HARD / FLOPPY
DISK CONTROLLER

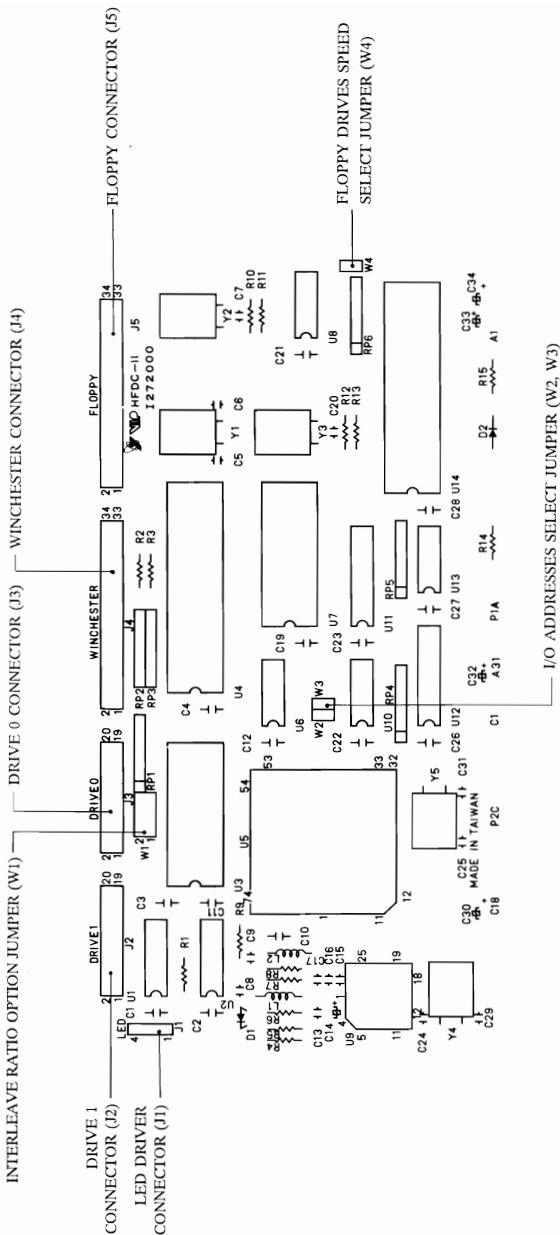**HFDC-II**   **VIP-I272000**

VERSION 1.0   AUGUST 1989

WINCHESTER(S) LATCHED MODE,
ECC, CACHEING SYSTEM,
INTERLEAVE RATIO OPTION JUMPER (W1)

FLOPPY CONNECTOR (J5)

FLOPPY DRIVES SPEED
SELECT JUMPER (W4)

WINCHESTER CONNECTOR (J4)

DRIVE 0 CONNECTOR (J3)

I/O ADDRESSES SELECT JUMPER (W2, W3)

DRIVE 1
CONNECTOR (J2)

LED DRIVER
CONNECTOR (J1)

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1. INTRODUCTION

The HFDC-II is a high-performance Hard/Floppy Disk Controller card
which is designed for use in AT or AT compatible personal computers.
The 16-bit card provides an interface for up to two Hard Disk Drives
and two Floppy Disk Drives. The Floppy Disk Drives can be of the 5.25"
format or the 3.5" format and have any of the standard capacities—
360KB, 720KB, 1.2MB, or 1.44MB. The Hard Disk drives must use an
ST506/412 interface with MFM (Modified Frequency Modulation) data
encoding. This card has the following features:

- The HFDC-II is compatible with AT PCs and can support high-speed
  AT buses from 8MHz to 16MHz

- Supports multiple sector read/write commands with 1:1 interleave
  formats

- Floppy Disk Controller has 500K-bit per second Data Transfer Rate

- Provides performance compatible with the Western Digital
  WD1006V-MM1/2 Winchester Disk Controller

- Uses standard ST506/412MFM interface

- Supports dual-speed Floppy Drives

2. CHECKLIST

Your HFDC-II package should contain the following components. Check that everything listed below is present. If anything is missing, contact your vendor immediately.

1. The HFDC-II card.

2. Control and Data cables. One 34-pin cable has five connectors. This is the Floppy Disk Control and Data Cable. The extra connectors allow connection to either 3.5" or 5.25" Floppy Drives. The other 34-pin cable has three connectors. This is the Hard Disk Control Cable and it connects the card to a maximum of two Hard Drives. Finally, there is a 20-pin cable for passing data from the card to one Hard Drive.

