The PerSci 1070 controller shown with single and dual disk drive units. This controller is based on an 8080 and can call files by name.

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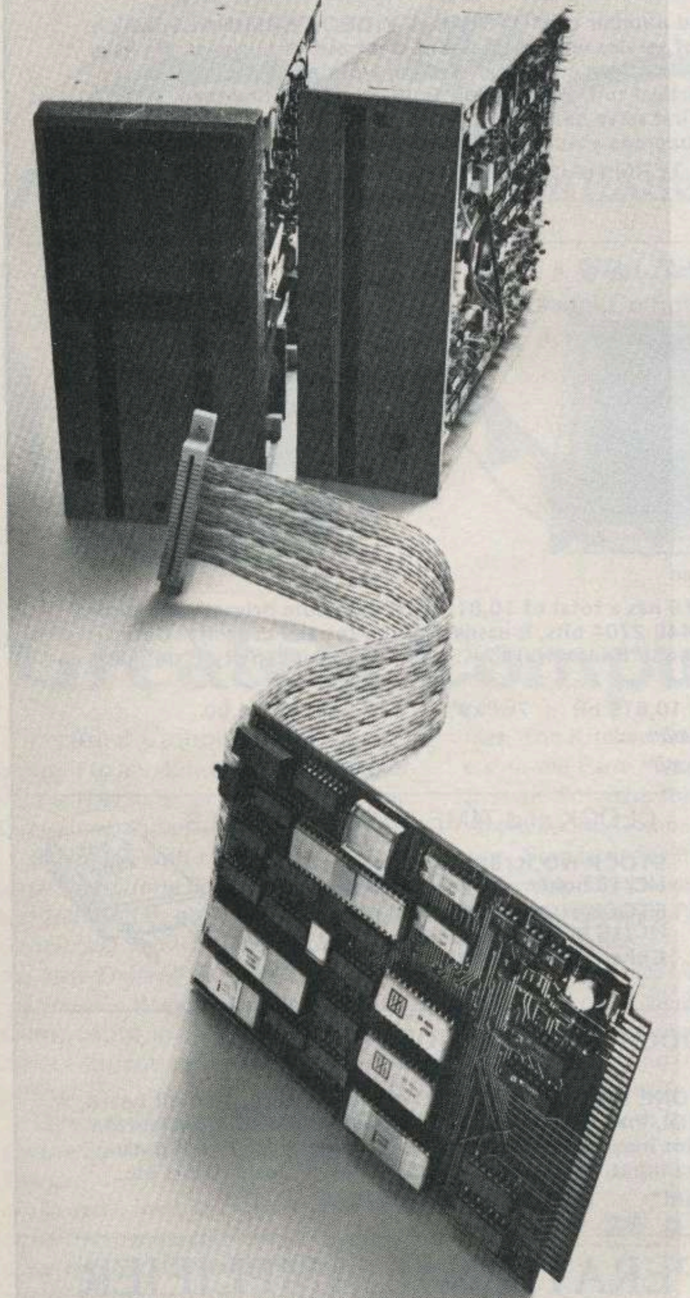


Floppy Disks

... What's the real story?

Doug has put together one of the most complete buyers guides for floppy systems we've seen in quite some time. He's broken it up into three sections: the available controllers, the drives, and the software. With the new minifloppies coming onto the market, the prospect of more people finally being able to afford disks for their systems is looking better and better. — John.

One of the most pressing needs for the computer hobbyist is for mass storage devices. This is not just for supplementing existing memory capacity but also to provide a nonvolatile means of storing programs. The simplest method of bulk storage is the audio cassette recorder. It is easy to interface, cheap, and reasonably reliable, but it has several shortcomings. The first is speed — most cassette units operate at a maximum of about 30 characters per second and thus require about five minutes to load 10K of memory. The one exception to this is the Tarbell interface which can run up to several hundred characters per second. Even this unit suffers from the disadvantage of not being computer controlled. For instance, the computer cannot rewind the unit or do a high speed search for a particular program. Paper tape is generally faster and more convenient than cassettes but it lacks the flexibility of magnetic recording. Digital cassettes, such as the ones from the Digital Group, are a partial solution to the problem. They are computer controlled, will do a high speed search, have a reasonable data transfer rate (about 800 characters per second) and are reasonably priced, about $375 for two drives and a controller. Their one disadvantage is the access time, which may be as much as 40 seconds depending on the position of the tape. There is a better solution, however. How about a device which can store 256K bytes, access any part of this storage in less than a second, and transfer information into the computer at a rate of 30,000 bytes per second? The device which can do all of this is the floppy disk. The fast access time and high data transfer make it practical to do a number of tasks, such as overlays and storing of intermediate results generated during the execution of a program, which take too long, even with digital cassettes, to be reasonable. There are six component pieces to a floppy disk system: the disk, the disk drive, the drive electronics, the controller, the computer interface, and the system software. These parts are discussed individually below. After this discussion, specific commercially available components are reviewed.

