

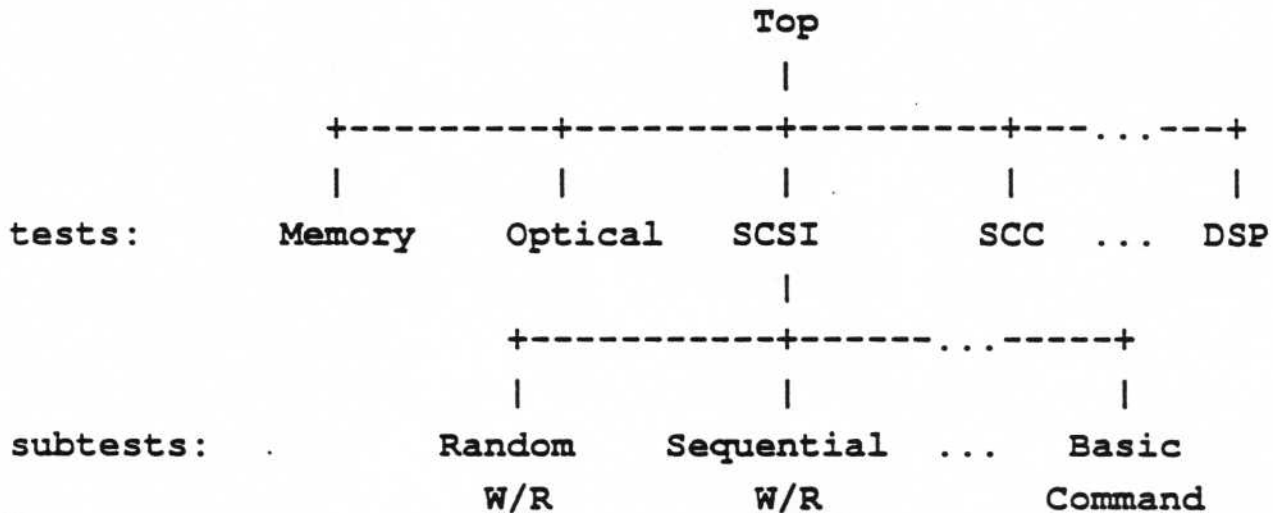
## NeXT Design Verification Test (DVT)

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### \* Features

- \* Standalone - does not run under Mach
- \* Boots from Ethernet, SCSI, or Optical Disk
- \* Tests Hardware ONLY
- \* Setup is menu driven; no similarity to NeXTStep
- \* Hands-off operation
- \* tests > 95% of hardware
  - \* does NOT test
    - \* Ethernet receive CRC checker
    - \* Data integrity out to printer. Must be done visually.
    - \* Data integrity of sound in
    - \* Video alignment. Must be done visually.
    - \* DSP Serial port
    - \* FPU (MC68881)
- \* Common User-specifiable Modes
  - \* Loop/Single Pass
  - \* Pause on Error/Halt On Error
  - \* Multiple/Single test Selection

\* Test/subtest hierarchy



- \* Tests are either "Enabled" or "Disabled"
- \* Subtests have loop counts; a loop count of 0 disables the subtest. A loop count of 'n' means that the subtest will run for 'n' loops before the next subtest runs.

\* Menu Overview

\* Common features

- \* Select entry w/single keystroke, no CR
- \* 'h' is HELP
- \* 'x' is EXIT to calling menu
- \* ESC all the way to top of calling sequence
- \* Radix ALWAYS displayed - (d) or H
- \* Types of menu entries
  - \* Name of another menu
  - \* Variable
    - \* Boolean - selecting toggles
    - \* Numeric
      - \* User is prompted, with a default taken for CR
      - \* Enter number in same radix it's displayed
    - \* Command - selecting executes the command

\* Tests

- \* Memory
- \* Optical Disk
- \* Monitor/Sound
- \* SCC
- \* DSP (56001)
- \* Ethernet
- \* Memory-to-Memory DMA
- \* Two-bit Graphics
- \* SCSI
- \* Laser Printer
- \* Timer



## 1. What is Magneto-Optic Storage ?

### - The 3rd Generation Technology of the Optical Disk Storage. -

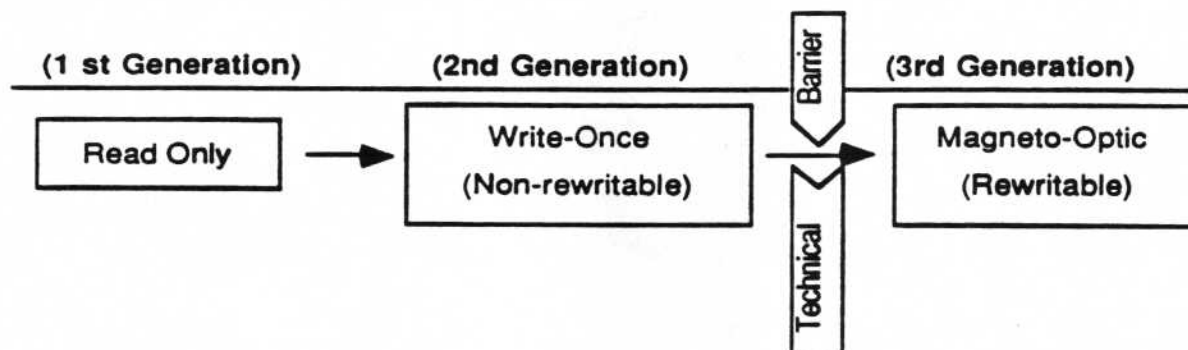
The **1st Generation** optical disk storage technology started with ROM or read only type. Examples of this are CD (Digital Audio Disc), Laser Vision (Video Disc) and CD-ROM. The basic mechanism is just like that of phonography except its data pattern is very small and reading is done with diode laser beam instead of stylus. ROM discs only replay information stamped at the disc plant. As of last year, CD already has dominated the conventional phonography which have been around since Edison.

Desire for writing your information generated the **2nd Generation** optical storage technology, called write-once (WORM). You can write information at will, but disadvantage is you can do it only once since the recording is done by generating an irreversible chemical or physical changes such as ablation and phase transition of amorphous materials with strong laser heat on a very thin recording layer. Write-once has been on the market for several years. However the applications have been limited to document filing system because of the limitation of write-once.

Write-once technology was developed because the rewritable optical technology seemed to be too great a technology hurdle several years ago.

Today, by breaking through difficult technical barrier, the **3rd Generation** rewritable optical technology is a reality. Three types of the rewritable optical technologies have been investigated so far. They are the Magneto-Optic, the reversible phase transition between crystal and amorphous state and the bubble formation of organic dye/polymer layer.

The M.O. technology has become available as the commercial product in advance of the other two types while they are fighting with such the problems as poor environmental stability and poor erase cycles.



## 2. What is the Erase/Write Principle?

### - Thermo-Magnetic Recording by Laser -

Basically M.O. is the **Thermo-magnetic recording** onto the **perpendicular magnetic** recording thin film by means of laser spot. The Perpendicular magnetic film means that the **magnetic moments** which generate magnetic field are oriented vertical to the recording layer. The conventional magnetic recordings have been done horizontally to the recording layer.

M.O. recording layer has the magnetic hysteresis as shown in the Fig. 2. 1. known as the **hysteresis loop** or the **magnetization curve**. The **coercive force** (H) represents the strength of magnetic property. At room temperature, M.O. layer has large coercive force (H<sub>R</sub>). When laser spot is exposed onto the M.O. layer, laser light is absorbed by the M.O. material and is converted into heat. This heat increases the temperature of the M.O. layer. As temperature goes up, the hysteresis loop shrinks and the coercive force becomes to zero at its **Curie Temperature** which is specific to M.O. layer material. When laser exposure is removed, the temperature of the M.O. layer decreases back to room temperature. During this cooling process, the coercive force increases again along the H<sub>c</sub> curve in Fig. 2. 1. (arrow B). If at this time, the **bias magnetic field** is applied to the opposite polarity direction to its original magnetic moment, the resulted direction of magnetic moment becomes just opposite to that of before the laser exposure. For example N -> S becomes S -> N.

This means that only the small spot area on the M.O. layer which is exposed by laser is altered to have the opposite magnetic moment orientation from the surrounding area. This is called as **magnetic domain**.

The generation process of the magnetic domain is used for writing the M.O. layer. The erasure can be done by applying an opposite bias magnetic field polarity in the same process as writing.

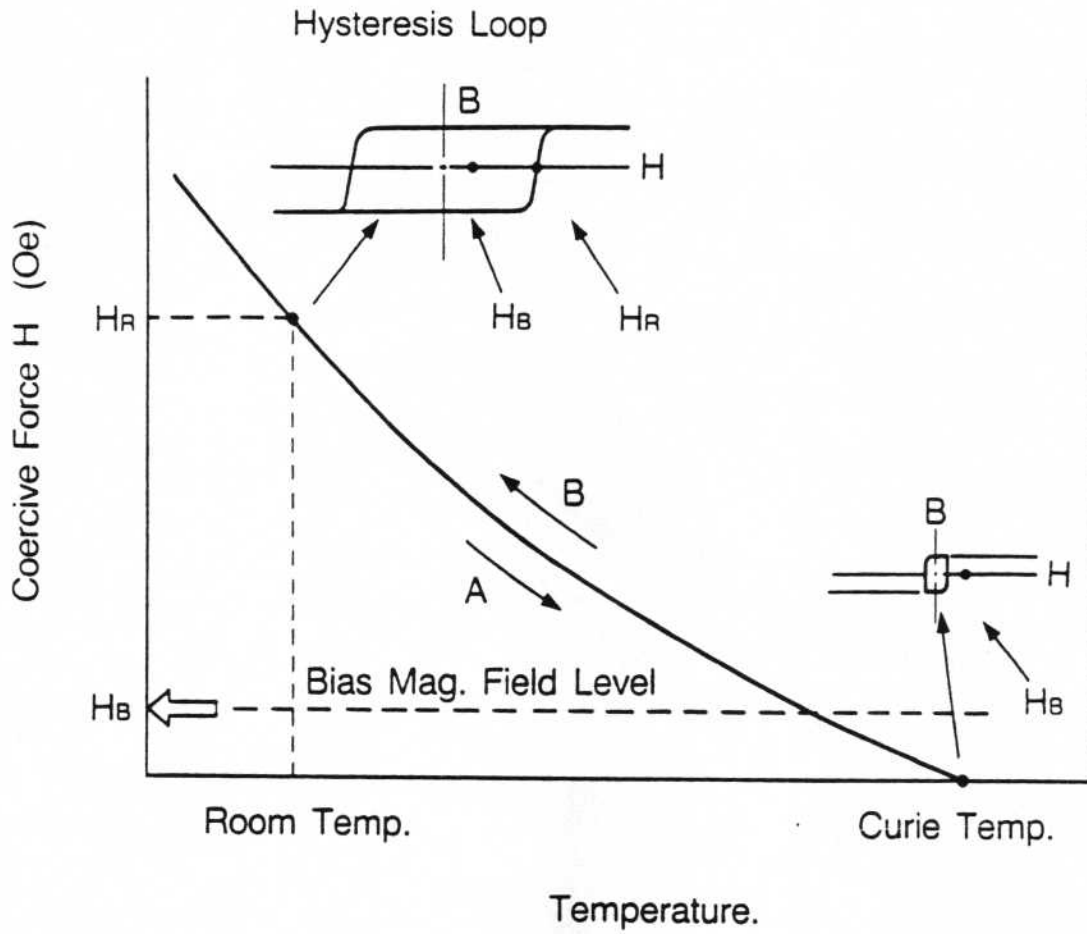


Fig. 2. 1. Erase/Write Principle

### 3. What is the Read Principle?

#### - Kerr Effect Reading by Laser -

Reading of the small magnetic domain in the M.O. layer is done by using either **Kerr Effect** or **Faraday Effect** which have been known since the late 1800's.

As shown in Fig. 3.1, when a polarized laser beam is reflected by the perpendicularly oriented M.O. layer surface, the **polarization angle** is twisted by small angle as expressed as  $\theta_k$ , (**Kerr Rotation**). Furthermore the direction of this twist is opposite according to the orientation direction of the perpendicular magnetic moment, which is either upward or downward. Therefore, there is a total of  $2\theta_k$  difference of the polarized surface angle between the two reflected lights from upward and downward oriented magnetic domains. Reading is done by detecting this difference.

The difficulty in M.O. technology has been that this Kerr Rotation ( $\theta_k$ ) is so small angle (approximately 0.3~0.4 degree). It is not enough for getting good **carrier to noise ratio** (C/N) of M.O. signal. Most of the development efforts have been on improving this carrier to noise ratio. As the result of the improvements in the M.O. media materials and layer configuration, optical head system and electronics, the M.O. storage system has become a commercial product.

If the rotation angle is detected in the mode of transmission beam, in stead of reflection, it is called the Faraday Rotation. The most of the commercial M.O. systems are expected to use Kerr Effect.

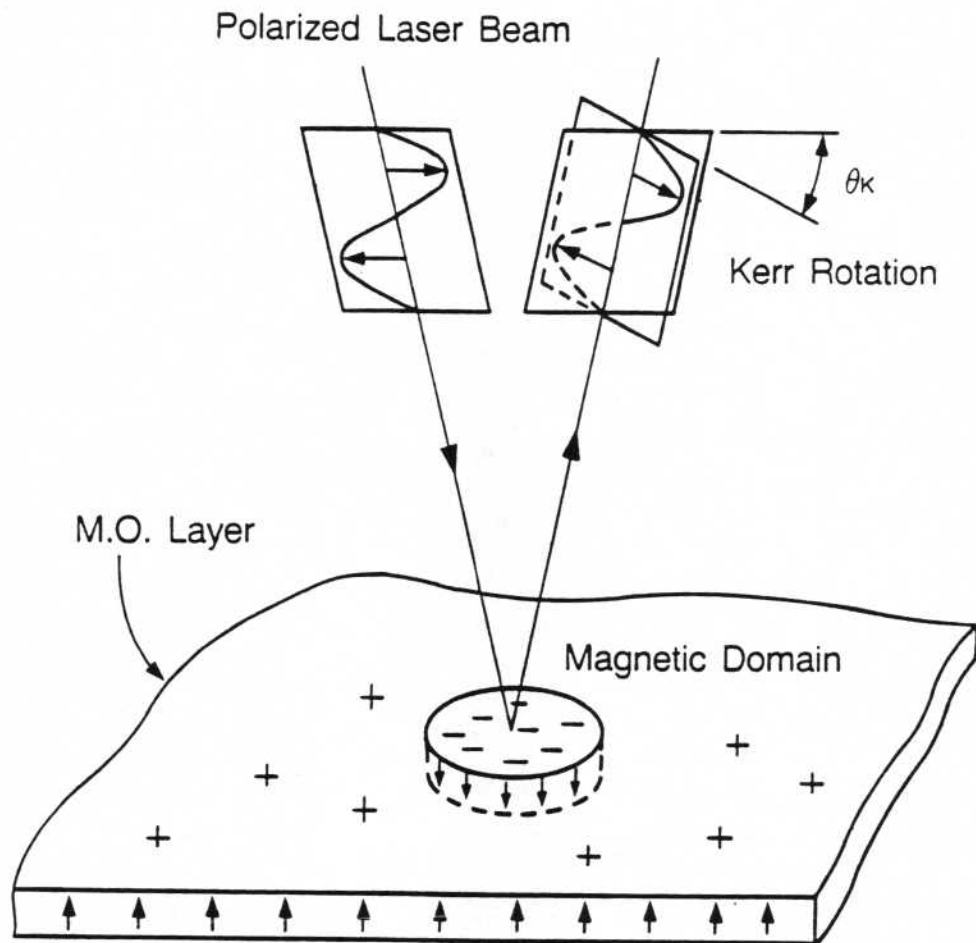


Fig. 3.1 Read Principle

## 4. What is the Tracking Servo Principle?

### -The Push-Pull Servo of Pre-groove -

Several **auto-tracking servo** technologies have been researched. Among them the **push-pull servo** using the **pre-stamped groove** (tracking guide), seems to have become popular. The following explains the principle of push-pull servo.

