SA200 Minifloppy™ Diskette Storage Drive

Preliminary OEM Manual

Shugart

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ABBREVIATIONS/MNEMONICS

AM	Address Mark	**MFM**	Modified FM (Double Density)
bpi	Bits per Inch	**MTBF**	Mean Time Between Failure
CRC	Cyclic Redundancy Check	**MTTR**	Mean Time to Repair
fci	Flux Changes per Inch	**PM**	Preventive Maintenance
FM	Frequency Modulation (Single Density)	**tpi**	Tracks per Inch
ID	Identification	**WG OFF**	Write Gate Off

ABOUT THIS MANUAL

This manual (P/N 39230-1) supersedes and makes obsolete P/N 39230-0. Changes between this manual and P/N 39230-0 are indicated by either a change bar in the margin or a black hand in some figures.

While every effort has been made to ensure that the information provided herein is correct, please feel free to notify us in the event of an error or inconsistency. Write any comments on the form in the back of this manual and send to:

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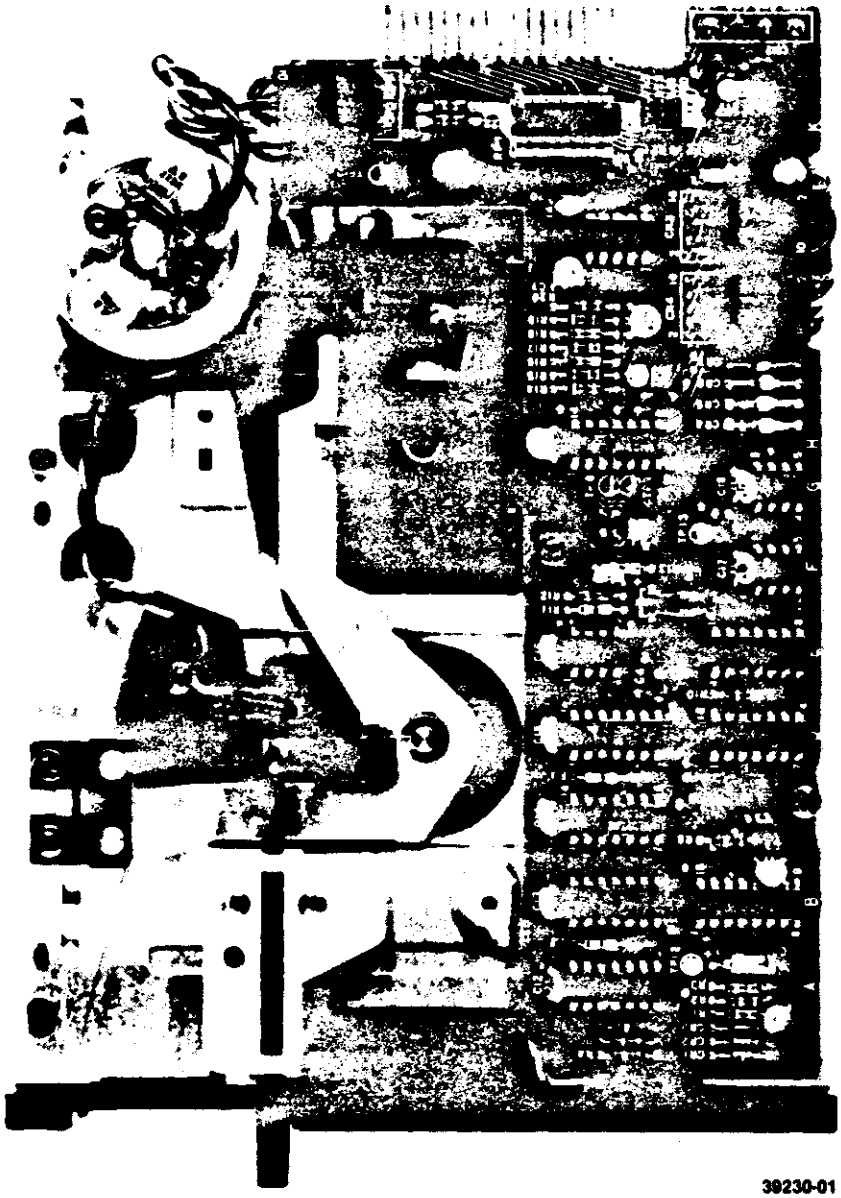


FIGURE 1-0. SA200 MINIFLOPPY DISKETTE STORAGE DRIVE

SECTION I
INTRODUCTION

1.1 GENERAL DESCRIPTION

The SA200 minifloppy™ drive offers the system designer the random access storage capacity of floppy disk drives in a package the size of most cassette tape units. This drive also provides superior data integrity and faster throughput of data when compared with cassette drives.

The SA200 is based on the proven floppy disk drive technology of the Shugart SA400 drive. The SA200 features a unique direct drive stepping motor actuator using a spiral cam with a v-groove positive detent. This actuator assures precise location of the read/write head on a track. The drive employs a ferrite/ceramic read/write head as the SA400. AC power requirements have been eliminated through the use of a dc spindle drive motor. The drive is also equipped with an interface which allows upward expansion of the units within the system and future system enhancements with the large capacity of the floppy drive.

Applications for the minifloppy drive include word processing and text editing systems, mini and micro computer program storage, memory typing systems, intelligent desktop calculators, and the microcomputer hobby market.

The SA104 Minidiskette™ media is used with the SA200. This media is available for soft (SA104) sectored formats. The minidiskette diameter is 5.125 inches (130.2 mm) and the jacket is a square 5.25 inches (133.4 mm).

1.2 SPECIFICATIONS SUMMARY

1.2.1 Performance Specifications

Capacity (in bytes)	**Single Density** (FM)	**Double Density** (MFM)
Unformatted (Per Disk)		
Per Disk	125 k bytes	250 k bytes
Per Track	3.1 k bytes	6.2 k bytes
Formatted (16 Records/Track)		
Per Disk	81,920	163,840
Per Track	2,048	4,096
Per Sector	128	256
Formatted (10 Records/Track)		
Per Disk	102,400	204,800
Per Track	2,560	5,120
Per Sector	256	512
Transfer Rate	125 k bits	250 k bits
Latency (avg.)	100 ms	100 ms
Access Time		
Track-to-Track	26 ms	26 ms
Average	358 ms	358 ms
Settling Time	20 ms	20 ms
Motor Start Time	350 ms	350 ms

1.2.2 Functional Specifications

Rotational Speed	300 rpm	300 rpm
Recording Density	2768 bpi	5536 bpi
Flux Density	5536 fci	5536 fci
Track Density	48 tpi	48 tpi

Media Requirements
SA104 (soft-sectored)

Industry standard flexible diskette
Oxide on 0.003 in. (0.08 mm) Mylar
5.25 in. (133.4 mm) square jacket

1.2.3 Physical Specifications

Environmental Specifications	Operating	Shipping	Storage
Ambient Temperature	50° to 115° F (10.0 to 46.1°C)	−40° to 144° F (−40.0° to 62.2°C)	−8° to 117° F (−22.2° to 47.2°C)
Relative Humidity	20 to 80%	1 to 95%	1 to 95%
Maximum Wet Bulb	85° F (29.4°C)	No Condensation	No Condensation

DC Voltage Requirements
+12 V ± 5% @ 0.77 A (typical), 1.05 A (max), 100 mV ripple
+ 5 V ± 5% @ 0.24 A (typical), 0.42 A (max), 50 mV ripple

Mechanical Dimensions (exclusive of front panel)
Width = 5.75 in. (146.1 mm)
Height = 2.05 in. (52.1 mm)
Depth = 7.87 in. (199.9 mm) Nominal
Weight = 3 lbs. (1.36 kg) Nominal

Power Dissipation
10.4 Watts (35.6 BTU/hr) Continuous (typical)
2.8 Watts (9.6 BTU/hr) Standby (typical)

1.2.4 Reliability Specifications

MTBF: 8000 power on hours under typical usage at 15% duty cycle.
PM: Not Required
MTTR: 30 minutes

Error Rates:
Soft Read Errors: 1 per 10^9 bits read.
Hard Read Errors: 1 per 10^{11} bits read.
Seek Errors: 1 per 10^6 seeks

Media Life:
Passes per Track: 3.0×10^4
Insertions: 30,000+

1.3 FUNCTIONAL CHARACTERISTICS

The SA200 consists of read/write, control electronics, drive mechanism, read/write head, write protect, index, and track positioning mechanism. These components perform the following functions:

a. Interpret and generate control signals.

b. Move the read/write head to the desired track.

c. Read and write data.

d. Clamp and rotate disk.