The Floppy Disk (also referred to as "the diskette")

Basically the floppy disk is a large round piece of recording tape enclosed in a protective envelope. The standard disk is shown in Fig. 1. The protective envelope is eight inches square with cutouts for the drive spindle, recording head and index position hole. The disk itself is made from 0.003" mylar covered with a thin layer of magnetic oxides.

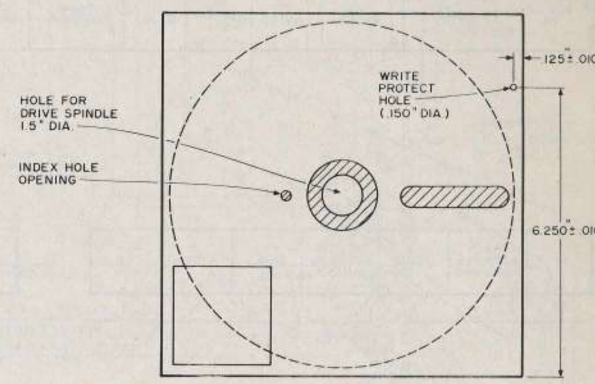
In nearly all of the drives, the data is recorded in IBM standard format. In this format, the disk is divided into 77 tracks. The tracks are in concentric circles starting near the edges of the disk. That is, one revolution of the disk, with the head fixed, covers one track, as shown in Fig. 2. Each track is further divided into sectors, the IBM format containing 26 sectors per track with the count starting at the index hole as shown in Fig. 3. The sectors may be marked either with information recorded on the disk (Fig. 3) or with actual sector holes punched in the disk (Fig. 2). These two methods are called soft sectoring and hard sectoring respectively. (An index hole is used as a starting reference in both cases.) Each IBM format sector is further divided, as shown in the lower part of Fig. 3, into four sections — two address markers, an ID field, and the data field. The first address marker identifies bytes between this mark and the next address marker as being the address portion of the sector. The ID field contains the sector and track number which are written during the initialization of the disk. The second address marker may be one of two types, the first type identifies a good record while the second type identifies either a bad sector or a sector containing a deleted record. The last section contains 128 bytes of data. A more detailed division of the sectors is shown in Fig. 4. The ID section contains seven bytes, 1) ID, 2) track address, 3) zero, 4) sector address, 5) zero, 6 and 7) two CRC (cyclic redundancy check) characters used for error detection. Thus even if the drive stops at the wrong track and wrong sector there is enough information for the controller to correct the positioning error while the CRC characters allow the controller to see if the error was in reading or positioning. The data section consists of an ID byte, 128 data bytes, and two CRC check characters for a total of 131 characters. There are 33 bytes in the first address marker and seventeen in the second address marker. So to record 128 bytes of data we use a total of 128+3+7+33+17 = 188 bytes. Since an unformatted disk holds about 400K bytes, a formatted disk can hold (128/188)*400K = 250K bytes. The IBM format is not particularly efficient but it allows for very reliable data reading and writing.

A particularly attractive feature of the floppy disks is the low cost of the storage medium — about $6 each in quantities of ten.

The Floppy Disk Drive

The floppy disk drive unit consists of a positioner for the disk envelope, a drive motor to turn the disk, a stepping motor or similar positioner for the read-write head, and a light and detector for the index hole in the disk. These features are shown in the block diagram in Fig. 5, which is taken from the Shugart SA800 manual. The disk sits on a drive cone (not shown in Fig. 5) which fits into the drive hole in the center of the disk. The cone may be either driven directly by the motor or, more commonly, by a connecting belt. The head is positioned over the proper track by one of two methods — either a stepping motor driving a positioning screw or a voice coil type positioner. The voice coil units have access times as much as five to ten faster than the stepping motor but they require more electronics to accurately position the head. The read-write head and pressure pad (positioned on the opposite side of the disk) generally do not touch the disk until information is to be read or

Fig. 1. A floppy disk in its protective envelope.



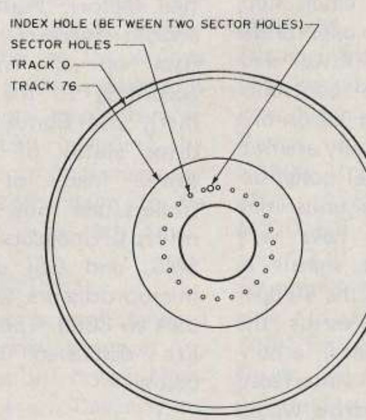


Fig. 2. A hard-sectored floppy disk showing the locations of the tracks.

