs. Super RAM 89 does not recognize the RAM on the CPU board in a 1-Megabyte configuration. While leaving these chips installed causes no side-effects, they do draw unnecessary voltage from the power supply.

The next step is to remove the Z-80 CPU and plug it into the SR-89 interface card. Check the pin position marker on the board, because the Z-80 plugs upside-down on the interface card. Take the triangular folded shielded cable and plug it into the 40-pin connector on the piggy-back card. Now plug the unit into P501. C.D.R. has installed a plug between the upper and lower bus connectors so that you can't possibly plug in the board without having the pins properly aligned.

Attach the 40-pin plug at the other end of the shielded cable to the Z-80 socket on the CPU board. There is a green ground wire with a spade-lug soldered into the shielded cable that you have to connect to the heatsink panel on the top of the CPU board. If possible, use a 6 × 32 hex-head screw and secure the ground cable to one of the holes for the mounting bracket.

When you reinsert the CPU board and slide it down the support brackets, use your left hand to push the shielded cable against the CPU board so that it doesn't hang up on the heatsink panel for the Video Board and Flyback Transformer. You may also find that the mounting screw for the right side of the Flyback Transformer may interfere with the cable. If it applies too much pressure to the cable, it may ultimately tear through the vinyl if you remove the CPU board with any regularity. You might find it advisable to take a pair of wire-cutting pliars and cut off the extended part of the Flyback Transformer mounting bolt to ease the installation and removal of the CPU board. If you have any sharp corners after cutting off the extended part, file it carefully and blow out all particles with a can of compressed air, or place several layers of electrical tape over the end.

The SR-89 Manual covers the installation adequately by providing illustrations and some cautionary notes. But there are some things you should look out for.

The shielded cable is quite stiff. This is due to the fact that it is directly in back of the flyback transformer and requires a rigid shield to insure that the high-speed data transmissions aren't volatile to magnetic interference. The way the cable positions itself against the CPU board interfers with the installation of any plug-in boards at P503 (such as the Universal Parallel Interface for the INTERACTIVE GRAPHICS CONTROLLER from SigmaSoft & Systems). You can squeeze such an expansion board into place, but you will have to lift up the triangular corner of the cable in order to do so. This may have a tendency to lift the 40-pin connector in the Z-80 CPU socket out at one end — so do it carefully.

Another aspect to watch out for after you have your system up and running is a potential power supply problem. C.D.R. claims that the fully-stuffed Super RAM 89 board set draws a maximum

of .55 Amps. This conservative rating may or may not be true to your system's configuration. Since my system has been re-oriented to handle a great many enhancements (see Figure 1), I began having some additional power supply problems.

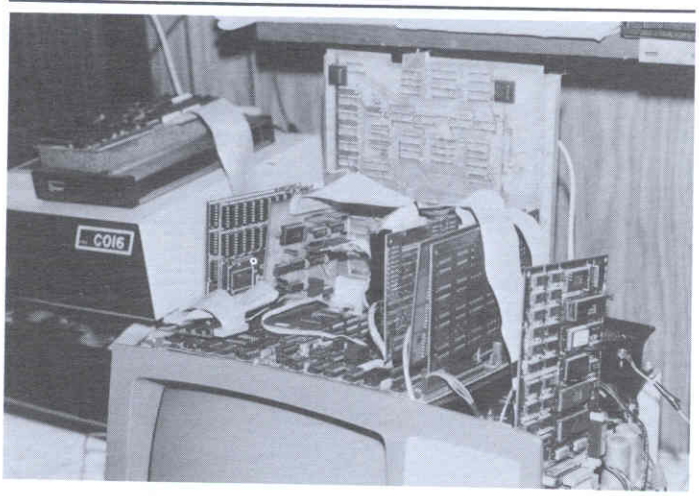

Figure 1

This may well be the ugliest H/Z-89 in captivity. I grew tired of tearing apart my computer in order to write this series, so I turned the H/Z-89 inside out. The CPU board has been repositioned over the CRT. The top of the CPU board is secured to the upright support brackets. The front rests over the CRT on several layers of insulated foam tape in order to prevent the shielding plate from coming in contact with the CRT's metal band. This makes board switching a snap, and you never have to worry about forgetting a cable connection. Of course, RFI emissions are horrendous to in-house TV reception, but you are compensated by having a cool-running unit.

The way things are installed: I have the HSC CO-16 Interface card plugged into the Z-80 socket on the CPU board. A connecting cable goes to the HSC MSDOS emulator unit. The SR-89 interface cable is plugged into the CO-16 Interface card. SR-89 is installed at P501. The hard disk interface cable from SR-89 runs to a Xebec S1410a controller and a Shugart SA712 10 MB Winchester drive. The Z-89-37 jumper wire goes to Pin 14 of P508 — the lower bus of P502. The SigmaSoft Universal Parallel Interface is located at P503, with a cable leading to an Epson MX-80. In the background, the SigmaSoft IGC graphics card is mounted vertically and connected to the Terminal Logic Board.

Moving to the right side: At P504, we have the Z-89-37 soft-sector controller serving 2 Teac 55F 96 tpi DS/DD drives. Spooldisk 89 is located at P505 with a parallel cable running to an Epson LX-80 printer. The H-88-1 hard-sector controller is at P506 to serve two Panasonic JA-551-2 48-tpi DS/DD drives. At alternate times, the H-88-1 is removed, Spooldisk 89 slides over to P506, and the Magnolia 77320 SASI card goes to P505 for use with a second Winchester drive.

On the extreme right, in the cavity where my internal drive used to be, are two boards that will be scrutinized in forthcoming articles in the WINCHESTER/'89 series. They are the new Ampro CP/M and 80186 PCDOS single-board computers with SCSI hard disk interfaces. Both mate easily with the '89's Terminal Logic Board, providing inexpensive upgrades. The CP/M version permits the conversion of all Heath/Zenith disk formats, plus the transfer of CP/M-85, CP/M-86 and MSDOS data files from the Z-100 and the Z-150 PC series computers. The total RAM installed between the various enhancements is 3.5 Megabytes.

My screen suddenly had several text lines with diminished intensity, which crawled up the screen like a shadow. At times, these lines would be stationary and flicker, or go beserk when the heating system kicked on. As I didn't have an oscilloscope to test out the voltage consistency from the +5 and +12 volt regulators, I clipped on the leads from a voltmeter and kept an eye on the dial. I also played with the G1 variable resistor on the Video Board and noticed that when I brought up the raster display, the lines were not horizontal but had a pronounced sawtooth pattern. This information, along with seeing rapid voltage drops from the +5-volt regulator led me to believe that the 10-Amp bridge rectifier and the +5-Volt regulator were on the verge of a thermal shutdown.

I decided at long last to do something about it and purchased a heavy-duty 25 Amp 50 PIV Full Wave Bridge (Radio Shack #276-1185) in place of Heath's modest 10 Amp 25 PIV part. The diminished lines disappeared; the raster screen returned to normal, and the voltage regulators started running much cooler.

I don't mean to imply that this problem is universal. But it will affect some systems more so than others. When I wrote to C.D.R. and mentioned that I was having this difficulty (as were some members of a mid-west HUG), I received a quick call from them to let me know that they had contacted those HUG members and helped to provide them with solutions. In some unusual circumstances, a small metal plate mounted over the flyback transformer will provide additional shielding from magnetic interference. In other cases, the 25 Amp 50 PIV bridge mentioned above will suffice. By the same token, I know of some H/Z-89s who exhibit none of these problems. These are primarily units that were built after 1983.

Super RAM 89's I/O Port assignments do not conflict with any existing H/Z-89 add-on hardware. The only possible mechanical interference is if you have any special graphics boards (such as the SigmaSoft IGC) mounted over the CRT. The .05" extension of the piggy-back board where the SCSI hard disk cable is mounted brings it flush with the top of the CPU board. This means it will come in contact with the ground plane of the IGC and one of the bolt/nuts that secure the IGC's mounting frame to the board. This is easily remedied by removing the bolt and placing a piece of insulated foam tape over the IGC's ground plane. Chances are that you may not be able to latch the computer's top cover, which really isn't a major catastrophe. Leaving it unlatched helps air circulation.

Theory Of Operation

The basic operation of Super RAM 89 is a result of a design decision to move the Z-80 CPU to the SR-89 board. This allows the SR-89 circuitry to access all Z-80 addresses, data and control signals, making it a kind of computer within a computer.

The contiguous use of RAM is based upon a bank switching technique which requires the use of an I/O Port. This was selected as 3A Hex. The signals required to produce the decoded I/O signal 3A Hex are fed to U19 (a 6301 PROM), which also provides decoding for the expansion board's Real Time Clock and SCSI hard disk controller interface. The Z-80 output signals are fed to the CPU board via the 6" shielded cable connected to J1 on the SR-89.

The I/O 3A HEX signal is used in conjunction with data bus bits D0, D1, D2 and D3 to select one of sixteen banks. This selection is performed by the interconnection of U20 and U22 (PAL chips). They also determine the amount of RAM reserved for global use

via Pin 8 at U20 (in conjunction with the jumper settings at JJ1 and JJ2). Pin 11 at U20 informs SR-89 if the CPU board RAM is to be used via JJ3. If you install less than One-Megabyte of RAM on SR-89, you can use the CPU board RAM. If you install the maximum configuration of RAM, it will not be recognized.

U21 is an 8409-2 Dynamic RAM Controller and when provided Refresh (Pin 28 of the Z-80), and MRQ (Pin 19 of the Z-80) will provide *CAS (Column Address Select), *RAS (Row Address Select), *WRITE and Multiplexed RAM addressed MA0 through MA8, for the RAM banks. U17 is used to prevent *CAS to the RAM banks when a program wishes to use the H/Z-89 ROMs for booting drives or running in the monitor. My system currently has the Magnolia Microsystem ROMs installed and I haven't noticed any conflict. Undershoot damping resistor networks are used in series with all signals for U21 and U17 to the RAM banks.

The *RAS signal for banks 2 and 3, together with all other output signals from the RAM controller, are fed to connector J3, which is used to provide drive to the SR-89 expander RAM. The RAM data pins are fed to the Z-80 data pins and to connector J2. This connector also carries the data developed by the circuitry on the expander board.

The SR-89 expansion board contains two RAM blocks. As mentioned earlier, they can either contain 256k or 64k chips. With 256k chips currently selling around $2.50 from many sources in COMPUTER SHOPPER, it would be a criminal waste to use the 64k chips. Control signals and power to these RAM banks are fed through P3. Data lines through P2.

The Clock I/O address is A0 HEX through B7 HEX via Pin 9 of P2. Timing for the clock is provided by a 32 KHZ NOM crystal located at X1, and the associated resistor capacitor networks of R1, R2, C18 and C19. The Clock runs off of 5-volts connected to Pin 24 through diode D2. When the computer is powered down, the clock receives its power from a 3-volt lithium battery. C.D.R. claims that you can also use a 9-volt transistor battery in place of the lithium battery, for an anticipated 3-year lifespan.

The PAL at U20 provides decoding and selection of the SCSI interface which is comprised of U17, U19, U20, U21, U22, U23 and resistors R2 through R18. The SCSI I/O decode is arrived from P2 pin 10 and is set at 90 HEX through 97 HEX. The DMA controller is addressed at C0 HEX through CF HEX. The SCSI ID generator, U19, is addressed at 88 HEX through 8B HEX.

Now — if you read the last few paragraphs closely, you may have noticed that there is some chip duplication. Unfortunately, both boards use the same numerical starting sequence, instead of having different numerical designations. That requires the user to be very specific when consulting the schematics and the parts list for the SR-89 boards. These are included in the revised CP/M software and installation manual. If you received one of the early manuals, two copies of the expansion board schematics were included due to an oversight by the printer. C.D.R. will provide copies of the interface board schematics if you want them as part of your documentation package.

A manufacturer is not obligated to provide schematics for his products. Heath/Zenith is one of the few computer manufacturers to provide complete technical data on its computers. This policy has been adopted by most of the major supporting vendors, except for Magnolia who regard their boards as proprietary secrets. C.D.R. seems to support this policy by allowing us to acquire additional knowledge by seeing how the SR-89 circuits work together.

The SCSI Interface/BUS

As you learned in the INTRODUCTION to this series, the drive manufacturer Schugart developed the original SASI (Shugart Associates System Interface) hard disk interface. They are also responsible for the development of the SCSI (Small Computer Systems Interface) bus in cooperation with NCR.

This is an evolved standard of the SASI interface which allows owners of SASI standard hard disk drives and controller boards to upgrade without having to scrap their original equipment. It is also the first step in the development of a common bus system among all computers and peripheral equipment.

Unlike the RS-232C and the Centronics Parallel interfaces which require a separate I/O Port connector to bridge it to a single peripheral (a printer, modem, plotter or floppy drive) the SCSI bus can connect several Host Processors with several peripherals. Specifically, 8 and 16-bit computers can hook up to each other through the simple SCSI Host Adaptors and share the same peripherals.

If you have acquisition mania and own an H/Z-89, Z-100 and Z-150 PC series computers in different rooms, a SCSI bus network will allow all computers to share a single (or multiple) hard disk drive and one printer — through an interesting bus arbitration scheme. In business situations, it avoids having to replace an entire series of computers. Additional systems can be acquired and hooked up to the existing network without the major expense of LAN or Network units that can cost between $800-1000 for each computer.

Computers equipped with a SCSI Host Adaptor/Interface are able to reside on the same bus because a Control Unit (an NCR 5380 SCSI Controller Chip) relieves the CPU of the chore of communicating and transferring of data to and from the peripheral. It also handles the complex and time consuming task of converting Serial Data to Parallel Data and back again, so that each CPU on the system is free to respond to continued user input.

Figure 2 illustrates how various single and multi-processors are interfaced with a variety of devices ranging from hard disk drives, magnetic back-up tape equipment, Bernoulli boxes, flexible disk media, and the developing optical disk storage technology.

Under the present proposed SCSI standard, a system can have a combined total of 8 Host Adaptors and Control Units. Each Control Unit can service 8 external devices. Thus, 64 devices can be connected on a single 50-pin cable. With the proper software development and the implementation of all signal lines on the bus, it is projected that the SCSI bus will ultimately be able to link 2,048 devices.

The 50-pin mechanical interface includes 9 Control and 9 Data lines. Differentially driven signals (those on a multi-user system) can use a maximum cable length of 25-meters between each shared device. Single-user systems are limited to 6-meters. Under an asynchronous protocol arrangement, the SCSI bus will transfer data at 1.5M bytes/sec. Synchronous protocol allows for a 4M bytes/sec. transfer rate. The older SASI interface transferred data 5M bytes/sec. But something has to give somewhere.

John Lohmeyer, of the Peripheral Product Development Department of NCR Corp. (Wichita, KS), described in the January 24, 1985 issue of EDN how linked devices on an SCSI bus asserted use of peripherals:

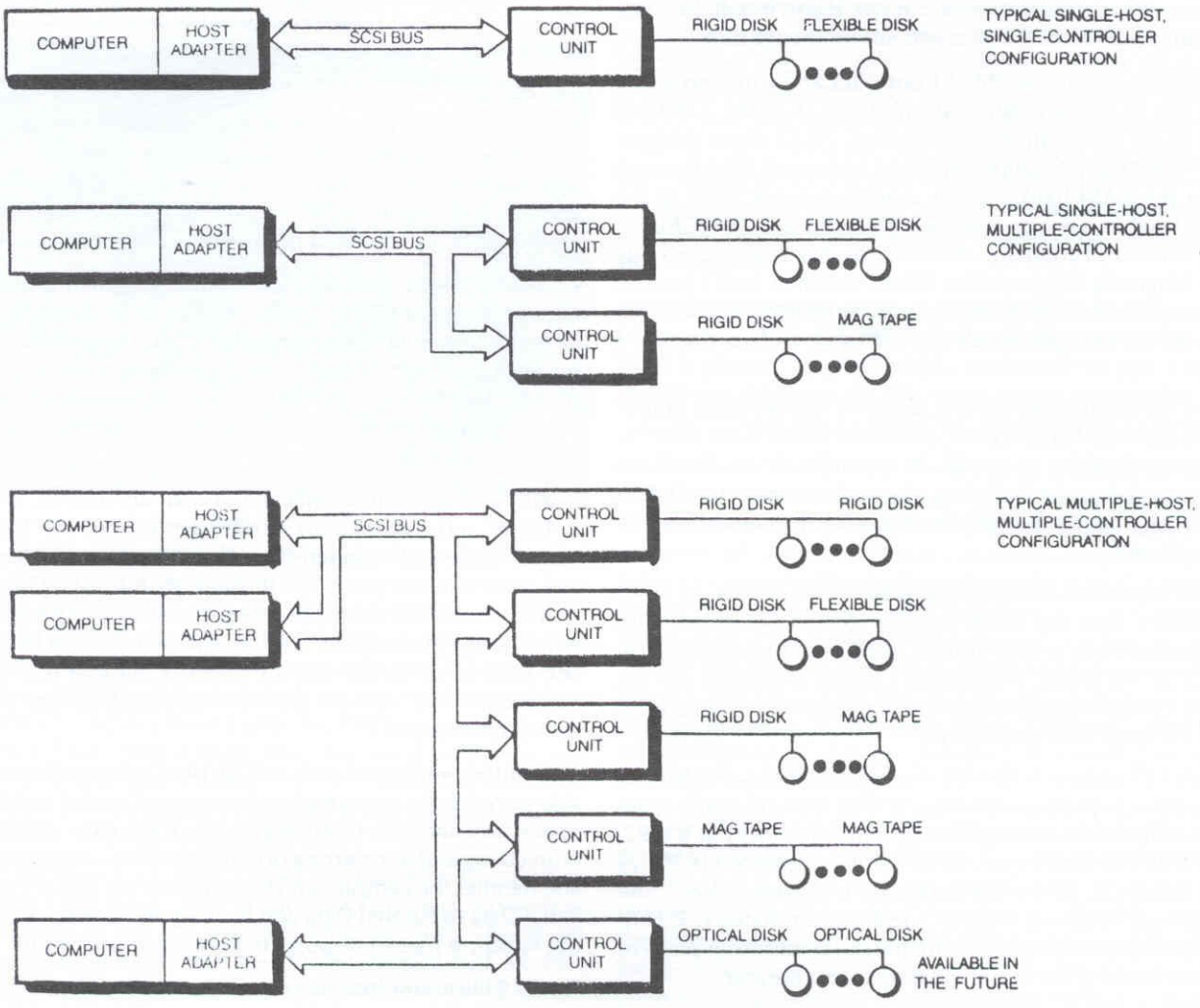

Figure 2

Here are examples of single and multi-user SCSI setups as taken from the ANSC X3T9.2 draft standard manual. It is available for $20 from The X3 Secretariat, Computer & Business Equipment Manufacturers Assoc., 311 First Street, N.W., Suite 500, Washington, DC 20001. Include a self-addressed mailing label.

"The SCSI's scheme for arbitrating bus contention specifies eight lines on the SCSI connector as device ID lines, numbered 0 to 7. To initiate a transaction, a device (the initiator) first checks the control lines to determine if the bus is busy. The initiator does so by detecting the presence or absence of Bsy (busy) and Sel (select) signals. If these signals are not detected, the device asserts Bsy and its own specified device-ID line. If more than one device contends for the bus, the device with the highest priority ID gains access to the bus.

"A general strategy for assigning bus IDs is to give the highest priorities to devices that are not fully buffered; this ensures that each device in the system has sufficient bandwidth to complete transactions. Printers and other fully buffered devices should generally be assigned a lower priority.

"A device that wins an arbitration asserts the Sel signal to end the arbitration. It continues asserting its own ID line and it asserts the ID line corresponding to the device it is selecting. It then stops asserting Bsy, and the selected device (called the target) responds by reasserting Bsy.

"This arbitration scheme is simple but effective. It requires no data transmission before establishing the connection between the initiator and the target, thus reducing system overhead. As a result, bus utilization improves."

