Conner Filepro Performance Series
CFP1060E/CFP1060S/CFP1060W

Intelligent Disk Drive
Product Manual

Revision A

May 1994

CONNER®
The Storage Answer

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FCC Notice

This equipment generates and uses radio frequency energy and, if not installed and used properly; that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, you should consult the dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet prepared by the Federal Communications Commission helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet (Stock No. 004-000-00345-4) is available from the U.S. Government Printing Office, Washington, DC 20402.

Warning: Changes or modifications made to this equipment which have not been expressly approved by Conner Peripherals, Inc. may cause radio and television interference problems that could void the user's authority to operate the equipment.

Further, this equipment complies with the limits for a Class B digital apparatus in accordance with Canadian Radio Interference Regulations.

Cet appareil numérique de la classe B est conforme au Règlement sur le brouillage radioélectrique, C.R.C., ch. 1374.

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Important Information About This Manual

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Overview of the Drives 1

What are the Drives?

The CFP1060 series are high performance 3.5-inch low-profile (1.0 inch high) 1.06 Gigabyte (formatted) disk drives. They all offer 9.0 millisecond average seek time for Reading , 9.5 millisecond seek time for Writing, with an average latency of only 5.55 ms. High capacity is achieved by utilizing a zone density recording technique using 9 recording zones at an areal density of 205 Mbits per square inch. These drives feature high performance while maintaining low power consumption to reduce power supply current and system cooling requirements in disk arrays.

They are designed to operate on the Small Computer System Interface (SCSI) and are SCSI-2/3 command compatible. The mechanical and major electronic components are identical between the models and differ only in the host interface implementation:

Drive Model	*Form Factor*	*Interface*	*Capacity*
CFP1060E	1 inch high, 3.5 inch	80-pin Single Connector FAST WIDE	1062.3MB
CFP1060S	1 inch high, 3.5 inch	50-pin FAST	1062.3MB
CFP1060W	1 inch high, 3.5 inch	68-pin FAST WIDE	1062.3MB

For simplicity, we often refer to these drives collectively in this manual as “the drive.”

Differences Between the Models

The three drive models differ only on the host interface implementation:

CFP1060E: SCSI 80-pin Wide Single Connector Attachment (SCA) interface designed for applications such as Redundant Arrays in which the drives are plugged directly into a backplane. The drive also implements a Wide SCSI interface for high interface bandwidth.

CFP1060S: SCSI 50-pin standard interface designed for applications which implement the standard SCSI-2 architecture.

CFP1060W: SCSI 68-pin Wide interface designed for applications which require high interface bandwidth and the option of cabled interconnect. The drive utilizes the Unitized Connector defined by the Small Form Factor Committee (refer to SFF-8009). The Unitized Connector combines the SCSI-3 P-connector Wide interface, the standard 4-pin power and a 2mm pin pitch Auxiliary connector into a single molded assembly.

Features of the Drive

The drive provide the following features:

- Automatic Spindle Synchronization
- 512 KB segmentable cache buffer with adaptive cache management
- LRU Cache replacement
- 88 bit Reed-Solomon EDAC with on the fly error correction
- High performance rotary voice coil actuator with embedded servo system
- No thermal recalibration required to maintain performance levels
- High Shock resistance
- Automatic actuator latch against the inner stop upon power down with dedicated landing zone
- Active Termination with removable Resistor Packs
- Active Negation output drivers for greater interface reliability
- SCSI-2/3 Compatibility
- Dual Microprocessor-controlled diagnostic routines that automatically execute at start-up
- Sealed HDA
- Automatic error correction
- Down-loadable Code through SCSI Interface
- 1,7 run length limited code
- Programmable Block Size (512-520 in 1 byte increments, 1024-1040 in 2 byte increments)
- Tagged Command Queuing with Seek Re-ordering and Write/Read Coalescing

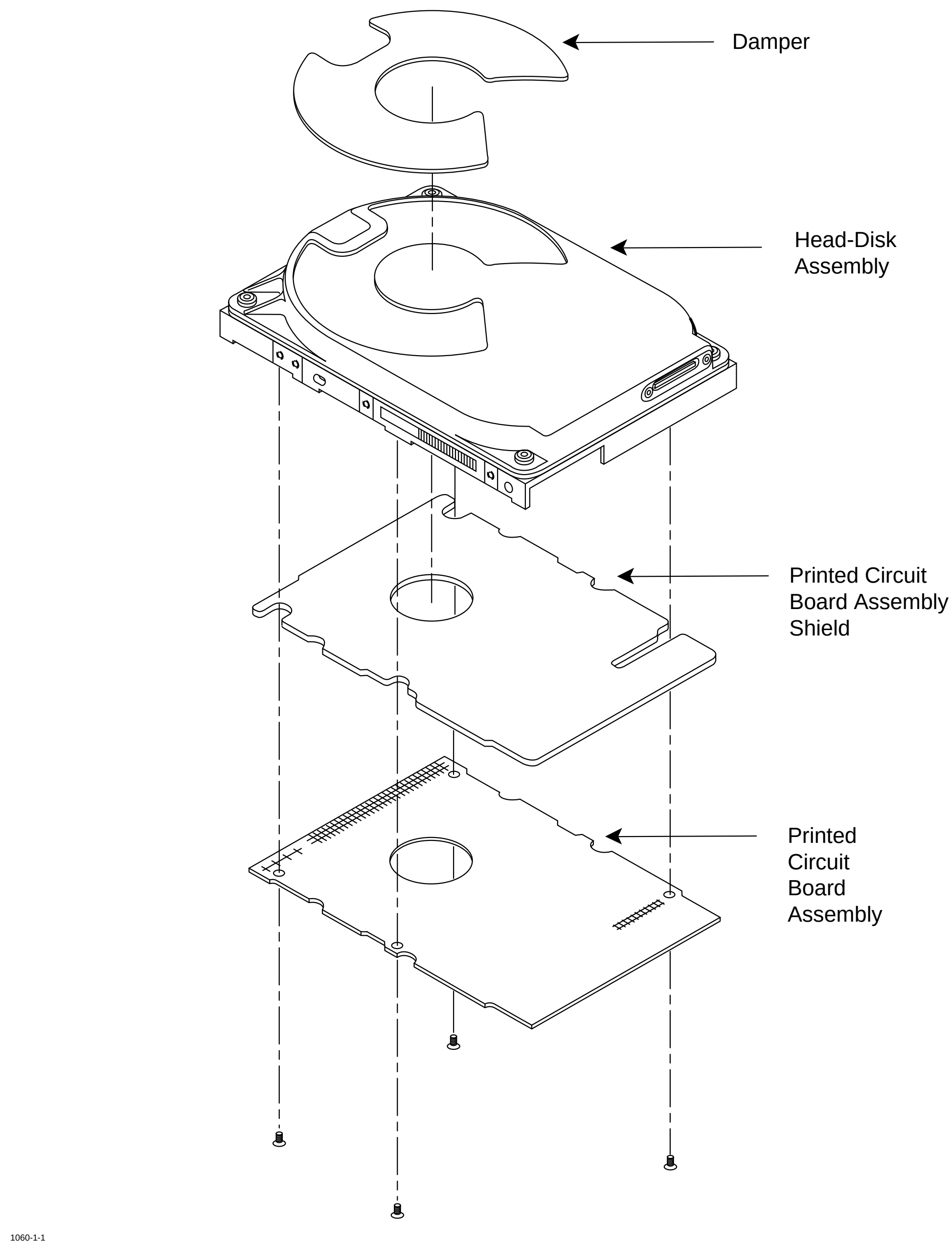
What the Drive is Composed Of

The drive is composed of **mechanical**, **electrical**, and **firmware** elements.

Mechanical Design Features

The drive's hardware includes the components described in the following sections. Figure 1-1 shows the drive top level assembly.

Figure 1-1
Drive Top Level Assembly

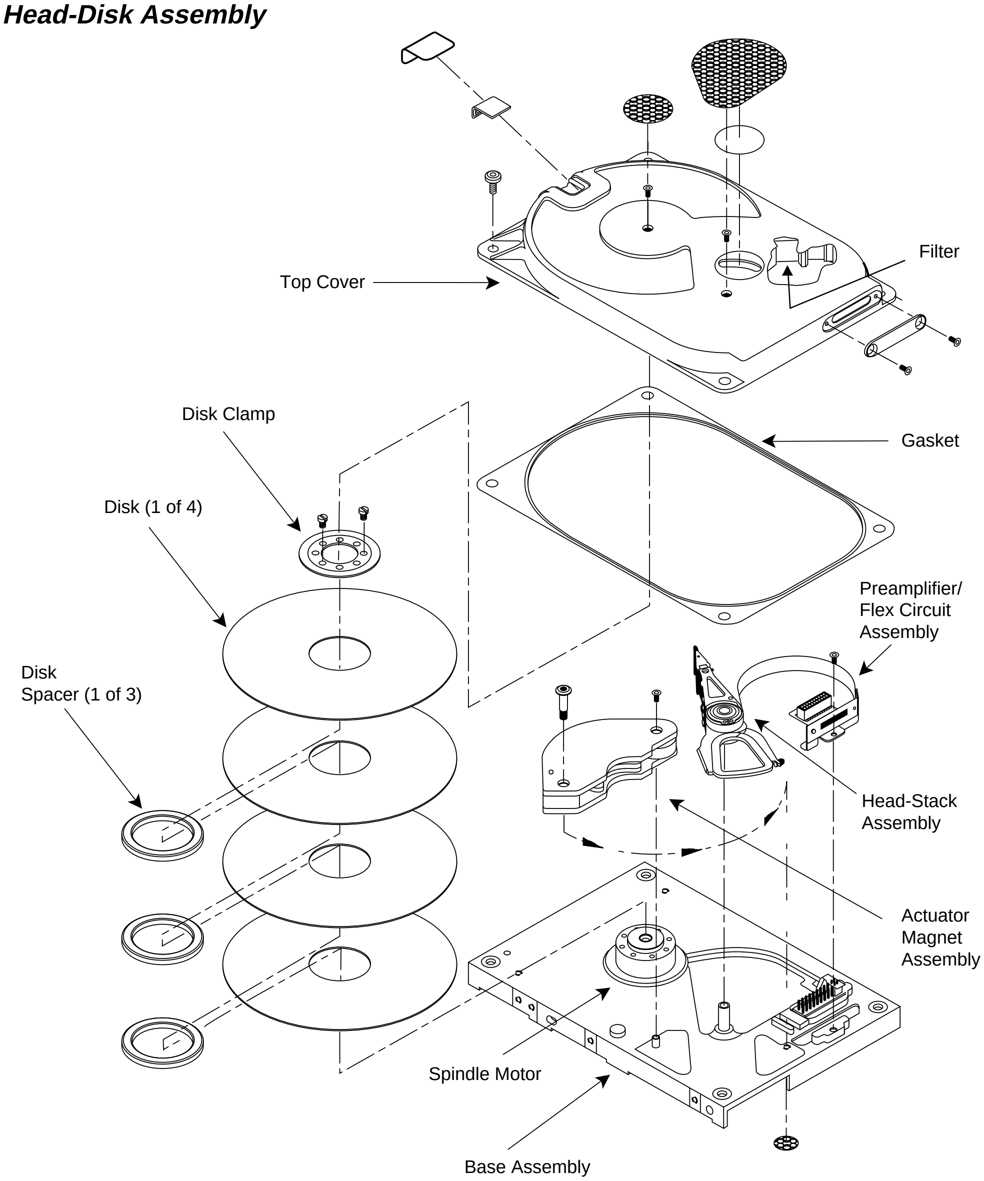


Drive Assembly Housing

The drive assembly housing, or Head-Disk Assembly (HDA) consists of a die-cast aluminum base on which is mounted a die-cast aluminum cover. Both the base and the cover are coated with a special material designed to seal out contaminants which might degrade head and media reliability. A gasket seals the joint between the base and cover to retard the entry of moisture and environmental contaminants from the assembly.

This assembly, the head-disk assembly, contains an integral 0.3 micron filter, which maintains a clean environment. Critical drive components are contained within this contaminant-free environment. Figure 1-2 shows the HDA and the major assemblies contained within it:

Figure 1-2
Head-Disk Assembly



Drive Motor and Spindle

A brushless DC direct-drive motor assembly is mounted on the drive's base. The motor rotates the drive's spindle at 5400 RPM. The motor/spindle assembly is dynamically balanced to provide minimal mechanical runout to the disks. A dynamic brake is used to provide a fast stop to the spindle motor and return the heads to the landing zone when power is removed.

Head Positioning Mechanism

The read/write heads are supported by a mechanism coupled to a rotary voice coil actuator.

Read/Write Heads and Disks

Data is recorded on 95mm diameter disks through 3370-type 50% nano-slider thin film heads with transverse pressure contour (TPC) air bearing surfaces. The TPC air bearing surface allows the head to fly at a uniform height regardless of radial position. This improves data reliability and allows the aerial density to be more uniform with radius. The drive contains four sputtered thin film disks with eight data surfaces and eight read/write heads.

At power-down, the heads are automatically retracted to the inner diameter of the disk and are latched and parked on a landing zone that is inside the data tracks.

Data and Power Connections

Data and power connections to the drive are differ between the drive models. Refer to chapter 4 for information regarding a specific model's requirements.

Electrical Design Features

Integrated Circuit

A single integrated circuit (IC) is mounted within the sealed hard drive assembly in close proximity to the read/write heads. The IC provides head selection, read pre-amplification, and write drive circuitry.

Circuit Board

The drive's dual-microprocessor-controlled circuit board provides the remaining electronic functions, which include:

- read/write circuitry
- rotary actuator control
- interface control
- spin speed control
- auto-park
- power management

The background processor is a 16-bit Motorola 68HC16. The entire data path between the serializer-deserializer and the interface chip, including the buffer (cache) is 16 bits wide to provide high data throughput. The "Catalina" SCSI interface chip manages a 16-bit to 8-bit conversion prior to transacting data over the SCSI bus for 8-bit narrow SCSI applications.

The data buffer (cache) utilizes a 256K x 16 Dynamic RAM. Data path integrity is ensured by using a 4-byte CRC which is appended to the data upon receipt by the Catalina. This CRC is verified by the "Indy" buffer manager when the data is taken out of the buffer to be written to the disk and the CRC is written with the data. A typical sector data field consists of 512 bytes of data, 4 bytes of CRC and 11 bytes of Error Detection And Correction (EDAC) code. The same CRC checks are performed during an outbound process and the CRC is stripped from the data prior to sending it to the Host.

The SCSI interface functions are managed by a 8-bit Motorola 68HC11 microprocessor. Low SCSI transaction overhead is maintained by automating common SCSI bus phase sequencing using a state machine in the Catalina chip.

Read/Write Channel

The Read/Write channel, in addition to the preamplifier discussed earlier, consists of three integrated circuits:

- Pulse Detector
- Data Separator
- Time base

Firmware

The drive's firmware can be considered in two parts. The first part principally resides in the ROM for the 68HC16 background processor. This processor is responsible for:

- starting the spindle motor and maintaining precise rotational speed
- controlling track following and actuator motion during seeking
- managing background R/W activity
- power management
- monitoring the overall health of the drive.