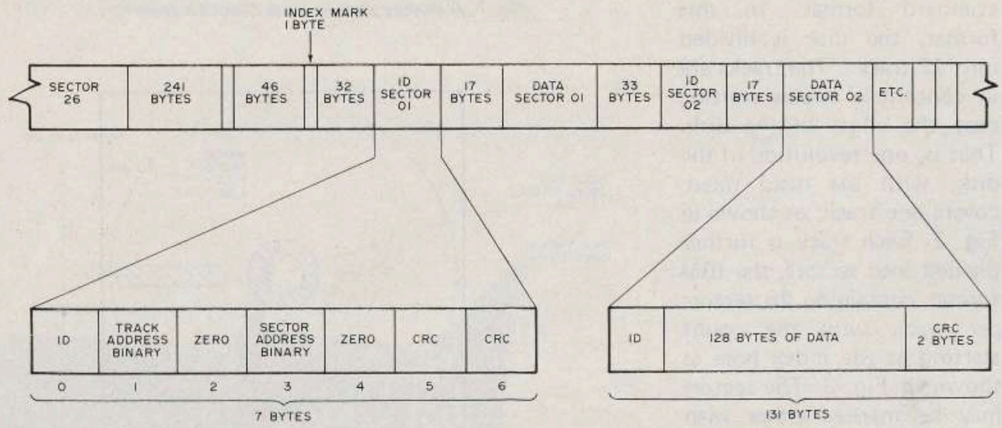


Fig. 4. The IBM data format.

written. This head-loading time varies in different drives from 30 to 75 msec. The index light and detector are positioned over the index hole cutout and tell the controller when sector 1 is in line. Some units have a write protect option which consists of an LED and detector positioned over a small hole near the edge of the floppy disk envelope. This feature functions like the write protect tab on an audio cassette. That is, if there is a write protect hole, the disk cannot be written on.

The Floppy Disk Drive Electronics

The drive electronics consist of the read circuits, write circuits, the motor control circuit and the head position and loading circuits. The drive electronics are typically interfaced to the controller which generates the signals (drive select, write data, read data, clock step, motor on, etc.) to operate the disk. While the drive electronics and the controller could in principle be on one board, they generally are not. Since the physical construction of the drive units may require them to have very different control signals (a good example is the stepper head positioner versus the voice coil positioner), a controller which interfaced directly with a drive would only be useable with that one drive. By having a drive electronics board between the drive and controller it is possible to produce a general purpose controller board.

The Controller

The controller is a processor which translates higher level commands from the host computer into instructions appropriate to the disk drive electronics. Typical instructions to the controller, given in the form of two-byte commands, are: Reset (resets the controller and all floppy disks in the system), Seek (steps the head to a specified track and veries the correct position), Read (reads a sector of data (128 bytes) from a specified sector and verified it with the CRC data), READID (reads the next sector ID information), Write (writes a sector of data (128 bytes) with the normal address mark in the specified sector), WRDEL (writes a sector of data with a deleted address marker in the specified sector), Format (writes address markers, gaps, and data on an entire track according to the IBM format), and Status (reads the drive status of the active drive). Many of the controllers are now based on microprocessors. Shugart, SMS, and GSI use bipolar microprocessors while PerSci uses an 8080. The controllers are discussed individually below.

The Computer Interface

The output of the controllers is generally in the form of bidirectional data lines and several status lines which then need to be interfaced to the host computer. In some cases this may be as simple as plugging the proper card (supplied by the controller manufacturer) into the computer backplane. Systems which have the controller and the interface on one card (such as North Star Computers products) are the most convenient to use but limit themselves to only one type of machine — which is fine if you have that type of machine. Generally the controller and interface are kept separate for the same reason, adaptability, as are controllers and drive electronics.

The interface may be done in two ways. The first, and simplest, is to input the data and output data and commands through standard parallel interfaces. This generally requires two output ports (data and commands) and two or three input ports (data and one or two for status). The second way to interface the controller is to use direct memory access (DMA) in which the controller takes control of the bus and either reads from or writes into the computer memory directly. This approach, which cuts down on the software overhead considerably, is used by Digital Systems and the software from Digital Research.