A very narrow and shallow tracking guide of  $0.4 \mu\text{m}$  ( $4,000 \text{ \AA}$ ) width and  $800 \text{ \AA}$  (angstrom) depth is applied with a **track pitch** of  $1.6 \mu\text{m}$  onto the disk substrate before the deposition of the M.O. layer, by means of either pre-stamping or 2P (**photo-polymer**) process as shown in Fig. 4. 1.

The push-pull servo is the **closed loop** auto-tracking technology which follows exactly on this groove using the same laser beam as read/write/erase of M.O. data. The **tail portions** of the **laser power Gaussian distribution** are used for tracking while the center portion, which is higher than **threshold level**, is used for write/erase (it is shown in Fig. 4. 1.).

As it is shown in Fig. 4. 2. the **reflected** and/or **diffracted** light from the M.O. layer surface is detected by the **quadruple photo sensors**.

Because of the difference of the reflection and/or diffraction patterns as shown with the shadowed portion in Fig. 4. 2. according to **on-track** or **off-tracks**, the exposed pattern on the quadruple photo sensors vary.

Outputs from quadruple sensors are calculated and the result is feed-back into a voice coil type objective lens **actuator** in order to compensate for positional deviations from the center of the groove.

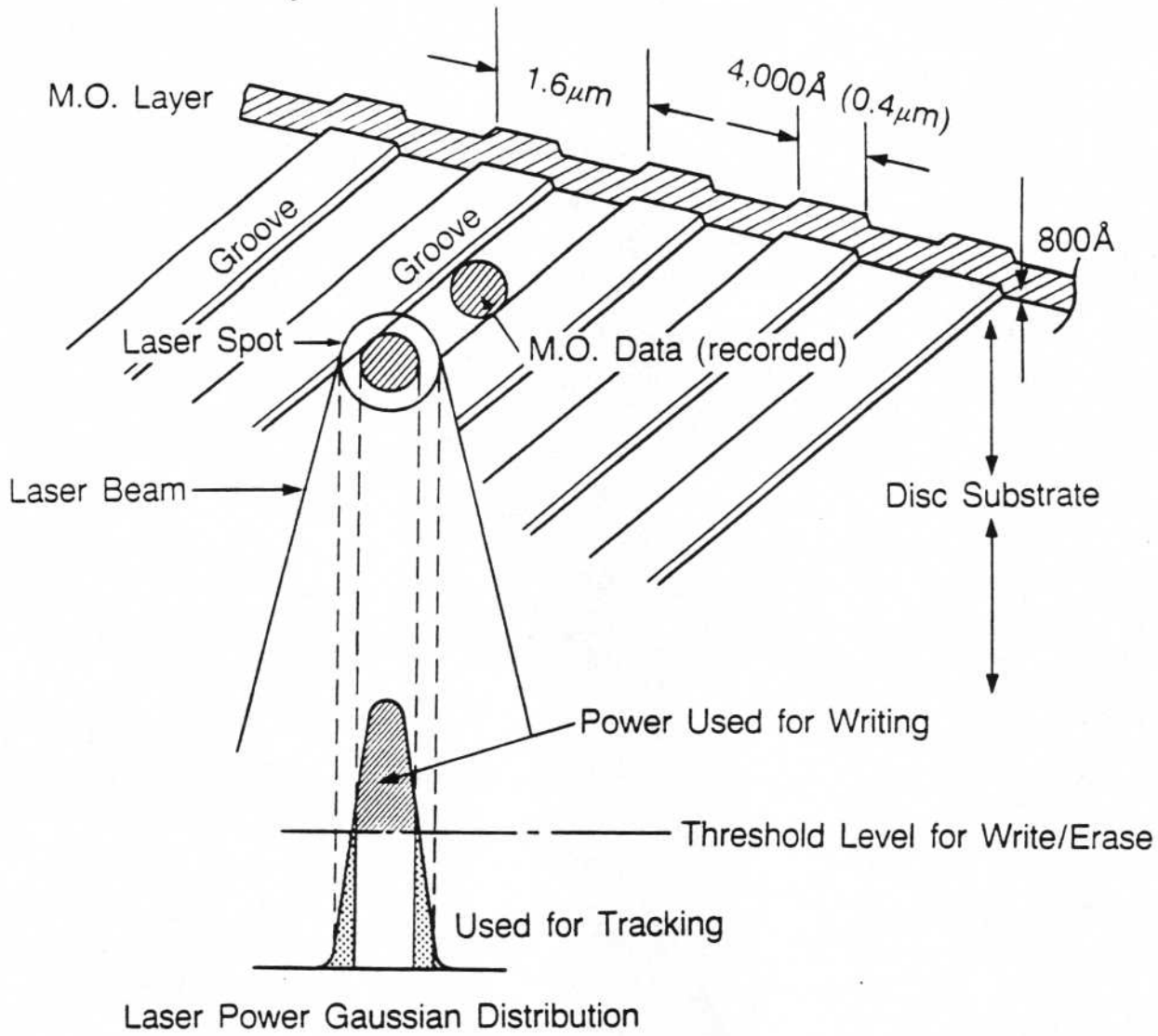
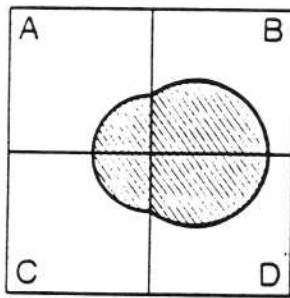
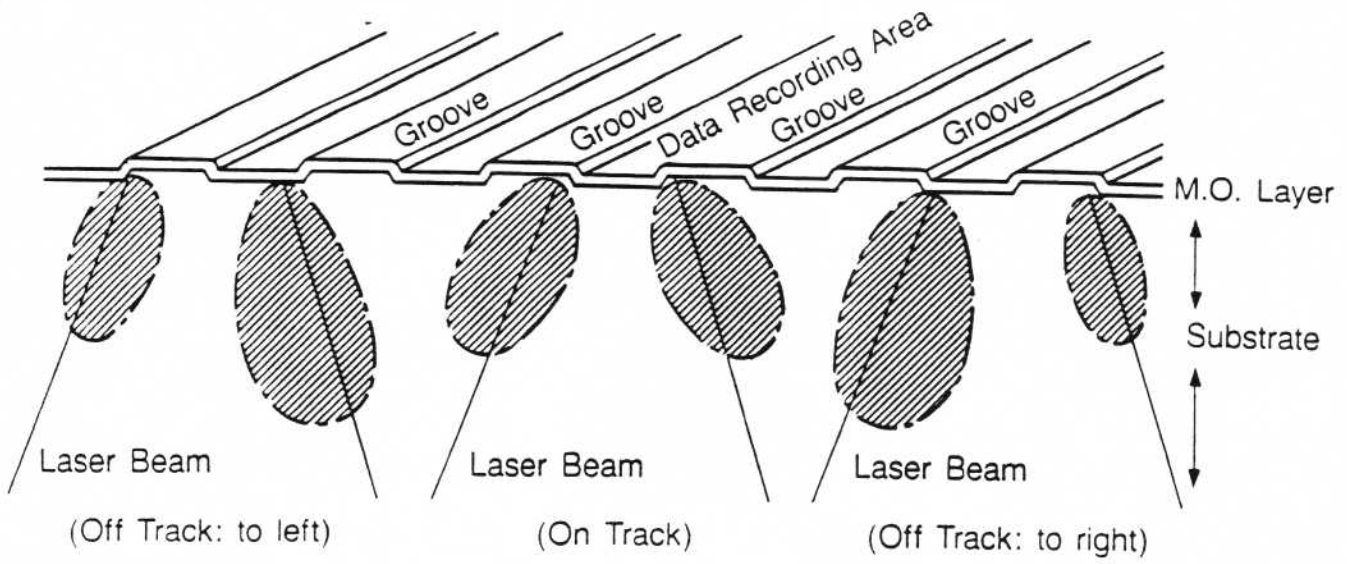
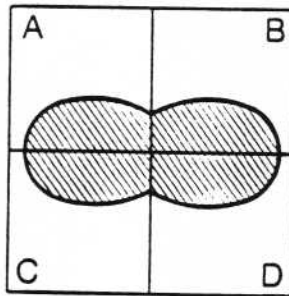


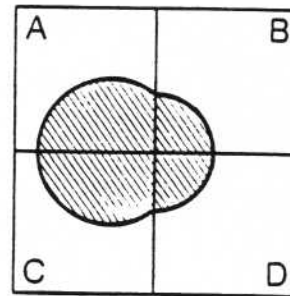
Fig. 4. 1. Disk Groove Configuration and Laser Spot



$A+C < B+D$



$A+C = B+D$



$A+C > B+D$

Pattern on quadruple photo sensor

Detected Signal

Fig. 4. 2. Principle of Push-Pull Servo



## 5. What are the Theoretical Advantages of M.O. Tech. over conventional Magnetic Technologies?

### -- Disk Removability and Interchangeability, High Areal Density and High Data Stability --

From its origin, M.O. disk storage technology has principal advantages over magnetic disk storage technology. They are defined as the the following:

- ◆ Disk Removability and Interchangeability-medium can be removed and interchanged among drives.
- ◆ High Areal Density - areal density is more than a magnitude higher than of the highest density magnetic disks.
- ◆ High Data Stability - recorded data are stable for more than ten years without rewriting.

The following explains the theoretical reasons for the advantages of M.O. storage technology.

#### 5. 1 Defocus Effect : Exceptional Reliability against Dust/Scratches, Removability.

Even with its very high density, optical recording is exceptionally well against the dust and scratches on the recording media as compared to conventional magnetic storage with the comparable linear recording density. The key is what is known as the **defocus effect** of the optical disk storage. This provides M.O. disk storage the essential advantage of the disk removability .

As shown in Fig. 5. 1, the read/write/erase are done from the side of **transmissive disk substrate**. By using an objective lens with high numerical aperture, the laser beam is sharply focused onto the M.O. recording layer. Even though the spot size of recording area is less than one  $\mu\text{m}$  in diameter, the beam incident area at the disk surface is more than one thousand times larger in diameter and more than one million times larger in area. Because of this, the effect of dust or scratches on the disk surface is about one million times less harmful. This is called as the **defocus effect** of optical disk storage.

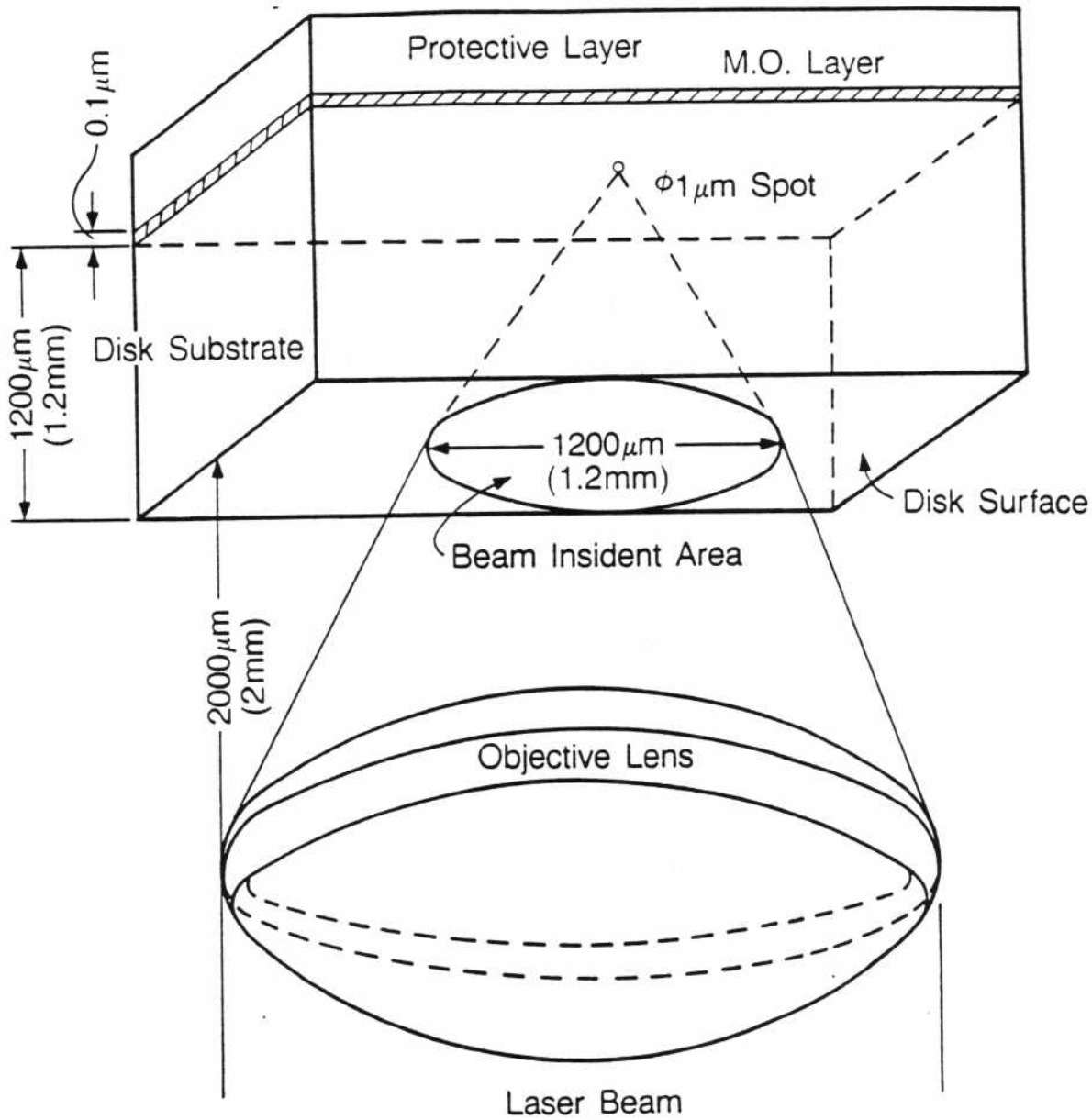


Fig. 5. 1. Defocus Effect (not to the scale)

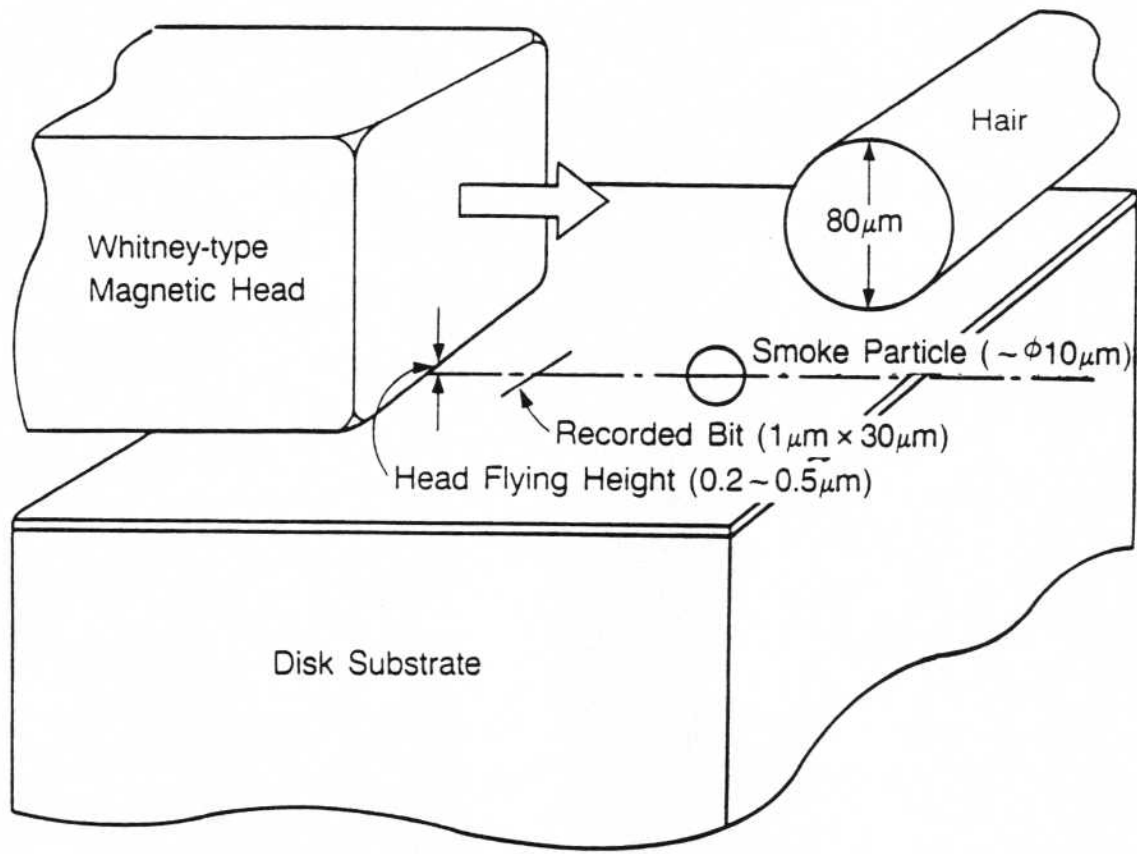


Fig. 5. 2. Dust Trouble of Magnetic Storage

When compared magnetic winchester drives, dust and scratches are very destructive since they are contact systems.