The interface processor's control microcode resides in both ROM and RAM. The RAM portion of the microcode can be upgraded in the field with using software. Additional information regarding the RAM code can be found in Chapter 3, page 23. The interface processor firmware functions include:

- reporting drive status and error conditions to the host
- manage operating parameters for the drive
- parsing the Command Descriptor Block and checking for illegal fields
- converting the LBA to CHS and initiating read and write operations to the background processor
- defect management
- serial port communications

Since parsing/decoding of commands and execution of the Read/Write functions are handled by separate processors, command execution can be overlapped in multiple initiator or Tagged Command Queuing environments. Functions such as seek re-ordering and command coalescing can also be overlapped when the drive is operating with a host environment capable of supporting Tagged Command Queuing.

For more information on the drive's interface implementation and command set, refer to the Ninth Generation SCSI Interface Manual.

Specifications 2

Specifications in this Chapter

This chapter provides the following specifications for the drive:

- drive capacity
- physical configuration
- performance characteristics
- read/write characteristics
- reliability
- power requirements
- environmental tolerances
- safety standards
- physical characteristics

Drive Capacity

Formatted Capacity*

- CFP1060E: 1,060.33MB
- CFP1060S: 1,060.33MB
- CFP1060W: 1,060.33MB

*1MB is equal to 10^6 or 1,000,000 bytes

Physical Configuration

Specification:	*CPF1060E CFP1060S CFP1060W:*
Disk Type	Sputtered Thin film
Head Type	Thin Film - TPC
Actuator Type	Rotary Voice-Coil
Number of Disks	4
Data Surfaces	8
Data Heads	8
Servo	Embedded
Tracks per Surface	2756
Track Density @ 0°Skew	3150 TPI
Bytes per Block	512-520, 1024-1040
Blocks per Drive (physical)	2,074,880

Physical Configuration per Zone

	Data Rate (Mbits/sec)	*Data Tracks per Zone per Surface*	*User Sectors per Track **
Zone 0 (OD)	55.072	884	111
Zone 1	51.304	316	103
Zone 2	48.889	214	99
Zone 3	47.246	147	95
Zone 4	44.242	250	89
Zone 5	41.818	206	84
Zone 6	37.460	361	79
Zone 7	34.242	275	69
Zone 8 (ID)	31.111	103	63

* The physical track configuration contains one spare sector per track.

Performance Characteristics

Seek Times (typical)*

- Track to Track: 2.0 msec
- Average (read/write): 9.0/9.5 msec**
- Full Track: 16 msec

* The timing is measured from the time the last byte of the command descriptor block is written to the time seek is initiated by the drive operating at nominal DC input voltage and nominal operating temperature.

** The average seek time is determined by averaging the seek time for a minimum of 1000 seeks of random length over the surface of the disk.

Average Latency

- 5.55 milliseconds

Rotation Speed (+0.1%)

- 5400 RPM

Controller Overhead

- 20 µsec

Start Time(Power Up)*

- 0 RPM to Ready
  - Typical: 12 seconds
  - Maximum: 20 seconds

* These numbers assume spin recovery is not invoked. If spin recovery is invoked, the maximum could be 40 seconds. Briefly removing power can lead to spin recovery being invoked.

Stop Time at Power Down

- Typical: 7 seconds
- Maximum: 10 seconds

Interleave

- 1:1

Read/Write Characteristics

Recording Method

- 1,7 RLL code

Recording Density (maximum)

- 65,131 bits per inch

Flux Density (maximum)

- 48,848 flux reversals per inch

Host Interface Characteristics

Command Set

- SCSI-2 (refer to the Ninth Generation SCSI Technical Reference Manual for command implementation)

Data Transfer Rate

- To/from Buffer, synchronous narrow: 10.0 MByte/second
- To/from Buffer, synchronous wide: 20.0 MByte/second

Maximum Synchronous Transfer Offset:

- 15 bytes/words

Maximum Tagged Command Queue Depth:

- 32 commands

Buffer Size:

- 512 KB, segmentable

Reliability

Data Reliability

- < 1 non-recoverable error in 10^{14} bits read

Component Design Life

- 5 years

Start/Stop cycles

- 10,000 minimum

Mean Time Between Failures:

- 500,000 power-on hours*

* Projected MTBF based on comparison of similar Conner products

Mean Time to Repair

- 10 minutes, typical

Preventive Maintenance

- None

Power Requirements (Typical)

Mode	+12V DC (typical[1])	+5V DC (typical)	Power (typical)	Power (maximum)
Read/Write	280 mA	685 mA	6.8 W	7.5 W
Seek (100%)	700 mA	640 mA	11.6 W	13.3 W
Seek (30%)	310 mA	490 mA	6.2 W	7.0 W
Idle	270 mA	510 mA	5.8 W	6.3 W
Standby	9 mA	475 mA	2.5 W	2.7 W
Spin-up	1.6 A	800 mA	n/a	1.7 A

1 Typical conditions are both voltages at nominal value, room temperature (25° C) ambient to the drive without terminators installed. Maximum power is when the supply voltage is at the worst case condition.

Minimum/Maximum Voltage:

- +5V: +5%
- +12V: +5%

Maximum Peak-to-Peak Allowable Noise (DC to 1 Mhz: equivalent resistive load):

- +5V: 2%
- +12V: 1%

Environmental Tolerances

Temperature:
- Operating: 5° to 55° C
- Non-operating: -40° to 60° C
- Thermal Gradient: 20° C per hour maximum

Relative Humidity (non-condensing):
- Operating: 5 to 95%
- Non-operating: 5 to 95%
- Maximum Wet Bulb: 29°C

Altitude (relative to sea level):
- Operating: -200 to 10,000 feet
- Non-operating: 40,000 feet (maximum)
- Altitude Gradient: 1,000 feet/minute

Shock (half-sine pulse, 11 ms duration):
- Operating: 10G peak without non-recoverable errors
- Non-operating: 75G without non-recoverable errors

Vibration (swept-sine, one octave per minute):
- Operating
  - 5 - 32 Hz: 0.010 inch displacement; peak to peak
  - 32 - 400 Hz: 0.5G without non-recoverable errors
- Non-operating
  - 5 - 28 Hz: 0.020 inch displacement; double amplitude
  - 28 - 400 Hz: 4G peak

Magnetic Field:

- The disk drive will meet its specified performance while operating in the presence of an externally-produced magnetic field under the following conditions:

Field Frequency	*Intensity*
DC	6 gauss
to 700 Khz	7 milligauss
700 Khz to 1.5 Mhz	3 milligauss

Acoustic Noise:

- The acoustic level will not exceed 37 dBA sound pressure or 43 dBA sound power in Idle Mode at a distance of 1 meter from the drive.

Safety Standards

The drive is designed to comply with relevant product safety standards, including:

- UL 478, 5th edition, Standard for Safety of Information Processing and Business Equipment
- UL 1950, Standard for Safety of Information Technology Equipment
- CSA 22.2 #220, Information Processing and Business Equipment
- CSA 22.2 #950, Safety of Information Technology Equipment
- IEC 380, Safety of Electrically Energized Office Machines
- IEC 950, Safety of information Technology Equipment Including Electrical Business Equipment
- VDE 0805, VDE 0805 TIEL 100, and VDE 0806
- Complies with FCC Class B, Part 15, Subpart J

Physical Characteristics - CFP1060E

Height:

- 1.0 inch ± .020

Width:

- 4.0 inches ± .020

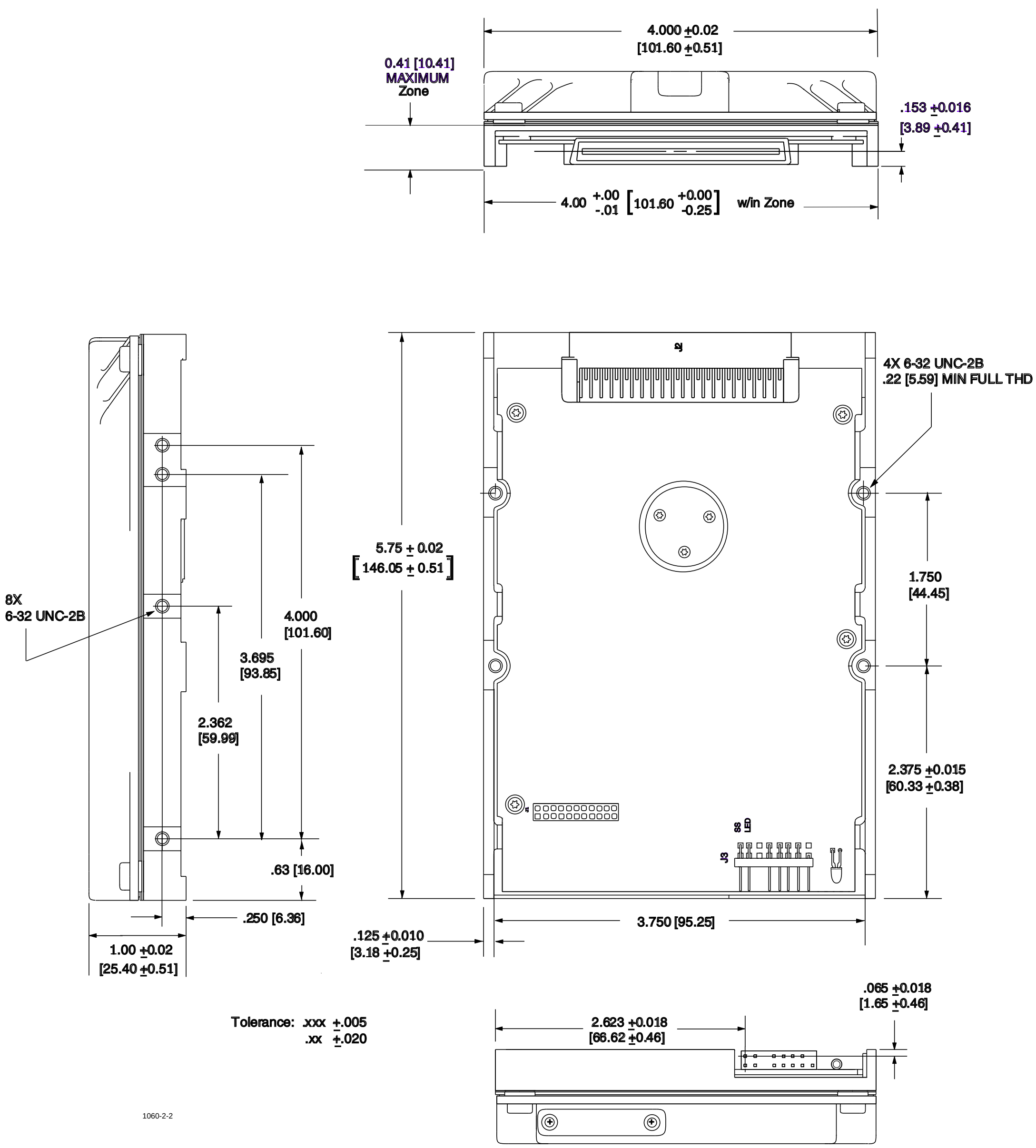
Depth:

- 5.75 inches ± .020

Weight:

- 1.3 pounds

Figure 2-2
The Drive's Physical Dimensions



Physical Characteristics - CFP1060S

Height:

- 1.0 inch ± .020

Width:

- 4.0 inches ± .020

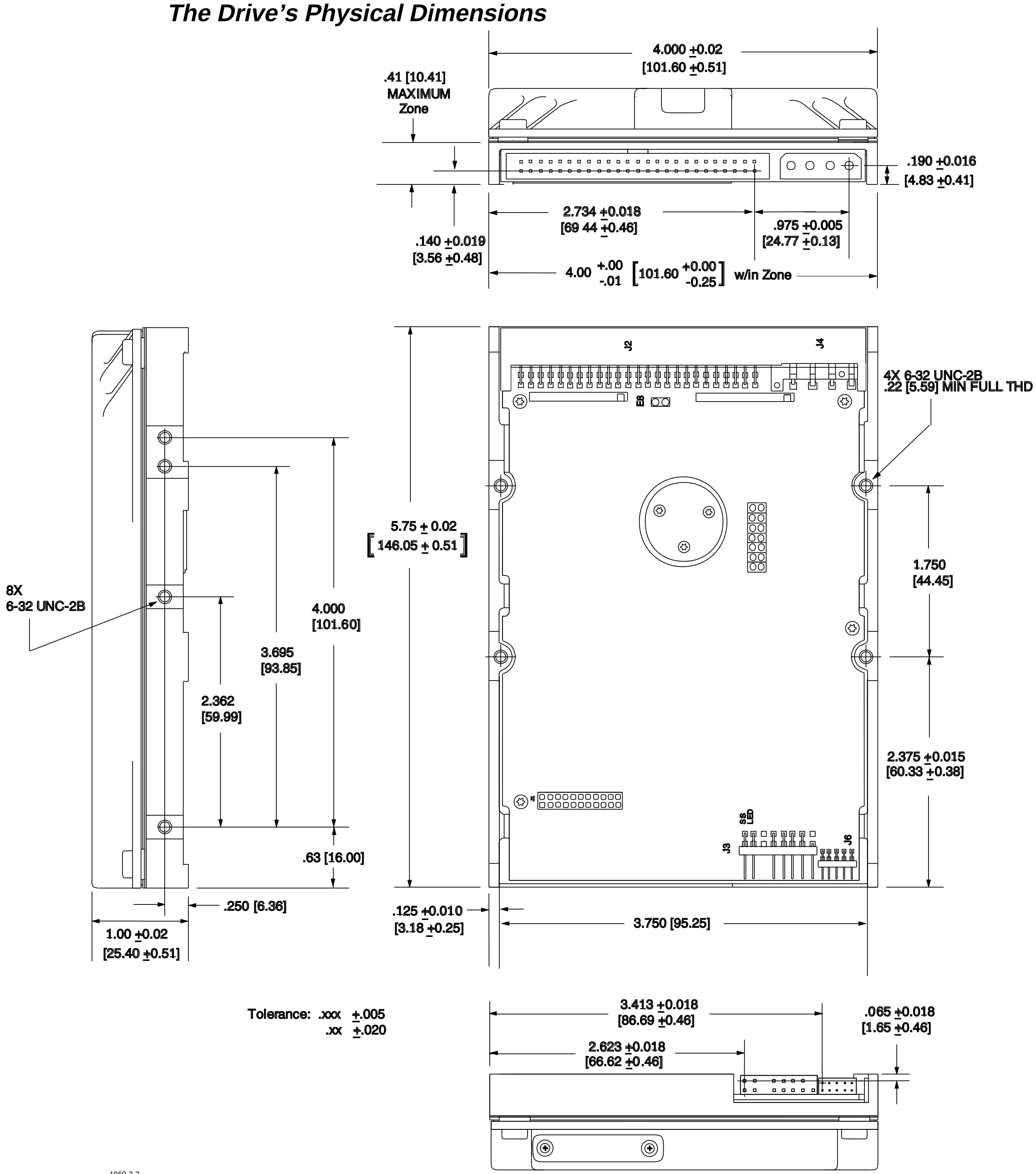
Depth:

- 5.75 inches ± .020

Weight:

- 1.3 pounds

Figure 2-3
The Drive's Physical Dimensions



Physical Characteristics - CFP1060W

Height:

