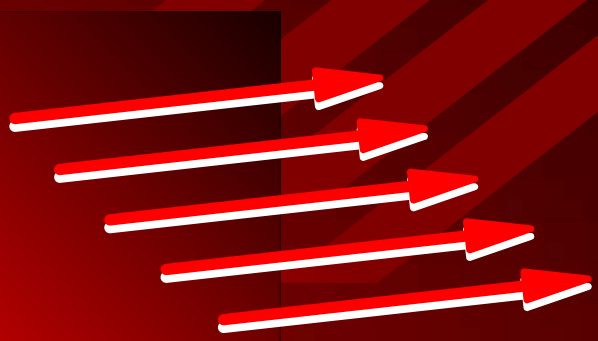
DPT™

SmartCache™

PM3011

ISA DISK CONTROLLER



USER'S MANUAL

OCTOBER 1990

This document is the user's manual for Distributed Processing Technology's SmartCache™ family of disk controllers. These caching disk controllers are designed for use with PC/AT compatible computers and include the PM3011/55 for ST506 disk drives, the PM3011/65 for RLL drives, and the PM3011/75 for ESDI drives. In addition, instructions for the installation of various operating systems are also provided.

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CHAPTER I
Introduction

The DPT SmartCache Disk Controller is the single most effective performance improvement tool available for disk intensive applications. In applications such as multi-user systems, engineering workstations, and network file-servers, well over half the time is taken up waiting for the disk. Reducing the disk access time is the key to breaking this disk bottleneck. SmartCache accesses data in as little as one-half millisecond – that's 50 to 100 times faster than a random disk access. Overall system performance gains of three to five times are common, with some programs running ten to fifteen times faster.

CHAPTER II
Theory of Operation

2.1 Introduction

Disk caching is a technique which has been used for many years in mainframe computers to increase system performance. Most disk controllers have a RAM buffer to hold the data that is read from the disk until the computer can accept it into its own memory. Usually this buffer is big enough to hold only one sector (512 bytes) of disk data, although some "high performance" disk controllers can hold several sectors of data. A cache, on the other hand, not only temporarily holds the data while it is in transit, but retains the data until some time later when the computer might need it again. The SmartCache Controller even reads data from the disk before the computer asks for it, and stores the data in its cache in anticipation of the computer's future needs. Later, when the computer asks for the "cached" data the controller then retrieves it in a fraction of the time it would take to read it from the disk.

Disk drives are mechanical devices. To retrieve data from a disk drive, the read/write head must first physically "seek" to the proper cylinder and then the disk must rotate until the desired data is in position under the head. Average seek times on drives range 15 milliseconds on the fastest, most expensive drives to 40 milliseconds on the least expensive drives. To that must be added the average rotation time which is typically 8 milliseconds regardless of the drive type. Therefor the total access time for high performance drives is 23ms.

In contrast, the SmartCache controller reads data from its cache within one-half millisecond. This means that SmartCache accesses data from cache 50 times faster than a "high performance" disk drive with a standard disk controller.

2.2 Cache Expansion Capability

The SmartCache controller's cache can be expanded incrementally as needed to maintain optimum system performance. To accomplish this, there should be enough cache to allow the most frequently accessed files to be stored in cache. Systems with many users generally need to cache more data than single-user systems. The same holds true for systems with large data files as opposed to small files.

In addition, SmartCache controllers use their cache to process ordered write-back sectors and read-ahead segments. Increasing the size of SmartCache's memory makes these features more efficient – a requirement for larger computer systems. Therefore, each system will require varying amounts of cache, and the amount of

cache needed will change as the demands of the system increase.

SmartCache controllers come with 512 Kbytes of cache on the controller card. This is generally enough cache for most single-user environments such as CAD or desktop publishing. The cache can then be expanded in two Mbytes increments to up to 16 Mbytes*. With 16 Mbytes of cache, a single SmartCache controller could typically support a multi-user system or network file-server with as many as 64 users.

In addition to the standard on-board 512 Kbytes of cache, one MM3011/2 two Mbyte Memory Module or MM3011/4 four Mbyte Memory Module can plug directly onto the PM3011 SmartCache controller card, providing 2.5 Mbytes or 4.5 Mbytes of controller cache while not taking up any additional card slots.

If more cache is required, an MX3011/4 four megabyte Expansion Card can be added. This card occupies the PC bus slot adjacent to the SmartCache controller. A two inch ribbon cable provides the connection between the controller and the Expansion Card.

One ore two additional MM3011 Memory Modules, each containing 2 or 4 Mbytes of RAM, can also be added to the MX3011 four Mbyte Expansion Card, upgrading the MX3011 card's capacity to 6, 8, 10, or 12 megabytes of expansion cache. These modules plug directly onto Bay 1 or 2 of the MX3011 and do not take up any additional card slots.

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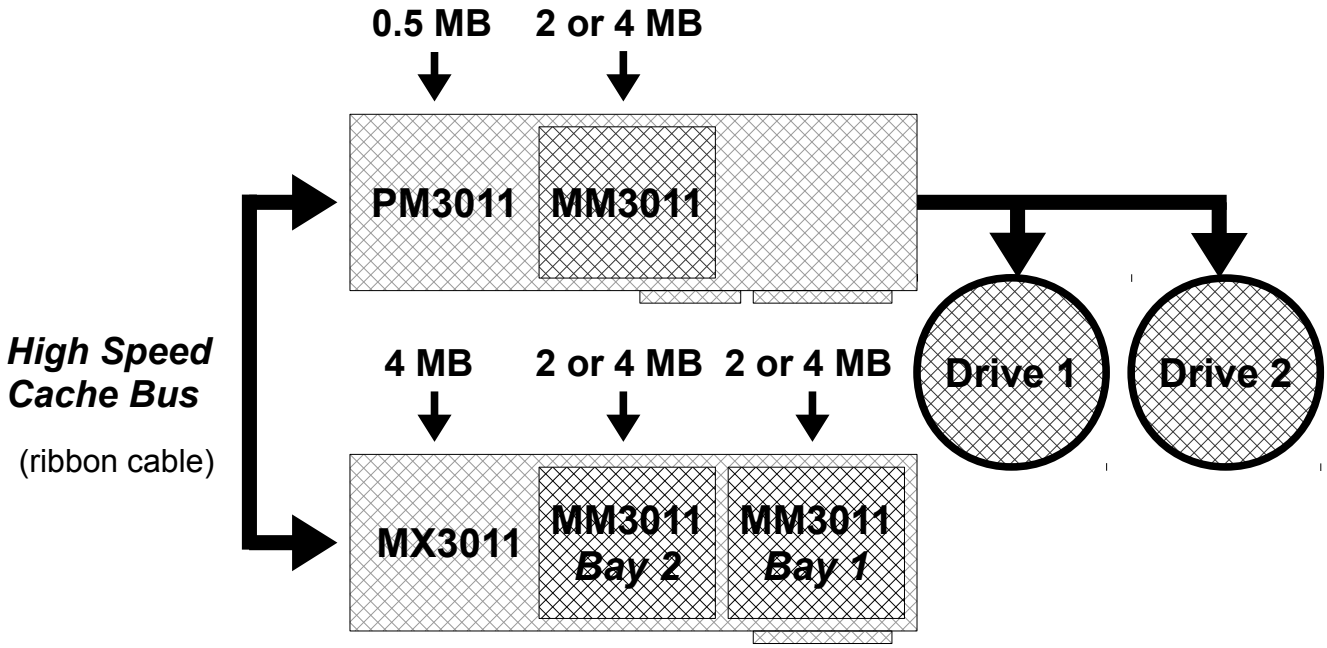
* References to 16 Mbytes will be used when 16 Mbytes of expansion cache is installed. Maximum usable cache size is actually 15.5 Mbytes due to microprocessor address limitations.

Figure 2-1 Maximum Cache Configuration

PM3011 SmartCache Controller with one MM3011 Memory Module plus MX3011 Expansion Card with two MM3011 Memory Modules.



With the one MX3011/4 Expansion Card and three MM3011/4 Memory Modules, the SmartCache controller can be configured with a maximum of 16 Mbytes of cache. Up to three 2 or 4 Mbyte MM3011 Memory Modules can be used in any combination, allowing the SmartCache to be configured with 0.5, 2.5, 4.5, 6.5, 8.5, 10.5, 12.5, 14.5, or 16 megabytes of cache memory. As a general rule of thumb, it is recommended that the system be configured with at least 1 Mbyte of cache for every four active users or tasks on the system.

2.3 Advanced Caching Algorithms

Advanced caching features such as automatic disk read-ahead and elevator sorting during cache write-back increase disk performance to levels unobtainable by non-caching controllers. The controller's on-board 68000 microprocessor enables it to access the disk drive at the same time as the computer reads or writes to the controller cache. This simultaneous transfer of data between the computer, the cache, and the disk enables the system to maintain a very high level of performance, even when heavily loaded.

SmartCache controllers utilize a sector caching algorithm that assures maximum efficiency in heavily fragmented environments such as multi-user operating systems or networks. Most multi-user systems do not store disk data in large contiguous segments but instead break up disk files into many small fragments which are scattered all over the disk. In addition, the computer's time is also "sliced" into small fragments which are in turn allocated to each user. Because of this fragmentation of the disk space and computer time, the disk controller receives many requests to read and write data in widely scattered areas of the disk.

In order to contend with this disk fragmentation problem, the SmartCache controller maintains a sector cache which can simultaneously hold thousands of disk sectors from widely scattered areas of the disk. Each disk sector is stored in an individual cache page. Up to 32,000 disk sectors can be simultaneously cached in a fully loaded 16 megabyte controller. Yet only the sectors which are needed are cached, unlike track caching schemes which must always read or write entire tracks of data.

Because of its powerful caching architecture and on-board 68000 microprocessor, the SmartCache controller accesses any cached data within one-half millisecond, regardless of the size of the cache. The design of some cache systems causes the cache search time and processor overhead to increase as the cache size increases. The SmartCache controller maintains the fast on-half millisecond access time regardless of the cache size.

2.4 Automatic Disk Read-Ahead

In addition to caching the sectors requested by the computer, the controller also caches sectors which have not yet been requested but which have a high likelihood of being requested in the near future. Since disk data is often grouped in "clumps" of sequential sectors on the disk, it is often beneficial to continue to read sequential sectors into cache following a sector that has recently been requested by the computer. After each read command, the controller quickly checks its cache to see if the next eight sequential disk sectors are present. If not, it continues to read ahead from the disk without missing a rotation until all eight sectors have been read into the cache. While this read-ahead operation is being performed, the computer does not have to wait for the data requested. As soon as the requested data has been read, the computer can start using it. Automatic read-ahead is then handled entirely by the controller, concurrent with other operations performed by the PC/AT.

The computer can also read or write other data to the cache without interfering with the read-ahead option. If the data that the computer requests is in cache, it is transferred between the PC/AT and SmartCache

concurrently with the read-ahead operation.

If the computer wants to read data that is not in the cache, the controller immediately stops the read-ahead and services the new read operation. Automatic Read-Ahead never slows down the PC/AT since it is controlled independently by SmartCache's own 68000 processor over SmartCache's high speed cache bus in parallel with other system bus activity.

Disk read-ahead helps by pre-loading the cache with information which has a high likelihood of being requested by the computer in the near future. However, in order for disk read-ahead to be effective in a multi-user environment, it is necessary for the cache to store a large number of read-ahead sectors from many different areas of the disk. This is because multi-user and networking operating systems "time-slice" I/O requests from many different users or tasks. Data which has been cached by a read-ahead operation may not be accessed until many commands in the future when the same user or task has another chance to access the disk. This is why controllers or disk drives which store a small number of read-ahead segments may perform well on simple sequential benchmarks, but often do not provide real performance benefits in actual multi-user environments.

It is possible to adjust the number of sectors in disk read operations as well as monitor the number of cache hits which have occurred due to read-ahead. This is recommended only for OEMs who wish to fine tune the caching algorithms for maximum performance in a particular environment. For more information on this feature, contact DPT Customer Support.

