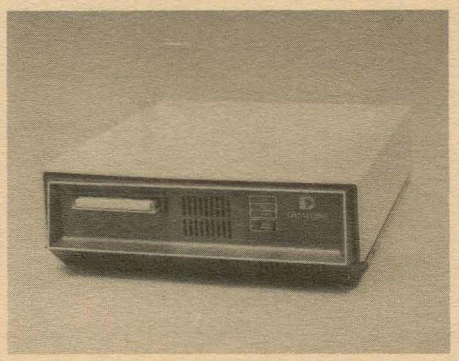
DATAPOINT
Product Specifications

Datapoint 9301

20MB Disk and 20MB Tape Drive



Datapoint 9301 20MB Disk on 20MB Tape Drive

October 1, 1981 Document No. 61173

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1.0 General Description

The Datapoint®9301 20MB Disk and 20MB Tape Drive provides 20 Megabytes of direct access data storage for Datapoint's 8600 series processors. The 9301 consists of a 20MB disk drive, a 20MB cartridge tape drive, an intelligent controller, and a power supply.

The controller interprets all commands, performs the indicated action, places status and user data in the controller buffer, and then informs the processor that the task is complete. The 8600 can access data or status directly through the controller's memory. Designed for operator convenience, the controller can spool the information from disk to tape or tape to disk automatically, without operator or processor intervention. The controller can back-up an entire 20MB disk in less than 15 minutes.

The disk storage unit in the 9301 utilizes a fixed thin-film disk for very high density recording. Data integrity is assured by a powerful error correction code, which not only recognizes hardware errors, but can also correct errors, allowing disk operation to continue undisturbed with no loss of data.

Integrated into the 9301 is an advanced tape drive capable of storing 20 Megabytes of data on a convenient removable tape cartridge. The tape cartridge can be used for system back-up or for transporting data from one system to another. A Datapoint developed self-alignment technique precisely aligns the tape recording head to each tape cartridge, allowing the tape to be interchanged between 9301 units.

Additional storage capability is available through the 9302 and the 9303 drives. The 9302 offers two 20MB disks for an additional 40 Megabytes of on-line storage. The 9303 contains one 20MB disk with space for an additional 20MB disk. Both the 9302 and 9303 are mounted in a desk top cabinet similar to the 9301 cabinet.

The 9304 is a 20MB disk upgrade kit for the 9303 making it an equivalent of the 9302 disk drive. Up to two 9302 equivalents may be connected to the 9301 providing an on-line storage capacity of 100 Megabytes. All information in this specification applies to the 9301, 9302, 9303, and 9304 drives.

Each extension disk drive requires the installation of one logic card in the 9301 controller card cage. When additional disk drives are added to the basic 9301 system, the controller interfaces with each of the drives independently. Because of the compact design of the disk housing, a 100 MB disk system with tape back-up will easily fit on a table top.

2.0 System Requirements

All communication between the 9301 controller and the 8600 processor is via the serial peripheral I/O bus. The peripheral I/O bus can support multiple peripherals. The cable used on the peripheral I/O bus is an eight conductor shielded twisted pair cable. Total cable length must be restricted to 100 feet.

The connectors are 15-pin "D" series with integral strain relief. The connectors on the cable are female at both ends. The last peripheral in the daisy chain will have a terminator that will plug into its next device connector. There are no power connections in the peripheral I/O bus cable, although a logical level power-on slave line is included.

3.0 Technical Description

3.1 Technical Specifications

3.1.1 Disk Capacity (formatted)

Cylinders/Drive	549
Tracks/Cylinder	6
Sectors/Track	24
Bytes/Sector	256
Bytes/Track	6144
Bytes/Drive	20.24 Megabytes
Disk Type	fixed

Continued....

3.1.2 Disk Timing

Bit Transfer Rate	5.802 Mbps
Rotation:	
Average Speed	5520 RPM
Average Delay	5.435 msec
Head Positioning:	
Average	75 msec*
Track to Track	15 msec*
Maximum	100 msec*
Start Time:	20 seconds (maximum)

* Head positioning times do not include settling or controller overhead.