- 1.0 inch ± .020

Width:

- 4.0 inches ± .020

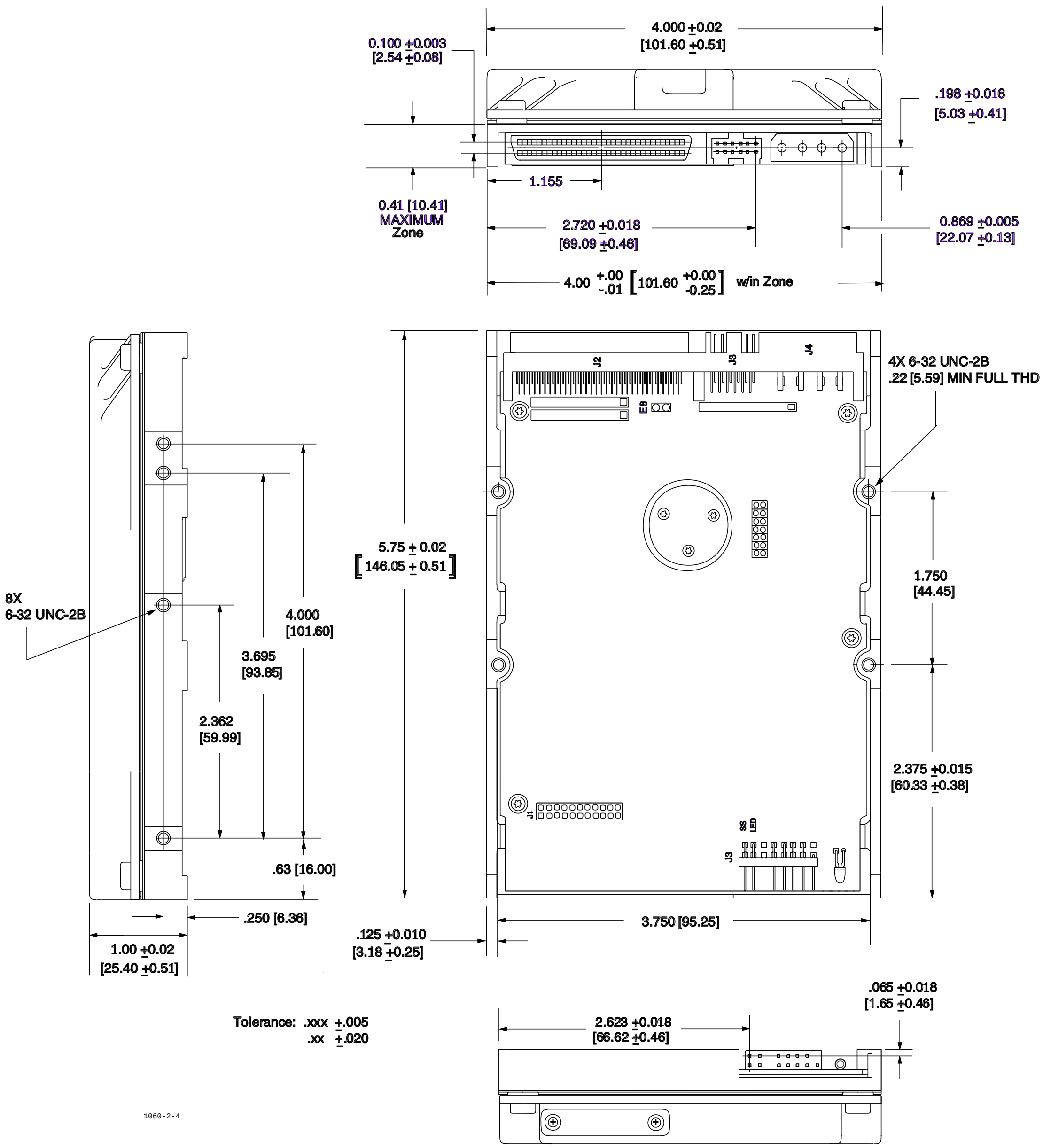
Depth:

- 5.75 inches ± .020

Weight:

- 1.3 pounds

Figure 2-4
The Drive's Physical Dimensions



How the Drive Operates 3

Functions of the Drive

This chapter describes certain operational aspects of the drive, including discussions of:

- drive operational modes
- error correction
- read error recovery
- downloadable microcode
- buffer management

Drive Operational Modes

The drive operates in the following modes:

- **Read/Write Mode** occurs when data is read from or written to the disk.

- **Seek Mode (100%)** occurs when the actuator is in motion.

- **Seek Mode (30%)** is based on 1/3 stroke seeks with a 30% seek duty cycle.

- **Idle Mode** occurs when the drive is not reading, writing, or seeking. The motor is up to speed and the **Drive Ready** condition exists. The actuator is residing on the last-accessed track.

- **Standby Mode** occurs when the motor is stopped and the actuator is latched in the landing zone. The drive will enter Standby mode after power-on reset if the Disable Spin jumper is installed or the DSPN bit in MODE SELECT page 0 is set. A STOP UNIT command will also place a drive into Standby Mode. The drive will spin up and go into Idle mode when a START UNIT command is issued or on a timed basis by SCSI ID if the SDLY bit is set in MODE SELECT page 0. Refer to the MODE SELECT and MODE SENSE commands in the Ninth Generation SCSI Interface Manual for additional details.

- **Spin-Up Mode** occurs while the drive's spindle motor is being spun up to speed after initial power on or after exiting Standby Mode.

Error Correction

The drive uses a Reed-Solomon code to perform error detection and correction. For each 512-byte block, the software error correction polynomial is capable of correcting:

- one error burst of up to 22 bits in length
- two error bursts each up to 11 bits in length

Single bursts of 11 bits or less are corrected on the fly (OTF) with no performance degradation. A larger defect up to 22 bits in length or a second defect of up to 11 bits in length is corrected using firmware within one latency period, after all retries have been exhausted.

The code has the following error detection capability:

- three error bursts each up to 11 bits in length
- a single burst of up to 51 bits in length

Read Retry Operations

The drive retries data field read operations in the following sequence if it detects an error which cannot be corrected on-the-fly. The default retry algorithm repeats eight times for a total of 128 retries or until the data is recovered.

1. Initial read
2. First retry
3. Read retry with data threshold offset +1
4. Read retry with data threshold offset -1
5. Read retry with data window offset +1
6. Read retry with data window offset -1
7. Write Spash
8. Read retry with data threshold offset +2
9. Read retry with data threshold offset -2
10. Read retry with data window offset +2
11. Read retry with data window offset -2
12. Normal read retry
13. Read retry with servo offset +8%
14. Read retry with servo offset -8%
15. Normal read retry
16. Software (2-burst) EDAC correction attempt

If retries are disabled, the drive retries the operation one time before it reports an error.

Downloadable Microcode

The SCSI interface code is split into two parts which are designated as ROM or RAM code. The ROM code contains the basic SCSI operating code and code to support commands such as INQUIRY, TEST UNIT READY, REQUEST SENSE, START/STOP UNIT, etc., which may have to be responded to prior to the drive being in a ready state. The part of the interface code referred to as RAM code resides on an area of the disk which is reserved to the drive and is not directly accessible through the interface. This code is referred to as RAM code because it is read from the disk and is loaded into static RAM after power is applied to the disk, as soon as the drive is able to read from the disk.

The RAM code consists of a resident portion which is loaded after a Power On Reset. Two different versions of RAM code overlays also reside on the disk. The read look ahead code overlay is the default and is loaded into RAM during the initial power-on. If a Queue Tag message is received by the drive, the drive will execute the command and while it is in Status Phase, will read the Queuing code overlay from the disk and load it into the RAM. This operation takes about 600 milliseconds, after which the drive will complete the command by sending the status. The drive will continue to operate with Queuing code residing in RAM until the next Power On Reset.

Refer to the next section for a discussion of the buffer management implications for the different RAM codes.

The RAM code may be upgraded on the disk via the factory serial port or through the interface using the WRITE BUFFER command. Refer to the WRITE BUFFER command in the Ninth Generation SCSI Interface Manual for a discussion of the procedure.

Buffer Management and Command Execution

The drive contains a 512Kbyte segmentable buffer which is dynamically configured to adapt to the particular drive configuration or operating environment.

Read Look Ahead Code

The Read Retention RAM code executes commands sequentially as they are received from the initiator(s). Commands from multiple initiators may be queued and overlapped so that the subsequent command can be parsed while the current command is being executed.

The drive's 512K byte buffer is configured as four segments. These segments allow the drive to cache sequential data from four separate areas on the disk. This can significantly improve performance in any environment in which multiple disk files are kept open simultaneously and operated upon in some interleaved fashion.

The Look-Ahead RAM code segments the 512 KB buffer into four 130,548 byte (FD_H blocks) segments. The remainder of the RAM is used by the microprocessor as a scratch pad area and for non read or write data information transfers. The buffer block size is equal to the data block size (typically 512 B) plus the 4 bytes of buffer CRC appended to each block. (refer to the Electrical Design Feature section in Chapter 1 for a description of the buffer CRC).

Buffer operations default on Power-up to Read Look Ahead enabled and Write Caching disabled. MODE SELECT page 8, byte 2, bit 0 (RCD), when set to one disables the read look-ahead cache function and bit 2 (WCE), when set to one enables write cache. In addition, MODE SELECT page 8, byte 3 contains two fields which control the retention priority for reads and writes. Refer to the Ninth Generation Disk Drive SCSI Interface Manual for additional details.

When a read command is received by the disk drive, the cache tables are searched to determine if the requested data is contained in any of the four cache segments (a cache hit). If there is no cache hit, the Least Recently Used (LRU) segment is selected and a read from disk is initiated into that segment which is now considered the Active Segment. The retention of data already transferred to the host and read look ahead in the Active Segment buffer is controlled by the state of the Read Retention Priority.

Read Retention On (Read Retention Priority = 0 or F):
The interface processor initiates a full segment read of 253 sectors (FD_H blocks) to the background processor. There are three different situations which would be considered a cache hit on a subsequent read.

- **Full:** All of the data requested is transferred from the buffer segment and retained.

- **Partial:** Some but not all of the data is cached in a buffer segment. If the cached data is in the Active Segment and the remaining data is part of the full segment read, the drive will transfer the requested data from the buffer as the background process fills it. If the cached data is in the Active Segment but the remaining data is not part of the full segment read, the drive will turn off read retention until the next Active Segment miss occurs and issues a new read (forever) to the background process. This allows the drive to adapt to long sequential reads even in read retention mode. If the data is part of an Inactive Segment, a new full segment read is initiated, making this the Active Segment.

- **Potential:** If none of the data is in the Active Segment, but is part of the full segment read, the drive will transfer the data as it becomes available.

Read Retention Off (Read Retention Priority = 1): The interface processor initiates a "read forever" command to the background processor and the buffer segment is treated as a circular buffer which is back filled as sectors are transferred to the host. There are three different situations which would be considered a cache hit on a subsequent read.

- **Full:** All of the requested data is cached in a buffer segment. If it is the Active Segment, the data will be transferred to the host and refilled with next sequential data. If the data in an Inactive Segment, the data is transferred to the host and retained.

- **Partial:** This is when some, but not all of the data is cached in a buffer segment. If the data is in the Active Segment, data is transferred to the host as the background process fills the buffer and the "read forever" is allowed to refill the buffer. If the data in an Inactive Segment, the cached data is transferred and a new read operation is initiated for the remaining data, making this the Active Segment.

- **Potential:** None of the data is cached. The active segment is checked and if the requested data is within 63 sectors of being read, the drive will allow the "read forever" operation to continue and the data is transferred to the host when it is available.

Write Caching

Write Caching allows multiple write commands operating on sequential blocks to be written to the medium without losing a motor revolution between commands. Write caching is enabled by setting the WCE bit in MODE SELECT page 8 to one. The WCE bit is only valid while the Read Look Ahead code is loaded. The WCE bit is ignored when the Tagged Command Queuing code is in RAM because write coalescing will be active.

The drive will send good status and command complete following the data out phase of a cached write command. The drive will cache writes when the following conditions are met:

- Two or more write commands (Op Code $0A_H$ or $2A_H$) execute consecutively without an intervening command.
- The write commands address consecutive logical block ranges.
- At least one logical block of data has been received in the buffer from the second write command in time to allow the medium to be written before an additional spindle revolution would be required.
- Both writes are from the same initiator.
- Neither write is a linked command.

If the drive encounters an error during a cached write operation, the drive will respond by:

If AWRE (MODE SELECT page 01_H) is 0: the drive will report a CHECK CONDITION on the next command and the response from a REQUEST SENSE will be a deferred error. (Asynchronous event notification is not supported by this drive.) Refer to the Ninth Generation SCSI Interface Manual for additional details.

If AWRE (MODE SELECT page 01_H) is set to 1: the drive will attempt to dynamically reassign the block of data and complete the operation. If the reassignment fails, the drive will continue to reassign the block until all the space in the grown defect list is filled (147 sectors, maximum).

Tagged Command Queuing

The drive, operating using the Tagged Command Queuing code, can queue up to 32 commands. Commands in the queue which involve seeks are re-ordered using a Scan (elevator seek methodology). Read and Write commands are coalesced (combined into a single operation to the background processor) to minimize inter processor communication overhead and reduce mechanical motion.

Seek Re-ordering

Seeks are re-ordered using the Scan or what is sometimes referred to as the elevator seek method. Seeks already in the queue are re-ordered so they can be executed sequentially on a sweep toward the inner diameter (ID) or the outer diameter (OD) of the disk. Any new seeks entering the queue ahead of the sweep is ordered for execution during the current sweep. Any new seeks entering the queue behind the current sweep are held for re-ordering during the reverse sweep. When there are no more commands in the queue ahead of the current sweep, the direction of the sweep is reversed.

Seek re-ordering is controlled by Message Code (Simple, Head of Queue or Ordered Queue) during the Message Phase. Re-ordering of seeks issued with a Simple Queue Tag message may also be restricted using the Queue Algorithm Modifier bits in MODE SELECT page $0A_H$. Refer to the Ninth Generation SCSI Interface Manual for additional information on Messages and MODE SELECT page $0A_H$.

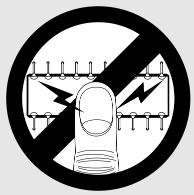
Buffer Management

The 512K byte buffer is treated by the queuing code as two 240KB buffers ($F0_H$ sectors) to maximize coalescing. Look ahead reads are performed by the drive when there are no commands in the queue awaiting execution. Look ahead reads are not performed when there are commands in the queue since another command will be waiting for execution as soon as the current command completes and because the queue affords pre-knowledge of subsequent commands instead of having to anticipate them.

Sequential read or write commands are coalesced into single commands to the background processor. On a read operation, the data associated with each queue tag is transmitted to the host as the buffer is filled by the background processor. On write operations, the drive will connect to the initiator(s), transmit the data into the buffer and disconnect; coalescing sequential data in the buffer before initiating the write to the background processor. The drive will reconnect with each of the writes, using the queue tags, completing the command after the data has been written to the disk. This operation provides the performance of write caching without the exposure of completing the command prior to writing the data to the disk.