2.5 Ordered Write-Back

When using the SmartCache controller, disk write operations always result in a cache hit within one-half millisecond, which is 50 to 100 times faster than a write operation with a standard controller. The SmartCache controller then copies the cached data to disk in the background so the computer never waits for the disk write. In addition, data is written in order of increasing cylinder, head, and sector number, minimizing disk seeks and missed rotations, thereby speeding up the entire operation. This feature called Ordered Write-Back, eliminates much of the "head trashing" commonly associated with disk-intensive operations.

In effect, the controller acts as a sorting pipeline. Random sector writes come in from the computer, and sequential sector writes go out to the disk drive. Whenever the controller has not received a command from the computer for 250 milliseconds, it begins copying "dirty" pages to disk. (When data has been written into a cache page by the computer but has not yet been copied to the disk, the page is said to be "dirty".) Since the data is written back to disk in an ordered fashion, several seconds of controller idle time will normally result in all dirty pages being copied to disk, even through it may have taken much longer for the computer to write the data to the computer.

The controller also writes bursts of ten ordered sectors back to disk whenever 50% ore more of the cache becomes dirty. These disk write operations occur concurrently with other cache read and write operations from the computer. As in disk read-ahead, the computer can also access other sectors in cache without interfering with the write-back operation. If the data that the computer requests is in cache, it is transferred to the PC/AT at the same time as the write-back operation is writing data to the disk. If the computer wants to write data, the this data can immediately be written to cache simultaneously with other data being written from the cache to disk.

It is possible to adjust the number of sectors written during disk write-back bursts, as well as the maximum percentage dirty limit. This is recommended only for OEMs who wish to fine tune the caching algorithms for maximum performance in a particular environment. For more information on this feature, contact DPT Customer Support.

2.6 Compatibility – Supports All Operating Systems

Since SmartCache controllers operate transparent to the operating system, special software drivers or ROM BIOS changes are not required. Operating systems such as 3COM 3+, 10NET, BOS, CCP/M, Concurrent DOS386, IGC VM386, Interactive Unix, Lifenet, Microport Unix, MS-DOS, MUMPS, Novell NetWare 286 and 386, OS/2, PC-Net, PC-MOS, Pick, Prologue, QNX, SCO Xenix and Unix, Theos, Thoroughbred, Venix, and Virtual Systems Quick Connect are all fully compatible with SmartCache controllers.

2.7 Optimum Drive Geometry Emulation

ESDI and RLL disk drives gain an additional storage capacity because the are formatted with more sectors per track than the standard 17 sectors per track of an ST506 drive. However, some PC/AT compatible operating systems only support drives which are formatted with 17 sectors per track. SmartCache controllers are capable of automatically remapping the drive geometry so that ESDI and RLL drives appear to the system as standard 17 sector -per-track drives.

In order to compensate for making an ESDI or RLL drive appear to have 17 sectors per track, the controller automatically increases the apparent number of heads and/or cylinders to yield the full drive capacity. During normal operation, operating systems requests for cylinder, head, and sector addresses within the limits that the OS supports are translated by the controller into the actual physical cylinder, head and sector addresses of the disk drive. As long as the operating system supports the increased number of heads and/or cylinders, the entire capacity of the drive can be utilized with the standard disk driver or BIOS. In fact, the SmartCache controller can emulate any drive geometry with up to 2048 cylinders, 64 heads, and 255 sectors per track.

When the DPTFMT disk format utility is run, the program analyzes the limitation of the operating system, ROM BIOS, and disk drive being used and instructs the controller to emulate the "best fit" drive geometry so that the maximum drive capacity can be utilized. The table in the section entitled *Determining If a BE3011 Is Needed* in the *Hardware Installation* chapter of this manual lists the maximum drive capacities of several popular operating systems

2.8 Controller Activity LEDs

A 10-segment LED display on the controller provides a means to visually monitor the state of the controller. There are five different controller states which are indicated by the LED: Idle, Active, Self-Test, Fatal-Trap, and Power-Up.

2.8.1 LED Display During Controller Idle

When no commands are in progress and all disk activity has ceased, the controller enters the Idle State. This is indicated by a rotating bit pattern in LED segments 1 through 8.

2.8.2 LED Display During Controller Active

By viewing these LEDs the user can determine information concerning cache hits and misses, disk reads and writes, and PC/AT bus reads and writes. In addition several LEDs are provided for troubleshooting purposes

Table 2-1 LED Display During Controller Active

Segment	Function
1	Busy
2	PC/AT Bus Transfer to Controller
3	PC/AT Bus Transfer from Controller
4	Cache Hit
5	Disk Read-Ahead Active
6	Disk Read
7	Disk Write
8	PC/AT Controller Reset
9	Controller Interrupt Pending to PC/AT
10	DRQ Asserted to PC/AT

2.8.3 LED Display During Manual Self-Test

A push-button switch is provided on the controller to allow manually activated self-diagnostic tests. Momentarily pressing the switch when the controller is in an idle state will cause the controller to "arm" for self test. During this time, the controller will not respond to PC/AT commands and segment 1 through 8 of the LED display will flash five times per second. If the switch is pressed again within three seconds, the controller will execute a series of self-diagnostic routines. Results of the test are displayed on the 10-segment LED display. These routines continue to execute until the switch is pressed a third time. If no fatal errors were detected during self-diagnostics, the controller then re-enters the Idle State; otherwise a fatal trap state is entered. If the switch is not pressed within three seconds, the LED display will flash twenty times per second for three seconds. If the switch is pressed during this time, the controller will enter a diagnostics mode as detailed in the OEM manual. If the switch is not pressed, the controller will re-enter the idle loop.

Six self-test routines are executed by the controller during self-diagnostics. During the execution of each routine, the corresponding LED segment flashes intermittently. If an error is detected by any one of the self-test routines, the LED segment remains lit and the controller executes the next diagnostic routine. Once an LED segment is lit to indicate an error, the corresponding diagnostic routine is not executed again and the LED segment remains lit through the duration of the self-diagnostics. The controller continues to execute diagnostics in an endless loop until the self-test switch is pressed again.

During self-diagnostics segments 1 through 10 of the LED have the following meaning:

Table 2-2 LED Display During Self-Test

Segment	Function
1	Cache RAM Test
2	Sector Buffer Test
3	PC/AT I/O Register Test
4	Disk Protocol Controller Test
5	always off
6	Hardware Test (EPROM Checksum)
7	Disk Read/Write Test
8	always off
9	always off
10	always off

2.8.4 LED Display During Fatal Trap State

If a fatal error is detected during the execution of controller diagnostic routines, the controller will enter the Fatal Trap State. Fatal errors are caused by controller or expansion RAM failure, or failure of other critical controller hardware. Disk drive ore PC/AT failure will not cause the controller to enter the Fatal Trap State. Fatal errors can be detected by Power-Up or Manual Self-Diagnostic tests.

In the Fatal Trap State, the controller alternately flashes LED segments 1 through 4 and segment 5 through 8, and will not allow the system to boot or respond to PC/AT commands. In this case, a manual self-test may be performed to determine the cause of failure. The Fatal Trap State is exited only by a PC/AT bus reset or by powering-down the PC/AT.

2.8.5 LED Display During Power-Up

During the power-up sequence, the 10-segment LED display on the controller displays the amount of expansion cache present in addition to the base 512k. The expansion cache size in megabytes is displayed as a binary pattern, with lit LEDs representing binary one. LED 1, the left most LED (see Appendix F), is the least significant binary bit. For example, if an additional 4MB of cache memory is installed, LED 3 will light. If 12MB of expansion cache are installed, LEDs 3 and 4 will light. If there are no cache expansion boards installed, then all the LEDs will go blank.

CHAPTER III
Hardware Installation

3.1 Introduction

The procedure for installing the SmartCache controller is presented in two formats. First, a quick step-by-step installation summary, followed by a comprehensive installation guide.

3.2 Quick Installation Summary

1. Power-down the computer.

2. Remove any hard disk controller already present.

3. Connect all required SmartCache accessories to the controller.

4. Connect the floppy drive cable to connector J8. Pin one (indicated by a stripe or arrow) must be at the top edge of the controller.

5. Connect the 34-pin hard drive control cable to connector J5. All drive cables should be connected to the controller with pin 1 at the top edge of the controller. Pin 1 on the cable is indicated by a stripe or arrow.

6. Connect the 20-pin drive data cable(s) to the SmartCache controller:

Connector J4 for the hard Drive 0, J3 for Drive 1, J2 for Drive 2 (PM3011/75 only) and J1 for Drive 3 (PM3011/75 only).

7. Connect the drive cables to the corresponding hard disk.

8. Install the SmartCache Controller in a sixteen-bit slot in the computer.

9. Proceed to the *Drive Formatting* chapter of this manual and continue with installation.

3.3 SmartCache Models

All SmartCache controllers are shipped from the factory with a floppy controller as standard equipment. The model numbers for the SmartCache controller differ according to the hard disk interface supported.

Table 3-1 SmartCache Controller Models

Model	Interface
PM3011/55	ST506 MFM
PM3011/65	ST506 RLL
PM3011/75	ESDI

3.4 SCSI Adapter Option

SmartCache controllers can be specially ordered from the factory with an optional SCSI adapter. The SCSI adapter is a SmartCache controller option which provides the hardware necessary to attach up to seven SCSI peripherals to the computer without using an additional computer bus slot.

Devices attached to the SmartCache SCSI adapter do not access the controller cache. Instead, all data is transferred directly to the PC bus. It is intended to be used with secondary storage devices such as SCSI tape, CD-ROMs and optical worm drives. The SmartCache SCSI adapter is not recommended for use with SCSI hard disk drives.

Device driver software is required for all SCSI peripherals connected to the SmartCache SCSI adapter. A Technical Reference Manual is available to developers and OEMs who wish to develop their own device drivers.

3.5 Floppy Controller

SmartCache's on-board floppy controller allows control of two 5¼ inch or 3½ inch, high or low-density floppy drives. SmartCache does not cache the floppy drives. The SmartCache floppy controller must be the only floppy controller operating in the computer. If there is another floppy controller either on the motherboard or in another slot, the SmartCache floppy controller must be disabled by changing its base address to the secondary location, or disabled by installing Jumper Y20 on the PM3011/75, or Y21 on the PM3011/55 and PM3011/65. SmartCache controllers can be specially ordered without floppy controller circuitry.

3.6 Computer

The SmartCache controller operates in a sixteen-bit slot in any 80286 or 80386 AT-bus computer. All CPU clock speeds are supported. The controller's maximum bus transfer rate is 4MB/s.

3.7 Disk Drives

PM3011/55 MFM and PM3011/65 RLL controllers can control up to two ST506 disk drives. Any standard ST506 drive can be used with the PM3011/55 MFM controller.

Although most ST506 drives will also work with the PM3011/65 RLL controller, for best results, only ST506 drives which have been certified by the drive manufacturer for RLL recording should be used. This is because RLL recording requires 50% tighter tolerances than standard MFM recording for the data timing on the drive. Thus non-RLL-certified ST506 drives may cause an unacceptable number of media defects to be generated.

The PM3011/75 will control standard ESDI drives with data rates of up to 20MHz, and with capacities of up to 4GB per drive. Although up to four ESDI drives can be controlled by the PM3011/75 controller, most operating systems will only allow a maximum of two drives to be used without special software drivers. Four ESDI drives may be used with any operating system however, when the DM3011 Disk Mirroring Module has been installed and disk mirroring is enabled. In this case, the operating system will "see" two drives, but data for each drive will be mirrored onto a drive pair, thus providing disk fault-tolerance.

3.8 SmartCache Accessories

There are several optional accessories available for SmartCache controllers. The installation of each accessory will be reviewed in this section. Optional equipment for the SmartCache controller includes:

BE3011 BIOS Table Expander Chip which plugs into the controller and allows certain operating systems to access disk drives with greater capacity than those in the standard BIOS. BE3011 chips are shipped as a standard accessory on all SmartCache controllers.