The interface signals and their relationship to the internal functions are shown in figure 1-1.

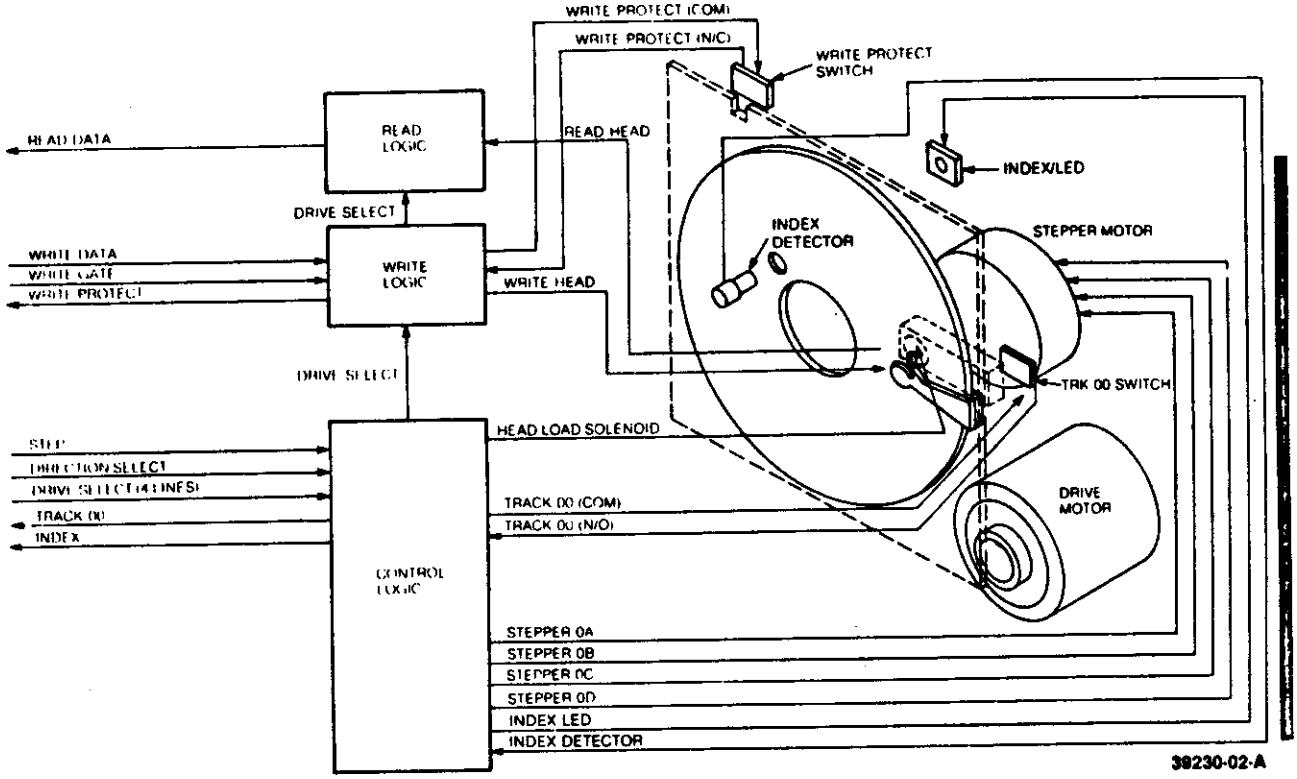


FIGURE 1-1. SA200 FUNCTIONAL DIAGRAM

The head positioning actuator positions the read/write head to the desired track on the minidiskette..

1.3.1 Read/Write and Control Electronics

The electronics are packaged on three PCB's which contain:

a. Index detector.

b. Read/write head position actuator drivers.

c. Write current drivers.

d. Read amplifier and transition detectors.

e. Write protect detector.

f. Drive select circuits.

1.3.2 Drive Mechanism

The mintfloppy drive motor operates on 12 Vdc and rotates the spindle at 300 rpm through a belt-drive system. The speed of the motor is internally controlled through mechanical dampening. A registration hub clamp that moves in conjunction with the door closure mechanism centers and clamps the minidiskette onto the spindle hub.

1.3.3 Read/Write Head Positioning Mechanism

An electrical stepping motor and a face cam positions the read/write head. The stepping motor rotates the cam clockwise or counterclockwise with two step increments per track. The using system increments the stepper motor to the desired track by selecting the proper direction and issuing one step pulse per track. The internal drive control electronics issue the second step pulse needed per track.

1.3.4 Read/Write Head

The SA200 read/write head has a ceramic head with straddle erase elements to provide erased areas between data tracks. Thus, normal interchange tolerances between media and drives will not degrade the signal-to-noise ratio and ensures minidiskette interchangeability.

The read/write head is mounted on a carriage assembly which moves on rails and is positioned by the cam. The minidiskette is held in a plane perpendicular to the read/write head by a platen located on the stamped steel base. This precision registration assures perfect compliance with the read/write head. The minidiskette is loaded against the head with a load pad.

The read/write head is in direct contact with the minidiskette. The head surface has been designed to obtain maximum signal transfer to and from the magnetic surface of the minidiskette with minimum head/minidiskette wear.

1.3.5 Recording Format

The format of the data recorded on the disk is totally a function of the host system. This format can be designed around the user's application to take maximum advantage of the total available bits that can be written on any one track.

For a detailed discussion of various recording formats, refer to section VI.

1.4 FUNCTIONAL OPERATIONS

The following paragraphs define the functional as well as the timing relationships of the operations for the SA200.

1.4.1 Power Sequencing

Applying dc power to the SA200 can be done in any sequence. However, during power-up, the Write Gate line must be held inactive or at a high level. This will prevent possible "glitching" of the media. After application of dc power, a 350 ms delay should be introduced before any operation is performed. After powering on, initial position of the read/write head with respect to the data tracks on the media can be read in the header ID field. In order to assure proper positioning of the read/write head after powering on, a Step Out operation should be performed until the Track 00 line becomes active (Recalibrate).

1.4.2 Drive Selection

Drive Selection occurs when the appropriate Drive Select line is activated and the proper select jumper block is installed.

1.4.3 Motor On

In order for the host system to read or write data, the dc drive motor must be turned on. This is accomplished by activating the Motor On line. A 350 ms delay must be introduced after activating this line to allow the motor to come up to speed before reading or writing can be accomplished.

The motor must be turned off by the host system by deactivating the Motor On line. This should be done if the drive has not received a new command within 2 seconds (10 revolutions of diskette) after completing the execution of the last command. This will ensure maximum motor and media life.

1.4.4 Track Accessing

Seeking the read/write head from one track to another is accomplished by:

a. Write Gate being inactive.

b. Activating the Drive Select line.

c. Selecting the desired direction using the Direction Select line.

d. Pulsing the Step line.

Multiple track accessing is accomplished by repeatedly pulsing the Step line until the desired track has been reached. Each pulse on the Step line will cause the read/write head to move one track either in or out, depending on the Direction Select line. Direction Select is triggered by the trailing edge of the Step pulse. Head movement is initiated on the trailing edge of the Step pulse.

1.4.5 Step Out

With the Direction Select line at a logic one level (2.5 to 5.25 V) a pulse on the Step line will cause the read/write head to move one track away from the center of the disk towards Track 00.