As shown in Fig. 5. 2. dust and scratches of one  $\mu\text{m}$  size is critical for read/write of magnetic recording signal since the flying height of Whitney magnetic head is as low as  $0.2\sim 0.5 \mu\text{m}$ . Dusts in the air are at least several micro-meter ( $\mu\text{m}$ ) in size and the size of smoke particle is close to  $10 \mu\text{m}$ . The diameter of human hair is about  $80\sim 100 \mu\text{m}$ . This is several hundreds times larger than the gap between head and media. This is one of the essential reason why high density magnetic disks has to be enclosed in the dust free clean box and why they are not removable.

## 5. 2 No Head/Media Contact : No Head Crash and Wear Down.

As it is shown in Fig. 5. 1, the objective lens of the optical head unit is located at about 2mm distance from the surface of M.O. disk. This means that the M.O. disk drive system is completely the **non-contact** system. Therefore the wear down or the head crash which are the critical problems for the magnetic tape system and the magnetic disk system are not a trouble at all for M.O. disk storage system.

## 5. 3 Optical Servoing : High Areal Density and Disk Interchangeability.

The ability to do closed loop **auto-focusing** and auto-tracking using the same laser beam during reads, writes and erases provides another key advantage over typical magnetic storage. Auto-tracking, which is explained in section 4, is the key to more than magnitude of one order higher **track density** than magnetic storage. The track pitch of M.O. disk storage is  $1.5 \sim 1.6 \mu\text{m}$  while the latest magnetic hard disk track pitch is  $20 \sim 30 \mu\text{m}$ .

This has resulted in an areal density of about more than 10 times greater than magnetic storage even though the **linear recording density** is about the same.

The tracking of typical magnetic disk drives is done using **open loop** mechanical positioning. This limits the track pitch because there are variations in mechanical dimensions of disk and head hold arm which are effected by temperature. This open loop tracking makes the magnetic storage difficult to achieve the disk

interchangeability since a disk clamping mechanism causes the disk **excenterisity** of at least 50  $\mu\text{m}$  which is more than the track pitch of high density magnetic storage.

## 5. 4 High Coercivity : High Data Stability

The **coercivity** of M.O. layer at room temperature can be designed to be more than ten times higher than magnetic storage. It is because, the erases and writes of data are done at an elevated temperature, and the coercivity becomes low enough to reverse polarity by a low bias magnetic field at such the elevated temperature (it is explained in section 2.).

In case of magnetic recording, the reverse of the magnetic moment is done by magnetic field from a magnetic head at room temperature. Because of this, the coercivity of the magnetic recording layer can not be as high. The small magnetic head flying above media can not generate a very high magnetic field which is sufficient enough to reverse the magnetic moment of high coercivity.

The coercivity of M.O. layer can be more than 20 kOe while magnetic recording can be at most 800~900 Oe. The higher the coercivity, the better the stability against the **self-demagnetization** of the written data. This high coercivity results in very high a data stability of more than ten years without need for rewriting data. In case of the magnetic tape and the magnetic hard disk storage, rewriting is required once every one to three years.

Additionally, M.O. disk can be designed to be extremely stable against erase of data by magnet or electromagnetic field. This added protection is achieved because the M.O. layer is under a thick disk substrate. Even in a situation where a piece of strong magnet comes in contact with the media, the data will not be erased.

## 5. 5 Perpendicular Magnetic Recording : High Data Stability.

Beside the high coercivity already discussed in section 5. 4, perpendicular magnetic recording provides another reason for high data stability in high density recording. The magnetic moment of the recorded data becomes energetically stable because of a **closed magnetic field flux loop** as shown in Fig. 5. 3. In contrast to this, the horizontal magnetic recording which is commonly used in magnetic storage, the recorded data becomes energetically unstable because the magnetic field flux loop of the data area is repulsive against the surrounding area and works as the self-demagnetization force (it is shown in Fig. 5. 3).

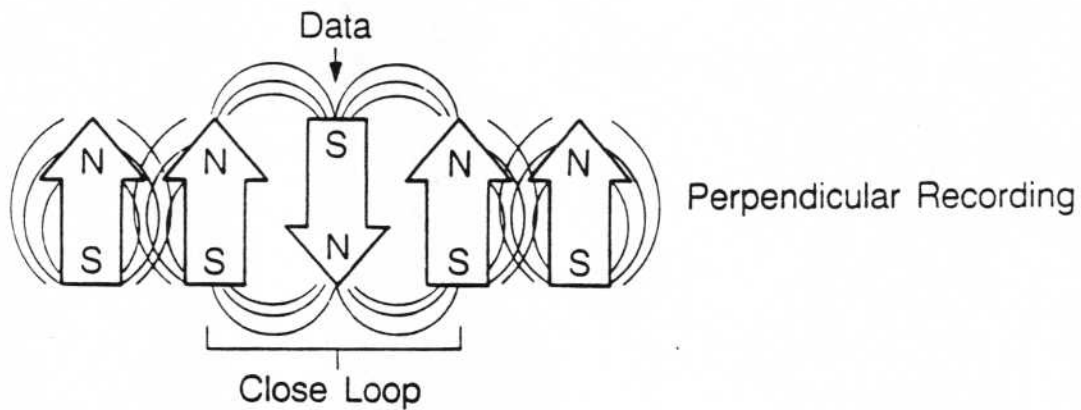
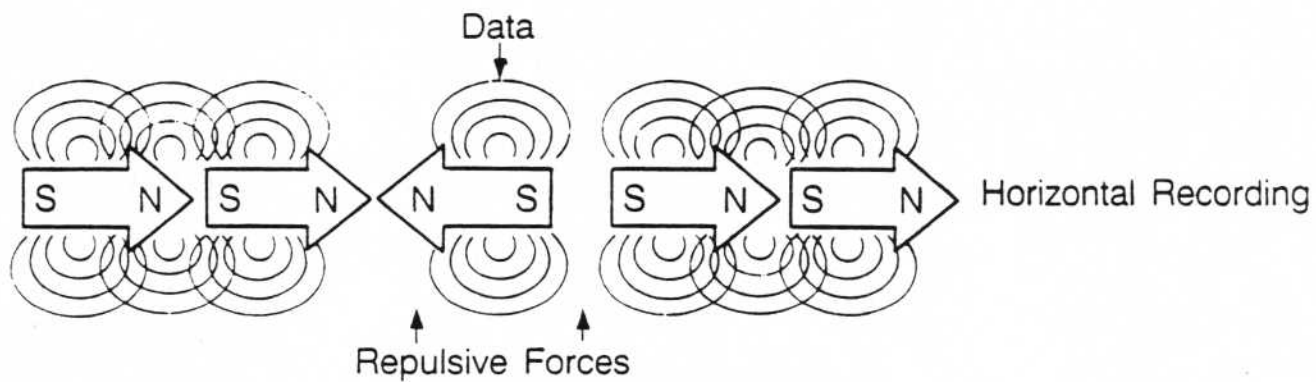


Fig. 5. 3. Energetical Stability of Magnetic Moment.

## 6. What is the Future of M.O. Technology?

- Overwriting, Fast Access, Fast Data Speed, More Capacity. -

Although there are many theoretical advantages explained in section 5, there are still some characteristics which should be further improved. Some of the obvious improvements will come by improving seek speed, data through-put and capacity. Less obvious and much more challenging will be **direct overwriting**.

### 6.1 Overwriting

Direct overwriting means that when writing data, the data can be simply overwritten over the existing data. Currently, writing over existing data requires erasing, writing and verifying. With current M.O., direct overwrite is very difficult. The reason is that since the electro-magnet that generates the bias magnetic field is located very further away from the M.O. layer than magnetic recording. With hard disk, the distance between the magnetic layer and the magnetic head is less than one  $\mu\text{m}$ . With M.O. disk technology, the distance between the **electro-magnet** and M.O. layer is about 3,000  $\mu\text{m}$  (3mm). This distance causes an electro-magnet that is very powerful which in turn slows down the speed of swiching of electro-magnet polarity.

Since the bias magnetic field can not be switched at the high speed required for high performance data storage device, current M.O. drive erases in the first spindle cycle. Then the polarity of bias magnet is switched and the new data is written on the second spindle cycle.

Once, direct overwrite technology can be developed, the performance of M.O. drives will rival today's highest performing hard disks.

Research into overwritable M.O. system are focusing on two approaches. The first is based on a multi-layer M.O. media which enables overwriting by **laser power modulation**. The second uses **semi-flying type magnetic bias coil** located on the reverse side of M.O. disk close to the M.O. layer.



## 7. Canon's Advanced M.O. Technology -Advanced M.O. Media Tech., High Performance Drive Unit-

### 7. 1. High Performance M.O. Media Technology.

The highest priority Canon has placed in research and development over the past seven years has been in M.O. media technology. As a result, Canon has come up with the high erase and write speed M.O. disk which Canon has coined "**EC type**" (**Exchange Coupling**) M.O. disk.

#### 7. 1. 1 "Canon EC type" M.O. Disk

EC type M.O. disk means that the disk is composed of two M.O. layers of different functional performances and they are **quantum-mechanically exchange coupled** to each other. The M.O. layer of high erase/write speed (low Curie Temp.) but poor in read performance (small Kerr rotation) is exchange coupled with another M.O. layer which is slow in speed (high Curie Temp.) but is especially good in read performance (big Kerr rotation). The writing to this EC type M.O. disk is done by heating the layers at around the Curie Temperature of the first M.O. layer. The magnetization of the second M.O. layer is sustained by the first M.O. layer through the exchange coupling. Accordingly the good reading can be done from the second M.O. layer because of its good carrier to noise ratio signal level.

What this means is that both the functions of the high speed writes and erases and good read performance are kept separately in two M.O. layers and the best of the functional combinations are used for maximizing performance. M.O. media that utilize a single layer can never achieve this performance.

The reason why such the best functional combination can not be expected in the single M.O. layer is well explained by so-called "Uchiyama Curve". As it is shown in Fig.7. 1. 1, every M.O. materials are plotted on the Uchiyama curve. What this means is that a Curie Temperature (which defines read/write speed) and Kerr rotation (which defines the read signal level) are in the contradictory relationship to each other. This means that a high speed M.O. layer is poor in carrier to noise level of read signal and, in turn, a good read performance M.O. layer is slow in erase /write sensitivity.



Canon has made the most use of the two contradictory functions by means of exchange coupling of two different M.O. layers. The basic patent of this EC type M.O. media concept based on **rare earth/ transition metal amorphous alloy system** has already been established in the 7 countries. Canon expects that the primary research and development in M.O. disk technology will involve Exchange Coupling in the future.

## 7. 1. 2 High Stability Plastic Disk

Besides the high speed, Canon's M.O. disk has achieved the overall stability using plastic substrate.

Because freedom of M.O. materials selection is very big in case of "Canon EC type", M.O. disk is designed to have very high coercivity of more than 20 kOe. This provides the high data stability (it is explained in section 5).

Besides high data stability, the long shelf life of M.O. layer also has been achieved even using the plastic substrate which is essential in reducing the cost of the media. The materials selection and the application technology of protective layer is key.

Canon has developed its own manufacturing equipment for depositing of M.O. layers .

Canon has plan to offer "Canon EC type" high speed M.O. disk with OEM customer's specifications , if any of the high performance drive unit manufacturers need it.

## 7. 2 High Performance 5.25" M.O. Drive

Making the most of the "Canon EC type" M.O. media performances, Canon has come up with the high performance 5.25" M.O. **rewritable** disk drive. Its disk rotational speed is 3,000 rpm making it the fastest optical disk drive in the industry. The media performance allowed the drive to erase and write at high speed using a 35 mW laser diode. This is the maximum power which is now available without fear of laser life and high cost.

Accordingly the **average latency** is 10 mS and the **sustained data transfer rate** at the drive interface is 9.1 M bits per second. The high **through-put** of erase-write-verify process is attributable to those high performances addition to the high speed **polarity switching bias-magnet**. This electro-magnet is developed by Canon and it has the maximum switching time of less than 4 mS.

