

# OKIDATA

## 3300 Disc Drive

The 3300 is a series of Winchester technology fixed-media, moving-head disc drives with a maximum storage capacity of 74 megabytes.



### Features:

- 74 MB of Moving Head Storage
- Winchester technology, simple rotary positioner
- Only 7" high x 22" deep
- Fixed Head option with overlap seek
- 9760 CDC Storage Module Interface option
- Clean air package
- Not a stripped-down version

✓ **BEST BUY for small systems**

The Okidata 3300 Series is a family of disc drives which fill the memory needs of a large variety of minicomputer and medium-scale computer systems. The 3300 Series is available with moving head storage and has a range of capacities from 12.4 megabytes to 74.4 megabytes. The entire series utilizes the proven fixed media IBM Winchester technology for heads and media to provide maximum capacity and reliability at a minimum cost.

The key to the performance of the 3300 Series is a unique rotary head positioner developed by Okidata. In this design, the heads are directly mounted to a rotating arm which moves across the disc surface much as a phonograph arm. This approach does away with the typical head carriage and its mass, while eliminating precision rails and ball bearings. The result—a 74.4 megabyte rack-mounted disc drive including power supply that is just 7" high by 22" deep and weighs less

than 65 lbs. In addition to the moving heads, the 3300 Series may be equipped with optional fixed heads to provide economical data storage with minimum access time.

The 3300 Series is equipped with an internal interface that may be easily customized to the user's requirements by changing one printed circuit card. A CDC 9760 Storage Module compatible interface is also available. If fixed heads are used with this interface, an "overlap seek" feature allows the use of the fixed heads while positioning the moving heads.

To provide even greater reliability, the 3300 Series has a clean air package. This subsystem provides positive pressure to the disc enclosure. Once every second, all air in the disc cavity is passed through an absolute filter that eliminates 99.97% of all particles larger than 0.3 micron diameter. This assures the cleanliness of the air in the disc cavity.

The 3300 Series is a fully equipped family of disc drives. Included as standard in every unit are: power supply, slides, data separation (NRZ data interface), direct track addressing, early/late data strobe, track offset, and sector and index look-ahead. With all these standard features, plus the high reliability, high storage capacity and low cost of fixed media Winchester technology, the 3300 Series is the best buy in disc drives for small systems!

**The 3300 Disc Drive...designed to your advantage.**

# CDC 9760-Compatible Interface

## 1.0-INTERFACE

The CDC 9760-compatible interface is such that the Moving Head Drives may be plugged into a system designed to operate with the CDC 9760 (Storage Module), and operate to its specifications, with the following exceptions:

- a) The system must handle the drive data transfer rate (7.33 Mbits per second).
  - b) The system should transfer the receive data in NRZ (CDC NRZ option).
  - c) Up to twelve heads must be addressed and only cylinder numbers 0 through 338 will be recognized by the drive.
- Note: An address mark option is available.

Moving head and fixed head hybrid drives utilize a common interface. Fixed head tracks are addressed using the cylinder address lines (also used for moving heads). Fixed heads will be designated by a unit select address which is different from the moving heads in the same drive. Unit addresses are accomplished with a plug on the interface board, or with optional control panel thumbwheel switches

## 2.0-OVERLAP SEEK

The fixed head unit and moving head unit appear to a controller as two independent drives permitting an overlap seek feature where read or write on fixed heads may be enabled while moving heads are undergoing a seek in the same drive.

## 3.0-TRANSMITTERS/RECEIVERS

Industry standard type 75110 and 75107 transmitters and receivers are used.

## 4.0-CONNECTORS

The CDC-compatible interface is intended for use with flat cables which plug directly to the interface board. Optional bundled cable connectors can be provided. Both connector types are compatible with the CDC 9760 series of disc drives.

The interface accommodates two "A" connectors and one "B" connector. If multiple drives are connected to the same controller, "A" connectors can be either in a "star" or "daisy chain" configuration. "B" connectors must be in a "star" configuration only. If the drive contains fixed heads, a second "B" connector is provided which must also be connected to the controller in a "star" configuration. The same "A" connectors can still be used in either a "star" or "daisy chain" mode. The maximum lengths of the cables can be 100 feet cumulative for the "A" cable "daisy-chained" and 50 feet for the "B" cable.

The connectors installed in the disc drive are:

- Flat ribbon A connector—AMP 87365-7
- Flat ribbon B connector—AMP 87365-3
- Optional bundled cable A connector—AMP 201310-1
- Optional bundled cable B connector—AMP 201357-1

## 5.0-EXTERNAL INTERFACE SIGNALS

**Cable "A" Signals** (Received by the Unit)

**Cylinder Address (TAG 1)** Ten bus lines (Tag 1) are used to carry the cylinder address to the 3300. Since the disc is a direct addressing device, the controller need only place the new address on the lines and strobe the lines with Tag 1. The unit must be On

Cylinder before Tag 1 is sent. The bus lines should be stable throughout the tag time. Tag 1 must be from 1.0  $\mu$ s to 0.5 ms in duration. Addresses greater than 338 will result in "Seek Error".