The Software

This is the most crucial part of the system as the disk and associated parts are not useful without the proper driving software. Actually any computer system is useless without proper software it is just that with a disk based system you have a much more powerful useless system. The purpose of the software is to keep track of what is stored on the disk and where. In addition, the software raises the level of involvement of the operator from calling for information by track and sector to calling programs or data by name and having the computer find which files are being asked for and then inputting (or outputting) them and checking for reading (or writing) errors. A good disk operating system will also contain routines for moving programs from device to device, an assembler, and perhaps a disk accessing BASIC. This last point is very important as having the disk and a file oriented operating system is of no help if your assembler and/or BASIC cannot com-

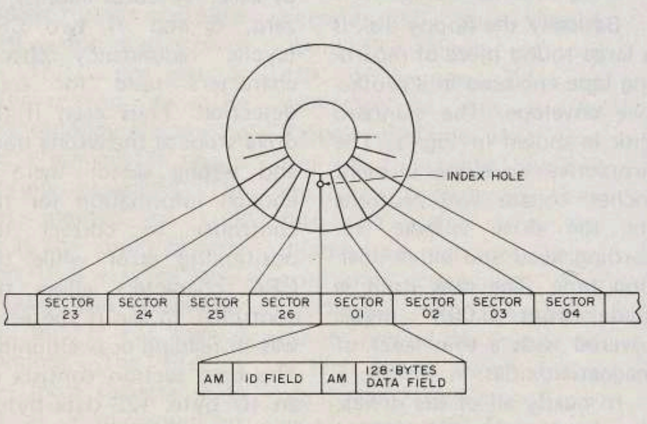


Fig. 3. The IBM format for a soft-sectored disk.

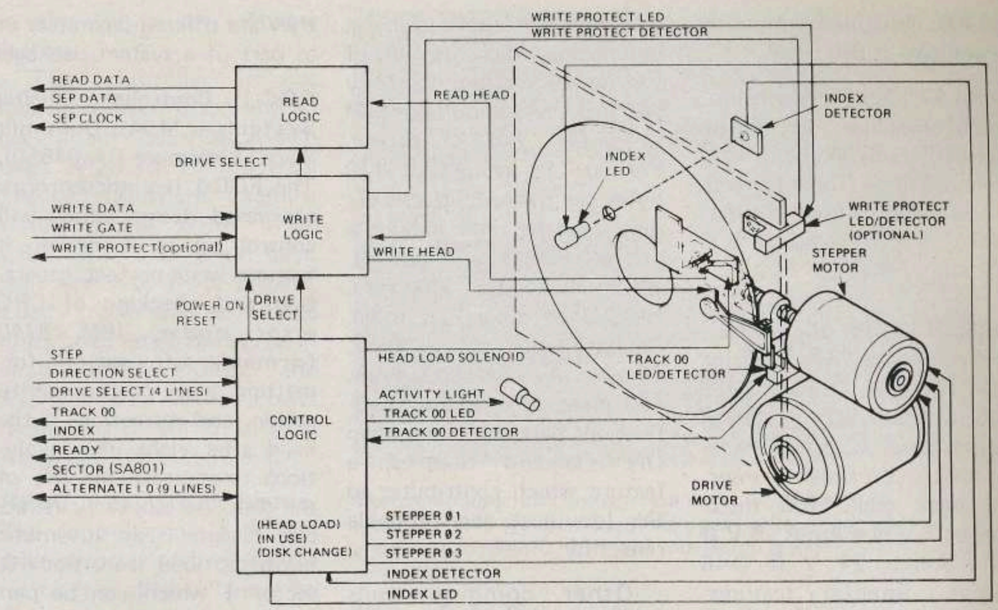


Fig. 5. The construction of the floppy disk drive unit.

municate with the disk. As an example, standard Altair BASIC has no provisions for supporting high speed peripherals and thus has no way, without modifications, of using the power of the disk to store programs. The disk versions of BASIC have provision for calling in programs from the disk by file name. The same method is used for dumping existing programs on the disc. Patching an existing operating system to access a disk is not a particularly pleasant task and fortunately there appear to be some good disk operating systems available for the 8080 and 6800 even now.

This is a good time to bring up the matter of speed of the disks. The literature all says prominently that the data transfer rate is 250K bits per second (about 30K bytes per second), a rate which could fill a 10K memory in about one third second (or about one half second including the average access time). However, the ICOM advertisements say that you can load an 8K program in less than seven seconds, a data rate of about 1100 bytes per second. Why the difference? There are several reasons, latency, head loading time, settling time, and track-to-track access time. Using a controller which requires extensive software support will be much slower since if you do not get ready for a sector when it comes by you must wait one turn of the disk (167 msec) for it to come around again. Thus if your system is not fast enough to prepare for sequential sectors, the data rate can be improved by having consecutive data stored in spaced out sectors. The speed of the TCH controller can be increased from an average of about 750 bytes per second to as much as 3000 bytes per second by putting the consecutive data in sectors spaced eight apart. Even if the software is fast enough to transfer consecutive sectors (the DMA systems may be this fast), some care is required to optimize data rate. The rate can be as much as doubled for large programs, ones which take more than one track to store, by offsetting the start of the data on each track. For instance, if a large program starts at sector 1 on track 10, fills the rest of track 10 and continues at sector 1 on track 11, the disk will have to wait one revolution for the sector to come by again since the track-to-track move time and settling time may be several sector times. If the program had continued at sector 8 or so, one less disk revolution would be required, increasing the average data transfer rate considerably. So depending on the quality of the software and the quantity of hardware, the average data transfer rate may vary from 750 bytes per second to perhaps as much as 10K bytes per second. The average rate will never reach the 30K bytes per second instantaneous rate because of the times required by the mechanical parts of the system.