3.1.3 Tape Capacity (formatted)

Recording Density	5208 BPI
Bytes/Record	6144 (nominal spooling)
Records/Track	48
Number of Tracks	9
Bytes/Tape	20.24 MB (minimum)

3.1.4 Tape Timing

Bit Transfer Rate	312.5 Kbits/ seconds
Tape Speed	60 inches/ second

3.2 Disk and Tape Format

3.2.1 Disk Format

The disk format is shown in Figure 3-1. Each data surface contains 549 tracks plus one track for diagnostic use only (cylinder 549). Each surface is divided into 27 sectors. Three sectors are used as spare sectors and twenty-four are available for user data storage. Each sector is divided into two subsectors, a header subsector, and a data subsector. Each header sector provides cylinder, header, sector and spared sector information. Each data sector contains six bytes of preamble, 256 data bytes, six bytes of Error Correction Code (ECC), and four bytes of postamble.

3.2.2 Tape Format

The tape data format is shown in Figure 3-2. Between any group of data records on the tape is an Inter-Record Gap (IRG). The IRG allows time for the tape write head to turn off after a write operation and also allows for data handling overhead.

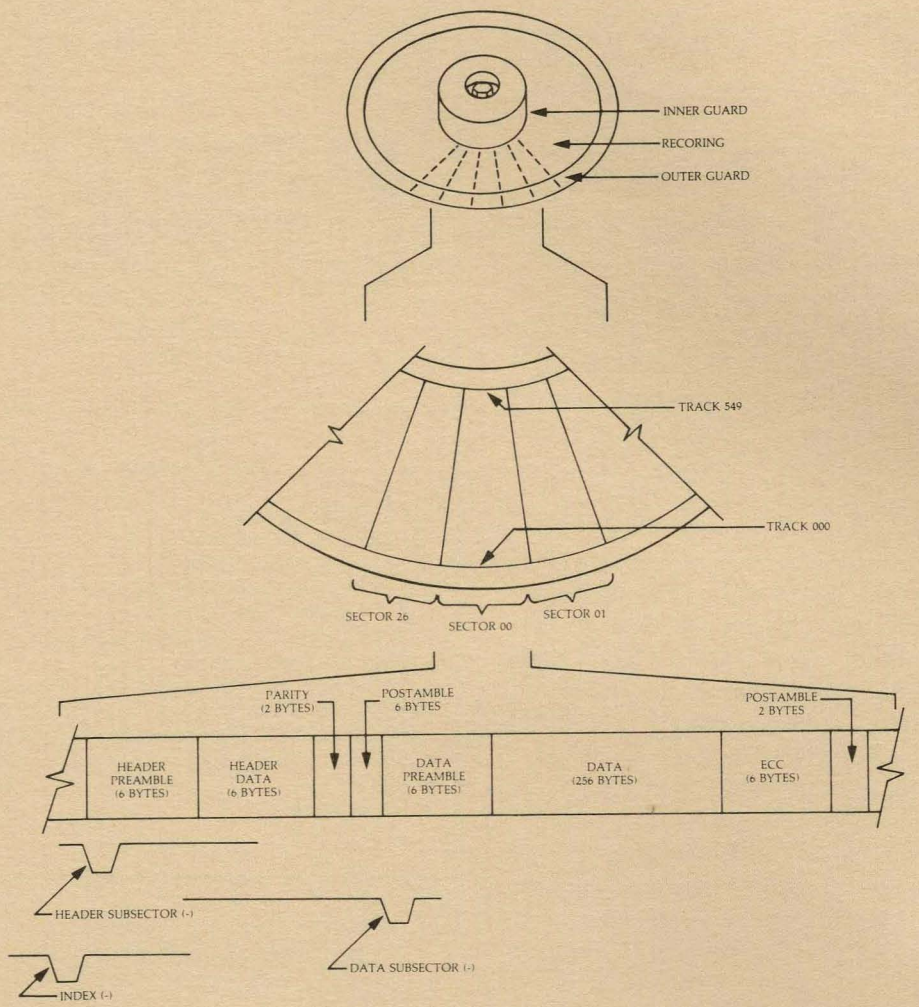


Figure 3-1: Disk Format

