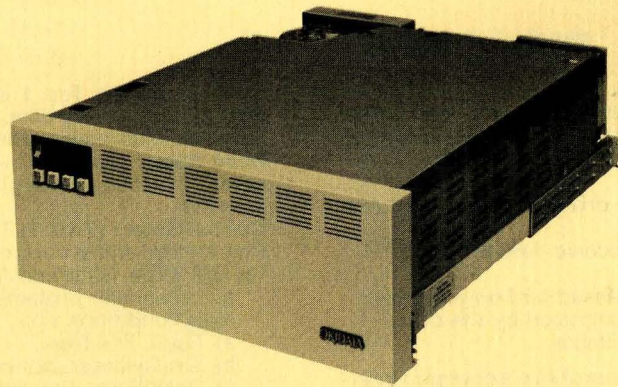# OKIDATA

Product Specification

3300 Series Disc Drive

Seven 3300 Series models, from 13 to 80 megabytes, fit in just 7 inches of rack space, complete with power supply and the finest air filtration system in the industry. Proven Winchester technology, fixed media, IBM-type moving heads, a CDC-type interface and Okidata reliability are combined at prices that create new minisystem market opportunities.

In addition, over two megabytes of fixed head storage may be added in the same package. The low cost per bit of the entire 3300 Series often makes it unnecessary to program for several memory types. The same interface, the same set of systems programs, the same 7 inch package, covers the full range of business, communications and distributed processing applications.

The 3300 Series offers system builders the lowest total cost, not just the lowest cost per megabyte—

the lowest total cost including programming, packaging, maintenance and system upgrades and enhancements.

3300 Series Features

- 13 to 80 Megabytes of moving head storage
- 2.4 Megabytes of fixed head storage with overlap seek
- Winchester technology
- Clean air package
- Complete in 7 inches
- 9760 CDC-type Interface
- Low mass rotary positioner
- 38 ms average seek
- 7.97 Megabits/sec transfer rate
- 20,160 Bytes/track

Model	Moving Head				Fixed Head	
	Unformatted Megabytes	Discs	Heads	Data Surfaces	Unformatted Megabytes	Data Surfaces
3301	13.47	1	2	1	0.80	1
3302	26.94	2	4	2	0.80	1
3303	40.39	2	6	3	0.80	1
3304	53.86	3	8	4	0.80	1
3305	67.33	3	10	5	0.80	1
3306	80.80	4	12	6	0.80	1
3307	0	1	—	—	2.40	2

All models are available with fixed head capacities of 0.40 or 0.80 megabytes.
Models 3302 and 3304 may be further expanded in 0.40 increments to 2.40 megabytes.
Model 3307 is fixed head only.

Okidata Sells Peripherals That Sell Minisystems

CDC 9760-Type Interface

1.0-INTERFACE

The CDC 9760-type 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 (7.97 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 interface is intended for use with flat cables which plug directly to the interface board. 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

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 µs to 0.5 ms in duration. Addresses greater than 339 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 µs 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-The 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

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.

Disc rotational speed	2964 RPM
Track density moving heads	286 Tracks/in.
Track density fixed heads	33.3 Tracks/in.
Bit density (inner track)	6122 Bits/in.
Capacity per track (unformatted)	20160 Bytes
Addressable Cylinders	339
Data Tracks per Surface (Moving Head)	678
Maximum Data Tracks per Surface (Fixed Head)	80
Moving Heads Per Surface	2
Methods of Positioning Moving Heads	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

Maximum Seek Time (Including Head Settling)	339 track seek 75 ms Single Track Seek 10 msec. Random Average 38 msec.
Average Latency	10.12 ms
Transfer Rate	7.97 (Megabits/sec)
Unformatted capacities range from:	13.47 to 80.80 Mbyte, moving head 0.403 to 2.42 Mbyte, fixed head in increments of 0.403 Mbyte in 3302, 3304 and 3307 models. 0.403 or 0.806 Mbyte, fixed head, in all other models.
Head Select Time	5 μsec
Write to Read Recovery Time	10 μsec
Read to Write Recovery Time	.3 μsec

Physical Characteristics

Height	7"
Width	17¾"
Depth	23½"
Mounting	Horizontal or Vertical on Slides
RETMA Rack Mountings Height and Depth	7" x 22"
Weight	75 pounds maximum

Power Requirements

Frequency Tolerances	60 Hz ±1% or 50 Hz ±2%
Line Voltage	105V, 110V, 115V, 120V, 210V, 220V, 230V, 240V, ± 10%

Environmental Limits

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

Reliability

Read Error (no retries)	1 error maximum in 10^{10} bits
Read Errors (after retries)	1 error maximum in 10^{11} bits
Unrecoverable Read Errors	1 error maximum in 10^{12} bits
Write Errors	1 error maximum in 10^{13} bits

Operator Control Panel

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

Standard Features

Clean Air Package	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.
Data Separation	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.
Direct Track Addressing	The difference between present head position and desired position is computed in the drive.
Built-In Power Supply	All DC power required by the drive is generated internally.
Track Offset and Early/Late Data Strobe	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.
Index and Sector (Look Ahead)	To provide "look ahead," sector and index marks can be transmitted independently of Unit Select to the controller.
Daisy Chain or Star Interconnect	Control lines for a number of drives may be interconnected to the same controller in either a "Star" or "Daisy Chain" mode.
Internal Interface	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.
Choice of Sectoring	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.
Slides, Control Panel, and Front Cover	These items are also included.