What is Available?

This section consists of a discussion of the specific equipment and software available from different manufacturers. The floppy disks (diskettes) themselves are available from all drive manufacturers and many supply places. Since they are all very similar and of high quality, we will not discuss particular brands except to say that the IBM disks appear to be the most popular. The floppy disk drives and the drive electronics come as one package so they are discussed together. Controllers and interfaces are discussed together since the specific interfaces offered are offered with particular controllers. The two available software packages are discussed in the separate software section. In considering what equipment is available, it is good to keep in mind that unless you are the intrepid type who enjoys challenges, and there are many of us left, to ensure compatibility of the various portions of the system it is perhaps wisest to purchase an entire system including the software from one source, or sources which claim to be compatible with each other.

Floppy Disk Drives

There are several standard specifications common to most of the disk drives: Number of disks – 1; Capacity per disk – 3.2 million bits unformatted; Head – Read-write with erase on either side to ensure a separation between the tracks; Rotational speed – 360 rpm; Data transfer rate – 250K bits per second; The description of each unit will include only the unique features or the variation from these standard specifications.

GSI-105, 110 (General Systems International, Inc., 1440 Allec Street, Anaheim CA 92805). Price: about $550 (105). Head engage time: 35 msec. Average access time: 156 msec. Power: 120 V, 24 V @ 1.8 Amps, 5 V @ 1.3 Amps, -5 V @ 0.1 Amps. Special features: fast access time – GSI-110 will record at double density which allows over 500K bytes per disk and 500K bits per second transfer rate.

MDD 50, 51, 52 (General Systems International) Price not available. These newly introduced units use the mini-floppy as do the Shugart SA400. However, these units offer a capacity of 65K (MDD 50), 131K (MDD 51), and 232K (MDD 52) bytes formatted with data transfer rates of 125K, 250K, and 500K bits per second respectively. The models 51 and 52 use double density recording and the model 52 turns at 600 rpm, twice the 300 rpm of the models 50, 51, and

SA400. No other information is available at this time.

Orbis 77 (Orbis Systems Inc., 14251 Franklin Ave., Tustin CA 92680) $704. Head load time: 30 msec. Track to track access time: 6 msec. Power: 120 V, 5 V @ 1 Amp, 24 V @ 1.2 Amps.

PerSci 70, 270 (PerSci Inc., 4087 Glencoe Ave., Marina Del Rey CA 90291) $625 (70), $1000 (270). Head engage time: 40 msec. Track-to-track access time: 10 msec. 76 track seek: 100 msec. Power: 5 V @ 4 Amps, -5 V @ 0.14 Amps, 24 V @ 0.46 Amps. Special features: Linear voice coil motor for positioning the head. The model 270 is one drive unit that handles 2 disks simultaneously.

Pertec FD400, FD500 (Pertec, 9600 Irondale Ave., Chatsworth CA 91311). Price not stated. Head loading time: 40 msec, track-to-track access time: 10 msec. Average access time: not stated. Power: FD400 24 V @ 2 Amps, 5 V @ 1 Amp, -5 V @ 0.3 Amp. FD500 120 V.

Shugart SA800/801 (Shugart Associates, 435 Indio Way, Sunnyvale CA 94086) Price for basic model is $580 in quantity of one. Head load time: 35 msec. Track-to-track access time: 10 msec. Average access time: 260 msec. Power: 120 V, 24 V @ 1.3 Amps, 5 V @ 0.8 Amp, -5 V @ 0.05 Amp.

Shugart SA400 (Shugart Associates) Price $390. This unit differs considerably from the preceding units in many respects besides price. First, it uses a small disk called a minidiskette™ which is 5.25" square compared to the 8" square standard disk. The drive itself is very small (3.25" high, 5.75" wide, and 8" deep) and uses very little power (15 Watts typical). It is, however, slower and has much less capacity than the standard disk. This drive and the companion controller, the SA4400, are intended for cost sensitive applications, a description which fits most of the hobby market. Capacity per disk in a modified IBM format: 80.6K bytes. Format: 18 sectors of 128 bytes per track, 35 tracks per disk. Transfer rate: 125 kbits per second (125 kilobaud). Rotation speed: 300 rpm. Head load time: 75 msec. Track-to-track access time: 40 msec. Average access time: 463 msec. Most of the specifications here are slower than the standard floppies, a feature which contributes to the low cost and probable reliability.

