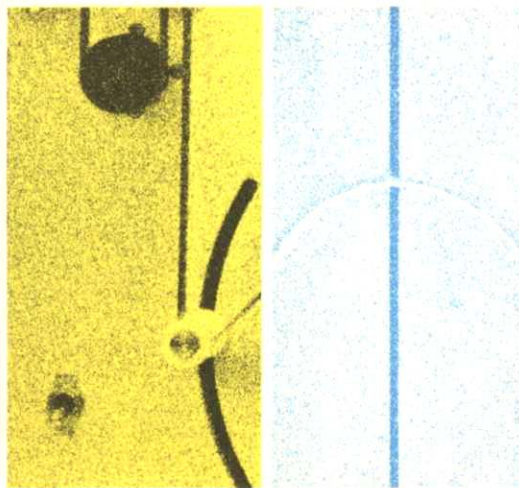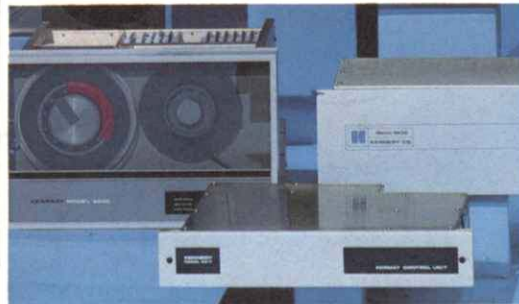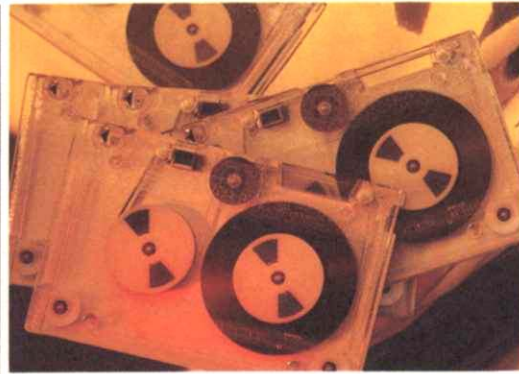# KENNEDY CO.

Model 5300
Fixed Disk Drive

SECTION I

APPLICATION DATA

1.1 INTRODUCTION

The Kennedy 5300 fixed disk drive offers extremely high data storage capacity at a low cost per bit. This is accomplished by converting NRZ data from the controller into the high density write compensated MFM format. Thus bit densities up to 6000 bpi are possible. Track density is 300 tracks per inch and the disk drive operates at 3000 rpm. During read operation, the Model 5300 converts MFM data back into the NRZ format prior to outputting it to the controller.

Unformatted data storage capacities range from 14 M bytes in the single disk version to 70 M bytes in the three disk model. Prerecorded servo tracks on the bottom disk assure accurate read alignment as well as providing write data timing information.

Disk drive packaging is compact. The Model 5300 takes up only 7 vertical inches in a standard 19 inch rack and its 23.5 inch depth behind the mounting surface facilitates use in a standard 24 inch deep cabinet.

Features include:

* NRZ-MFM data encode/decode electronics
* Daisy chaining of up to four drives
* Address mark capability for variable length records
* Built-in power supply
* Easy service access
* Small, easily replaced circuit cards
* Standard, industry compatible interface

1.2 ELECTRICAL AND MECHANICAL SPECIFICATIONS

Data capacity (unformatted 8 bit bytes)

Per surface	14 M bytes
Per track	20, 160 bytes
Per cylinder	40, 320 bytes min
	201, 600 bytes max
Per drive	14 M bytes min
	70 M bytes max
Cylinders per surface	350
Tracks per surface	700

Processing speed

Data transfer rate	1.0 M bytes/sec
Bit rate	8.0 MHz
Spindle speed	3000 rpm

Accessing Time

Full stroke	80 msec (max)
Average	45 msec
One track	10 msec (max)

Sectoring

Number of sectors	1-256
	(selected by internal switch)
Recording method	Write compensated MFM
Number of heads	2 min, 10 max, plus servo head
Operator controls	Start/stop switch
Indicators	Start
	Select
	Ready
	Fault

Dimensions (See Figure 1-1)

Disc Drive Mounting – standard 19 inch (48.26 cm) RETMA track
Height – 7 inches (17.78cm)
Width – 19 inches (48.26 cm)
Depth (behind mounting surface) – 23.5 inches (59.69 cm)
Depth overall – 23.937 inches (60.801 cm)
Weight – 45 pounds (20.412 Kgm)
Shipping weight – 56.25 pounds (25.514 Kgm)

Operating Environment
Ambient temperature – to be determined
Relative humidity (non-condensing) – to be determined

Power Requirements
120 vac, 60 Hz standard
230 vac, 50 Hz optional

Volt amps nominal – to be determined
Volt amps maximum – to be determined
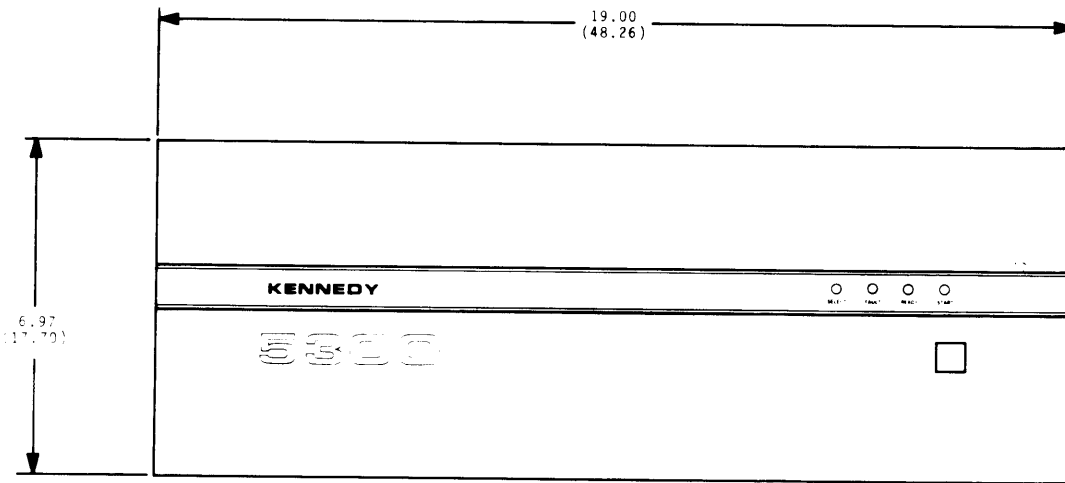
1.3 INTERFACE CONNECTIONS

The Model 5300 interface combines radial high speed lines and daisy chain control lines for maximum system flexibility and economy. High speed lines utilize 75110/75107A transmitters and receivers while bus lines are open collector TTL suitable for daisy chaining. Adapters are available to convert TTL lines to differential if required by existing compatible controllers.