## 7.3 Major Specifications

### 7.3.1 M.O. Drive and Disk Cartridge

#### Model Number Designations

Drive Unit

Model OM-500D

Disk Cartridge (single sided)

Model OM-X131

Disk Cartridge (dual sided)

Model OM-X132

#### Formatted Capacity

256 MB (OM-X131)

512 MB (OM-X132)

Disk Rotation Speed

3,000 rpm

Average Latency

10 mS

Average Seek Time

92 mS

Sustained Data Transfer Rate

9.1 M bps

Power Requirement

+5 V(DC), +12V(DC)

Power Consumption

Typical 18W, Max.40 W

Bias Magnet Polarity Change Speed

< 4 mS

Bias Magnet Type

High Speed Electromagnet

Disk Format

1,024 Bytes/Sector

16 Sectors/Track.

Continuous Spiral Groove

MTBF 20,000 Hours (Target)

Drive Size

5.25" Full Height

Disk Size

ø 130 mm

Cartridge

ISO TC97 SC23 like

Disk Substrate

Polycarbonate

### 7.3.2 Controller (OM-C10)

Size of PCB

118 x 190 mm

Interfaces

to Drive

ESDI like

to Host

SCSI (ANSI X3.131-1986,  
ccs Rev. 4.B)

ECC

Corrected BER

Data Transfer Rate

  Burst

  Sustained

Buffer size

Daisy Chain

Power Requirement

Cross-interleave Reed Solomon

Product Code

< 10<sup>-12</sup>

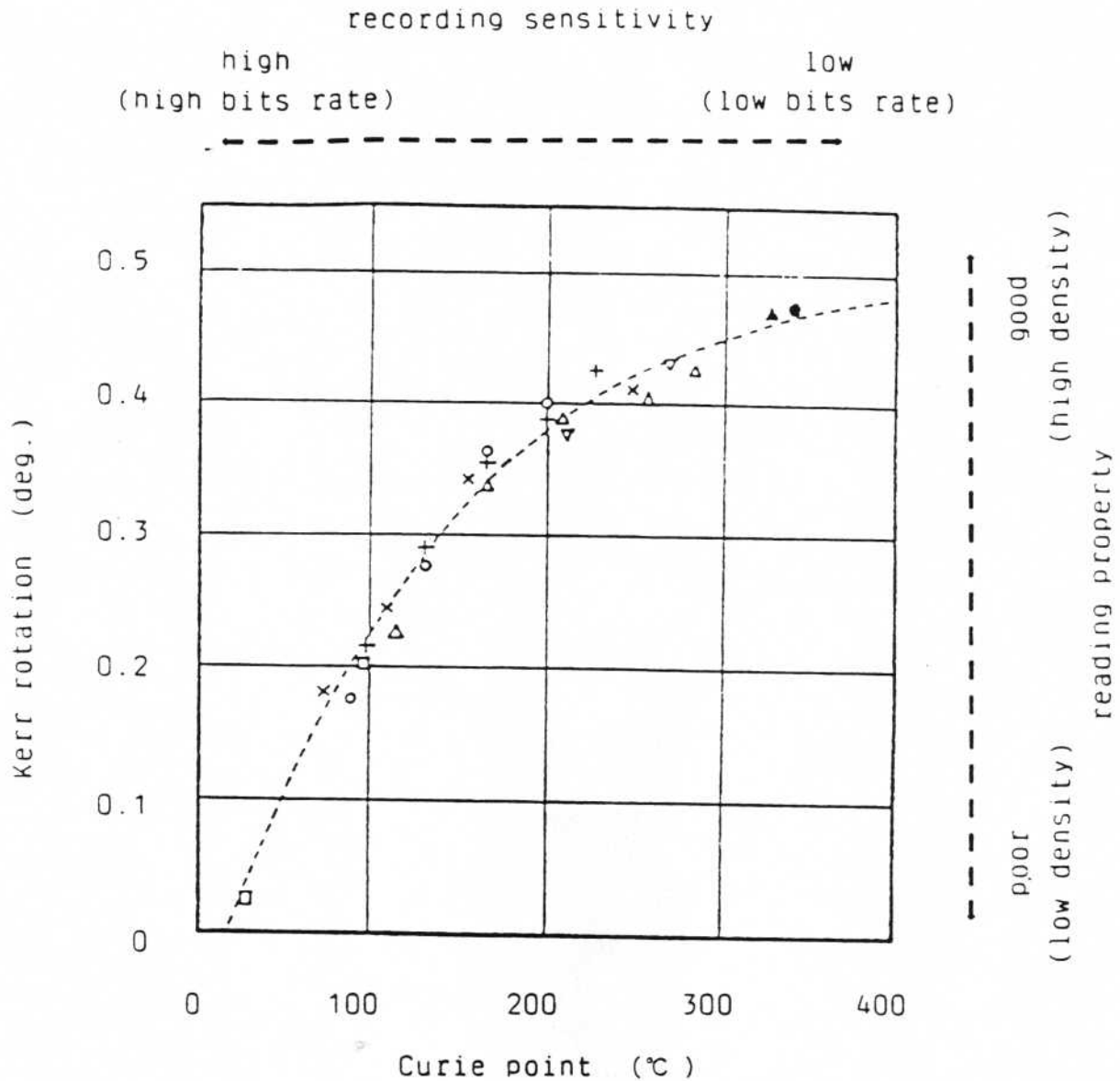
1.5 M bytes/sec.

6.6 M bits/sec.

64 K Bytes

2 Drives

+5V (DC) Max. 5W



- : Tb-Fe, Tb-Fe-Co (after Tsujimoto et al.)
- △ : Tb-Fe, Tb-Fe-Co (after Endo et al.)
- : Ho-Fe-Co (after Endo et al.)
- ▽ : Gd-Fe, Gd-Fe-Co (after Tsunashima et al.)
- + : Tb-Fe, Tb-Fe-Co (after Kobayashi et al.)
- × : Dy-Fe, Dy-Fe-Co (after Endo et al.)
- : Gd-Tb-Fe-Co (after Matsushima et al.)
- ▲ : Gd-Tb-Fe-Co (after Yamada et al.)

Fig. 7. 1. 1 "Uchiyama Curve"

# Product Description

The NeXT Computer combines the best attributes of personal computers and workstations, adds features previously found only on mainframe computers, and introduces entirely new innovations.

The NeXT Computer System begins with the Computer, a one-foot cube that houses the main CPU (central processing unit) board (with room for three additional expansion boards of the same size); a universal power supply, which makes the system usable throughout the world; and up to two 5.25-inch full-height mass storage devices. Standard in the cube are eight megabytes (MB) of main memory, expandable to 16 MB on the main CPU board.

The computer is powered by Motorola's top-of-the-line microprocessor and memory management unit, the 68030, and the 68882 Floating-Point Unit for fast mathematical computation, both running at 25 megahertz (MHz). The system also includes a 10 MIPS (million instructions per second) Motorola 56001 Digital Signal Processor, which supports complex, computation-intensive processes including CD-quality music and sound synthesis. Also standard is high-performance Ethernet<sup>®</sup> networking.

The CPU board contains two proprietary VLSI (very large-scale integration) chips that endow the NeXT Computer System with mainframe-like qualities. One, called the Integrated Channel Processor (ICP), ensures high system throughput by carefully managing and optimizing the flow of data within the system, particularly between the main memory, the CPU and peripheral devices such as the network, sound output, monitor and disk drives.

The other VLSI chip, called the Optical Storage Processor (OSP), controls the system's read/write/erasable 256 Megabyte Optical Disk. The Optical Disk represents a new form of mass storage technology, combining laser technology and magnetic (Winchester disk) technology. Information on the Optical Disk can be edited and manipulated, not just read, and the entire disk can be removed and carried between computers for convenience and security.

The NeXT Computer System also features the MegaPixel Display, with a 17-inch, crisp, high-resolution screen. Images on the screen can appear as black, white and various shades of gray, through the use of two bits per pixel. This shading ability adds depth to the images that appear on the MegaPixel Display, which in turn adds depth to an observer's interpretation.

In addition to its visual capabilities, the MegaPixel Display houses impressive sound capabilities. The system can generate CD-quality stereo sound (i.e., 44.1 kHz, 16-bit two-channel digital audio). Users can listen to the sound through a built-in speaker, through stereo headphones via a built-in headphone jack or through a connected audio system via built-in line-out jacks. The Display also features a microphone jack for voice input. Because the MegaPixel Display derives its power from the cube, it requires no separate AC plugs or external power sources.

Taken together, the hardware components of the NeXT Computer System create a powerful, efficient and aesthetic platform that allows users to extend far beyond their traditional desktop computer boundaries.

## **Options**

### **The 400dpi laser printer**

An optional but recommended component of the NeXT Computer System is the 400 dpi Laser Printer. As its name implies, the printer can produce extremely high-quality output of 400 dots per inch (dpi), as well as the standard desktop laser printer output of 300 dpi.

### **Memory Expansion**

Memory on the NeXT Computer is expandable to 16MB using 1MB, 100 nanosecond, page memory, nonparity SIMMs. These are available in packs of 4MB.

### **Mass storage options**

NeXT offers both 330MB and 660MB SCSI hard disks for the NeXT Computer. These high-performance storage devices provide the added storage capacity necessary in server and heavy development environments.

## **Accessories**

### **Blank media**

Optical disk cartridges, which have a 256MB capacity, are available individually, in packs of 10, or packs of 40.

### **MegaPixel Display**

Ordered as a separate item, this accessory includes the MegaPixel Display, keyboard, mouse, and 3-meter display cable.

### **Ethernet Connector Kit**

This kit includes a T-connector, 30 feet (9 meters) of thin ethernet cable, and a terminator.

# Product Specifications

## Computer

### Processors

Motorola 68030 25 MHz CPU

Motorola 68882 25 MHz FPU

Motorola 56001 25 MHz DSP

NeXT integrated channel processor

12 DMA channels

32 MB/sec bandwidth

NeXT optical storage processor

### Memory

64Kbytes boot ROM

8 to 16 MB of memory, user expandable in 4 MB increments

256K bytes of dual-ported video RAM

### Communications and Interfaces

Video monitor interface (DB19)

Thin wire Ethernet ® (BNC), IEEE 802.3 compatible

Two RS-422 serial ports (SCC chip Z8530) with 8-pin mini-DIN connectors

SCSI interface implemented with a 53C90 SCSI chip with transfer rate of 4.8 MB/sec (burst rate), DB 25 external, 50-pin shrouded vertical header internal

Four enhanced NuBus expansion slots (three after main processor board), type C Eurocard connector operating at a basic cycle rate of 12.5 MHz, a burst rate of 25 MHz and a peak transfer rate of 100 MB/sec.

400 dpi Laser Printer port (DB9) with 5 Mbits/sec serial transfer rate

Digital signal processor port (DB15) with a maximum transfer rate of 2Mbits/sec

### Power

Powers up to four slots with 25 watts each

Automatically adjusts to line frequency and voltage

Voltage: 90 to 270 volts AC

Frequency: 47 Hz to 63 Hz single phase

Power: 300 W (including MegaPixel Display)



### **Clock/calendar**

32.768 KHz crystal powered by a 3.0 volt removable lithium battery

### **Environment**

Ambient temperature: 32° to 104 ° F (0 ° to 40 ° C)

Relative humidity: 10% to 90% non-condensing

Altitude: 0 to 15,000 feet (0 to 4,500 meters)

### **Regulations**

UL listed and CSA certified

Complies with FCC Part 15 Class A requirements

### **Size and weight**

Weight: 25 to 40 lbs (10 to 19 Kg) depending on peripheral configuration

Height x width x depth: 12 x 12 x 12 (30 x 30 x 30 cm)

Can hold two full-height, 5.25 storage devices

## **MegaPixel Display**

### **Monitor**

17 " monochrome, flat screen

1120 x 832 pixels, 2-bit resolution (black, dark gray, light gray, white)

94 pixels per inch

100 MHz video bandwidth

68.3 Hz vertical refresh rate

### **Input/output**

Video monitor interface (DB19) carries +12/-12 VDC, video, and I/O

Keyboard jack, 5-pin mini-din connector

16-bit, 44.1 kHz stereo output through gold-plated RCA phono line-out jacks

Mini-connector stereo headphone jack

Integrated speaker

8-bit, 8 kHz audio input via monophonic microphone jack

### **Keyboard/mouse**

85-key low-profile keyboard, including cursor keys, numeric keypad, brightness and volume controls, and power on/off

Two-button opto-mechanical mouse

**Size and weight**

Weight: 50 lbs (23 Kg)

Height x width x depth: 17.3 x 16.0 x 14.0 (44 x 40 x 35 cm)

**Mass Storage****Magneto-Optical Disk Drive**

256 MB (formatted)

92 ms average seek time

5 ms average seek time within 5 MB range

1.14 MB/sec raw burst transfer rate

0.26 – 0.83 MB/sec raw sustained transfer rate

3000 RPM

Infinite read/write/erase

Removable, primary storage and/or backup device

**SCSI Hard Disks**

Rotary voice coil actuator and integrated SCSI controller for speed and reliability

Formatted capacities: 330 MB and 660 MB

Average seek time: 14.5 and 16.5 ms respectively

5 and 8 platters respectively

45 KB dual ported FIFO buffer

4.8 MB/sec raw burst transfer rate

3600 RPM

# Care and Feeding of the NeXT System

The NeXT Computer is designed to be rugged and reliable, but some care should be taken to avoid scratching surfaces. The Cube is coated with a water-based black paint which can be scratched with sharp objects. Do *not* use solvents such as alcohol, ammonia, or any abrasives to clean the computer. Repeated use of these substances will cause the paint to soften and rub off. We recommend water-based soap cleaners such as Formula 409.

The computer will operate best if not exposed to extreme temperatures. Keep it out of direct sunlight. You should not stack the cube on top of the NeXT LaserPrinter, or put the LaserPrinter on top of the cube. Cubes may be stacked atop one another but should not be stacked more than three high. Make sure that nothing blocks the vents on the bottom of the cube, to allow for adequate air flow. If the cube is placed on a shag carpet, it is a good idea to put a piece of cardboard or wood underneath the computer to prevent excessive dust or fibers from getting inside.

Thumb screws on cable connectors should be tightened fully (but not excessively). Be sure to avoid excessive crimping or stressing of any cables. Stressing or crimping the cable between the cube and the monitor can cause distortions in the display.

The NeXT Computer is designed to withstand normal static conditions. However, if service work is being performed with the back of the cube removed, full static-safe procedures should be followed.

Do *not* defeat the purpose of the grounded power cord. The three-prong plug should only be connected to grounded electrical outlets.

*Never* transport a cube with an optical disk inserted in the optical disk drive. Serious damage can be done to the drive mechanism.

See *The NeXT User's Reference Manual* for further information about keeping the NeXT Computer in good condition.

# Using the NeXT Interface

## Introduction

As you sit facing a NeXT computer, many questions are probably crowding your mind. The first might even be, "What are all those *things* on my screen?". Moving to more specific issues, you may be wondering how to rearrange your screen layout, access files or run applications. Over and over, the phrase "How do I ..." is undoubtedly repeating itself in your brain. Never fear—the answers to these and many other questions are at hand. Once you have completed this module, you will be able to perform basic operations on the NeXT computer: identify (and move) screen objects, access files and applications and copy, move, rename and delete files. So, limber up those fingers and prepare for your introduction to the NeXT interface.

## Introducing the Workspace Manager

The items you see before you on your screen are brought to you courtesy of the Workspace Manager. The Workspace Manager is an application program that greets you when you access a NeXT computer, and remains active as long as you are using the system. The function of the Workspace Manager is to provide access to all of the files and applications stored on your system. A similar service is provided by the shell in a traditional UNIX environment, and by Finder in the Macintosh environment.

- ▣ **Identifying the objects:** At this point you should see four objects of interest displayed on your screen:

**Menu** In the upper left corner is a *menu* associated with the Workspace Manager, which allows you to issue commands (note that it is labeled **Workspace**).

**Window** Near the center of your screen is a *directory window*, labeled **Directory Browser**, which provides a view into the directory structure.

**Dock** On the right edge of the screen is a column of icons, called the *dock*, which provides easy access to commonly used applications.

**Black Hole** Finally, a special icon called the *black hole* is provided for file removal (as the bottom icon of the dock).

- ▣ **Using the mouse:** Now that you've examined your screen, it's time to begin exploring. The first thing to do is select an item from the main menu. Use the mouse to position the cursor over the menu item labeled **Info ...**. Next, press and release either mouse button (this is called *single clicking*, or just *clicking*). As a result of your action, a *panel* has appeared on the screen. On this panel is a button in the upper right corner marked with an X. Use the mouse to single click this button. The panel disappears, and your screen is once again in its original configuration. (The button you clicked is a *close button*—more on it later.)

- ▣ **Moving the dock:** All of the objects on your screen can be moved (within limits). Start testing the extent of these limits by relocating the dock:

Use the mouse to position the cursor over the NeXT icon  
Press down on a mouse button  
Move the mouse until the dock is in a desirable location  
Release the mouse button

This process of pressing the mouse button and moving the mouse is called *dragging*. Specifically, the four steps of dragging are:

- 1) Position the cursor
- 2) Press a mouse button
- 3) Move the mouse
- 4) Release the button

As you have just seen, moving an object involves dragging. Try moving the dock a few more times. You have undoubtedly discovered two fascinating things (at least) about the dock:

*The dock can only be moved up or down, and the NeXT logo cannot be moved off the screen.*

This icon is a permanent fixture of the dock. Moving any of the other icons may cause them to disappear. (If this happens to you, don't worry—you'll see how to replace them a little later.)