NCR claims that peripherals attached to an SCSI bus have an activity limit factor of about 30% before things bog down. The bulk of this time is consumed by buffered devices (printers) while high-density storage media has a much lower activity factor due to the rapid transfer of data to and from the host com-

puters. A semblance of order is maintained through the use of sub-channels on the SCSI bus which can thread data from several computers to different target devices at the same time.

The Microprocessor Products Division of Motorola has gone one step further. In developing the MC68HC99 IC, it has incorporated both a microprocessor and an SCSI port structure into one chip. This chip also contains a serial data processor (serializer-deserializer, which we discussed in the Introductory part of this series), DMA-driven sector buffers, and Reed-Solomon error checking and correction circuitry.

Chips like the MC68HC99 are also capable of maintaining integrity of data. Some disk drives are able to isolate tracks that may have trouble-spots which are caused by defects in a disk's surface that may have occurred during the manufacturing process or during prolonged use. They can help the drive controller isolate these areas and automatically map them out. This is accomplished by the alternate-sector, alternate-track method. Each track is assigned several spare sectors. Thus, if a drive encounters a bad sector, it automatically attempts to use one of the spares. If there are no spare sectors available, the entire track is deemed defective and all data is routed to an alternate track. With the DMA taking control of the data transfers, the CPU can assist by monitoring the spindle rotation of the motor, the consistency of the drive's power supply and the accuracy of the drive controller — creating a check and balance within the system that is able to isolate malfunctions before they result in a breakdown.

A major application for this type of data integrity is in systems where breakdowns cannot be tolerated — such as in banks, airline scheduling, database banks and communications transmissions.

The SCSI standard has been several years in development and is only now being adopted by drive, controller and computer manufacturers as older equipment heads for the second-hand junk heap. It is probably the only standard that will prevent the ultimate industry take-over by the IBM hardware standard for computers, because it allows special applications hardware and different Microprocessors to co-reside on the same bus and share common peripherals, even if they have proprietary interfaces based on the SCSI standard. It may also trigger more independent development of unique hardware, as well as give it a better chance of capturing enough market share to insure even modest success without it having to buy its way to fame, whether deserving or not.

The effect these chips have achieved is the reduction of the old SASI interface to just a couple of parts rather than whole boards. I should also mention that the development of the SCSI bus standard has resulted in manufacturers working together to establish a common interchange of hard disk controllers and hard disk drives without the need of system integrators and software houses having to develop specific software for a specific group of drive/controller combinations.

The established ST506 hard disk interface has been incorporated into the new SCSI ST412 interface. Some manufacturers will list them as ST506/412 compatible. And since the SCSI firmware contains a super-set of the SASI firmware, equipment originally designed for the SASI standard will run perfectly well on an SCSI system. The only exception to this rule is that an SCSI system using SASI controllers will require specific software drivers for specific controller boards.

The foregoing may be regarded as a general overview of the SCSI standard. There are some new products coming available for the H/Z-89, Z-100 and Z-150 series of computers that will exploit the SCSI bus potential in interesting ways. The hardware isn't quite ready for release, but I expect to obtain evaluation units very shortly for a future article in this series.

* * *

I have a strong feeling C.D.R. plans to be in the forefront of the SCSI development for all Heath/Zenith computer systems. By the time this article appears, they will have released a hard disk controller board for the Z-100 series computers that will not only look like a Zenith Z-217 hard disk controller to the computer, but it will also enable the Z-100 to communicate externally with other SCSI devices — including the H/Z-89 with Super RAM 89 and the SCSI option.

The hard disk software presently available (December 1985) for SR-89 follows the SASI conventions in communicating with the Adaptec ACB-4000 controller. A modified version for use with the Xebec S1410/a controllers is also available.

Full implementation of the SCSI bus is currently in Beta site testing at a San Diego school district where three SCSI/SR-89 equipped H/Z-89s are linked to two 54 MB hard disk drives and a 90 MB MAG tape system to handle employee payroll and scheduling information. The SCSI software is being developed and tested by Eugene Skopal, Systems Administrator for Copley Computer Services (7701 Herschel Drive, La Jolla, CA — 619-457-3880). C.D.R. expects that the general release of this software will coincide with their own release of the SCSI controller for the Z-100.

As a closing note, Figure 3 shows a comparative chart that I have compiled to illustrate the SASI interface in comparison to the single and multi-user SCSI bus.

Figure 3

This is a compilation/comparison of the SASI and SCSI Connector Pin Assignments. Applicable notes have been included at the end of the chart.

SASI INTERFACE		SCSI SINGLE ENDED OPTION	SCSI DIFFERENTIAL OPTION			
Signal	Pin	Signal	Signal	Pin		Signal
DATA0	2	-DB(0)	SHIELD GROUND	1	2	GROUND
DATA1	4	-DB(1)	+DB(0)	3	4	-DB(0)
DATA2	6	-DB(2)	+DB(1)	5	6	-DB(1)
DATA3	8	-DB(3)	+DB(2)	7	8	-DB(2)
DATA4	10	-DB(4)	+DB(3)	9	10	-DB(3)
DATA5	12	-DB(5)	+DB(4)	11	12	-DB(4)
DATA6	4	-DB(6)	+DB(5)	13	14	-DB(5)
DATA7	16	-DB(7)	+DB(6)	15	16	-DB(6)
SPARE	18	-DB(PARITY)	+DB(7)	17	18	-DB(7)
SPARE	20	GROUND	+DB(PARITY)	19	20	-DB(PARITY)
SPARE	22	GROUND	DIFFSENS	21	22	GROUND
SPARE	24	GROUND	GROUND	23	24	GROUND
SPARE	26	TERMPWR	TERMPWR	25	26	TERMPWR
SPARE	28	GROUND	GROUND	27	28	GROUND
SPARE	30	GROUND	+ATN	29	30	-ATN
SPARE	32	-ATN	GROUND	31	32	GROUND
SPARE	34	GROUND	+BSY	33	34	-BSY
BUSY-	36	-BSY	+ACK	35	36	-ACK
ACK-	38	-ACK	+RST	37	38	-RST
RST-	40	-RST	+MSG	39	40	-MSG
MSG-	42	-MSG	+SEL	41	42	-SEL
SEL-	44	-SEL	+C/D	43	44	-C/D
C-/D	46	-C/D	+REQ	45	46	-REQ
REQ-	48	-REQ	+I/O	47	48	-I/O
I-/O	50	-I/O	GROUND	49	50	GROUND

1 - In the SASI option, all odd numbered pins are GROUND.

2 - In the single-ended SCSI option, all odd pins except 25 are connected to GROUND IN. Pin 25 may be OPEN or GROUNDED.

3 - Shield ground is optional.

4 - TERMPWR pins may be used to provide 5V for terminator power.

5 - Pin 21 in the Differential Option may be used to provide active high sensing for enabling differential drivers.

In the next installment, we will discuss the creation of Super RAM 89 — the people who contributed to its hardware and software development — and evaluate all the software packages. My opinion after working with Super RAM 89 for the past two months is that it is an exciting product whose best applications are yet to come.

* * *

Super RAM 89 Board 1 (w/o RAM) is $190. Board 2 is $90. Real Time Clock option is $45. SCSI/DMA option is $95. HDOS software is $35. CP/M is free with Board 1. Hard disk software — either for their Adaptec or Xebec controllers — is $75. For current pricing 256k RAM, hard disk drives and controllers, please contact:

CONTROLLED DATA RECORDING SYSTEMS, INC.
7210 Clairemont Mesa Blvd.
San Diego, CA 92111
(619) 560-1272

*

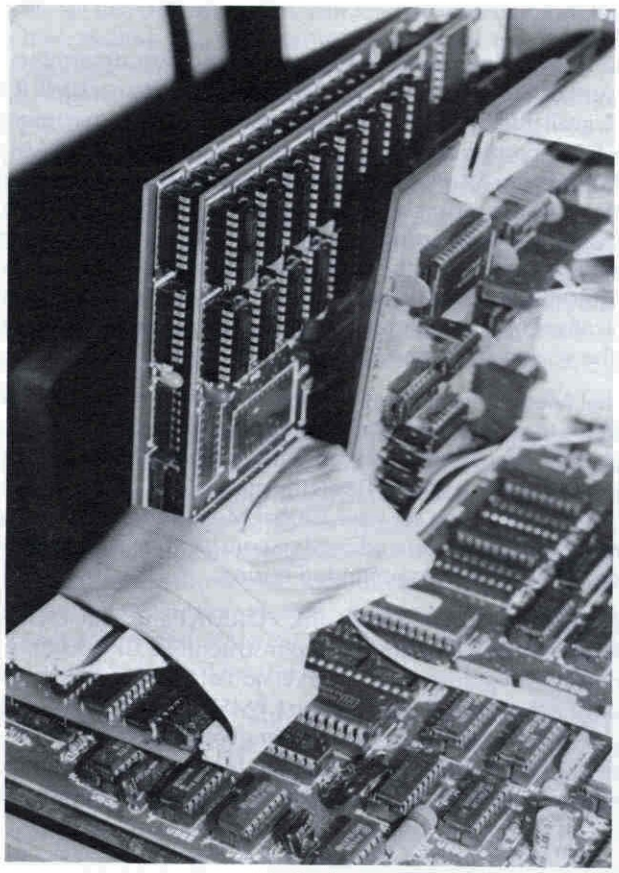

Photo 1
Super RAM 89 installed in the H/Z-89.

A Winchester For The '89

Part Six

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

C.D.R.'s Super RAM 89 (II)

In the previous article, I presented an overview of Super RAM 89, a unique multi-faceted enhancement for the H/Z-89 computer system that adds (on two piggy-back boards that plug into one left-side expansion slot) 1-Megabyte of RAM, a DMA controller, a Clock, and the latest in hard disk interfacing technology — the SCSI bus.

This concluding portion will discuss the pros and cons of the software and documentation, and provide you with some background on the development of Super RAM 89.

The Creation Of Super RAM

According to Marc Brooks, this product was not on C.D.R.'s list of priorities. They were designing a new hard disk controller for the Heath/Zenith Z-100 computer series that incorporated the new SCSI bus. They had a variety of hard disk packages available for the H/Z-89 that used the Magnolia 77320 SASI host adaptor and CP/M, and the standard Xebec and Adaptec controllers with assorted Winchester drives, which they felt were adequate.

But as their work on the Z-100 controller proceeded, they began to succumb to the suggestion of L. D. Haag and John Allen (and other members of the San Diego HUG) that they do a RAMdisk board for the H/Z-89 that went beyond the 128k limit of the Magnolia and FBE Research boards. Early in 1985, as the prices of 256k RAMs began to plunge, a RAMdisk board began to appear more and more as a viable product that could be produced at a realistic price.

As the design criteria took shape, the Brooks' began to realize that the design principles they were incorporating in the Z-100 SCSI card could readily be adapted to the emerging Super RAM 89 by simply adding a DMA controller and a few extra parts.

By this time, too, the number of people involved in the project had also grown. L. D. Haag was assigned the job of developing the CP/M software. Haag, a long-time user of the H/Z-89 and related C.D.R. products, is a Master Chief and Electronic Warfare Technician for the U.S. Navy, currently the supervisor and course curriculum model manager for basic electricity and electronics schools for the U.S.N.

Haag also assisted in the initial bread-boarding of the project that was dubbed RAM 89. Eugene Skokal of Copley Computer Services and Peter Shkabara of Analytical Products (a C.D.R. dealer) contributed the Clock design and software. Skokal's firm also began to develop networking software for the SCSI implementation that would ultimately allow a group of H/Z-89s to share the SCSI bus and use high storage drive and tape media. Marc Brooks took on the task of developing the driver software for Super RAM 89 that would enable it to interface with the Xebec and Adaptec hard disk controllers.

The final design, layout and hardware implementation was done by Herm Brooks, who also supervised the entire project. Testing was assigned to John Allen, and C.D.R.'s technician, Steve Devlin. Super RAM 89 was released with CP/M in June of 1985.

Since, C.D.R. does not use HDOS for in-house purposes, they contracted with Alan L. Heigl of Mill City Records, Minneapolis, MN, to develop the necessary drivers and supporting software. Heigl is a software designer with many years of experience and a former employee of the Heath Company. He managed to imple-

ment more capabilities into the HDOS drivers than C.D.R. thought possible. The HDOS software became available in October 1985, about the same time as the SASISOFT hard disk software for the Adaptec ACB-4000 was released. The SASISOFT utilities for the Xebec S1410/a controllers were released in January 1986.

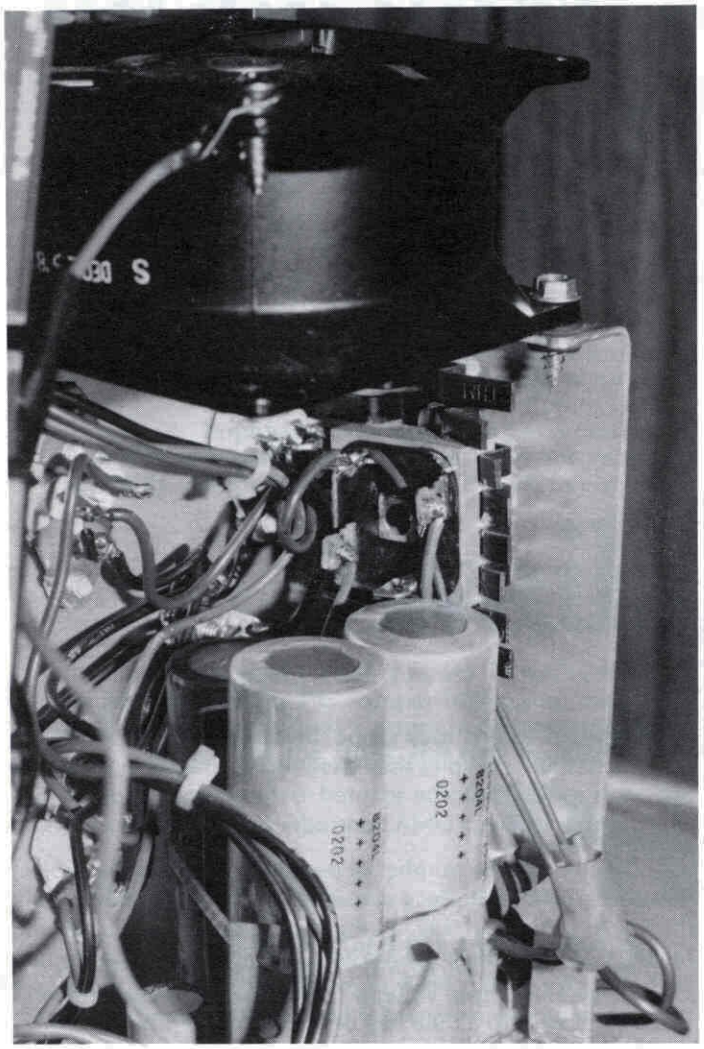

Photo 2

In the first segment of the Super RAM 89 review, I mentioned having replaced Heath's 10 Amp 25 PIV bridge rectifier with a 25 Amp 50 PIV unit and installing it on the replacement heatsink assembly available from Technical Micro Systems (P.O. Box 7227, Ann Arbor, MI 48107). Note that the bridge rectifier was moved from its heat generating position on the lower right to the back panel of the new heatsink assembly. The fan was moved from its original position on the inside of the top panel and now mounts directly on the new heatsink forcing air down on the power supply components. The result is a cool, quiet and highly stable power supply. If your H/Z-89 exhibits erratic screen behavior or generates too much heat in the power supply area when your system is over-stuffed with expansion boards, you might well consider this modification.

CP/M For Super RAM 89

All the software for SR-89 is easy to use. CP/M, which usually requires that devices be incorporated into the BIOS through the painfully slow MAKEBIOS procedure, spares us on this occasion as the file INSRAM.COM enables us to attach the RAMdisk parameters by just answering a few questions in a menu-driven format.

Prior to installing the CP/M software, you must determine the amount of Global Memory you wish to allocate to each 64k RAM bank available on the RAMdisk. You are allowed a maximum of two RAM partitions as long as you have at least 256k RAM installed on your SR-89. I should note that bank switching is automatic in order to make each RAMdisk partition available as contiguous RAM. Partition 0 will always be one 64k bank larger than Partition 1. Since the RAM on the two SR-89 boards can be an intermingling of 64k and 256k RAM chips, the software automatically senses the amount of RAM available and will display it on the screen each time you boot the system.

Global Memory is generally called "common memory" that is used to store data common to all the banks — such as the Z-80 stack data. You establish the amount of Global Memory by setting the jumpers at JJ1 and JJ2 on the main board. Standard CP/M 2.2 requires that you set your Global Memory for 1k. If you are using CP/M 3.0, you are advised to consult your system manual to determine the recommended setting.

The next step is to take a fresh disk, FORMAT and SYSGEN it, and then set the Global Memory by constructing a CP/M system of 63k bytes, using the appropriate version of MOVCPM from your CP/M 2.2 distribution disks, or the CPMSIZE utility from C.D.R. if you are using their floppy controller. Now, you transfer the the INSRAM.COM and RAMTST.COM files to your newly SYSGENed disk, plus PIP, STAT, DIR and other frequently-used files.

INSRAM.COM allows you to establish several parameters on your new system disk:

1. RAMdisk and Logical Disk drive letter assignments
2. Number and size of RAMdisks you want
3. The ability to warm boot from RAMdisk, even if you do a SHIFT/RESET in the event a program locks

You answer the on-screen questions in a few seconds, and you're ready to go to work. You have the option to create an "auto-install" file. If you choose this, INSRAM.COM will create two files called SRAM.COM (which brings up the RAMdisk in a preset form) and ARAM.COM, which is the auto-install version. It automatically checks for the amount of RAM available, and if the RAM drives have valid files and sets a clean directory if they don't.

INSRAM.COM also allows you to set the drive designations for the RAM partitions; and, if you choose A: and B:, your logical floppy assignments move down accordingly.

If you wish, you can create an autoload routine that will automatically load the RAMdisk with your favorite application program when you boot up. The documentation provides you with a step-by-step guide using any Text Editor to construct a SUBMIT file for this purpose. If you use several application programs with any regularity, you might want to consider creating a SUBMIT file for each one on different disks, and then making an extra file copy for backup purposes. By including ARAM.COM in the first line of your SUBMIT file, followed by the names of the programs you want to load into an assigned RAMdisk partition, you actually create an "auto-boot" situation that eliminates a lot of typing and file PIPing.

Since RAMdisk allows you to create a single 1-Megabyte partition, you can really appreciate this amount of overhead if you have 96-tpi DS/DD drives. You can load an entire disk of database files, mailing lists, inventories, or whatever into RAM and have almost instantaneous manipulation of data. Certain programs require the presence of two drives — one for the program files, the other for the data files. Setting your RAMdisk for 2 logical partitions is most useful in these instances, especially if you are going to record specific data on different disks. This will allow you to transfer the files from the second partition to your disk, clear the workspace and then dump more data files in this area of RAM. When you combine RAMdisk with a Winchester drive you'll never be satisfied in using your floppy drives. The H/Z-89 RAMdisk/Winchester combination operating at 2-MHz sure beats the pants off my 4.77-MHz IBM clone and gaudy color screen.

The original version of the Super RAM 89 CP/M software set the I/O port for the RAMdisk as 38H. This conflicted with the Magnolia Microsystems double-density controller which also used this port, as did C.D.R.'s own 5"/8" floppy controller. The software was quickly updated in version 1.5 to change this to 39H. The disk currently distributed includes both versions to allow some flexibility in the choice of floppy controllers. The INSRAM0.COM and RAMTST.COM files use 38H; INSRAM .COM and RAMTST.COM use 39H.

I was a little disappointed with the original documentation supplied in the CP/M Manual. It only provided 5 pages of instructions on using the CP/M programs. I felt a better effort could have been made on the part of L. D. Haag and C.D.R. Even the installation section is meager and it does not live up to either the quality of the hardware or the software. When version 1.5 was released, the disk included more comprehensive documentation on using the software in the form of INSRAM.DOC and README.DOC text files. Seven pages are devoted to schematics, physical layouts of the two boards, and a complete list of all the parts.