The write clock, timed to the servo tracks, is
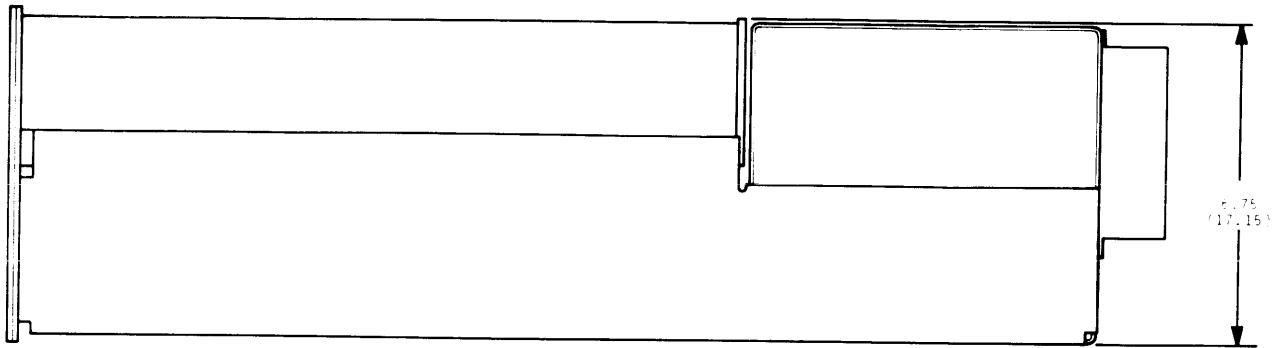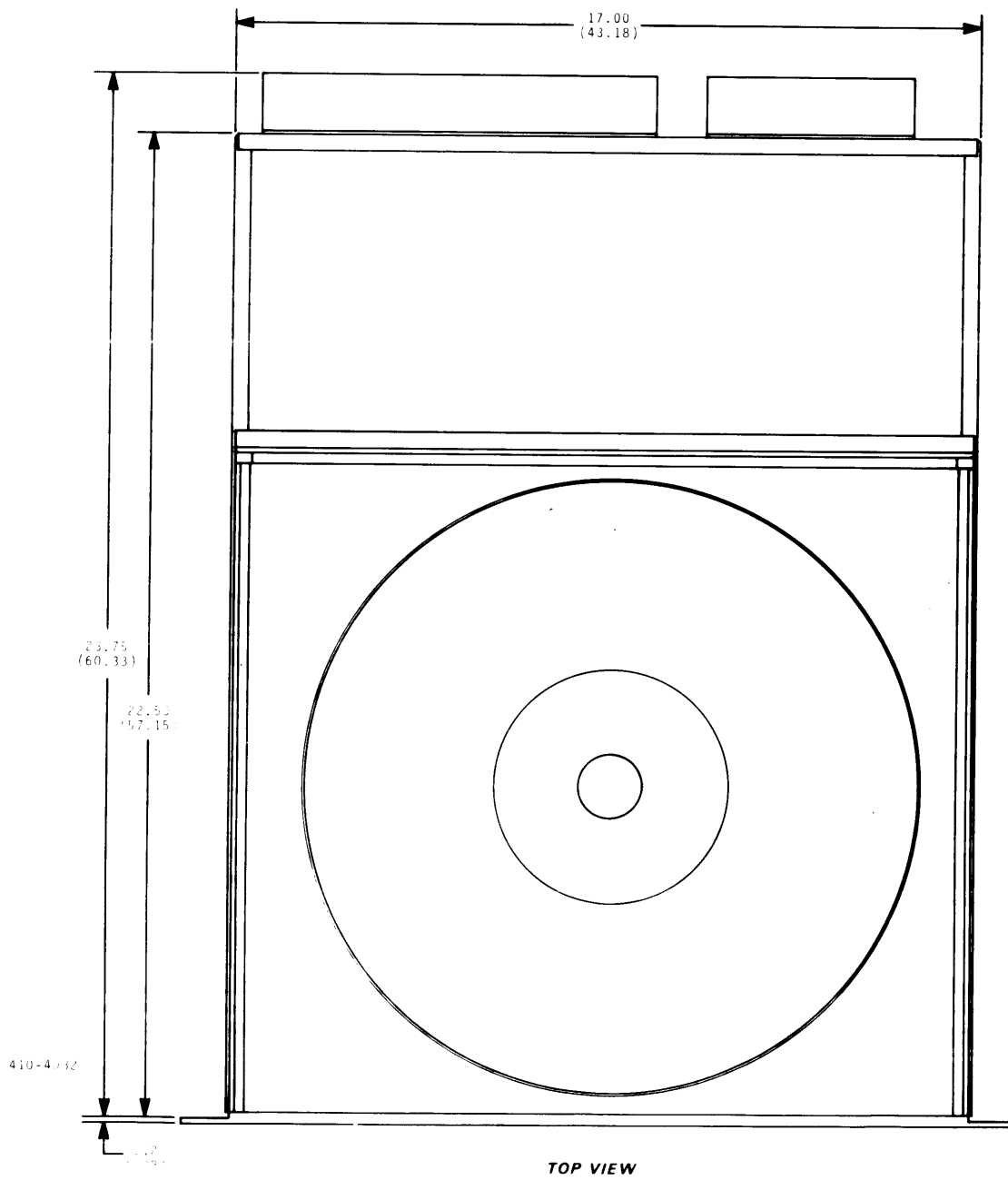
SIDE VIEW

FIRST DIMENSION SHOWN IN INCHES.
DIMENSIONS IN PARENTHESES ARE
IN CENTIMETERS.

19.00
(48.26)

6.97
(17.70)

KENNEDY

5300

FRONT VIEW

410-4032

Figure 1-1

Outline and Installation Drawing

Model 5300

REAR VIEW

2.12
(5.40)

5.6?
(14.?9)

33 P1 RADIAL 1   49 P2 BUS 1

TRIP ON   3A   120V
3AG   60HZ

17.00
(43.18)

23.75
(60.33)

22.50
(57.15)

410-4?32

TOP VIEW
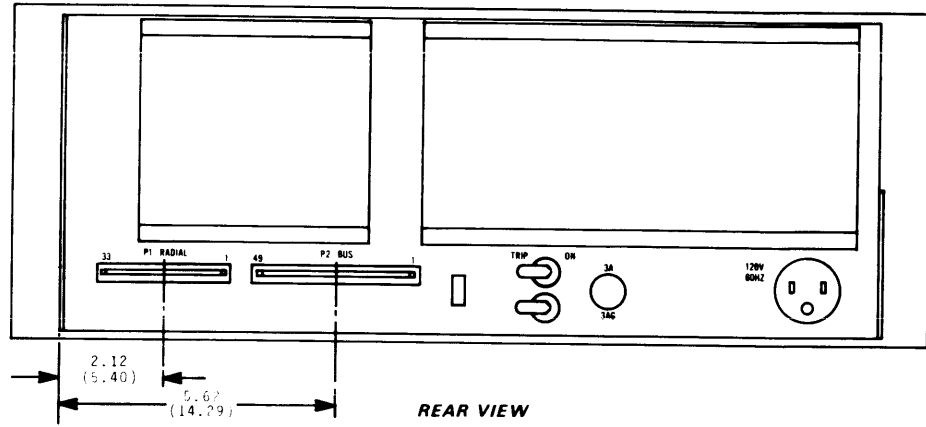
transmitted to the controller for data synchronization and then returned to the drive, eliminating the need for accurate cable lengths.

Both the radial and bus interface utilizes 3M flat cable and connectors. The bus cable is 50 conductor 3M cable or equivalent and should not exceed 30 feet in length. The radial cable is 34 conductor 3M type or equivalent. Each cable should not exceed 12 feet in length.

1.4 INTERFACE SIGNAL DESCRIPTION

1.4.1 COMMAND SIGNALS

UNIT SELECT (FSEL0/; FSEL1/)
(P2-1; P2-3)

By means of binary code, these lines determine which of up to 4 disk drives will be selected. The unit number (binary 0 through 3) is selected through an internal switch setting in each daisy chained disk drive. Obviously switch settings must be different for each unit.

UNIT SELECT TAG (FSELTAG/) pulse
(P2-5)

This signal gates the desired logic number into the logic number compare circuit. The disk drive will be selected 200 nsec (max) after FSELTAG's trailing edge. The select lines should be stable throughout the tag time.

F BUS LINES (F BUS 0-9/)

These lines are multiplexed disk drive inputs providing either a 10 bit cylinder address, a 3 bit head address, or a control command depending on whether FCYLTAG/, FHDTAG/ or FCMDTAG/ is true.

CYLINDER SELECT (FCYLTAG/) pulse
(P2-27)

When true, this pulse initiates a SEEK operation to cylinder whose 10 bit address is on BUS lines. The bus lines should be stable throughout the tag time.

HEAD SELECT (FHDTAG/) pulse
(P2-29)

When true, this pulse causes selection of head addressed by F Bus lines 0-2.

COMMAND SELECT (FCMDTAG/) level
(P2-31)

When true this level enables controller commands for its duration. It must be held true for the entire operation.

WRITE GATE (F BUS 0/) level
(P2-7)

When true, this level enables the write driver.

READ GATE (F BUS 1/) level
(P2-9)

When true, this level enables digital read data. The read chain sychronizes on an all zeros pattern on the leading edge of the read gate signal.

FAULT CLEAR (F BUS 4/) pulse
(P2-15)

This is a 100 nsec (min) pulse which clears the fault logic.

AM ENABLE (F BUS 5/) level
(P2-17)

When AM (Address Mark) ENABLE is true together with either a write or read gate, address marks may be written on read. When used in conjunction with a write gate, the writer stops toggling and data is erased to create an address mark. Write fault detection is inhibited by this signal.