Optional Features

Fixed Heads	Fixed heads can be added to moving head models in groups of 20 heads each.
Contiguous Fixed Head Addressing	A PROM can be provided to make all fixed heads addressable by a contiguous set of binary numbers.
Variable Sectoring (Address Mark)	Read and Write address marks can be provided.
Write Protect	A portion of moving head data, all fixed head data, or the entire drive can be protected from writing with control panel switches.
Industry Standard Interface	The 3300 can be made compatible with the flat cable version of the CDC 9762 (Storage Module).
Choice of Track Capacity	The number of data bytes per revolution can be varied to accommodate unique user formats and sector data fields without waste of capacity.
Unit Select Switches	Unit select thumbwheel switches can be provided on the control panel.

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 (2^0, 2^1, 2^2, 2^3) 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 μsec. 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.

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 7.97 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 μs 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.

Internal Interface Signals

GENERAL

The Okidata 3300 provides a full set of internal interface signals at the Servo and Data board connectors enabling custom I/O board designs to create the desired drive/controller interface. All internal interface signals, except for Read Analog Data, are TTL compatible logic levels. The Servo board header, P12, (Amp P/N 1-85018-3) and Data Board header, P11, (Amp P/N 1-85018-3) mate with two I/O board connectors, J11 and J12 (Amp P/N 2-86415-3).

SIGNALS FROM THE SERVO/DATA BOARDS TO THE I/O BOARD

READ ANALOG SIGNAL: Amplified differential analog signal from the selected head, used for Address Mark detection option.

MOVING HEAD WRITE CURRENT SENSE: Indicates with a logic low level the presence of write current in the selected moving head.

MULTIPLE MOVING HEADS SELECTED: Indicates with a logic high level that more than one moving head is selected.

FIXED HEAD WRITE CURRENT SENSE: Indicates with a logic low level the presence of write current in selected fixed head.

MULTIPLE FIXED HEADS SELECTED: Indicates with a logic high level that more than one fixed head is selected.

READ DATA: PLO separated NRZ data with 125.5 ns cell time.

READ CLOCK: 7.97 MHz clock derived from the MTM data recorded on the disc. The rising edge occurs in the middle of the data cell.

SEEK LATE: Indicates with a logic high level the occurence of a seek error condition where the positioner arm failed to seek to the specified address. This condition is cleared with "Restore".

DC POWER OK: Indicates with a logic high level that all DC voltages are within tolerance. This signal is invalid during "Power On Initiate".

READY: Indicates with a logic high level that the drive is up-to-speed and is ready to accept seek and restore requests.

SEEK COMPLETE: Indicates with a logic high level that the positioner arm is on cylinder. The signal is invalid during servo offset.

UP-TO-SPEED: Indicates with a logic high level that the drive is up to speed.

ILLEGAL ADDRESS: Set high with "Seek Strobe" if the Demand Address exceeds 339, cleared by "Seek Strobe" when the Demand Address is 339 or less.

INDEX A: This positive going pulse occurs once per revolution.

BIT CLOCK: A phase-locked 15.92 MHz clock generated from the servo track signal. This signal is double frequency in order to allow generation of a symmetrical 7.97 MHz servo clock.

ADDRESS ACKNOWLEDGE: A positive going pulse indicating that the Demand Address has been accepted.

460 KHZ CLOCK: A square wave whose frequency is 1/32 of the "Bit Clock" frequency.

POWER ON INITIATE: This signal is at a logic low level for several seconds following power-on, after which it remains at a logic high level.

SIGNALS TO THE SERVO/DATA BOARDS FROM THE I/O BOARD

WRITE DATA: NRZ data with 125.5 ns cell time to be converted within the drive to MFM and written on the disc.

WRITE ENABLE: This signal is a logic low level when data is to be recorded through the selected head.

WRITE ADDRESS MARK: This signal is a logic low level when a non-toggling pattern is to be recorded on the selected head creating an address mark. "Write Enable" must be high during the write address mark operation.

SELECT MOVING HEADS: This signal is a logic low level when moving heads are selected for read/write and a logic high level when fixed heads are selected for read/write.