Installing the Drive 4

Take These Precautions



To protect your equipment from electrostatic damage, perform the installation at a static-safe workstation. If one is not available, follow these guidelines:

1. Work in an uncarpeted area.

2. Before removing the equipment from its anti-static bag, discharge static electricity by touching your computer's metal chassis (or any other grounded object) while touching the anti-static bag.

3. Do not touch circuit boards unless instructed to do so.

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Installing the Drive

To install the drive, you must:

- set the drive's jumpers, if desired
- attach a data cable to the drive
- attach power to the drive
- mount the drive

These procedures differ between the various drive models.

Installing a CFP1060E

The following paragraphs describe the installation procedure for a 16-bit Single Connector Attachment (SCA) interface, model CFP1060E drive.

Setting the Drive's Jumpers - 1060E

There are no jumpers to set on the model CFP1060E drive since all the necessary control signals are on the SCA connector. This drive is intended for applications where the drive is configured at the interface when the drive is plugged into the interface connector.

Setting the SCSI Bus Address - CFP1060E

The SCSI bus ID of the drive is set by grounding the Interface bus signals shown below in Table 4-4.

Table 4-4
Setting the SCSI ID

SCSI ID	*SCSI ID(0)*	*SCSI ID(1)*	*SCSI ID(2)*	*SCSI ID(3)*
0	Open	Open	Open	Open
1	Ground	Open	Open	Open
2	Open	Ground	Open	Open
3	Ground	Ground	Open	Open
4	Open	Open	Ground	Open
5	Ground	Open	Ground	Open
6	Open	Ground	Ground	Open
7	Ground	Ground	Ground	Open
8	Open	Open	Open	Ground
9	Ground	Open	Open	Ground
10	Open	Ground	Open	Ground
11	Ground	Ground	Open	Ground
12	Open	Open	Ground	Ground
13	Ground	Open	Ground	Ground
14	Open	Ground	Ground	Ground
15	Ground	Ground	Ground	Ground

Disabling Spin-Up at Power On - CFP1060E

Spin up upon application of power to the drive can be disabled by grounding the RMT_START line on the interface. Disabling spin up on application of power can also be enabled by setting the DSPN bit in MODE SELECT page 00_H (Operating Parameters). The Host must issue a START UNIT command to cause the drive to spin up. Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT and START/STOP UNIT commands.

Table 4-5
Disabling Spin Up at Power On

RMT_START	*DSPN*	*Result*
Ground	0	Spin Disabled
Ground	1	Spin Disabled
Open	0	Spin up on Power On
Open	1	Spin Disabled

Delaying Spin Up at Power On - CFP1060E

Grounding the DLYD_START signal on the interface delays spin up on power-up by the value of the drive's SCSI ID multiplied by 4 seconds (i.e. SCSI ID 4 will delay 16 seconds). Delaying spin up on application of power can also be enabled by setting the SDLY bit in MODE SELECT page 00_H (Operating Parameters). Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT command.

Table 4-6
Delaying Spin Up at Power On

DLYD_START	*SDLY*	*Result*
Ground	0	Spin Delayed
Ground	1	Spin Delayed
Open	0	Spin up on Power On
Open	1	Spin Delayed

Cabling the Drive - CFP1060E

The drive is intended for direct backplane connection to the SCA connector rather than through cabling.

Attaching Power to the Drive - CFP1060E

The drive is powered through the SCA connector and is intended for direct backplane connection rather than through cabling.

Mounting the Drive - CFP1060E

The drive is designed to be used in applications where the unit may experience shock and vibrations at greater levels than larger and heavier disk drives will tolerate.

The design features which allow greater shock tolerance are the use of rugged heads and media, a dedicated landing zone, closed loop servo positioning and specially designed motor and actuator assemblies.

Eight side, or four bottom base mounting points are provided to the customer. The drive is mounted using 6-32 UNC -2B X 0.16 maximum insertion length screws. Refer to Figure 2-2 in Chapter 2 for the location of the mounting holes. The system integrator should allow ventilation to the drive to ensure reliable drive operation over the operating temperature range. The drive may be mounted in any orientation.

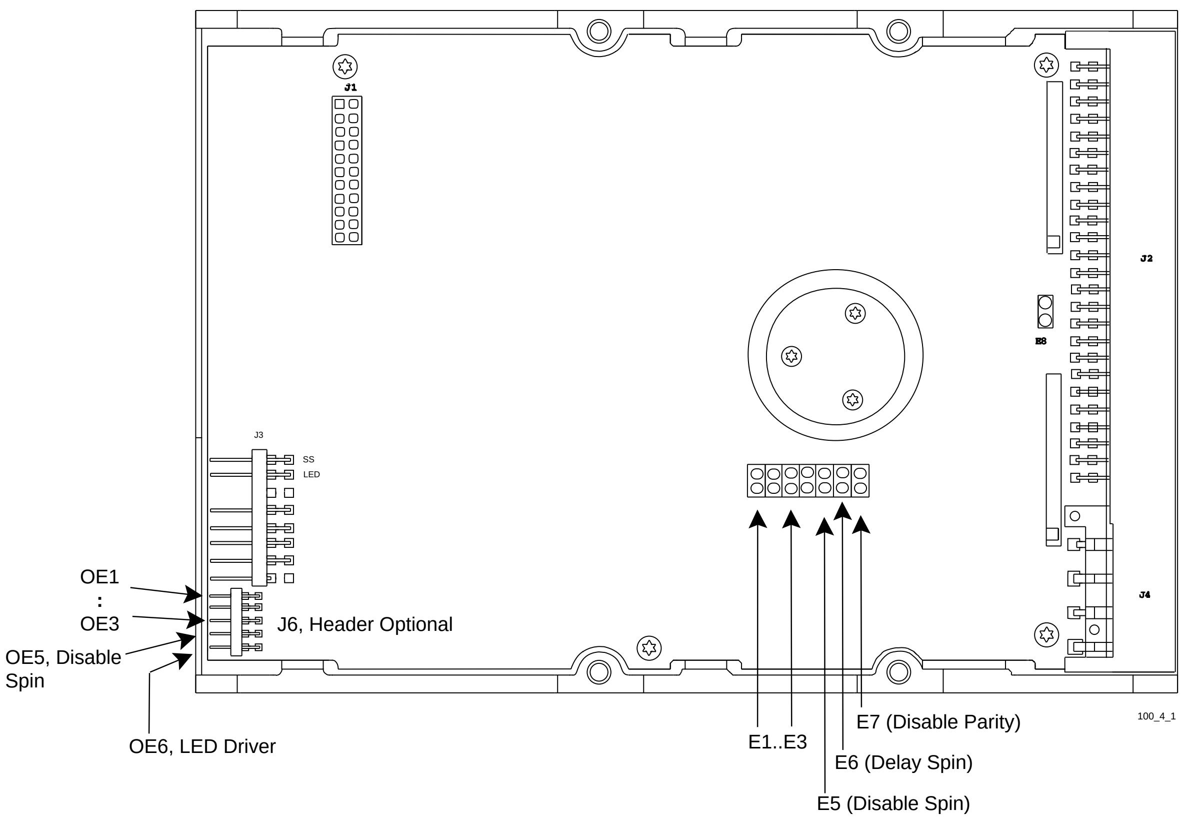
Installing a CFP1060S

The following paragraphs describe the installation procedure for a 8-bit, 50-pin SCSI-2 interface, model CFP1060S drive.

Setting the Drive's Jumpers - CFP1060S

Figure 4-3 shows you where the drive's jumpers are located.

Figure 4-3
Jumper Locations



E4: Reserved

Setting the SCSI Bus Address - CFP1060S

There are three jumpers available for configuration of the SCSI ID: E1, E2, and E3.

An optional 2mm pin pitch right angle header is located on the front of the PCBA (opposite the SCSI interface connector) which allows changing the SCSI IDs while the drive is mounted in the system. The header includes three pins, 0E1, 0E2 and 0E3 which can alternatively be used to select the SCSI Bus address. This connector may also be used to cable the SCSI ID select to a remote switch. A receptacle connector Amp P/N 111622-1 or equivalent can be used to connect a ribbon cable to this header.

Table 4-6 defines the relationship between the jumpers and the SCSI ID:

Table 4-7
Setting the SCSI ID

Optional header	*0E1*	*0E2*	*0E3*	
Standard	***E1***	***E2***	***E3***	***SCSI ID***
	Out	Out	Out	0
	In	Out	Out	1
	Out	In	Out	2
	In	In	Out	3
	Out	Out	In	4
	In	Out	In	5
	Out	In	In	6
	In	In	In	7

Note: When controlling the SCSI ID remotely, In = Ground or TTL Low and Out = Open or TTL High.

Disabling Spin-Up at Power On - CFP1060S

A jumper in the E5 location, disables spin up after power-on for applications where spin up sequencing is necessary. An optional 2mm pin pitch right angle header is located on the front of the PCBA (opposite the SCSI interface connector) which can alternatively be used to disable spin up. Disabling spin up on application of power can also be enabled by setting the DSPN bit in MODE SELECT page 00_H (Operating Parameters). The Host must issue a START UNIT command to cause the drive to spin up. Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT and START/STOP UNIT commands. Refer to Figure 4-3 for the location of the Disable Spin jumper, E5 or 0E5.

Table 4-8
Disabling Spin Up at Power-On

E5 or 0E5	*DSPN*	*Result*
In	0	Spin Disabled
In	1	Spin Disabled
Out	0	Spin up on Power On
Out	1	Spin Disabled

Note: In = Ground or TTL Low and Out = Open or TTL High.

Delaying Spin Up at Power On - CFP1060S

A jumper in the E6 location, delays spin up on power-up by the value of the drive's SCSI ID multiplied by 4 seconds (i.e. SCSI ID 4 will delay 16 seconds). Delaying spin up on application of power can also be enabled by setting the SDLY bit in MODE SELECT page 00_H (Operating Parameters). Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT command. Refer to Figure 4-3 for the location of the Delayed Spin jumper, E6.

Table 4-9
Delaying Spin Up at Power On

E6	*SDLY*	*Result*
In	0	Spin Delayed
In	1	Spin Delayed
Out	0	Spin up on Power On
Out	1	Spin Delayed

Disabling the SCSI Bus Parity - CFP1060S

SCSI parity is always enabled in both directions, unless the E7 Parity disable jumper is installed. Installing the jumper will cause the drive to ignore SCSI bus Parity In but it will continue to generate SCSI bus Parity Out.

Disabling SCSI Bus Terminator Power (TERMPWR) - CFP1060S

Power to the on-board terminators is provided by the higher of the voltage supplied at Pin #26, J2 or the voltage level at the 5 Volt power input to the drive minus one diode drop. Termination Power to external terminators can be supplied by the drive through Pin #26, J2. The signal output characteristics are described in chapter 5. The TERMPWR line can be disconnected from the drive by removing Jumper E8.

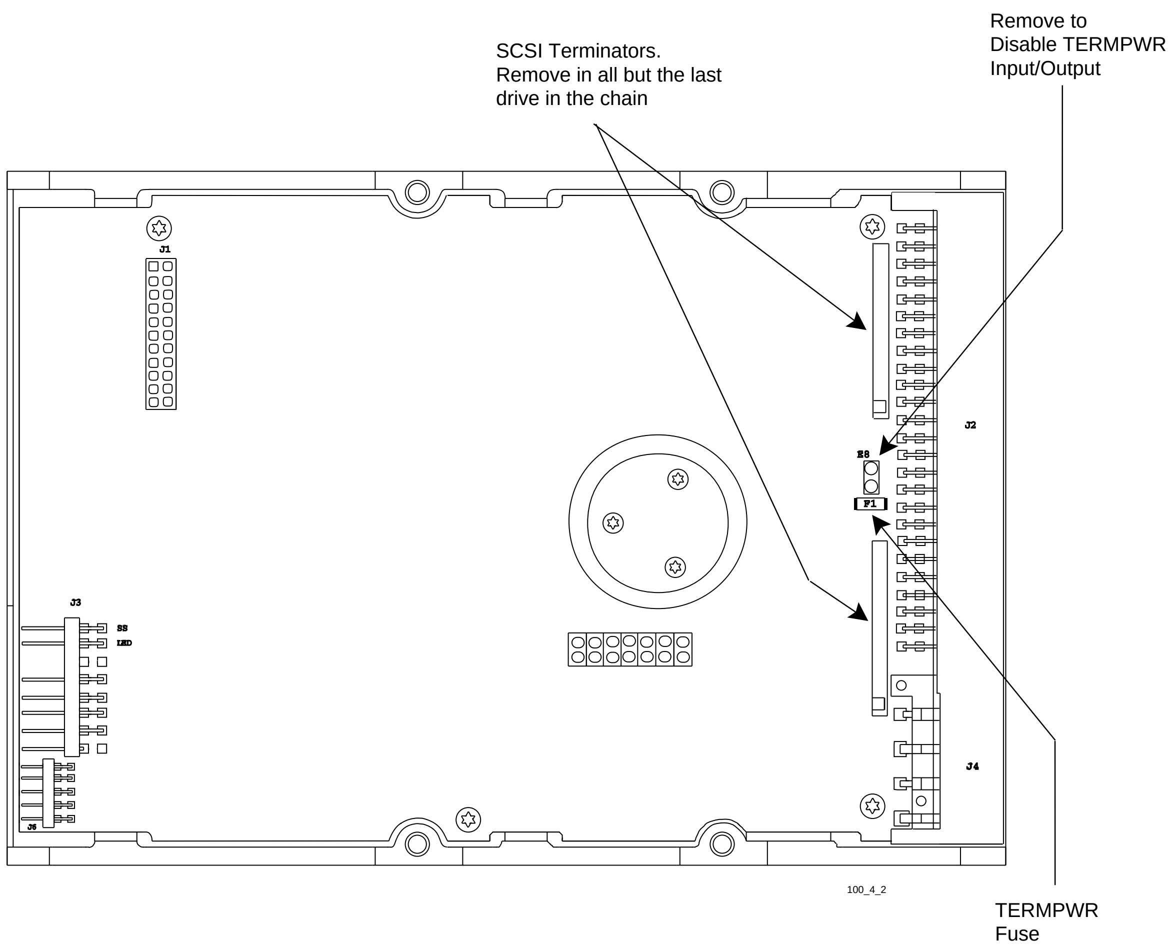
Table 4-10
Disabling SCSI Bus TERMPWR

Jumper E8	*Result*
In	TERMPWR (J2, Pin #26) connected to the drive's internal termination power.
Out	TERMPWR (J2, Pin #26) open circuit.

Setting the Bus Termination - CFP1060S

This drive provides on-board Alternative 2 active termination for the SCSI bus. The termination resistors, which are contained in two Single Inline Packs (SIPs) should be removed from the drive unless it is a SCSI device at the physical end of the bus. Figure 4-4 shows the location of the terminator resistors.