**Head Select (TAG 2)** This signal is the head address that will be selected by bits 0 through 4. Tag 2 must be from 1.0  $\mu$ s to 0.5 ms in duration.

**Control Select (TAG 3)** The signal acts as an enable and must be true for the entire control operation.

- 1-Write Gate line (Bit A) enables the write driver. Data is automatically protected by inhibiting the Write Enable in all fault conditions via:
  - a) Fault, line true
  - b) On Cylinder, not true
  - c) Seek Error, line true
  - d) Ready, not true
  - e) Open cable
- 2-Read Gate (Bit 1)  
Enabling of the Read Gate enables digital read data to the transmission lines. The leading edge of Read Gate triggers the read chain to synchronize on all zeroes pattern.
- 3-Servo Offset Plus (Bit 2)  
When this signal is true, the actuator is offset from the nominal On Cylinder position towards the spindle.
- 4-Servo Offset Minus (Bit 3)  
When this signal is true, the actuator is offset from the nominal On Cylinder position away from the spindle.

### 5-Fault Clear (Bit 4)

A 100 ns minimum pulse sent to the 3300 will clear the fault flip-flop for the selected unit if the fault condition no longer exists.

### 6-AM Enable (Bit 5) (See Note) (Optional)

The AM (Address Mark) Enable line, in conjunction with Write Gate or Read Gate, allows the writing or recovering of Address Marks. When AM Enable is true while Write Gate is true, the writer will stop toggling and erase the data, creating an Address Mark. Write Fault detection in the unit is inhibited by this signal.

When AM Enable is true while Read Gate is true, an analog voltage comparator detects the absence of read signal. If the duration of the erased area is greater than 16 bits, an Address Mark Found signal will be issued.

NOTE: If Address Mark is not used, Bit 5 must be held inactive during Control Select functions.

Address Mark should be 3.0 to 3.5 bytes in length with no transitions.

### 7-RTZ (Bit 6)

A 250 ns minimum, 1.0 ms maximum pulse, sent to the unit will cause the actuator to seek track 0, reset the Head Register and clear the Seek Error flip-flop. For the fixed head unit, the Track Address Register will be cleared as opposed to the Head Register.

This seek is significantly longer than a normal seek to track 0, and should only be used for recalibration, not Data acquisition.

### 8-Data Strobe Early (Bit 7)

When this line is true, the PLO Data Separator will strobe the data at a time earlier than nominal. Normal strobe timing will be returned when the line is false.

### 9-Data Strobe Late (Bit 8)

When this line is true, the PLO Data Separator will strobe the

data at a time later than nominal. Normal strobe timing will be returned when the line is false.

**NOTE:** The Data Strobe and Servo Offset signals are intended to be used as an aid to recover marginal data. The carriage and data strobe position return to nominal when the respective signals go false. A servo offset will result in loss of On Cylinder and Seek End for a period of 3.2 ms maximum.

The maximum time for the servo to move from forward to reverse offset or vice-versa will not exceed 7 ms. Data shall not be written while in the offset mode.

**10-Release (Bit 9) (Dual Channel Only)**

This bit is currently ignored by the interface.

**Unit Select Lines (2<sup>0</sup>, 2<sup>1</sup>, 2<sup>2</sup>, 2<sup>3</sup>) and Unit Select Tags** The Unit Select Tag signal gates the four Unit Select Lines into the logic number compare circuit. The unit will be selected internally 200 nsec (maximum) after leading edge of this signal. The moving head and fixed head unit numbers may be selected by either two thumbwheel switches on the front panel or by one jumper plug on the I/O board. Unit addresses 14 and 15 are reserved for use in field maintenance.

**Open Cable Detector** Inhibits write gate and unit select when the "A" interface cable is disconnected or controller power is lost.

**Power Sequence Pick and Hold** The lines are bussed through on the drive to prevent interference with a "daisy-chain" of drives which utilize the automatic power sequencing option.

**Cable "A" Signals** (Transmitted by the Unit)

**Sector Mark** Signal derived from the servo track. Any number of sectors can be provided ranging from 2 bytes per sector to 8192 bytes per sector. The number of bytes per sector is selected by one jumper on the I/O board. The last sector of the revolution may be longer if necessary.

**Index** This signal occurs once per revolution, and its leading edge is considered the leading edge of the Sector Zero, typically 2.5  $\mu$ sec. Timing integrity is retained throughout seek operations.

**Unit Ready** Indicates that selected unit is up to speed, heads are on a track, and no fault exists.

**Address Mark Found** (Optional) Address Mark Found is a 9.0 maximum usec pulse which is sent to the controller following recognition of at least 16 missing transitions and the first zero of the zeroes pattern.