1.4.6 Step In

With the Direction Select line at a minus logic level (0 to 0.4 V), a pulse on the Step line will cause the read/write head to move one track closer to the center of the disk towards Track 39.

1.4.7 Read Operation

Reading data from the SA200 is accomplished by:

a. Activating Drive Select line.

b. Write Gate being inactive.

1.4.8 Write Operation

Writing data to the SA200 is accomplished by:

a. Activating the Drive Select line.

b. Waiting for the appropriate sector.

c. Activating the Write Gate line.

d. Pulsing the Write Data line with the data to be written.

1.4.9 Sequence of Events

The timing diagram shown in figure 1-2 shows the necessary sequence of events with associated timing restrictions for proper operation.

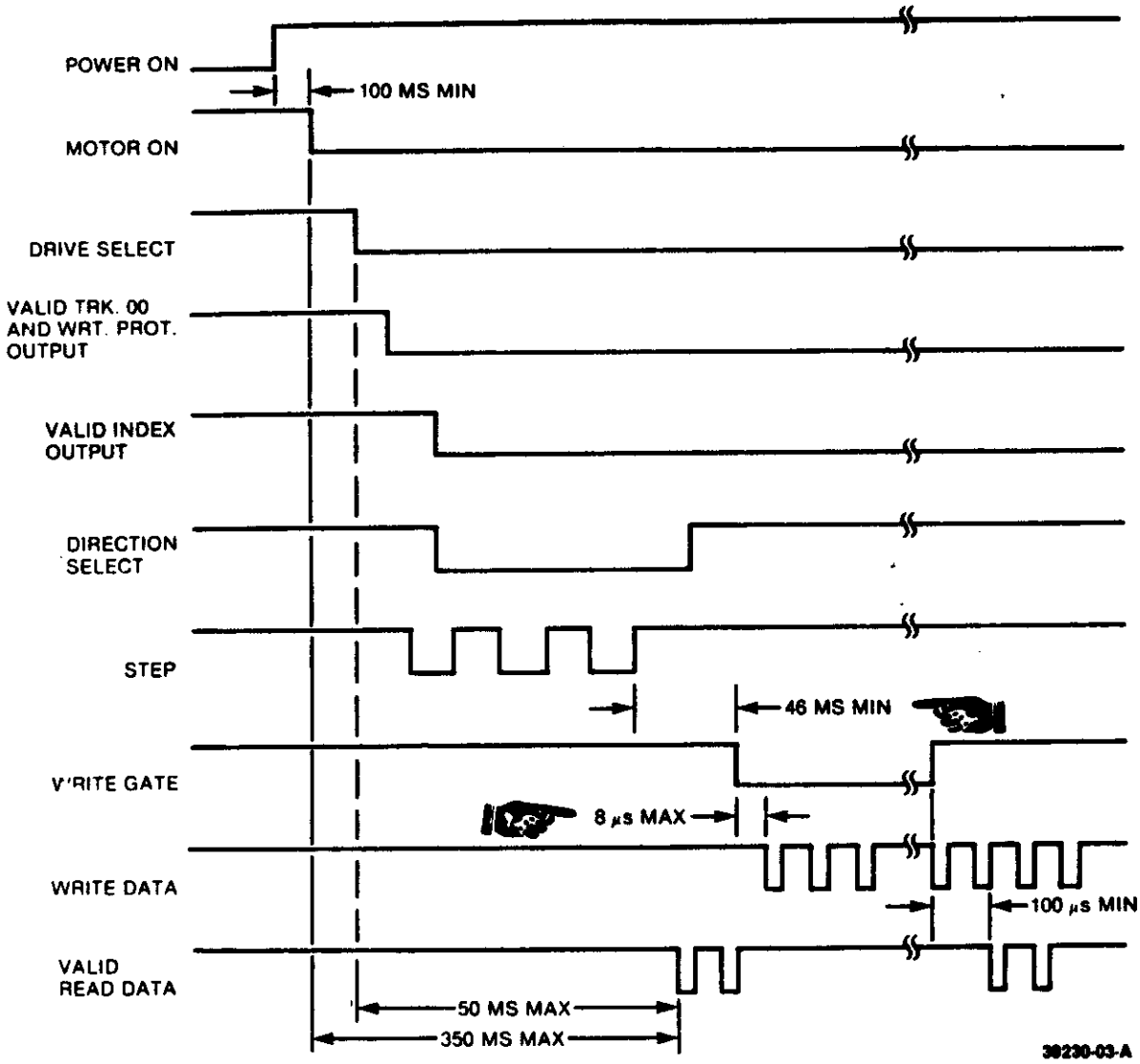


FIGURE 1-2. GENERAL CONTROL AND DATA TIMING REQUIREMENTS

SECTION II
ELECTRICAL INTERFACE

2.1 INTRODUCTION

The interface of the SA200 can be divided into two categories:

a. Signal

b. Power

The following paragraphs provide the electrical definition for each line. See figure 2-1 for all interface connections.

2.2 SIGNAL INTERFACE

The signal interface consists of two categories:

a. Control

b. Data transfer

All lines in the signal interface are digital in nature and either provide signals to the drive (input), or provide signals to the host (output), via interface connector P1/J1.

2.2.1 Input Lines

The input signals are of three types: those intended to be multiplexed in a multiple drive system, those which will perform the multiplexing, and motor control.

The input signals to be multiplexed are:

a. Direction Select

b. Step

c. Write Data

d. Write Gate

The input signals which are intended to do the multiplexing are:

a. Drive Select 1

b. Drive Select 2

c. Drive Select 3

d. Drive Select 4

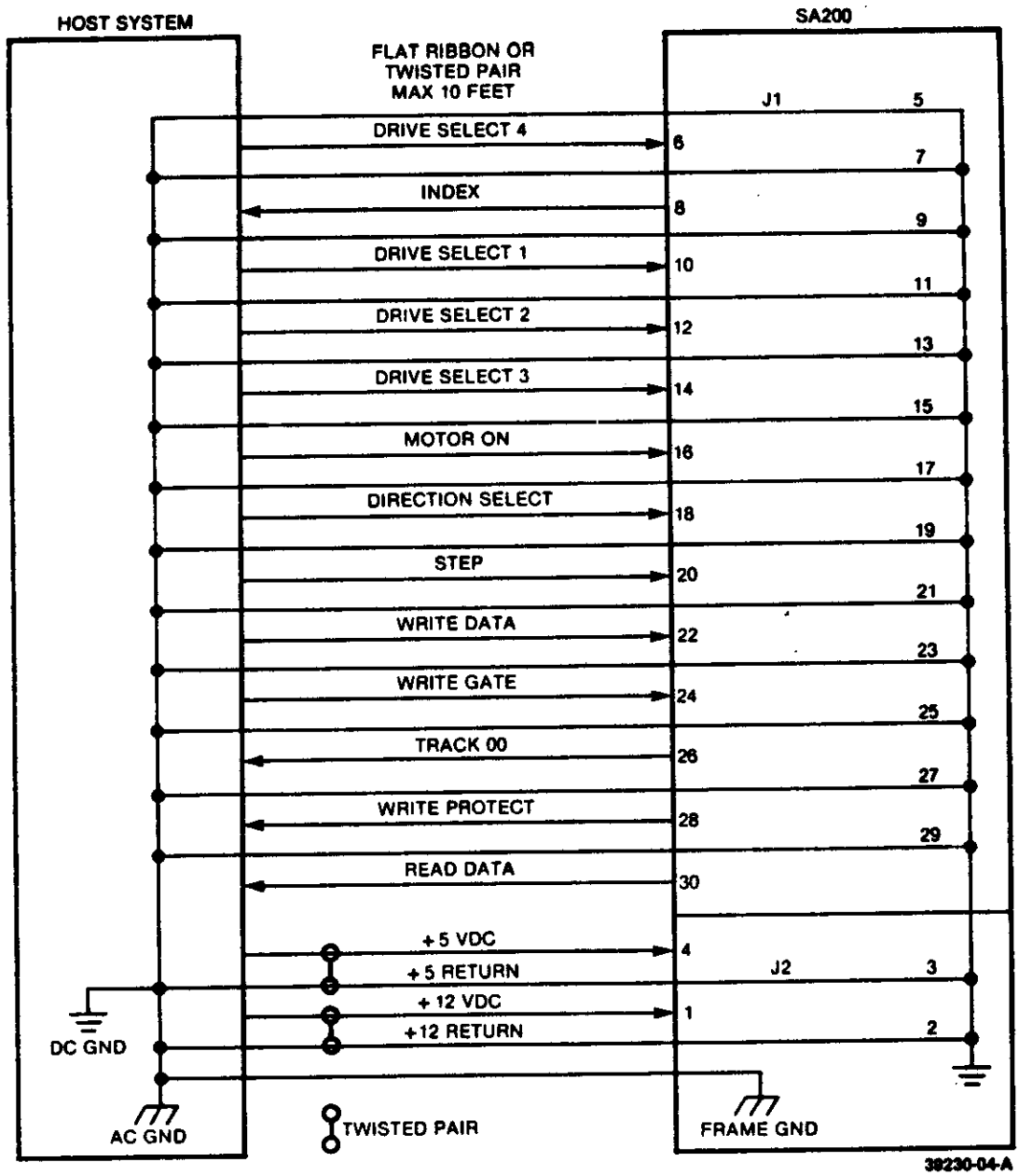


FIGURE 2-1. INTERFACE CONNECTIONS

The input lines have the following electrical specifications. See figure 2-2 for the recommended circuit.

True = Logical Zero = V_{IN} + 0.0 to + 0.4 V @ I_{IN} = 40 mA (max)
False = Logical One = V_{IN} + 2.5 to + 5.25 V @ I_{IN} = 250 μA (open)
Input impedence = 150 ohms

2.2.2 Input Line Terminations

The SA200 has been provided with the capability of terminating the five input lines listed below:

a. Motor On

b. Direction Select

c. Step

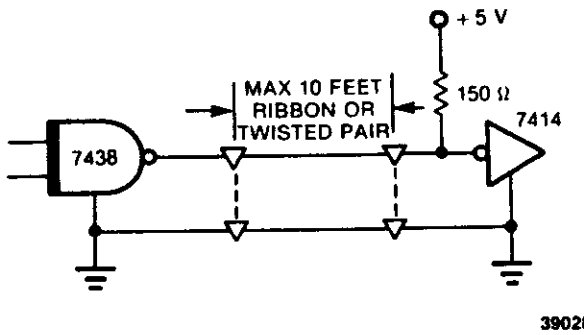


FIGURE 2-2. INTERFACE SIGNAL DRIVER/RECEIVER

d. Write Data

e. Write Gate

These lines are terminated through a 150-ohm resistor pack installed in the dip socket at location B11.

In a single drive system, this resistor pack should be kept in place to provide the proper terminations.

In a multiple drive system (Program Shunt position MX open), only the last drive on the interface is to be terminated. All other drives on the interface must have the resistor pack removed. External terminations may also be used. However, the user must provide the terminations beyond the last drive and each of the five lines must be terminated to + 5 Vdc through a 150-ohm, ¼-watt resistor.

2.2.3 Drive Select 1–4

The SA200 as shipped from the factory is configured to operate in a single drive system. The SA200 can be easily modified by the user to operate with other drives in a multiplexed multiple-drive system. The user can activate the multiplex option by cutting the MX position of the programmable shunt. This will allow the multiplexing of the I/O lines.

In a single drive system (program shunt position MX open), the four input lines (Drive Select 1 through Drive Select 4) are provided so that the using system may select which drive on the interface is to be used. In this mode of operation only the drive with its Drive Select line active will respond to the input lines and gate the output lines.

The program shunt positions DS1, DS2, DS3, and DS4, are to be used to select which Drive Select line will activate the I/O lines for a unique drive. As an example, if the user wants the first drive on the interface to be address 1, a program shunt must be installed in position DS1.

2.2.4 Motor On

This input, when activated to a logical zero level, will turn on the drive motor. A 350 ms delay after activating this line must be allowed before reading or writing. This line should be deactivated for maximum media life if no commands have been issued to the drives within 2 seconds (10 revolutions of the media) after completion of the last command.

2.2.5 Direction Select

This interface line is a control signal which defines the direction of motion the read/write head will take when the Step line is pulsed. An open circuit or logical one defines the direction as out. If a pulse is applied to the Step line the read/write head will move away from the direction of the center of the disk. Conversely, if this input is shorted to ground or a logical zero level, the direction of motion is defined as in. If a pulse is applied to the step line, the read/write head will move towards the center of the disk.

2.2.6 Step

This interface line is a control signal which causes the read/write head to move with the direction of motion as defined by the Direction Select line.

The access motion is initiated on each logical zero to logical one transition, or the trailing edge of the Step pulse.

2.2.7 Write Gate

The active state of this signal, or logical zero, enables the Write Data to be written on the diskette. The WRITE GATE signal is ignored when the write protect detector is true. The inactive state, or logical one, enables the read data logic and stepper logic.

2.2.8 Write Data (FM)

This interface line provides the data to be written on the diskette. Each transition from a logical one level to a logical zero level will cause the current through the read/write heads to be reversed, thereby writing a data bit. This line is enabled by Write Gate being active. Write Data must be inactive during a read operation.

2.2.9 Output Lines

The output control lines have the following electrical specifications. See figure 2-2 for the recommended circuit.

True = Logical Zero = V_{OUT} + 0.0 to + 0.4 V @ I_{OUT} = 48 mA (max.)
False = Logical One = V_{OUT} + 2.5 to + 5.25 V (open collector) @ I_{OUT} = 250 μA (max.)

2.2.10 Track 00

The active or logical zero state of this interface signal indicates when the read/write head of the drive is positioned at track zero (the outermost track) and the access circuitry is driving current through phase A of the stepper motor. This signal is at a logical one level, or inactive state, when the read/write head is not at track zero. When the read/write head is at track zero and an additional step out pulse is issued to the drive, a mechanical stop will keep the read/write head at track zero but the Track 00 signal will go inactive. This is because the stepper motor will go to phase C and not phase A. One more step out pulse will put the stepper motor back into phase A and the Track 00 signal will go active again.

2.2.11 Index

This interface is provided by the drive each time an index hole is sensed at the Index photo detector. Normally, this signal is at a logical one level and makes the transition to the logical zero level each time a hole is sensed.

When using SA104 media (soft sectored), there will be one pulse on this interface signal per revolution of the diskette (200 ms). This pulse indicates the physical beginning of a track. See figure 2-3 for the timing.

When using the Index signal, look for an edge or transition rather than a level for determining the status. With no diskette inserted, this signal remains active or at a logical zero level which is an erroneous status.

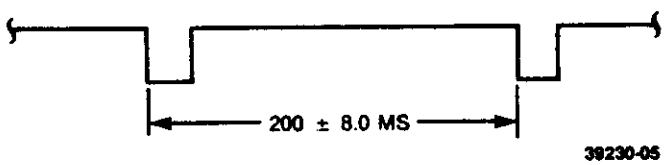


FIGURE 2-3. INDEX TIMING (SA104 MEDIA)

2.2.12 Read Data

This interface line provides the raw data (clock and data together) as detected by the drive electronics. Normally, this signal is a logical one level and becomes a logical zero level for a clock or data pulse.

2.2.13 Write Protect

This interface signal is provided by the drive to give the user an indication when a Write Protected Diskette is installed. The signal is logical zero level when it is protected. Under normal operation, the drive will inhibit writing with a protected diskette installed in addition to notifying the interface.

2.3 POWER INTERFACE

The SA200 requires only dc power for operation. DC power to the drive is provided via P2/J2 located on the non-component side of the PCB near the drive motor. The two dc voltages, their specifications and their P2/J2 pin designators are shown in table 2-1. The specifications outlined in current requirements are a multiple of the maximum current times the number of drives in the system.