Figure 4-4
Terminator Resistor Locations

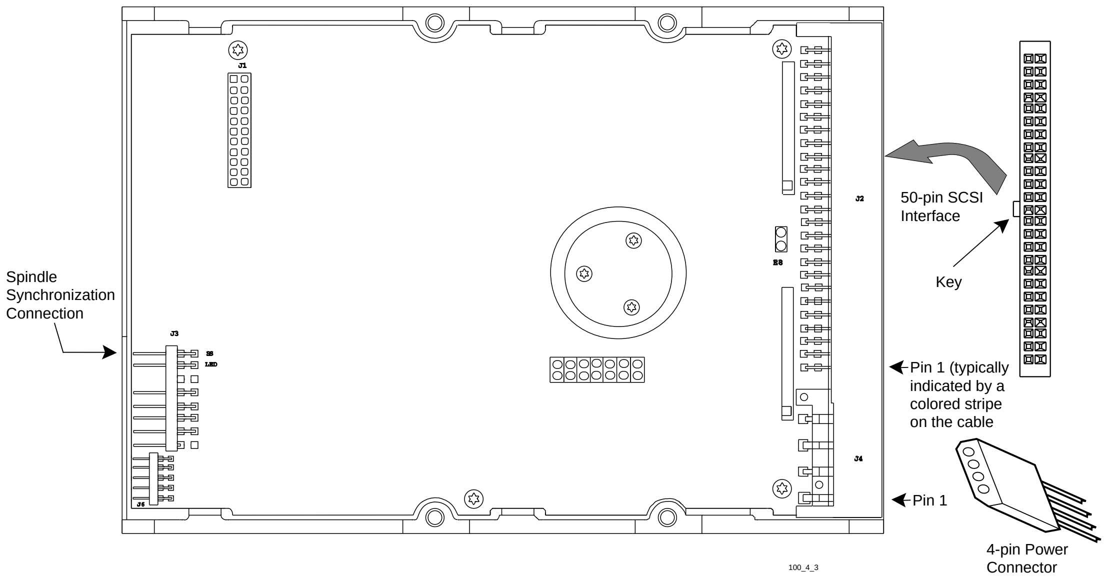


NOTE: The TERMPWR output of the drive is protected by a 1 Ampere fuse. If external terminators are being powered from the drive and SCSI bus problems are suspected, verify that the fuse is still operational using a meter.

Cabling the Drive - CFP1060S

Connect the SCSI interface cable and the spindle synchronization cable (when needed) as shown in Figure 4-5.

Figure 4-5
Connecting the cabling



SCSI Bus Cable

The cable and mating connector required to connect the drive to the SCSI bus are described in Chapter 5. In addition, the cable should meet the following guidelines, particularly with FAST SCSI-2 systems:

- Do not route the data cable next to the drive PCB or any other high frequency or large current switching signals. Improper drive operation can result from improper cable routing.
- Cable stubs should not exceed 0.1 meter (4 inches).
- There should be 0.3 meters (12 inches) of cable between drives.
- The total cable length should not exceed 6 meters (20 feet) and may have to be reduced if a mixture of round and flat cable are used.
- Do not tightly bundle excess flat cable against each other since this promotes cross coupling of signals on the cable. Use spacers to maintain a minimum of 0.050 inches (1.27mm) gap between cable runs.
- Do not clamp the cable tightly against a metal chassis since this will degrade the signal. Use spacers or a non-flammable insulation material to maintain a gap between the chassis and the cable.

Spindle Synchronization

The spindle rotation of up to 35 drives may be synchronized together by daisy chaining pin 1 to pin 1 and pin 2 to pin 2 on connector J3. The spindles are synchronized using a "floating master" concept, where the drives will synchronize to the first drive to reach full speed. The synchronization tolerance is 1%.

Attaching Power to the Drive - CFP1060S

The drive has a 4-pin DC power connector, J4 mounted on the PCB. The recommended mating connector is AMP part number 1-480424-0 utilizing AMP pins, part number 350078-4 or equivalent.

Connect the DC Power cable to the drive as shown in Figure 4-5.

Mounting the Drive - CFP1060S

The drive is designed to be used in applications where the unit may experience shock and vibrations at greater levels than larger and heavier disk drives will tolerate.

The design features which allow greater shock tolerance are the use of rugged heads and media, a dedicated landing zone, closed loop servo positioning and specially designed motor and actuator assemblies.

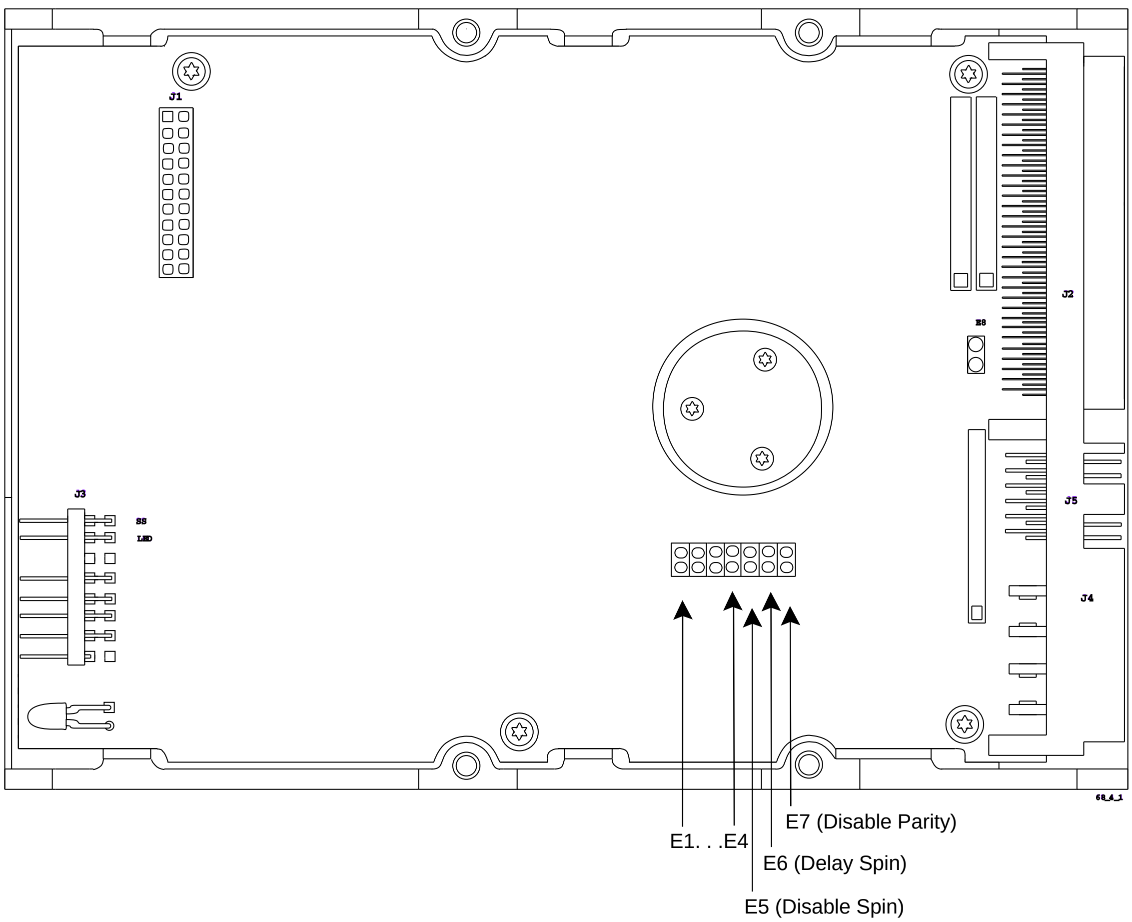
Eight side, or four bottom base mounting points are provided to the customer. The drive is mounted using 6-32 UNC -2B X 0.16 maximum insertion length screws. Refer to Figure 2-3 in Chapter 2 for the location of the mounting holes. The system integrator should allow ventilation to the drive to ensure reliable drive operation over the operating temperature range. The drive may be mounted in any orientation.

Installing a CFP1060W

Setting the Drive's Jumpers - CFP1060W

Figure 4-6 shows you where to access the drive's jumpers.

Figure 4-6
Jumper Locations



Setting the SCSI Bus Address - CFP1060W

There are four jumpers available for configuration of the SCSI ID: E1, E2, E3 and E4.

The 68-pin unified connector includes a standard 2mm pitch auxiliary header which includes pins to allow remote selection of SCSI IDs. A receptacle connector Amp P/N 1-111623-7 or equivalent can be used to connect a ribbon cable to this header.

Table 4-11 defines the relationship between the jumpers or the pins on J5 and the SCSI ID:

Table 4-11
Setting the SCSI ID

SCSI ID	*E1 / Pin 1*	*E2 / Pin 3*	*E3 / Pin 5*	*E4 / Pin 7*
0	Out/Open	Out/Open	Out/Open	Out/Open
1	In/Ground	Out/Open	Out/Open	Out/Open
2	Out/Open	In/Ground	Out/Open	Out/Open
3	In/Ground	In/Ground	Out/Open	Out/Open
4	Out/Open	Out/Open	In/Ground	Out/Open
5	In/Ground	Out/Open	In/Ground	Out/Open
6	Out/Open	In/Ground	In/Ground	Out/Open
7	In/Ground	In/Ground	In/Ground	Out/Open
8	Out/Open	Out/Open	Out/Open	In/Ground
9	In/Ground	Out/Open	Out/Open	In/Ground
10	Out/Open	In/Ground	Out/Open	In/Ground
11	In/Ground	In/Ground	Out/Open	In/Ground
12	Out/Open	Out/Open	In/Ground	In/Ground
13	In/Ground	Out/Open	In/Ground	In/Ground
14	Out/Open	In/Ground	In/Ground	In/Ground
15	In/Ground	In/Ground	In/Ground	In/Ground

Note: Open means open circuit or high impedance. Ground means TTL logic low or logic ground.

Disabling Spin-Up at Power On - CFP1060W

A jumper in the E5 location, disables spin up on power-on for applications where spin up sequencing is necessary. Disabling spin up on application of power can also be enabled by setting the DSPN bit in MODE SELECT page 00_H (Operating Parameters). The Host must issue a START UNIT command to cause the drive to spin up. Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT and START/STOP UNIT commands. Refer to Figure 4-6 for the location of the Disable Spin jumper E5 and the option header.

Table 4-12
Disabling Spin Up at Power On

E5	*DSPN*	*Result*
In	0	Spin Disabled
In	1	Spin Disabled
Out	0	Spin up on Power On
Out	1	Spin Disabled

Delaying Spin Up at Power On - CFP1060W

A jumper in the E6 location, delays spin up on power-up by the value of the drive's SCSI ID multiplied by 4 seconds (i.e. SCSI ID 4 will delay 16 seconds). Delaying spin up on application of power can also be enabled by setting the SDLY bit in MODE SELECT page 00_H (Operating Parameters). Refer to the Ninth Generation SCSI Technical Reference Manual for additional information regarding the MODE SELECT command. Refer to Figure 4-6 for the location of the Delayed Spin jumper, E6.

Table 4-13
Delaying Spin Up at Power On

E6	*SDLY*	*Result*
In	0	Spin Delayed
In	1	Spin Delayed
Out	0	Spin up on Power On
Out	1	Spin Delayed

Disabling the SCSI Bus Parity - CFP1060W

SCSI parity is always enabled in both directions, unless the E7 Parity disable jumper is installed. Setting the jumper will cause the drive to ignore SCSI bus parity in but it will continue to generate SCSI bus parity out.

Disabling SCSI Bus Terminator Power (TERMPWR) - CFP1060W

Power to the on-board terminators is provided by the higher of the voltage supplied at Pins #17, 18, 51 & 52, J2 or the voltage level at the 5 Volt power input to the drive minus one diode drop. Termination Power to external terminators can be supplied by the drive through Pins #17, 18, 51 & 52, J2. The signal output characteristics are described in chapter 5. The TERMPWR line can be disconnected from the drive by removing Jumper E8.

Table 4-14
Disabling SCSI Bus TERMPWR

Jumper E8	*Result*
In	TERMPWR (J2, Pins #17, 18, 51 & 52) connected to the drive's internal termination power.
Out	TERMPWR (J2, Pins #17, 18, 51 & 52) open circuit.

Using the J5 Auxiliary Connector

External logic cabled to the J5 connector may be used to control certain characteristics of the drive or access signals.

Table 5-15
J5 Auxiliary Connector Signal Definitions

Pin Number	*Signal Name*	*Pin Number*	*Signal Name*
1	- SEL0	**2**	- XTFALT
3	- SEL1	**4**	- VUNIQ
5	- SEL2	**6**	- SPSYNC
7	- SEL3	**8**	- XTACTV
9	- ENTERM	**10**	- GROUND
11	+5V	**12**	- FAULT

- SEL0

Bit 0 of the binary coded SCSI ID selection input. This signal has a value of 0 when it is negated and a value of 1 when it is asserted for the purpose of selection or arbitration.

This signal is latched within 250 msec of the application of valid power to the drive or optionally the negation of -RST.

If SCSI ID SEL0 is intended to be selected, the host must provide a low impedance connection from - SEL (0) to - XTFALT or to ground, while the ID is being latched, through an appropriate means. Refer to chapter 5 for specific electrical characteristics of these signals.

- XTFAULT

This signal is intended to drive an LED to indicate an external fault condition has occurred. This signal is held asserted following the application of power or optionally the negation of -RST during initialization while the SCSI ID is being read. This signal is not supported but meets the requirement of negating the signal while the ID is being read.

- SEL1

Bit 1 of the binary coded SCSI ID selection input. This signal has a value of 0 when it is negated and a value of 2 when it is asserted for the purpose of selection or arbitration.

This signal is latched within 250 msec of the application of valid power to the drive or optionally the negation of -RST.

If SCSI ID SEL 1 is intended to be selected, the host must provide a low impedance connection from - SEL1 to - VUNIQ or to ground, while the ID is being latched, through an appropriate means. Refer to chapter 5 for specific electrical characteristics of these signals.

- VUNIQ

This signal is an open-collector output available for Vendor Unique usage. This signal is not supported but meets the requirement of negating the signal while the ID is being read.

- SEL2

Bit 2 of the binary coded SCSI ID selection input. This signal has a value of 0 when it is negated and a value of 4 when it is asserted for the purpose of selection or arbitration.

This signal is latched within 250 msec of the application of valid power to the drive or optionally the negation of -RST.

If SCSI ID SEL2 is intended, to be selected, the host must provide a low impedance connection from - SEL2 to - SPSYNC or to ground, while the ID is being latched, through an appropriate means. Refer to chapter 5 for specific electrical characteristics of these signals.

- SPSYNC

This signal used to provide a spindle rotation synchronization reference. The pins for all of the drives which are to be synchronized must be connected together. The drives must be of like model to operate. The spindles are synchronized using a "floating master" concept, where the drives will synchronize to the first drive to reach full speed. The synchronization tolerance is 1%.

This signal meets the requirement of negating the signal while the ID is being read.

- SEL3

Bit 3 of the binary coded SCSI ID selection input. This signal has a value of 0 when it is negated and a value of 8 when it is asserted for the purpose of selection or arbitration.

This signal is latched within 250 msec of the application of valid power to the drive or optionally the negation of -RST.

If SCSI ID SEL3 is intended, to be selected, the host must provide a low impedance connection from - SEL3 to - XTACTV or to ground, while the ID is being latched, through an appropriate means. Refer to chapter 5 for specific electrical characteristics of these signals.

- XTACTV

This signal is an open collector output intended to drive an LED to indicate the device is active. This signal is negated while the SCSI ID is being read.

- GROUND

This signal is connected to the drive's logic ground.