NOTE: F BUS 5 must be held inactive during command select functions if the address mark will not be used.

When AM ENABLE is applied in conjunction with a read gate, an analog voltage comparator will detect the absence of read data and flag an address mark in any read data gaps greater than 20 bits and less than 28 bits.

RTZ (F BUS 6/) pulse
(P2-19)

This pulse (100 nsec min/100 usec max) will cause the head positioner to seek track 0, clear the seek error flip-flop and reset the head register.

This pulse should be used only for recalibration, since it is significantly longer than a nominal seek to track 0.
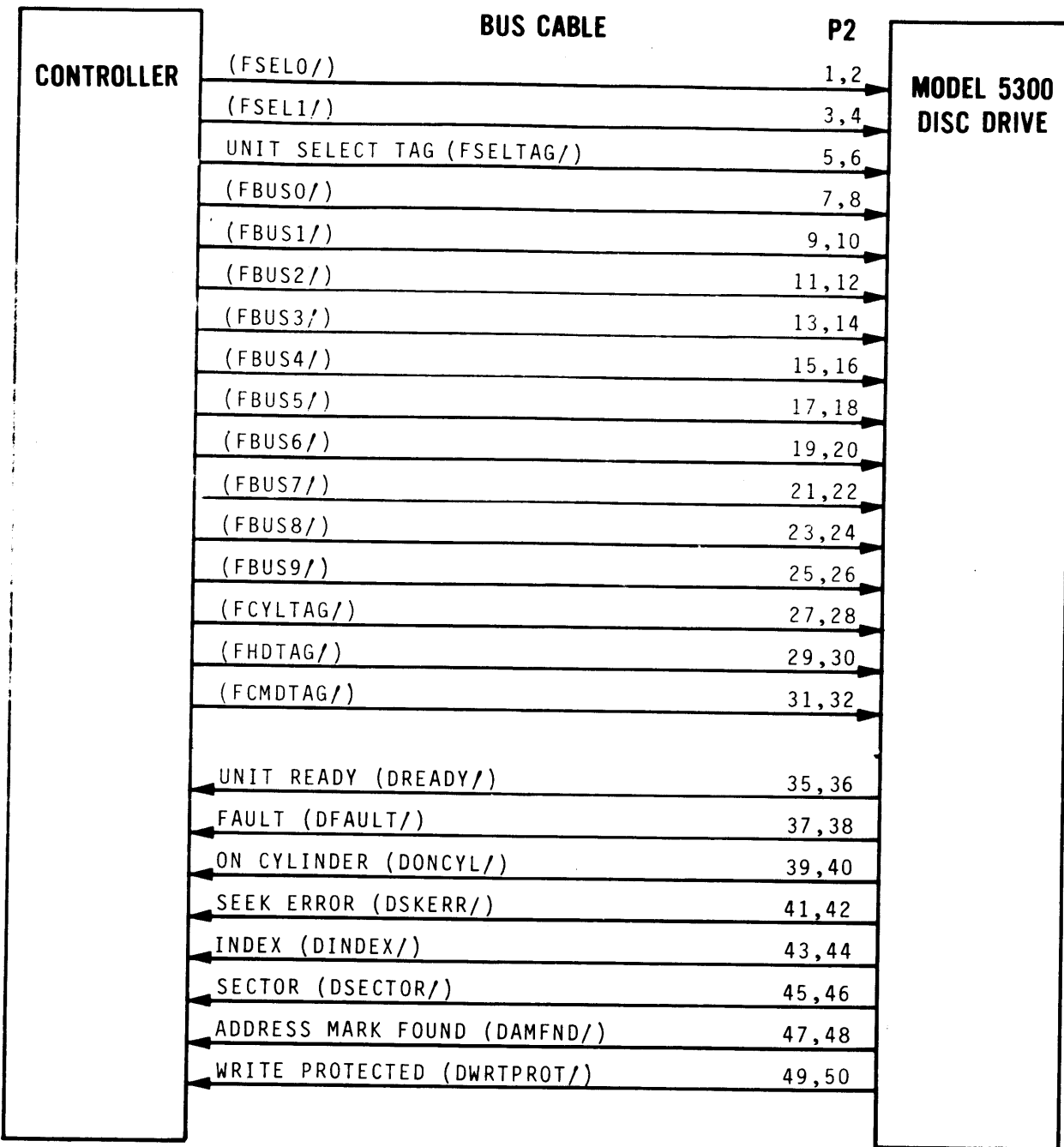
DATA STROBE EARLY (F BUS 7/) level
(P2-21)

A true condition on this line causes the Read Data Separator in the disk drive to strobe data earlier than optimum strobe timing. Used for recovering marginal data.

DATA STROBE LATE (F BUS 8/) level
(P2-23)

A true condition on this line causes the Read Data Separator in the disk drive to strobe data later than optimum strobe timing. Used for recovering marginal data.

1.4.2 STATUS SIGNALS
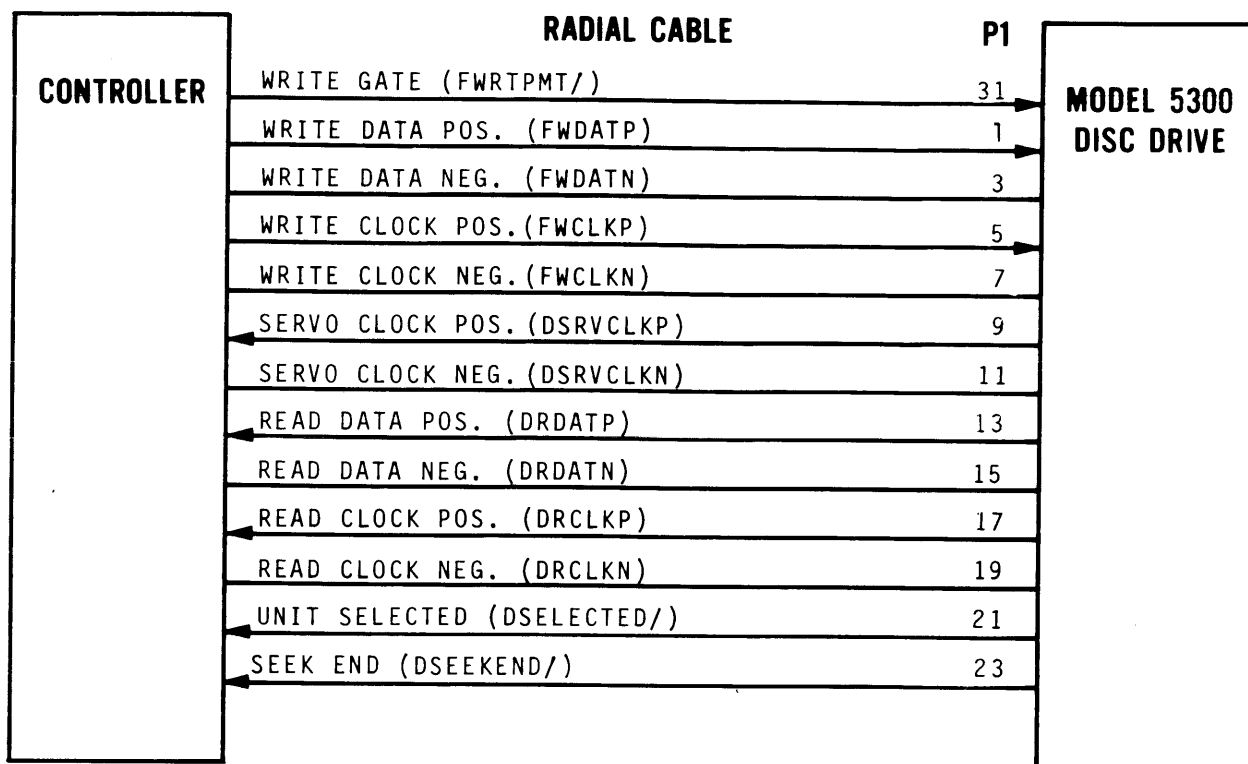(Active low disk drive outputs only when disk drive is selected.)