TABLE 2-1. DC VOLTAGES

P2 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (p to p)
1	* + 12 VDC	± 0.6 VDC	1.05 A MAX 0.77 A TYP	100 mV MAX ALLOWABLE
2	+ 12 RETURN			
3	+ 5 RETURN			
4	+ 5 VDC	± 0.25 VDC	0.42 A MAX 0.24 A TYP	50 mV MAX ALLOWABLE

*The 12 Vdc current is composed of three components; diskette drive motor current, PCB functions, and stepper motor.

39230-12-A

2.4 FRAME GROUND

It is important that the drive be frame-grounded to the ac ground or frame ground of the host system. Failure to do so may result in drive noise susceptibility. Refer to paragraph 3.2 for the procedure.

SECTION III
PHYSICAL INTERFACE

3.1 INTRODUCTION

The electrical interface between the SA200 and the host system is via two connectors. The first connector, J1, provides the signal interface. The second connector, J2, provides the dc power.

This section describes the physical connectors used on the drive and the recommended connectors to be used with them. See figure 3-1 for connector locations.

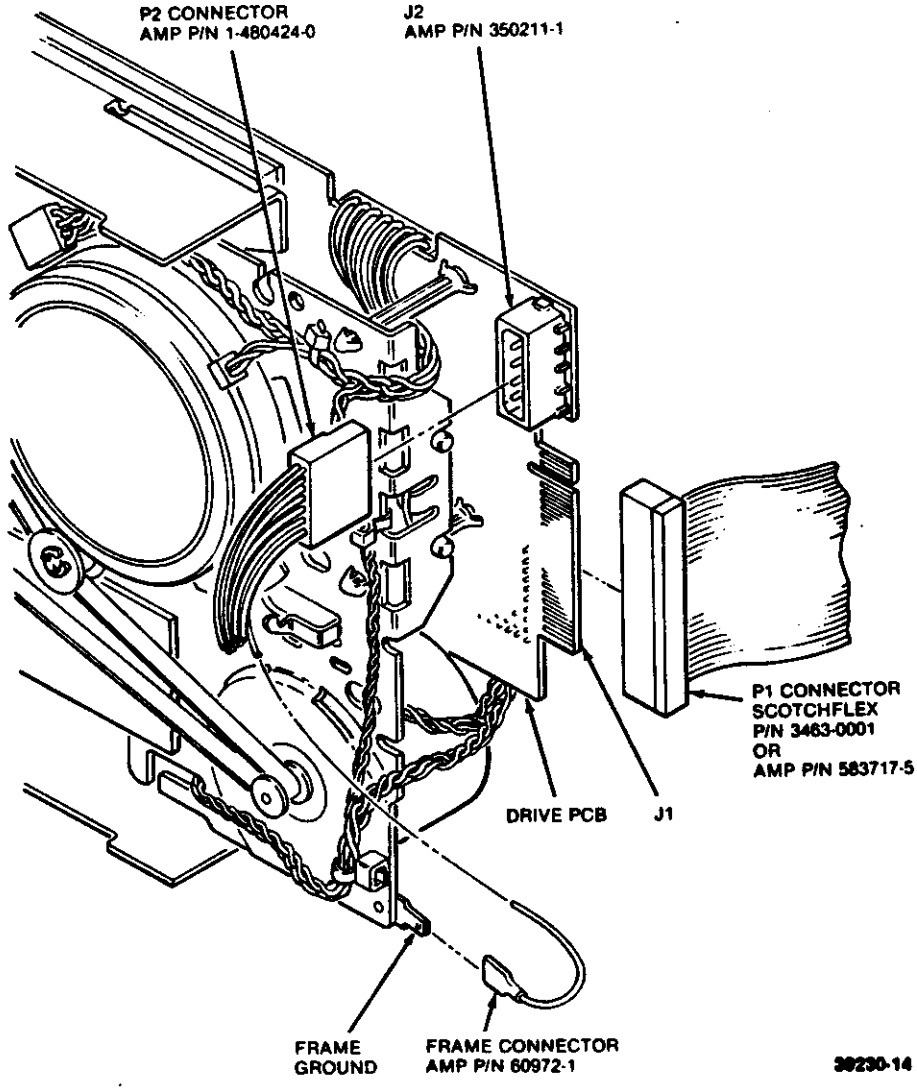


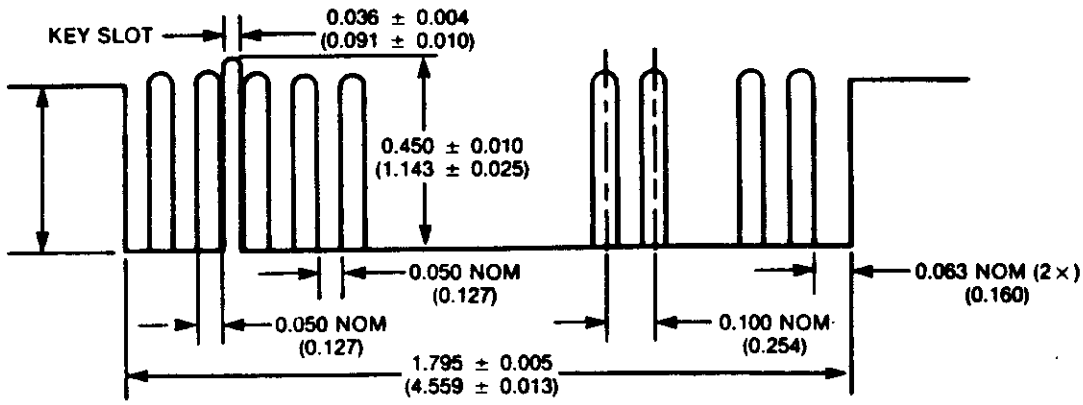
FIGURE 3-1. INTERFACE CONNECTORS - PHYSICAL LOCATIONS

3.2 CONNECTORS

3.2.1 J1/P1 Connector

Connection to J1 is through a 34-pin PCB edge card connector. The dimensions for this connector are shown in figure 3-2. The pins are numbered 1 through 34 with the even-numbered pins on the component side of the PCB and the odd-numbered pins are on the non-component side. Pin 2 is located on the end of the PCB connector closest to the corner and is labeled 2. A key slot is provided between pins 4 and 6 for optional connector keying.

The recommended connectors for P1 are shown in table 3-1.



NOTE: Top nos. in inches.
(Bottom nos.) in cm.

FIGURE 3-2. J1 CONNECTOR DIMENSIONS

TABLE 3-1. P1 CONNECTORS

TYPE OF CABLE	MANUFACTURER	CONNECTOR P/N	CONTACT P/N
TWISTED PAIR, #26	AMP	583717-5	1-583616-1
FLAT CABLE	3M "SCOTCHFLEX"	3463-0001	NA

39230-13

3.2.2 J2/P2 Connector

The dc power connector, J2, is mounted on the PCB and is located near the drive motor. J2 is a 4-pin AMP Mate-N-Lok connector, P/N 350211-1. The recommended mating connector (P2) is AMP P/N 1-480424-0, using AMP pins P/N 61473-1. J2, pin 1, is labeled on the component side of the PCB. Wire used should be #18 AWG. Figure 3-3 illustrates J2 connector as seen on the drive PCB from the non-component side.

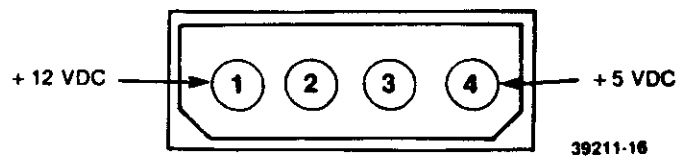


FIGURE 3-3. J2 CONNECTOR

3.3 FRAME GROUNDING

The SA200 must be frame-grounded to the host system to insure proper operation. If the frame of the drive is not fastened directly to the frame of the host system with a good ac ground, a wire from the system ac frame ground must be connected to the SA200. For this purpose, a faston tab is provided on the drive at the rear of the casting where a faston connector can be attached or soldered. The tab is AMP P/N 61664-1 and its mating connector is AMP P/N 60972-1 (see figure 3-1).