3. This Installation Manual.

If everything is in order you may proceed to install the card in your system.

Follow the instructions in the manual to configure your card, cable up the drives, and set up (and format, if necessary) your hard disks.

3. THE CARD LAYOUT
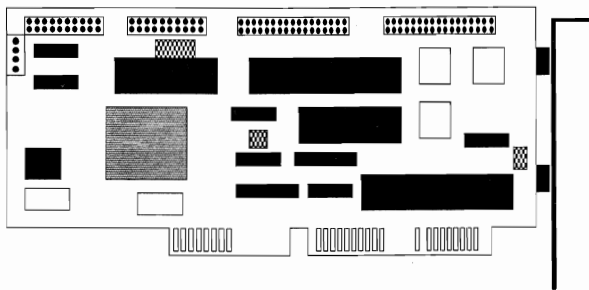
The HFDC-II is a 16-bit card. That is, it has two card-edge connectors for installation in a 16-bit slot on PC mainboards.

The card is mounted with the controllers and processors for controlling two Floppy and two Hard Drives.

The checkered areas on the diagram show the location of the configura-tion jumpers W1, W2, W3, and W4. These are 2-pin jumpers which can be opened or closed with a jumper plug. You will use them to configure the card to work in your particular system.

The card has five connector sockets for cabling to other components in your system. On the top left corner of the card, is a four-pin connector labelled J1 LED. If your system unit case has a Hard Disk Indicator light, you may connect it to the card through these pins. The card will ignite the LED when the disk is being accessed.

Ranged along the top edge of the card are the four connecting sockets for the control and data cables of your Hard and Floppy Drives. The diagram below shows these connectors as they appear on your card.

```
    DRIVE 1              DRIVE 0                  WINCHESTER                    FLOPPY
2 ●●●●●●●●●● 20   2 ●●●●●●●●●● 20   2 ●●●●●●●●●●●●●●●●●● 34   2 ●●●●●●●●●●●●●●●●●● 34
1 ●●●●●●●●●● 19   1 ●●●●●●●●●● 19   1 ●●●●●●●●●●●●●●●●●● 33   1 ●●●●●●●●●●●●●●●●●● 33
      J2                 J3                    J4                          J5
```

Take careful note of the pin numbers on either side of each connector. The cable connectors must match the correct pin numbers when they are installed.

4. CONFIGURING THE CARD

The card is configured by opening or closing the four jumpers W1, W2, W3, and W4.
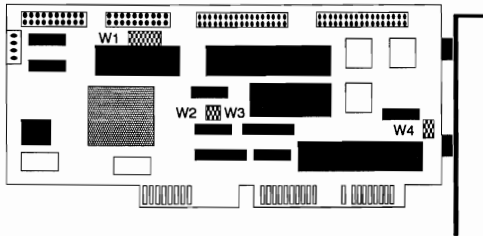
JUMPERS W1

W1 consists of four 2-pin jumpers in a row. Jumpers 1/2, 3/4, 5/6, and 7/8. Each jumper selects a different option for card configuration. Each of the jumpers may be left in an OPEN position, by removing the jumper plug or by leaving it inserted on only one pin. The jumper is CLOSED by using the plug to cover both pins.
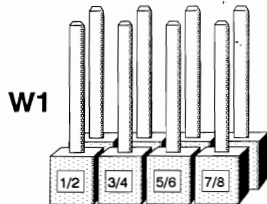
Jumper 1/2

This jumper controls the actions of the Hard Disk LED which is connected through connector J1-LED. If Jumper 1/2 is OPEN, this is called Latched mode, and your hard disk LED will be always on whenever the system is in use. If Jumper 1/2 is CLOSED, this is called Non-latched mode. In Non-latched mode, the hard disk LED will only ignite when the system is physically accessing the hard disk.

Jumper 3/4

Jumper 3/4 is used to select the form of the ECC (Error Correction Code). The error correction feature is different depending on the data-encoding method of your hard disk. Hard Disks using the ST506/412 interface generally use MFM (Modified Frequency Modulation), or RLL (Run Length Limited). MFM disks have 17 sectors per track, and RLL disks have 26 sectors per track. Since this card has been designed for MFM hard disks, Jumper 3/4 must be set to the OPEN position. This sets the ECC to 4 bytes allowing the controller to correct up to 11 bits of data.