HDOS For Super RAM 89

By way of comparison, the 21-page HDOS manual prepared by Alan Heigl really sparkles, and attests to his experiences at the Heath Company. But I had a small problem.

Whenever I booted up my HDOS RAMdisk system volume and tried to mount a disk in another floppy drive or attempted to invoke the SET option help menu, the computer just locked up. With the aid of Alan Heigl, this difficulty was traced to the fact that I had the Magnolia Boot ROM installed. The HDOS SR-89 software requires that you have the Heath MTR-90 Monitor ROM installed as it makes several calls into the MTR-90 ROM for various operations.

I have encountered this problem with other recent software. Writers of HDOS software automatically assume that all systems use the MTR-90 ROM. It would be nice if somewhere it would state that specific Monitor ROMs or TLB ROMs are required to run certain programs or operating system enhancements that are tied to hardware. There are so many alternate ROMs in use on the '89 that the user often neglects to suspect that a specific software problem is related to the ROM set installed in his computer. Including me.

First of all, the HDOS software includes a utility called RAMTST14 .ABS so that the user can run some comprehensive diagnostics tests on the RAM banks. This program is identical to the RAMTST utility on the CP/M disk. This is a handy program if you ever develop a hardware problem with SR-89 that you suspect might be related to a faulty RAM chip. The program first asks you to identify the type of RAM chips installed in each bank (whether 64k or 256k) and then performs a read/write to each bank.

The HDOS RAMdisk software requires that you patch the HDOS .SYS file on each disk you want to use with the RAM drive capability. This is similar to SYSGENing a 63k CP/M disk. The program HDOSCDR.ABS will make automatic patches to any disk by creating a 63.5k system bank. The unique aspect of this is that it will do so not only to new disks, but to existing disks loaded with your application software, even though HDOS.SYS is a write protected file. You can perform this function to a disk in any drive, whether or not the disk in mounted. All you do is specify the name of the drive, and answer YES, and the program mounts the drive, patches the HDOS.SYS file and then dismounts it.

The actual HDOS RAMdisk driver is called RD.DVD. It can only be loaded into memory if RAMDRIVE.SYS is resident on the same disk. If you forgot to copy RAMDRIVE.SYS, RD: will actually remove itself from the HDOS list of available drivers, and you have to start over again.

When you boot up an HDOS system volume containing the RAMDRIVE.SYS file and RD.DVD on a 1-Megabyte SR-89, RAMDRIVE.SYS automatically identifies the amount of RAM you have and breaks it up into 15-63.5 banks. The RAMdisk partitions are established by performing the SET routine: SET RD: UNITS 1 (for a single partition) or SET RD: UNITS 2 (for two partitions). If the latter is chosen, the first partition will have 8 banks of RAM available and the second only 7 banks. This allows for a 63.5k RAM bank for system overhead.

You can also do a SET SWAP or SET NOSWAP. A SET NOSWAP sets up partitions RD0: AND RD1: as electrical disk devices that you access like any other device under HDOS conventions. The SET SWAP option automatically locks RD0: and RD1: into memory as SY0: and SY1: and assigns your original boot drive to SX0: and your second drive as SX1:. Your alternate system drives remain as DK0:, etc. The swapping also transfers essential HDOS system files to the electrical disk so that it is able to perform the usual I/O communications with other devices and peripherals on your system. You are also able to create a RAMDRIVE.DAT file with the utilities provided on the distribution disk that will allow you to automatically load special programs and files to the RAMdisk at the same time that the system files are transferred. It is the functional equivalent of the CP/M ARAM.COM and SUBMIT.COM programs.

The HDOS RAMdisk cannot be SYSGENed, nor can it be used to SYSGEN disks, as the conventions of the software look for the presence of the original SY0: drive that you booted from.

While the HDOS version has, until now, appeared to be similar in functions to the CP/M version of RAMdisk, it doesn't incorporate the feature and the ability to keep RAMdisk files in memory when you do a SHIFT/RESET, followed by the usual Boot routine. Therefore, you must exercise care and make certain that you save any files you have been working on to disk before exiting.

Since I use SPOOLDISK 89 from FBE Research Company as my main workhorse (it is also a silent disk with 128k RAM), I generally PIP my files there and use it as a storage depot if I'm not quite finished with my work, because it is impervious to a system SHIFT/RESET and provides me with a safety margin. If it were

possible, I would like to see some kind of inexpensive back-up battery device that would keep the SR-89 RAM alive and refreshed even during a system shutdown or power failure.

Several other programs are worth mentioning. CDRDATE.ABS is a stand-alone program that will supply the correct date to HDOS during BOOT providing the C.D.R. Clock option is installed and set. A lithium battery maintains the clock when the computer's power is off. The CP/M version will insert the date and time at the beginning of each file you save to disk and provide you with a reference period as to when the file was created or worked with last. But unlike the HDOS version, it can't insert the file's date in the directory listing.

The other programs are ASMCDRC.ABS, which is the standard Heath HDOS assembler with 5 changes; and XREFCDRC.ABS, the standard Heath HDOS cross-reference program with 2 changes. They were provided pursuant to a license courtesy of Heath Company and Zenith Data Systems. The HDOS software manual requires a careful reading as it is chock full of information and options that help to make Super RAM 89 the interesting and useful enhancement it is.

The Winchester Software

Incorporating a hard disk drive on Super RAM 89 will be an evolutionary process covering at least a year or more.

I say this because the initial SASISOFT program, released in September 1985 was specifically geared to the Adaptec ACB-4000 controller. This is a SASI hard disk controller usable on a SCSI bus that doesn't have all the features of the Adaptec ACB-5000, which I suspect C.D.R. will ultimately select for an expanded implementation of the SCSI bus in a networking arrangement with the SCSI hard disk interface they expected to release for the Zenith '100 computer series as this article was being written.

Since there is a sizable installed base of hard disk systems on '89s using the Xebec S1410/a hard disk controller, a special version of SASISOFT is also in preparation.

As you will have noted from previous articles in this series, setting up a Winchester hard disk is not overly difficult, but you must perform a variety of steps in a certain order and must read the documentation very carefully.

The User Manual for the Adaptec ACB-4000 version of SASISOFT has been thoughtfully prepared, and includes a veritable treasure of hard disk drive information that I will discuss in a few moments. It is only available for use with CP/M.

The SASISOFT distribution disk contains the following programs:

SASIPREP.COM — This is the main program file, which is used to initialize a hard disk drive. It also tests the drive and creates SASI.COM, which becomes the hard disk boot set to run with the current system configuration. It uses SASIPREP.TBL and SASIPREP.OVL to perform some of its tasks.

SASIPREP.OVL — This file is used by SASIPREP.COM as an overlay which contains the subroutines necessary to communicate with the SR-89 SCSI interface.

SASIPREP.TBL — This file is used by SASIPREP.COM as a table of hard disk types to choose from. It contains all of the pertinent information used by SASIPREP.COM to initialize a large number of hard disk drives. The user can add to this list through the SASIPREP.COM program.

SASICCP.SPR — This is a ZCPR version of the CP/M 2.2 CCP in a relocatable form. It is used by SASIPREP.COM for part of the hard disk section in the creation of SASI.COM.

SASIBDOS.SPR — This is a modified BDOS for CP/M 2.2 in a relocatable form. It is used by SASIPREP.COM for part of the hard disk section in the creation of SASI.COM.

SASIBIOS.SPR — This is the hard disk addition to the system CP/M 2.2 BIOS. SASIPREP.COM uses it to create the SASI .COM file.

SUBMIT.COM — This is the standard batch file processor modified to be able to run from the hard disk. The conventional SUBMIT program will not work if installed on a hard disk.

D.COM — This is a variation of the many directory display programs. Most directory programs do not act correctly with large disk or large directories and will often show strange results.

The Manual does a creditable job in guiding the first-time user through the steps of formatting, partitioning and setting up an operational BIOS on a hard disk. The software appears to limit a CP/M partition size of about 8-Megabytes. I haven't been able to confirm this with C.D.R. and it isn't mentioned anywhere in the documentation. It also doesn't make use of the DMA option included on the hardware, and consequently, the transfer of data between RAM and the hard disk is considerably slower than the 1.5 Mbyte/sec allowed under the SCSI standard.

In terms of educating the user on how a hard disk functions, how you can formulate sector or cluster sizes to maximize the storage on your partitions, interfacing with controllers, and the inclusion of additional utility programs that would increase the versatility of the software package, the SASISOFT programs and documentation are not in the same league as the QUIKSTOR hard disk software from Quikdata Computer Services.

SASSISOFT is a basic set of programs that get the job done, and in this regard it does it very well. I found the setting quite simple and free of anxiety inducing error messages. Quite possibly, when C.D.R. issues their full SCSI implementation, they will treat us to a more explicit manual — one that will demonstrate how multiple computers can share a common group of peripherals.

The "treasure" I mentioned earlier is in the form of a list that provides complete data on 127 hard disk drives from 23 manufacturers: number of cylinders, number of heads, write reduction information, formatted capacities, etc. This allows the user a great deal of flexibility in using any drive, rather than being limited to Shugart, Seagate, Tandon or Microscience drives. The size of the drives on the list range from 5 to 50-Megabytes, and includes not only the manufacturers listed above, but Atari, Computer Memories, Disctron, Evotek, Fujitsu, International Memories, Mitsubishi, Memorex, Micropolis, Nippon Peripherals, Olivetti, Priam, Rodime, Quantum, Densei, Vertex and Maxtor.

In a conversation I had with Herm Brooks relating to this list, I learned that C.D.R. went out and purchased a sizable number of these drives just to be able to include the pertinent data in their chart. I can appreciate this because personal experience in writing to drive manufacturers over a period of many months has netted very few responses for technical information. It's almost as if they couldn't be bothered. Hard disk drive controller manufacturers, on the other hand, have been uniformly helpful in providing me with technical manuals and other pertinent informa-

tion quite promptly. Having this information also allows the user to take advantage of some of the hard disk closeout bargains in the marketplace that are usually sold without a User Manual.

Summing Up

Viewed from an overall perspective, Super RAM 89 is one of the more significant enhancements for the H/Z-89, and ranks with the H-1000 replacement CPU board from Technical Micro Systems, plus the many boards from Magnolia Microsystems, Spooldisk 89 from FBE Research, and the Interactive Graphics Controller from SigmaSoft & Systems as add-on hardware that will pay for itself in terms of productivity many times over. And it helps to demonstrate that an 8-bit computer can be every bit as powerful as a 16-bit system. The appearance of this product also demonstrates not only the versatility of the H/Z-89, but the commitment of a handful of talented firms to continue support for this interesting machine.

* * *

Super RAM 89 Board 1 (w/o RAM) is $190. Board 2 is $90. Real Time Clock option is $45. SCSI/DMA option is $95. HDOS software is $35. CP/M software is free with Board 1. Hard disk software — either for the Adaptec or Xebec controllers — is $75. For current pricing on 256k RAM, hard disk drives, controllers, please contact:

CONTROLLED DATA RECORDING SYSTEMS, INC.
7210 Clairemont Mesa Blvd.
San Diego, CA 92111
(619) 560-1272

*

A Winchester For The '89 Part Seven

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

The Ampro/Heath CP/M Computer

Interesting things sometimes come in small packages. And if you're looking for alternative solutions to upgrading your H/Z-89 computer in a very economical manner, the next two articles will offer enhancements that may surprise you.

The person responsible for these articles is Henry Fale of Quikdata Computer Services. Most readers of this series will recall my evaluation of Quikdata's QUIKSTOR Winchester software in Part Three. Several months ago, I received a call from William Dollar, president of Ampro Computers. He had been speaking with Henry Fale earlier that day, and Henry suggested that I would probably be interested in looking at the new CP/M and PCDOS single board computers with the SCSI hard disk interface.

After a brief exchange of letters, the boards arrived. A quick review of the documentation convinced me that I had some impressive hardware that had to be written about in this series. For those of you who aren't familiar with Ampro Computers, they began to market a product several years ago called the "Little Board". This was a complete CP/M computer on a board no larger than the standard 5.25" floppy drive. In fact, it was designed to mount directly on a floppy drive, from which it derived its power, and included the necessary circuitry to control up to four drives of various configurations.

Recently, the original "Little Board" computer came out in an enhanced version for only $289, which included an SCSI hard disk interface. And a short while later, Ampro issued a PCDOS version using an 80186 8-MHz CPU, with SCSI interface and 128k RAM (expandable to 1-Megabyte), for $495. Because of the diversified software and hardware complexity of both boards, we will devote a separate article to each system.

Connecting The Hardware

If you're wondering how all of this relates to the H/Z-89, bear in mind that the CP/M Little Board/PLUS computer was designed to operate with any RS-232C terminal. Since the '89 was an outgrowth of the H-19 terminal, and because it communicates serially with the '89's CPU Logic Board, it is a simple matter to convert the '89 into a full-featured terminal by disconnecting the Molex cable plugged into P404 on the back of the TLB. In order to complete the external communications ability of the TLB, you then take the 134-1070 DTE connector from P605 of your H-88-3 Serial I/O card and plug it into P404 on the TLB. While you're at it, you might as well disconnect the power supply plug at P516 on the top right of the CPU board in order to reduce the drain on the power supply.

Doing this will not affect the proper operation of the TLB because the required voltages and sync pulses used by the TLB are derived from P514 and P515 on the left side of the CPU board. This is to say that the signal and power lines from the transformer and the video board are supplied to P514 and then fed to P515, which in turn transports them to P401 on the TLB.

Mating the '89's Terminal Logic Board to the Ampro CP/M-PLUS computer board requires a six-wire cable between the DTE connector and J3 on the Little Board, which is nicely detailed in the Ampro Technical Manual. While the board itself uses keyed Molex shell connectors, you can cut down any long connector and make do with it. Additionally, all you need is a six-wire ribbon cable, six miniature shoe clips that will have to be soldered to one end of the cable, and one DB-25 female connector. I used a Radio Shack D Subminiature Flat Cable Connector (#276-1565), which had metal teeth that would ordinarily grip a 25-wire ribbon cable and simply soldered the other end of the six-wire cable to it.

Here is a diagram of the terminal connector:

Ampro Pins	Signal Name	Function	In/Out	H-89/ DTE Pins
1	Ground	Protective Ground	--	1
2	Ground	Signal Ground	--	7
3	TxD	Data Output	Out	3
4	HSO	Handshake Out (RTS)	Out	5
5	RxD	Data Input	In	2
6	HSI	Handshake In (CTS)	In	20

If you're planning to mount the CP/M board inside your H-37 drive cabinet, you will need to clamp on a 34-pin edge card connector to the drive cable and a standard floppy power "Y" connector to provide the +5 and +12 volt power to the Ampro computer.

Since I don't have any internal floppy drives, I mounted the Ampro board inside the cavity where the drive used to be, using right angle brackets secured to the inside of the cover plate. (See Photo 1) I connected the 4-wire floppy drive plug to the board and then the edge card connector from my hard sector controller. That enabled me to connect either 48tpi or 96tpi drives to the back panel of the '89.

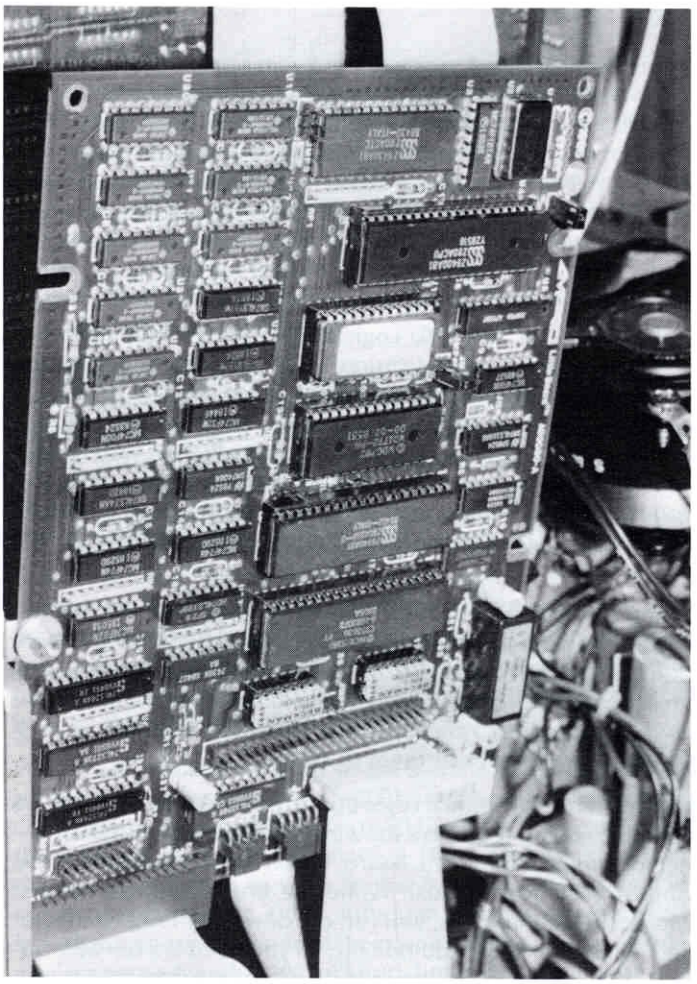

Photo 1
This is a quick and dirty installation of the Ampro CP/M Little Board/PLUS computer mounted inside the '89 where the internal disk drive used to be. See text for interfacing procedures.

Additional connectors on the Ampro board include a second serial port for hooking up a modem or a serial printer; a parallel printer port; an SCSI hard disk interface connector; a user ID connector, if you plan to hook a group of Little Boards together around your house or office in a networking arrangement; and a dual purpose 4-pin that will allow you to connect an LED to monitor the board and install a Reset switch.

Computing Power

When you first look at the Ampro CP/M Little Board/PLUS, you wonder where the ICs are, because it only contains 27 chips, not counting the 8/4164 DRAMS. The effect is unimpressive until you begin to study the specification pages in the Technical Manual.

But it is the board level equivalent in terms of functions and features to:

- The H/Z-89 CPU Board
- The H-88-3 Serial I/O, together with a Parallel Card (or the Z-89-11 Multi I/O card)
- The Magnolia 77320 SASI hard disk host adaptor card
- The H-88-1 hard sector disk controller
- The Z-37 soft sector disk controller

plus other features not found on the '89 — all on a card measuring 5.75" × 7.75".

Fast And Powerful

The Ampro CP/M Little Board/PLUS is controlled by a 4-MHz Z-80A CPU. All system functions are based on a single 16-MHz master clock. A Z-80 Counter Timer Circuit (CTC) provides four programmable counter or timer channels. Two of the CTC channels provide the baud rate clocks used by the two serial I/O ports. The other two CTC channels are available for use as programmable timers in applications programs or for real-time clock functions.

A Z-80 Dual Asynchronous Receiver/Transmitter (DART) provides two fully programmable serial I/O ports. Each channel has four of the standard RS-232C signals: TxD, RxD, RTS and CTS. These signals are sufficient for interfacing most serial printers, modems and terminals. In those cases where other interface signals are required for one of the serial ports, handshaking signals can be borrowed from the second port (if not needed by that port).

Programmable baud rate clocks are supplied by the CTC for baud rates up to 9600. Additional circuitry provides baud rates of 19.2K and 38.4K baud for Port A only. Using the Watzman or other TLB ROMS supporting these higher baud rates should provide you with a highly responsive terminal/computer relationship. If you plan to use the '89's Terminal Logic Board at baud rates higher than 9600, the video tearing you see when text scrolls up the screen becomes more pronounced. Technical Micro System, Inc. (P.O. Box 7227, Ann Arbor, MI 48102) has an inexpensive "Flicker-Free" modification kit that eliminates this problem.

The parallel printer port provides the 10 essential signals of a Centronics-type printer interface: Data Bits 1-8, Data Strobe and Busy.

A Western Digital 1772 floppy disk controller provides all of the functions required to interface with standard 5.25" drives and most 3-4" micro drives. The 1772 includes within a single LSI device digital phase locked loop, digital write precompensation, motor on start/stop delay and software controlled step rates. It will support 4 floppy drives of any configuration, including 40 and 80 track single-sided and 40 and 80 track double-sided drives. It will also support sector sizes of 128, 256, 512 or 1024 bytes.