The controller should drop the Address Mark Enable line (Bit 5) upon receiving Address Mark Found (AMF) and valid data will be presented on the I/O lines following the AMF pulse.

**On Cylinder** For moving heads "On Cylinder" indicates that the heads are positioned over a track. For fixed heads, this response is made automatically once a track is selected. This status line is cleared with any seek instruction. For moving heads, a carriage offset will result in loss of "On Cylinder" for a period of 3.2 ms maximum.

**Seek Error** Seek Error will be true for moving heads when either Seek Late or Illegal Address (an address greater than the number of data cylinders) occurs. Seek Error will also be set true for "Tag 1" signals received when "On Cylinder" is false. Seek Error will inhibit "On Cylinder" and Write Enable and will only be cleared by performing an RTZ. For fixed heads Seek Error will not be used unless the contiguous track address option is present. In that event Seek Error will be true if an address greater than the

number of fixed heads in the drive is requested. "On Cylinder" and Write Enable are disabled in the same fashion as the moving heads.

**Fault** Fault for the selected unit will be set true for a number of fault conditions and will remain true until the fault condition no longer exists and a Fault Clear pulse is received. Fault conditions are:

- 1-Multiple Heads Selected
- 2-Write Protect Violation
- 3-Multiple Control Tags Received
- 4-Read or Write Off Cylinder
- 5-Simultaneous Write and Read Gates
- 6-Write While Servo Offset
- 7-Write Current Not On During Write
- 8-Write Current On During Non-Write
- 9-Fixed and Moving Head Unit Number Set equal by Front Panel Switches or by Unit Addressing Plug
- 10-Loss of DC Power

**Write Protected** (Optional) This signal is true for the selected unit for as long as a Write Protected portion of the drive is addressed. Those portions which may be protected are:

- 1-Moving Head 0 (all associated tracks)
- 2-All Fixed Head Tracks
- 3-Entire Drive (all moving and fixed head tracks)

Attempting to write while protected will cause a fault to be issued.

**Busy** This line provides compatibility with controllers which utilize the dual port option. Busy is always low to indicate the drive is not currently busy with another controller.

**Cable B Signals** (Received by the Unit)

**Write Clock** This line transmits the Write Clock signal which must be synchronized to the NRZ data. The Write Clock is the Servo Clock retransmitted to the drive by the controller, during a write operation. The Write Clock need not be transmitted continuously, but must be transmitted at least 250 ns prior to Write Enable.

**Write Data** Carries data to be recorded on the disc. Data is NRZ, and is clocked onto the disc by the disc drive.

**Cable B Signals** (Transmitted by the Unit)

**Servo Clock** Phase-locked 7.33 MHz clock generated from the servo track tribits. It is used to transfer data to the drive. Servo Clock is available at all times (not gated with Unit Select).

**Read Data** Carries data recovered from the disc. Data is NRZ.

**Read Clock** The Read Clock defines the beginning of a data cell. It is an internally derived clock signal and is synchronous with the detected data. This signal is transmitted continuously, and is in phase sync within 7  $\mu$ s after Read Gate.

**Seek End** Seek End goes true with either "On Cylinder" or "Seek Error" indicating that a seek operation has terminated. Seek End will remain true so long as the positioner remains on cylinder.

**Unit Selected** When the four unit select bit lines compare with the jumper plug on the interface board, and when the leading edge of unit select tag is received, the unit selected line becomes true and transmitted to the controller on the "B" cable. Multiple unit selected responses on a daisy-chain system indicate duplicate plugs have been installed.

**Sector** Sector Mark is transmitted continuously, independent of Unit Select, in order to provide look-ahead for the controller.

**Index** Index is transmitted continuously, independent of Unit Select in order to provide look-ahead for the controller.

# The 3300 Disc Drive. From OKIDATA

## Designed to your advantage.

**DESIGN:** Only the discs, spindle, and heads are located inside the disc enclosure. All electronics and sub-assemblies are located outside of the disc cavity.

**ADVANTAGE:** A maximum amount of servicing can be done without disturbing the sealed disc enclosure.

**DESIGN:** Winchester technology heads and media.

**ADVANTAGE:** Winchester technology is proven. Originally used by IBM on its 3340 disc drive, it is now used by IBM for the System 32 and the latest drives for the 370, the 3350.

**DESIGN:** Fixed media for high reliability.

**ADVANTAGE:** With fixed media, the heads never have to be retracted or unloaded, which is the prime contributing factor to head crashes. Loading and unloading of discs is not necessary so handling accidents are avoided.

**DESIGN:** Fixed media for large capacity.

**ADVANTAGE:** The number of tracks on the surface may be increased and the capacity of the disc drive may be larger without any sacrifice in reliability.