MX3011 Expansion Card or **MM3011** Memory Modules to increase the cache size above the 512Kbytes that reside on the controller.

DM3011 Disk Mirroring Module which mirrors one or two pairs of drives together to create a disk fault-tolerance system.

The controller is automatically configured at power-up, hence there are no jumpers or switches when adding or removing an accessory. The only exception is when removing the BE3011 chip (reviewed in the section entitled *BE3011 BIOS Table Expansion Chip* later in this chapter) which requires Jumper Y7 to be removed.

3.8.1 Cache Expansion

SmartCache controllers come with an integral 0.5 Mbytes of cache RAM. The SmartCache controller can be configured with a maximum of 16 Mbytes of cache by adding one MX3011 Expansion Card and up to three MM3011 memory modules. MM3011 Memory Modules come in both a 2 Mbyte and 4 Mbyte variety, both of which can be used interchangeably. (See the section entitled *Cache Expansion Capability* in the *Theory of Operation* chapter of this manual.)

One MM3011 Memory Module can plug directly onto the PM3011 SmartCache controller card, providing 2.5 Mbytes or 4.5 Mbytes of controller cache while not taking up any additional card slots. Appendix F contains drawings showing MM3011 connector locations on the SmartCache controller.

If more cache is required, an MX3011/4 four megabyte Expansion Card can be added. This card occupies the PC bus slot adjacent to the SmartCache controller. A two inch ribbon cable provides the connection between the controller and the Expansion Card. One or two additional MM3011 Memory Modules can also be added to the MX3011. These modules plug directly onto the MX3011 and do not take up any additional card slots.

There are many possible ways to configure the expansion cache since the 2 or 4 Mbyte MM3011 Memory Modules can generally be added to the PM3011 and MX3011 in any order. However, there are several unallowed configurations. Refer to the table of the following page for the various possible configurations for SmartCache expansion boards. The following section contains step-by-step instructions for adding Expansion Cards and Memory Modules.

Table 3-2 Cache Size Configurations

Total Cache	MM3011 on PM3011	MX3011	MM3011 on MX3011 (Bay 1)	MM3011 on MX3011 (Bay 2)	Allowed
0.5 MB	none	none	none	none	yes
2.5 MB	2 MB	none	none	none	yes
4.5 MB	none	4MB	none	none	yes
4.5 MB	4 MB	none	none	none	yes
6.5 MB	none	4 MB	2 MB	none	yes
6.5 MB	none	4 MB	none	2 MB	yes
6.5 MB	2 MB	4 MB	none	none	yes
8.5 MB	none	4 MB	4 MB	none	yes
8.5 MB	none	4 MB	none	4 MB	yes
8.5 MB	2 MB	4 MB	2 MB	none	yes
8.5 MB	2 MB	4 MB	none	2 MB	yes
8.5 MB	4 MB	4 MB	none	none	yes
10.5 MB	none	4 MB	2 MB	4 MB	yes
10.5 MB	none	4 MB	4 MB	2 MB	yes
10.5 MB	2 MB	4 MB	2 MB	2 MB	yes
10.5 MB	2 MB	4 MB	4 MB	none	yes
10.5 MB	2 MB	4 MB	none	4 MB	yes
10.5 MB	4 MB	4 MB	2 MB	none	yes
10.5 MB	4 MB	4 MB	none	2 MB	not allowed
12.5 MB	none	4 MB	4 MB	4 MB	yes
12.5 MB	2 MB	4 MB	2 MB	4 MB	yes
12.5 MB	2 MB	4 MB	4 MB	2 MB	yes
12.5 MB	4 MB	4 MB	2 MB	2 MB	not allowed
12.5 MB	4 MB	4 MB	none	4 MB	not allowed
12.5 MB	4 MB	4 MB	4 MB	none	yes
14.5 MB	2 MB	4 MB	4 MB	4 MB	yes
14.5 MB	4 MB	4 MB	2 MB	4 MB	not allowed
14.5 MB	4 MB	4 MB	4 MB	2 MB	not allowed
15.5 MB	4 MB	4 MB	4 MB	4 MB	yes

3.8.1.1 Adding a Memory Module to the PM3011

One MM3011/2 or MM3011/4 Memory Module can be added to the PM3011 SmartCache controller, increasing the on-board cache size to 2.5 or 4.5 megabytes. The MM3011 attaches to connectors J7 and J12 on the controller. All expansion memory is automatically sensed by the controller so no jumper settings or system setup changes are required.

3.8.1.2 Adding the MX3011 Expansion Card

One MX3011 Expansion Card can be used with the SmartCache controller. This card must occupy the adjacent PC bus slot and connects to the controller via a 60-conductor, two inch ribbon cable. To install the MX3011, follow the following instructions:

1. Place the MX3011 in a slot adjacent to the controller. An 8 or 16-bit slot may be used.

2. Connect the MX3011 to the controller with the cable provided with the MX3011. The cable runs from J1 on the MX3011 to J9 on the controller. The memory is now installed and ready to function.

3.8.1.3 Adding Memory Modules to the MX3011

One or two MM3011/2 or MM3011/4 Memory Modules can be added to the MX3011/4 Expansion Card, increasing the expansion cache on-board the MX3011 to 6, 8, 10, or 12 megabytes. All expansion memory is automatically sensed by the controller so no jumper settings or system setup changes are required.

1. The first MM3011 added should be attached to Bay 1 (connectors J4 and J5 on the MX3011/4.

2. If a second MM3011 is installed it should be attached to Bay 2 (connectors J2 and J3) on the MX3011/4.

NOTE: The MX3011/2 is a two Mbyte half-populated Expansion Card which has been discontinued. Although it does not provide the two bays for plugging in MM3011 modules, it can still be used along with the one MM3011 which plugs directly into the PM3011 controller. For information regarding upgrading MX3011/2 cards to MX3011/4 cards, contact DPT Customer Support.

3.8.1.4 Cache Expansion Size Tests

There are three methods to confirm that the expansion cache has been properly installed and is being recognized by the controller:

1. BIOS Table Expander Diagnostics (BE3011) – If a BIOS Table Expander chip is installed on the SmartCache controller, the amount of cache installed will be displayed on the screen during the power-up self-test sequence.

2. DPT Format Utility (DPTFMT) – The DPT Format Utility reports the amount of cache memory present each time the program is run. Cache size is displayed on the initial screen at the top left corner.

3. LED display – During the power-up sequence for a brief moment, the 10-segment LED display on the controller displays the amount of expansion cache present in addition to the base 512KB. (See the section entitled LED Display During Power-Up in the Theory of Operation chapter of this manual.)

The MX3011 Expansion Card and MM3011 Memory Module are sensed by the SmartCache controller in two independent ways. First of all, the controller senses a special configuration signal which indicates which boards are present. Then the controller tests the cache RAM on each board to assure that it is fully functional. If this test is not passed, the controller will enter the Fatal Trap State, flash the 10-segment LED (see the section entitled LED Display During Power-Up in the Theory of Operation chapter of this manual.), and will not allow the system to boot.

3.8.2 Using High Capacity Disk Drives

Many operating systems such as DOS and Novell will only access a disk drive if there is a corresponding entry for that particular drive type in the system BIOS.

When using the SmartCache controller, the actual number of cylinders, heads, and sectors on the disk drive does not have to exactly match any of the drive types listed in the BIOS drive table. The DPTFMT format utility automatically examines the BIOS drive table and selects the "best fit" BIOS drive type which matches the total capacity of the drive being installed as closely as possible. It then tells the SmartCache controller to emulate a drive with the same number of heads, tracks, and sectors as that drive type. As long as the total capacity of the drive is the same or greater than the selected BIOS drive type, the drive can be used.

However, many BIOS tables do not include any entries with capacities sufficient for the new high-capacity drives. Therefore, a considerable amount of disk space will be inaccessible to the operating system.

For example, suppose you wanted to install a 380MB ESDI drive under DOS, which requires use of the system BIOS, but the largest BIOS drive type was 1024 cylinder, 15 heads, and 17 sectors, resulting in a capacity of 134MB. The operating system would only be able to access the first 134MB of the disk, and the remaining 246MB would be wasted.

Presently, there are two methods of correcting this condition of lost capacity:

1. Using a user-definable BIOS type.

2. Using a BE3011 BIOS Table Expander Chip.

3.8.2.1 User-Definable BIOS Types

Some PCs have BIOSs which include a user-definable BIOS type which allows the user to create a BIOS type with any parameters desired. This user-definable BIOS type should allow the operating system to access the entire disk drive. Instructions for utilizing user-definable BIOS types are noted in the *Drive Formatting* chapter of this manual.

3.8.2.2 BE3011 BIOS Table Expander Chip

BE3011 BIOS Table Expander chips are shipped as standard configuration on all SmartCache controllers.

If your computer's BIOS does not have a user-definable BIOS type or a drive type with a large enough capacity for your drive, a BE3011 BIOS Table Expander chip will be required in order to access the drive's full capacity.

The BE3011 BIOS Table Expander chip provides additional high capacity drive types for the computer's ROM BIOS table. The BE3011 chip plugs directly in the $C800_H$ ROM socket on the PM3011 SmartCache controller. The BE3011 chip has over 300 drive types ranging from 60MB to 1200MB, beginning at type 48, following the possible 47 drive types supplied by the standard BIOS. With the BE3011, the computer's BIOS can support capacities up to the maximum capacity limits of any operating system.

3.8.2.3 Determining If a BE3011 Is Needed

Some operating systems use the computer's BIOS drive type table and some do not. The following table lists various OSs, along with the maximum number of heads, tracks, sectors per track, and resultant drive capacity supported by that OS. If the OS uses the BIOS drive table then a BE3011 may be needed in order to support high-capacity drives. The BE3011 will allow the computer's BIOS to support up to, but not exceed, the maximum drive capacity for that OS as listed in the table below.

Table 3-3 Operating System Maximum Drive Capacity

Operating System	Cyls	Heads	Secs		Uses BIOS Table	Capacity
Interactive 386/ix	2048	16	63	1057 MB	YES	
MS/PC DOS	1024	16	63	528 MB	YES	
Novell 2.1	2048	16	63	1057 MB	YES	
OS/2	1024	16	63	528 MB	YES	
PCMOS	1024	16	63	528 MB	YES	
Pick 2.2	1024	64	63	2114 MB	YES	
Microport Unix	2048	16	63	1057 MB	NO	
QNX	2048	16	63	1057 MB	NO	
Theos	2048	16	255	4228 MB	NO	
Xenix	2048	16	63	1057 MB	NO	
Novell 2.0	1024	16	17	142 MB	*	

* Novell 2.0 will not operate with the BE3011. The DUB-14 from Golden Bow Systems is recommended and like the BE3011, will socket directly onto the PM3011 controller.

NOTE: Operating systems which are DOS overlays have the same physical disk parameter limitations as DOS. These include any operating system which is executed from the DOS prompt. Examples of DOS overlay operating systems include Alloy NTNX, Concurrent DOS386, Network OS, PC-MOS, PC-NET, and VM386

3.8.2.4 BE3011 Chip Installation

Typically, the operating system must be reinstalled if a BE3011 is added to an existing system.

NOTE: ALL DATA ON THE DISK WILL BE LOST AND SHOULD BE BACKED-UP BEFORE INSTALLATION OF THE BE3011.

1. Insert the BE3011 in the empty EPROM socket (denoted as 8K boot prom) on the controller with the notch facing to the left, the same direction as all the other chips. Refer to the assembly drawing in Appendix F for details.

2. Enable the BE3011 by installing Jumper Y7 on the PM3011 controller.

3. The following message appears at boot-up, indicating that the BE3011 is present:

   BIOS Table Expander Vxxxxx
   Distributed Processing Technology
   (c) Copyright 1988, 1989, 1990

As the system boots, one of the following messages will appear:

A. **BTE Version Change, Call Customer Support.**

B. **BE3011 Detected! Finish Installation:**

(1) Backup disk data if installed.
(2) Run DPTFMT and Calculate Drive Parameters.
(3) Reinstall data.