BUS CABLE   **P2**

CONTROLLER — MODEL 5300 DISC DRIVE

Signal	P2
(FSEL0/)	1,2
(FSEL1/)	3,4
UNIT SELECT TAG (FSELTAG/)	5,6
(FBUS0/)	7,8
(FBUS1/)	9,10
(FBUS2/)	11,12
(FBUS3/)	13,14
(FBUS4/)	15,16
(FBUS5/)	17,18
(FBUS6/)	19,20
(FBUS7/)	21,22
(FBUS8/)	23,24
(FBUS9/)	25,26
(FCYLTAG/)	27,28
(FHDTAG/)	29,30
(FCMDTAG/)	31,32
UNIT READY (DREADY/)	35,36
FAULT (DFAULT/)	37,38
ON CYLINDER (DONCYL/)	39,40
SEEK ERROR (DSKERR/)	41,42
INDEX (DINDEX/)	43,44
SECTOR (DSECTOR/)	45,46
ADDRESS MARK FOUND (DAMFND/)	47,48
WRITE PROTECTED (DWRTPROT/)	49,50

110-0151

	FBUS0/ THROUGH FBUS9/									
	9	8	7	6	5	4	3	2	1	0
FCYLTAG/	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
FHDTAG/								2^2	2^1	2^0
FCMDTAG/	RELEASE	STROBE LATE	STROBE EARLY	RTZ	AM ENABLE	FAULT CLEAR			READ	WRITE

110-0152

Figure 1-2. Bus Cable Pin List

RADIAL CABLE

CONTROLLER		P1	MODEL 5300 DISC DRIVE
	WRITE GATE (FWRTPMT/)	31	
	WRITE DATA POS. (FWDATP)	1	
	WRITE DATA NEG. (FWDATN)	3	
	WRITE CLOCK POS.(FWCLKP)	5	
	WRITE CLOCK NEG.(FWCLKN)	7	
	SERVO CLOCK POS. (DSRVCLKP)	9	
	SERVO CLOCK NEG. (DSRVCLKN)	11	
	READ DATA POS. (DRDATP)	13	
	READ DATA NEG. (DRDATN)	15	
	READ CLOCK POS. (DRCLKP)	17	
	READ CLOCK NEG. (DRCLKN)	19	
	UNIT SELECTED (DSELECTED/)	21	
	SEEK END (DSEEKEND/)	23	

Figure 1-3. Radial Cable Pin List

110-0152

UNIT READY (DREADY/) level
(P2-35)

When true the disk is up to speed. The heads are loaded and no fault condition exists. UNIT READY will be dropped after a load sequence if servo track pulses are not sensed within 350 msec. Further load attempts will require operator intervention.

FAULT (DFAULT/) level
(P2-37)

When true, some of the following disk drive faults have occurred: DC Power Fault, Write Fault, Head Select Fault, Write or Read while Off Cylinder, or WRITE GATE true during a read operation. DFAULT true immediately inhibits writing to prevent possible data erasure. Here is a description of some fault types cited above. Faults not described are self-explanatory.

DC Power Fault: Abnormal DC voltage
Head Select Fault: More than one head selected
Write Fault: Abnormally low write current/ no write transitions

A FAULT CLEAR · COMMAND SELECT, will clear the FAULT line, provided no fault now exists. Fault conditions are stored in flip-flops for maintenance aid and may be cleared by means of a fault clear switch on the fault card.

SEEK ERROR (DSKERR/) level
(P2-41)

When true, a seek error has occurred and may be cleared only by performing an RTZ. DSKERR true indicates:

a. the unit couldn't complete a SEEK within 500 msec, or
b. an address greater than track 699 was selected, or
c. the carriage has moved outside the recording field. Where the address exceeds 699 tracks the seek error signal goes true within 200 nsec of FCYLSEL/. No carriage movement occurs.

ON CYLINDER (DONCYL/) level
(P2-39)

When true, this signal indicates the heads are positioned over a track.

INDEX (DINDEX/) pulse
(P2-43)

This pulse occurs once per disk revolution and defines sector zero. Width is nominally 2.5 microsecond. This pulse is derived from the servo track on the bottom of the disk.

SECTOR MARK (DSECTOR/) pulse
(P2-45)

This mark is also derived from the servo track on the bottom of the disk. The number of sectors per revolution is determined by counting servo track pulses. Timing integrity is maintained throughout seek operations. The number of sectors is switch selectable. Nominal width is 1.25 microseconds.

ADDRESS MARK FOUND (DAMFND/) pulse
(P2-47)

When true, this pulse indicates at least 20, but not more than 28, missing data transitions have occurred, together with the first zero of an all zeros pattern. The controller should now drop ADDRESS MARK ENABLE following DAMFND/ true. Nominal width is 8 microseconds.

WRITE PROTECTED (DWRTPROT/) level
(P2-49)

When DWRPROT/ is true, the write driver has been disabled to prevent data destruction.

WRITE PERMIT (FWRTPMT/) level
(P1-31)

This level must be true for writing to occur. Without this level, the WRTPROT status is returned to the controller.

UNIT SELECTED (DSELECTED/) level
(P1-21)

This line goes true from the selected disk drive on the trailing edge of the UNIT SELECT tag, and is sent back to the controller on the radial cable.

SEEK END (DSEEK END/) level
(P1-23, Radial Cable)

This signal goes true when either SEEK ERROR or ON CYLINDER is true. Thus a seek operation has been terminated.

1.4.4   DATA AND CLOCK SIGNALS

WRITE DATA POSITIVE (FWDATP)
(P1-1)
WRITE DATA NEGATIVE (FWDATN)
(P1-3)

These differential signals input NRZ data to the disk drive. Writing will occur so long as WRITE GATE ' COMMAND SELECT and WRITE PERMIT are active and the unit is READY and ON CYLINDER.

WRITE CLOCK POSITIVE (FWCLKP) pulse
(P1-5)
WRITE CLOCK NEGATIVE (FWCLKN) pulse
(P1-7)

This differential clock pulse must be used to synchronize the NRZ write data.

SERVO CLOCK POSITIVE (DSRVCLKP) pulse
(P1-9)
SERVO CLOCK NEGATIVE (DSRVCKLN) pulse
(P1-11)

This is a differential, phase locked 8 MHz clock generated from the servo track pulses on the bottom of the lower disk.

READ DATA POSITIVE (DRDATP) pulse
(P1-13)
READ DATA NEGATIVE (DRDATN) pulse
(P1-15)

These lines output recovered NRZ read data from the disc drive.
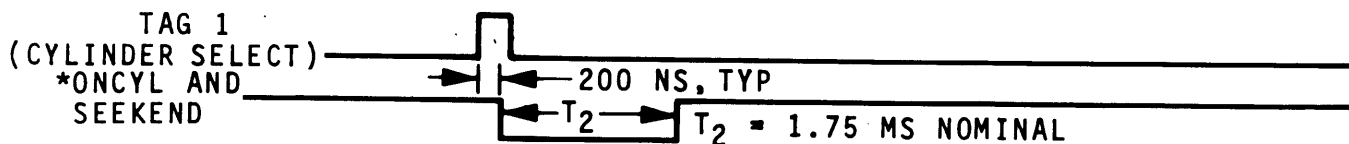
READ CLOCK POSITIVE (DRDCLKP) pulse
(P1-17)
READ CLOCK NEGATIVE (DRDCLKN) pulse
(P1-19)