The SCSI hard disk interface is implemented through the NCR 5380 SCSI bus controller IC (the same as used on C.D.R.'s Super RAM 89). It fully supports the ANSC X3T9.2 standards, but will

additionally allow the connection of up to 64 target devices instead of the standard 8 devices.

The Ampro CP/M SCSI bus can control up to 8 hard disk drive controllers, and a total of 11 Winchester drives. The capacity of each drive can be of any size from 5-MB to 88-MB. That's nearly 1-Gigabyte of on-line hard disk storage.

How The Software Works

If you find the hardware specifications impressive not only in terms of the $289 price, but the power you get with just a handful of parts, the software is equally impressive and is easily worth more than the price of the board.

To make your Ampro/Heath 89 computer operational, you will need one or more double-sided floppy drives (either 48 or 96-tpi) capable of a 6 mS step rate.

When you first turn on your terminal and disk drives, you will notice that the LED in drive A: goes on. This is a signal that everything is ready. You load the Ampro CP/M distribution disk and close the drive's latch or door. The Boot ROM does everything else without intervention: it mounts the disk, loads the operating system into memory, and presents you with a Menu Screen of various functions.

Our first order of business is to make several backup copies of the distribution disk and create a working system volume. This is easily accomplished with either a single or double drive system, although the former will require the usual disk switching routine. If you booted from a 96-tpi DS/DD drive (the Ampro CP/M 2.2 media comes on a 48-tpi DS/DD disk), you will only be able to read from, but not write to, the 48-tpi format. So, if you have both types of drives, it might be advisable to create separate system volume for each format.

The format command is called AMPRODSK, which is accessed from the main Menu Screen (as are a dozen other often used commands, such as SYSGEN, CONFIG, DIR, ERA, STAT, TYPE) by typing the number 1 and following the instructions. The screen displays the track number and disk side as it formats. The same applies to SYSGEN. To then backup your Ampro CP/M system volume, you then type the letter "C" from the Menu, and then the wild card designation of *.*. This procedure takes a few minutes because each file that is being copied is also verified, which provides you with a means of testing the media integrity of your disk.

You also receive a Public Domain program for terminal communications called MDM740 which has been enhanced by Ampro. Typing the letter "X" from the Main Menu activates the program. Like everything else, it is completely menu driven using mostly one-letter (or sometimes a three-letter) commands. It supports full up and downloading and saving to disk and printer, plus everything else you expect from an intelligent terminal program.

The Ampro CP/M distribution disk is packed with nearly five-dozen files. You receive the standard CP/M 2.2 utilities, the Ampro BIOS, the ZCPR3 enhancement package, plus a host of special utilities written by Ampro to make life easier for you. As one who has had his ups and downs with CP/M over the years, this is, by far, the finest implementation I have ever used. In addition, you can create your own Menu Screens with one of the ZCPR3 "shell" programs to assign one-letter commands for any frequently used programs or utilities you wish to invoke from the Main Menu rather than entering the Manual CP/M command and typing the filename.

The Ampro User Manual is only a small step below the excellent standards created by Heath/Zenith over the years, and certainly a model of clarity that some H/Z support vendors should emulate. All CP/M, ZCPR3 and Ampro utilities are covered with as much detail as is required for you to understand their purpose. It is intelligently written so beginners will feel comfortable using CP/M. Old-timers of CP/M won't be left out because there are enough technical details to keep them happy for many weeks.

The important feature of the Ampro CP/M software that I was anxious to check out was the MULTIDSK Version 2 utility, because it concerns the compatibility factor between this system integration, the expensive software sitting on your shelves, and the data files you have built up over the years. If this compatible relationship did not exist, there would not have been much purpose in reviewing this product.

Fortunately, Ampro designed a great deal of CP/M compatibility into their software implementation. Among the drive formats it will support are those of the Actrix, DEC VT180, IBM (CP/M-86), Kaypro II, Lobo Max80, Morrow MD2, NEC PC8001A, Osborne 1 and 2, TI Pro (CP/M-86), TRS80-1-3-4, Xerox 820 (I & II), Kaypro 4/10, Morrow MD3, PMC-101, Sanyo MBC 1000/1100, Televideo 802/803, DEC Rainbow (CP/M), Eagle IIE-2 — and every Heath/Zenith format you may have, including the reading and formatting of Z-100 48-tpi SS and DS CP/M-85 disks. You cannot use CP/M-85 on the Little Board, nor the IBM CP/M-86 operating system, but all data files created on those system disks can be transferred to Ampro's CP/M and worked with if you have the appropriate program software — i.e. word processing, database, spreadsheet, etc.

The following lists the Heath/Zenith specific formats that are readable with the MULTIDSK utility:

SS 48-tpi Menu:	H/Z 100
	H/Z 89 SD
	H/Z 89 DD
	H/Z 89 XD
	H/Z w/Magnolia
DS 48-tpi Menu:	H/Z 100
	H/Z 89 DD
	H/Z 89 XD
96-tpi Menu:	H/Z 89 SSDD
	H/Z 89 DSDD
	H/Z 89 SSXD
	H/Z 89 DSXD

A utility called MULTIFMT will allow you to format disks in a variety of Heath/Zenith '89 and '100 formats. This creates mobility in transferring your Text or Data files between the Ampro CP/M computer and the H/Z-89 and '100. If you have an oddball CP/M computer at the office, the RESET utility will allow you to establish disk track and sector parameters for the target drive, so you can use data disks from that system on the Ampro. This program is quite complicated. A thorough reading of the documentation and a detailed knowledge of the foreign disk format is necessary before you attempt to use this program.

Not wanting the user to be restricted to merely using files from other CP/M computers, the DOS and DOSMFT programs will allow you to read, copy and format MSDOS compatible 8 or 9 sector/track disks (either single or double-sided) if you have a Z-100 or Z-150 PC series computer (or an IBM clone). While I haven't used this feature a great deal, I did a directory check of

about 30 MSDOS program disks and then verified them on a Z-151 PC. When you read the directory of an MSDOS disk, you only see the actual program and data files. MSDOS or PCDOS .COM files will not show up on the screen.

One of the interesting features I found on the CP/M distribution disk is that the command format when you log onto a specific drive is A0-15 or B0-15, etc. These are referred to as user specific partitions. Thus, if you are using your computer in an office situation where several people will be sharing the system, or even at home if several members share your enhanced Ampro/Heath computer, a numerical designation can be assigned either to each user, or the numerical designation can represent a type of data file.

For example, if you're in the habit of using correspondence disks in a numerical sequence, rather than maintaining a separate disk for each person you write to, you can prepare a list of how you wish to assign these partitions. To wit:

A0: Heath/Zenith Users' Group
A1: FBE Research Co.
A2: Quikdata Computer Services
A3: C.D.R.
A4: SigmaSoft & Systems
A5: Technical Micro Systems

and so forth. Generally, I use PIE for daily correspondence. It's quick and simple and allows me to use the screen as a typewriter. Most short articles are prepared on PIE, too, because magazines require unformatted ASCII text files for computerized typesetting. Articles longer than the 1000-line limit imposed by PIE are either broken up into separate files or I use the SPELLBINDER Office Management System.

So, when I produce my daily correspondence, I type PIE A0: HUG1.LTR to enter the HUG letter file partition so that the letter will be saved accordingly. Since I don't keep copies of letters, it used to be that I had to sift through a directory listing in excess of a hundred or more files on a 96-tpi disk in order to locate the numerical designation of the last letter written to a specific person. This involved a time consuming use of CTRL S/Q to stop and start the scrolling director screen.

Now I simply type DIR A0: or DIR B9: and receive a directory listing of only those files I need be concerned with. This is also ideal if you use your '89 as a billing system with separate disks for each month. A disk partition can be assigned to each account. The size of the partition is flexible according to how you use it. You aren't required to maintain equal size partitions for each numerical designation. It's just that you have the flexibility to use this feature as it is appropriate to your needs. Or ignore it entirely.

Low-Cost Upgrade

The greatest savings in considering the Ampro CP/M board will be realized by H/Z-89 owners who currently have only a single hard-sector drive. For an investment of $289 for the Little Board, plus another $250 for double-sided drives, you can put together (software included) an up-to-date system with a hard disk drive interface that will not force you to give up your current software.

If you own an H-19 terminal in conjunction with an H-8 computer, the addition of an Ampro CP/M Little Board/PLUS will give you H/Z-89 compatibility, plus all the other features. Going the conventional route of spending $300 for a soft-sector controller, plus $250 for a hard disk host adaptor card, $100 for a parallel card, and $250 for drives is nearly twice the cost.

Or, if you want H/Z-89 compatibility with the features and excellent keyboards offered by the newer Z-29, Z-39 and Z-49 terminals, you can put together your own system quickly.

Then, you can add the Ampro PCDOS 80186 CPU single board computer for some real fun. But you'll have to wait to learn about this board.

The SCSI Winchester Software

The hard disk partition and driver software is supplied on a separate disk. Because of the overhead required by the size of the Winchester drive you will be using, you must create a CP/M size through MOVCPM.COM (or ZMOVCPM.COM if you are planning to use the enhanced Console Command Processor software).

Unlike the Magnolia and Quikdata Winchester software which is hardware specific to the Xebec S1410 or S1410a controllers (or the C.D.R. SASISOFT partitioning software which is available for either the Xebec or the Adaptec ACB-4000 controllers), the Ampro SCSI bus interface can be used with all the above, as well as the Adaptec ACB-5000 and the Shugart 1610-4 controller, and the Xebec OWL, which is a relatively inexpensive integration of a 10-MB hard disk with an S1410a controller in a single unit.

The Ampro Z-80 hard disk software diskette includes the new SCSI BOOT EPROM code in Intel HEX format (SBT-1-0.HEX), which permits auto-booting directly from a hard disk drive if you are using the Xebec OWL, Adaptec or Shugart controllers.

The Xebec S1410 and S1410a controllers (and the DTC 510A and 510B, as well) are not self-initializing. They require the addition of installation-specific commands in either the SCSI BOOT EPROM or in the boot strap loader contained in the HGEN utility, in order to initialize the controller prior to drive access. Ampro will provide the source code for its BIOS and the SCSI BOOT EPROM for a nominal charge. This will allow you to select a controller at the best price advantage. The Shugart 1610-4 can often be purchased from Ampro for $125, while the Xebec and Adaptec units sell for $250-$290.

The simplistic usage I enjoyed with Ampro's CP/M has been carried over to the hard disk software implementation. First step is to make a system volume labeled "Hard Disk System", and construct a CP/M system size based on the supplied chart as it relates to the size of the hard disk drive you will be attaching to your system. Then, use SYSGEN to write this to your newly formatted diskette. Next, you use the CONFIG utility to set your port configuration and other initialization parameters. Test the new disk by booting on it.

After transferring all the hard disk utility software to your Hard Disk System Volume disk, and the standard utilities for transferring files, directory listings, etc., run the HFORMAT program to format the hard disk drive. Enter the specific data on your controller (brand and model number), the information on your hard disk drive (number of cylinders, number of heads, step rate, write precomp data, etc.), and the number and size of the partitions you wish to write on to the hard disk. You can create partitions of 1 to 8-MB in size based on your requirements, which you accomplish by assigning an alphabetical letter for each partition.

One of the utility programs you will appreciate is a Public Domain program called FINDBAD which, when you run it, will perform a read of every sector of each CP/M drive letter partition you specify, logging all errors encountered during the check. It

will log and group all bad sectors in a file called [UNUSED].BAD and lock them out. The drive will then be unable to read or write to these sectors, thus preserving the integrity of your data. If you erase any partition and then SYSGEN it at any future date, you must run FINDBAD again and re-identify the bad sectors on the partition.

If you choose to boot directly from a hard disk partition shown on a Menu screen, you will have to create a hard disk initialization alias with the ZCPR3 ALIAS utility, so that in effect the hard disk partitions become the primary boot drives and the floppy drives the secondary boot drives. During this process the drive ID's are swapped. For example, if you have installed a 20-MB Winchester with four 5-MB partitions identified as drives F: to I:, they will become drives A: to D:, and your actual and logical number of floppy drives will become F: to I:.

Documentation

A user's success in installing a new product is closely related to the quality of the documentation, and there is nothing skimpy about what you receive.

You get a 98-page System Software User's Manual, a 46-page Hard Disk Software User's Manual and a 68-page Little Board/PLUS Technical Manual, to which is appended 76 pages of component specification data on all the master ICs that control the operations of the board.

The first two manuals are presented in a HOW-TO (setting up and using the software, how to use the commands in creating specific system volumes) and WHAT'S-WHAT (a thorough explanation of all the related utility programs). For users who are being exposed to CP/M for the first time, text references are supplied and sources for expanded ZCPR3 utilities are given.

As stated earlier, the CP/M BIOS can be modified if you are an experienced programmer, and Ampro will provide the source code for a nominal charge. Ampro also maintains a technical hotline for those who may have difficulty with any software or hardware aspects of the system. They would also like to hear from anyone who may have discovered a "bug" of any sort.

There are also several Ampro User Group Bulletin Board Systems operating 24-hours a day in California, which can provide assistance, Public Domain software, and a general exchange of ideas relating to the Little Board series. One board is owned and operated by Ampro to disseminate information.

My favorite part of the documentation package was the Technical Manual. This presents full schematics, parts lists, theory of operation, block diagrams, details for interfacing all connectors, manufacturer part numbers for all connectors, plus the IC specification sheets.

My criteria in reviewing any product is that I must first like it. If I don't, I won't bother to work with it because I consider it an intrusion on my time. It is difficult to find fault with the Ampro CP/M Little Board, except that the manufacturer should include the connectors and shoe clips for the two serial ports and the LED/Reset post headers. These parts are not generally found in your local Radio Shack store and must be ordered by mail. And if you don't have a healthy supply of odd parts in your hobby box, you will experience a delay of 3-4 weeks before you can get your Little Board operational.

* * *

In addition to offering the CP/M Little Board/PLUS by itself, Ampro Computers has complete systems available with assorted drives and cases with all connectors terminating on the back plane for easy interfacing with your modified '89 or Zenith terminal.

The package I received also contained some product literature from several support firms who can supply assorted cases and hardware, LAN devices to network the Little Boards for office usage. The Little Boards are also available from a growing network of dealers, including some Zenith Data Systems Distributors who are packaging them as low-cost systems with Zenith terminals.

The Ampro CP/M Little Board/PLUS is warranted for 90 days. Thereafter, servicing is provided on a "board exchange" basis for $99 on a 24-hour turn-around basis. Although the boards are stamped out like cookie cutters in a Singapore factory, I have been informed that the failure rate after 90 days is less than 1%. Only the master ICs are socketed (CPU, SCSI Controller, DART, ROM and Disk Controller); RAM, TTL chips and passive components are soldered directly to the board, making it difficult for the user to troubleshoot his own board. Nor will it be offered as a kit by Digital Research Computers, Inc. as was the original board, because the NCR SCSI controller and Western Digital floppy controller chips are expensive to replace if damaged by static electricity.

For additional information and current pricing of Little Boards, please contact:

AMPRO COMPUTERS, INC.
67 East Evelyn Avenue
Mountain View, CA 94041
(415) 962-0230

*

A Winchester For The '89

Part 8

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

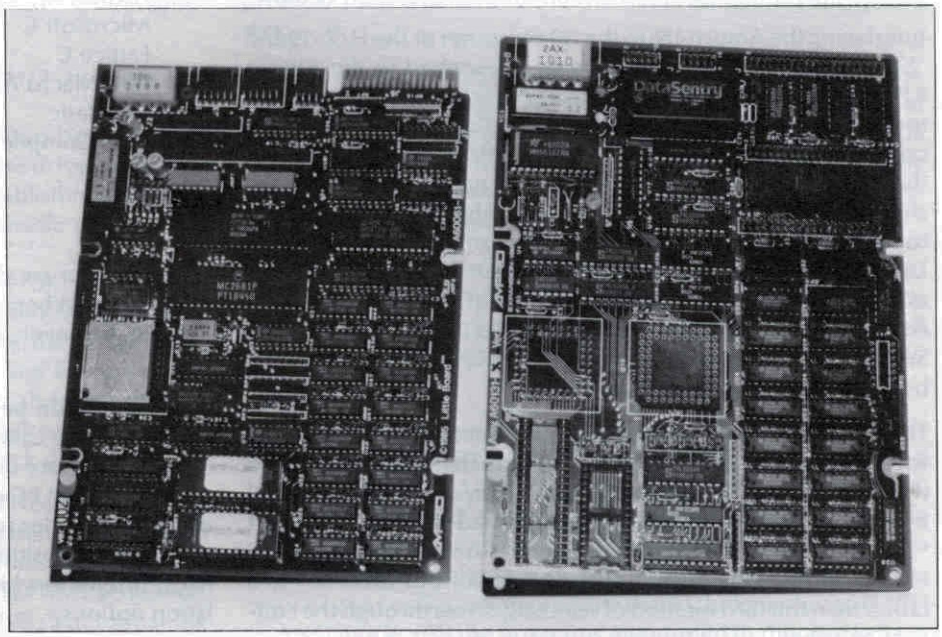

Photo 1
When the Ampro 186 PC-DOS board (left) is mated with the EXPANSION/186 (right), you have a very formidable IBM compatible computer for your '89 or your H-19 or H-29 terminals. The features include an 8 MHz 80186 CPU, 4 serial ports (2 of which are programmable for RS232 or RS422 Sync/Async), a Centronics parallel port, floppy disk control for 4 40- and/or 80-track drives, an SCSI hard disk controller and interface for up to 64 devices, a non-volatile programmable clock, 1024k RAM and a provision for a 10 MHz 8087 Math co-processor and an 82188 bus controller. New software now allows the networking of 4 186 PC-DOS boards under CONCURRENT DOS, and a simple serial interface connection allows it to use an IBM compatible computer as a terminal or to act as a co-processor for multi-tasking.

When you were left hanging with the previous installment in this series, I promised you a full review of the Ampro 186 PC-DOS Little Board computer. Even though I had this board installed in my '89 when I wrote about the Ampro CP/M Little Board, I hadn't as yet had the time to do a thorough check of the hardware and test out an armload of software. This process has taken more than two months, during which time I made a pest of myself at Ampro's offices and a variety of software houses.

Of all the co-processors available for the '89 (or your H/Z-19 or H/Z-29 terminal), this is by far the fastest, cheapest, and most sophisticated piece of hardware on the market. So, if you're planning to sell your '89 because you've just purchased a new Heath/Zenith PC computer, the best advise I can give you is — DON'T.

The Ampro 186 PC-DOS single board computer system offers all the features of the Ampro CP/M Little Board/PLUS computer: 2 Serial Ports, a Parallel Port, an LED Monitor/Reset switch, a connector for 4 Floppy disk drives, an SCSI hard disk connector, and a user ID header for networking applications. All sockets and headers are in the same location, even the physical size is approximately the same. It was also designed to mount directly to a standard 5.25" floppy drive, but that's where the relationship ends.

What we have here are nearly all the components of a full-blown IBM compatible desktop system that you can hold in the palm of your hand. The 186 board has even fewer components than the CP/M Little Board, and it is an exciting example of Ampro's technical wizardry. However, the aspect I liked best of all is that Ampro continues to provide support for the durable Heath/Zenith terminals.

Where Are The ICs?

At first evaluation, stuffing an 8-MHz 80186 CPU onto the 186 Little Board is like trying to cram the engine of a Sherman Tank into a Volkswagon. The 80186 CPU is a highly advanced integrated microprocessor (in a 64-pin quad in-line package) that can eliminate some 15-20 support chips found in most standard 8088 IBM-compatible systems. It is a "true" 16-bit CPU, that includes 2 independent high-speed DMA channels, three 16-bit timers, a programmable interrupt controller, as well as programmable memory, I/O chip-select logic and system bus control. It offers twice the performance of the 8086; it has a 4 MByte/Sec bus bandwidth interface, and can directly address 1 MByte of memory. It is completely Object Code compatible with all existing 8086 and 8088 software through an extended instruction set. It is mounted in an exotic Textool Socket with a metal heat-shield, because it gets so hot that it will burn your fingertips.