SECTION IV
DRIVE PHYSICAL SPECIFICATIONS

4.1 GENERAL

These paragraphs contain the mechanical dimensions and mounting recommendations for the SA200.

4.2 MECHANICAL DIMENSIONS

See figure 4-1 for dimensions of the SA200.

4.3 MOUNTING

CAUTION

DO NOT HORIZONTAL MOUNT WITH PCB DOWN. Damage to the drive could result.

As shipped from the factory, the SA200 is capable of being mounted in one position, horizontal within a ± 20° tilt around the head to spindle axis.

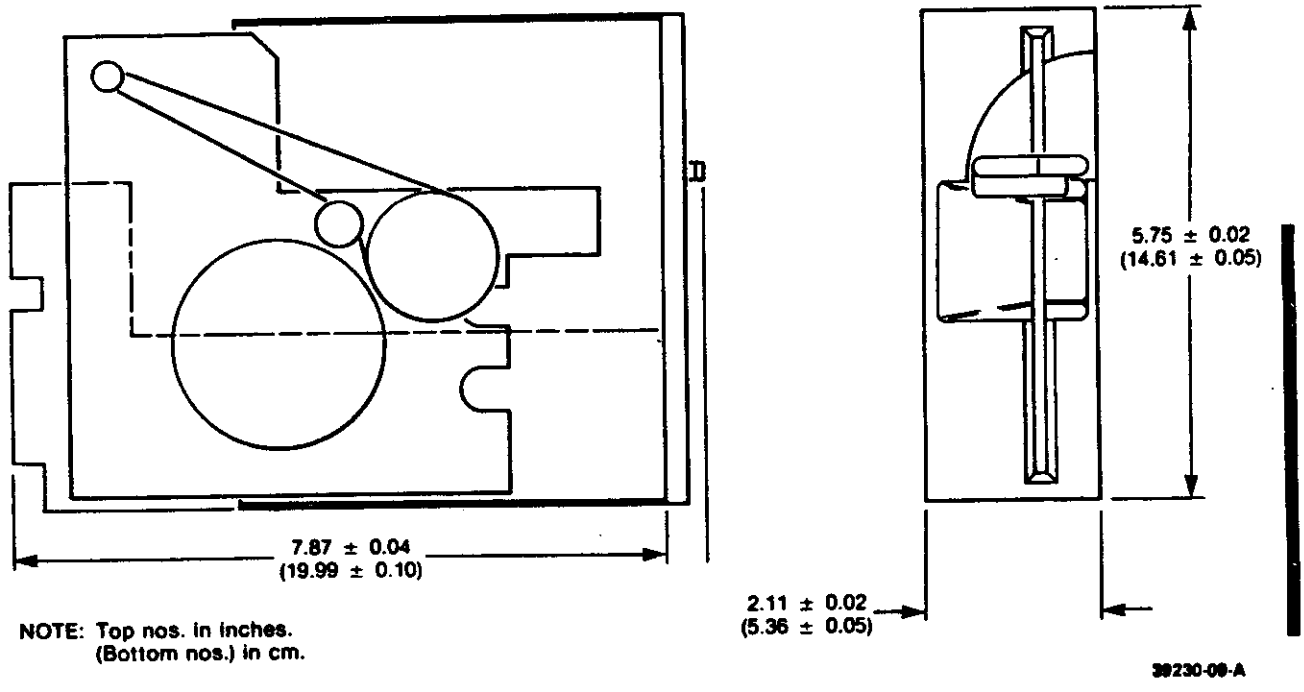


FIGURE 4-1. SA200 PHYSICAL DIMENSIONS

SECTION V
ERROR RECOVERY

5.1 WRITE ERROR

If an error occurs during a write operation, this error will be detected on the next revolution by doing a read operation (commonly called a write check). To correct the error, another write and write check operation must be done. If the write operation is not successful after 10 attempts have been made, a read operation should be attempted on another track. This is done to determine if the media or the drive is failing. If the error still persists, the disk should be considered defective and discarded.

5.2 READ ERROR

Most errors that occur will be soft errors. Soft errors are usually caused by the following:

a. Airborne contaminants passing between the read/write head and the disk. The contaminants will generally be removed by the cartridge self-cleaning wiper.

b. Random electrical noise which usually lasts for a few microseconds.

c. Small defects in the written data and/or track not detected during the write operation which may cause a soft error during a read.

The following procedure is recommended to recover from errors:

a. Reread the track 10 times or until such time as the data is recovered.

b. If data is not recovered after doing step a, access the head to the adjacent track in the same direction previously moved. Return to the desired track.

c. Repeat step a.

d. If data is not recovered, the error is not recoverable.

5.3 SEEK ERROR

Seek errors are detected by reading an ID field after the seek is completed. The ID field contains the track address. If a seek error is detected, the host system should issue a recalibrate operation (step out until Track 00 line goes active) and seek back to the original track.

SECTION VI
RECORDING FORMAT

6.1 GENERAL

The format of the data recorded on the diskette is totally a function of the host system. As discussed in paragraph 1.4.8, data can be recorded on the diskette using FM or MFM encoding. In these encoding techniques, clock bits are written at the start of their respective bit cells and bits at the centers of their bit cells.

Byte

A byte, when referring to serial data (being written onto or read from the disk drive), is defined as eight consecutive bit cells. The most significant bit cell is defined as bit cell 0 and the least significant bit cell is defined as bit cell 7. When reference is made to a specific data bit (i.e., data bit 3),it is with respect to the corresponding bit cell (bit cell 3).

During a write operation, bit cell 0 of each byte is transferred to the disk drive first with bit cell 7 being transferred last. Correspondingly, the most significant byte of data is transferred to the disk first and the least significant byte is transferred last.

When data is being read back from the drive, bit cell 0 of each byte will be transferred first with bit cell 7 last. As with reading, the most significant byte will be transferred first from the drive to the user.

Figure 6-1 illustrates the relationship of the bits within a byte and figure 6-2 illustrates the relationship of the bytes for read and write data.

6.2 FORMATS

Tracks may be formatted in numerous ways, depending on the using system.

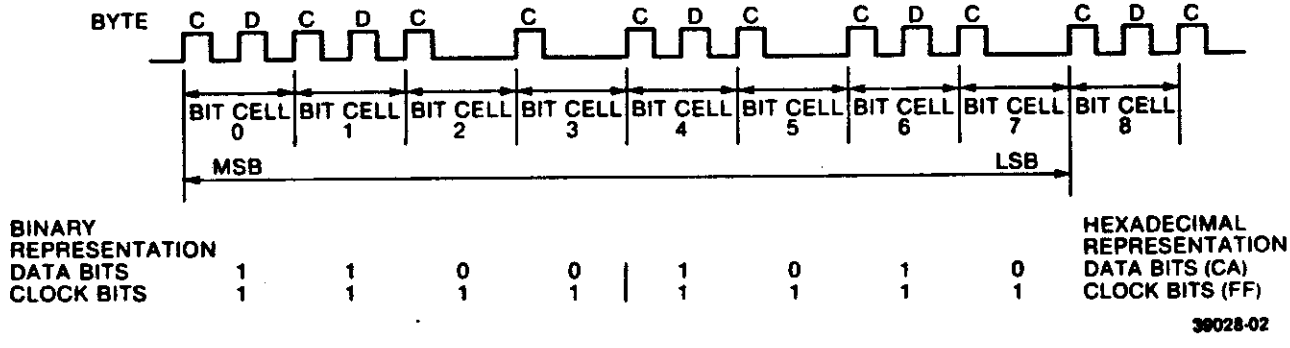


FIGURE 6-1. BYTE (FM ENCODING)