This clock is derived internally and is synchronous with detected read data so that the negative edge of the clock precedes significant edge of the data by 6 (+4) ns at the I/0 connector.
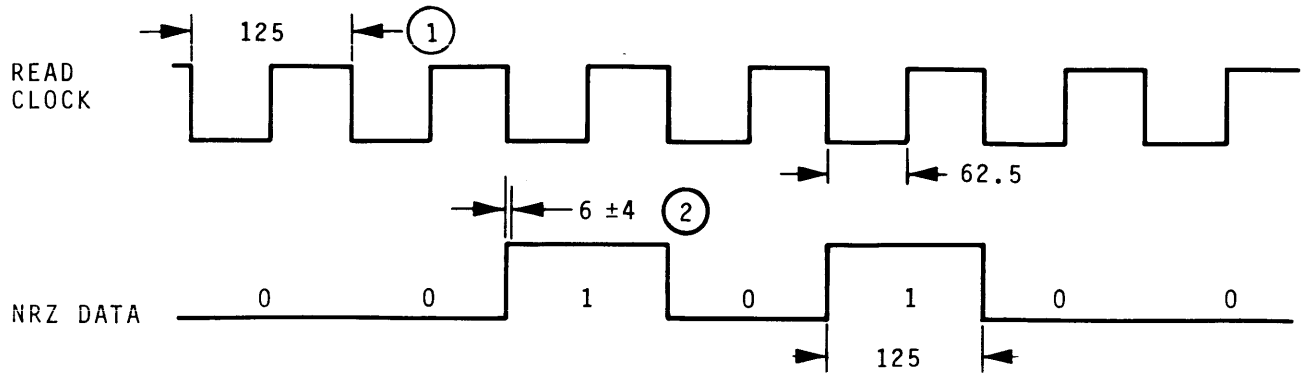
TYPICAL SEQUENCE
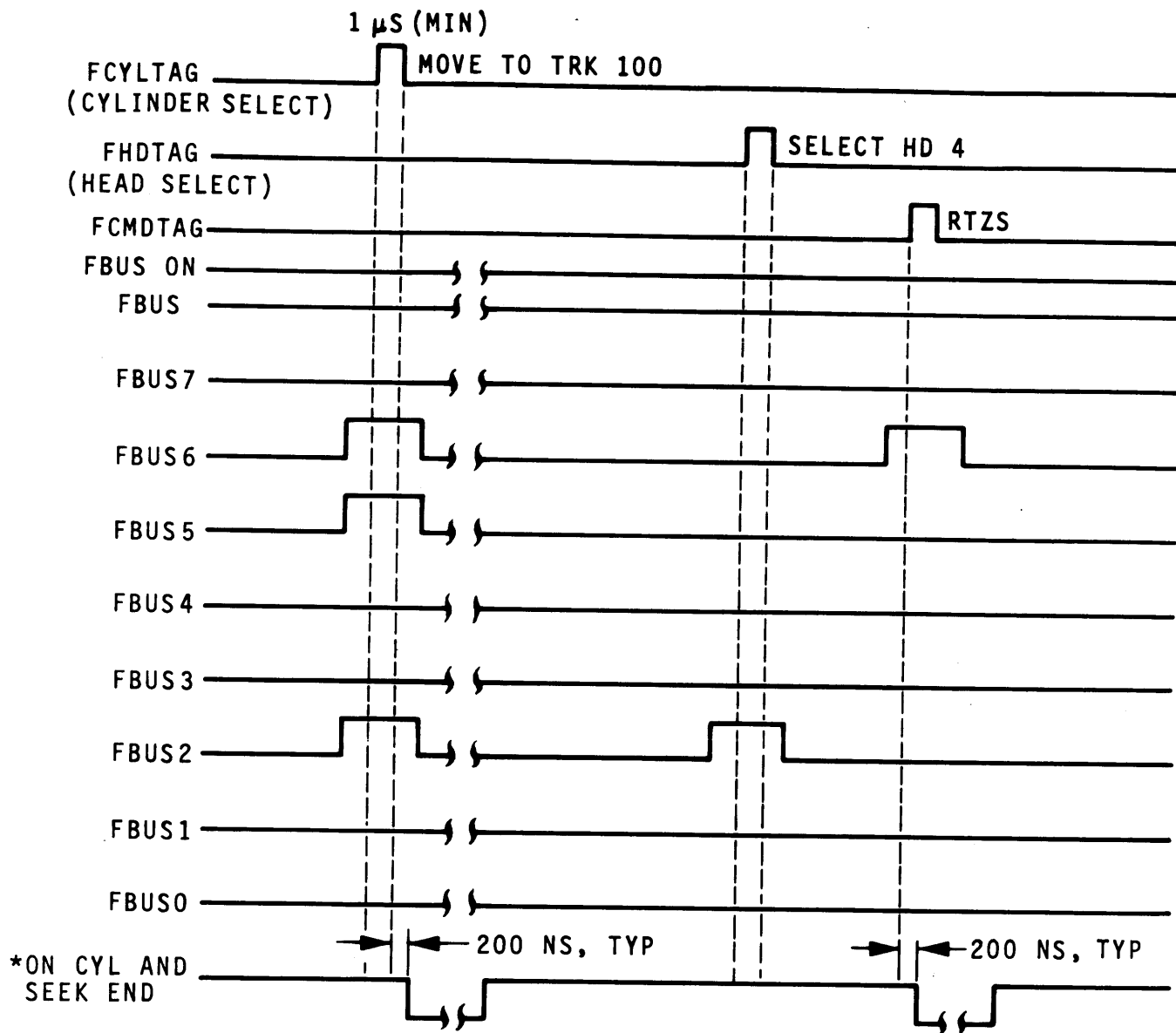
Figure 1-4. Tag and Bus Timing

*ONCYL AND SEEKEND SIGNALS ARE IDENTICAL UNLESS SEEK ERROR OCCURS.
SEEK ERROR INITIATES A CONSTANT SEEKEND. TIMING SHOWN IS AT THE
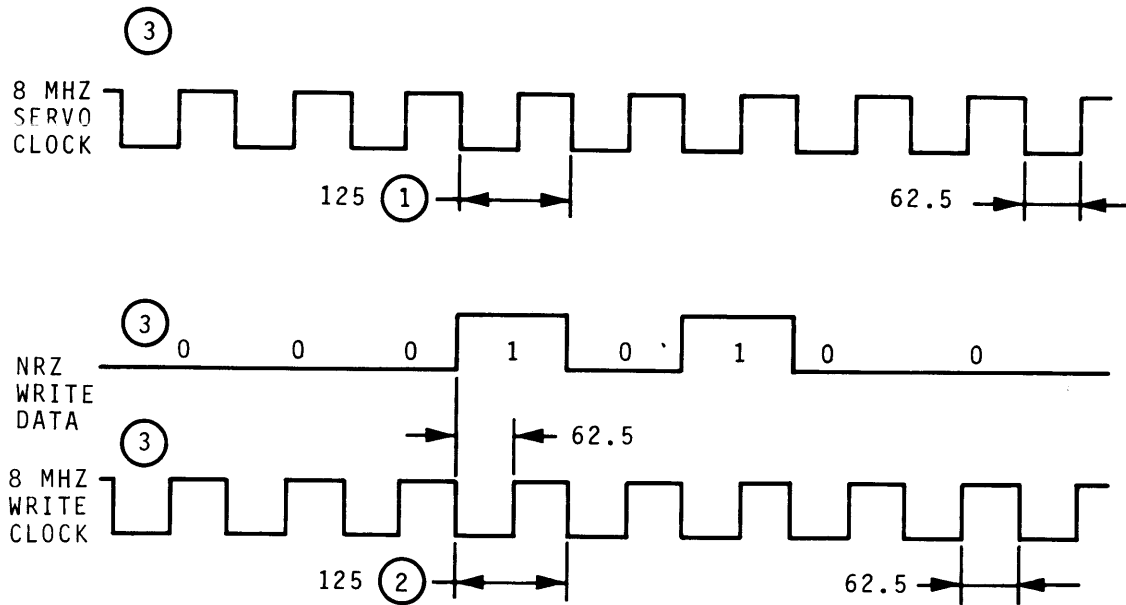INPUT TO THE 75110 DIFFERENTIAL LINE DRIVERS.

110-0162

NOTES:

①. ALL TIMES IN NSEC.