If the BE3011 is being added to an existing system with an operating system already installed then proceed with step 4 below. Otherwise go on to the *Drive Formatting* chapter of this manual.

4. Load DPTFMT.

5. Select the correct drive make and model. Do not reenter defects if the drive has previously been formatted.

6. Select "Option 3 – Calculate Best Drive Parameters". Do not reformat the disk if it has previously been formatted.

7. The optimum drive type will automatically be selected from the list in the BE3011 chip. DPTFMT will automatically select and set the drive type in CMOS. The type selected will usually be 1. Do **not** change it.

8. The final step is to reinstall your operating system.

3.8.3 Disk Mirroring Module

The DM3011 Disk Mirroring Module, when installed on the SmartCache controller, will mirror one or two pairs of drives together to create a redundant, disk fault-tolerant system. Please refer to the SmartCache Mirroring Users Manual for installation instructions.

3.9 Jumpers

The SmartCache controller is shipped from the factory with all jumpers in default position and should not need to be changed. Refer to Appendix C for the default jumper positions.

3.10 Cabling

All drive cabling with the SmartCache controller is the same as with a standard disk controller.

3.10.1 Control Cable (34-pin)

Attach the 34-pin control cable to Connector J5 on the SmartCache controller. Drive 0, the first logical drive, should be attached to the last connector (end of the cable) on the control cable.

3.10.2 Data Cable (20-pin)

The disk drive data cables must be connected as specified below. Refer to the illustration in Appendix F for connector locations.

Table 3-4 Data Cable Connectors

Drive	SmartCache Connector
0	J4
1	J3
2	J2 (PM3011/75 only)
3	J1 (PM3011/75 only)

3.11 Drive Select Numbering

All disk drive have jumpers or switches which allow the drive select number to be programmed for the drive. The drive numbering to be used is dependent upon the type of control cable used and the number of drives installed in the system. Drive numbering options are described below.

3.11.1 ESDI vs ST506

Confusion often results due to the differences in the drive numbering schemes found on ST506 disk drives (both MFM and RLL) and ESDI disk drives. This differences are inherent in the drive interfaces, not the disk controller. The ST506 interface is capable of supporting four drives, numbered 0 through 3 – the first drive being drive 0. The ESDI interface is capable of supporting seven drives, numbered 1 to 7 – the first drive being drive 1. In the following cabling descriptions, the drives are simply referred to as "first" and "second".

3.11.2 Straight vs Twisted Control Cable

1. Straight control cable with no twists:

   Drive 0 (C:) should be attached to the last connector on the end of the control cable, and the drive select should be set to the "first" drive (as described above).

   Drive 1 (D:) should be attached to the middle connector on the control cable and the drive select should be set to the "second" drive.

2. Control cable with twisted end:

   Drive 0 (C:) should be attached to the last connector on the end of the control cable, and the drive select should be set to the "second" drive.

   Drive 1 (D:) should be attached to the middle connector on the control cable and the drive select should also be set to the "second" drive.

3.12 Drive Termination

Drive Termination is typically accomplished with a socketed terminating resistor on the disk drive. The drive attached to the last connector on the control cable must have a terminating resistor installed. All other drives installed should have the terminating resistor removed. Refer to the disk drive manual for a complete description of drive termination.

CHAPTER IV
Drive Formatting

4.1 DPT Format Utility Introduction

Once the SmartCache controller and drive have been installed, it is necessary to perform a low-level format using the DPT Format Utility (DPTFMT). This utility program can be found on the SmartCache Utilities diskette provided with the controller.. The program runs under MS/PC DOS and is loaded by typing "DPTFMT" at the DOS prompt. Formatting the disk drives using DPTFMT is mandatory with SmartCache model PM3011/75. It is highly recommended, but not required, for models PM3011/55 and /65. In addition to providing a disk format optimized for highest performance, DPTFMT allows the SmartCache controller to provide a number of advanced disk management features not previously available on PCs. These are described briefly in the following pages:

1 **Defect Management** – The SmartCache controller handles all media defects automatically. It remaps data around the defects so the computer and operating system always "see" a defect free disk. Defects are remapped on a block-by-block basis, rather than remapping an entire track, ensuring that valuable disk space is not wasted.

ESDI disk drive manufacturers store a list of media defects on the disk itself. As part of the format process, the controller automatically reads this list, eliminating the need to type them in manually, saving time and reducing errors. Only ESDI drives have the media defect list stored on the disk. The defects for ST506 (MFM and RLL) drives must be input manually from the list supplied by the drive manufacturer.

2. **Media Certification** – After the low-level format has been performed, the controller will write and read several worst-case data patterns onto every sector on the disk. Any additional defects detected will be automatically remapped by the controller. The "Format with Certify" option of the DPT format utility is highly recommended for all installations.

3. **Automatic Sensing and Remapping of "Grown" Media Defects** – Disk drives will often develop additional media defects during normal operation. The SmartCache controller senses these grown defects and remaps them to spare sectors on-the-fly. This means that any defects detected in the future will be automatically repaired and added to the defect list.

4. **Best Fit Drive Emulation** – The SmartCache controller has the ability to change the apparent number of cylinders, heads, and sectors per track on the disk drive, in order to emulate a disk geometry which provides the optimum capacity for the particular operating system and ROM BIOS being used. The DPTFMT format utility automatically examines the BIOS drive table and calculates the "Best Configuration" drive geometry for the operating system. It then tells the SmartCache controller to emulate a drive with that geometry.

4.2 Drive Formatting – Quick Summary

This section provides a quick, step-by-step summary, and a comprehensive formatting guide.

1. Boot-up the computer under PC/MS DOS.

2. Place the DPT Utilities diskette in Drive A: or B:.

3. Type "DPTFMT" and press **Enter**.

4. Note the information displayed and press **Enter**.

5. Enter the drive number to be formatted and press **Enter**. If no drive type is set in CMOS, it will be set to type 1. Do **not** change it. The system will then automatically reboot and the formatting procedure must be restarted from step 1.

6. Insure that the correct drive make and model are selected and press **Enter**. In the case of ESDI drives, DPTFMT automatically identifies the drive manufacturer and model and highlights that selection (only EDSI drives can report this information). If enough information is supplied to guarantee automatic drive selection, this window will be skipped.

7. If a PM3011/75 (ESDI) controller is being used, answer "No" to the prompt: "Do you want to enter additional defects?" These defects will be read from the disk automatically. If a PM3011/55 or /65 (ST506 MFM or RLL) is being used, answer "Yes". In this case you must enter all media defects from the list provided with the disk drive.

8. Select formatting "Option 2 – Format and Certify".

9. Press **Enter** when the format is complete.

10 Select the operating system to be installed on the disk from the list provided.

11. Note the BIOS drive type selected by DPTFMT and record the information. DPTFMT automatically selects the "best fit" BIOS drive type which provides the most capacity.

12. If DPTFMT displays "Best Configuration" information, write it down and follow the instructions provided.

13. Prepare the computer to boot up the operating system to be installed and press **Enter** to reboot. If another drive is to be formatted press **F5** to return to Step 5.

14. Go on to the *Operating System Installation* chapter of this manual and proceed with the operating system installation.

4.3 Comprehensive Drive Formatting Instructions

Formatting and certifying a disk with DPTFMT is an extensive test of both the SmartCache controller and the disk drive.

4.3.1 Getting Started

DPTFMT will run under all versions of PC/MS DOS on high or low-density floppy drives.

1. Boot-up your computer with any version of PC/MS DOS. If the drive has not been previously formatted with the SmartCache controller, a drive error may be reported during boot-up. This is normal.

2. Place the DPT Utilities diskette in drive A: or B:.

3. Type "DPTFMT" and press **Enter**.

4.3.2 Special Keys

Esc displays the previous screen each time it is pressed and will exit the DPTFMT program if pressed enough times. This allows you to use DPTFMT to obtain information about the system, such as the cache size, best drive configuration, etc., without actually formatting the drive.

4.3.3 Initial Screen

[Section is missing.]

4.3.4 Drive Number

[Section is missing.]

4.3.5 Selecting The Drive

[Section is missing.]

4.3.6 Entering Defects

[Section is missing.]

4.3.6.1 Entering Defects for ESDI Drives

[Section is missing.]

4.3.6.2 Entering Defects for ST506 Drives

[Section is missing.]

4.3.6.3 Entering Drive Defects Manually

[Section is missing.]

4.3.6.4 Retrieving a Defect List Already Entered

[Section is missing.]

4.3.6.5 Entering a New Defect List

[Section is missing.]

4.3.7 Formatting The Disk

[Section is missing.]

4.3.8 Setting The BIOS Type

[Section is missing.]

4.3.8.1 Best Drive Configurations

[Section is missing.]

4.3.8.2 User-Definable BIOS Option

[Section is missing.]

[Section is missing.]

4.3.9 Calculating Drive Parameters

[Section is missing.]

4.3.10 DPTFMT /CUSTOM

[Section is missing.]

CHAPTER V
Operating System Installation

[Section is missing.]

5.1 PC/MS DOS

[Section is missing.]

5.1.1 BIOS Requirements

[Section is missing.]

5.1.2 DOS Disk Capacity Limitations

DOS supports disk drives with a maximum of 1024 cylinders, 16 heads, and 63 sectors per track for a capacity of 528 megabytes per disk. This means that DOS cannot utilize the full capacity of a disk with more than 528 megabytes, including disks on which DOS is co-resident with another operating system, unless special software utilities are used. Software is available from companies such as Ontrack, which increases the maximum drive capacity supported by DOS to over one gigabyte. (A BE3011 BIOS Table Expander chip may also be needed when using high capacity drives with DOS, since quite often, high-capacity drive types are not listed in the BIOS drive tables.)

For example, Xenix supports drives with a maximum of 2048 cylinders, 16 heads, and 63 sectors per track for a capacity of 1057 megabytes. A 670 megabyte drive with both a DOS partition and a Xenix partition will only be able to access 528 megabytes, wasting 142 megabytes. With partitioning software from Ontrack and a BE3011 installed on the SmartCache controller, the entire drive can be used.

5.1.3 DOS Disk Partitioning

By default, DOS will create partitions of up to 32 megabytes. If a larger partition is required the following options are available:

A. Newer releases of DOS, including DOS 4.0, have a revised FDISK program which generates one partition of up to 528 megabytes.

B. Several software companies market packages which break the 32 megabyte boundary. Disk Manager from Ontrack and VFeature Deluxe from Golden Bow have been tested and approved by DPT.

The Limitations of DOS described above are inherent to DOS and are not a result of using the SmartCache controller. The SmartCache controller can emulate drive geometries with up to 2048 cylinders, 16 heads and 255 sectors per track, for maximum capacity of 4.27 gigabytes per drive.

5.1.4 Accessing Over 528MB with DOS

The Disk Manager software utility version 4.0 and later from Ontrack when combined with the BE3011 BIOS Table Expander chip from DPT can be used to access over 528MB per disk under DOS. Follow the steps below when using Disk Manager to exceed the 528MB DOS limitation.

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select Novell 2.1 from the list of operating systems provided. (The Novell 2.1 option does not limit you to 528MB.) DPTFMT will automatically select a BIOS type from the BE3011 which will provide access to the full capacity of the disk drive.

3. Press **Enter** to accept the BIOS type selected.

4. Press **Enter** once again to reboot the system and insert the DOS Boot diskette.

5. Insert the Disk Manager Utility diskette and run SWBIOS. This is the software driver provided by Ontrack to handle cylinders over 1024 and capacity over 528MB.

6. Run DM on the Disk Manager disk. This option will provide four partition configurations. If the provided partition configurations are not satisfactory, then run DM/M (manual mode). This will allow custom design of the partition table.

7. Disk Manager will display the number of disk drives detected. Insure this information is correct and press **Y** to continue.

8. Disk Manager will offer a list of drives to select. Press **Esc** for Standard Drive. (Do not select the drive from the list provided by DM.)

9. Answer **N** to the question: "Do you wish to initialize this drive?"

10. Select the desired Partitions option.

NOTE: Disk Manager will increase the minimum Cluster size to 32KB so even the smallest files will occupy a minimum of 32KB of disk space. In systems with many small files, a large amount of disk capacity may be wasted.