+5 Volts

This signal provides 5 volts of DC power to drive LEDs and is current limited by a 120 ohm resistor.

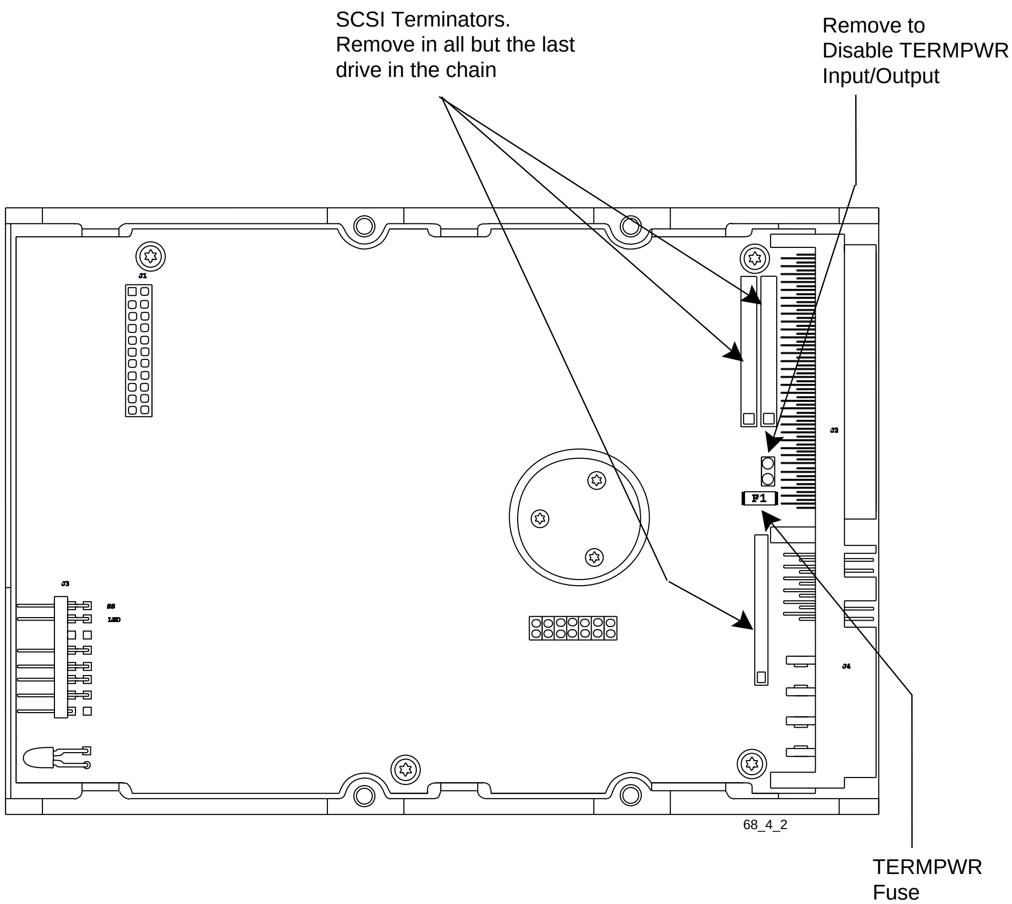
- FAULT

The assertion of this signal will cause the drive to stop any media-altering activity, which may result in the drive asserting -XTFALT or -VUNIQ, or both. This signal is intended to be used as a power failure warning and/or as a write protect input. This signal is not supported by this drive.

Setting the Bus Termination - CFP1060W

This drive provides on board Alternative 2 active termination for the SCSI bus. The termination resistors, which are contained in three Single Inline Packs (SIPs) should be removed from the drive unless it is a SCSI device at the physical end of the bus. Figure 4-7 shows the location of the terminator resistors.

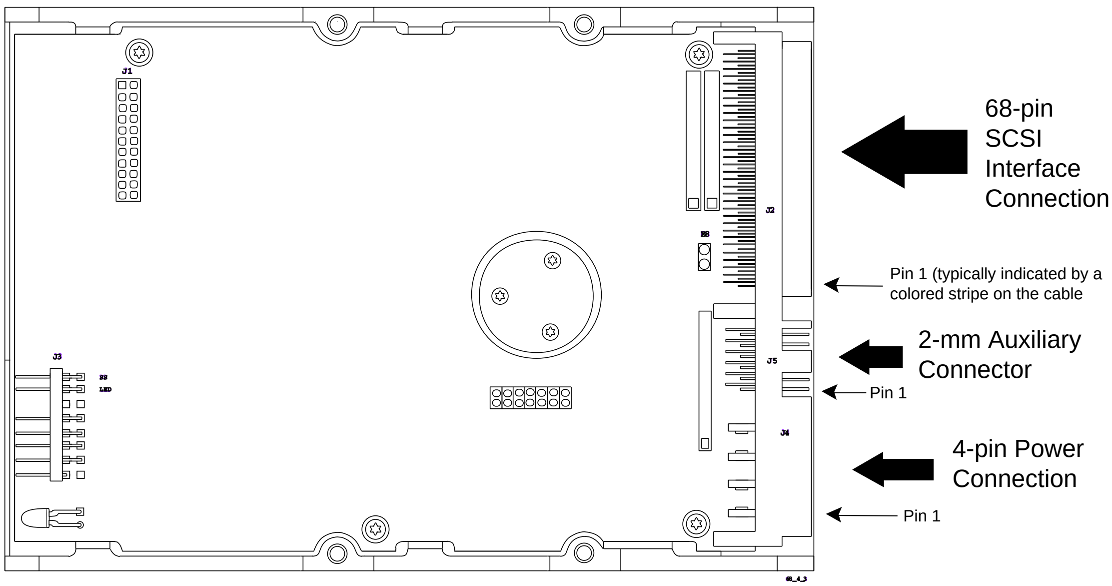
Figure 4-7
Terminator Resistor Locations



Cabling the Drive - CFP1060W

Connect the SCSI interface cable and the spindle synchronization cable (when needed) as shown in Figure 4-8.

Figure 4-8
Connecting the cabling



SCSI Bus Cable

The cable and mating connector required to connect the drive to the SCSI bus are described in Chapter 5. In addition, the cable should meet the following guidelines, particularly with FAST SCSI-2 systems:

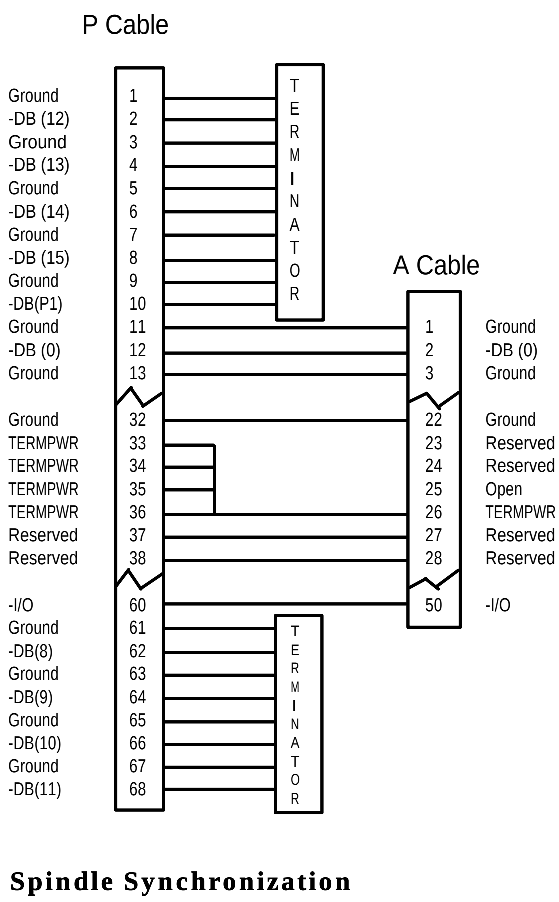
- Do not route the data cable next to the drive PCB or any other high frequency or large current switching signals. Improper drive operation can result from improper cable routing.
- Cable stubs should not exceed 0.1 meter (4 inches).
- There should be 0.3 meters (12 inches) of cable between drives.
- The total cable length should not exceed 3 meters (10 feet) and may have to be reduced if a mixture of round and flat cable are used.
- Do not tightly bundle excess flat cable against each other since this promotes cross coupling of signals on the cable. Use spacers to maintain a minimum of 0.050 inches (1.27mm) gap between cable runs.
- Do not clamp the cable tightly against a metal chassis since this will degrade the signal. Use spacers or a non-flammable insulation material to maintain a gap between the chassis and the cable.

Mixing Wide and Narrow SCSI Devices on a SCSI Bus

It may sometimes be desirable to attach Narrow SCSI devices such as tape backup devices or CDROMs to the same SCSI Host Bus Adapter being used to control Wide SCSI devices, such as the CFP1060W. Intermixing of both Wide and Narrow SCSI devices on the same bus required special considerations:

- The Narrow SCSI devices must be placed at the physical end of the bus
- The high byte of the SCSI data bus must be terminated at the transition adapter from the 34-pair wire to the 25-pair wire. Figure 4-9 shows the interconnection.
- The cable impedance of the 34-pair wire and the 25-pair wire should be as closely matched as possible.
- The 68-pair cable with 30 AWG wire uses four wires to carry TERMPWR, which must be joined to wire 26 of the 25-pair wire, if terminator power has to be carried over the cable.

Figure 4-9
Wide-to-Narrow Adapter



Spindle Synchronization

The spindle rotation of up to 35 drives may be synchronized together by daisy chaining pin 1 to pin 1 and pin 2 to pin 2 of each drive on connector J3 or chaining pin 6 of the 2mm option header J5. The spindles are synchronized using a "floating master" concept, where the drives will synchronize to the first drive to reach full speed. The synchronization tolerance is 1%.

Attaching Power to the Drive - CFP1060W

The drive has a 4-pin DC power connector, J4, which is part of the Unified Connector, mounted on the PCB. The recommended mating connector is AMP part number 1-480424-0 utilizing AMP pins, part number 350078-4 or equivalent.

Mounting the Drive - CFP1060W

The drive is designed to be used in applications where the unit may experience shock and vibrations at greater levels than larger and heavier disk drives will tolerate.

The design features which allow greater shock tolerance are the use of rugged heads and media, a dedicated landing zone, closed loop servo positioning and specially designed motor and actuator assemblies.

Eight side, or four bottom base mounting points are provided to the customer. The drive is mounted using 6-32 UNC -2B X 0.16 maximum insertion length screws. Refer to Figure 2-4 in Chapter 2 for the location of the mounting holes. The system integrator should allow ventilation to the drive to ensure reliable drive operation over the operating temperature range. The drive may be mounted in any orientation.

Interface Physical Characteristics 5

Electrical Description

The paragraphs which follow describe the input and output electrical characteristics of the drive.

Output Characteristics

The output drivers for Data, Parity, REQ and ACK are optionally active negation. When they are set for active negation, they have three states: asserted, negated and high impedance. The remainder of the signals have open collector (drain) outputs. The drivers maintain a high impedance state during power-on and power-off cycles. The driven signals have the following output characteristics when measured at the drive connector:

Table 5-1
Active Negation Driver Output Signal Characteristics

Signal Characteristic	*Value*
Signal Assertion	0.1 VDC to 0.5 VDC at 48 mA
Minimum Driver Output Capability	48 mA (sinking) at 0.5 VDC
Signal Negation	2.0 VDC to 3.24 VDC at 7 mA
	3.0 VDC at 20 mA

Table 5-2
Open Collector Driver Output Signal Characteristics

Signal Characteristic	*Value*
Signal Assertion	0.0 VDC to 0.5 VDC at 48 mA
Minimum Driver Output Capability	48 mA (sinking) at 0.5 VDC
Signal Negation	2.5 VDC to 5.25 VDC

Input Characteristics

The characteristics of the input receivers and the requirements for each signal received by the drive as measured at the drive connector are shown in table 5-3:

Table 5-3
Drive Input Signal Characteristics

Signal Characteristic	*Value*
Signal Assertion	0.0 VDC to 0.8 VDC
Signal Negation	2.0 VDC to 5.25 VDC
Input Load (low level)	-20 µA to 0.0 mA at 0.5 VDC
Input Load (high level)	0.0 mA to 20 µA at 2.7 VDC

Model-Specific SCSI Physical Characteristics

The sections which follow describe, for each of the drive models, those SCSI characteristics which vary from model to model. These characteristics include:

- Termination
- Cable requirements
- Connector requirements
- Connector Pin assignments
- Interface Timing requirements

CFP1060E (WIDE, 80-pin Single Connector Attachment [SCA])

External Terminator Power

The interface connector carries both power and ground so a separate TERMPWR interface line is not provided.

Internal Termination

This version of the drive has no on-board termination so the drive must be externally terminated. Alternative 2 active termination is recommended. Alternative 1 passive termination is not suitable for this application.

Cable Requirements

This version of the drive is designed to interface directly to a mating connector which is on a passive back plane or directly into a motherboard. The same guidelines relative to impedance, stub length and distance between stubs apply for SCSI bus signal reliability. These guidelines may not be directly translated to a back plane design so these design rules are to be viewed with respect to the intended purpose of controlling reflections and the propagation of signals down the bus. Since the characteristics for PCB signal traces are affected by trace width, proximity to ground, and trace routing, careful review of the back plane design and analysis of signal quality is highly recommended.

Connector Requirements

The drive's connector will mate with a AMP Champ 2-557103-1 vertical receptacle or the AMP Champ 2-557101-1 right angle receptacle.

Single Connector Attachment (SCA) Signal Definitions

Power

Four +12 Volt signals provide the +12 volt power to the drive. The current return for the +12 volt power is through the +12 Volt Ground signals. The maximum current that can be provided to the drive through the +12 Volt signal pins is 3 Amperes. The supply current and return current must be distributed as evenly as possible among the pins. The maximum current is while the drive motor is starting.

Three +5 Volt signal pins provide +5 volt power to the drive. The current return for the +5 volt power is through the +5 Volt Ground pins. It is expected that the +5 Volt Ground will also establish the digital logic ground for the drive. The maximum current that can be provided to the drive through the +5 Volt signal pins is 2 Amperes. The supply current and return current must be distributed as evenly as possible among the pins.

These specifications refer to the connector's characteristics. Refer to Chapter 2 for the drive's power requirements.

Spindle Sync

The spindle rotation of up to 35 drives may be synchronized together by daisy chaining pin 1 to pin 1 and pin 2 to pin 2 of each drive on connector J3. The spindles are synchronized using a "floating master" concept, where the drives will synchronize to the first drive to reach full speed. The synchronization tolerance is 1%.

Table 5-4
Electrical Characteristics for the Spindle Sync Signal

STATE	Current	Voltage
High	$0 < I_{IH} < 20\ \mu A$	$2.5\ V < V_{IH} < V_{CC} + 0.3\ V$
Low	$0 < I_{OH} < -48\ mA$	$-0.1\ V < V_{IL} < 0.4\ V$

LED Out

The LED out signal is driven by the drive when the drive is performing a SCSI operation. The LED out signal is designed to pull down the cathode of an LED. The anode is attached to the proper +5 volt supply through an appropriate current limiting resistor. The LED and the current limiting resistor are external to the drive.