② NEGATIVE EDGE OF CLOCK PRECEDES SIGNIFICANT EDGE OF DATA AT I/O CONNECTOR.
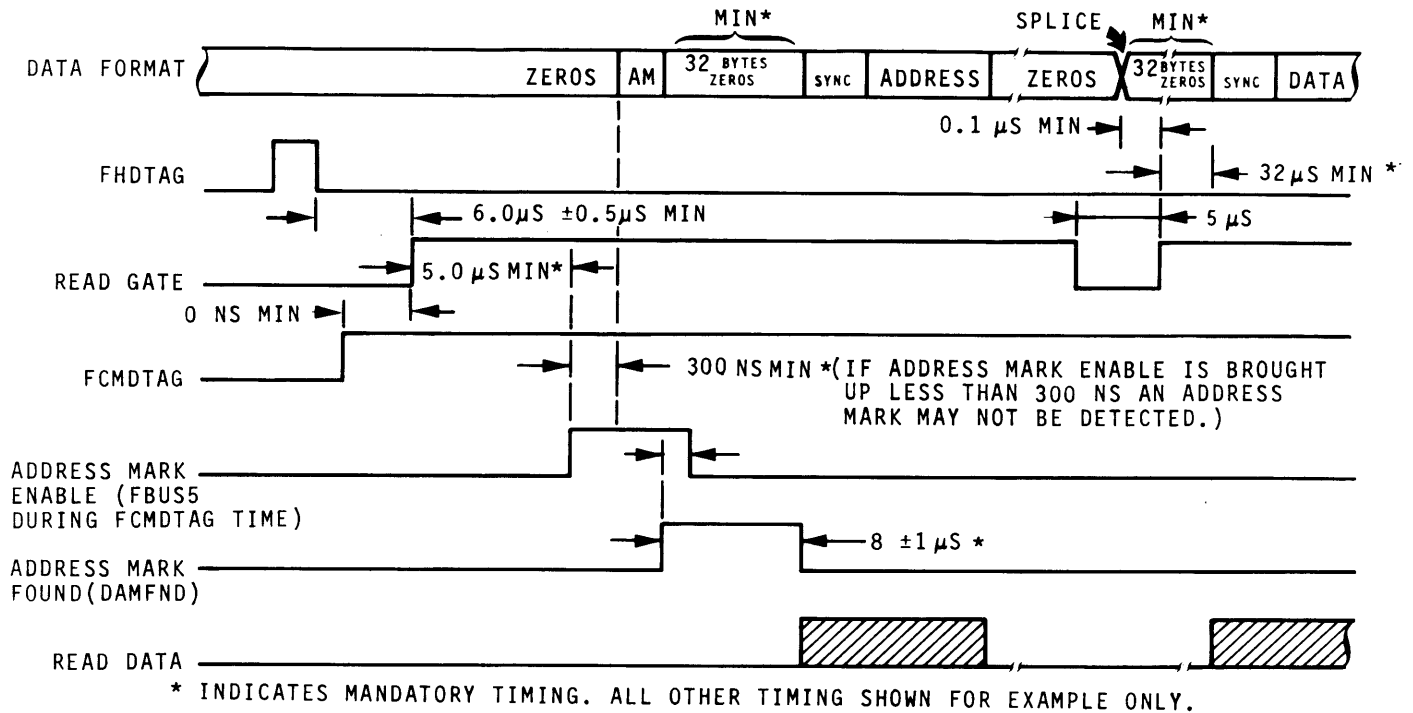
110-0159

Figure 1-5. Read Data Timing

NOTES:

① ALL TIMES IN NS

② SIMILAR PERIOD SYMMETRY SHALL BE ±2 NS AT I/O CONNECTOR IN DRIVE,
SPEED VARIATION TOLERANCE SHALL BE ±5% OF PERIOD WHICH INCLUDES
SPINDLE SPEED TOLERANCE AND DIBIT DROPOUT WHILE CARRIAGE IS MOVING.
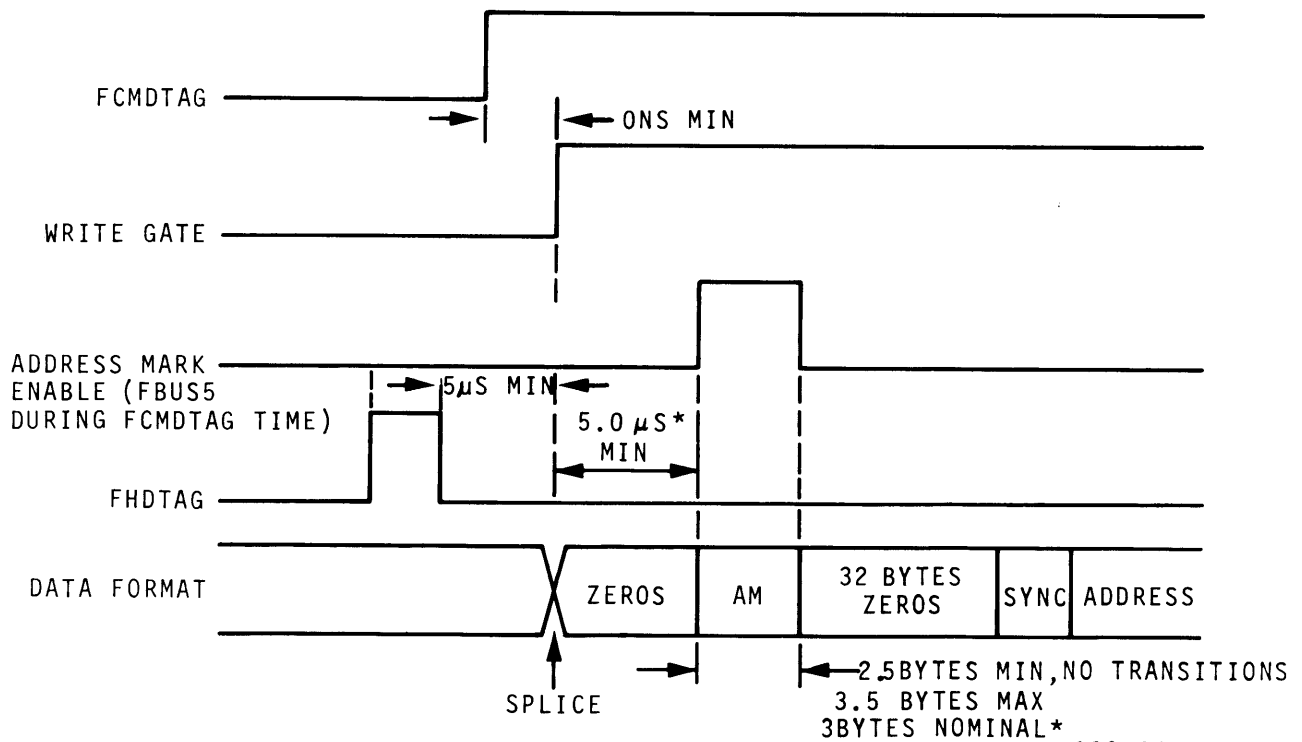
③ AT I/O CONNECTOR IN CONTROLLER.
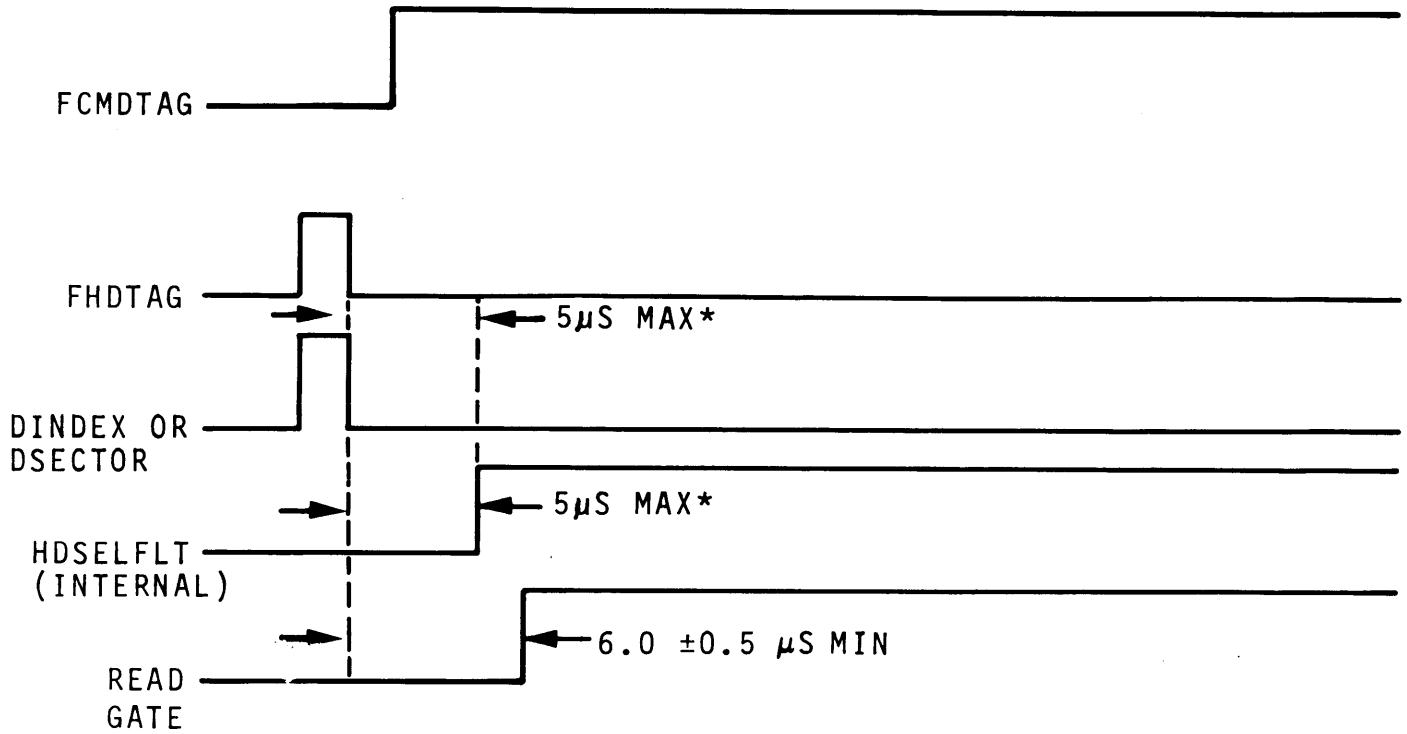
110-0158