Jumper 5/6

This jumper controls the card's caching system. The controller has 8KB memory and on any given read operation, will also read ahead one sector, and store the data in the 8KB cache. This feature allows faster disk access.

Set Jumper 5/6 OPEN to enable the caching system. CLOSE Jumper 5/6 to disable the caching system.
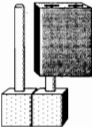
Jumper 7/8
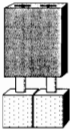
The HFDC-II controller allows interleaving of 1:1. Jumper 7/8 must be set OPEN to enable this option. If 7/8 is CLOSED, the maximum interleave ratio is 1:3. Interleaving refers to the sequence in which data is written and read onto the disk. 1:1 interleaving writes data sequentially onto the track. 1:3 interleaving leaves two spaces between each write operation, and so on. As the disk is spinning at high speed, a looser interleave ratio (e.g. 1:3) increases the possibility that the read/write heads can carry out a read or write operation in one disk revolution. If

the interleave ratio is too stiff (e.g. 1:1), the read or write process must wait a full disk revolution before the next sector of data is available.

If you intend to use the HFDC-II with a completely new hard disk(s), or reformat your old hard disk under the HFDC-II controller, OPEN jumper 7/8 for better interleave options. If you intend to incorporate an old disk into your system, (that is, the disk was formatted under a WD1003-WAH controller) and you DO NOT intend to reformat your disk under the new HFDC-II, you must leave 7/8 CLOSED to retain format compatibility with the old disk.

JUMPERS W2 AND W3

These two 2-pin jumpers are used to select the I/O addresses for the Floppy and Hard Drive(s)

	W2 - FLOPPY DRIVE ADDRESS	W3 - HARD DRIVE ADDRESS
	PRIMARY ADDRESS 3F2-3F7	PRIMARY ADDRESS 1F0-1F7
	SECONDARY ADDRESS 372-377	SECONDARY ADDRESS 170-177

JUMPER W4

Jumper W4 is a single 2-pin Jumper. Some Floppy Disk Drives can operate using two speeds, 300 and 360 RPM. Other Floppy drives can only operate at one speed, either 300 or 360 RPM.

If your Floppy Drive(s) operates at dual speeds, set Jumper W4 CLOSED.

If your Floppy Drive(s) can only operate at a single speed, set Jumper W4 OPEN.

5. INSTALLING THE HFDC-II

The HFDC-II is installed in much the same way as any other kind of 16-bit interface card. Follow the steps given below for a successful installation.

NOTE: The HFDC-II cannot work in conjunction with any other disk controller. If you are currently using another Hard/Floppy or Floppy only controller, you must disconnect it and transfer all disk control operations to your new HFDC-II card. If you have a mainboard with an onboard floppy controller, consult your mainboard manual to find out how to disable the onboard controller.

1. Disconnect the power sources to the system unit and all peripheral components, and open up your system unit. Be aware that static electricity can damage vital components of your system so take anti-static measures. Use anti-static mats if they are available. Discharge body static by touching the bare metal case of a grounded electrical appliance. Handle the card carefully when you are configuring and installing it.

2. As the note above states, control of all your drives must now be transferred to the HFDC-II, so disconnect the control and data cables to any current disk controller card and remove the card.

3. Configure the card according to the instructions given in the previous chapter. Select a vacant 16-bit slot for the new card. This should be as close as possible to the drives to allow easy cabling.

4. Remove the slot protector blank from the unit case. Insert your new card firmly but gently, and secure the card slot protector to the unit case.

6. CONNECTING THE DRIVES

You may run up to two Floppy and two Hard drives with the HFDC-II.

Floppy Drives

The control and data signals for Floppy Drives are transmitted through a single 34-wire cable. Some of the wires are twisted as they run from the two middle connectors to the two end connectors. One edge of the cable is picked out in red. This identifies the side of the cable which corresponds to pin 1 on connecting sockets. The diagram below shows your floppy drive connector with three connection areas A, B, and C.

Area A: Think of it as A for Drive A: there are two connectors here for connection to that drive which you call drive A: under DOS. The very last connector is an edge type connector for connection to 5.25" drives. The connector next to it is a 34-pin female socket for connection to 3.5" drives.