- ▣ **Moving windows:** The next item to throw around is the directory window. Across the top of this window is a black band that contains two buttons and a title. This band is called the *title bar*. Moving a window is achieved with the same method that you used with the dock, with one constraint:

*When moving a window, the cursor must be placed over the title bar before you begin dragging.*

Do not, however, click either of the buttons contained in the title bar (one, you will remember, closes the window, the other will be explored a little later). How far can you drag the directory window? Can you remove it from the screen?

Try moving the menu now, using the same method (again, dragging on the title bar). Can the menu be pulled off the screen?

As you may have noticed, the menu, directory window and panel all look pretty similar. Each is a special kind of *window*. Like all windows, they are each rectangular and have a title bar.

Just about any visual object can be dragged partially off the screen, as long as some part of the object is always visible. For those items with a title bar, part of the bar must remain visible.

## Using the Browser

- ▣ **Examining the directory structure:** As mentioned earlier, the directory window is a view into the directory structure. With this facility, you can locate and access the files and applications on your system. The directory structure used on the NeXT machine is a hierarchical directory tree based on the UNIX file system.

A directory tree is a method of organizing files that involves a topmost directory pointing at files and other directories (called subdirectories). These subdirectories can themselves point to files or additional subdirectories (which may point to additional subdirectories, and so on). Thus, you have a directory structure containing many different levels, all of which can be traced back to a common starting point.

There are many ways to represent such a structure. Outline format is a possibility, as is a tree with branches and leaves, or nesting folders within folders within folders. The directory window on your screen is currently displaying a standard *Browser view*.

*The standard Browser representation has the advantage of displaying several different levels of the directory hierarchy simultaneously within a single window.*

In this representation, the leftmost column is topped by the label */*. This character is used to represent the *root* directory, the topmost level of the directory hierarchy. This column is a listing of the file and subdirectory names contained in the root directory. The subdirectory name **me** is highlighted. The column to the right of */* is labeled **me** and displays the contents of that directory. To the right of the columns is an icon of a folder labeled with the name **me**. This area is called the *Browser icon well*.

- ▣ **Traversing the directory tree:** Use the mouse to move the cursor until it is over the word **NextLibrary** in the leftmost column of the Browser view. Notice the arrowhead to the right of the name. Watch the screen carefully as you click once. Several things happen:

The word **NextLibrary** is highlighted

The title of the second column of the window changes to **NextLibrary**

The second column displays the contents of the directory (folder) **NextLibrary**

The icon well on the right changes to be a folder with the name **NextLibrary**

Find the word **Documentation** in the **NextLibrary** column, and click that. Again, the selected name is highlighted, the rightmost column displays the contents of the indicated directory, and the icon well shows the selected directory name. The full path of this directory can be read from the column headings across the top of the Browser: **/NextLibrary/Documentation**. As you might expect, this is where the on-line documentation can be found

In the **Documentation** column, click **NeXT** (again note the arrowhead), and observe what happens. All the columns shift to the left to make room for the new directory.

In the **NeXT** directory, select **SysRefMan**.

- ▣ **Scrolling a column of names:** At the bottom of every column in the Browser is a pair of *scroll buttons*. Place the cursor over the left button at the bottom of the **SysRefMan** column. Note that this button has a black arrowhead pointing down. Now, press down on a mouse button and watch the names scroll by as you hold it down (holding down a mouse button is called *pressing*).

*Pressing an active scroll button produces a continuous scrolling of text.*

In this case, the text is a list of names in a directory. Try scrolling up the list. Notice that the arrowhead on a scroll button turns gray when it is inactive, and black when it is active.



- ▣ **Scrolling the Browser horizontally:** On the left edge of the Browser view are two additional scroll buttons. These function very similarly to the other scroll buttons. Experiment with horizontal scrolling by alternately pressing the two buttons.
  
- ▣ **Selecting a file:** Use your traversing skills to move to the directory **/NextApps**—scroll the Browser to the left until the root directory appears, then click the name **NextApps**. Notice that the rightmost column is cleared.

In this directory, locate the name **Webster**. Notice that there is no arrowhead to the right of this name. Click on **Webster** (make sure that it is only a single click) and observe.

No new column was created for you this time. Instead, the name was highlighted (as usual), and the icon well changed to display a picture of a terminal. **Webster** is the name of the file containing the Digital Webster application.

*Whenever an arrowhead appears to the right of a name in the Browser view, it indicates a subdirectory. Names without this indicator are files.*

Compare the icon displayed in the Browser icon well to those on your dock. Is there a match?

Select another file in this directory by single clicking its name. Is the icon for this application stored on your dock?

Continue selecting file names and comparing icons until you have identified several of the icons populating the dock.

- ▣ **Launching an application from the Browser:** Once you have finished your explorations, select the application **Webster** by clicking its name in the directory window. Now, move the cursor over the icon in the Browser icon well and press twice on either mouse button in very rapid succession (this is called *double clicking*). The icon will immediately flash white, indicating that the icon has been double clicked. The icon on the dock will turn into a "ghost" version of itself (a very pale image), indicating that the application is being launched. (If you removed the **Webster** icon from your dock in earlier explorations, the icon will appear somewhere near the bottom of your screen. More about this later.) A short time later, the application will become active, and several

things will happen at once. The **Webster** menu will appear in the top left corner of the screen, a window will appear on some other part of the screen, and the docked icon will return to its normal color. Notice, however, that this icon no longer has three little dimples in its lower left corner.

*The presence of three dimples on a docked application icon indicates an inactive application. The absence of these dimples indicates that the application is running.*

- ▣ **Quitting an application from the menu:** You'll be able to explore this application later. For now, exit the program by selecting the **Quit** command from **Webster's** main menu (notice the dimple reappearing on the docked icon).

*Almost all applications can be exited by selecting the **Quit** option from their main menu.*

- ▣ **Depopulating the dock:** Locate the icon associated with the **Shell** application on your dock (if you removed it earlier in your explorations, just select some other icon). Using the dragging method, begin to pull the icon away from the dock. Notice that a ghost version of the icon remains on the dock as you begin to pull away. Release the mouse button while the ghost image is still on the dock. Watch as the icon "snaps" back onto the dock in its original position.

Drag the icon again, this time pulling it far enough away so that the ghost image disappears. Now release the mouse button, and the icon itself vanishes. This is called *depopulating* the dock. (Don't worry, you're not really eliminating any files or applications, simply eliminating access to that application from the dock.)

*Removing an icon from the dock is accomplished by dragging the icon away from the dock until the ghost image disappears and then releasing the mouse button.*

- ▣ **Populating the dock:** Now, place the cursor over the **Webster** icon displayed in the Browser window. Using the dragging method, pull the icon toward the dock. Notice that the ghost image of the icon appears in the dock as you approach. As soon as the ghost image appears, you can release the mouse button, and the icon will be placed on the dock.

*Whenever a dragged icon approaches the dock, a ghost image appears in the position where the icon will be placed when the mouse button is released.*

If you have removed any other icons from your dock (and remember what they look like), use this method to restore your dock to its original condition. As it is changed, the contents of the dock are remembered so that it will look the same when next you log in. As you gain more experience with the system, you will undoubtedly determine your own favorite dock configuration.

- ▣ **Launching an application from the dock:** Launching an application from the dock is achieved with the same procedure as launching from the Browser icon well. Go ahead and double click the **Shell** icon on the dock. Do you notice anything different about the way the application is launched? You shouldn't; the functionality is exactly the same.
- ▣ **Quitting an application using the keyboard:** Examine the menu for the **Shell** application. Notice that to the right of the **Quit** option is the letter **q**. Exit the application by holding down the **Command** key (lower left or right on the keyboard) and pressing **q**. This is called a *keyboard alternative*.

*Whenever a letter appears to the right of a menu item, it is an indication that that menu item can be selected by pressing the indicated letter in conjunction with the **Command** key.*

- ▣ **Using additional directory windows:** There will be times when one directory window is just not enough—copying or moving files between directories requires multiple directory windows. To open a second directory window, place the cursor over the Browser window (avoiding its buttons) and click. This makes the Browser active (more on this later). Now, single click the word **NextApps** in the leftmost column. The icon well will be changed to display the folder icon for **NextApps**. Place the cursor over this icon and double click. The icon will flash white and a second window will appear. This second window should be partially overlaying the original directory window.

*Double clicking a directory icon in the Browser icon well opens an additional directory window.*

It is entirely possible that this window does not look anything like the original Browser view (and if it does, it soon won't).

The standard Browser view with which you have become familiar is only one of several available representations. To change the way the directory information is presented, place the cursor over the **View** command in the **Workspace** menu and click. Note that this item has an arrowhead to its right, indicating a submenu. In the submenu are listed the various ways in which the directory information can be shown. Select one of them and observe your new view. One by one, select each of the other available views, comparing them to ones you have already seen. Which is your favorite?

- ▣ **Determining the key window:** After you've reviewed all the possible views, make sure the view for your second window is set to **Browser**. You may have noticed that your original window now has a grey title bar, while the new window has a black bar. The black title bar indicates which window on the screen is the *key window*.

*The key window is the window that will receive keystrokes and be affected by menu commands. It is identified by a black title bar.*

Remember, only the key window was affected when you changed the directory representation with the **View** command. Changing the key window is a very simple matter—move the cursor so that it is anywhere within the borders of your original directory window (except over either of its buttons) and click once. The title bar of the original window turns black and the entire window moves to the foreground—it has become the key window. Any keyboard or menu actions taken now will affect this window (go ahead and change the view, just to prove it, but be sure to change the view back to **Browser**). Now, click anywhere within your second window (again, avoiding its buttons) to make it the key window.

- ▣ **Closing a window:** Now that you've got a second directory window, how do you get rid of it? Right—click the close button (remember it's the button in the top right corner of each of your windows marked with an X). This process is called *closing* a window, and the button you clicked is a *close button*. Be sure you don't confuse closing a window with quitting an application. Just because you've closed the Browser window doesn't mean that you have quit Workspace Manager.

*Clicking a close button closes a window.*

- ▣ **Copying a file:** One of the most popular activities on a computer system is to copy files. Copying files on the NeXT system involves opening a second directory window. So, first make sure that your directory window has its view set to **Browser**. Then, make sure that the current directory in that window is **/NextApps**. Now, open a second window by double clicking the icon **NextApps**. In this second window, make sure the view is set to **Browser** and then change the current directory to be your home directory (**/me**).

Make the original view the key window by clicking anywhere within its borders. In the directory **NextApps**, once again locate the file **Webster** and single click its name. Notice that the associated icon appears in the icon well.

At this point, you need to be able to see the icon well in both windows. If this is not the case, move the key window until it is.

Now, to copy the file **Webster** into your home directory, place the cursor over the **Webster** icon and drag the icon toward the icon well in the second window. As the icon approaches, watch the folder open up to receive the new file as the cursor changes to represent two small sheets of paper. As soon as this occurs, release the mouse button. If the operation takes more than a second or two, a panel will appear, indicating that the system is **Copying** the file **Webster**.

*Copying a file is accomplished by dragging a file's icon from one directory window to another.*

Ta-da—you now have your very own copy of the **Webster** application residing in your home directory. Notice that the original **Webster** file was not affected, and the word **Webster** now appears in the listing of your home directory.

- ▣ **Moving a file:** But wait—you didn't really want the file to be in your home directory, you wanted it to be in the **Apps** directory *under* your home directory. You now need to move the file from its current location to the **Apps** directory.

First, make sure your original Browser view is the key window (the one pointing to **NextApps**). Then, make the current directory of that window be **/me/Apps**.

Make your second window the key window and make sure the file **Webster** is selected in your home directory. To move the file, simply place the cursor over the icon in the well, hold down the **Command** key, press down the mouse button and drag the icon to the folder in the original directory window. Once again, the folder opens to receive the new file (but the cursor does not change). Release the mouse button and the **Command** key (in that order). (You must release the mouse button *before* you release the **Command** key, because the significance of the **Command** key is only noted at the time the mouse button is released.) After you release the button, if the operation is lengthy, a **Moving** panel will appear. This time, the file is moved from one directory to another, so that the file no longer appears in your home directory.

*Moving a file is accomplished by dragging a file's icon from one directory window to another while pressing the **Command** key.*

- ▣ **Renaming a file:** Now that you've got this spiffy new file, how about giving it a spiffy new name? Make the view containing the new file the key window. Make sure the icon for the **Webster** file appears in the icon well, then move the cursor so that it is over the file name under the icon. Double click the name, and it will be highlighted. Now, enter **Dictionary**. Notice that, as you type, an insertion point appears (a blinking vertical bar) that indicates where your characters will be placed.

*A double click selects an entire word, allowing you to overwrite it.*

Press **Return** and an Alert panel will appear informing you that changing the name of this file will cause problems for the Workspace manager and asking you if you want to change the name anyway. Since we are working with a copy of the application, changing the name won't cause any problems, so you can go ahead and select **Yes**. Watch as both



the name and the icon are changed in the Browser. The icon changes because the original icon was associated with an application file named **Webster**. The new icon is a generic one used for files containing applications that do not have their own icon specified.

Use the mouse to place the cursor immediately before the **D** in **Dictionary**. Click once. Now enter **My** followed by **Return**.

*A single click positions the insertion point and allows you to insert or delete characters.*

- ▣ **Deleting a file:** Now that you've gone to all the trouble of copying, moving and renaming this file, you discover that you don't really need it. To get rid of the file **MyDictionary**, place the cursor over the associated icon in the Browser, then drag it towards the black hole. As the icon approaches, watch the hole begin to spin. As soon as this occurs, you can release the mouse button, and the icon will be sucked into the black hole. Once again, a **Moving** panel may appear, indicating that the file is being moved into the black hole.

*Deleting a file is accomplished by dragging the associated icon to the black hole.*

- ▣ **Recovering a file:** Sending a file to the black hole seems pretty final, but is it? Can a file ever be recovered? Place your cursor over the black hole and double click. Surprise—what you see now is another directory window containing the names of all the files that have been deleted. (For those of you who are curious, the black hole is actually a directory to which deleted files are moved. For the insatiably curious, the name of this directory is `~/NeXT/NeXTtrash`.) At this point, you can drag a file out to a different directory to recover it. Go ahead and try moving the file **MyDictionary** from the black hole back to your **Apps** directory (by dragging its icon). Then, move it into the black hole once again.

*Files that have been deleted can be recovered by double clicking the black hole and then dragging the appropriate icon from the resulting directory window into another directory window.*

When you're finished looking at this window, you'll want to turn it back into the black hole. To accomplish this, find the button at the left of the title bar that has a black bar across its top. Click once, and the black hole returns. (This button is the *miniaturize* button. More on it later.)

- ▣ **Destroying files:** Well, if removed files still exist, don't they take up space? Certainly. Can you remove them permanently? Of course.

*To destroy files dragged to the black hole, select **Utilities** from the **Workspace Manager** menu, and then **Destroy Deleted Files**.*

So, has the file truly been destroyed? How can you find out? You got it—double click the black hole to turn it into a directory window. Once you've verified that the file is really gone, turn the view back into the black hole.

Before moving on, clean up the Workspace a little—close all directory windows but one, and make sure that the directory for that view is **/NextApps**.

- ▣ **Using the Browser's text window:** Now it's time to play with a couple of shortcuts for selecting files. Type in an upper case **S**. A new window appears on your screen labeled **Name Expansion; Return Opens**.