**DESIGN:** Fixed media for low cost.

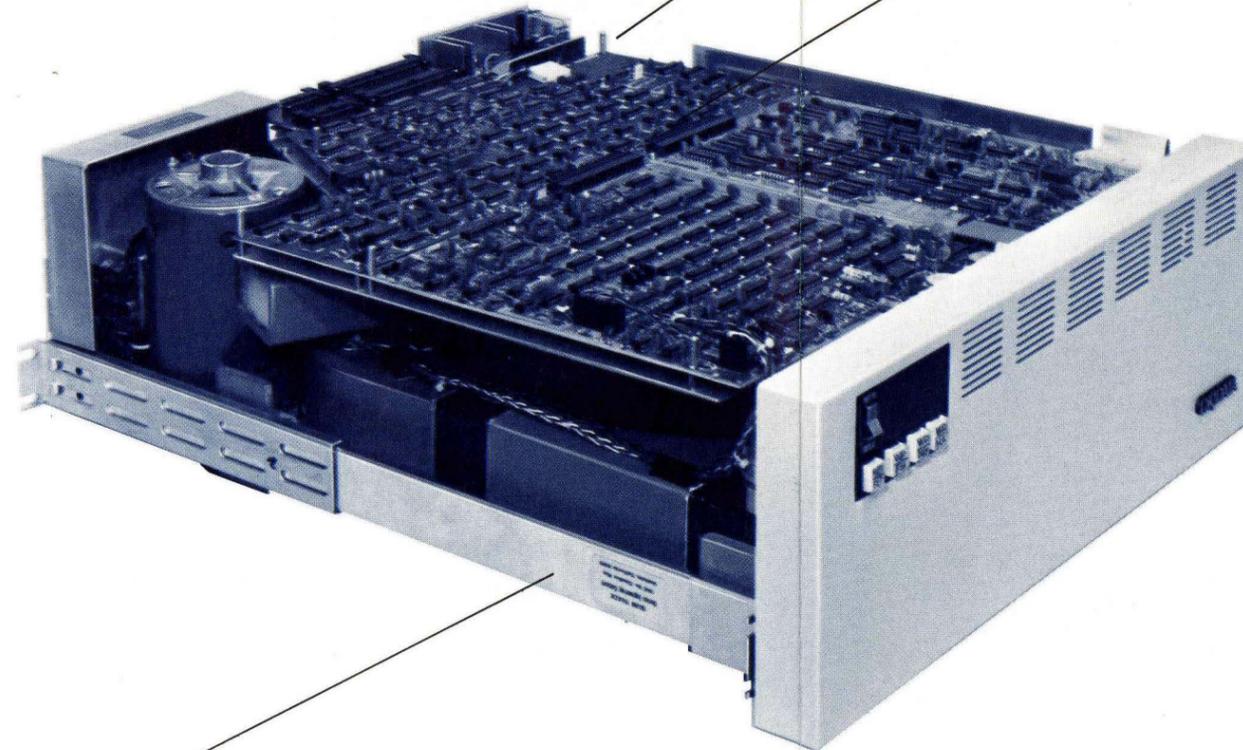
**ADVANTAGE:** The elimination of mechanisms to allow the heads to be unloaded and the disc to be removed plus the larger capacities per disc surface result in lower costs.

**DESIGN:** Data separation (NRZ) and direct track address, standard; continuous fixed head addressing, optional.

**ADVANTAGE:** Ease of controller design.

**DESIGN:** Compare size—7" high x 22" deep rack-mounted with a maximum weight of 65 lbs. including power supply.

**ADVANTAGE:** Easy to mount; less weight to ship.



**DESIGN:** Power failure interlocks—to detect dc levels and ac power failures.

**ADVANTAGE:** Maximum protection against data loss and machine damage.

**DESIGN:** The number of sectors and unit address may be changed by simply changing a DIP pack on the interface board.

**ADVANTAGE:** Ease in customizing a disc drive to the optimum format of the data being stored.

**DESIGN:** Internal interface consisting of a comprehensive set of lines that will allow many different system interfaces to be accommodated by changing only the interface printed circuit board.