Other common units about which we have received no information are: Innovex 220, Remex RFD7400, CDC 9400, and CALCOMP 140.

Controllers

While the various drives differ only slightly in features and price, the same is not true for the controllers. The basic difference is how much is expected from the host computer by the controller, with the super simple interface designed by TCH requiring total support from the host to the PerSci 1070 which contains its own 8080 and can access files directly by name. The following discussion lists the various controllers and their specific features and notes whether they are offered separately or as part of a system package.

FDC-1 Controller (Digital Systems, 1154 Dunsmuir Place, Livermore CA 94550). The FDC-1 is a microprocessor vased design which will control up to 4 drives. It features write protect, generation and checking of CRC error codes, IBM 3740 format, soft sector formatting, track position verification, and retraction of the head after eight idle revolutions to increase the life of the disk. An especially attractive feature is an automatic bootstrap load from track 0, sector 1 which can be performed at power on *without* host processor intervention.

The commands for the FDC-1 are: File inoperative reset, step the head to another track, step in or step out, enable loading of drive select, read 128 bytes of information into memory, write 128 bytes of information from memory into the previously addressed sector and track.

Control and status information are transferred through an 8-bit input-output port. The information to be read from or written onto the disk is transferred by direct memory access. Prices: FDC-1 controller and cable $520; FDC-1 controller and Shugart SA800 drive $1095; FDC-1 controller and two Shugart SA800 drives $1670. A reference manual package including an FDC-1 manual, a disk drive manual, and diagrams for the Altair bus interface as well as simple 8080 software sells for $5. Note that no interface is provided with this controller but they do provide a schematic for an Altair compatible interface containing about 20 ICs.

GSI FDC300 (General Systems International, Inc., 1440 Allec Street, Anaheim CA 92508).

Shugart SA4400 (Shugart Associates, 435 Indio Way, Sunnyvale CA 94086).

SMS FDO300 (Scientific Micro Systems, Inc., 520 Clyde Ave., Mountain View CA 94043).

These three controllers are grouped together since they appear both from the description and photographs to be identical. These units are microprocessor based with fairly high level command information. The eight commands and functions implemented by them are:

RESET: Aborts the current operation and resets controller and all floppy disks in the system.

SEEK: Steps the head to the specified track and verifies correct positioning.

READ: Reads a sector of data from the specified sector.

READID: Reads the next sector ID information.

WRITE: Writes a sector of data with a normal Data Address Marker into the specified sector.

WRDEL: Writes a sector of data with deleted Data Address Marker into the specified sector. Format: Writes address marks, gaps, and data on an entire track according to the IBM format.

STATUS: Returns the status for the addressed drive.

These units include a general purpose host interface which provides 18 TTL signal lines for interface to a host system. This interface requires 3 I/O ports for control, status, and data.

Although all three units appear identical in their specifications and pictures, there are a total of four sets of widely differing dimensions quoted for them with two different sizes listed for the Shugart controller. From the pictures, they appear to be about 6" x 9".

Drive Compatibility:

GSI-FDC300. Not specific except to say . . . IBM compatible drives".

Shugart SA4400. Specifically for the SA400 minifloppy.

SMS FDO300. Orbis 76, Shugart SA800, Calcomp 140, Pertec SD400 and SD500, and Innovex 210. It also says "for IBM compatible drives." Prices: SMS $640, Shugart $490 (for the minifloppy version), GSI not specified.

ICOM CF360 (ICOM Microperipherals, 6741 Variel Ave., Canoga Park CA 91303). Price is $650 for the controller only. (See photo.)

This controller and a Pertec drive are sold together as the "Frugal Floppy" for $1195. Also available are interfaces for the Altair, IMSAI, and Poly 88 for $330 each. The system comes with the FDOS-II software which is described in the software section.

The controller is not microprocessor based and so uses about 125 ICs on two large (7.25" x 15") boards. The commands are: Examine status, Read, Write, Read CRC, Seek, Clear error, flags, Seek track 0, Write DDAM, Load track address, Load unit, Load write buffer, Shift read buffer, Clear, and Examine read buffer. Power requirements are 5 V at 6 Amps and -12 V at 1 Amp.