Table 5-5
Output Characteristics of the LED Driver Signal

State	*Current Drive Available*	*Output Voltage*
Drive LED Off	$0 < I_{OH} < 100\ \mu A$	
Drive LED On	$I_{OL} < -30\ mA$	$0 < V_{OL} < 0.8$ Volts

Motor Start Controls

Table 5-6
Electrical Characteristics for RMT_START and DLYD_START

State	*Current*	*Voltage*
Open	$0 < I_{IH} < \pm 100\ \mu A$	$2.4\ V < V_{IH} < V_{CC} + 0.5\ V$
Ground	$0 < I_{OH} < -3\ mA$	$-0.5\ V < V_{IL} < 0.4\ V$

SCSI ID Selection

Table 5-7
Electrical Characteristics for the SCSI ID Signals SCSI ID (0) - (3)

State	*Current*	*Voltage*
Open	$0 < I_{IH} < \pm 100\ \mu A$	$2.4\ V < V_{IH} < V_{CC} + 0.5\ V$
Ground	$0 < I_{OH} < -3\ mA$	$-0.5\ V < V_{IL} < 0.4\ V$

Interface Pin Assignments

The pin assignments for the interface connector are shown below:

Table 5-8
Interface Signal Definitions

Pin	*Signal*	*Pin*	*Signal*
1	+12 Volt	41	+12 Volt Ground
2	+12 Volt	42	+12 Volt Ground
3	+12 Volt	43	+12 Volt Ground
4	+12 Volt	44	+12 Volt Ground
5	Reserved / NC	45	Reserved / NC
6	Reserved / NC	46	Reserved / NC
7	-DB(11)	47	Ground
8	-DB(10)	48	Ground
9	-DB(9)	49	Ground
10	-DB(8)	50	Ground
11	-I/O	51	Ground
12	-REQ	52	Ground
13	-C/D	53	Ground
14	-SEL	54	Ground
15	-MSG	55	Ground
16	-RST	56	Ground
17	-ACK	57	Ground
18	-BSY	58	Ground
19	-ATN	59	Ground
20	-DB(P0)	60	Ground
21	-DB(7)	61	Ground
22	-DB(6)	62	Ground
23	-DB(5)	63	Ground
24	-DB(4)	64	Ground
25	-DB(3)	65	Ground
26	-DB(2)	66	Ground
27	-DB(1)	67	Ground
28	-DB(0)	68	Ground
29	-DB(P1)	69	Ground
30	-DB(15)	70	Ground
31	-DB(14)	71	Ground
32	-DB(13)	72	Ground
33	-DB(12)	73	Ground
34	+5 Volt	74	+5 Volt Ground
35	+5 Volt	75	+5 Volt Ground
36	+5 Volt	76	+5 Volt Ground
37	SYNC	77	LED
38	RMT_START	78	DLYD_START
39	SCSI ID (0)	79	SCSI ID (1)
40	SCSI ID (2)	80	SCSI ID (3)

Notes:
1. The minus sign (-) indicates active low.
2. Pins marked Reserved are not connected.

Interface Timing Requirements

Unless otherwise noted, the delay-time measurements are calculated from signal conditions existing at the drive's own SCSI bus connector. Normally these measurements (except cable skew delay) can be made without considering delays in the inter-connect system.

Table 5-9
SCSI Bus Timing Values

	Timing Value *		
Timing Description	***fast***	***slow***	***asynch***
Arbitration Delay	2.4 µs	2.4 µs	2.4 µs
Bus Clear Delay	800 ns	800 ns	800 ns
Bus Free Delay	800 ns	800 ns	800 ns
Bus Set Delay	1.8 µs	1.8 µs	1.8 µs
Bus Settle Delay	400 ns	400 ns	400 ns
Cable Skew Delay [1]	4 ns	4 ns	4 ns
Data Release Delay	400 ns	400 ns	400 ns
Receive Assertion Period	22 ns	70 ns	n/a
Receive Hold Time	25 ns	25 ns	n/a
Receive Negation Period	22 ns	70 ns	n/a
Receive Setup Time	15 ns	15 ns	n/a
Reset Hold Time	25 µs	25 µs	25 µs
Selection Abort Time	200 µs	200 µs	200 µs
Selection Time-out Delay [2]	250 ms	250 ms	250 ms
System Deskew Delay	20 ns	45 ns	45 ns
Transmit Assertion Period	30 ns	80 ns	n/a
Transmit Hold Time	33 ns	53 ns	n/a
Transmit Negation Period	30 ns	80 ns	n/a
Transmit Setup Time	23 ns	23 ns	n/a

Notes:

1 This time does not apply at the SCSI connector of the drive.

2 This is a recommended time. It is not mandatory.

Model CFP1060S (Narrow, 50-pin SCSI)

External Terminator Power

Power to the on-board terminators is provided by the higher of the voltage supplied at Pin #26, J2 or the voltage level at the 5 Volt power input to the drive minus one diode drop. The diode prevents back flow of current to the drive. Termination Power to external terminators can be supplied by the drive through Pin #26, J2. The TERMPWR line can be disconnected from the drive by removing Jumper E8. Table 5-10 describes the electrical characteristics of the TERMPWR line when it is used to supply power to an external terminator. Table 5-11 describes the required electrical characteristics for any external source of termination power.

Table 5-10
TERMPWR Output Electrical Characteristics

Signal Characteristic	***Value***
Supply voltage	4.06 VDC to 4.56 VDC
Minimum source capability:	800 mA (fused at 1000 mA)

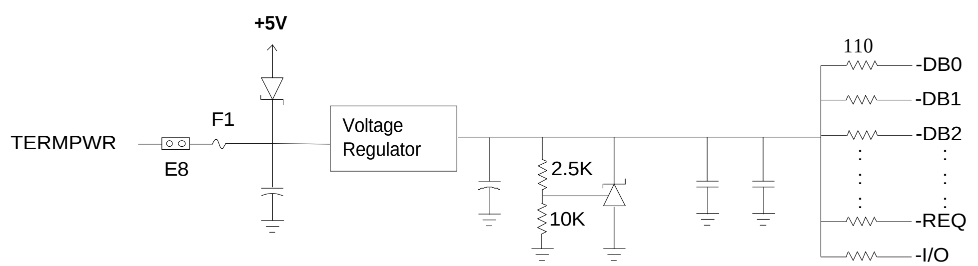
Table 5-11
TERMPWR Input Electrical Characteristics

Signal Characteristic	***Value***
Input voltage	4.00 VDC to 5.25 VDC
Minimum source capability:	1000 mA (fused at 1000 mA)
Sink current:	1.0 mA maximum, excluding power to the internal terminator.

Internal Termination

This drive provides on-board Alternative 2 active termination for the SCSI bus. The termination resistors, which are contained in two Single Inline Packs (SIPs) should be removed from the drive unless it is a SCSI device at a physical end of the bus. The terminator equivalent circuit is shown below for reference:

Figure 5-1
Terminator Equivalent Circuit



Cable Requirements

A 50 conductor cable no more than 6 meters (19.68 feet) cumulative length with at least 28 AWG wire size and a characteristic impedance of 70 to 100 ohms (84 ohms nominal) is required. In systems which use the fast synchronous transfer option, the cable should meet the following additional requirements:

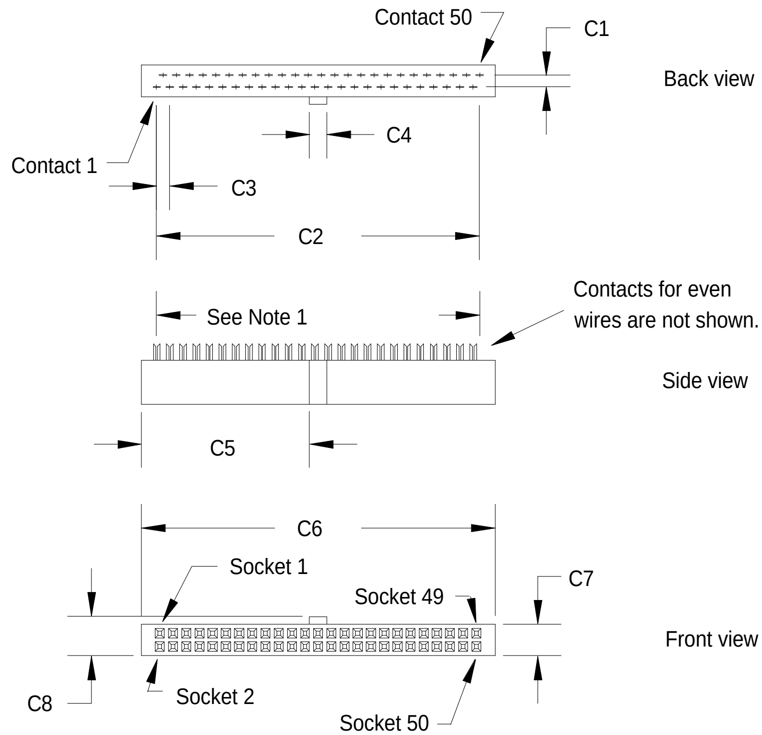
Table 5-12
Interface Cable Electrical Characteristics

Specification	*Value*
Signal Attenuation	0.095dB maximum per meter at 5 Mhz
Pair-to-Pair Propagation Delay Delta	0.20 ns maximum per meter
DC Resistance	0.230 ohms maximum per meter at 20° C

Connector Requirements

The connector on the drive is a 50-position header which consists of 2 rows of 25 male pins on 0.100 inch centers. The mating connector is a SCSI-2 Non-shielded Alternative 1, A-cable connector which is shown below:

Figure 5-2
A-Cable Connector



Dimensions	Millimeters	Inches
C1	2.540	0.100
C2	60.960	2.400
C3	2.540	0.100
C4	3.302	0.130
C5	32.385	1.275
C6	68.072	2.680
C7	6.096	0.240
C8	7.620	0.300

Notes:

(1) Fifty contacts on 1.27mm (0.05 inch) staggered spacing = 62.23mm (2.450 inch) [ref.]

(2) Tolerances +0.127mm (0.005 inch) noncumulative unless specified otherwise.

(3) Connector cover and strain relief are optional

Interface Pin Assignments

The pin assignments for the interface connector are shown below:

Table 5-13
Interface Signal Definitions

Pin	*Signal*	*Pin*	*Signal*
01	GND	**02**	-DB0
03	GND	**04**	-DB1
05	GND	**06**	-DB2
07	GND	**08**	-DB3
09	GND	**10**	-DB4
11	GND	**12**	-DB5
13	GND	**14**	-DB6
15	GND	**16**	-DB7
17	GND	**18**	-DBP
19	GND	**20**	GND
21	GND	**22**	GND
23	RESERVED	**24**	RESERVED
25	OPEN	**26**	TERMPWR
27	RESERVED	**28**	RESERVED
29	GND	**30**	GND
31	GND	**32**	-ATN
33	GND	**34**	GND
35	GND	**36**	-BSY
37	GND	**38**	-ACK
39	GND	**40**	-RST
41	GND	**42**	-MSG
43	GND	**44**	-SEL
45	GND	**46**	-C/D
47	GND	**48**	-REQ
49	GND	**50**	-I/O

Notes:
1. The minus sign (-) indicates active low.
2. All odd pins except pin 25 must be connected to ground. Pin 25 is left open.
3. Pins marked Reserved are connected to ground.

Interface Timing Requirements

Unless otherwise noted, the delay-time measurements are calculated from signal conditions existing at the drive's own SCSI bus connector. Normally these measurements (except cable skew delay) can be made without considering delays in the cable.

Table 5-14
SCSI Bus Timing Values

	Timing Value *		
Timing Description	***fast***	***slow***	***asynch***
Arbitration Delay	2.4 µs	2.4 µs	2.4 µs
Bus Clear Delay	800 ns	800 ns	800 ns
Bus Free Delay	800 ns	800 ns	800 ns
Bus Set Delay	1.8 µs	1.8 µs	1.8 µs
Bus Settle Delay	400 ns	400 ns	400 ns
Cable Skew Delay [1]	4 ns	4 ns	4 ns
Data Release Delay	400 ns	400 ns	400 ns
Receive Assertion Period	22 ns	70 ns	n/a
Receive Hold Time	25 ns	25 ns	n/a
Receive Negation Period	22 ns	70 ns	n/a
Receive Setup Time	15 ns	15 ns	n/a
Reset Hold Time	25 µs	25 µs	25 µs
Selection Abort Time	200 µs	200 µs	200 µs
Selection Time-out Delay [2]	250 ms	250 ms	250 ms
System Deskew Delay	20 ns	45 ns	45 ns
Transmit Assertion Period	30 ns	80 ns	n/a
Transmit Hold Time	33 ns	53 ns	n/a
Transmit Negation Period	30 ns	80 ns	n/a
Transmit Setup Time	23 ns	23 ns	n/a

Notes:

1 This time does not apply at the SCSI connector of the drive.

2 This is a recommended time. It is not mandatory.

Model CFP1060W (Wide, Unitized SCSI-3 P-Connector)

External Terminator Power

Power to the on-board terminators is provided by the higher of the voltage supplied at Pin #17, 18, 51, & 52, J2 or the voltage level at the 5 Volt power input to the drive minus one diode drop. The diode prevents back flow of current to the drive. Termination Power to external terminators can be supplied by the drive through Pin #17, 18, 51, & 52, J2. The TERMPWR line can be disconnected from the drive by removing Jumper E8. Table 5-11 describes the electrical characteristics of the TERMPWR line when it is used to supply power to an external terminator.

Table 5-15
TERMPWR Electrical Output Characteristics

Signal Characteristic	*Value*
Supply voltage	4.06 VDC to 4.56 VDC (dependent on power supplied to the drive)
Minimum source capability:	1500 mA

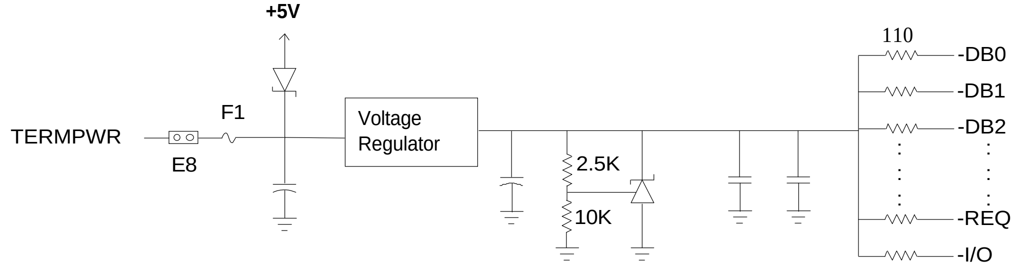
Table 5-16
TERMPWR Input Electrical Characteristics

Signal Characteristic	*Value*
Input voltage	4.00 VDC to 5.25 VDC
Minimum source capability:	1500 mA (fused at 1500 mA)
Sink current:	1.0 mA maximum, excluding power to the internal terminator.