HEAD ADDRESS LINES (0-3): These four signals specify the address from 0 to 11 of the moving head to be selected. A logic high level specifies "true" for the associated line.

FIXED HEAD ADDRESS LINES (0-8): These nine signals specify the address from 0 to 126 of the fixed head to be selected. A logic high level specifies "true" for the associated line.

DATA STROBE EARLY: Specifies with a logic low level that the PLO data separator will strobe the MFM data at a time earlier than nominal.

DATA STROBE LATE: Specifies with a logic low level that the PLO data separator will strobe the MFM data at a time later than nominal.

MARGIN MODE: Specifies with a logic low that the PLO data separator will strobe the MFM data at marginal boundaries to facilitate a search for media defects.

READ ENABLE: This signal is a logic low level when data read from the selected head is to be sent to the I/O board in NRZ form.

SERVO OFFSET REVERSE: Specifies with a logic low level that the positioner arm should offset from the nominal on cylinder position away from the spindle.

SERVO OFFSET FORWARD: Specifies with a logic low level that the positioner arm should offset from the nominal on cylinder position toward the spindle.

RESTORE: Specifies with a positive going pulse that the positioner arm should seek to cylinder 0 and that "Seek Late" should be reset.

DEMAND ADDRESS LINES (0-11): These twelve signals specify the absolute address from 0 to 339 of the cylinder to which the positioner arm should seek. A logic high level specifies "true" for the associated line.

SEEK STROBE: A positive going pulse causes the demand address to be loaded and the positioner arm to initiate the associated seek.

MAINTENANCE MODE: A logic low level causes the positioner arm to be disengaged and to rest at magnetic detent.

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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.

Disc rotational speed	2964 RPM
Track density moving heads	286 Tracks/in.
Track density fixed heads	33.3 Tracks/in.
Bit density (inner track)	6122 Bits/in.
Capacity per track (unformatted)	20160 Bytes
Addressable Cylinders	339
Data Tracks per Surface (Moving Head)	678
Maximum Data Tracks per Surface (Fixed Head)	80
Moving Heads Per Surface	2
Methods of Positioning Moving Heads	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

Maximum Seek Time (Including Head Settling)	339 track seek 75 ms Single Track Seek 10 msec. Random Average 38 msec.
Average Latency	10.12 ms
Transfer Rate	7.97 (Megabits/sec)
Unformatted capacities range from:	13.47 to 80.80 Mbyte, moving head 0.403 to 2.42 Mbyte, fixed head in increments of 0.403 Mbyte in 3302, 3304 and 3307 models. 0.403 or 0.806 Mbyte, fixed head, in all other models.
Head Select Time	5 μsec
Write to Read Recovery Time	10 μsec
Read to Write Recovery Time	.3 μsec

Physical Characteristics

Height	7″
Width	17¾″
Depth	23½″
Mounting	Horizontal or Vertical on Slides
RETMA Rack Mountings Height and Depth	7″ x 22″
Weight	75 pounds maximum

Power Requirements

Frequency Tolerances	60 Hz ±1% or 50 Hz ±2%
Line Voltage	105V, 110V, 115V, 120V, 210V, 220V, 230V, 240V, ± 10%

Environmental Limits

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

Reliability

Read Error (no retries)	1 error maximum in 10^{10} bits
Read Errors (after retries)	1 error maximum in 10^{11} bits
Unrecoverable Read Errors	1 error maximum in 10^{12} bits
Write Errors	1 error maximum in 10^{13} bits

Operator Control Panel

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

Standard Features

Clean Air Package	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.
Data Separation	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.
Direct Track Addressing	The difference between present head position and desired position is computed in the drive.
Built-In Power Supply	All DC power required by the drive is generated internally.
Track Offset and Early/Late Data Strobe	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.
Index and Sector (Look Ahead)	To provide "look ahead," sector and index marks can be transmitted independently of Unit Select to the controller.
Daisy Chain or Star Interconnect	Control lines for a number of drives may be interconnected to the same controller in either a "Star" or "Daisy Chain" mode.
Internal Interface	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.
Choice of Sectoring	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.
Slides, Control Panel, and Front Cover	These items are also included.

Optional Features

Fixed Heads	Fixed heads can be added to moving head models in groups of 20 heads each.
Contiguous Fixed Head Addressing	A PROM can be provided to make all fixed heads addressable by a contiguous set of binary numbers.
Variable Sectoring (Address Mark)	Read and Write address marks can be provided.
Write Protect	A portion of moving head data, all fixed head data, or the entire drive can be protected from writing with control panel switches.
Industry Standard Interface	The 3300 can be made compatible with the flat cable version of the CDC 9762 (Storage Module).
Choice of Track Capacity	The number of data bytes per revolution can be varied to accommodate unique user formats and sector data fields without waste of capacity.
Unit Select Switches	Unit select thumbwheel switches can be provided on the control panel.

OKIDATA

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