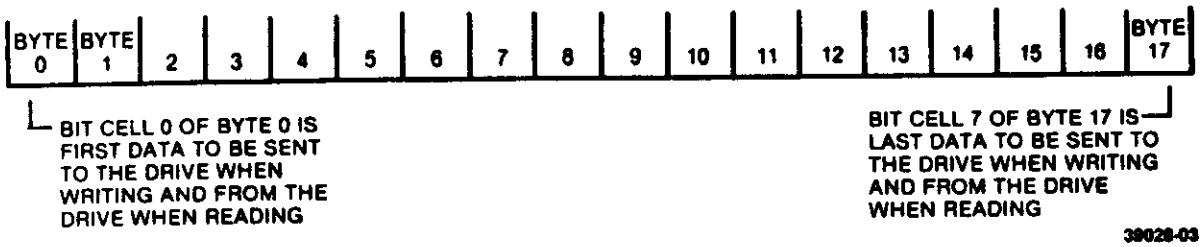


FIGURE 6-2. DATA BYTES

6.2.1 Soft Sectored Recording Format

In this format, the using system may record one long record or several smaller records. Each track is started by physical index pulse and then each record is preceded by a unique recorded identifier. This type of recording is called soft sectoring. Figure 6-3 illustrates the recommended single density (FM) formats. Figure 6-4 shows the recommended double density (MFM) format.

6.2.2 Track Layout

Index is the physical detector indicating one revolution of the media. Index is used to initiate format operations, ensure one complete revolution of the media has been searched, and for a deselect storage signal after a certain number of revolutions.

Gap 1 — **Gap 1** is from the physical index mark to the ID field address mark sync. Gap 1 allows for physical index variation, speed variation, and interchange between storage devices.

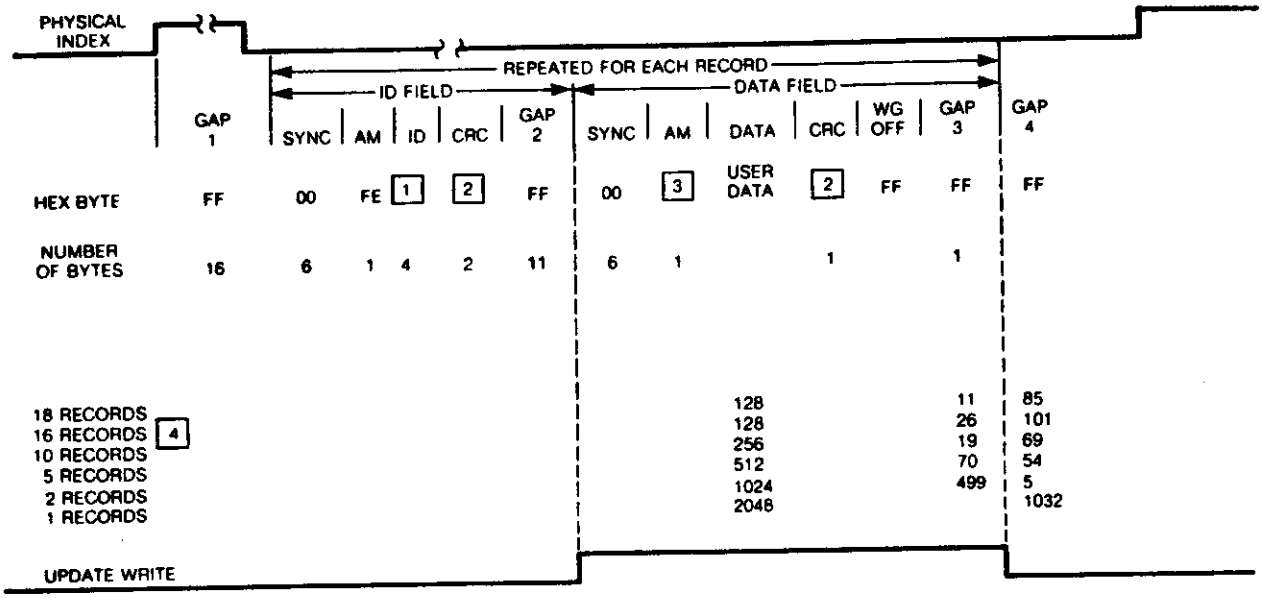
ID Field — **Sync** is a fixed number of bytes for Separator synchronization prior to AM. Sync includes a minimum of two bytes plus worst case Separator sync up requirements.
ID Pre-Address Mark (MFM) is three bytes of A1 with unique clock bits not written per encode rules.
ID Address Mark (FM) is a unique byte to identify the ID field and not written per the encode rules.
ID Address Mark (MFM) is one byte of FE and is written per the encode rules.
ID is a four-byte address containing track number, head number, record number, and record length.
CRC is two bytes for cyclic redundancy check.

Gap 2 — **Gap 2** is from ID CRC to data AM sync. Gap 2 allows for speed variation, oscillator variation, and erase core clearance of ID CRC bytes prior to write gate turn on for an update write.

Data Field — **Sync** is a fixed number of bytes for Separator synchronization prior to the AM. Sync includes a minimum of two bytes plus worst case separator sync up requirements.
Pre-Data Address Mark (MFM) is three bytes of A1 with unique clock bits not written per the encode rules.
Data Address Mark (FM) is a unique byte to identify the Data Field and not written per the encode rules.
Data Address Mark (MFM) is one byte of FB or F8 and is written per the encode rules.
Data is the area for user data.
CRC is two bytes for cyclic redundancy check.
WG OFF (Write Gate Off) is one byte to allow for Write Gate turn-off after an update write.

Gap 3 — **Gap 3** is from WG OFF to next ID AM sync. Gap 3 allows for erase core to clear the Data Field CRC bytes, speed and write oscillator variation, read preamplifier recovery time, and system turn-around time to read the following ID Field.

Gap 4 — **Gap 4** is the last gap prior to physical index. Gap 4 allows for speed and write oscillator variation during a format write and physical index variation.



NOTES:
1. Track Number, Head Number.
2. IBM or Equivalent CRC Generator.
3. FB for Data or F8 for Deleted Data.
4. 16 Record format has a Gap 2 of 11 bytes.

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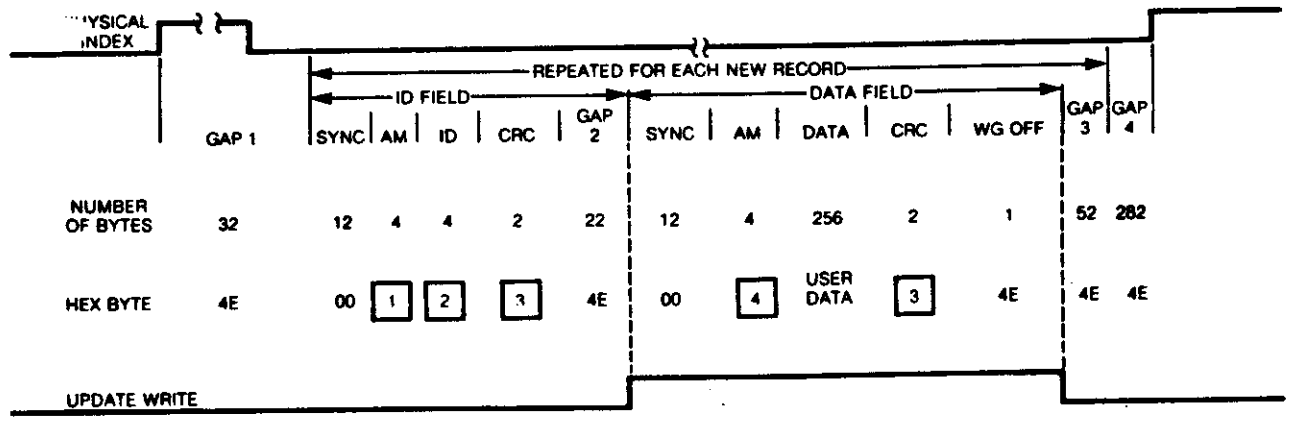
FIGURE 6-3. RECOMMENDED SOFT SECTOR DENSITY (FM - EVEN BOUNDARIES)



NOTES:
1. First three bytes are Hex A1 with missing Clock Transitions between bits 4 and 5. Last byte is Hex FE
2. Track Number, Head Number.
3. IBM or Equivalent CRC Generator.
4. Same as Note 1, except last byte = Hex FB.