Figure 1-6. Write Data/Servo Clock Timing
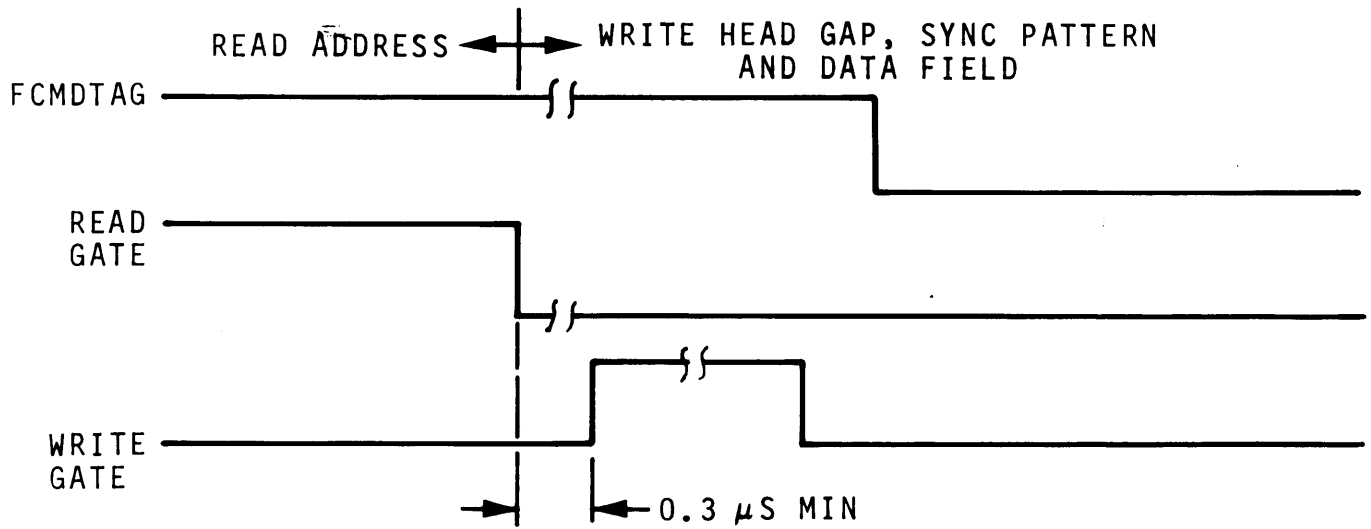
Figure 1-7. Read Timing (Address Mark time)

Figure 1-8. Write Timing (Address Mark time)
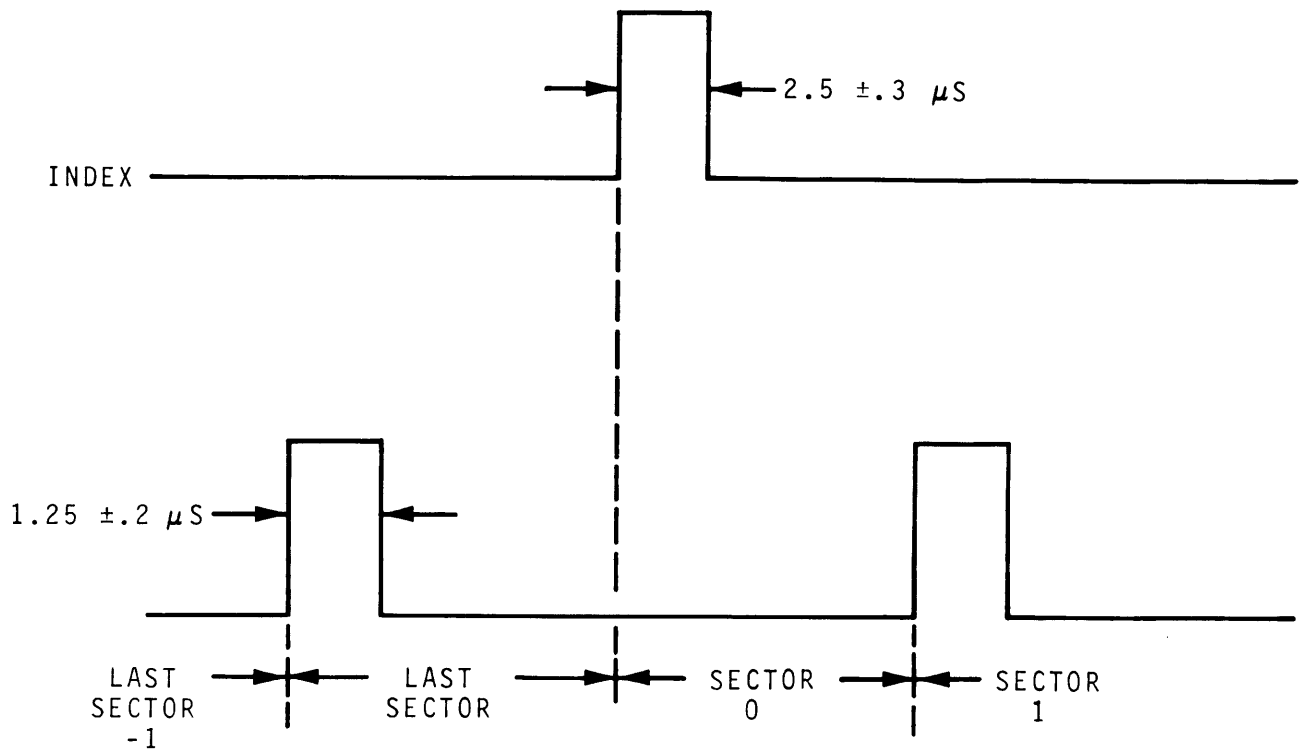
A. TYPICAL READ CONTROL TIMING

B. TYPICAL WRITE CONTROL TIMING

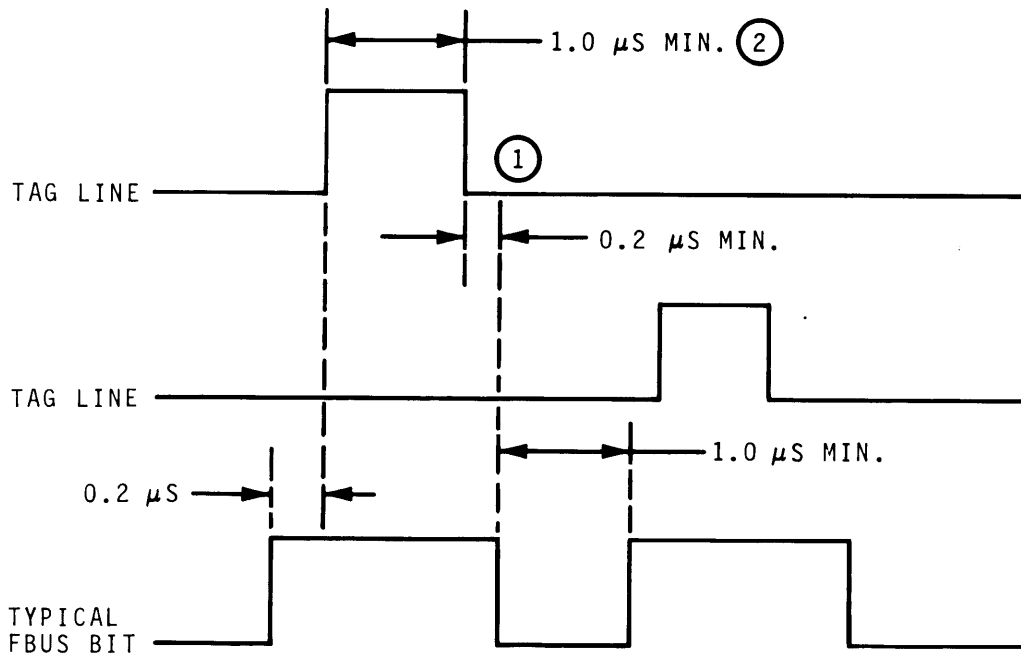*INDICATES MANDATORY TIMING. ALL OTHER TIMING SHOWN FOR EXAMPLE ONLY.