Disk Manager automatically increases the DOS buffer size to approximately 12KB so a statement of BUFFERS=10 will take 120KB of system RAM. In order to conserve system RAM, it is recommended that the number of buffers be reduced.

5.1.5 Installing DOS Step-By-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select "DOS" from the list of operating systems.

3. Boot-up under DOS.

4. Run FDISK or other partitioning software to create your partitions.

5. Format your disk with DOS.

5.1.6 DOS Buffers

With a SmartCache controller installed, do not include a BUFFERS statement in the CONFIG.SYS file unless specifically required by the application being used. Unnecessarily assigning buffers can degrade system performance.

5.2 SCO Unix and Xenix

Installing SCO Unix or Xenix with a SmartCache controller is simple and straightforward. Review the *BIOS Requirements* section below and then follow the steps listed.

5.2.1 BIOS Requirements

Disk I/O for SCO Unix or Xenix is not dependent on the system BIOS and therefore is not limited to using only the drive types listed in the BIOS drive table. The exception to this is a system in which DOS and SCO Unix or Xenix are co-resident.

5.2.2 Software Cache – I/O Buffers

When configuring a SCO Unix or Xenix system with a SmartCache controller, the software cache, or I/O buffers, should be set to use approximately 10% of the system RAM. Increasing the I/O buffers to use more system RAM or eliminating them completely will reduce system performance. (See the section entitled *Optimum Cache Size* later in this chapter.)

5.2.3 Installing SCO Xenix Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select "SCO Unix/Xenix" from the list of operating systems.

3. DPTFMT will report the "Best Configuration" parameters for the drive/operating system combination. Write these down because they will be needed later during the operating system installation.

4. DPTFMT reboots the computer. Place the Xenix N1 Boot Diskette in Drive A.

5. Xenix will warn: "During installation you may choose to overwrite all or part of the present contents of your disk" and ask if you which to continue. Answer "Yes" and Xenix will display the current CMOS drive parameters.

6. Select "Option 2 – Modify Disk Parameters" and enter the Best Configuration information from step 3 above.

7. Select the desired partitioning option.

8. Do **not** enter any defects when prompted to do so by Xenix. All defect management is handled by the controller.

9. Do **not** perform a Xenix Scan of the disk. If the "Format and Certify" option was selected during the DPTFMT low-level format, all bad blocks will have already been remapped by the controller.

10. Continue with the standard SCO Xenix installation procedure.

5.2.4 Installing SCO Xenix GT Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select "SCO Unix/Xenix" from the list of operating systems.

3. DPTFMT will report the "Best Configuration" parameters for the drive/operating system combination. Write these down because they will be needed later during the operating system installation.

4. DPTFMT reboots the computer. Place the Xenix GT N1 Boot Diskette in Drive A.

5. Xenix GT will prompt with the question "What type of disk controller will be supporting this disk" and offer three options. Since the DPT controller emulates the WD1003 ST506 controller, choose "Option 1 – ST506 (Standard Disk Support)".

6. Xenix GT will warn: "During installation you may choose to overwrite all or part of the present contents of your disk" and ask if you which to continue. Answer "Yes" and Xenix GT will display the current CMOS drive parameters.

7. Select "Option 2 – Modify Disk Parameters" and enter the Best Configuration information from step 3 above.

8. Select the desired partitioning option.

9. Do **not** enter any defects when prompted to do so by Xenix GT. All defect management is handled by the controller.

9. Do **not** perform a Xenix GT Scan of the disk. If the "Format and Certify" option was selected during the DPTFMT low-level format, all bad blocks will have already been remapped by the controller.

10. Continue with the standard Xenix GT installation procedure.

5.2.5 Installing SCO Unix Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select "SCO Unix/Xenix" from the list of operating systems.

3. DPTFMT will report the "Best Configuration" parameters for the drive/operating system combination. Write these down because they will be needed later during the operating system installation.

4. DPTFMT reboots the computer. Place the Unix N1 Boot Diskette in Drive A. At the Unix "Boot:" prompt press **Enter** and the system will proceed until prompting for the N2 File System Diskette.

5. Insert the N2 File System diskette and press **Enter**.

6. Unix will provide Disk Initialization Information and offer three options for system initialization.

7. Select "Option 1 – Fully Configurable Installation".

8. Unix will warn: "During installation you may choose to overwrite all or part of the present contents of your disk" and ask if you which to continue. Answer "Yes" and Unix will display the current CMOS drive parameters.

9. Select "Option 2 – Modify Disk Parameters" and enter the Best Configuration information from step 3 above.

10. Select the desired partitioning option.

11. Do **not** enter any defects when prompted to do so by Unix. All defect management is handled by the controller.

12. Do **not** perform a Unix Scan of the disk. If the "Format and Certify" option was selected during the DPTFMT low-level format, all bad blocks will have already been remapped by the controller.

13. Continue with the standard SCO Unix installation procedure.

5.3 DOS and SCO Unix/Xenix Co-resident

When installing DOS and SCO Unix or Xenix on the same disk drive, the maximum disk drive capacity of DOS is the limiting factor. A maximum of 528MB of Disk capacity may be used regardless of the actual physical disk capacity.

Refer to the table in the section entitled *Determining If a BE3011 Is Needed* in the *Hardware Installation* chapter of this manual, which lists the maximum drive capacity for several operating systems and specifies which operating system/drive combinations typically require a BE3011.

As a general rule, DOS and DOS-compatible operating systems require the BE3011 when using high-capacity drives.

5.3.1 Installing DOS and Unix/Xenix Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select "DOS" from the list of operating systems.

3. Boot-up under DOS.

4. Run FDISK or other partitioning software to create your partitions.

5. Format your disk with DOS.

6. Boot-up under Unix/Xenix.

7. Do not select Modify Disk Parameters. Accept the CMOS parameters and proceed to step 8.

8. Create the Unix/Xenix partition and make it active.

9. Do **not** enter any defects when prompted to do so by Unix/Xenix. All defect management is handled by the controller.

10. Do **not** perform a Unix/Xenix Scan of the disk. If the "Format and Certify" option was selected during the DPTFMT low-level format, all bad blocks will have already been remapped by the controller.

11. Continue with the standard SCO Unix/Xenix installation procedure.

5.3.2 Booting Unix/Xenix or DOS

With the SCO Unix or Xenix partition active, you have the option of booting Unix/Xenix or DOS. When the "BOOT" prompt appears during boot-up:

1. Press **Enter** to continue to boot Unix/Xenix

2. Type "DOS" and press **Enter** to boot DOS.

5.4 Novell NetWare 286 and 386

Before installing Novell NetWare 286 or 386, review the following information and determine if any additional hardware or software will be required to complete the installation. All of the information in this section refers to Novell NetWare 386 and NetWare version 2.1 and later.

5.4.1 BIOS Requirements

Novell NetWare is limited to the drive capacities supported by the system BIOS. If the disk drive being used is not supported in the standard drive types provided with the computer, a BE3011 is probably required. Refer to the table in the section *Determining If a BE3011 Is Needed* in the *Hardware Installation* chapter of this manual, which lists the maximum drive capacity for several operating systems and specifies which operating system/drive combinations typically require a BE3011.

5.4.2 Differences Between Novell 2.0 and 2.1

The only significant difference in the installation of Novell NetWare 2.0 and 2.1 is the maximum number of cylinders, heads, and sectors per track supported. Refer to the table in the section *Determining If a BE3011 Is Needed* in the *Hardware Installation* chapter of this manual for details.

The BE3011 is compatible with Novell NetWare version 2.1 or higher. It is not compatible with NetWare version 2.0. The DUB14 from Golden Bow Systems is recommended for NetWare 2.0 installation requiring a BIOS table extension.

5.4.3 Novell Software Cache

Novell software can be divided into two categories: Directory Cache and File Cache. The directory cache must be left enabled. DPT recommends that the Novell file cache be set to the minimum possible value. Since Novell 2.1 automatically allocates all available system memory for file caching, the easiest way to limit the amount used is to lower the total amount of system memory. Two megabytes is normally recommended. Some additional system memory may be required, depending on the system configuration.

5.4.4 Installing NetWare 286 Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select the version of Novell NetWare to be installed from the list of operating system options.

3. Boot-up under DOS.

4. Begin the Novell NetWare installation procedure.

5. Select "No" in response to the Novell drive formatting option.

6. Select a 0 Pass Compsurf with the I/Os set to 100 (this is only true for version 2.1). Since the controller has already performed a thorough media certification during the DPTFMT low-level format, only a zero-pass Compsurf is needed.

7. Continue with a standard Novell NetWare 286 installation.

5.4.5 Configuration and Installation of NetWare 386

Please review the section on BIOS requirements regarding Novell NetWare in the preceding section. Novell is limited to the drive capacities supported by the system BIOS and a BE3011 may be required.

NetWare 386 can reside co-resident on a disk drive with MS/PC DOS. Therefore, if a MS/PC DOS partition is desired, pay special attention to instructions regarding drives over 528mb in the section on MS/PC DOS installation in this chapter. Many NetWare installations include drives over 528mb and even if the DOS partition will be less than 528mb, the DOS portion of the drive will have to be partitioned with special software like Disk Manager from Ontrack.

5.4.6 Installing NetWare 386 Step-by-Step

1. Boot the machine with MS/PC DOS from the floppy.

2. Format and Certify the disk using DPTFMT as described in the previous chapter.

3. Select "NetWare 386 3.x" from the list of operating systems offered. DPTFMT will reboot the system.

4. Boot the machine with MS/PC DOS from the floppy.

5. If an MS/PC DOS partition is desired, create and format the DOS partition as described in the MS/PC DOS installation section in this chapter. If no DOS partition will be on the drive, insert the NetWare System Diskette 1 in Drive A: and proceed to Step 6.

6. Create a NetWare sub-directory and copy the contents of System Diskette 1 and System Diskette 2 into that sub-directory.

7. Run SERVER.EXE.

8. From the ":" prompt, type "LOAD ISADISK".

9. NetWare will prompt for the I/O address of the controller and offer $1F0_H$ by default. Press **Enter** and accept this default.

10. NetWare will prompt for the Interrupt Number of the controller and offer $0E_H$ (14) by default. Press **Enter** and accept this default.

11. From the ":" prompt, type "LOAD INSTALL".

12. Select "Disk Options".

13. Select "Partition Tables".

14. Select the drive(s) from the list that are to have a NetWare 386 partition.

15. Select "Create NetWare Partition".

16. Repeat Steps 13 and 14 as necessary for all drives that are to have a NetWare 386 partition.

17. Return to the Main Menu and select "Volume Options".

18. Create the NetWare Volumes as necessary.

19. After the desired Volumes are created, use the **Ctrl Esc** key to get to the System Console (":" prompt) and type "MOUNT ALL".

20. Load any other necessary files from the ":" prompt (BTRIEVE, Network Interface Cards, BINDing the IPX, etc.).

21. Use the **Ctrl Esc** key sequence to get to the Install Screen and proceed to System Options to copy the desired NetWare 386 files to the server.

5.5 Interactive Unix

Interactive Unix may be easily installed with the SmartCache controller. Review the *BIOS Requirements* section below and follow the installation steps.

5.5.1 BIOS Requirements

Interactive Unix can take full advantage of most disk drives available when combined with a SmartCache controller and a BE3011. A BE3011 should be installed if the disk drive being used is not directly supported by the computer's BIOS table. Interactive Unix requires that heads and sectors match the BIOS table entry being used exactly. It does not require that the cylinders match the cylinders of BIOS table entry being used and DPTFMT will automatically supply a new value if it is required to get full disk capacity.

5.5.2 Installing Interactive Unix Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select the correct version of Interactive Unix from the list provided.

3. DPTFMT will report the "Best Configuration" parameters for the drive/operating system combination. The cylinders of the Best Configuration may be different than the actual BIOS entry. The heads and sectors will match those of the BIOS entry exactly. Write down the Best Configuration parameters.