The remainder of the prime ICs number only three. A Western Digital 1772 Floppy Disk Controller, a Signetics 2681 Dual Asynchronous Receiver/Transmitter (DUART) provides a programmable interface for the 2 Serial Ports and the Parallel Printer Port. Lastly, there is the NCR 5380 SCSI Controller for hard disk interfacing and networking applications.

Two 2764 programmed ROMS contain a highly compatible emulation of the IBM BIOS, a couple of custom PAL and logic chips round out the circuitry. My board arrived with 512k memory in the form of two banks of 41256 ICs. Ampro also offers a 128k version for $50 less, but it isn't worth considering for such a small price spread. Besides, most of the important software is so memory-intensive that 512k is the minimum configuration to have.

Interfacing the Ampro 186 to the '89 computer or the H/Z-19 and '29 terminals is exactly the same as I described in the Ampro CP/M Little Board/PLUS article (Part 7 in this series). All connector pin designations are the same on both boards. The cables I constructed out of spare parts for the CP/M board worked for the 186. Over protracted use, however, I noticed that my makeshift assembly had some loose contacts which caused oxidation to form on some of the pins due to the damp coastal climate on Long Island. This was rectified when I ordered a neat harness assembly from Ampro for $36. This had the proper plugs and connectors for the 2 Serial Ports and the LED Monitor and Reset Switch. I was not aware of this when I reviewed Ampro's CP/M board and hasten to mention it now.

The current Ampro ROM BIOS was enhanced to be compatible with IBM'S PC-DOS 3.1, allowing for more than the standard two floppy drives on a system. Additional floppy drives and the redefining of hard disk drive letters is supported by the PC-DOS 3.1 "SUBSTITUTE" command. Floppy drives on the 186 are jumpered according to conventional designations of drive 0-1-2-3 rather than the IBM method of selecting drives through the connecting cable.

While working on this evaluation, I received the new floppy disk software driver called AMPRODSK.EXE. This allows the user to mix any combination of 40- and 80-track drives on his system. 80-track drives cannot only be formatted, but the system DOS can be placed on them with the FORMAT B:/S commands. This has a very distinct advantage, as you can now Boot from 80-track drives, include your program files and still have ample storage available on the disk for saving data files. There is no loss of flexibility because an 80-track drive can read and copy data from a 40-track disk.

Is It, Or Isn't It, IBM Compatible?

Answer: Yes, No — and Almost! I'm sorry if this sounds ambiguous or confusing, but this is a complex aspect of the 186 Little Board that will require a detailed explanation.

You will have to purchase a copy of PC-DOS ($95) in order to Boot the system. I tried a "generic" version of MS-DOS and the DOS of several compatible systems but I got funny results. I have been advised that the Compaq version of MS-DOS will work. The 186 will work with Versions 2.1 and 3.1. Ampro recommends the latter for its enhanced features and because it also allows direct booting from a hard disk and larger hard disk partitions.

On the other hand, though, you can only use "GENERIC" MS-DOS programs on the system at the present time. This is because the 186 doesn't support the IBM's screen graphics commands, nor the IBM's hardware I/O due to the reassignment of these ports to conform with the 2681 DUART.

The "generic" software is also a requirement because the 186 hardware has to be able to function with a variety of terminals, each of which has its own protocol structure. This isn't an inhibiting factor as there are literally thousands of MS-DOS programs on the market that will run on the Ampro 186 and a Heath/Zenith terminal, so you would not be wanting for development or application software.

All software development tools available for the 8088 will work on the Ampro 186. Here is a partial list:

Turbo Pascal
Fortran 77
Microsoft C
Lattice C
IBM Macro Assembler
GW Basic
Intel Compilers & Tools
Palasm
Abel
Masm

Programs that are developed on the 186 will run on an IBM or compatible. When you perform assembly or compiling tasks on the 186, however, there is a definite speed increase of about 300%.

Communication between the 186 and an H/Z terminal is handled with a file called TERM.SYS which is provided on Ampro's Support Software diskette. This is a Terminal Device Driver that transforms IBM PC compatible terminal control sequences into the control codes required by a specific ASCII terminal. It provides cursor position, clear screen, etc, and allows the use of many programs which lack "MS-DOS Generic" terminal installation options.

Having experimented with a variety of programs that are labelled as "generic", I have been able to classify them into three distinct groups:

1. Programs which include the H/Z terminal in their installation file.
2. Programs which include an ANSI installation mode.
3. Programs which have no installation mode.

The H/Z-19 (and '89) terminal fares a lot better than most others because it can also be configured for ANSI mode by moving Pin #5 of Switch 401 on the Terminal Logic Board to "1". The H/Z-29, being more sophisticated, can be set up for ANSI mode through a keyboard routine and stored in non-volatile memory.

I did some checking and found out that the latest crop of Zenith Terminals — the Z-39 and Z-49 — can also be used with the 186 in not only the H/Z-19/29 or ANSI mode, but in DEC VT101 or Hazletine 1500 mode, which permits access to certain "generic" MS-DOS software that includes installation routines for these terminals.

I guess I was a bit spoiled by the vast documentation that Ampro provided with the CP/M board, because the data on the 186 board is skimpy by comparison, and intimidating by its brevity. But somewhere along the 4th dedicated reading I realized that my recent introduction to MS-DOS was lacking and that I'd better do some quick boning up. Microsoft's MS-DOS manual doesn't exactly inspire confidence. It's almost a journey backward to the original cryptic documentation that came with early versions of CP/M.

Fortunately, Microsoft Press published a decent book by Van Wolverton, called "Running MSDOS", which attempts to demystify the operating system's manual and to compensate for Microsoft's inability to produce documentation with a reasonable degree of clarity. (Wait till you tackle Microsoft's "Word" manual: it's grimace and groan from first page to last!)

There are two basic setups to consider with the Ampro 186 integrations with the H/Z-89/19. One is a floppy disk system; the other a hard disk system. We'll cover the floppy disk version first.

Setting Up A Floppy System

Ampro provides four software drivers to get a basic system functional:

TERM.SYS — This is the Terminal Driver. The H/Z-19 configuration designation is T4.
SETCON.SYS — This initializes the Terminal Port (Serial Port A) which is the DOS "CON" Port. By including this driver as the first entry in the system CONFIG.SYS file, and establishing a console baud rate. No characters are sent to the console prior to this function.
SETCOM1.COM — This sets up Serial Port "B" as the DOS "COM1" port for connecting either a modem or serial printer. You can set (as with Port A) the baud rate, parity, data length, stop bits and the hardware handshaking option, and borrow under software control additional handshaking signals from Port A.
AMPRODSK.EXE — As mentioned above, this driver can be used to format and set up a DOS system on 80-track drives.

When you first power up your Ampro 186/Heath system, the light in drive A: comes on to signal that the system is ready. Load your PC-DOS 3.1 system disk into drive A: The system will now automatically boot itself and display the DATE/TIME sequence. Place a blank disk in drive B:. Type FORMAT B:/S to format the blank disk and place the system COMMAND.COM file on it. Then COPY the three Ampro files described above to the newly sysgened disk. Also COPY the EDLIN and ANSI.SYS programs to it.

Invoke EDLIN and enter filename: CONFIG.SYS. At the prompt, type I (for insert data) and hit RETURN. Then create the command lines for the CONFIG.SYS program:

```
DEVICE = \SETCON.SYS B9600 D8 S1 PN H
DEVICE = \TERM.SYS T4
DEVICE = \ANSI.SYS
```

Type a ^C to end the program, then E to exit, and your CONFIG.SYS file is ready.

What we have done here is to initialize Terminal Port A with a Baud Rate of 9600, 8 Data Bits, 1 Stop Bit, No Parity, and Hardware Handshaking. The Heath system doesn't require hardware handshaking, but setting it up won't hurt.

Now, RESET the system and boot up on the new disk to check it out. Just prior to the screen display of the DATE/TIME boot sequence you should see a message saying HEATH TERMINAL DRIVER INSTALLED.

In order to test out a variety of programs, I made a half-dozen copies of this master working system volume and placed major programs on each disk.

Two key word processing programs I worked with were T/MAKER Integrated Software from T/Maker Software, Inc., and SPELLBINDER from Lexisoft. Ampro has licensed T/MAKER for both their CP/M and 186 systems. I did not have it available when I worked with the CP/M board, but I have become so impressed with it on the 186 that I shall spend some time on a formal review in the near future. It sells for $159 and offers sophisticated Word Processing, File Management, Spell Checking, Spreadsheet, Database Management, List Processing, Data Transfer, Graphics (Bar Charts), and Programming.

It provides a good contrast to SPELLBINDER because it doesn't contain a Heath/Zenith configuration file, while SPELLBINDER does. Copy the main T/MAKER program files to one of your system volumes, put the second T/MAKER disk in drive B: and type B:TMODIFY. When the modification program is on screen, type 1 to configure your terminal. Select ANSI by typing YES after the prompt. Then type 99 to write the modification to your system disk.

Lexisoft was kind enough to provide me with a "generic" MS-DOS version of SPELLBINDER to evaluate with this system. After placing the essential program files to a system volume, type CONFIGSB to call up the configuration program. Just follow the prompts by entering the appropriate numbers for the H-19 terminal, your printer, etc.

As I mentioned earlier, any program that doesn't contain a configuration file that includes Heath terminals will generally include an ANSI mode. This will do just fine if you remember to set the proper switch on the '19's TLB. You can do this on the keyboard with the '29.

Programs that have Heath terminal configuration files are dBASE, WORDSTAR, SUPERCALC 2, and others that were converted from 8-bit systems. Utility programs like DSPOOL, SIDEWAYS, RAMDISK, FORMAT are generally designed to work on a variety of MS-DOS systems and will work on the 186. It is advisable (at least for the moment) to check out any program at your dealer to see if it has a configuration program that includes either a HEATH or ANSI mode. (All the programs mentioned in this article have been tested, including the NORTON UTILITIES.)

You can also use the powerful PC-DOS batch processing utility to create an AUTOEXEC.BAT file to automatically load during the boot process not only the terminal configuration operation but your program file as well. (I have to confess that by the time you read this article, Ampro will have an enhancement available that will allow the 186 greater latitude. I will explain this shortly.)

Setting Up A Hard Disk System

Ampro's 186 Little Board currently supports the following SCSI hard disk controllers: The Adaptec ACB-4000 and -5000, the Shugart 1610-4 and the Xebec "Owl". The latter combines their 1410 controller and the drive electronics all on one card mounted on a 10-MByte drive. Any ST506 compatible hard disk can be used as long as you have a manual or data sheet on the drive's characteristics:

- Number of cylinders
- Number of heads
- Starting cylinder for reduced write current (RWC), if needed
- Starting cylinder for write precompensation (WPC), if needed
- Landing zone cylinder
- Drive step rate

The only cautionary note issued by Ampro is that not all Seagate model ST-506 (5-MByte) Winchester drives will work reliably with the Adaptec ACB-4000 hard disk controller. The Adaptec controller uses a 5 microsecond step pulse width. Although this pulse width technically meets the ST-506 specifications, some Seagate ST-506 drives will not seek properly with such a short pulse. The Adaptec's short pulse width allows the controller to "slew" high performance drives (such as Maxtor) at their fastest possible rate. The Seagate ST-406, and most ST-506 compatible drives, do not exhibit this problem.

The Ampro HARD.SYS device driver supports one or more hard disk drives connected to one or more SCSI (SASI) compatible hard disk controllers. It is only required if you add additional drives and controllers to your system.

As with other device drivers accessing I/O ports on the 186 board, HARD.SYS must be added to your CONFIG.SYS file if you ultimately elect to install large capacity drives and multi-partitions. An enhancement being developed by Ampro, as I write this article, will allow partitions as large as 32-MBytes on hard disk drives capable of storing 100-MBytes or more of data.

But for general user purposes of a single drive you merely need to include HFORMAT.EXE and HPARK.EXE on your System Disk. HFORMAT.EXE is the hard disk formatter utility, and it is quite simple to use.

At the system command prompt, type HFORMAT [R]. The program will then prompt you for the information it requires to format your hard disk. You will be prompted for:

Controller SCSI ID (this depends on the jumper setting on the controller).
Controller make and model.
Drive "logical unit number" (this depends on which connector on the controller the drive's data cable is connected. Drive must also be correctly jumpered according to this number.
Drive characteristics (these were mentioned above).
Format interleave (Ampro advises an interleave factor of 2. The Adaptec controller will function with an interleave factor of 1 for increased speed).

HFORMAT will format and initialize your drive(s) by writing a "clean" set of data to the drive. It also stores information about the drive needed by the SCSI controller, and it maps out any bad regions on the drive's storage surface. HFORMAT will, in the event of a problem with either the drive or the controller, issue an error message suggesting that you check out cable connections, jumper configurations and drive parameter information.

When this procedure is finished, RESET the computer and boot again. PC-DOS will now recognize the presence of the hard disk drive as DOS letter "C". As a test, you can use the PC-DOS DIR command.

Now run the PC-DOS FORMAT utility on the hard disk drive:

```
A>FORMAT C: /S/V [RETURN]
```

Remove the system disk from drive A and RESET your computer again. This time it should "boot" from the hard disk. From this point on, if you put a floppy disk in drive A, the system will boot from the floppy disk. IF there is no disk in drive A, the system will boot from the hard disk.

As a safety feature, Ampro provides a utility called HPARK.EXE which positions the read/write heads of the hard disk drive to a predefined landing zone on the disk surface. This guards against the possibility of data loss due to power on/off glitches. You should always run HPARK prior to turning off the AC power.

If you have parked your drive's read/write heads and decide not to turn off the computer, you must perform a RESET of the system before you access the drive again.

Installing The 186 Little Board

My own 186 Little Board is mounted inside my H/Z-89 computer in the cavity where the internal disk drive used to be. The floppy drive connector provides the +5 and +12. The -12 volts required by the RS232C signals is derived from an on-board voltage converter. This is not a very permanent housing, because too many external cables are required to connect the board to floppy disk drives, a printer, and a hard disk system.

If you are planning to use it with an H/Z-19 or -29 terminal, a separate case should be considered. A company called Integrand Research Corp. has designed a variety of full-height and low profile "main frame" cases that have been designed especially for the Little Board series and contain powerful switching power supplies to handle up to 2 floppy drives, 2 hard disk drives, as well as an area to mount the Little Board and a hard disk controller card. The prices range from $125 to $195. All connectors terminate on the backplane with cutouts for all connectors, so that you can easily plug in the terminal. This gives you a more transportable system if you plan to move it around. The low profile cases are quite durable and will support the H/Z-29 terminal monitor on top and allow you to position the keyboard more comfortably on your desk.

Ampro has also integrated the 186 Little Board into a complete system with assorted floppy and hard disk drives. It is called the Bookshelf 200 series and it is worth investigating. A number of system components are available separately (cables, cases, drives, controller boards, etc.). There are just too many options to list within the limitations of this article.

Documentation

Two manuals are available with the 186 Little Board: one covers the system's support software; the other all technical aspects of interfacing, system set-up, schematics, diagrams of system functions, plus specification sheets on the major component ICs.

They are well-written and easy to follow, but require the user to have a working knowledge of PC-DOS. Some minor problems you might encounter in setting up and using "generic" MS-DOS software have been covered above. The solutions are simple, of course, once you understand the configuration conventions of individual software packages.

The hardware functions superbly. The data on my '89 screen zips around at incredible speeds. It is, as I stated at the beginning, the fastest, cheapest and most sophisticated enhancement available for the '89.

Ampro has the Source Code available for all the drivers and utilities on the Support Software package for $79. For programmers and system developers, Ampro offers a 2-ROM Monitor EPROM set for $65. It includes not only standard monitor functions, but advanced debugging and hexdump features. The Monitor EPROM set is a substitute for the system ROMS and all hardware I/O is accessible. The Monitor EPROM can also be used to check out the system RAM and other operations in trouble-shooting situations.

What's Next?

Ampro has apparently decided to stretch the 186 Little Board to the limits. It already has a plug-in daughter board that contains an additional 512k RAM, 2 more Serial Ports and a socket for an 8087 Math co-processor.

Another software driver that will remap the '89s (and '19) keyboard to emulate IBM function keys is on its way.

And then, there's SUPER DUO, a terminal-type program that will permit the 186 board to hook into an IBM or compatible com-

puter via the Serial Ports, with a one-key toggle to switch back and forth. Thus, programs developed on the 186 can be tested and run on an IBM moments later. Other applications that come to mind include loading different portions of large database or spreadsheet programs into each system and then being able to transfer sections of data from one computer to the other.

I have also received an interesting program that Ampro has licensed from Microtec Research, Inc. called PLUS80 CP/M & 8080 EMULATOR. This attaches an 8080 CPU instruction set and the CP/M operating system to PC-DOS. Programs are then transferred via a terminal program from the CP/M computer to the 186. Although the PLUS80 emulator does not provide 100% equivalence to an 8080-CP/M environment, most commercial CP/M applications programs are properly emulated. There are a few restrictions: no support for direct BIOS calls; programs may not access I/O ports directly; programs must not use the Z80 instructions not common to the 8080; certain public domain CP/M disk utilities violate the PLUS80 restrictions and are not properly emulated. The only testing I have had time for involved WORDSTAR and MBASIC, which ran on the 186 with PC-DOS as though it was a high-speed CP/M computer.

I've saved the best part for last. Yes, there will be IBM graphics compatibility for the '89 through a plug-in VIDEO RAM EMULATOR. This daughter-board will intercept all IBM graphic calls and displays and convert them to their ASCII equivalents, and then translate them to the terminal screen.

This means LOTUS 1-2-3, SYMPHONY and other graphic intensive programs will run on the '89. In black and white, or green or amber only. I assume that the combination of the VIDEO RAM EMULATOR and the IBM KEYBOARD EMULATOR will also permit the installation of SIDEKICK and other Borland utilities which make specific use of the function keys.

For additional information, please contact:

AMPRO COMPUTERS, INC.
67 East Evelyn Avenue
Mountain View, CA 04041
(415) 962-0230

Other references made in this article:

T/Maker Company
2115 Landings Drive
Mountain View, CA 94043

Lexisoft, Inc.
P. O. Box 1950
Davis, CA 95317

Integrand Research Corp.
8620 Roosevelt Avenue
Visalia, CA 93291

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A Winchester For The '89

Part Nine

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

SigmaSoft Strikes Again [I]

When I began this series, Winchester hardware implementations for the '89 were primarily limited to the SASI hardware interface developed by Magnolia Microsystems (see Part 2, March 1986) and their CP/M implementation; and the Quikstor software package from Quikdata, Inc. which conformed to standard Heath/Zenith CP/M and HDOS, but used the Magnolia interface (see Part 3, April 1986). Along the way there was Heath's own short-lived Z-67 Winchester system, but it was not discussed because both the hardware and software were removed from distribution about 6 months before the '89 itself became extinct.

Since that time, several new products from C.D.R. Systems and Ampro Computers were released. They used the powerful SCSI hard disk interface, that provided the '89 with multi-user and networking capabilities, a domain that was thought to be the exclusive property of 16-bit computers.

I suppose 8-bit computers like the '89 are a bit primitive when you compare them to the graphics abilities of a PC. But, with the addition of a hard disk system you gain a tremendous amount of speed and power in a no-frills sort of way. If these additional Winchester systems had not materialized, I probably would have phased out my own '89, except for occasional projects.

But I have had a change of heart because my '89 is very good at performing the kind of tasks I require — namely word processing. Even screen editing is much faster on the '89 than on any of the PCs I've worked with. And a hard disk system only enhances these virtues.

Rather than spend additional money on enhancing my "clone", I decided to invest in yet another '89 and a couple of '19 terminals for my Ampro CP/M and PC-DOS "Little Boards" with hard disks, because their inherent speed advantage and clearer CRT display over the PC's make these much better working tools.