The name **Shell** is highlighted in the **NextApps** column, and the icon well now holds the associated icon. This is just the same as if you had single clicked the name **Shell**. Finish typing in the word **Shell**, but do NOT press **Return**.

*Typing in a file name selects that file, just as clicking its name in a directory window does.*

Close the **Name Expansion** window by clicking the close button, and then enter an upper case **L**. Now, press the **Esc** key. The name in the window expands to be **Librarian.app**, and that file is selected in the Browser view.

Close the window once again, and then enter a capital **W** followed by the **Esc** key. Rather than being expanded into a name, the system beep is sounded, indicating that the expansion was not successful (there are two files that begin with **W**). Even so, the first file that matches is highlighted (**Webster**).



The **Esc** key is the expansion key. When you enter one or more characters, the first file with a name matching the entered character(s) is selected. If you follow the characters with the **Esc** key, the name is expanded to whatever file matches. If no files have a name matching the characters you've entered, the expansion will not work. The same is true if more than one file matches (you must enter enough characters to identify the file uniquely).

Now, for the grand finale. Close the **Name Expansion** window, type an **S** and press **Return**. The name is expanded to **Shell**, the file is highlighted, and then the application is launched, all in one fell swoop.

*Entering an application's file name in the Name Expansion window, followed by a Return, selects the file and launches it, just as double clicking its name in a directory window does.*

## Conclusion

At this point, you have explored the very basics of dealing with your NeXT system—using the mouse, selecting items, moving objects, manipulating the dock, traversing the directory structure, using menus and windows, and accessing applications. Hopefully, there are several fewer questions rattling around in your brain than when you started. You are, obviously, far from finished, but you now possess the basic tools necessary to begin a thorough exploration of the NeXT computer.

# Keyboard Overview

The NeXT keyboard looks much like ordinary typewriter and computer keyboards and is used to enter text, perform software operations that can also be performed with the mouse, and perform hardware operations such as turning the system on and off. The keyboard is divided into three different sections: the regular keypad, the system control keys and the numeric keypad.

**Character Keys:** Character keys are labeled with letters, numbers, punctuation marks, or other typographical symbols and are used to enter text.

**Special Character Keys:** Special character keys generate non-printing characters that perform special functions depending on the context in which they are used. These keys include:

- Return**      Pressing this key most often simply starts a new line of text. In other contexts it is used to tell the system to interpret a command line.
  
- Enter**        Pressing this key often has the same effect as pressing **Return**. It is used by some applications to initiate the interpretation of a command line. **Command-Return** generates the same special character as **Enter**.
  
- Tab**            Pressing this key moves to the next preset tab stop. **Shift-Tab** moves the cursor in the reverse direction.
  
- Delete**        This key is most often used to delete previously entered text or other objects. **Shift-Delete** produces a backspace character which usually produces the same effect as **Delete**.
  
- Esc**            The Escape key is most often used to change modes when you are communicating with a UNIX utility.

**Modifier Keys:** Modifier keys do not generate characters but change the effect of the mouse or other keys. They are used by holding them down while pressing another key. For example, holding down the **Command** key while pressing the **h** key will hide the current application. This action is indicated with the notational convention **Command-h**. These modifier keys include:

**Shift** This key is used to produce capital letters and the upper character of keys labeled with two symbols.

**Alternate** This key is most often used to produce special-purpose, infrequently used characters, such as scientific and mathematical symbols. See Chapter 2 of *The NeXT User's Reference Manual* for coverage of the available symbols.

**Command** This key is used chiefly to provide a keyboard alternative to making a menu selection with the mouse. Several of the more commonly used keyboard alternatives are labeled in green on the keyboard.

**Control** This key is most often used when you are communicating with UNIX to perform traditional UNIX functions (e.g., stopping a job with **Control-z**).

**Arrow Keys:** Arrow keys are most often used to move the insertion point in the indicated direction when you are entering text or graphics.

**System Control Keys:** The five system control keys modify the computer's physical functions:

**Power** This key turns the computer on and off. See the handout *Shut Down Procedures* for more information.

**Volume** These keys adjust the volume of the speaker contained in the MegaPixel display. The upper key increases volume, the lower one decreases it. Holding down the **Command** key and pressing the lower volume key will mute the speaker.

**Brightness** These keys adjust the brightness of the MegaPixel display. The upper key increases the brightness, the lower one decreases it.

## Less Than One Hundred and One Things You Can Do with a Mouse

There are really only two simple actions that can be performed with a mouse:

- Moving the mouse, which results in the cursor moving in an analogous direction
- Pressing and releasing either of the mouse buttons.

These two simple actions can be combined to produce the following four basic mouse-initiated operations:

**Clicking:** Clicking the primary mouse button results in the selection of an object, while clicking the secondary mouse button results in the appearance of a popup menu at the cursor's location. Clicking is accomplished by using the mouse to move the cursor to the desired location and pressing and releasing the appropriate mouse button. The **Preferences** application is used to determine which mouse button is which. The default is that both buttons act as the primary mouse button. If the popup menu button is enabled in **Preferences**, then the **Handedness** option determines whether the left or right button is the primary button.

**Multiple clicking:** Multiple clicking is used to extend the meaning of a single click. For example, positioning the cursor on an icon in the workspace and double clicking results in the application associated with that icon being selected and launched.

**Dragging:** Dragging with the mouse is accomplished by placing the cursor over an object, pressing the primary mouse button, moving the mouse, and then releasing the mouse button. Dragging is used to:

- Move an object. For example, a scroll bar or workspace icon.
- Define a range. For example, a range of text can be selected by dragging from the first to the last character you wish to select.
- Slide from one object to another. For example, you can slide from a menu item to the submenu that appears when the initial item is selected.

**Pressing:** Pressing an object, like multiple clicking, results in an extension of the function performed by clicking on that object. Pressing is accomplished by positioning the cursor over the desired object and holding the primary mouse button down for some period of time. For example, pressing a scroll button results in continuous scrolling until the mouse button is released.

## Less Than One Hundred and One Things You Can Do to a Dock

The NeXT dock is used to provide easy access to frequently used applications. An application's icon can be docked (placed in the dock) and that application can then be launched by double clicking the docked icon. The dock is defined as the area below the NeXT logo on the right side of your screen.

**Moving the dock:** The dock can be moved up and down the right side of your display. Simply position the cursor over the NeXT logo and drag up or down. Notice that the NeXT logo cannot be moved off the screen. This icon provides a handle that is always available to move the dock back onto the screen.

**Docking an application:** To dock an application, grab the application's icon from the Browser and position it somewhere near the dock. Notice that a "ghost" version of the icon appears in the dock as your selected icon approaches the dock. This is where the icon will be placed when you release the mouse button. Once an application's icon has been docked, it will remain docked, through logging out and logging in, through sleet and rain and dark of night—until you explicitly remove it from the dock.

**Undocking an application:** To remove an application's icon from the dock, grab the application's docked icon and drag it to any location not in the dock's region.

**Peeking behind the dock:** For those of you who care, the names of all docked applications are stored in a file called `~/NeXT/.dock`. This file is updated whenever you change the dock, so that it will be identical when you next log in. Be warned, this is a non-ASCII file.

## Less Than One Hundred and One Things You Can Do to a Window

The following is a list of the most common things users do to windows:

**Opening a standard window:** In most cases, standard windows are automatically opened when you launch an application. Many applications also provide a menu selection for opening a new window or a window containing previously stored contents.

**Closing a window:** When you are done working with a window you will want to close it. Closing a window has the effect of removing it from the screen. Almost all applications provide a mechanism for closing their standard windows. In most cases these mechanisms include a close button and a close menu selection. Many panels also include a close button.

**Moving a standard window:** All windows can be moved anywhere on your screen. Simply drag the window by any portion of its title bar except its buttons (you wouldn't want to push anyone's buttons accidentally).

**Miniaturizing a standard window:** Another way to put a window aside without getting rid of it completely, besides dragging it off the screen, is to miniaturize it. Miniaturizing a window only changes its appearance. A miniaturized window changes into a miniwindow—an icon that appears out of your way at the bottom of the screen. Most standard applications include both a miniaturize button in their title bar and a **Miniaturize** menu command.

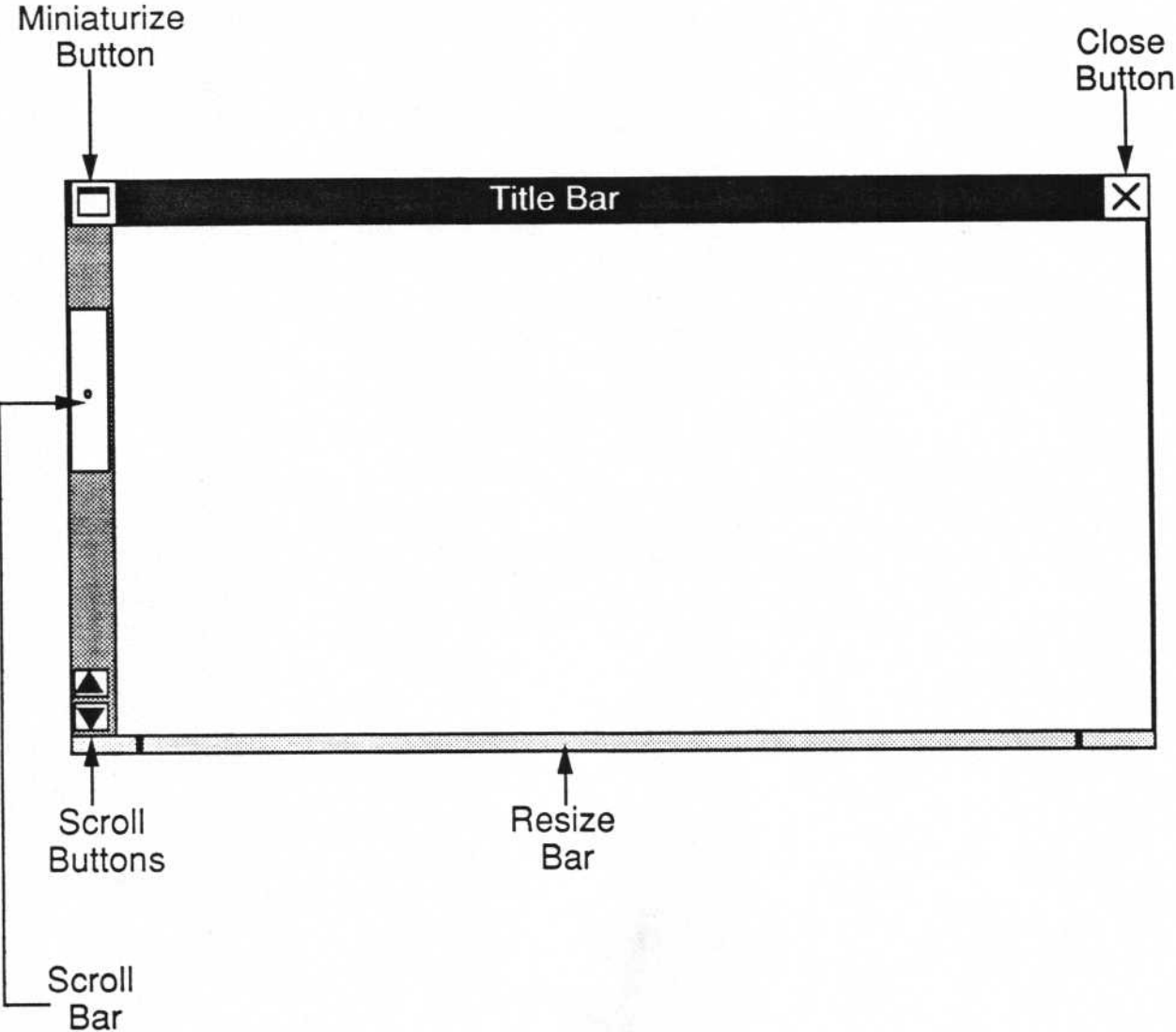
**Resizing a standard window:** It is also easy to change the size of most standard windows (and some panels). Resizable windows can be enlarged or shrunk by relocating the bottom border and/or either the left or right border. Windows are resized by positioning the cursor over the window's resize bar, pressing the primary mouse button, and dragging in the direction desired. As you drag the bar, a dashed line will appear indicating the new size of the window. When the button is released, the window will be resized to match the dashed line. Dragging anywhere between the two marks on the resize bar will change the vertical dimensions of the window. Dragging outside of these marks, on either side, will change the horizontal dimensions, or both dimensions simultaneously. Dragging inward makes the window smaller, outward makes it larger.

**Scrolling within a standard window:** There are three ways to scroll within standard windows. Pressing a scroll button produces a slow continuous scroll. Selecting and dragging a scroll knob is usually used for larger motions and also produces a continuous scroll. Clicking directly above or below the knob will relocate the knob to the cursor position, producing a jump scroll of the window contents.

**Making a standard window the key window:** The key window is the standard window or panel that is currently receiving keyboard input. The title bar of the key window will always be black. To make a window the key window, simply click anywhere within its boundaries (other than its buttons). This window will be moved to the front and become the key window.



# Standard Window Components



## Less Than One Hundred and One Things You Can Do to a Menu

Menus are windows containing lists of commands. They are used to control the actions performed by applications. In addition, several actions can be performed on menus themselves. The following is a list of the most common things users do to and with menus:

**Opening a main menu:** In most cases a main menu is automatically opened when you launch an application and closed when you quit the application. Usually, only the menu(s) associated with the active application will be visible.

**Moving a menu:** Any menu (in fact, any window) can be moved by positioning the cursor over the title bar, pressing the primary mouse button, and dragging the cursor and the menu to the desired location.

**Making a selection from a main menu:** To select a command from the main menu of the active application, simply click the desired command. Menu items appear in one of the following four forms:

**label only:** Many menu items contain only a functional description of the action that will be performed when the item is selected.

**label and keyboard alternative:** Many menu items also contain a letter indicating a keyboard alternative that can be used to initiate the associated action without the mouse.

**label and "...":** Some menu items, when selected, result in the display of a panel. These items contain "." following the label.

**label and arrowhead:** Some menu items, when selected, result in the opening of a submenu. These items contain an arrowhead following the label.