Area B: Similarly, the two sockets here are for connection to either a 5.25" or 3.5" drive which you would treat as drive B: under DOS.

Area C: This is a female 34-pin socket which connects to the 34-pin connector 'J5 FLOPPY' on the HFDC-II.

Use the guide above to connect your Floppy drive(s) to the card. Take great care that the pin 1 wire (picked out in red) is connected through to pin 1 on all the connectors.

Hard Drives - Control Cable

The control signls for one or two hard disks are carried on a 34-wire cable with three connectors. Like the floppy disk cable, pin 1 side is identified with a red stripe. Some of the wires, like the floppy cable, are twisted between the first and second drive connectors. Take note of this fact, as some hard drives require to be configured depending on whether a twisted or straight-through cable is in use. The diagram below shows the hard disk control cable with connectors C, D, and E.

Connector C: Think of this as the Drive C: connector under DOS. The hard drive connector is an edge connector. Ensure thar you get the pin 1 side correctly aligned.

Connector D: This connects to your 'second' hard drive, Drive D: under DOS.

Connector E: This is the connector to the HFDC-II card. It is a 34-pin female socket that connects to the card connector marked 'J4 WINCHESTER'. Make sure you align the red stripe with pin 1.

Hard Drives - Data Cables

You may install up to two hard drives, but each drive requires its own Data Cable. The Data Cable is a 20-wire cable with one connector at either end. The connector to the Interface card (G in the diagram) is a 20-pin female socket. The connector to the hard drive is an edge connector (F in the diagram). Once again, the pin 1 side is picked out in red.

F   G

Connect the data cable(s) from the connector on the HFDC-II to the edge connector on the hard disk(s). Take care to get the pin 1 side correctly aligned. Your first hard disk, that is Drive C: under DOS must be connected to the 20 pin socket on the card marked 'J3 DRIVE0'. A second hard disk, if installed, would be Drive D: under DOS, and would connect to 'J2 DRIVE1' on the card.

With all the cables correctly connected, your installation is almost complete. It only remains to connect the Hard Disk LED(s) and terminate the last hard drive.

Termination

Termination means to reduce interference in the communication cables by installing resistors at either end of the communication chain. For the HFDC-II, termination is required only for the Hard Disk cable. The HFDC-II is already installed with suitable termination. If you look at your hard disk you will find an installed terminator. This terminator is usually brightly colored for easy identification. If your system has only one hard disk (that would be Drive C:) leave the terminator in place. If you have installed two hard drives, remove the terminator from the drive attached to the middle of the control cable (Drive D:) and leave the terminator in place on the drive attached to the end of the cable (Drive C:).

LEDs

The HFDC-II has a 4-pin connector J1 which will ignite a hard disk LED whenever your hard disk(s) is in use, or being accessed.

A hard disk LED connector will generally consist of a four- or two-pin socket. Connect the four-pin type directly to J1. Connect the two-pin type to either pins 1 & 2 or 3 & 4.

LED
J1
1
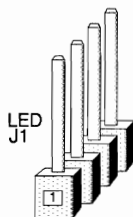
That completes the hardware installation. It's a good idea to go ahead with the software setup, and check out the system before you secure everything in your unit.

7. SOFTWARE SETUP

Assuming you have installed one or two new hard disks with your new HFDC-II Disk Controller, you are going to have to prepare them for use by formatting, partitioning, etc. Similarly, you will have to go through the same procedure if you have a hard disk which was functioning under a previous controller, and you wish to run it under the improved perfor-mance capabilities of the HFDC-II. In this case, remember that refor-matting will wipe your disk clean and every bit of data will be lost. Make a backup of everything that you wish to save, and check out that the master copies of your favorite applications programs have not been eaten by your dog!

Only if you are running an old and trusted hard disk, and you have configured the HFDC-II to be compatible with your old controller (see 'Configuring The Card' Chapter) can you ignore the following setup.

The procedure here depends a lot on the kind of hard disk you have, the utility disk which was provided by your hard disk vendor, your DOS version, and your Mainboard BIOS.

Given that, this manual can only give you a very general outline of what needs to be done, and you will have to consult your System, DOS, and Hard Disk documents for further guidance.

In broad terms, there are 4 basic operations to get your hard disk up and running.

STEP 1

After you install your HFDC-II and a new hard disk, you will find that your CMOS Setup Configuration program will be first to spot the change. Moments after power on, you will get an error message and a recom - mendation to run Setup.