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FIGURE 6-4. MFM RECOMMENDED FORMAT, 256 BYTES/16 RECORDS PER TRACK (IBM TYPE)

SECTION VII
CUSTOMER INSTALLABLE OPTIONS

(To be furnished at a later date.)

SECTION VIII
OPERATION PROCEDURES

8.1 INTRODUCTION

The SA200 was designed for ease of operator use and to facilitate a wide range of operator-oriented applications. The following paragraphs are a guide to the handling procedures for the minidiskette and minifloppy drive.

8.2 MINIDISKETTE LOADING

To load the diskette, open the door on the front panel, insert the diskette with label towards the door handle, and close handle.

8.3 MINIDISKETTE HANDLING

To protect the diskette, precautionary procedures are as follows:

a. Return diskette to storage envelope whenever it is removed from drive.

b. Do not bend or fold diskette.

c. Store diskettes not for immediate use in their box.

d. Keep diskettes away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can destroy recorded data on disk.

e. Replace storage envelopes when worn, cracked, or distorted. Envelopes are designed to protect disk.

f. Place I.D. labels in correct location, never use in layers.

g. Do not write on plastic jacket with lead pencil or ball point pen. Use felt tip pen.

h. Do not use erasers.

i. Heat and contamination from carelessly dropped ash can damage disk.

j. Do not expose diskette to heat or sunlight.

8.4 WRITE PROTECT FEATURE

The SA104 minidiskette has the capability of being write protected. A write protect notch is located on the diskette jacket. When the notch is open, writing is allowed. When the notch is covered with a tab, writing is inhibited and the interface signal will be activated. Figure 8-1 illustrates the SA104 minidiskette write protected and unprotected.

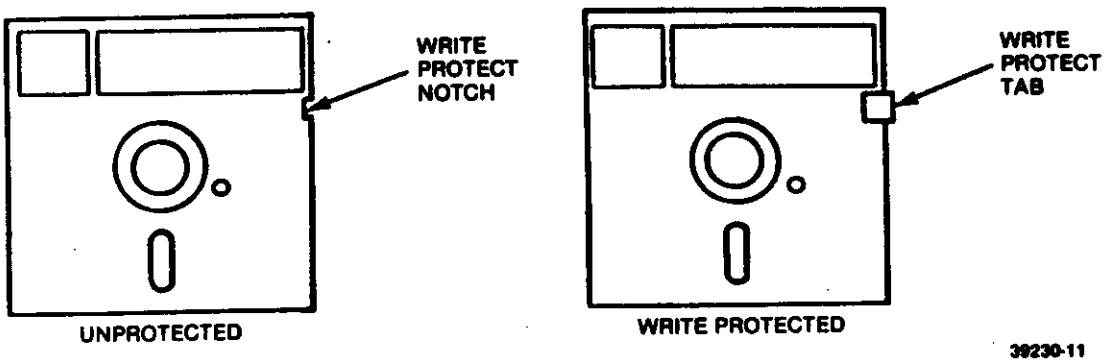

FIGURE 8-1. SA104 WRITE PROTECT

SECTION IX
PACKAGING

9.1 GENERAL INFORMATION

The SA200 shipped from the factory and regional depots, is equipped with a carriage stop. The carriage stop is designed to prevent head carriage movement while the drive is in transit. Upon receipt of the drive, the carriage stop should be removed and retained. The stop must be reinstalled prior to any further shipment of the drive.

9.2 PACKING FOR RESHIPPING

To prepare a drive for shipment:

a. Locate the head carriage at Track 00.

b. Insert the carriage stop in the same manner as a diskette. Ensure the tab is under the head carriage.

c. Place the drive in its packing container (see figure 9-1).

Failure to follow this procedure may result in damage to the drive.

It is suggested that packing material be kept in case the unit must be returned to Shugart for repair. Regardless, the unit must be individually packaged in comparable packing as shipped to preclude damage in shipping and handling (see figure 9-1). **Damage to the unit as a result of inadequate packaging will void the warranty on the unit.**

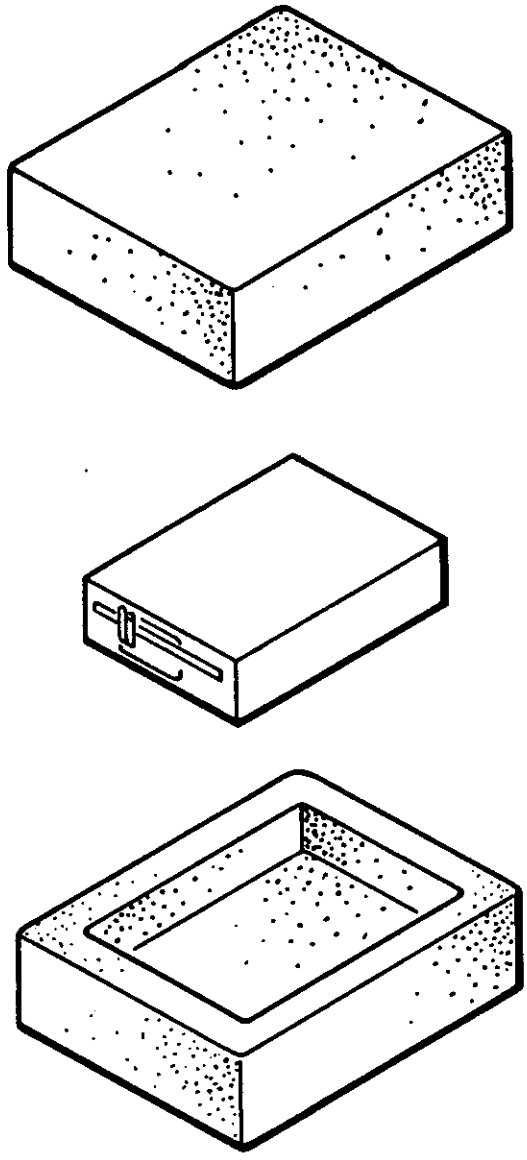

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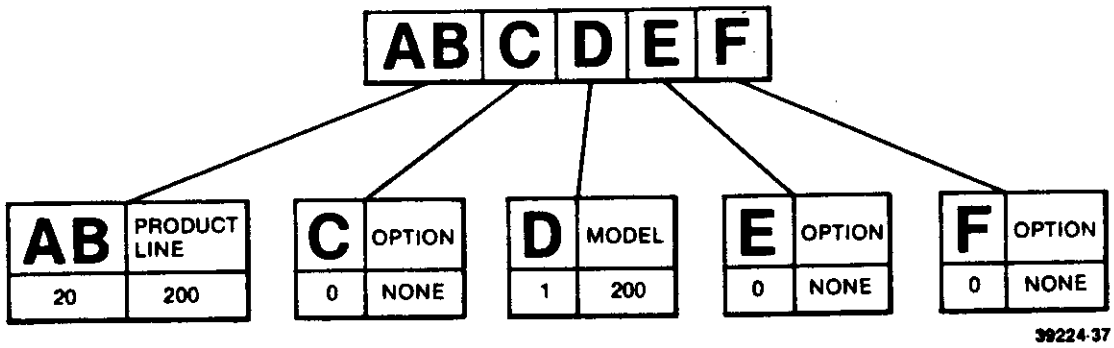
FIGURE 9-1. SHIPPING CONTAINER

APPENDIX A
ORDERING INFORMATION

The table below can be used to construct a part number for a unique drive configuration. This table is interim and not complete. Further information will be furnished later.

TABLE A-1. SA200 PSI

SA200



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