4. When DPTFMT reboots the computer, place the Unix Boot Diskette in Drive A.

5. Press **Enter** to begin the Unix installation.

6. Interactive Unix will display the disk parameters and ask if they are correct. If the disk parameters displayed are different than the Best Configuration, answer **N** and enter the Best Configuration. Otherwise enter **Y** and continue.

7. Interactive Unix will ask if the drive should be formatted. Do **not** format the drive.

8. Interactive Unix will ask what interleave factor the drive was originally formatted at and offer 0 as the default answer. Enter **0**.

9. Continue with the standard Interactive Unix installation procedure.

5.6 Pick Installation

Installing Pick with the PM2001 controller requires no special steps. Review the *BIOS Requirements* section below and follow the installation steps.

5.6.1 BIOS Requirements

If the disk drive being used is not listed in the standard BIOS table, a BE3011 will be required. Installing the SmartCache controller with a BE3011 will allow access to the disk drive's full capacity within the limits of Pick.

5.6.2 Installing Pick Step-by-Step

1. Format and Certify the disk using DPTFMT as described in the previous chapter.

2. Select the version of Pick from the list provided.

3. DPTFMT will reboot the computer

4. Place the Pick System Diskette 1 in Drive A: and proceed with the standard Pick installation procedure.

5.7 Optimum Cache Size

A common question asked is, "How much cache is required?" While there is no exact formula for determining the amount of cache required to get maximum performance, there are some guidelines to follow which should make the task easier.

5.7.1 Determining Hardware Cache Size

There are two key factors to take into account when determining what amount of cache is needed for optimum performance. First, the number of active users at a given time, and second, the size of the common data set.

The common data set is the programs and data files being accessed at one time, either by a single user or shared by more than one user. Any programs or data which are shared by more than one user should be counted only once when calculating the amount of cache needed. Through testing, DPT has generated a list of minimum cache requirements as well as suggestions for expanding cache.

If a system has a small number of users (less than eight) but the data set per user is above average (over 256K), add more cache. If a system has a large number of users who use a less than average file size, less cache is needed.

The Table below shows the number of users, terminals, network nodes, or tasks that could typically be supported under each operating system with a given hardware cache size. As an example, under OS/2 one or two simultaneous tasks would typically experience performance improvement with 512 Kbytes of cache, while under Pick up to four users could be supported. Sixteen users would typically require at least 4.5 Mbytes of cache. Adding more cache to the system will often result in even greater performance. Unlike software caches, adding more hardware cache will never decrease performance when using a SmartCache controller.

Table 5-1 Recommended Cache Size Versus Users

Operating System	512KB	4.5MB	8.5MB	12.5MB
OS/2	1-2	3-18	19-34	35-50
PCMOS	1-2	3-18	19-34	35-50
Novell 2.1	*	1-18	19-34	35-50
Pick 2.2	1-4	5-18	19-34	35-50
Interactive Unix	*	1-18	19-34	35-50
Xenix	*	1-18	19-34	35-50
Microport Unix	*	1-18	19-34	35-50
QNX	1-4	5-18	19-34	35-50
Theos	1-4	5-18	19-34	35-50
Prologue	1-2	3-18	19-34	35-50

* This cache size is not recommended for the listed OS.

5.7.2 Operating System Software Cache

Many operating systems offer a software cache as an option during installation. The question of how much software cache to enable is commonly asked. There are a number of issues to consider when allocating system RAM for I/O buffers or software cache. If too much system RAM is allocated to software cache or I/O buffers, not enough system RAM will be left open to hold the operating system code and application programs. This will cause the computer to have to swap or page the programs and OS code back and forth from the disk, and the total system performance will degrade. As a rule of thumb, in multiuser environments, it is best to limit the operating system's software cache or I/O buffers to no more than 10% of the total system RAM.

Large software caches can degrade system performance for a variety of reasons. However, completely disable some operating system's caches also degrades performance. Please see the section on your particular operating system for more information on operating system software cache.

CHAPTER VI
Troubleshooting Guide

6.1 Introduction

This Troubleshooting Guide provides answers to many commonly asked questions. If a situation occurs which is not covered in this chapter, or if the recommendations here do not correct the problem, contact DPT Technical Support at phone: (407)830-5522 or FAX: (407) 260-5366. We will be happy to assist you.

The following topics are covered:

1. Diagnostics
2. Physical Installation
3. Performance
4. DPT Format Utility (DPTFMT)
5. BIOS Table Expander (BE3011)
6. Operating Systems Compatibility

6.2 Diagnostics

Various levels of diagnostics can be performed on the SmartCache controller as explained in the sections below:

6.2.1 Power-Up Diagnostics

Whenever the SmartCache controller is power-up, a quick series of self-test diagnostics is performed. If these diagnostics are not passed, the controller will not report good status to the computer and the LEDs will flash. (See the section entitled *LED Display During Fatal Trap State* in the *Theory of Operation* chapter of this manual.)

6.2.2 Manual Self-Test

The push-button and a 10-segment LED on the controller can be used to perform more thorough diagnostics to help determine the source of a problem. The meanings of the individual LEDs are defined in the section entitled LED Display During Manual Self-Test in the Theory of Operation chapter of this manual.

6.2.3 DPTFMT Certify

Formatting and certifying a disk with DPTFMT is an extensive test of both the PM3011 SmartCache controller and the disk drive. Upon completion the SmartCache controller and the disk are fully tested and ready for operation. This operation tests the controller/drive interface only. It does not test the controller/computer interface.

6.3 Physical Installation

Question: *Do any jumpers need to be set or changed when installing the SmartCache controller?*

Answer: No. All SmartCache controllers are shipped from the factory ready to operate. Under normal circumstances, the jumpers will never need to be changed.

Question: *How do the cables connect to the SmartCache controller?*

Answer: All cables connect to the SmartCache controller with Pin 1 towards the top edge of the board. Pin 1 of most cables is marked with a red or blue stripe. Some cable connectors indicate Pin 1 with an arrow.

Question: *Do any jumpers need to be set when adding or removing the cache memory expansion boards?*

Answer: No. All SmartCache controllers automatically sense the amount of cache installed and configure themselves each time they are powered on.

Question: *I have a 32-bit computer memory board in the slot next to the controller and I want to install an MX3011 Expansion Card. What should I do?*

Answer: Move the 32-bit memory board to another 32-bit slot if possible. The MX3011 requires only an 8-bit slot, but it also will work in a 32 or 16-bit slot, or move the controller to a slot with an adjacent 8 or 16-bit slot.

Question: *Is it possible for the controller to conflict with any of the other boards in my system?*

Answer: It is possible but not likely. All DPT controllers operate at Interrupt 14, the standard for all disk controllers. DMA Channel 2 is only used for the floppy – also standard. The BE3011 is located at $C800_H$ and uses 2 Kbytes of memory. If it is enabled, make sure no other devices are operating in this address range.

Question: *Will a software or CPU cache conflict with the SmartCache controller?*

Answer: No, but some software caches can degrade the performance of the system. Refer to the section entitled *Operating System Software Cache* in the *Operating System Installation* chapter of this manual for more information about software cache.

Question: *Can more than one controller be installed in a system?*

Answer: Yes, but if the operating system does not support two controllers a special driver may have to be written.

Question: *The SmartCache PM3011/75 can control up to four disk drives. How are the third and fourth drives accessed?*

Answer: The SmartCache hardware mirroring option will mirror drives 1 and 2 as recognized by the operating system to drives 3 and 4. The operating system only "sees" two disk drives.

Presently none of the PC/AT operating systems available off-the-shelf recognize more than two disk drives per controller. DPT is working closely with several operating system companies to increase their support to four drives per controller.

Question: *When the computer is powered on, all ten segments of the controller's LED stay on continuously and the computer will not boot?*

Answer: Power-down the computer and re-seat the SmartCache controller and MX3011 Expansion Card, if one is present. Also re-seat the ribbon cable connecting the controller to the MX3011. If the problem persists, remove the MX3011 from the system. If this does not help, try placing the SmartCache controller into a different bus slot.

Question: *The floppy drive light stays on all the time, but the floppy drive operates normally?*

Answer: Most floppy drives have a jumper labeled IU (in use). Remove the IU jumper and the light will operate correctly.

6.4 Performance

Question: *What is the best way to confirm the SmartCache controller is performing at it's expected level?*

Answer: Create a batch file which performs disk intensive operations. A batch file that copies a large sub-directory (80-90% of cache size) to a different directory, several times, is a good test.

If a multitasking operating system is used, it is an even better test to run multiple copies of this batch file concurrently. Run the tests with and without the SmartCache controller installed, and with different amount of cache installed.

Question: *The system does not seem to operate any faster with the SmartCache controller installed. Why?*

Answer: The application may not be disk intensive. Install a standard controller and observe the disk activity light while the program is running. If the light is off most of the time the program is not disk intensive. If the light is on the majority of the time, it is disk intensive. Now install the smart cache controller and run the program again, adding more cache until you achieve optimum performance.

Another possibility is that the computer being used is CPU bound. Slower processors spent very little time waiting for the disk. Therefore increasing disk I/O performance may only produce a minimal gain in overall system performance.

Question: *My operating system uses it's own cache. How much system RAM should be allocated to software caching when the SmartCache controller is installed?*

Answer: Large software caches can degrade system performance for a variety of reasons. However, completely disabling some operating system's caches also degrade performance. To determining the best configuration, test the system with and without the software cache enabled, and with different amounts of software cache.

Refer to the section entitled *Operating System Software Cache* in the *Operating System Installation* chapter of this manual for more information about software cache. Also see the sections on Buffers and/or Software Cache in the individual OS installation sections of that chapter.

Question: *I have a fast 386 or 486 PC with software caching. Why don't I just add more RAM and let the system CPU handle all the caching?*

Answer: The system CPU, no matter how fast, can only do one thing at a time. Adding the SmartCache controller, with it's on-board 68000 processor, enables the system to do more than one thing at a time. SmartCache utilizes the time that the system CPU is busy executing user programs to simultaneously perform caching activities with its own CPU over a separate high-speed cache I/O bus. For overall system performance, SmartCache provides the best solution.

6.5 DPT Format Utility (DPTFMT)

6.5.1 Error Messages

Message: **No drive type small enough.**

Solution: Escape out of DPTFMT. Run the setup program that came with the computer and set the disk type to 1. Run DPTFMT and select the "Calculate Drive Parameters" option.

Message: **DPT Controller not found.**

Solution: The SmartCache controller may need to be reseated. Power-down the computer, remove the controller, and re-seat it. If the problem still occurs, try placing the controller in another bus slot.

Message: **Drive not connected correctly.**

Solution: This indicates an error in drive setup or cabling. Refer to the sections entitled *Cabling, Drive-Select Numbering,* and *Drive Termination* in the *Hardware Installation* chapter of this manual.

Insure that the SmartCache controller is the only hard disk controller enabled in the system.

Make sure the drive spins-up when power is applied. If it does not, the drive's jumpers may not be set correctly. Some ESDI drives can optionally be set to spin-up automatically when power is applied.

Message: **Sense Key 03H x Error 0AH – RECORD NOT FOUND.**

Solution: Check drive cable connections. Replace cables. Try another disk drive.

Message: **Sense Key 04H x Error 20H – CONTROLLER FAULT.**

Solution: A controller hardware fault is being reported. Remove the controller and make sure all socketed components are firmly in place. Contact DPT technical support.

Message: **Sense Key 05H x Error 33H – INVALID PARAMETER.**

Solution: A bad drive cable can cause this error. Check cable connections and configuration. Check all drive switch settings. The drive must be setup for 512-byte sectors.

Message: **Sense Key 05H x Error 50H – DEFECT MAP OVERFLOW.**

Solution: The disk has too many defects. DPTFMT will allow 0.25% of the disk drive to be defective. This is twice the required percentage for a worst case drive. Check all connections. Change drive cables. Try another disk drive.