A Winchester & Floppy Interface

My '89 is currently hyper-ventillating over the latest product offering from SigmaSoft & Systems — a kind of Grand-Slam approach to implementing both a Winchester and floppy disk interface all in one package.

The primary hardware component in this package has been on the market for several years and used in other computer systems. Its application in the '89 proves that there are devious minds at work at SigmaSoft.

This is a versatile system with many options. Since there is so much to explore and explain, I will devote the next two articles to the new SigmaSoft Disk System.

The Nuts & Bolts

The Western Digital WD1002-05 controller is a multi-faceted piece of hardware that combines a hard disk interface and soft-sector disk controller all on one board. It isn't the only species of its kind. The OMTI 20L will perform a similar function, but is limited to controlling 2 hard disk and 2 floppy drives, whereas the WD1002-05 will handle 3 hard disks and 4 floppy drives.

This has enabled SigmaSoft to offer '89 users a combined interface that doesn't use any of the right-hand expansion slots. Since the WD1002-05 is essentially a Parallel-driven interface, SigmaSoft modified the Universal Parallel Interface card they have been using with their Interractive Graphics Controller Card by adding 2 logic chips and a second 34-pin header.

The new UPI card provides 16 parallel ports. Six are used by the IGC, 2 are Printer ports; the remaining 8 by the floppy and hard disk interface. Since both of these are assigned Port 0, you can, if you like, leave your Z-37 and H-17 or H-47 controllers installed and still use them.

SigmaSoft also has a new version of their Universal Parallel Interface available for the H-8, so that their Winchester/Floppy imple-

mentation can be used on this computer, too. This is especially welcome, because a soft-sector/hard disk for this computer system is extremely hard to come by. Quikdata recently offered a limited run of the H-8 Z-37 controller at nearly twice the cost of the WD 1002-05, which has probably sold out at the time this article appears.

Continuing the precedent they established with the IGC, SigmaSoft offers a total hardware and software integration with their Disk System. This means that it is compatible with:

Heath/Zenith CP/M
Heath/Zenith HDOS
C.D.R. CP/M
Magnolia CP/M
TMSI H-1000 replacement CPU board

The SigmaSoft Disk System can be installed inside the H-89, an H-19 in conjunction with an H-8, or it can be installed in an external cabinet. The SigmaBIOS replacement ROM that is provided with the system allows you to have three types of disk devices resident at one time, though only two can be configured as BOOT devices. The secondary boot device need not necessarily be the Z-37 compatible soft-sector disk controller on the WD1002, but any two additional disk controller types. The C.D.R. hard disk system allows 2 types of floppy disk controllers. The Magnolia and Quikdata systems allow only 1 type of floppy controller due to I/O port decoding limitations.

The SigmaBIOS and the partitioning support software allows the presence of both CP/M and HDOS partitions on the same disk — up to a maximum of 16 partitions.

The basic 10-MB system costs only $895. The 20-MB version is $995. If you presently own a Z-37 controller, this board commands a premium price on the market and can be sold for $200-250. This further reduces your overall investment and makes this system very affordable.

Mounting the SigmaSoft Disk System inside your '89 should not provoke any power supply fears because SigmaSoft provides you with a small supplemental power supply that mounts inside the cabinet between the power transformer and the power distribution board. This is to compensate for the fact that the WD1002 controller will consume up to 3.0 amps of +5 volts. Were you to draw this much power from the '89s own supply, you would throw the system into cardiac arrest, a subject I discussed in Part 4 of this series. In checking with Western Digital and SigmaSoft, I learned that current production models of the WD1002 controller actually consume only 1.5 amps from the +5 volt supply. Even so, this is still too much of a load for the '89 to handle without assistance.

All the literature and documentation provided by SigmaSoft states that if you install the WD1002-05 and hard disk inside the '89 you cannot use their IGC card. This is due to the fact that the supplemental power supply provides a regulated +5 volts needed by the WD1002; whereas the IGC supplemental power supply provides +8 volts of unregulated power which is then refined through a +5 volt regulator on the board.

I consulted with Clay Montgomery of SigmaSoft who indicated to me that the Disk System power supply can be daisy chained off the IGC power board and then mounted in the empty area on the front left of the Video Board directly under the CRT. The reason for not advertising this fact is that you must insulate the power supply to insure there is no contact with any of the Video Board components or the CRT. They prefer that you call them for advice on this installation. It is a risky procedure if not handled properly.

H/Z-89 Installation

If you contemplate installing the SigmaSoft hard disk inside the '89, the first step is to mount the supplemental power supply board. When I reviewed SigmaSoft's IGC board in the August 1985 issue of REMark, I spent some time outlining this procedure because it was a bit delicate. I'm glad I did, because in the past year I have received calls from a number of people who apparently didn't heed my warning about insulating the braided grounding strap that snakes around the power supply area. If any bare portion of this strap comes in contact with the supplemental power supply, you will short the '89s power distribution board. Rather than dwell on these steps a second time, please go back and read my IGC review.

If you're working with an early model '89 with an H-17, you will need to replace the secondary address decoder IC at U516 with Heath Part #444-83. This is only available from Heath. Newer models have this part installed.

In order to minimize the amount of space used by the internal hard disk drive and controller card, SigmaSoft uses the new LaPine low-power 3.5" drives. This unit has a full-size bezel and replaces any internal drive you may have in the '89. The drive power cable is used only to power the LaPine drive. The supplemental power supply provides the +5 volts (@ 3 amps) for the Western Digital controller board.

SigmaSoft's Universal Parallel Interface plugs into any of the '89s left hand expansion ports. Port decoding signals are picked up via a DIP-plug that mounts in the U553 socket and connects to the UPI through a 3-wire cable. A standard 34-wire ribbon cable then bridges the WD controller to the UPI. If you plan to add an external hard disk drive in the future, you only need a cable from the WD controller to the external cabinet.

Two LaPine hard disk drives are available for internal installation — the Titan-10 (which has a formatted capacity of 9.99 MB) and the Titan-20 (which formats to 20.15 MB). These drives have received high ratings from several computer engineering magazines and will provide years of reliable use.

All external drives are from Seagate: The 10-MB ST213 and the 20-MB ST225. The formatted capacity is the same as the LaPine Titan drives. There are also 30- and 40-MB versions. Both internal and external drives are half-height. The external drive and controller are mounted in a handsome two-tone gray cabinet that resembles the '89. It is fan-cooled and has room for two drives. The initial drive comes with a full-size bezel. On the inside, taped to the drive, is a half-height bezel, mounting hardware and cables so that a second drive can be mounted in a matter of minutes.

While this article was being written, I was informed that SigmaSoft has now added a 67-MB Maxtor XT-1085 hard disk drive to their choice of systems. This drive is primarily aimed toward businesses that require a greater amount of storage. Since the WD 1002-05 controller can handle up to 1024 cylinders and 8 heads per drive, 3 of these drives can be installed on your system. Three additional Maxtor drives can be added by installing a second UPI interface card inside the '89. This provides a total of 402-Mebabytes of hard disk storage for large applications.

H/Z-19 Installation

Since SigmaSoft has made it a point to support the H-8 with its Interractive Graphics Controller Card, it was to be expected that their Disk System would do likewise. This is a rapidly shrinking market, so it is to SigmaSoft's credit that they are continuing their support, even though it is only marginally (if at all) profitable.

Mounting the hard disk inside the H/Z-19 terminal is a major chore because you need to upgrade the power supply with that of the '89 in order to have access to the +5 and +12 volts needed by the drive. You will also need a new backplane with the cutouts so that you can connect a ribbon cable from the WD controller to the Universal Parallel Interface card that plugs inside the H-8.

This involves rewiring the AC receptacle, assembling a new power distribution board, an upright heat-sink with the appropriate voltage regulators, and a heftier power transformer. If (and I say this advisedly) you are able to obtain all these parts from Heath's Parts Department, the expense will be in excess of $100. Then, in order to perform the installation, you will need the H-19A-To-H-89A Conversion Manual (Part No. 595-2709).

It is simpler to mount the hard disk and controller card in the H-77 Drive Cabinet. If, like a surprising number of other H-8 and H-89 owners, you're still using the SS/SD 40-track drives, you can now upgrade to DS/DD 40- and/or 80-track drives at a cost of somewhere between $70-120 by shopping around for some of the many discontinued models flooding the market.

The Western Digital 1002-05 Controller

Unlike the SASI controllers which use a Serializer/Deserializer approach to transferring data to and from the host interface, or the SCSI which employs a DMA mode (through the NCR 5380) and a bus arbitration scheme, the Western Digital Controller uses the Modified Frequency Modulation scheme to transfer data from the hard disk and floppy drives through the controller to the host interface. Both the SASI and SCSI data-transfer schemes are much more complex and less efficient in terms of speed. What the SCSI controller offers by way of versatility in allowing multiple computers, controllers, I/O and high-density storage to co-exist on the same bus, it has a data-transfer limit of only 1.5 MBits per second. The WD1002 can transfer data at 5.0 MBits per second, which compensates for the slower I/O between the '89s CPU and Terminal Logic Boards.

Modified Frequency Modulation (generally referred to as MFM), is the way double-density floppy disk drive data has been transferred between the controller and the drive since the year one. A flux transition is always recorded at the center of a bitcell for each "one" data bit. No flux transition is recorded for a "zero" bit unless it is not followed by another "zero" bit. In this case, the flux transition is provided at the end of the first bit cell. What this amounts to, is that clock timing is employed to define bit cells in the transfer of data. And while this conventional method is slower when used with floppy disk systems, the ten-fold speed increase of a hard disk drive (3600 RPM vs. 300 RPM) will provide a corresponding increase in data transfer.

The WD Controller Board uses three VLSI chips to handle each chore. Floppy control is through the WD2797 FDC IC. The hard disk is managed through the WD1010 Winchester Drive Controller IC, which also provides all the data separation logic needed. Housekeeping chores are provided by a 1K x 8 Sector Buffer that keeps the data flowing smoothly on the Data Bus between the hard disk, the floppy drives and the Host Interface. The Control Bus of the system is supervised by the WD1015 Control Processor. This chip manages the on-board static RAM buffer. All bytes of data written to, and read from disk is first stored in this Sector Buffer. When the buffer is full, the data is transferred, on command, to its intended destination.

In addition to controlling data flow between the Host, Sector Buffer, and the Disk Controllers, it also translates Host Winchester command format to Floppy Disk format when addressing the WD2797 Floppy Disk Controller. This permits the Host to maintain a single command format, while in effect controlling two different disk command formats.

The WD1014 EDS chip provides the Error Detection and Support logic. Within a single device designed to add ECC (Error Correction Coding) to 5.25" Winchester disk drives, it also contains three 8-bit registers and three counters, and several latches that enhance the Control Processor capabilities for control functions in a real time operation. As such, it replaces approximately 35 TTL packages consisting of shift registers, flip-flops and combinatorial logic gates. Which explains to some extent why SigmaSoft was able to create a Host Adapter out of their UPI card by merely adding a couple of TTLs, a 34-pin header and some Data and Control lines.

Cost Comparisons

What impressed me about SigmaSoft's use of the WD1002-05 Controller Board was their obvious cost-consciousness. Purchased separately, the WD1002-05 costs $195. In effect, it replaces the approximate $275 cost of a Xebec 1410/a Hard Disk Controller, the $225 Magnolia SASI Host Adaptor Card, and the $300 Heath/Zenith Z-37 Double-Density Floppy Disk Controller — which are at the heart of the Magnolia and Quikdata Winchester Systems.

It was refreshing that SigmaSoft & Systems chose to re-think the concept of interfacing by integrating a commercially available multi-purpose product to replace proprietary system boards, while maintaining Heath/Zenith software integrity. This has resulted in a more versatile and less expensive system.

One of the inevitable results of this recent influx of new Winchester implementations (from C.D.R. and SigmaSoft) is that it tends to provide a confusing number of system choices and options for H/Z-89 users. This is more beneficial than damning, and when you're upgrading the '89, you should consider the merits and limitations of each system in relation to what you want or need for your purposes.

Eighteen months ago, when I first started the planning of this series, I was impressed with what Magnolia and Quikdata had to offer. Magnolia's original SASI interface is now almost six years old. Quikdata, who improvised on the Magnolia interface by providing software for standard Heath/Zenith CP/M and HDOS, seems to be losing ground on a cost basis, primarily because Quikdata is performing a role as a Systems Integrator, and therefore, must charge

extra for the software they have developed. The QUIKSTOR software may be a bit high-priced ($195 if purchased separately; $149 if purchased with a system) at this point in time, because there has been a tremendous drop in the cost of Winchester hardware.

Do not construe that I don't like the QUIKSTOR software. It is first rate on all accounts, as is Magnolia's implementation of CP/M. However, as I have worked with all these systems for a considerable amount of time, it was inevitable that I would become more critical.

The C.D.R. SUPER RAM 89 (with the SCSI interface) also costs more than the SigmaSoft, but then you have additional options such as 1-Megabyte of dynamic RAM, a system Clock and multi-user capability if it is ever developed as planned.

Both C.D.R. and Sigmasoft use the left side of the '89's CPU board for their expansion for the Winchester interface. The C.D.R. system frees one right-hand slot; SigmaSoft frees two right-hand slots by effectively removing the hard disk host interface and the floppy controller off the CPU board.

On the other hand, the replacement CPU boards from Ampro Computers (the SCSI CP/M and PC-DOS boards) can upgrade an H/Z-19 or '29 terminals to full computer status; or allow a high degree of IBM compatibility for the '89 by means of a co-processor board for a moderate cost.

But all of these options make the '89 upgrade an exciting prospect because there are so many "different" systems to choose from. It also demonstrates the flexibility of the original design concept that allowed future innovators to simply change the '89's ROM and tantalize us with new hardware applications.

I think this is the key point of the whole issue. The '89 is certainly unwieldly in size and complexity when you compare it to what can be accomplished in less space by 16-bit systems. But there is little charm to these bright and shiny appliances. You set them up and run them. No challenge. No fun through experimentation. No other computer of its day (or even now) has permitted so much freedom for designers, even though it has one of the most constricting expansion bus designs.

The Documentation

SigmaSoft provides a manual covering the different hardware and software installation procedures that is up to their usual high standards. Included in this 100-page document is the Western Digital 1002-05 Controller OEM Manual.

However, don't plan to breeze through it because the text is terse and covers a lot of territory. It is also a little hard to follow at times, particularly in the hardware installation sections, because it covers the '89, the '19 and H-8 in a narrative format with occasional illustrations.

While all the information is there, do read it carefully if you're not overly familiar with stripping down your system and reassembling it again. The required steps aren't difficult, but care must be taken with the internal installation of the hard disk and the supplemental power supply.

The external hard disk system installation is quite simple by comparison. However, it would have been easier to follow if all the installation steps had been prepared in a checklist type format. As such, the descriptive text could have been judiciously condensed, thus simplifying everything.

I have basically the same comments for the software installation section which I will discuss in detail in the next installment of this series. SigmaSoft assumes that you are familiar with the CP/M and HDOS conventions for modifying the BIOS to incorporate your system hardware and the installation of device drivers. If you're not, you should keep the appropriate Heath/Zenith manuals with you.

CP/M is the most difficult part and the support disk software provides no fewer than 7 different BIOS choices to cover all possible drive formats on your system. All the standard Heath/Zenith entry points have been maintained, so you will not have to fear that any software that specifically accesses the ROM will be unusable. The only exception is that the entry points for Heath's Z-67 Winchester system have been eliminated.

Separate disks are provided for CP/M and HDOS versions for partitioning the hard disk, initializing hard disks and floppies, drive head parking, parallel printer drivers and much more.

Conclusion

This is an intelligently planned piece of hardware, made even more so by the fact that SigmaSoft's Universal Parallel Interface also services their Interactive Graphics Controller card. With this you add high-resolution graphics, a 256k RAM space and print-spooling software. All of this makes me wonder what they have planned for Phase III.

* * *

Current pricing for 10- and 20-MB internal hard disk systems is $895 and $995. External systems pricing: 10-MB, $995; 20-MB, $1095; 30-MB, $1425; 40-MB, $1535; 67-MB, $2395.

For additional information on a variety of system options, and for an informative article on the SigmaSoft Disk System, please contact:

SigmaSoft & Systems
17000 Dallas Parkway
Suite #207
Dallas, TX 75248
(214) 380-6187

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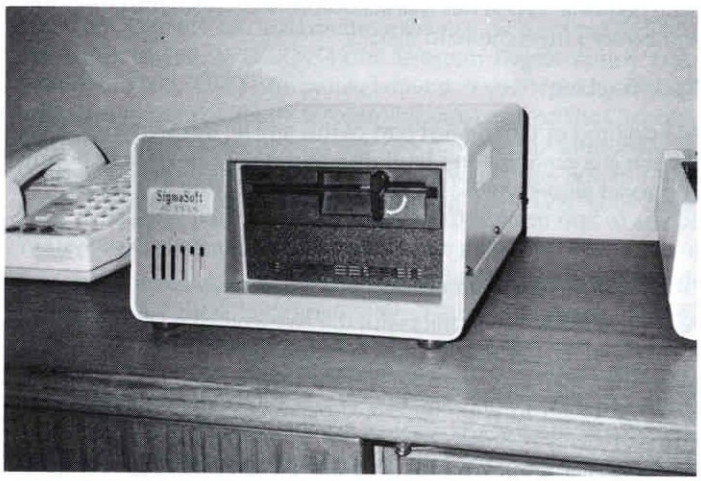
A Winchester For The '89

Part Ten

Peter Ruber
P.O. Box 502
Oakdale, NY 11769



SigmaSoft Strikes Again [II]

With all Winchester hardware being relatively equal in terms of quality and reliability, the versatility and ease in setting up a system rests solely in the hands of the software developer. The SigmaSoft Disk System installation software is a series of easy to follow menu screens that guide you through the hard disk formatting and partitioning stages.

If you're accustomed to working with Winchester systems, the basic set-up procedures are quite similar no matter whose system you are working with. The amount of information you have to supply to the system software depends pretty much on the data needed by the hard disk controller and the software. Some systems require that you provide the Write Precompensation Cylinder Number, as well as the Write Reduction Cylinder Number for the hard disk drive you are using. This information is recorded on the system tracks for future reference by the controller. Sometimes the Write Reduction Cylinder number is ignored, and any number you supply is simply recorded as a Zero.

Other systems require that you insert the name of the controller and the name of the drive, in addition to the standard data on the number of cylinders available, interleave factor, step-rate, landing (or parking) zone, etc.

But whatever is required by the system software, there are 4 basic steps:

1. Hard disk formatting, which includes the entry of the data mentioned above.
2. Hard disk partitioning, which breaks up the available work space into manageable chunks.
3. Initializing (or formatting) the partition tracks the same way as you would a floppy.
4. Sysgening the partitions with the disk operating system so that you create bootable partitions.

The SigmaSoft Disk System is compatible with both Heath/Zenith CP/M and HDOS, and software for both of these operating systems is supplied. HDFORMAT.COM (for CP/M) and HDFORMAT .ABS (for HDOS) are the hard disk formatting utilities. It doesn't matter which one you use because they perform the same task.

Getting Started

When you invoke HDFORMAT, you enter the data for the drive you received with your system from the chart in the manual. The initial formatting procedure takes about five minutes for a 20-MB drive. The second portion of the utility takes about 12 minutes, during which a read/write is performed on every cylinder in order to check for bad sectors.

Generally, you will get a message saying NO BAD SECTORS FOUND. But, you may receive a list of a few bad sectors, which is nothing to be concerned about. In order to bring the cost of hard disk drives down to the level of what you paid for a floppy just a few years ago, manufacturers occasionally release drives with minor flaws. If HDFORMAT encounters any bad sectors, they will record the numbers on Sectors 11 and 12 on the drive's Track 0 so that the system will not access these when you read and write data to the drive.

Even if your drive was flawless when you formatted it for the first time, you may sometime in the future encounter bad sectors in a particular partition. SigmaSoft has included a Public Domain program called FINDBAD.COM that can be used to test a partition if you start receiving read/write errors. It will map out the newly-found bad sectors and write them on the system's tracks.