**ADVANTAGE:** Ease in customizing the 3300 Series to function with a wide variety of systems.

**DESIGN:** Line voltage can be changed by changing a transformer tap. Frequency can be changed by changing a pulley.

**ADVANTAGE:** Ease in customizing a unit for international operations.

**DESIGN:** Standard error recovery features include early/late data strobe and track offset.

**ADVANTAGE:** Maximum possibility of recovering data in the event of a malfunction within the disc drive.

**DESIGN:** Proprietary rotary positioner.

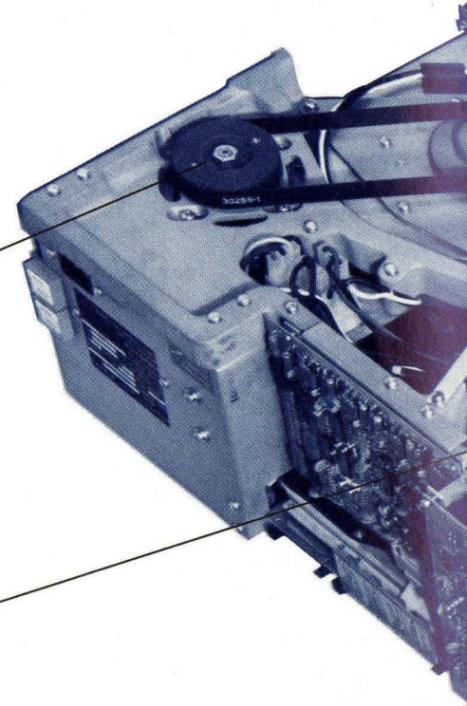
**ADVANTAGE:** This approach does away with the typical head carriage and its mass, while eliminating precision rails and ball bearings. Only two ball bearings are used. The positioner uses a brushless D.C. motor which can be removed without disturbing the arm, heads or the sealed disc cavity.

**DESIGN:** Optional fixed heads may be added for data accessibility with minimum access time.

**ADVANTAGE:** Fixed heads with an average access time of 10.1 ms. When the optional CDC 9760 interface is used, an overlap seek feature allows data to be read or written with the fixed heads while the moving heads are being repositioned.

**DESIGN:** Two heads per disc surface.

**ADVANTAGE:** Each disc drive may contain from one to four discs with up to six surfaces used for moving heads. With two heads per surface, a maximum of 12 cylinders may be accessed without having to reposition the heads. Twice the amount of data is available per positioner access time than was available with previous technology.



**DESIGN:** Power failure interlocks—to detect dc levels and ac power failures.

**ADVANTAGE:** Maximum protection against data loss and machine damage.

**DESIGN:** The number of sectors and unit address may be changed by simply changing a DIP pack on the interface board.

**ADVANTAGE:** Ease in customizing a disc drive to the optimum format of the data being stored.

**DESIGN:** Internal interface consisting of a comprehensive set of lines that will allow many different system interfaces to be accommodated by changing only the interface printed circuit board.

**ADVANTAGE:** Ease in customizing the 3300 Series to function with a wide variety of systems.

**DESIGN:** Line voltage can be changed by changing a transformer tap. Frequency can be changed by changing a pulley.

**ADVANTAGE:** Ease in customizing a unit for international operations.

**DESIGN:** Standard error recovery features include early/late data strobe and track offset.

**ADVANTAGE:** Maximum possibility of recovering data in the event of a malfunction within the disc drive.

**DESIGN:** Proprietary rotary positioner.

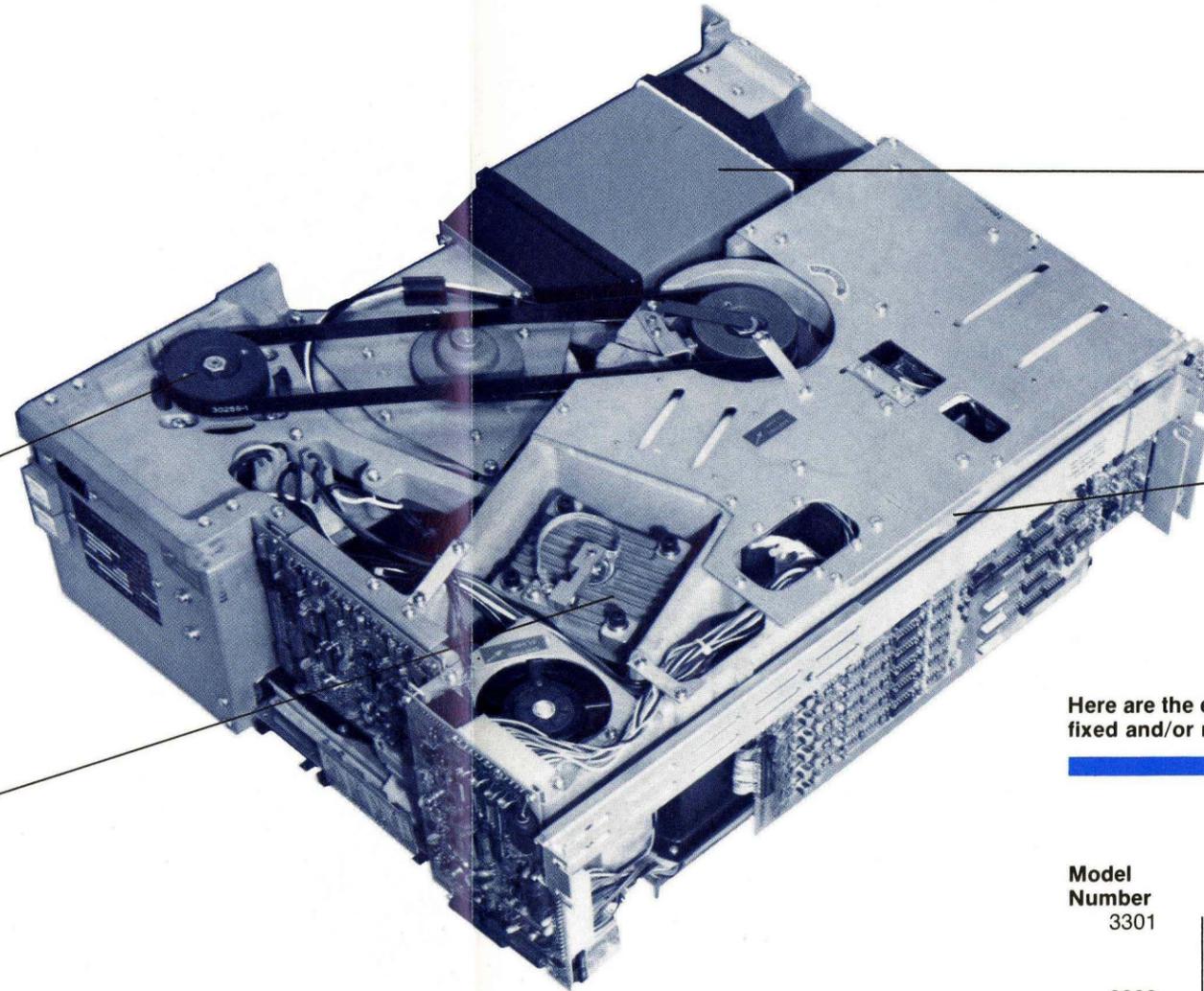
**ADVANTAGE:** This approach does away with the typical head carriage and its mass, while eliminating precision rails and ball bearings. Only two ball bearings are used. The positioner uses a brushless D.C. motor which can be removed without disturbing the arm, heads or the sealed disc cavity.