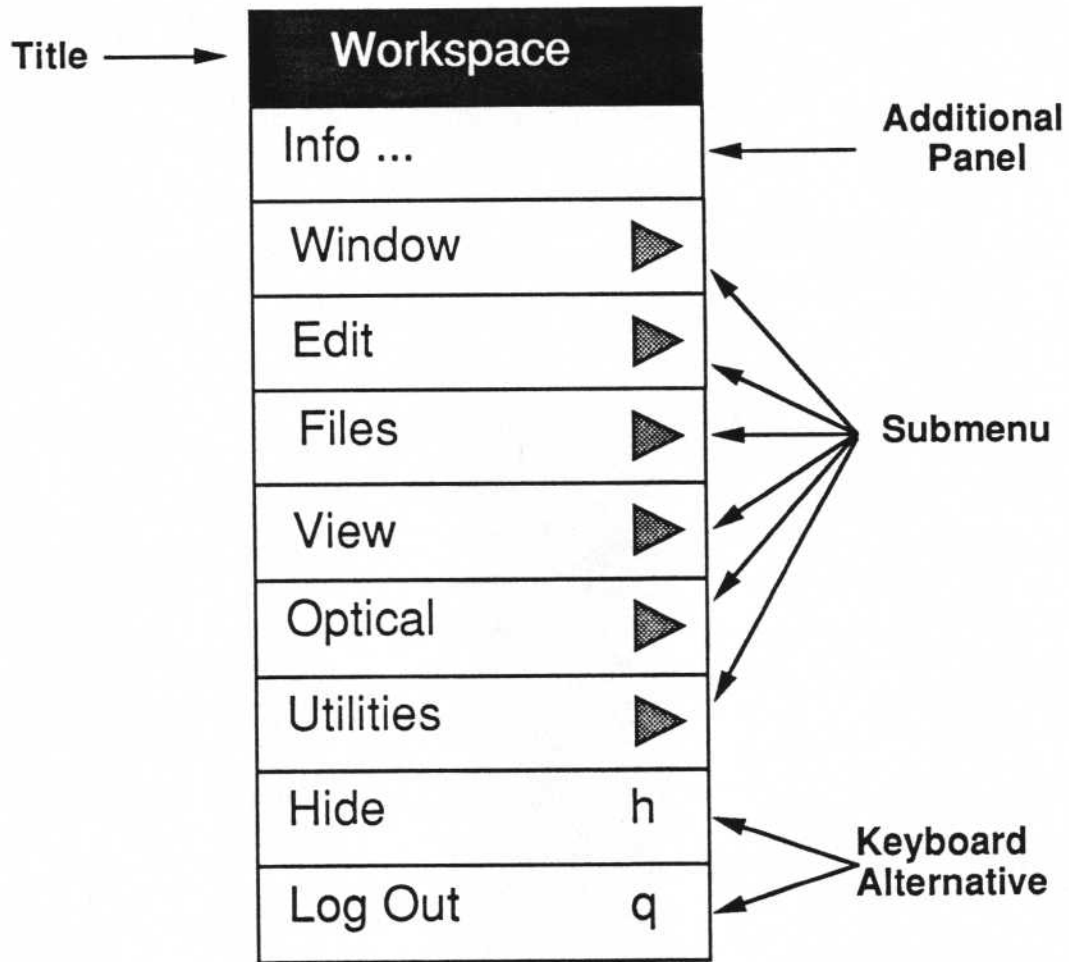
**Opening a submenu:** To open a submenu, simply position the cursor on any menu item that contains an arrowhead and hold the primary mouse button down. The submenu associated with your selection will appear directly to the right of the main menu. If you release the mouse button at this point the submenu will remain displayed.

**Making a selection from a submenu:** Whatever menu item is under the cursor when you release the primary mouse button will be selected and executed. Thus, there are two ways to select an item from a submenu. The first is to click the submenu name, wait for the submenu to appear, and click the desired item on the submenu. The second is to press the primary mouse key while the cursor is over the name of the submenu, drag the cursor into the resulting menu, and release the mouse button while the cursor is over the desired selection.

**Tearing off a submenu:** Submenus can be torn off and moved in much the same way as main menus. Once the submenu is open, simply position the cursor over the menu's title bar, press the primary mouse button and drag the cursor and the menu to the desired location. When you release the mouse button the submenu will grow a close button and remain visible until you close it.

**Popping up a menu:** For users who believe in economy of motion (i.e., are truly lazy), and don't like having to move the cursor to the menu to make a selection, it is a simple matter to have the main menu associated with the active application pop up at the cursor's current location. One of the **Preferences** options regarding the mouse is **Enable menu button**. If you have selected this option, you can just press down on the secondary mouse button (determined by the **Handedness** option in **Preferences**) to bring up the menu. You can then drag the cursor to the desired selection or submenu and release it. The popup menu will disappear after use.

# Standard Menu Components



## Less Than One Hundred and One Things You Can Do to an Application

**Launching an application:** Applications can be launched (executed) in numerous ways:

- double clicking the name in the Browser
- double clicking the icon in the Browser icon well
- double clicking the icon in the dock
- entering a command line in a UNIX shell
- entering the name and pressing **Return** in the Browser **Name Expansion** window
- opening a file associated with the application (double clicking the file's name or icon, or selecting **Open** from the Workspace Manager's **Window** submenu)
- selecting **Dock Info...** from the **Utilities** submenu and checking off the application to be auto started at login

**Hiding an application:** Almost all applications can be hidden either by selecting the **Hide** menu choice or by using the **Command-h** keyboard alternative. Hiding an application removes all visual objects associated with that application from the screen, including open windows, but excepting the icon. The docked icon associated with a hidden application will be missing its dimples. Applications that are hidden but were not launched from the dock will be marked by their icon at the bottom of the screen.

**Unhiding an application:** Applications can be unhidden by double clicking their icon in the dock or at the bottom of the screen.

**Making an application active:** To make an application active, click any visual object associated with that application or double click the associated icon.

**Quitting an application:** All applications can be exited either by selecting the **Quit** menu choice or by using the **Command-q** keyboard alternative.

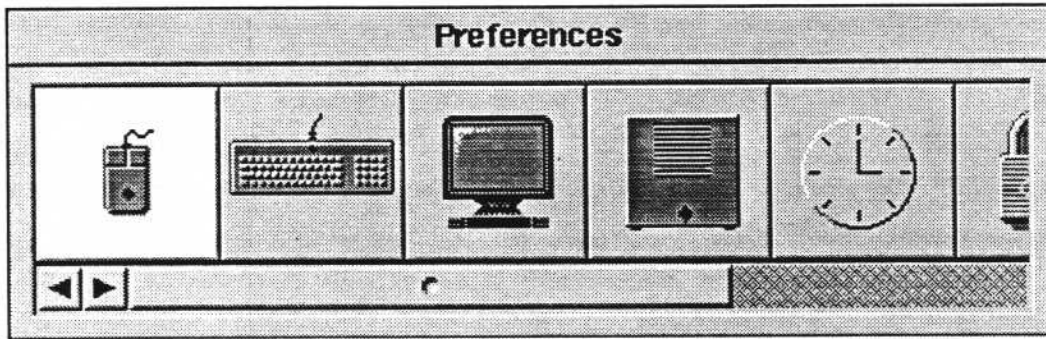
In summary, an application can be in one of five states at any time:

- 1) Not running
- 2) Launching
- 3) Running, inactive, and visible
- 4) Running, inactive, and hidden
- 5) Running, active and visible

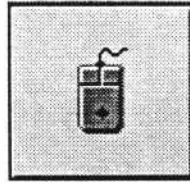
## Relationships Between Window and Application Functionality

<b>Applications</b>	<b>Windows</b>
Launch	Open
Hide (token)	Miniaturize (mini-window)
Quit	Close

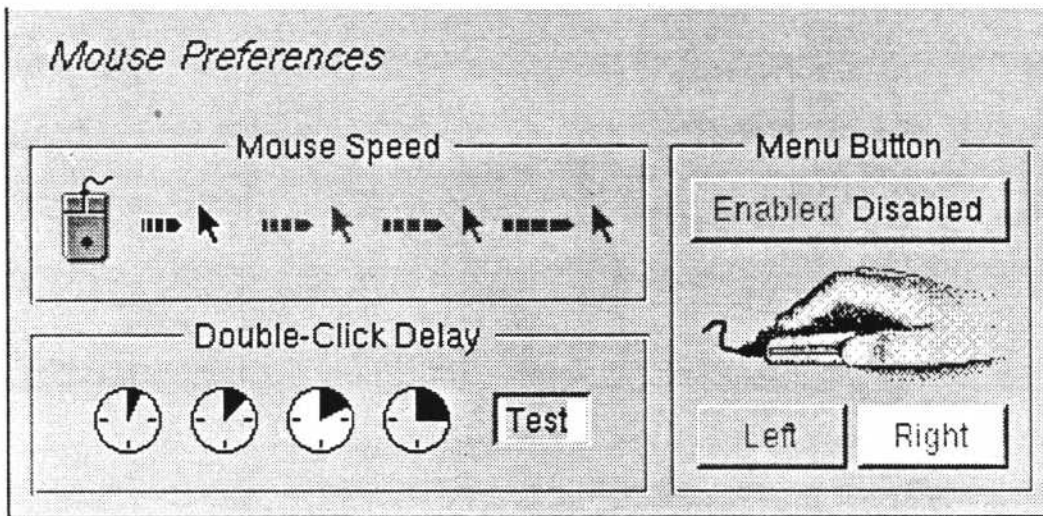
# The Preferences Application



The **Preferences** application is used to set several system variables to meet your individual needs. The available options are separated into different components of the system, as described on the following pages.



## Mouse



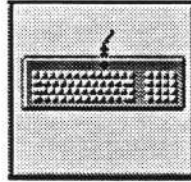
**Mouse Speed:** Four different speeds are available, with the leftmost button representing the fastest mouse speed.

**Double-Click Delay:** Four different double click intervals are available, with the leftmost button representing the shortest interval (the amount of time allowed between clicks constituting a double click).

**Menu Button:** When Enabled is selected, pressing the secondary mouse button will display a pop up menu at the current cursor location.

The handedness buttons determine which mouse button will serve as the primary button. The left mouse button is the primary one for right-handedness, the right button for left-handedness.





## Keyboard

*Keyboard Preferences*

Initial Key Repeat

...a	..a	.a	a
------	-----	----	---

Key Repeat Rate

a..a..a	a.a.a	a.a.a	aaa
---------	-------	-------	-----

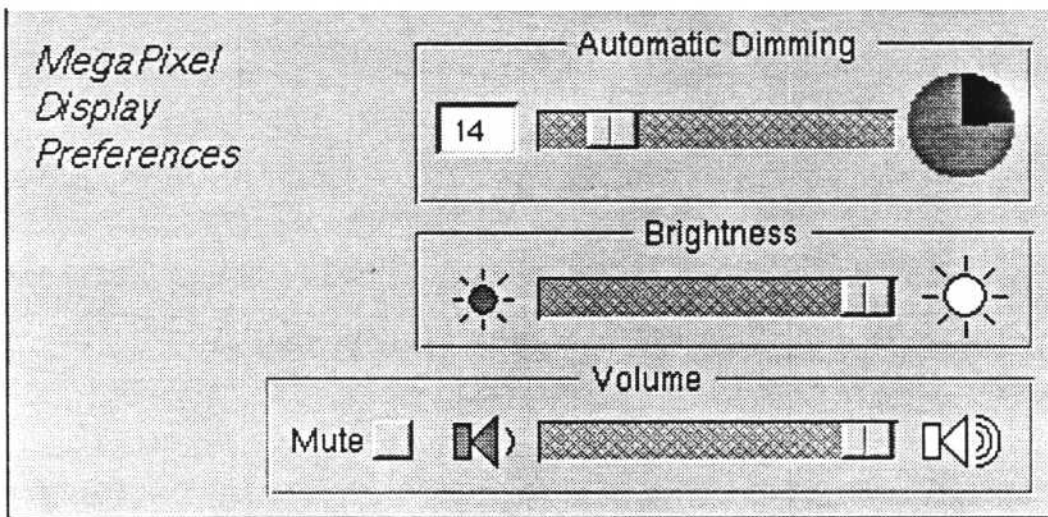
Type here to test setting

**Initial Key Repeat:** Sets the amount of time a key must be held down before repeat starts. Leftmost button selects the most amount of time before repeat starts.

**Key Repeat Rate:** Sets the speed at which keys will repeat when held down. The leftmost button represents the slowest repeat.



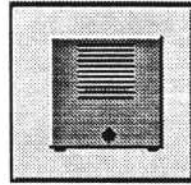
## Monitor



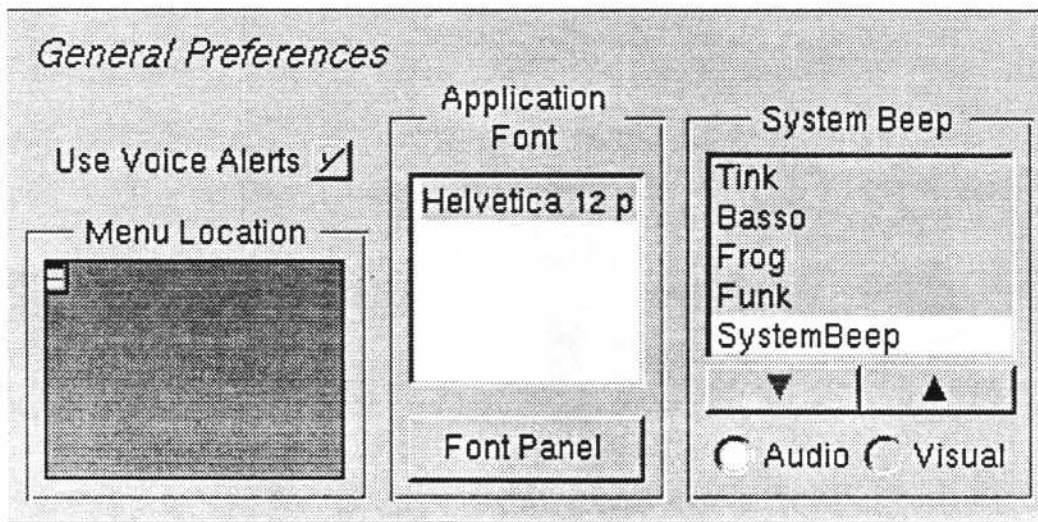
**Automatic Dimming:** Selects the number of minutes of inactivity before screen will automatically be dimmed.

**Brightness:** Sets screen brightness, just as pressing the brightness keys do.

**Volume:** Slider sets volume; button turns muting on or off.



## General

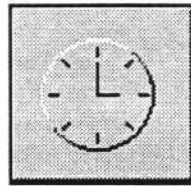


**Use Voice Alerts:** Allows you to turn on Voice Alerts (verbal messages are up to each individual application; currently, only printing makes use of any).

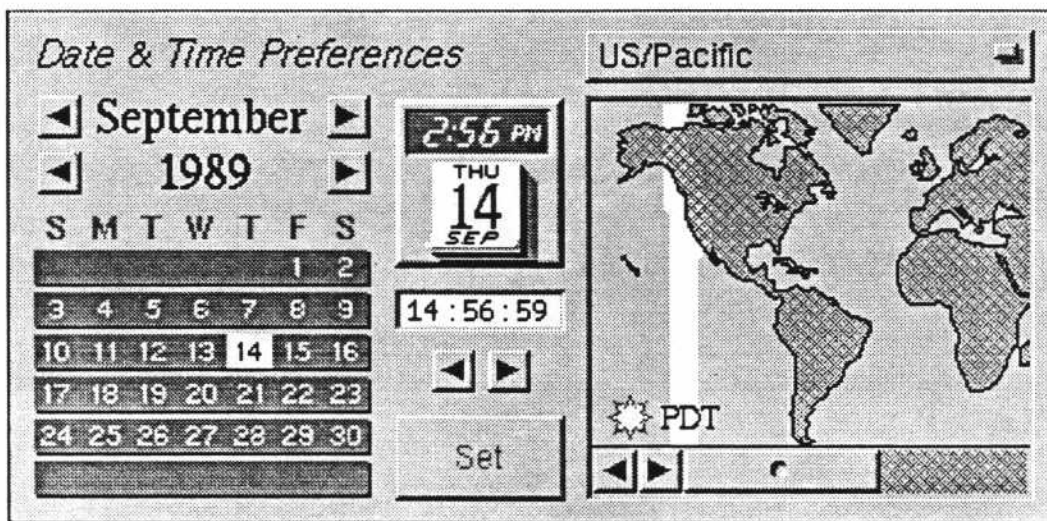
**Menu Location:** Determines the initial location of the main menu for applications.

**Application Font:** Sets the default font for applications. The Font Panel button will bring up a font panel from which you can select the application font.

**System Beep:** Allows you to select the sound used as the system beep. If Visual is selected, the system beep will be represented by the NeXT logo at the top of the dock graying out briefly. The system beep is played or displayed when selected.



## Date and Time



**Date:** Allows you to change the system date. The arrow buttons scroll select the month and year, while clicking a date in the calendar selects that date.