The next step in using the SigmaSoft Disk System is to run the HDPART program. Again, there are like versions for CP/M and HDOS, and either version can be used. This program is probably the most practical I have used to date.

After entering the data for the Hard Disk Base Port and the Hard Disk Drive Number, you enter a spreadsheet type of menu that lists several categories —

TYPE — (CP/M or HDOS partition)
NAME — (An Alpha code name you can assign to each partition)
FIRST CYLINDER — (The number of the next available cylinder number)
CYLINDER COUNT — (Number of free cylinders remaining on the hard disk)
PARTITION SIZE — (Kilobyte space remaining on disk)
DEFAULT BOOT — (Shows which partition will be your CP/M and HDOS primary boot partition)

At the bottom of the screen you have a choice to —

A — Add a Partition
D — Delete a Partition
B — Set Boot Default
X — Exit This Utility

And, you are informed that the cylinder size is 32k byte.

Now, before you jump ahead to create a partition, you should give special consideration to how you want to assign the partitions for the most productive purposes. SigmaSoft's documentation recommends that you establish your Default Boot Partitions for CP/M and HDOS at the beginning of the drive for faster access. That aspect of your work most frequently used should become your Default Boot Partition.

In order to illustrate this for you, I'll explain what I did during the initial partitioning of the drive.

I typed letter "A" to Add a Partition. Then I selected the type of partition (CP/M or HDOS) by typing 1 or 2, and the number of cylinders that I wanted to assign to the partition. I chose HDOS and a partition size of 40 cylinders. This would give me 1,280,000 bytes of work space with a small cluster size. The cluster size, as you'll recall in my discussion of the QUIKSTOR software from Quikdata (Part 3), is the minimum file space consumed. In a 1.0 to 1.5-MB partition your cluster size will be about 2k. From 2.0 to 4.0-MB, the minimum cluster size becomes 4k. And at 8.0-MB, that jumps to 8k. Thus, the larger your partition size, the more actual unused space you wind up wasting.

The program then asks you to enter a NAME for the partition. I selected LETTERS. When I hit the return key, the menu came up again showing the data I had just entered and the remaining number of cylinders and kilobytes remaining on the disk.

Then I set up a second HDOS partition of 40 cylinders called ARTICLES. A third called INVOICES, and a fourth called NOTES.

Under CP/M I created a partition called ARTICLES and one called NOTES. The program allows you to create duplicate names for each of the operating systems. I wasn't certain what I wanted to do with the rest of the space, so I left it blank for the time being. The HDPART program allows you complete the partitioning at any future date or to delete a specified partition at any time, and even to change the default boot partition.

I set the BOOT partition for each operating system from the menu and exited the program.

The next step with the SigmaSoft Disk System (which isn't generic to all hard disk installation software) is to run the ASSIGN utility. This assigns the partition names to each respective drive unit: A:, B:, or SY1:, SY2:, etc.

You invoke ASSIGN directly from the system prompt in the same way that you would use the SET option. This is done as follows:

```
>ASSIGN HD0:=LETTERS, HD1:=ARTICLES, HD2:=NOTES, etc.
```

Since I started off with HDOS, I performed an INIT and a SYSGEN on each partition in the same way as I would a floppy disk. When INIT asked for a system label, I assigned the same name as I had for the partitions. If you jam the hard disk with the maximum of 16 allowable partitions and you forget what is where, simply run HDPART for the menu screen, or ">ASSIGN?"

My final step was to PIP my Text Editors and Word Processors to each partition. When this was accomplished, I reset the computer and booted from the hard disk.

Back Tracking

As I pointed out in the first part of this article, the SigmaSoft Disk System is a combination hard disk and Z-37 compatible floppy controller all on one board. Since a single IC (the 1015) controls access to and from both types of disks (via their respective controller chips) through a sector buffer, the SigmaSoft Disk System shares a single I/O Port (0).

As such, it does not conflict with the two available Disk I/O Ports (170Q and 174Q) that Heath/Zenith allows on the '89. If you presently own one or more floppy interfaces (H-17, Z-37 or Z-47) installed in your system, they will be fully functional as before. However, only 2 devices can be selected as PRIMARY and SECONDARY Boot devices through Switch S501 on the CPU board. The remaining devices can be accessed by the normal device selection manner peculiar to each operating system. Your Boot devices can, of course, be changed by simply rearranging S501. Also, the normal H/Z conventions of booting from different drives within a specified device has been preserved.

Turning To CP/M

The running of the ASSIGN program under HDOS applies as well to CP/M. Since I performed the initial formatting and partitioning under HDOS, I now had to boot up a CP/M disk containing the SigmaSoft support software. Assigning partitions is performed through the ASSIGN program:

```
A>ASSIGN A:=ARTICLES, B:=NOTES, etc.
```

SigmaSoft has allowed the following labels to each possible device on a CP/M system:

```
WD1002 Hard Disk      A:, B:, C:, D:
H-17, Z-37 or Z-47    E:, F:, G:
H-17, Z-37 or Z-47    H:, I:, J:
WD1002 Floppy         K:, L:, M:, N:
```

While 8 HDOS partitions can be created through the HD.DVD device driver, only 4 CP/M partitions are available. If you actually require 8 CP/M partitions (for a total of 16 partitions on the drive),

you can assign any unused floppy device designation as a hard disk partition via ASSIGN:

```
A>ASSIGN K:=PARTNAME, L:=PARTNAME, M:=PARTNAME, etc.
```

In this fashion, while you could assign up to 16 CP/M, using any valid drive select letters from A: through P:, only 4 CP/M partitions can be assigned as bootable partitions at any given time. When you run the ASSIGN program to designate new CP/M partitions, floppy devices will automatically be reassigned to another drive letter if conflict occurs.

There are two methods of accessing a CP/M partition on the SigmaSoft hard disk. If you don't want to bother installing the appropriate SigmaBIOS version that corresponds with the type of disk system you have on line (which we will get to shortly), you can use the LOADD.COM utility.

The utility allocates space from the Transient Program Area (TPA) of the CP/M system and reserves it for the installed driver module. It's primary advantage is that it is simple to use and acts just like an HDOS device driver. The disadvantage is that you must initiate LOADD.COM from a floppy drive, and it remains active only until the next cold boot. A CTRL-C warm boot doesn't dismount the driver from the system. It also doesn't allow you to boot directly from the hard disk.

The LOADD utility can load multiple drivers, such as the HD.DVD (hard disk driver), WDC.DVD (the Western Digital floppy controller), the UPC.DVD (the parallel driver). If you're using the SigmaSoft Interractive Graphics Controller, you can load the Graphics Driver, Ramdisk Driver or Print-Spooler driver at the same time. In specialized applications, this is a simple way to go. But, as I said earlier, these drivers only remain active until you cold boot again.

A practical use, however, for the LOADD utility is that it helps to overcome any BIOS incompatibilities that are hardware dependent — such as the CDR 5/8 floppy controller, the Magnolia version of CP/M, etc. Since these BIOSes cannot be incorporated into a standard H/Z BIOS, you are likely to encounter occasional software problems. LOADD will allocate space from any incompatible BIOS for a device driver, so that specific hardware and software will function correctly with the SigmaSoft Disk System. SigmaSoft first used this method with their IGC in order to allow this graphics board to function with almost any proprietary Heath/Zenith compatible CP/M BIOS.

To boot from the hard disk, you will have to incorporate the SigmaBIOS into the CP/M operating system. You have 7 versions to choose from —

```
SBIOS1.SYS      WD1002 only
SBIOS2.SYS      WD1002 and H-17
SBIOS3.SYS      WD1002 and Z-37
SBIOS4.SYS      WD1002 and Z-47
SBIOS5.SYS      WD1002 and H-17 + Z-37
SBIOS6.SYS      WD1002 and Z-37 + Z-47
SBIOS7.SYS      WD1002 and Z-47 + H-17
```

Create a bootable CP/M disk and place the appropriate SBIOS?.SYS file on the disk. Make certain that the disk also contains the basic CP/M programs: SYSGEN.COM, MOVCPM??.COM, STAT.COM, PIP.COM.

Type:

```
A>ASSIGN ?:=PARTNAME (the "?" represents the letter of
                      the drive partition we will SYSGEN)
```

Type:

```
MOVCPM * SBIOS?.SYS (the SigmaBIOS provides a 64K system
                     as indicated by the "*" to SYSGEN)
```

When completed, type SYSGEN. When SYSGEN asks you for a source drive name, hit RETURN because the system has already been placed into memory by MOVCPM. When you are asked for the destination, type the designated letter for your drive (which was created above by ASSIGN. After the FUNCTION COMPLETED message appears, type an extra RETURN to exit from the SYSGEN utility.

The next step is to rename the newly created BIOS:

```
A>PIP "?":BIOS.SYS=SBIOS?.SYS[0]
```

This completes the installation of the SigmaBIOS on your CP/M partition.

If you are working with a non-Heath/Zenith CP/M system, you have to create a system size that allows for sufficient space above the CCP (Console Command Processor) to hold all the device drivers. The Bytes these drivers consume will reduce your system size. Each Kilobyte of driver overhead will cause a corresponding decrease in your system size.

The MOVCPM program will place the system size into memory:

```
A>MOVCPM 60 (this size is for illustrative purposes only)
```

Then use SYSGEN to place it from memory to disk.

Now you can SYSGEN your CP/M partitions and PIP your designated programs to the hard disk. Once you've installed the SigmaBIOS to your non-Heath/Zenith CP/M system and then placed it on your hard disk partition, the SigmaBIOS provides a full 64K system.

Plan Your System

As you've probably concluded by now, there is a certain amount of work involved in setting up your SigmaSoft Disk System for the first time. It is fair to assume that you will probably spend the better part of an evening doing it right. There isn't much point in rushing through all the steps, because you might overlook something and then wind up spending twice as much time redoing the work.

The more sophisticated PC-DOS (MS-DOS) already contains all the utilities for setting up a hard disk from start to finish in about 20 minutes. And while CP/M and HDOS may seem primitive by comparison, MS-DOS has some irritating limitations when it comes to setting up hard disks.

Most versions of MS-DOS distributed by computer manufacturers, however, exclude the FDISK utility that prepares the hard disk for formatting. Generally, the OEMs performs this task, because they want to sell you a controller and drive combination. Early versions of MS-DOS limit you to using 10-20 MB hard disk drives. Versions 3.0 or higher allow you to use up to 40 MB drives. But it is difficult to break up this space into manageable partitions unless you can find a special partitioning program.

All of the CP/M and HDOS hard disk software available for the systems I have discussed allow you to create partition sizes to suit your working requirements. In order to isolate yourself from a massive directory listing on an MS-DOS hard disk, you have to resort to creating numerous subdirectories for each program category so that you maintain some semblance of order. Not only is is easier to work with smaller partitions, but you will avoid the confusion caused by a subdirectory "tree" structure. In this respect, using hard disks with CP/M and HDOS has very practical advantages.

What isn't evident at first when you read the SigmaSoft documentation is that you should sit down and really plan out the physical mapping of the hard disk drive. If your system is used for even small business purposes, you are probably better off getting the larger capacity drive. The cost difference between a 10-MB and 20-MB drive is only about $100, which brings your cost per kilobyte of storage way down. The SigmaSoft Disk System offers enhancements in the partitioning program that aren't available with any other system on the market.

Other Utilities

A number of Public Domain programs and SigmaSoft utilities are supplied with the HDOS and CP/M support software. HDPARK is generic to both operating systems. When called up it will park the hard disk drive heads to an unformatted track area where they will be secure. This is recommended if you ever have the need to ship the drive or move it. I use HDPARK and its counterparts on all the hard disk drives I have because I am constantly shifting my equipment and I feel more confident if I know the heads are locked in place.

You must remember that if you park the read/write heads, and then change your mind, you must first reset your computer before you boot again. Trying to power up the hard disk through a warm boot or by trying to access a program can cause problems.

SigmaSoft has also provided generic HDUMP utilities for backing up hard disk files, and a CONFIG.COM utility for CP/M that works the same as standard CONFIGUR.COM, but allows you to establish all possible parameters for all the devices supported by the SigmaSoft Disk System.

The MAKESBC.COM utility will allow you to recreate the Software Boot Code portion of the format table on cylinder 0 of an installed hard disk. This will allow you to install an updated or revised version of the support software, repair certain types of partition damage, and enable you to move partition table information to another drive without the need to use HDFORMAT for this purpose.

Under HDOS, the WDC.DVD floppy device driver works the same way as the standard SY.DVD and DK.DVD do. It will support up to four 40- and/or 80-track DS/DD drives in a soft-sectored format. Your Z-37 and H-17 (or H-47) floppy controller cards can coreside with the WD-1002 controller. You do, of course, need to be mindful of the total number of device drivers placed on your system disk to allow room for printer device drivers and others which may be needed by plug-in cards in your '89.

It is, of course, impossible to describe all the software features in clinical detail. I have tried merely to illustrate how the basic set-up is performed so that you have a reference in comparing the SigmaSoft Disk System to the systems discussed in previous articles. SigmaSoft provides a series of examples, for instance, on how to use the various HDOS and CP/M device drivers for accessing the combined Western Digital hard disk and floppy disk system; setting the printer parameters for the Universal Parallel Interface. All these require some study and practice so that you are comfortable with them.

Summing Up

This has been a fun system to work with because there are so many options. And even though I have become accustomed to it, I still hold to my earlier comments that SigmaSoft should consider preparing a check-list type of installation procedure, as well as a step-by-step procedure for installing the software. This can be accomplished by providing a couple of supplement sheets. Details of how a software utility functions can be learned from the documentation itself, but the order of how the utilities are to be used is important, especially since they are scattered throughout the manual, and can be confusing to users exposed to a hard disk system for the first time.

Aside from this criticism, the SigmaSoft Disk System is intelligently conceived and a high caliber product. I encountered no problems using a variety of enhancement boards from Heath/Zenith and some independent manufacturers.

The Users Manual also includes a complete parts list and pin-out specs for the Universal Parallel Interface card which provides two separate Centronics compatible parallel ports. The product is warranted for 6 months.

* * *

Current pricing for 10- and 20-MB internal hard disk systems is $895 and $995. External systems begin at $995.

For additional information and an informative booklet explaining the SigmaSoft Disk System, please contact —

SIGMASOFT & SYSTEMS
17000 Dallas Parkway, Suite #207
Dallas, TX 75248
(214) 380-6187

A Winchester For The '89

Part Eleven

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

Time Out

In place of the usual product dissection this month, I thought I would take time out to reflect and make some observations that have been prompted by the bulk of the correspondence that I have received over the course of this series.

Eighteen months have elapsed since I first contemplated writing this series, and fourteen months since the first installment appeared in REMark. This is a long time to devote to one category of computer hardware for a single computer, but worth the time and effort because it helped to fill a void in the published material available for the '89. The series was launched at a fortuitous time, because a number of systems appeared suddenly and provided a lot of additional material that enabled me to cover all Winchester systems and related products one after another.

I also mentioned that my familiarity with hard disk systems was practically nil and that researching and writing the series would be a learning experience for me, as it would for others who were in the same boat.

One of the articles I planned to do in the projected scope of the series, was a do-it-yourself Winchester system using public domain CP/M utilities and some close out bargains from various electronic wholesalers. While this appeared, at first, to be a sound project, I discovered very quickly that close out bargains don't remain on the market for any extended period of time. So, considering the delays incurred by working with a "home-brew" system, and testing it, writing the article, and then waiting for it to be scheduled for publication, most of the hardware would have disappeared from the market.

Hard disk controller boards were another problem. Each has its own protocols for accessing a hard disk drive, which require a driver and a hard disk formatter. While these are not difficult to customize (providing you could get the source code to a public domain driver and are experienced in assembly language programming), access to controller and disk drive technical manual is a problem. Most suppliers I contacted informed me that they don't always get the necessary documentation from the manufacturers.

The final topic I had to consider was system reliability. What if it failed? How could you determine which element was at fault — the drive or the controller — short of having duplicate hardware to substitute? Could you get the component serviced? Would the cost be reasonable?

Unfortunately, the answers weren't always encouraging. Some close-out drives were reconditioned or tested units taken out of service from leased equipment. Others were manufacturers' overstocks. The drives that had a reliable reputation disappeared quickly. The oddballs remained on the catalog pages like relics from the stone age. For the most part, they were all specimens of an older technology that had a higher failure rate than drives in current production. Worse still, the cost of servicing a hard disk drive is costly. It's not an object you dump on your workbench and then take apart. The plated media is highly sensitive to contamination and must be serviced in a near-sterile environment. That costs money — often as much as twice what you paid for your bargain drive. A lot of drives (even though still in manufacturers' original packing) were sold without warranty, or on a limited 30-day exchange basis. The odds of getting all your components together during the same 30-day period, and then getting the system up and running, were rather slim.

You could also have problems even with a brand new hard disk system. Two of the systems I worked with developed problems. One apparently was sensitive to power surges and damage occurred to the drive's electrical system. Another unit worked like a charm one day, and wouldn't boot the next, for no apparent reason. I did not mention these problems because I felt they were

isolated. Furthermore, as the systems had been supplied by reliable vendors, the defective products were replaced immediately.

I therefore reached the conclusion that it was safer to spend a little more and get a guaranteed turn-key system that you could get serviced or replaced if the worst fears come true. This is especially recommended if you are going to store data that has work related importance.

The Mail Bag

A few days before I sat down to write this column, I received the following letter from a HUG member in Pittsburgh:

"I am a fellow HUGGIE and I'm impressed by your ambitious and thoroughgoing series of H-89 articles in REMark. I own an H-89 and love it, although I do still just use floppies. Nevertheless, the H-89 is our common ground in these days when your REMark articles alone represent a substantial portion of total user-generated information currently being published. The magazines and newsletters are swinging over to the PC-compatibles. We don't need PCs, and we are being left behind. Where they make their mistake is in overlooking the fact that we don't want to be left behind . . ."

Flattering letters are always nice to read — but a lot of the correspondence I received had a prevailing mood that I feel deserves some commentary. Most H-89 owners have a fanatical loyalty to their machine, a kind of beneficence some people bestow on their first born. My own fanaticism for the '89 has been on the downslide lately.

This is due in large part to my involvement with the Winchester series. My system ceased to be a functional working tool except for writing the related articles. Equipment moved in and out regularly and my '89 never had the same configuration for more than a few weeks at a time. At one point, I had several different hard disk systems, co-processing units, graphic cards and more RAM installed than I could use in a month of Sundays, that my '89 grew into an obsessive monstrosity. These interfacing projects were fun but not productive in terms of my regular work.

I picked up a Zenith PC along the way, and a Visual PC portable I could lug to and from my office. And it was inevitable that my tastes would alter in the process. I started making comparisons, but this was like comparing a Chevy to a Corvette. The analogy wasn't really fair, because the '89 and the PCs are products of radically different technologies. IC technology has progressed to such a point where it takes half the number of components to produce a computer that is ten times more powerful at half the price.

The only consumer product that can offer this kind of cost effectiveness is a computer. A short four to five years ago a basic 48K '89 went for nearly $2,000 in kit form. Today, for the same money, you can buy two H-148 PCs. But you can't buy two Corvettes for the price of a four-year old Chevy, even though auto manufacturing techniques have the same kind of high volume, automated assembly-line production as computers now do.

Don't be misled into thinking that I have turned my back on the '89, or consider it less important than my PCs. I'm fond of all my children, even though their personalities and abilities differ. And so it goes with my computers. When the opportunity presented itself recently to pick a low-priced used '89 and an H-19 terminal, I snapped them up, and my office is cozier now that I have six computers cranking up the monthly electric bill.

The only real benefit a PC has over an '89 (aside from a lower cost ratio) is the software. It has become more user friendly, and the functions of many sophisticated programs can be mastered without having to digest reams of unintelligible documentation. Too bad that software manual writers haven't achieved haven't and mastered the art of simplicity. It's easier to learn Microsoft's WORD by loading the disk and playing with the program than by trying to understand the manual.