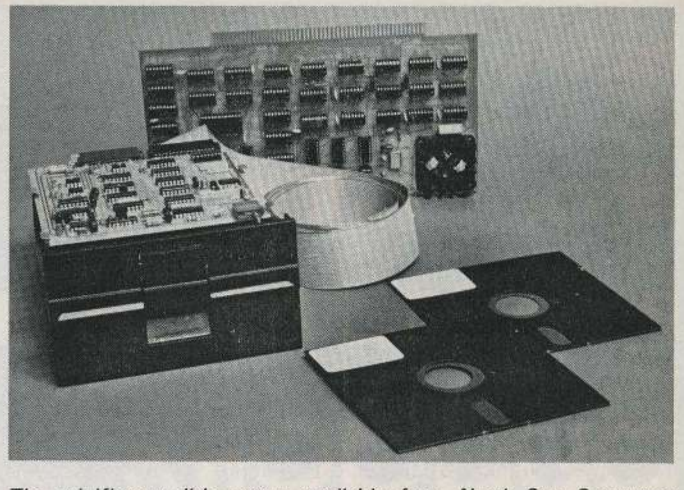
IMSAI Floppy Disk System. The controller has a built-in microprcessor and will handle up to four drives. This is an easy way to get going in a hurry and is priced in kit form at $1449, assembled at $1649, and with two drives at $2374. The disk operating system is available for an additional $40. An extended BASIC with disk access is also supposed to be available.

Floppy Disk 88-DCDD (MITS, 2450 Alamo SE, Albuquerque NM 87106). Price for the system is about $1500. (See photo.)

The controller consists of two boards which plug into the Altair backplane. Up to 16 drives can be addressed by the controller. The disk drive is a Pertec FD400 which is packaged in a 5½" x 17" x 17" box, the same size as the Altair 8800.

This system uses hard sectored disks in a nonstandard format of 32 sectors per track giving a total storage capacity of 310K bytes per disk. Although nonstandard, this format is convenient in that it allows storage of 4K bytes per track, a nice round number which simplifies software housekeeping. But keep in mind the factors discussed in the speed section.

An extended BASIC with disk access is also available for use with this system. This includes programs for copying disks (Mits and copying?), initializing blank disks, etc. A minimum of 20K of RAM is required.



The minifloppy disk system available from North Star Computers which includes the minifloppy disk, controller, Altair bus interface and a disk based BASIC. The disk operating system is on ROM on the controller.

Micro Disk System (North Star Computers, Inc., PO Box 4672, Berkeley CA 94704). Price is $599 for the controller, Altair type interface, and one Shugart Minidisk drive with two disks, one containing the operating system. (See photo.)

The controller is a single Altair compatible board which can control up to three drives. An on board PROM contains the power on bootstrap software. The introductory price includes the controller kit, the minifloppy drive, cables, connectors and two disks. The software included has a file oriented disk operating system and a disk version of an extended BASIC. Additional drives are $425 each.

OSI 470 Floppy Disk System (OSI, 11679 Hayden Street, Hiram OH 44234).

This controller consists of a bare PC board which when populated will plug into the backplane of the OSI 400 computer. It is a very minimal controller which relies on the processor for essentially 100% support. This results in a very inexpensive, yet flexible controller at the expense of speed and the requirement of considerably more software than the intelligent controllers. Price for the PC board, minimal operating system (described as a sector per track system) and a GSI 105 disk is $599.

PerSci 1070 (PerSci, Inc., 4087 Glencoe Ave., Marina Del Rey CA 90291). (See photo.)

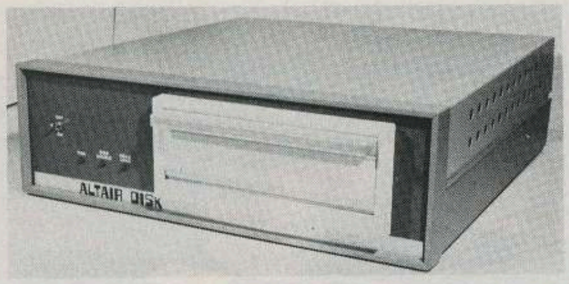
This controller is based on the 8080 microprocessor and as an intelligent controller can communicate by file name and perform all housekeeping functions which would otherwise have to be performed by the host computer. The disk operating software is internal to the controller's 8080 system and includes functions for formatting to the IBM 3740 standard. This unit was designed for use with the PerSci model 70 and 277 drives.

The controller commands are: File, Eject, Initialize, List, Kill (clears and table of contents), Seek Delete, Write, get, and Execute. Writing the necessary operating software for this controller should be very straightforward.

The price is $1195 with the model 70 drive and $1495 with the model 277 dual disk drive.

Sykes OEM Floppy System Kit (Sykes Datatronics, Inc., 375 Orchard St., Rochester NY 14606).