**DESIGN:** Optional fixed heads may be added for data accessibility with minimum access time.

**ADVANTAGE:** Fixed heads with an average access time of 10.1 ms. When the optional CDC 9760 interface is used, an overlap seek feature allows data to be read or written with the fixed heads while the moving heads are being repositioned.

**DESIGN:** Two heads per disc surface.

**ADVANTAGE:** Each disc drive may contain from one to four discs with up to six surfaces used for moving heads. With two heads per surface, a maximum of 12 cylinders may be accessed without having to reposition the heads. Twice the amount of data is available per positioner access time than was available with previous technology.



**DESIGN:** The 3300 Series uses a track following servo system. The bottom surface of the bottom disc contains pre-written servo tracks used to position the heads.

**ADVANTAGE:** This eliminates close tolerances and thermal problems associated with drives that use the positioner to derive track position information.

**DESIGN:** Clean air package which recirculates air in the disc cavity through an absolute filter once every second. The filter removes 99.97% of all particles larger than 0.3 micron diameter on each pass. Pressure within the disc cavity is reference to outside through breather filter.

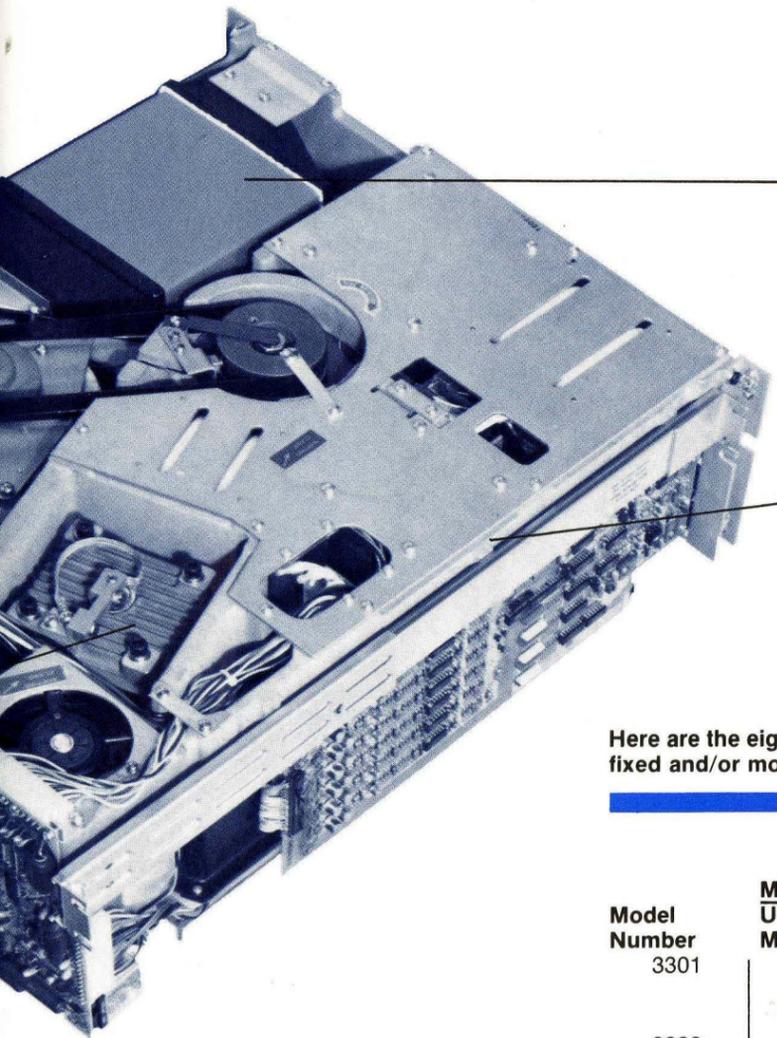
**ADVANTAGE:** Unprecedented cleanliness in the disc cavity and a slight positive pressure in the cavity which will prevent contaminants from entering in the event of a small opening or leak.