At the primitive level, all computers function in much the same fashion, and the only difference between a 16-bit PC computer with lots of available RAM and an 8-bit '89, is that there is generally less disk I/O traffic with a PC, because larger portions of a program can remain in memory. An '89, with a hard disk overcomes some of the speed advantage a PC has in this respect. But the PC's cursor movement is pathetic when you compare to the '89. The '89 has a separate CPU for the terminal board, so it zips along more than twice as fast as the cursor on my PC's. This is a benefit when there are numerous editing changes to be made within a manuscript. You can easily become spoiled by the bells and whistles found in PC software; and, by the same token, you can ignore most of them as you'll never have need for them. So, for most general business and personal productivity and programming functions, an 8-bit '89 is not really so backward as some pundits will tell you. The one area in which the PC does shine is in CAE/CAD applications. These types of programs were never fully developed for 8-bit computers because they required massive chunks of free memory.

To get back on the track, the general undercurrent of the letters I've received indicate that there is still a sizable installed base of '89 users who want (and demand) support. But what some people seem to ignore is that the '89 has been around since 1979 and a lot of articles have been written about the computer. Some people may not be aware of the fact that all the early issues of REMark are available from the Heath Users' Group in bound volumes, and that Sextant still has a supply of their old magazines.

They're worth collecting if you plan to keep your '89 as your main computing tool in the years ahead. If it continues to function without problems, and the software you have collected is suitable for your needs, then by all means enjoy your machine. But you must realize that sooner or later people are going to run out of worthwhile things to write about, but an important contribution on a hardware enhancement will not be overlooked by the editors.

I think the fears of some '89 owners who believe that support will dissipate in the next few years is unfounded. Heath/Zenith has always provided a minimum of seven years of service and technical support for any product they discontinue. There is also support at the local HUG level, and through correspondence with others. I honestly feel that the kind of user participation and help available within the H/Z community is far better than what is available for other computer systems. Where can you get support for your Osborne, Eagle, Columbia, OSI, Exidy Sorcerer, or a dozen others?

But there is the other side of the coin when you discuss support. How many '89 owners have given support to the enhancement products offered by Heath and by independent vendors?

I have gotten to know some H/Z support vendors rather well in the last few years, and most of them feel that '89 owners always had a "Look but don't buy" attitude, and that only a relatively small percentage of these people ever enhanced their systems beyond the basic configuration.

I also know for a fact that most vendors of '89 enhancement products made very little profit from their ventures. In some cases it was a hobby for an engineer or a programmer, or a sideline for a dealer of a broad range of computers and peripheral products. No more than a half-dozen products out of the 70 or so that were produced over the years ever returned a half-way decent profit. A powerful expansion chassis suitable also for controlling external devices sold less than two dozen units.

It costs money to advertise, which must come out of the profit of the product. If the vendor of a first-rate product cannot sell enough units to pay for his time and efforts, then obviously he's going to turn his talents toward machines that offer more of a potential for him.

Not everyone is going to need a graphics card, or a RAM card, or what have you. But some exciting products that offer speed and power to rival the PC's have been largely ignored. I have heard the argument that some of these products were very expensive. This is true. Custom products assembled in limited quantities have a higher unit cost.

If, for the sake of argument, a vendor's profit on a $200 board is $60, and he has a monthly advertising expense of $300, then he must sell 5 boards just to meet his advertising bill, not counting his telephone, office expenses, printing and mailing costs, etc. If he only sells 4 units that month, he's lost money, and too many losing months will put him out of business. The same analogy holds true whether you must sell 5 boards or 50 boards every month. The more you sell, the higher your costs go up in proportion.

You can't survive in an atmosphere of diminishing returns. So, support is a two-way street. If you don't support your vendors, they will ultimately abandon you. You don't have to rush out and buy everything in sight, because you'll never use it, let alone afford it. And if you do contemplate a purchase, check it out at a dealer or with someone who has the product. Learn if it will do what it claims it will. It might turn out that it's just what you needed to make your computing tasks a little easier and productive.

A few readers have chided me for not being more opinionated about recommending this product over that one. Well, I didn't feel it was appropriate to be too subjective, because I worked with one system at a time and really had no idea what the next one would be like. So I attempted to approach each system with a fresh mind and from the viewpoint of an average user. I have no exceptional hardware or programming skills that would enable me to nit-pick here and there. And I tried to arrange the format of each article the same way. I listed the features and explored the software and hardware installation. I didn't concern myself too much with the price spreads because a user would have to make up his own mind of which system was suitable to his or her budget. Some systems also had expansion options that others didn't, and those costs would have to be equated by the user in terms of need.

Occasionally some of the documentation irritated me, especially since I expected a little more. Other systems had superb documentation. Where a system might generate power supply problems, I went to some lengths to secure solutions and compiled a list of the power requirements of most of the major '89 enhancement cards so that users had a means for analyzing their own system. In another instance where a system exhibited possible problems by its close proximity to the flyback transformer, I recommended shielding and additional power supply modifications.

These suggestions were by no means arbitrary solutions. They were tested and retested, checked out by some willing victims I recruited, and then double-checked by the manufacturer. I tried, in a sense, to cover all contingencies where there was doubt in my mind — or where a problem was brought to my attention.

Since hindsight is a great teacher, it is, of course, possible that I overlooked a feature or a minor problem here or there. If I have, no one has brought them to my attention, so I assume that, despite deadlines and other writing obligations, every system got a fair shake, and readers had a reference source by which to make comparisons.

What's Next?

Working with hard disk systems has been very interesting. There is a new technology emerging that is not only lowering costs dramatically, but making drives more reliable. There is also the SCSI interface, and a universal SCSI/PLUS I/O bus being promoted by Ampro Computers that will open up the architecture of closed computer systems.

I spent several days in Silicon Valley toward the end of last August nosing around and talking with people. I also visited the management at Ampro to get some first-hand information on SCSI/PLUS. I will therefore spin off a limited series devoted to the SCSI and SCSI/PLUS interfaces and discuss some of the new hard disk technologies for PCs. There will be more than a few surprises.

There will be two more articles in the present series. The next one will deal with some product updates, and the final piece will discuss a new 16-bit co-processor that can be used with the '89 and Heath/Zenith terminals. This will be a blockbuster to end the Winchester/'89 series, because there is nothing like it on the market. ✱

Winchester For The '89

Part Twelve

Peter Ruber
P.O. Box 502
Oakdale, NY 11769

IBM Screen Emulation On The '89

In Part 8 of this series (September 1986), I discussed how you could turn your H/Z-89 computer, or H/Z-19/29 terminals, into a powerful 16-bit system by interfacing them to an Ampro LITTLE BOARD/186 PC-DOS single board computer. This article generated a surprising response in terms of calls and letters. Since I only gave a brief mention to the Video RAM Emulator in the article, the principal question presented to me related to software compatibility. The VRE was finally released in September 1986, so I have finally had a chance to play with it.

However, before I tell you about the VRE, I should backtrack a bit. The Ampro 186 is a complex and versatile product, and it has grown into a powerful system that includes not only the VRE, but the EXPANSION/186 board, the SCSI/IOP and the PROJECT BOARD/186. A year has now passed since I started working with the 186, so my perspective has altered and I can more fully appreciate the considerations of its original design concept.

The 186 was designed as a PC-DOS "engine" for industrial automation and as a means to upgrade terminal work stations to full computer status. It has a highly defined extension of the SCSI interface called SCSI/PLUS (tm), which provides users with a multi-master system bus for interfacing to other computers, I/O and mass storage devices through the NCR 5380 SCSI Protocol Controller. While the standard SCSI definition only allows for 8 devices on the bus, Ampro's enhancement will allow up to 64, each with 4 logical units.

PC-DOS (MS-DOS) and UNIX are not capable of handling a real time control environment. PC compatible systems can be set up to control industrial automation devices, assembly station robots, analog/digital converters, display processors, etc., on a one-to-one basis, but at the expense of the computer's native functions. Why tie up a $3,000 PC computer when a $500 board, that was specifically designed to handle these chores, can do it cheaper and more efficiently? Ampro's 186 "SCSI engine", their SCSI/IOP (input/output processor) and other new products offer the PC computing environment some extraordinary opportunities.

I spent several days this past August visiting Ampro's offices in California, and I was able to learn how their products can be used in office and industrial situations. As a result, I am currently developing a limited series for REMark that will demonstrate how the Ampro products can be used with PC computers for remote control applications, inexpensive networks, and mass storage. This series will also discuss the technical aspects of Ampro's SCSI/PLUS multi-master system bus. Although the slant of these articles will be directed to the larger user — corporate offices, universities, OEM's and the military — these concepts can be scaled down to provide users of Heath/Zenith PC/AT compatible systems with additional power in interesting ways.

The Video RAM Emulator

The Video RAM Emulator is a PC compatible monochrome display adapter. When programs attempt to access video display hardware, a software driver converts the data written to the Video RAM into properly formatted serial data for display on the RS232C ASCII terminal connected to Serial Port A of the Little Board/186.

The Video RAM Emulator will run a greater selection of MS-DOS (PC-DOS) software beyond the "generic" category. "Generic" MS-DOS software usually means programs that write to the ROM BIOS instead of specific hardware within the PC. Software that requires extensive hardware compatibility with a PC — such as those which use bit-mapped graphics, or require a color display adapter, or make direct access to the PC's floppy disk controller, serial ports and Interrupts, generally will not load or run.

I suppose this sounds a bit confusing, so let's see if we can't narrow down the types of programs that we can use on the VRE with the '89 or '19/'29, by isolating those categories of programs we know will defi-

nitely not work unless they are extensively modified — a task that is beyond most of us, and certainly not worth the effort.

Software programs that require a color display board — the standard Color Graphics Adapter (CGA) or the Enhanced Graphics Adapter (EGA) — are easy to isolate. The packaging usually indicates which board is needed to run the program.

Software that accesses the PC's serial ports are communications programs (CROSSTALK XVI, PROCOM II, MIRROR, and Hayes' SMARTCOM II). They look for the 8250 communications controller and an attached modem.

Software that makes access to the PC's NEC765 floppy controller are those which are copy protected by PROLOK, SUPERLOCK, HDCOPY, PADLOCK II, SAFEGUARD, COUPON, PC-PADLOCK. Most of these annoying schemes use a "fingerprint" burned into a disk to foil duplication, and COPY2PC and COPYWRITE won't always provide successful backups with some of these methods.

There recently emerged an interesting program from Transec Systems, Inc., called UNLOCK, that will remove the copy protection schemes from many major protected programs that employ the PROLOK and SUPERLOCK protection schemes. When UNLOCK has removed the protection, clean duplicates can be made through the DOS DISKCOPY command, and whole programs can be placed on a hard disk without the need to keep the main program disk in the Drive A: floppy. Some of the programs that UNLOCK is guaranteed to work on, are: Lotus, Symphony, Harvard Total Project Manager, Framework, Signmaster, Chartmaster, Thinktank, DoubleDOS, Realia Cobol, Fastback, Clipper, The PFS series, dBASE III, dBASE III Plus, IBM Writing Assistant, IBM Filing Assistant, Microsoft Word, among others.

With respect to the Video RAM Emulator, I was advised by Ampro's Technical Support section that unprotected versions of Lotus and Symphony will now run on the 186. I could not confirm this because my copies are protected. However, I did have an unprotected version of dBASE III PLUS that ran like a charm, except that the on-screen clock in the upper right-hand corner was not transferred to the H/Z-89/19/29 screens. Conversely, some of the PFS series (WRITE, FILE and REPORT) worked on the 186 with the VRE even with the copy protection intact. This may be due to the fact that the degree of protection was not as violent as some of the programs I tried. I could not, however, place PFS WRITE on my hard disk. It had to remain in my Drive A: floppy while I created and edited files on my hard disk. This was a small price to pay for a program that is simple to use and adequate for letters and short documents.

Just what programs write to the PC's (8088 CPU) Interrupt structure, I have no idea of knowing. The only obvious one is clock hardware and software. When writing or reading to clocks, the device must interrupt the CPU in order to update the screen. The Heath/Zenith or FBE Research Company "SmartWatch" packages (the clock chip in a CMOS socket) will not install. The 80186 CPU in the Ampro board has a different Interrupt structure than the 8088.

However, Ampro has it's own "SmartWatch" package which plugs in under EPROM U9, when the 186 is used in conjunction with the VRE. The EXPANSION/186, which adds many additional functions (see REMark, September 1986), has its own clock.

The following is a list of programs by category that have been tested and known to work. This is not, by any means, a definitive list, because there are many programs available that are suitable for the IBM Monochrome Display Adapter. This would include programs that have an installation program to set the type of display within a PC compatible.

Database

Dataease
dBase III
dBASE III Plus
PFS: File

Spreadsheets

Supercalc 3
Lotus 1-2-3
Symphony

Word Processors

Multimate 3.20
IBM Easywriter
Wordstar
Wordstar 2000 v1.01
Right Writer
PC-Write
PFS: Write
Spellbinder

Integrated Software

Peachtree 5000
T/Maker

Communications

MEX
Link II

Languages

Borland's Turbo Pascal
Borland's Turbo Prolog
Microsoft "C"
MASM
GW Basic
IBM Macro Assembler
All Intel 8088, 8086, 80186 development tools and other utilities mention in the 9/86 REMark

You are not likely to need any additional software to handle the bulk of your computing requirements.

IBM Function Key Emulation

Since many of the programs listed above make use of the IBM function keys, the H/Z driver for the VRE has incorporated key mapping that will allow about 95% emulation of the IBM's function keys. There are a couple of restrictions. The PC's keyboard system reset of CTRL-ALT-DEL can not be emulated. It has to do with the way IBM keyboards are encoded. Doing a manual RESET accomplishes the same thing. And the CTRL-ALT sequence used by memory resident programs such as SIDEKICK, has not been effected properly as of this writing. Fred Willink, head of Ampro's Technical Support, is seeking a solution for the H/Z driver that he has written for the VRE. Fred is also an old-time user of the '89, a member of the San Jose HUG, and the man to hound with questions, so he has a personal stake in this.

PC Key	H/Z-89/19 Keys
<F1>	<ESC> <1>
<F2>	<ESC> <2>
<F3>	<ESC> <3>
<F4>	<ESC> <4>
<F5>	<ESC> <5>
<F6>	<ESC> <6>
<F7>	<ESC> <7>
<F8>	<ESC> <8>
<F9>	<ESC> <9>
<F10>	<ESC> <0>
<HOME>	HOME
<Pg Up>	Keypad <9>
<Pg Dn>	Keypad <3>
<Ins>	Keypad <0>
<End>	Keypad <.> or <Del>
<+>	<+>
<Num Lock>	<F4>
<Scroll Lock>	<F3>
<Break>	<White> <F3>

Modifier Keys

<Ctrl>	<Blue>
<Alt>	<Red>
<Shift>	<White>

Arrow Keys	
<Up>	Keypad <8> Up
<Down>	Keypad <2> Down
<Left>	Keypad <4> Left
<Right>	Keypad <6> Right

<F2> — is the toggle key to move screen up or down one line. The PC has a full 25-line screen display. The H/Z has a 24-line screen with the 25th implemented as a status line under software control.

In addition to the H/Z driver, the VRE has drivers for the DEC VT100, Televideo 925, and Wyse 50 terminals. One of my two Ampro systems has a Qume VT108, which emulates the Televideo terminal. The H/Z driver seems to work best and is not as flaky in some clear screen and screen rewrite operations when using page up or down commands. This was particularly evident with my H/Z package of Microsoft Word version 1.0. I did not include this in my list because there is a slight problem when the screen clears and shifts up to display the next available workspace. The previously written text seems to linger in the screen buffer, and the only way to empty it is to use the up arrow and scroll the cursor up the screen past line one. Then scroll the cursor down. I understand this will be eliminated in a future revision. My PC version 3.0 of WORD is copy protected and dies.

New Support Software Enhancements

Many changes have taken place with Ampro's Support Software programs. Being involved with other projects, I missed a number of interim revisions, but caught up with them during my visit to Ampro. As of September 1986, the ROM BIOS version is .005, and the Support Software version "H".

Most of the changes were a result of ROM BIOS revisions that had been optimized for PC-DOS 3.0, then for 3.1, and finally for 3.2. PC-DOS 3.2 finally included a utility to format 720K floppy drives, so Ampro dropped theirs. Ampro also revised their hard disk format routines to include the new 20-MB Seagate 225n hard disk drive with the imbedded SCSI controller chips. This eliminated the need to purchase a separate hard disk controller card.

The terminal driver source code, which had only been available previously at additional cost, is now included, so that code-lovers can play with it. An interesting user-supplied communications program, called LBCOMM, is now included with full documentation. It features auto-dialing, a library of frequently called numbers, up-loading and down-loading, and is more than adequate in communicating with the several Ampro BBS systems around the country.

Utilities that will allow the LITTLE BOARD/186 to access the SCSI/IOP have been included, as well as programs for advanced users that will perform block data transfers from one hard disk drive to another. My favorite utility is the one that allows me to designate a CP/M drive on my system.

CP/M On The 186

Die-hard '89 users have mentioned to me that one of the basic reasons they've been reluctant to venture into the world of MS-DOS is because they have compiled large database and word processing files over the years and are afraid to lose them.

There are several noteworthy programs on the market that will allow you to run CP/M programs on a PC compatible system once the NEC V-20 CPU has replaced the 8088 CPU. A few limitations exist, particularly with programs that write to the Z-80's registers, since the V-20 only emulates the Intel 8080 instruction set.

Ampro has had a program for some time, called PLUS80 CP/M and 8080 EMULATOR. PLUS80 attaches an 9090 microprocessor instruction set and CP/M operating system software emulator to the desired CP/M program. Thereafter, the program appears to be a normal PC-DOS program, and it works with most commercial CP/M application programs.

As an alternative, if you have dBASE or WordStar in the MS-DOS versions (or any similar programs that have been transferred from 8-bit to 16-bit formats, or which will accept ASCII file transfers), you can very easily incorporate your CP/M files into your MS-DOS program with Ampro's new CPMDRVR.SYS and SETCPM.COM utilities.

They allow you to define any of the 4 logical floppy drives as a CP/M drive. SETCPM selects the desired CP/M disk format. Most H/Z-89 disk formats and the Z-100's CP/M-85 disk format can be selected. By placing CPMDRVR.SYS in your CONFIG.SYS file, this driver will be loaded automatically into the PC-DOS root directory.

The CP/M drive format can also be established during BOOT by creating a short text file called SETCPM.TXT, and containing a single letter referencing the disk format. Then you add the following line to your AUTOEXEC.BAT file:

```
SETCPM <SETCPM.TXT
```

When you boot up the system you will always have access to a CP/M drive, and data transfers between CP/M and PC-DOS disk formats will be a breeze.

SUPERDUO: IBM Terminal Program

If you also own any of the Heath/Zenith PC compatible computers, you can do some interesting things between the '89 and the PC. SUPERDUO is a program that will turn the PC into a terminal for the LITTLE BOARD/186. Once the corresponding programs have been installed on the PC and the 186, the PC's keyboard can access either system by a simple ALT-P or ALT-A command.

This will allow you to run separate programs in each system. Each computer can be reset without affecting the other. If you have a Z-148 or Z-138 without a hard disk drive, the 186 system can act as the hard disk host for these computers. If you're working with a large database file, you can let the 186 do the onerous chore of sorting and printing, while you continue work on your PC. If you have two projects going at once, you simply toggle back and forth between the two systems and update each file as needed.

Versatile And Fun

Since the advent of the PC, a lot of the fun many of us once had in tinkering with the '89 is gone. The PC has become such a commodity item that everything is "plug in and run". A large part of the computing world probably prefers this kind of convenience, because they don't want to be bothered learning about their computers. But true-blue hackers will be happy to know that they can still have their '89 and tinker with it as a powerful 16-bit computer.

For more information, please contact:

AMPRO COMPUTER, INC.
67 East Evelyn Avenue
Mountain View, CA 94041
(415) 962-0230

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