This unit has several noteworthy features. It has hardware address search, automatic sector and track sequencing, a FIFO buffer for asynchronous operation and automatic CRC generation



and detection. In addition the controller electronics are contained on one board which pancakes directly onto the Sykes floppy disk drive to take up a minimum of space. The interface requires only 13 lines – reset, 3 control lines, 1 flag and 8 bidirectional data lines. The price for the controller and one Sykes floppy disk drive is $1398.

TCH Super Simple Interface. This unit designed by *The Computer Hobbyist Magazine* is intended to be a very simple (and therefore cheap) interface to be constructed by the more technically oriented hobbyist. While they are not in the manufacturing business, they do plan to offer a PC board in the Altair format for the controller. Although the board will be in the Altair format it has been designed to be easily adaptable to any other computer. The basic operating system is contained on two 1702A EROMs on the board so the unit is ready to go when the computer is powered up.

The controller is very basic and requires the host computer to do all of the housekeeping duties. It is hard sectored (32 sectors per track) so the data capacity is the same as the Altair disk, 310K bytes. The concession to price that had to be made is average transfer speed. They say that the typical average transfer rate is one sector per revolution, a transfer rate of about 750 bytes per second with the best rate being about 3000 bytes per second. The lower value is lightly slower than a good digital cassette but the access time is still much less. Some small hardware additions should allow higher speed since the bottleneck is the requirement for the host computer to do the parallel-to-serial conversion. The popular 8 bit microprocessors cannot do this at the rate of 250000 bits per second required to keep up with the disk. TCH claims that there will be some spare room on the board for modifications. In addition to being suitable for most, if not all of the home computers, the board has a series of jumpers which allow the controller to be used with almost all of the available drives.

This interface and controller are certainly the cheapest (about $60 for the parts plus the cost of the drive) for the technically oriented hobbyist to get set up.

Software

At present there appear to be only two systems which are being offered separately to the hobbyist. Only one, the Digital Research offering, is specifically intended for the hobbyist to use on a variety of drives and interfaces.

FDOS-II (ICOM, Inc.) $250. This operating system was written by Art Childs, former editor of *SCCS Interface*, and is intended for use with the ICOM FD360 controller. It features variable length named files of any length which may contain program source data, program object data, or user generated data. The commands are:

ASMB – assembles a source file and creates a destination file

BUILD – builds a new file from ASCII input

CHGAT – changes file specifications

COPY – copies disk on unit 0 onto the disk on unit 1

CREAT – creates a file in the directory

DELET – deletes the designated file and repacks the contents of the disk making space for additional files

DUMP – dumps a file to the output device

EDIT – edits a file

HOME – moves the head to track 0

INIT – initializes the file directory

LIST – lists the contents of the file directory

LOAD – loads a file from a reader device into the disk

MERGE – used to concatenate files

MNTR – returns to the host monitor

PRINT – prints the file on the console device

RENAM – renames a file

RUN – loads the file into RAM and begins execution

XGEN – enables system generation of future versions of FDOS-II

This looks like an excellent operating system if you have the ICOM system. It is also not clear whether this is available for the 6800.

CP/M (Digital Research, Box 579, Pacific Grove CA 93950). Price with complete documentation $70. Documentation alone is from $5 to $25.

This system which has been in use for over two years is intended for an 8080 based system (originally the Intel development system). It supports a named file system with up to 64 distinct files on each disk. File storage is dynamically allocated and released with algorithms for optimal read-write head movement. This should help keep the average data transfer rate up by a considerable amount.

The CCP (Command Console Processor) features the basic commands:

DIR – searches the directory

TYPE – outputs a file to the console

REN – renames a file

ERA – erases a file

SAVE – saves memory on the disk for later reload or test

PIP is the peripheral interchange program which controls transfer of files between various devices of the system.

SUBMIT allows the operator to prepare command files with parametric substitution which can then be subsequently executed automatically.

ED is the text editor.

ASM is an assembler which can use either the Intel or Processor Technology assembly language.

DDT is the dynamic debugging tool. This is used for program tracing, debugging and testing.

LOAD loads a file from an Intel hex format file (whatever happened to octal?) ready for execution.

DUMP prints a file in hex onto the console device.

SYSGEN is used to copy a system disk for backup purposes.

While the package was designed for the Intel MDS microcomputer development system it can be easily altered to work with most 8080 based microprocessors with at least 16K of memory and one or more IBM compatible disk drives. The apparently extensive documentation gives instructions for making the patches for other systems.

For hobbyists with IBM format equipment and an 8080 based system, this package looks very hard to beat especially considering the price. What we need to find out is if there is some reasonable way to patch this system into use with the TCH interface.

After seeing the extensive list of goodies that are available, the only two problems that remain are which unit to buy (they all look good), and how to come up with the money. ■