Internal Termination

This drive provides on-board Alternative 2 active termination for the SCSI bus. The termination resistors, which are contained in three Single Inline Packs (SIPs) should be removed from the drive unless it is a SCSI device at a physical end of the bus. The terminator equivalent circuit is shown below for reference:

Figure 5-2
Terminator Equivalent Circuit



J5 Auxiliary Connector Signal Characteristics

Table 5-17
J5 Auxiliary Interface Electrical Characteristics

State	Current	Voltage
High	$0 < I_{IH} < 20\ \mu A$	$2.5\ V < V_{IH} < V_{CC} + 0.3\ V$
Low	$0 < I_{OH} < -48\ mA$	$-0.1\ V < V_{IL} < 0.4\ V$

Cable Requirements

A 68 conductor cable no more than 3 meters (9.84 feet) cumulative length with at least 30 AWG wire size and a characteristic impedance of 70 to 100 ohms (84 ohms nominal) is required. In systems which use the fast synchronous transfer option, the cable should meet the following additional requirements:

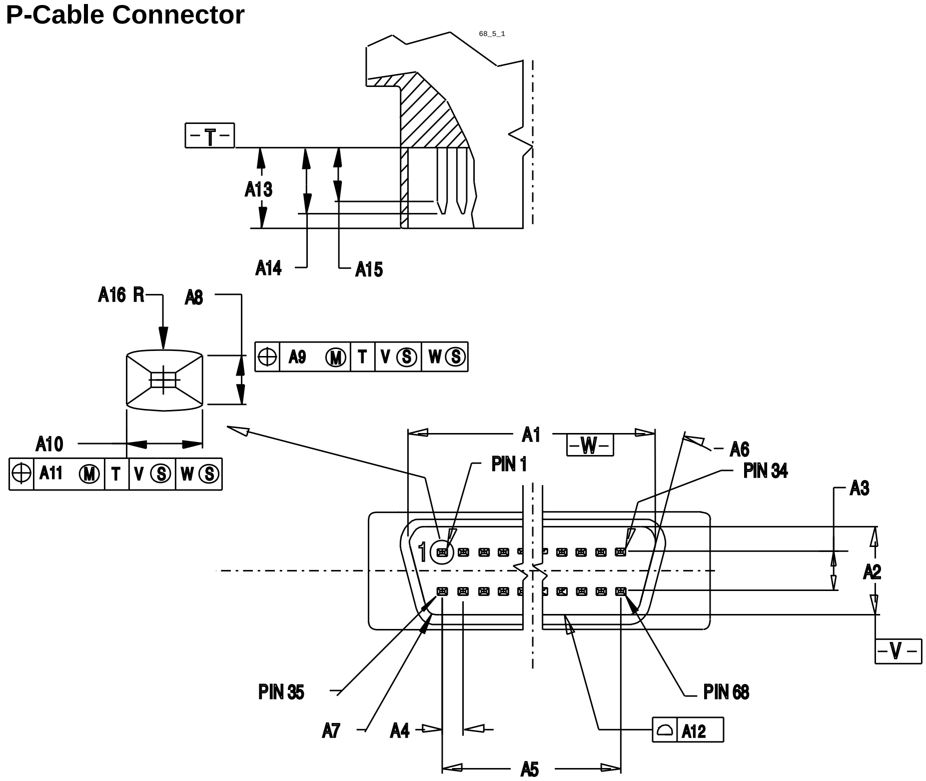
Table 5-18
Interface Cable Electrical Characteristics

Specification	Value
Signal Attenuation	0.095dB maximum per meter at 5 Mhz
Pair-to-Pair Propagation Delay Delta	0.20 ns maximum per meter
DC Resistance	0.230 ohms maximum per meter at 20° C

Connector Requirements

The connector on the drive is a 68-pin . The mating connector is a SCSI 3 Non-shielded P-cable connector which is shown below:

Figure 5-4
P-Cable Connector



DIMENSIONS	Millimeters	Inches
A1	46.28	1.822
A2	5.69	0.224
A3	2.54	0.100
A4	1.27	0.050
A5	41.91	1.650
A6	15°	15°
A7	1.04 R	0.041 R
A8	0.396 ± 0.010	0.0156 ± 0.0004
A9	0.23	0.009
A10	0.60 ± 0.03	0.024 ± 0.001
A11	0.23	0.009
A12	0.05	0.002
A13	5.15 ± 0.15	0.203 ± 0.006
A14	4.39 MAX	0.173 MAX
A15	3.02 MIN	0.119 MIN
A16	1.02 ± 0.25	0.040 ± 0.010

Interface Pin Assignments

The pin assignments for the interface connector are shown below:

Table 5-19
Interface Signal Definitions

Pin	Signal	Pin	Signal
1	Ground	35	-DB(12)
2	Ground	36	-DB(13)
3	Ground	37	-DB(14)
4	Ground	38	-DB(15)
5	Ground	39	-DB(P1)
6	Ground	40	-DB(0)
7	Ground	41	-DB(1)
8	Ground	42	-DB(2)
9	Ground	43	-DB(3)
10	Ground	44	-DB(4)
11	Ground	45	-DB(5)
12	Ground	46	-DB(6)
13	Ground	47	-DB(7)
14	Ground	48	-DB(P)
15	Ground	49	Ground
16	Ground	50	Ground
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	Reserved	53	Reserved
20	Ground	54	Ground
21	Ground	55	--ATN
22	Ground	56	Ground
23	Ground	57	-BSY
24	Ground	58	-ACK
25	Ground	59	-RST
26	Ground	60	-MSG
27	Ground	61	-SEL
28	Ground	62	-C/D
29	Ground	63	-REQ
30	Ground	64	-I/O
31	Ground	65	-DB(8)
32	Ground	66	-DB(9)
33	Ground	67	-DB(10)
34	Ground	68	-DB(11)

Notes:
1. The minus sign (-) indicates active low.
2. Pins marked Reserved are not connected.

Interface Timing Requirements

Unless otherwise noted, the delay-time measurements are calculated from signal conditions existing at the drive's own SCSI bus connector. Normally these measurements (except cable skew delay) can be made without considering delays in the cable.

Table 5-20
SCSI Bus Timing Values

	Timing Value *		
Timing Description	***fast***	***slow***	***asynch***
Arbitration Delay	2.4 µs	2.4 µs	2.4 µs
Bus Clear Delay	800 ns	800 ns	800 ns
Bus Free Delay	800 ns	800 ns	800 ns
Bus Set Delay	1.8 µs	1.8 µs	1.8 µs
Bus Settle Delay	400 ns	400 ns	400 ns
Cable Skew Delay [1]	4 ns	4 ns	4 ns
Data Release Delay	400 ns	400 ns	400 ns
Receive Assertion Period	22 ns	70 ns	n/a
Receive Hold Time	25 ns	25 ns	n/a
Receive Negation Period	22 ns	70 ns	n/a
Receive Setup Time	15 ns	15 ns	n/a
Reset Hold Time	25 µs	25 µs	25 µs
Selection Abort Time	200 µs	200 µs	200 µs
Selection Time-out Delay [2]	250 ms	250 ms	250 ms
System Deskew Delay	20 ns	45 ns	45 ns
Transmit Assertion Period	30 ns	80 ns	n/a
Transmit Hold Time	33 ns	53 ns	n/a
Transmit Negation Period	30 ns	80 ns	n/a
Transmit Setup Time	23 ns	23 ns	n/a

Notes:

1 This time does not apply at the SCSI connector of the drive.

2 This is a recommended time. It is not mandatory.

SCSI Command Implementation 6

This section contains a brief summary of the SCSI Interface implemented in the drive. For additional details regarding command descriptions, please refer to the Ninth Generation SCSI Interface Manual.

SCSI Command Summary

Following is a list of commands that the drive supports:

Format Unit	04H
Inquiry	12H
Mode Select	15H
Mode Sense	1AH
Read (6)	08H
Read Buffer	3CH
Read Capacity	25H
Read Defect Data	37H
Read Extended (10)	28H
Read Long	3EH
Reassign Blocks	07H
Receive Diagnostics	1CH
Release	17H
Request Sense	03H
Reserve	16H
Re-zero Unit	01H
Seek (6)	0BH
Seek Extended (10)	2BH
Send Diagnostic	1DH
Start/Stop Unit	1BH
Test Unit Ready	00H
Verify	2FH
Write (6)	0AH
Write Extended (10)	2AH
Write and Verify	2EH
Write Buffer	3BH
Write Long	3FH

Drive Dependent SCSI Data

Format Drive Page - 03_H

The Format Drive page contains parameters which specify the medium format.

Table 6-1
Format Drive Page Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Rsvd	Rsvd	Page Code = 03_H					
1	Page Length = 16_H							
2	Tracks per Zone (MSB) (00_H)							
3	Tracks per Zone (LSB) (01_H)							
4	Alternate Sectors per Zone (MSB) (00_H)							
5	Alternate Sectors per Zone (LSB) (01_H)							
6	Alternate Tracks per Zone (MSB)							
7	Alternate Tracks per Zone (LSB)							
8	Alternate Tracks per Logical Unit (MSB)							
9	Alternate Tracks per Logical Unit (LSB)							
10	Sectors per Track (MSB) (00_H)							
11	Sectors per Track (LSB) ($40*_H$)							
12	Data Bytes per Physical Sector (MSB) (02_H)							
13	Data Bytes per Physical Sector (LSB) (00_H)							
14	Interleave (MSB) (00_H)							
15	Interleave (LSB) (01_H)							
16	Track Skew Factor (MSB) (00_H)							
17	Track Skew Factor (LSB) (05_H)							
18	Cylinder Skew Factor (MSB) (00_H)							
19	Cylinder Skew Factor (LSB) ($0C_H$)							
20	SSEC	HSEC (1)	RMB	SURF	Reserved			
21-23	Reserved							

* *Varies depending on active notch.*

Tracks Per Zone: Defines the number of tracks per zone to use in dividing the capacity of the drive for the purpose of allocating alternate sectors. A value of zero means that one zone is defined for the entire drive.

Alternate Sectors Per Zone: Defines the number of spare sectors per zone the drive reserves for defect handling. Not supported. Must be set to zero.

Alternate Tracks Per Logical Unit: Not supported. Must be set to zero.

Sectors Per Track: Defines the number of physical sectors per track. The number includes the one alternate sector per track the drive allocates. The value reported for the number of sectors per track is dependent on the active notch value.

Data Bytes Per Physical Sector: Defines the number of data bytes per physical sector.

Interleave: Defines the interleave value used by the drive.

Track Skew Factor: Defines the number of physical sectors between the last logical block of one track, and the first logical block on the next sequential track of the same cylinder.

Cylinder Skew Factor: Specifies the number of physical sectors between the last logical block of one cylinder and the first logical block on the next sequential cylinder.

SSEC (Soft Sector Format): Set to zero to indicate the drive does not support a soft sector format.

HSEC (Hard Sector Format): Set to one to indicate the drive supports a hard sector format.

RMB (Removable Media): Set to zero to indicate the drive does not have removable media.

SURF (Surface Format): The SURF bit is set to zero, meaning the drive allocates progressive addresses to all logical blocks within a cylinder prior to allocating addresses on the next cylinder.

Drive Geometry Page - 04_H

Table 6-2
Drive Geometry Page

Bit ***Byte***	***7***	***6***	***5***	***4***	***3***	***2***	***1***	***0***
0	Rsvd	Rsvd	Page Code = 04_H					
1	Page Length = 16_H							
2	Number of Cylinders (MSB) (00_H)							
3	Number of Cylinders ($0A_H$)							
4	Number of Cylinders (LSB) ($C4_H$)							
5	Number of Heads (08_H)							
6	Starting Cylinder - Write Precompensation (MSB) (00_H)							
7	Starting Cylinder - Write Precompensation (06_H)							
8	Starting Cylinder - Write Precompensation (LSB) (00_H)							
9	Starting Cylinder - Reduced Write Current (MSB)							
10	Starting Cylinder - Reduced Write Current							
11	Starting Cylinder - Reduced Write Current (LSB)							
12	Drive Step Rate (MSB)							
13	Drive Step Rate (LSB)							
14	Landing Zone Cylinder (MSB)							
15	Landing Zone Cylinder							
16	Landing Zone Cylinder (LSB)							
17	Reserved						RPL (0_H)	
18	Rotational Offset							
19	Reserved							
20	Medium Rotation Rate (MSB) (15_H)							
21	Medium Rotation Rate (LSB) (18_H)							
22-23	Reserved							

* *Varies depending on active notch.*

Only one copy of this page is maintained. There is only one changeable field, RPL. All other fields are described in the MODE SENSE Command.

RPL (Rotational Position Locking): Enables spindle synchronization. Setting either bit 0 or 1, or both, causes multiple drives which have their spindle synchronization (SS) pins daisy chained together to synchronize their spindles.

Notch and Partition Parameters Page - $0C_H$

The Notch and Partition Parameters Page contains information which pertains to each notch of the drive. Each section of the drive with a different number of logical blocks per cylinder is referred to as a notch or zone. Only one copy of this page is maintained. The only changeable field in this page is Active Notch.

Table 6-3
Notch and Partition Parameters Page Format

Bit *Byte*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Rsvd	Rsvd	Page Code - OC_H					
1	Page Length = 16_H							
2	ND (1)	LPN	Reserved					
3	Reserved							
4	Maximum Number of Notches (MSB) (00_H)							
5	Maximum Number of Notches (LSB) (09_H)							
6	Active Notch (MSB) (00_H)							
7	Active Notch (LSB) (0_H)				($9*_H$)			
8	Starting Boundary (MSB) ($00*_H$)							
9	Starting Boundary ($0A*_H$)							
10	Starting Boundary ($65*_H$)							
11	Starting Boundary (LSB) ($00*_H$)							
12	Ending Boundary (MSB) ($00*_H$)							
13	Ending Boundary ($0A*_H$)							
14	Ending Boundary ($CB*_H$)							
15	Ending Boundary (LSB) ($00*_H$)							
16	3F	Pages Notched (MSB)						38
17	37	Pages Notched						30
18	2F	Pages Notched						28
19	27	Pages Notched						20
20	1F	Pages Notched						18
21	17	Pages Notched						10
22	0F	Pages Notched (10_H)						08
23	07	Pages Notched (LSB) (08_H)						00

* *Varies depending on active notch.*

ND (Notched Drive): If set to zero, the drive is not notched and all other parameters in this page are returned as zeros. If set to one, the drive is notched and this page defines the starting and ending boundaries for each active notch. This parameter is always set to one.

LPN (Logical or Physical Notch): When set to zero, indicates the notch boundaries are physical addresses (i.e., cylinder and head). An LPN bit of one is not supported.

The **Maximum Number of Notches** field indicates the maximum number of notches supported by the drive.

The **Active Notch** field indicates which notch is being referred to by this and subsequent MODE SELECT and MODE SENSE commands, until changed by a later MODE SELECT command. Active notches are numbered beginning from one up to the maximum number of notches.

The **Starting Boundary** field indicates the beginning of the active notch; the three most significant bytes represent the cylinder number and the least significant byte represents the head number.

The **Ending Boundary** field indicates the ending of the active notch; the three most significant bytes represent the cylinder and the least significant byte represents the head number.

The **Pages Notched** field is a bit map of the MODE SELECT page codes which indicates the pages containing parameters that are changed for different notches. The most significant bit of this field corresponds to page code 3F and the least significant bit represents page code 0. If a bit is a one, the corresponding MODE SELECT page contains parameters that are changed for different notches. If a bit is a zero, the corresponding MODE SELECT page parameters are constant for all notches.