Run Setup and fill in the new information about your hard disk(s). Hard Disks types are numbered 1-47. Your hard disk documents should provide the type number. If not, you will have to run through the options until you find the mix of cylinders, heads, sectors, etc., matching your disk. As this is an MFM controller, your sector value will be 17. The other factors depend on your hard disk size.

After entering the new information, exit the setup program.

STEPS 2, 3, & 4

The steps here are the low-level formatting, the partitioning, and the formatting. If you have a good Utility program/Disk manager, you can probably get all three done with little fuss. If you have to use DOS commands, you will have to be more circumspect and complete each stage a step at a time.

STEP 2: This is the low-level formatting. On many hard disks, this step may have been carried out by the vendors. At this step too, any bad sectors on the disk, can be 'locked-out' so that data will never be written to them. Your disk will have a list of the location of any bad sectors. Usually the list is taped to the disk case.

STEP 3: This step partitions the hard disk. Your system recognizes partitions as areas under the control of different operating systems. For example, if you wished to run some of your software under a non-DOS operating system, you would have to specify one partition for DOS and another for the other operating system. Under DOS 3.3x and earlier, maximum partition size is 32MB. So if you are installing a 40MB drive, you would be forced to make at least two partitions in any case. One partition must be designated the 'active partition' where your system will look to boot on startup. Partitioning can be done using the DOS FDISK command.

STEP 4: The final step is to format your hard disk. This can be done by using the DOS format command. At this point, too, you can install a bootable DOS in your 'active' partition.
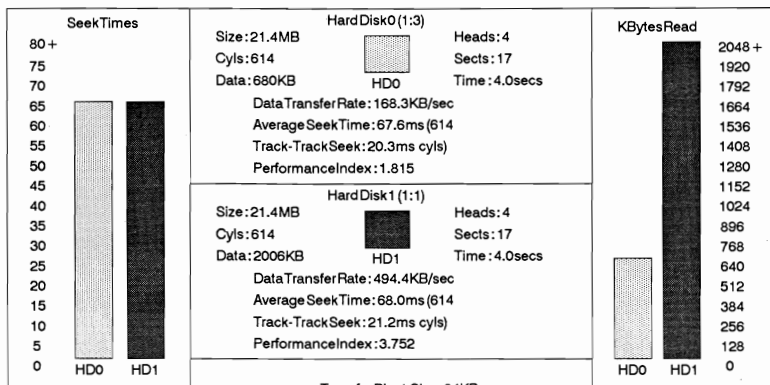
APPENDIX 1:

COMPARISON OF 1:1 & 1:3 INTERLEAVING

To demonstrate the effect of interleaving rates on performance, we fitted a 16MHz AT compatible with two Seagate ST-225 20MB Hard disks running under the HFDC-II Controller. Hard Disk 0 was formatted using 1:3 interleaving, and Hard Disk 1 was formatted using 1:1 interleaving. The disk performance was then compared using the CORE™ Test program Version 2.6. The results are illustrated below:

CORE Disk Performance Test Program Version 2.6
(C) Copyright CORE International, Inc. 1986

Seek Times

	HD0	HD1
80+		
75		
70		
65		
60		
55		
50		
45		
40		
35		
30		
25		
20		
15		
10		
5		
0	HD0	HD1

Hard Disk 0 (1:3)

Size: 21.4MB   Heads: 4
Cyls: 614   Sects: 17
Data: 680KB   HD0   Time: 4.0secs
   Data Transfer Rate: 168.3KB/sec
   Average Seek Time: 67.6ms (614
   Track-Track Seek: 20.3ms cyls)
   Performance Index: 1.815

Hard Disk 1 (1:1)

Size: 21.4MB   Heads: 4
Cyls: 614   Sects: 17
Data: 2006KB   HD1   Time: 4.0secs
   Data Transfer Rate: 494.4KB/sec
   Average Seek Time: 68.0ms (614
   Track-Track Seek: 21.2ms cyls)
   Performance Index: 3.752

KBytes Read

		2048+
		1920
		1792
		1664
		1536
		1408
		1280
		1152
		1024
		896
		768
		640
		512
		384
		256
		128
HD0	HD1	0

Transfer Block Size: 34KB
Hard Disk 1 transfer rate is 194% faster than Hard Disk 0
Hard Disk 0 seek time is 1% faster than Hard Disk 1