110-0160

Figure 1-9. Control Timing

Figure 1-10. Index and Sector Timing

110-0165

NOTES

① DOES NOT APPLY TO CONTROL SELECT FUNCTIONS.

② FCYLTAG MAX. LENGTH IS 0.5 MS.

110-0164

Figure 1-11. Tag Line/Bus Timing Tolerance

SECTION II

INSTALLATION AND OPERATION

2.1 INSTALLATION

2.1.1 INSPECTION

Prior to installation thoroughly inspect the disk drive and remove any foreign material which may have become lodged in the drive mechanism.

2.1.2 MOUNTING

Physical dimensions of the disk drive are provided in the Outline and Installation Drawing, Figure 1-1. The disk drive requires 7 inches vertical space in a standard 19 inch wide x 24 inch deep rack. For daisy chain applications, the maximum bus cable length is 30 feet. The maximum radial cable length is 12 feet.

2.1.3 SERVICE ACCESS

Most of the PC boards are socket-connected to the masterboard and are removed from the top of the disk drive.

The power supply/disk drive motor assembly can be detached as a unit. The Model 5300 incorporates twin

circuit breakers connected in series with the positive and negative primary input lines, as well as a smaller fuse for protection against voltage transients. The power connector, fuse, circuit breakers, bus connectors and the radial connectors are accessible from the rear of the unit.

PC board test points are standoff pins and are identified as TPA, TPB, etc., on both the PC board and its schematic.

2.1.4 POWER CONNECTIONS

CAUTION

Before connecting the unit to the power source, make certain fusing and the line voltage are correct. (See fuse label.)

2.2 OPERATION

Before operating the disk drive, make certain that the bus and radial interface connectors are properly attached.
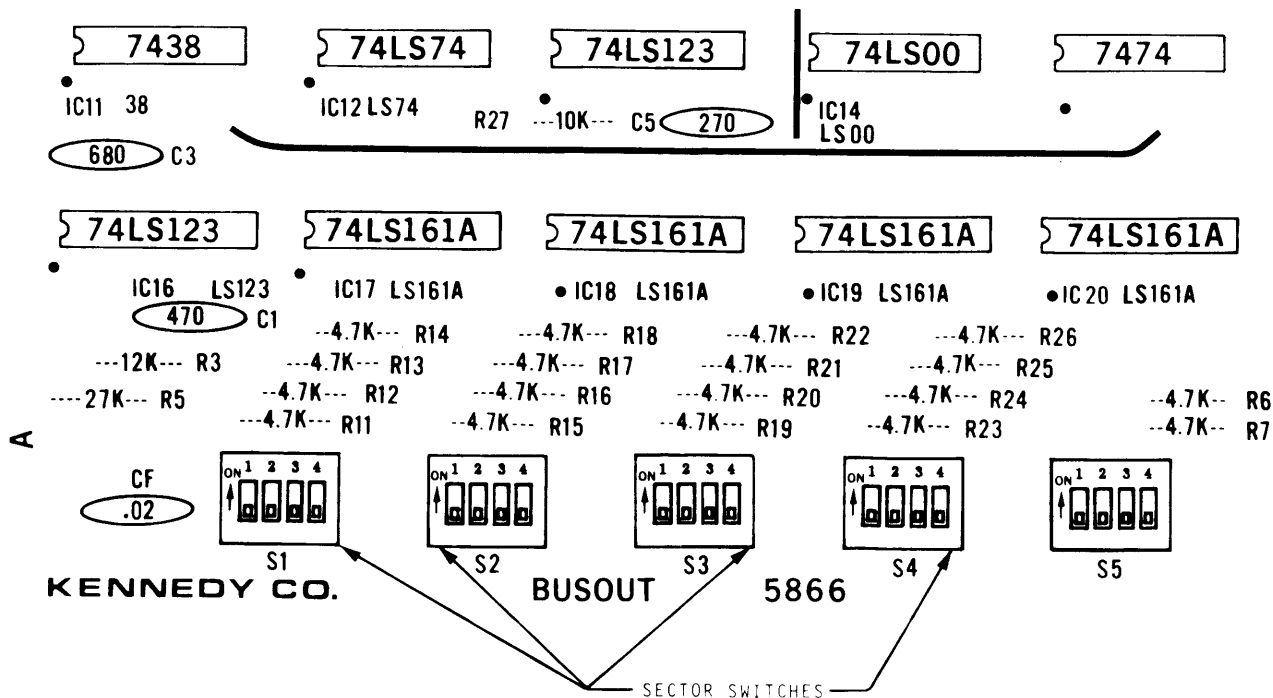

Figure 2-1. Sector Switches, Busout Board

2.2.1 SECTOR SELECTION

When fixed length records will be written, the track can be divided into 1256 sectors by means of the 16 SECTOR switches on the Bus Out PC Board. (See Figure 2-1.) These switches are connected to a 16 bit counter which outputs a 1.25 microsecond SECTOR pulse each time the counters overflow.

SECTOR Switch IC22-4 outputs the most significant bit, IC25-1 outputs the least significant bit. There are two methods for setting these SECTOR switches. If a fixed number of <u>bytes</u> <u>per</u> <u>sector</u> is desired, the formula is

> switch binary value =
> 2's complement (B/2)
> B = number of bytes desired

Example:

> Suppose 195 bytes per sector are desired.
> Thus: 196/2 = 98 = 0000000001100010
> 2's complement 0000000001100010 =
> 1111111110011110

In order to determine the settings of all 16 SECTOR switches, nine zeros are added in front of the most significant bit as shown above. These zeros are inverted, since the formula calls for the two's complement of one half the bytes. Thus, the final binary value assigned to the switches looks like this:

	IC22	IC23	IC24	IC25	
MSB	1111	1111	1001	1110	LSB
Switch No.	4 1	4 1	4 1	4 1	

(Remember that the OFF switch position = 1; ON switch position = 0.)

A second switch setting method is employed when a certain number of <u>sectors</u> <u>per</u> <u>track</u> are desired. In this case the formula is

> switch binary value = 2's complement (10,080/N)
> N = number of sectors

The figure 10,080 is half the maximum number of bytes which may be stored per track. Once again, the decimal answer would be converted to binary, the two's complement determined, and this value assigned to the SECTOR switches. If variable length records are to be written, address marks rather than sectors should be used. An address mark is a 3 microsecond erasure within an all zeros preamble made prior to the first record bit. When address marks are employed, the controller may disregard the DSECTOR signal from the disk drive. It is not relevant for address mark applications.

2.2.2 UNIT SELECT SWITCHES

These are IC26-1 and IC26-2 on the Bus Out Board. (IC26-4 should always be OFF; IC26-3 is not used and can be ON or OFF.) The unit address assures that only one disk drive in a daisy chain reacts to controller commands and returns status. Even in single disk drive application, a unit address must be assigned. Here is a table showing the unit addresses and their respective switch positions:

IC26-1	IC26-2	UNIT SELECTED
ON	ON	UNIT 0
ON	OFF	UNIT 1
OFF	ON	UNIT 2
OFF	OFF	UNIT 3

KENNEDY CO.

540 WEST WOODBURY ROAD, ALTADENA, CALIFORNIA