A preamble follows the IRG. The preamble is made up of 127 bytes of zeros and one byte of sync code for a total length of 128 bytes. The preamble serves the same function for the tape drive that it does for the disk drive. A phase-locked loop in the read/write electronics must have time to lock on to the frequency of the tape data before actually attempting a read or write. Next on the tape are twenty-four data records, each composed of 256 bytes of data plus the six bytes of ECC. Following the data records is a postamble of 240 bytes.

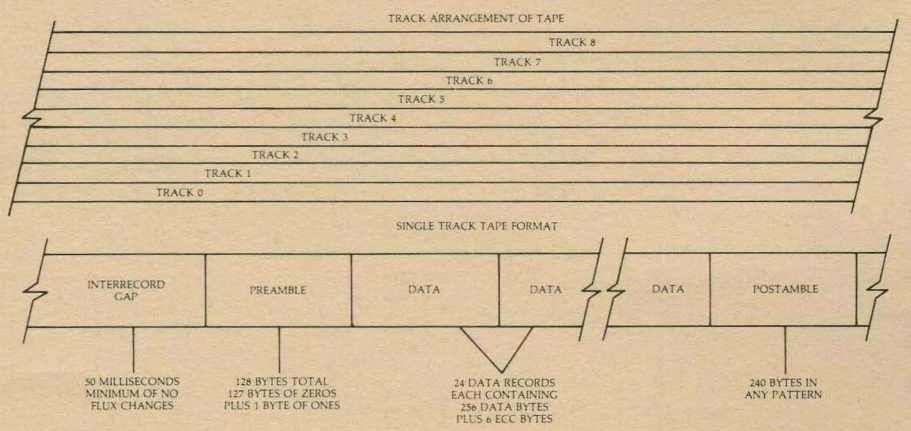
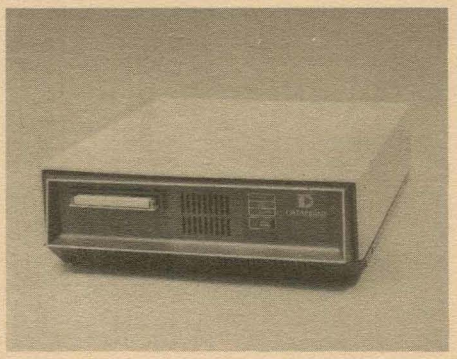


Figure 3-2: Tape Data Format



3.3 Operator Controls and Indicators

The 9301 front panel switches and indicators provide basic operator control of the disk drive with the switches and indicators described in the following subsections. See Figure 3-3 for an illustration of these controls and indicators.

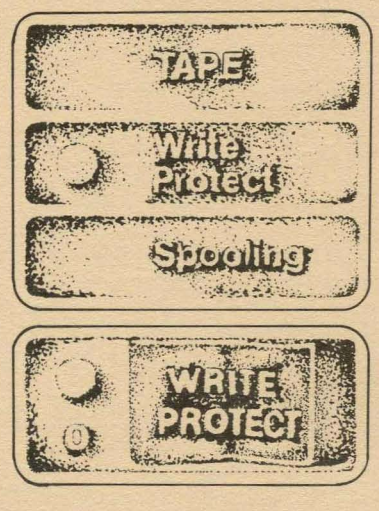


Figure 3-3: Operator Controls and Indicators

3.3.1 Switches

WRITE-PROTECT (DISK)

When the WRITE-PROTECT switch is in the PROTECT position, the controller inhibits all write functions to the disk and the drive becomes a read-only drive. When the WRITE-PROTECT switch is set to the PROTECT position, the write-protect function will not be activated until all data transfer operations in progress have been completed. A total of five switches may be on the front panel of the 9301. One switch is for the main disk drive and the others are for any extension disk drives contained in the system.