**DESIGN:** Power supply contained within disc drive.

**ADVANTAGE:** System integration, ease of testing, and no line noise.

Here are the eight basic models of the 3300 family, and their maximum fixed and/or moving head capacities .

Model Number	CAPACITY		Moving Head Unformatted Megabytes	Remarks
	Max. Fixed Head Option Unformatted Megabits	Unformatted Megabytes		
3301	5.94	0.74	12.40	1 Disc 1 Surface Moving Head
3302	17.82	2.23	24.80	2 Discs 2 Surfaces Moving Head
3303	5.94	0.74	37.19	2 Discs 3 Surfaces Moving Head
3304	17.82	2.23	49.59	3 Discs 4 Surfaces Moving Head
3305	5.94	0.74	61.99	3 Discs 5 Surfaces Moving Head
3306	5.94	0.74	74.39	4 Discs 6 Surfaces Moving Head (Max. Capacity)
3307	23.76	2.97	—	1 Disc Fixed Head Only
3308	47.51	5.94	—	2 Discs Fixed Head Only



**DESIGN:** The 3300 Series uses a track following servo system. The bottom surface of the bottom disc contains pre-written servo tracks used to position the heads.

**ADVANTAGE:** This eliminates close tolerances and thermal problems associated with drives that use the positioner to derive track position information.

**DESIGN:** Clean air package which recirculates air in the disc cavity through an absolute filter once every second. The filter removes 99.97% of all particles larger than 0.3 micron diameter on each pass. Pressure within the disc cavity is reference to outside through breather filter.

**ADVANTAGE:** Unprecedented cleanliness in the disc cavity and a slight positive pressure in the cavity which will prevent contaminants from entering in the event of a small opening or leak.

**DESIGN:** Power supply contained within disc drive.

**ADVANTAGE:** System integration, ease of testing, and no line noise.

Here are the eight basic models of the 3300 family, and their maximum fixed and/or moving head capacities .

Model Number	CAPACITY		Moving Head Unformatted Megabytes	Remarks
	Max. Fixed Head Option Unformatted Megabits	Unformatted Megabytes		
3301	5.94	0.74	12.40	1 Disc 1 Surface Moving Head
3302	17.82	2.23	24.80	2 Discs 2 Surfaces Moving Head
3303	5.94	0.74	37.19	2 Discs 3 Surfaces Moving Head
3304	17.82	2.23	49.59	3 Discs 4 Surfaces Moving Head
3305	5.94	0.74	61.99	3 Discs 5 Surfaces Moving Head
3306	5.94	0.74	74.39	4 Discs 6 Surfaces Moving Head (Max. Capacity)
3307	23.76	2.97	—	1 Disc Fixed Head Only
3308	47.51	5.94	—	2 Discs Fixed Head Only

## Specifications

### Technology

The heads, discs, spindle speed, bit density, and track density used in the 3300 are equivalent to those used in the IBM 3340.

<b>Disc rotational speed</b>	2964 RPM
<b>Track density moving heads</b>	286 Tracks/in.
<b>Track density fixed heads</b>	33.3 Tracks/in.
<b>Bit density (inner track)</b>	5636 Bits/in.
<b>Capacity per track (unformatted)</b>	18560 Bytes
<b>Addressable Cylinders</b>	339
<b>Data Tracks per Surface (Moving Head)</b>	678
<b>Maximum Data Tracks per Surface (Fixed Head)</b>	80
<b>Moving Heads Per Surface</b>	2
<b>Methods of Positioning Moving Heads</b>	The 3300 uses a rotary positioner and a track following servo which does not require a tachometer. A portion of the lower disk surface contains pre-recorded information allowing for servo positioning directly off the disks.