**Clock:** Allows you to change the system time, using the arrow buttons (double click the hour, seconds or minutes of the digital clock display before using the buttons).

**Time Zone:** This is where you select the time zone, by clicking the map of the world in the appropriate spot. The pop-up list can be used to further refine your selection.



## Password

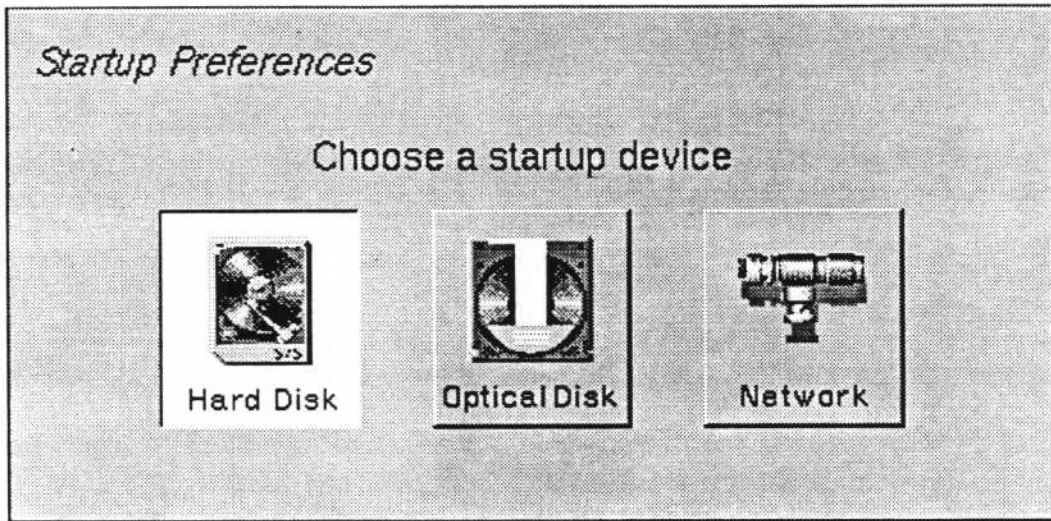
Please enter your old password

Cancel OK ↵

Changes your **Netinfo** password. If this is unsuccessful, changes your yp password.



**Startup**



Allows you to select the boot device (Hard Disk, Optical or Network).





## Expert

*Expert Preferences*

UNIX Expert <input type="checkbox"/>	File-Creation Mask			
Public Window Server <input type="checkbox"/>		Owner	Group	Others
	Read	On	On	On
	Write	On	Off	Off
	Execute	On	On	On

**UNIX Expert:** When selected, all files on the system will be visible through the Browser. When not selected, only a subset will be displayed. (See the handout *NeXT Directory Structure* for details.)

**Public Window Server:** When selected, allows remote connections to your window server.

**File-Creation Mask:** Determines the default permissions for newly created files.

# Shut Down Procedures

**Shutting down the NeXT way:** Before shutting down the machine, you should quit each and every application that is running, so that any open files will be saved to disk. Once this is done, simply press the **Power** key. A panel will appear, warning you to save all files by quitting all active applications. You may then select **Power Off**. This is a clean shut down.

**Shutting down the UNIX way:** If you can become the superuser, log in and launch either **Terminal** or **Shell** and switch user to the super user. From here, you can issue the standard UNIX **shutdown** or **halt** commands. This will leave you in the ROM Monitor with the **NeXT>** prompt. From there you can press the **Power** key, which will give you a prompt asking if you really wish to power off. Respond with a **y** to turn off the power.

If you cannot log in because the Workspace Manger is tossing you back out, you can enter **console** at the loginwindow and get a standard UNIX login prompt. You can now log in and go through the above steps.

These are all clean shut downs.

**Returning to the NMI monitor:** If you cannot get anywhere because PostScript is locked up, or can't become the superuser, you must resort to keystroke shutdown. Hold both **Command** keys down while typing the keypad tilde key. This will present you with the NMI mini monitor prompt, **nmi>**. From this prompt, type **halt**. After the monitor has **synched** your disk(s) you will be left in the ROM monitor, from which you can use the **Power** key. This, too, is a clean shut down.

If entering **halt** does not work, you can enter **monitor**. This will take you directly to the ROM monitor, but it is *not* a clean shut down.

**If all else fails:** If none of the above mechanisms are available to you, you can do a hard reset of the CPU by pressing **Alternate-Command-\*** (that's the left **Alternate** and **Command** keys and the numeric keypad \* key). This will not power off the machine, but it will restart everything. Or, you can pull the plug. (Obviously not a clean shut down.) Be warned—both of these two procedures are potentially damaging to an optical disk if the drive is in the middle of a write operation.



# ROM Monitor Commands

The NeXT ROM monitor automatically performs self-test diagnostics and initiates the boot procedure when the system is powered up or restarted. Less frequently, the ROM monitor is used interactively to perform specialized functions. The more frequently used of these infrequently used functions, and how to perform them, are described below. For more information on the NeXT monitors see Chapter 17 in the *NeXT System Reference Manual*.

**Note:** All monitor and mini-monitor commands can be abbreviated. The minimum abbreviation for each command is in bold face.

## Using the NMI Mini-monitor

**Accessing the NMI Mini-monitor:** To enter the NMI (non-maskable interrupt) mini-monitor from a running system, enter **Command-Command--~**. You will be greeted by the mini-monitor's friendly **nmi>** prompt.

**Displaying the Commands that can be Executed from the NMI Mini-monitor:** To display a listing of all of the commands that can be executed from the NMI mini-monitor, enter **?** at the NMI prompt. (Because of the size of the nmi window, the first several commands cannot be read.)

**Returning to the Operating System from the NMI Mini-monitor:** To resume execution after an escape to the NMI mini-monitor, enter **continue**.

**Displaying System Messages from the NMI Mini-monitor:** To display the kernel message buffer which includes the machine's Ethernet address, enter **msg**.

**Shutting Down the System from the NMI Mini-monitor:** If you want to shut the system down and are in contact with the NMI or panic mini-monitor, and the power switch is not responding, enter **halt**. You should also use this procedure to reboot the system if you are stuck in either mini-monitor.

**Rebooting the System from the NMI Mini-monitor:** To reboot the system, enter **reboot** at the NMI prompt. This will save files to disk and then reboot with the last boot command used.

**Accessing the Monitor from the NMI Mini-monitor:** The ROM monitor itself is not directly accessible from the operating system. To access the ROM monitor from the operating system you must first access the NMI mini-monitor and then enter `monitor`. Please note that this is *not* a clean shut down and should only be performed when nothing else works.

## Using the ROM Monitor

**Accessing the Monitor During the Boot Process:** To access the ROM Monitor during the boot process, enter `Command--~` as soon as the message **testing system** is replaced by the **loading from disk** message. You will be greeted by the Monitor's **NeXT>** prompt.

**Booting from the Monitor Using Default Parameters:** To boot the system from the monitor using the default boot device enter `boot`.

**Booting from a Non-default Device:** To boot the system from a device that is not the default device enter the command listed below that corresponds to the device from which you wish to boot:

boot device	command
optical disk	<code>bod</code>
SCSI disk	<code>bsd</code>
ethernet	<code>ben</code>

The **b** in each of these commands stands for boot, **od** stands for optical disk, **sd** for SCSI disk, and **en** for Ethernet. Each can be followed by a **-s** to boot the system from the specified device in single user mode (e.g., `bod -s`).

**Ejecting an Optical Disk:** To eject an optical disk from the monitor, enter the command `eject`. Please see the handout titled *Ejecting an Optical Disk*.

**Setting the Hardware Password:** If security is an issue at your site, you will probably want to restrict access to the ROM monitor commands. This is possible by setting a hardware password. To set the password, enter `P`. Once set, three configuration parameters (described in the following section) determine which monitor commands will be restricted.

**Changing default boot parameters:** Which device is the default boot device can be set through the **Preferences** application or from the ROM monitor. It is also possible to change whether or not several power-on tests are performed, as well as set several security parameters. The basic method for changing any of these defaults is the same. You enter the **p** parameter command at the ROM monitor's **NeXT>** prompt, which initiates a dialogue like the one illustrated below:

**NeXT>p**

```
boot command: od?
DRAM tests: yes?
perform power-on system test: yes?
    sound out tests: yes?
    SCSI tests: no?
    loop until key press: no?
    verbose test mode: no?
boot extendeddiagnostics: no?
serial port A is alternate console: no?
allow any ROM command even if password protected: no?
allow boot command from any device even if password protected: no?
allow optical drive #0 eject even if password protected: no?
```

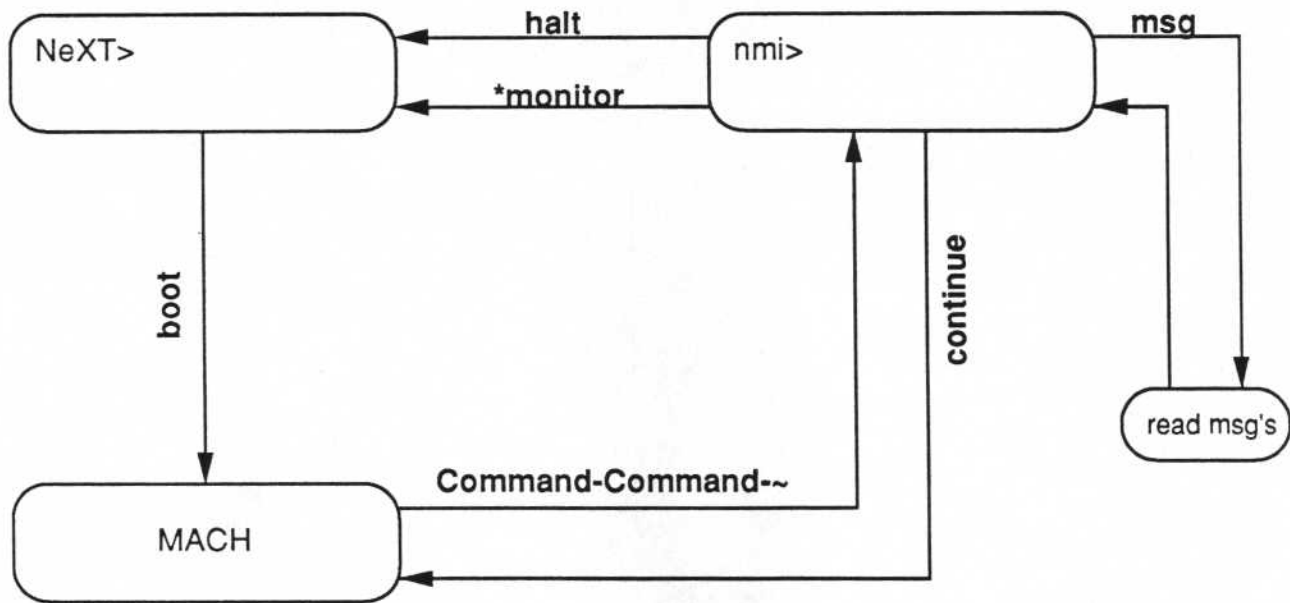
Pressing **Return** in response to any of the monitor's questions will result in the value named before the question mark remaining in effect. To change a value simply specify the new value after the question mark and press **Return**.

The possible values for the boot command are the name of the device you wish to be your default boot device as listed below (note that they are *not* preceded by a b):

boot device	command
optical disk	<b>od</b>
SCSI disk	<b>sd</b>
ethernet	<b>en</b>
null	.

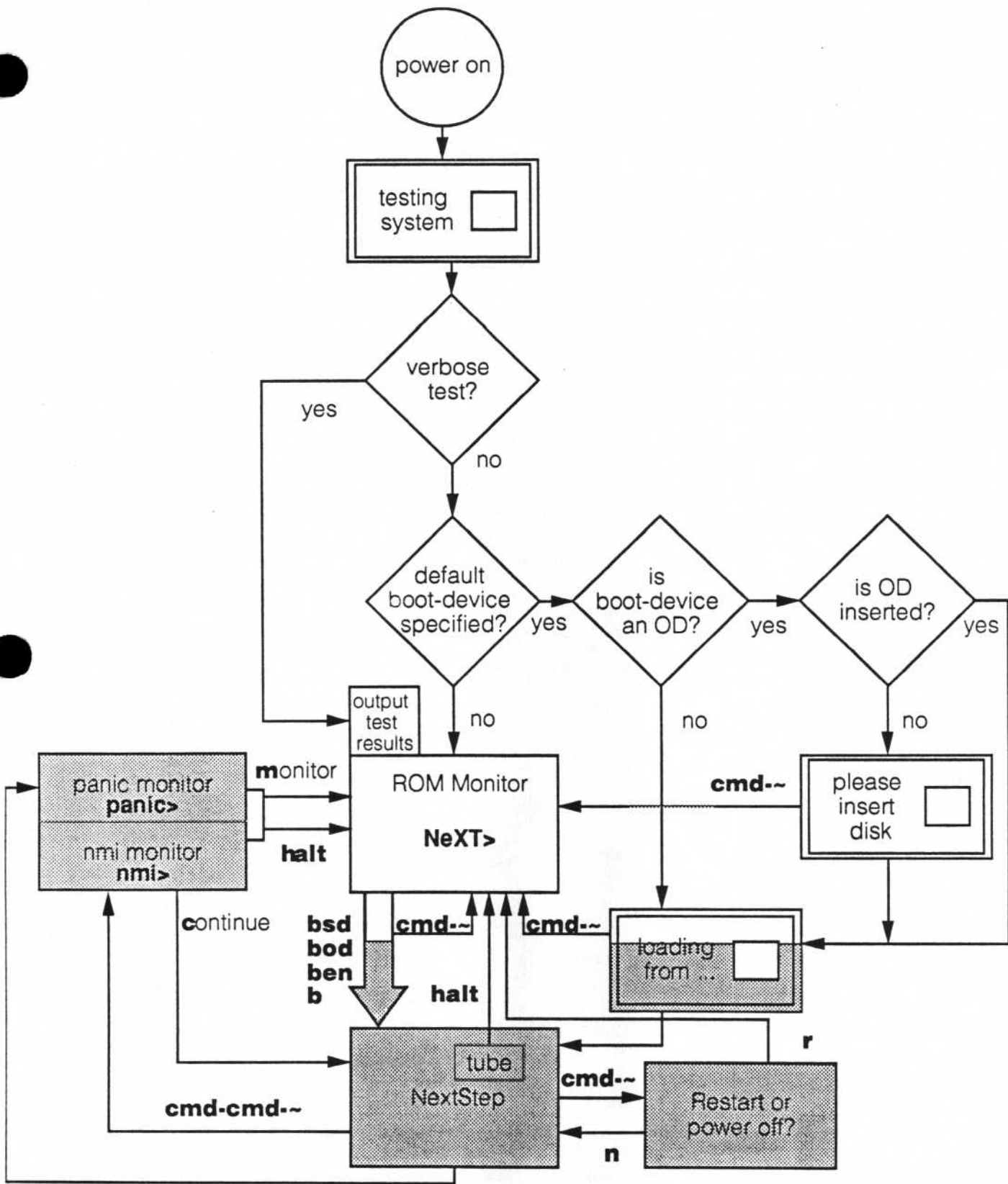
The remaining parameter values are boolean. Here you can answer **yes** or **y** to have the test performed, **no** or **n** to have the test not performed, or simply press **Return** to leave the values as they are. The final three parameters determine which ROM commands will be protected when the hardware password is set.

# Monitor Command Sequence



\* Not a clean shutdown. Use only when **halt** doesn't work.


# Monitor Map



**cmd** = hold down the Command key

**Alt** = hold down the Alternate key

**Alt-cmd-\*** (hard reset) will always return to "testing system", regardless of system state

 = Mach running