WRITE PROTECT ARROW (TAPE)

The WRITE PROTECT ARROW is located on the upper left corner of the tape cartridge and is shown in Figure 3-4. To the right of the arrow, you will see the word 'SAFE'. When the WRITE PROTECT ARROW is pointed toward SAFE, the tape is write protected and no data can be written to the tape cartridge. When the WRITE PROTECT ARROW is pointed away from SAFE, data may be written to the tape. The Tape Cartridge WRITE PROTECT ARROW may be turned with a coin, a screw driver, or your fingernail.

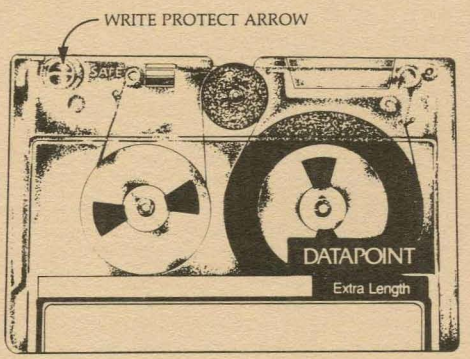


Figure 3-4: TAPE WRITE PROTECT ARROW

POWER

The POWER switch is located on the back panel of each disk cabinet (see Figure 3-5). This switch is a three position switch which allows switching to three different AC power modes:

Set the switch to the LOCAL position if the disk drive is to be powered on manually.

Set the switch to the REMOTE position if the drive is to be powered on or off by the Datapoint processor. (When the switch is set in the REMOTE position on the 9302 and 9303 drives, the 9301 controller turns power on and off to the drives.)

Set the switch to the OFF position if the drive is to powered off manually.

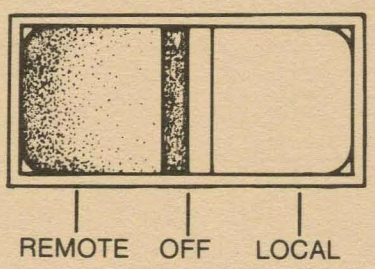


Figure 3-5: POWER switch

3.3.2 Indicators

DRIVE READY

The DRIVE READY indicator will be illuminated when all power on diagnostics have successfully completed and the disk drive is ready for operation. There is one DRIVE READY indicator on the 9301 front panel for each drive in the system.

WRITE-PROTECT (DISK)

The WRITE-PROTECT (DISK) indicator will illuminate when the WRITE-PROTECT switch is in the PROTECT position. When the WRITE-PROTECT indicator is lit, no data may be written on the disk. When you are ready to write to the disk again, press the WRITE-PROTECT (DISK) switch to the WRITE position and the WRITE-PROTECT (DISK) indicator light will go out.

SPOOLING (TAPE)

The SPOOLING (TAPE) indicator will light when spooling or despooling is in progress.

TAPE (WRITE PROTECT)

The TAPE (WRITE PROTECT) indicator will light when the tape cartridge is in the Write Protect mode.

3.3.3 Tape Loading and Unloading

To load the tape cartridge, grasp the cartridge with the logo facing up (see Figure 3-6) and insert it in the tape slot on the left front panel of the 9301. When the tape cartridge snaps into position, tape spooling or despooling operations can begin.

To remove the tape cartridge from the 9301 cabinet, grasp the center of the cartridge with your thumb on top and fingers underneath the cartridge case (see Figure 3-6). Pull the cartridge firmly toward you and out of the drive cabinet. To prevent contamination of the track surfaces, you should place the tape back in its plastic case when the tape is not in use.

Continued....