### Performance

<b>Maximum Seek Time (Including Head Settling)</b>	339 track seek 75 ms Single Track Seek 10 msec. Random Average 38 msec.
<b>Average Latency</b>	10.12 ms
<b>Transfer Rate</b>	7.33 (Megabits/sec)
<b>Unformatted capacities range from:</b>	12.40 to 74.39 Mbyte, moving head. 0.371 to 2.23 Mbyte, fixed head in increments of 0.371 Mbyte when added to a moving head spindle. 0.74 to 5.94 Mbyte, fixed head, in increments of 0.371 Mbyte fixed head only.
<b>Head Select Time</b>	5 $\mu$ sec
<b>Write to Read Recovery Time</b>	10 $\mu$ sec
<b>Read to Write Recovery Time</b>	.3 $\mu$ sec

### Physical Characteristics

<b>Height</b>	7"
<b>Width</b>	17 $\frac{3}{4}$ "
<b>Depth</b>	23 $\frac{1}{2}$ "
<b>Mounting</b>	Horizontal or Vertical on Slides
<b>RETMA Rack Mountings Height and Depth Weight</b>	7" x 22" 70 pounds maximum

### Power Requirements

<b>Frequency Tolerances</b>	60 Hz $\pm$ 1% or 50 Hz $\pm$ 2%
<b>Line Voltage</b>	105V, 110V, 115V, 120V, 210V, 220V, 230V, 240V, $\pm$ 10%

### Environmental Limits

<b>Operation Temperature</b>	+50°F (+10°C) to +104°F (+40°C)
<b>Non Operating Temperature</b>	- F (-40°C) to +158°F (+70°C)
<b>Operating Humidity</b>	20% to 80% RH with a minimum gradient of 10% per hour. No condensation.
<b>No Operating Humidity</b>	5 to 95%. No condensation.
<b>Operating Altitude</b>	500 ft. below sea level to 7,000 ft. above sea level.
<b>Non Operating Altitude</b>	500 ft. below sea level to 40,000 ft. above sea level.

### Reliability

<b>Read Error (no retries)</b>	1 error maximum in 10 <sup>10</sup> bits
<b>Read Errors (after retries)</b>	1 error maximum in 10 <sup>11</sup> bits
<b>Unrecoverable Read Errors</b>	1 error maximum in 10 <sup>12</sup> bits
<b>Write Errors</b>	1 error maximum in 10 <sup>13</sup> bits

### Operator Control Panel

<b>Standard Controls</b>	Power On/Off with power ON indicator Ready/Fault Indicator
<b>Optional Controls</b>	Fixed Head Write Protect, Moving Head Write Protect (1 Head Only), Write Protect for Entire Drive, Unit Address thumbwheel switch

### Standard Features

<b>Clean Air Package</b>	Consisting of blower, main filter, and breather filter which once every second passes all the air within the disc cavity through an absolute filter that removes 99.97% of all particles larger than .3 micron in diameter.
<b>Data Separation</b>	Although data is recorded on the disc in MFM (Modified Frequency Modulation), encoding and decoding circuits are provided to utilize NRZ (Non Return to Zero) at the interface.
<b>Direct Track Addressing</b>	The difference between present head position and desired position is computed in the drive.
<b>Built-In Power Supply</b>	All DC power required by the drive is generated internally.
<b>Track Offset and Early/Late Data Strobe</b>	Heads can be moved slightly off track and the data "window" can be moved by the controller to aid in the recovery of problem data.
<b>Index and Sector (Look Ahead)</b>	To provide "look ahead," sector and index marks can be transmitted independently of Unit Select to the controller.
<b>Daisy Chain or Star Interconnect</b>	Control lines for a number of drives may be interconnected to the same controller in either a "Star" or "Daisy Chain" mode.
<b>Internal Interface</b>	A comprehensive set of internal lines which connect the interface board to the rest of the machine allow many different interfaces to be accommodated by changing only the interface board.
<b>Choice of Sectoring</b>	Any number of sectors can be provided between 2 and 8192 bytes per sector. This number is selected by a plug in the interface board.
<b>Slides, Control Panel, and Front Cover</b>	These items are also included.
<b>Optional Features</b>	
<b>Fixed Heads</b>	Fixed heads can be added to moving head models in groups of 20 heads each.
<b>Contiguous Fixed Head Addressing</b>	A PROM can be provided to make all fixed heads addressable by a contiguous set of binary numbers.
<b>Variable Sectoring (Address Mark)</b>	Read and Write address marks can be provided.
<b>Write Protect</b>	A portion of moving head data, all fixed head data, or the entire drive can be protected from writing with control panel switches.
<b>CDC Bundled Cable Connector</b>	A CDC 9762 (Storage Module) compatible bundled cable (75 pin) connector and interface can be provided.
<b>Industry Standard Interface</b>	The 3300 can be made compatible with the flat cable version of the CDC 9762 (Storage Module).
<b>Choice of Track Capacity</b>	The number of data bytes per revolution can be varied to accommodate unique user formats and sector data fields without waste of capacity.
<b>Unit Select Switches</b>	Unit select thumbwheel switches can be provided on the control panel.