Message: **Sense Key 05H x Error 54H – RESERVE BLOCK ERROR.**

Solution: A defect has occurred in an area of the disk where it is not permitted according to the ESDI drive specifications. (Cylinder 0, Head 0), Try another disk drive.

Message: **Sense Key 05H x Error 55H – NONE ASCENDING BLOCK.**

Solution: This error will occur, when the user enters defects manually and one of the defects is entered out of order and rejected by the controller. Try re-entering the defect list and re-formatting the drive. If the error is reported again, select the "Format and Certify" option in the DPTFMT utility without entering any defects. View the defect map when the format is complete to make sure all the listed defects have been mapped out.

6.5.2 Questions About DPTFMT

Question: *When the operating system is selected, DPTFMT picks a drive type with less capacity than the actual drive. Why?*

Answer: Review the section entitled Using High Capacity Disk Drives in the Hardware Installation chapter of this manual.

Another possibility if you have an ESDI drive is that the sectors per track switch setting may not be correctly. It should be set to a value equal to or greater than the sectors per track of the drive type displayed by DPTFMT.

Question: *When the operating system is selected, DPTFMT selects a drive from the system BIOS that is smaller than the drive I have installed and ignores a larger type which would be a better match. Why?*

Answer: Some PCs have an extended drive table in addition to the standard 47 drive entries. Unfortunately, there is no standard location for these extended disk drives in the system BIOS, so all computer manufacturers store them in a different place. Therefore DPTFMT cannot use them because it does not know where to find them. Installing a BE3011 will solve the problem.

Question: *DPTFMT takes a lot longer to format the disk than it estimated. Why?*

Answer: The time to complete the operation should be within 10% of the time estimated by DPTFMT. If it is greater than 10%, the drive may be defective or have a large number of defects. Check all connections and try again, or try another disk drive.

6.6 BIOS Table Expander (BE3011)

Question: *After Installing the BE3011 ROM, the message "Byte version change, call customer support" appears when the computer boots up. What should I do?*

Answer: Refer to Step 3 of the section entitled *BE3011 Chip Installation* in the *Hardware Installation* chapter of this manual.

Question: *The Drive type provided by the BE3011 and selected by DPTFMT matches the capacity of the disk installed, but it does not match the drives configuration. Is this okay?*

Answer: Yes, DPTFMT selects drive types based on capacity, not drive configuration. It is a more flexible approach which allows the BE3011 to be used with a much broader range of disk drives.

6.7 Operating System Compatibility

Question: *If the operating system being installed is not listed in the manual, will the SmartCache controller work?*

Answer: Yes. The SmartCache controller works with all PC operating systems designed to operate with the WD1003, the standard PC/AT disk controller.

Question: *What partitioning software can be used with the SmartCache controller?*

Answer: DPT has tested and approved Disk Manager from Ontrack, and VFeature Deluxe from Golden Bow Systems.

Question: *Is it possible to access more than 528 megabytes with DOS or DOS compatible operating systems?*

Answer: Yes, up to 1 gigabyte can be accessed using a BE3011 BIOS Table Expander from DPT and partitioning software such as Disk Manager 4.0 from Ontrack. Refer to the section entitled *Accessing Over 528MB with DOS* in the *Operating System Installation* chapter of this manual.

Question: *After installing PC/MS DOS the system will not boot off the hard disk. Why?*

Answer: Run FDISK to make sure the partition is marked active. If the Partition is active and the system still will not boot, delete the partition, recreate it, and reformat it.

APPENDIX A
Specifications

DC POWER REQUIREMENTS	PM3011E /55 /65 /75
Voltage:	5V ± 5%
Current:	2.8A typ
	3.4A max
Ripple and Noise:	50mv peak to peak max

DC POWER REQUIREMENTS	MX3011/4	MM3011/4
Voltage:	5V ± 5%	5V ± 5%
Current:	1.0A typ	0.2A typ
	1.2A max	0.25A max
Ripple and Noise:	50mv peak to peak max	

ENVIRONMENTAL SPECIFICATIONS

Ambient Temp (operating):	0 to 50 degrees Centigrade
Relative Humidity (operating):	10% to 90% (non-condensing)
Altitude (operating):	10,000 feet (3,000 meters)

APPENDIX B
Cable Specifications

PM3011 /55 /65 CABLE SPECIFICATIONS

ST506 Hard Drive Control Cable Type	34 conductor flat
ST506 Hard Drive Control Cable Length	10 feet (3 m) max
ST506 Hard Drive Data Cable Type	20 conductor flat
ST506 Hard Drive Data Cable Length	10 feet (3 m) max
Floppy Drive Cable Type	34 conductor flat
Floppy Drive Cable Length	10 feet (3 m) max
MX3011 Expansion Card Cable Type	60 conductor flat
MX3011 Expansion Card Cable Length	2 inches (5 cm) max

PM3011 /75 CABLE SPECIFICATIONS

ESDI Hard Drive Control Cable Type	34 conductor flat
ESDI Hard Drive Control Cable Length	10 feet (3 m) max
ESDI Hard Drive Data Cable Type	20 conductor flat
ESDI Hard Drive Data Cable Length	10 feet (3 m) max
Floppy Drive Cable Type	34 conductor flat
Floppy Drive Cable Length	10 feet (3 m) max
MX3011 Expansion Card Cable Type	60 conductor flat
MX3011 Expansion Card Cable Length	2 inches (5 cm) max

APPENDIX C
Jumper Settings

The following jumper settings should be checked before the PM3011/75 ESDI controller is installed:

Y7 OFF BE3011 ROM Disabled (default)
ON BE3011 ROM Enabled

Y18 OFF BE3011 ROM address $C8000_H$ (default)
ON BE3011 ROM address $D8000_H$

Y17 OFF Hard Disk I/O address $1F0\text{-}1F7_H$ (default)
ON Hard Disk I/O address $170\text{-}177_H$

Y5 OFF Floppy Disk I/O address $3F0\text{-}3F7_H$ (default)
ON Floppy Disk I/O address $370\text{-}377_H$

Y8	Y9	Y10	Hard Disk Interrupt Level
ON	OFF	OFF	IRQ 14 (default)
OFF	OFF	ON	IRQ 12
OFF	ON	OFF	IRQ 7

The following jumper settings should be checked before the PM3011/55 ST506 controller or PM3011/65 RLL controller is installed:

Y7 OFF BE3011 ROM Disabled (default)
ON BE3011 ROM Enabled

Y19 OFF BE3011 ROM address $C8000_H$ (default)
ON BE3011 ROM address $D8000_H$

Y18 OFF Hard Disk I/O address $1F0\text{-}1F7_H$ (default)
ON Hard Disk I/O address $170\text{-}177_H$

Y5 OFF Floppy Disk I/O address $3F0\text{-}3F7_H$ (default)
ON Floppy Disk I/O address $370\text{-}377_H$

Y9	Y10	Y11	Hard Disk Interrupt Level
ON	OFF	OFF	IRQ 14 (default)
OFF	OFF	ON	IRQ 12
OFF	ON	OFF	IRQ 7

The following jumpers are used to configure the SCSI adapter on SmartCache model PM3011/759. This controller is available by special order only. These jumpers are not used on SmartCache model PM3011/75.

Y6	Y19	SCSI I/O ADDRESS
ON	OFF	$CB000_H$ (default)
ON	ON	$DB000_H$
OFF	OFF	Disabled

Y11	Y12	SCSI INTERRUPT LEVEL
OFF	OFF	Disabled (default)
ON	OFF	IRQ 12
OFF	ON	IRQ 7

Y13	Y14	Y15	Y16	SCSI INTERRUPT LEVEL
OFF	OFF	OFF	OFF	Disabled (default)
ON	OFF	ON	OFF	Enables AT DMA channel 1
OFF	ON	OFF	ON	Enables AT DMA channel 3

APPENDIX D
Connectors

CONNECTORS ON PM3011 /55 /65 CONTROLLERS

J4	-	Hard disk drive 1 data cable
J3	-	Hard disk drive 2 data cable
J5	-	Hard disk drive control cable
J8	-	Flexible disk drive control cable
J6	-	Disk activity LED cable
J9	-	60 conductor cable for the MX3011 Expansion Card
J7, J12	-	Plugs into one optional Memory Module:
		MM3011/2 - 2 Mbyte Memory Module
		MM3011/4 - 4 Mbyte Memory Module

CONNECTORS ON PM3011 /75 CONTROLLERS

J4	-	Hard disk drive 1 data cable
J3	-	Hard disk drive 2 data cable
J2	-	Hard disk drive 3 data cable
J1	-	Hard disk drive 4 data cable
J5	-	Hard disk drive control cable
J8	-	Flexible disk drive control cable
J6	-	Disk activity LED cable
J9	-	60 conductor cable for the MX3011 Expansion Card
J7, J12	-	Plugs into one optional Memory Module:
		MM3011/2 - 2 Mbyte Memory Module
		MM3011/4 - 4 Mbyte Memory Module

CONNECTORS ON PM3011 /759 CONTROLLERS

J4 - Hard disk drive 1 data cable
J3 - Hard disk drive 2 data cable
J2 - Hard disk drive 3 data cable
J1 - Hard disk drive 4 data cable
J5 - Hard disk drive control cable
J8 - Flexible disk drive control cable
J6 - Disk activity LED cable
J10 - SCSI peripheral cable (internal)
J11 - SCSI peripheral cable (external)
J9 - 60 conductor cable for the MX3011 Expansion Card
J7, J12 - Plugs into one optional Memory Module:
MM3011/2 - 2 Mbyte Memory Module
MM3011/4 - 4 Mbyte Memory Module

CONNECTORS ON MX3011/4 EXPANSION CARD

J1 - 60 conductor cable from PM3011 SmartCache controller
J2, J3, J4, J5 - Plugs into one or two optional Memory Modules:
MM3011/2 - 2 Mbyte Memory Module
MM3011/4 - 4 Mbyte Memory Module

APPENDIX E
Errata

1. When configured with only one hard drive, the IBM 8MHz PC/AT and systems which use an old version AMI BIOS will display a warning message: SYSTEM OPTIONS NOT SET – HIT <F1> TO CONTINUE, during boot-up. At this point it is not necessary to change the system options. Hitting <F1> will allow the system to continue booting normally. Also, internal AMI diagnostics will not operate correctly with only one drive installed in the system. These problems have been corrected in version 102386 of the AMI 386 BIOS.

2. The Read/Write-long commands on the PM3011 will not function correctly. These commands are only used to test the controller's ability to read and write ECC bytes on the hard disk and does NOT actually affect the controller's ability to detect ECC errors or correct data with the ECC algorithm.

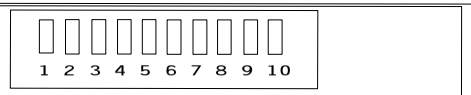
3. THEOS version 2.2 a multi-user operating system, will hang during writes to the hard disk on fast 286 and 386 PC/Ats. A package is available from the manufacturers of THEOS that corrects this problem.

4. The TI Business Pro will not operate with the PM3011 controller if the DPTFMT format utility has been run. This precludes the PM3011/75 from being used in the TI Business Pro.

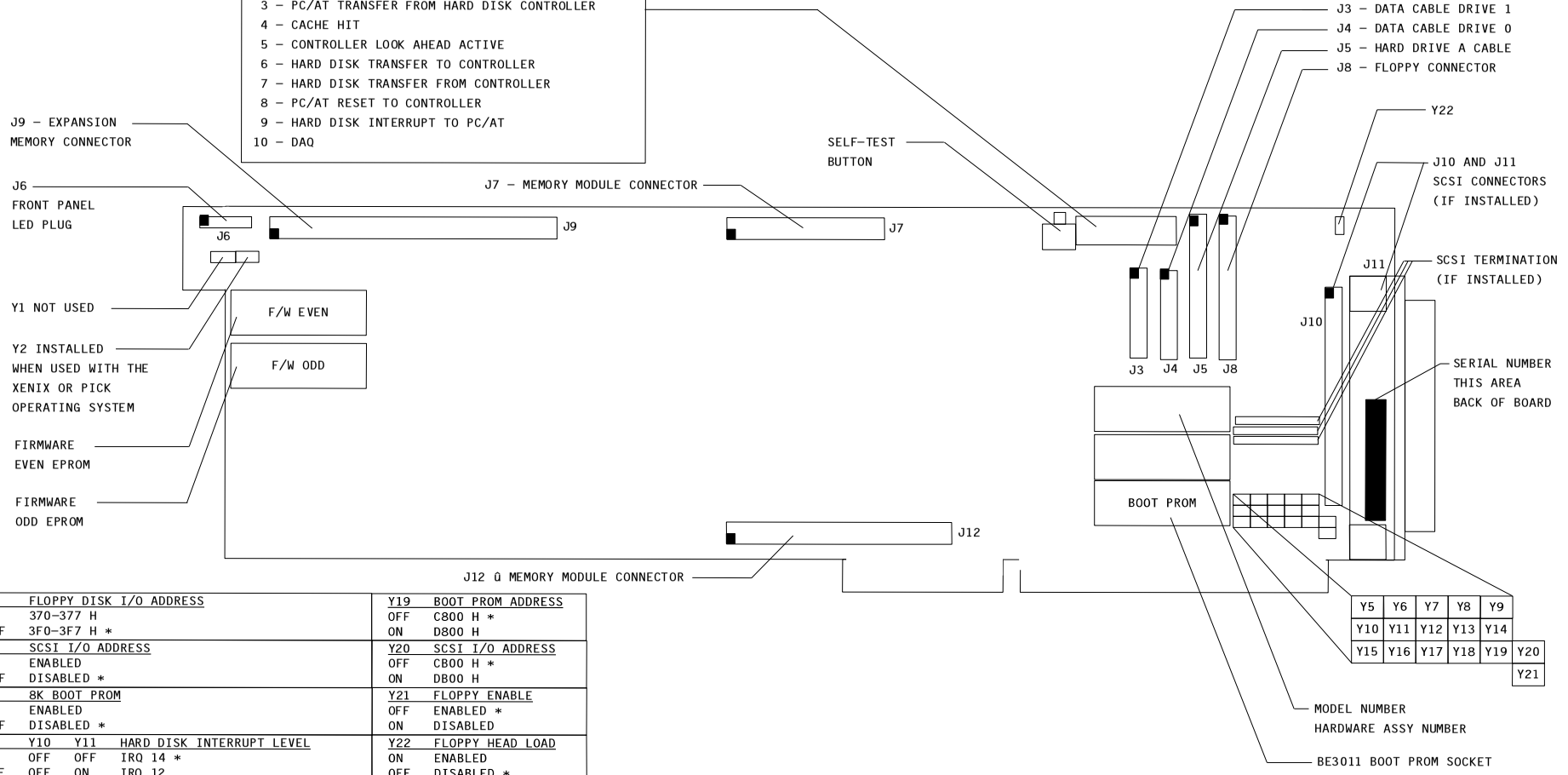
NOTE: For more information concerning PM3011 errata and scheduled fix dates, contact Distributed Processing Technology customer support at (407) 830-5522.

APPENDIX F

(PM3011E/55/65)



1 – DISK CONTROLLER BUSY
2 – PC/AT TRANSFER TO HARD DISK CONTROLLER
3 – PC/AT TRANSFER FROM HARD DISK CONTROLLER
4 – CACHE HIT
5 – CONTROLLER LOOK AHEAD ACTIVE
6 – HARD DISK TRANSFER TO CONTROLLER
7 – HARD DISK TRANSFER FROM CONTROLLER
8 – PC/AT RESET TO CONTROLLER
9 – HARD DISK INTERRUPT TO PC/AT
10 – DAQ



Y5	FLOPPY DISK I/O ADDRESS
ON	370–377 H
OFF	3F0–3F7 H *

Y6	SCSI I/O ADDRESS
ON	ENABLED
OFF	DISABLED *

Y7	8K BOOT PROM
ON	ENABLED
OFF	DISABLED *

Y9	Y10	Y11	HARD DISK INTERRUPT LEVEL
ON	OFF	OFF	IRQ 14 *
OFF	OFF	ON	IRQ 12
OFF	ON	OFF	IRQ 7

Y12	Y13	SCSI INTERRUPT LEVEL
OFF	OFF	NO IRQ *
ON	OFF	IRQ 12
OFF	ON	IRQ 7

Y14	Y15	Y16	Y17	SCSI DMA CHANNEL
OFF	OFF	OFF	OFF	NO DMA *
ON	OFF	ON	OFF	ENABLES AT DMA CHANNEL 1
OFF	ON	OFF	$ON	ENABLES AT DMA CHANNEL 3

Y16	HARD DISK I/O ADDRESS
ON	170–177 H
OFF	1F0–1F7 H *

Y19	BOOT PROM ADDRESS
OFF	C800 H *
ON	D800 H

Y20	SCSI I/O ADDRESS
OFF	CB00 H *
ON	DB00 H

Y21	FLOPPY ENABLE
OFF	ENABLED *
ON	DISABLED

Y22	FLOPPY HEAD LOAD
ON	ENABLED
OFF	DISABLED *

LEGEND
* FACTORY SETTING
■ DENOTES PIN 1

DPT
DISTRIBUTED PROCESSING TECHNOLOGY
132 CANDACE DRIVE
MAITLAND FLORIDA 32751

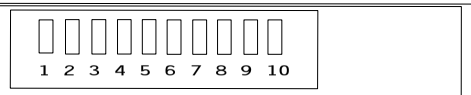
TITLE: MFM CACHING DISK CONTROLLER
PC BOARD INFORMATION

SIZE	DRAWING NUMBER	REVISION
A	DO–803–00–4	A

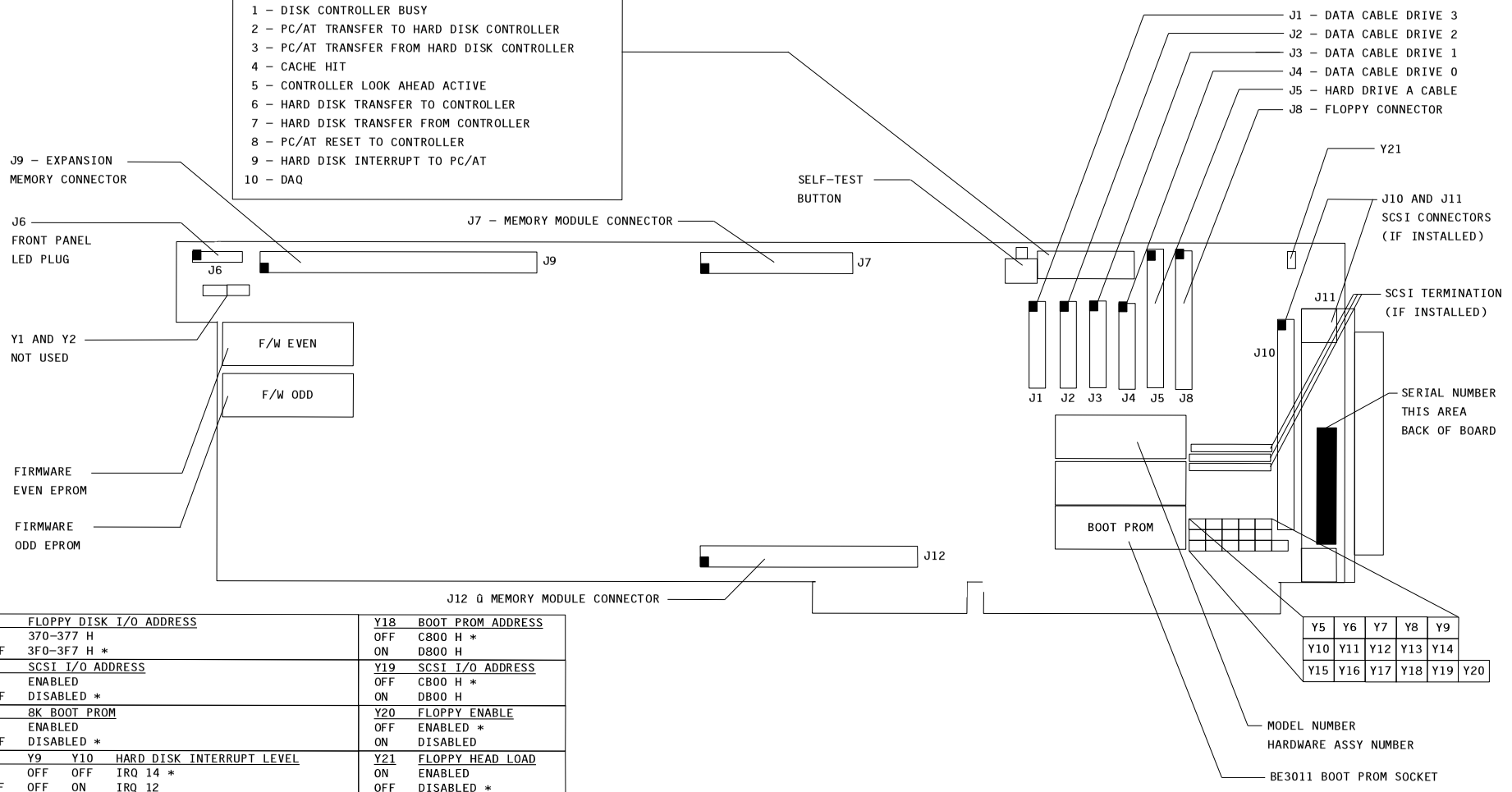
DATE	SHEET
8–11–89	F –1

APPENDIX F

(PM3011E/75)



1 – DISK CONTROLLER BUSY
2 – PC/AT TRANSFER TO HARD DISK CONTROLLER
3 – PC/AT TRANSFER FROM HARD DISK CONTROLLER
4 – CACHE HIT
5 – CONTROLLER LOOK AHEAD ACTIVE
6 – HARD DISK TRANSFER TO CONTROLLER
7 – HARD DISK TRANSFER FROM CONTROLLER
8 – PC/AT RESET TO CONTROLLER
9 – HARD DISK INTERRUPT TO PC/AT
10 – DAQ



Y5	FLOPPY DISK I/O ADDRESS
ON	370–377 H
OFF	3F0–3F7 H *

Y6	SCSI I/O ADDRESS
ON	ENABLED
OFF	DISABLED *

Y7	8K BOOT PROM
ON	ENABLED
OFF	DISABLED *

Y8	Y9	Y10	HARD DISK INTERRUPT LEVEL
ON	OFF	OFF	IRQ 14 *
OFF	OFF	ON	IRQ 12
OFF	ON	OFF	IRQ 7

Y11	Y12	SCSI INTERRUPT LEVEL
OFF	OFF	NO IRQ *
ON	OFF	IRQ 12
OFF	ON	IRQ 7

Y13	Y14	Y15	Y16	SCSI DMA CHANNEL
OFF	OFF	OFF	OFF	NO DMA *
ON	OFF	ON	OFF	ENABLES AT DMA CHANNEL 1
OFF	ON	OFF	$ON	ENABLES AT DMA CHANNEL 3

Y17	HARD DISK I/O ADDRESS
ON	170–177 H
OFF	1F0–1F7 H *

Y18	BOOT PROM ADDRESS
OFF	C800 H *
ON	D800 H

Y19	SCSI I/O ADDRESS
OFF	CB00 H *
ON	DB00 H

Y20	FLOPPY ENABLE
OFF	ENABLED *
ON	DISABLED

Y21	FLOPPY HEAD LOAD
ON	ENABLED
OFF	DISABLED *

LEGEND
* FACTORY SETTING
■ DENOTES PIN 1

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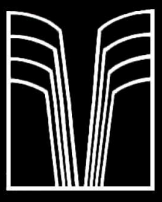
132 CANDACE DRIVE
MAITLAND FLORIDA 32751

TITLE	ESDI CACHING DISK CONTROLLER PC BOARD INFORMATION	
SIZE A	DRAWING NUMBER DO–803–00–4	REVISION A
DATE 7–11–89	SHEET F –2	



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