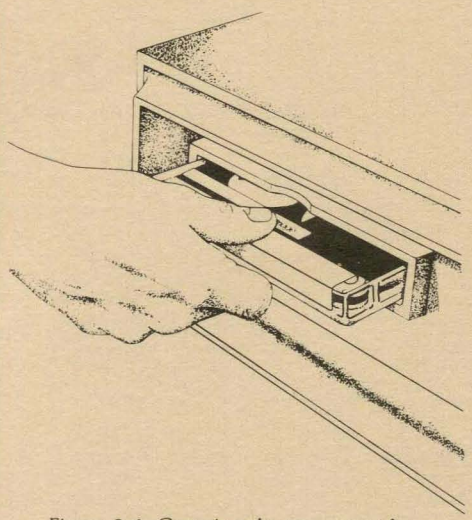


Figure 3-6: Grasping the tape cartridge

3.4 Tape Operations

The cartridge tape drive uses a single-track indexing head to either record or read data from the nine-track tape. The controller automatically precedes and appends preamble and postamble to the user data. The gaps between tape records are inserted by the controller. The host program does not have access to the erase gate which generates inter-record gaps.

During a tape write operation, the erase head is turned on. When the tape is up to speed, the preamble, user data, and postamble are written on the tape. The erase head is then used to generate an Inter-Record (IRG) gap, and the tape is either stopped or an additional write is performed.

During a tape read operation, the tape is brought up to speed. When a gap is detected, the data following the gap is read and transferred to the host processor. Tape motion stops or continues depending on the host's response to data from the controller memory.

3.4.1 Spool/Despool Error Log Format

A second tape file is written to the tape after a disk to tape spool is performed. This file consists of a single 256 byte record containing up to 64 entries defining tracks which could not be read without hardware or software error. The format of the file is as follows:

1st entry - total number of tracks in error (0 through 63)
Byte 0 : error count
Byte 1 : unused
Byte 2 : unused
Byte 3 : unused

2nd though 64th entry
Byte 0 : cylinder number LSB of error
Byte 1 : cylinder number MSB of error
Byte 2 : head number of error
Byte 3 : unused

The host processor can read these entries using a search to file mark and a normal tape record read command.

3.4.2 Tape Commands

3.4.2.1 Spool DIsk to Tape

The Spool Disk to Tape command copies the entire disk to tape. During the spool operation, the entire disk system is unavailable for use. A file mark is written as the last entry on the tape. This operation always starts at the beginning of the tape.

The first tape record consists of two non-spool data sectors. The first sector is a copy of the command string initiating the spool operation. The second sector consists of data supplied by the host processor program. The remaining data is one record per track for all tracks on the disk starting at head 0 of cylinder 0.

The sequence of operations that the host processor should execute when spooling the disk to the tape is described below:

1. Format a 256 byte data block with the historical data you want in the header record of the spool tape.
2. Issue a Spool Disk to Tape command and wait for the controller to set the Ready to Receive Data Interrupt status.
3. Send the 256 byte data block to the controller.
4. Wait for the spool operation to complete.
5. On completion the controller will perform one of the following two operations:

- Set the Command Complete Interrupt status indicating that there were no errors during the operation.
- Set the Data Available Interrupt status indicating that there is one or more entries in the spool log. The host processor should read in the spool log at this time and take the appropriate action.

3.4.2.2 Spool Tape to Disk

The entire tape is copied to the disk starting at sector 0, track 0, of cylinder 0 on the disk. The first tape record is a header record which contains the following information:

- The first 256 bytes (sector) is a copy of the command string (16 bytes followed by 240 bytes of zeros) issued by the host processor which resulted in the spool tape being created.
- The second 256 byte is host supplied data which consists of date, time and whatever information the host program deems necessary.

To copy the tape to the disk (despool), the host processor should perform the following sequence of commands:

1. Rewind the tape.
2. Issue a Read Tape Record of 512 bytes.
3. Verify that this is the tape you want to copy to the disk.
4. Issue a Despool command to copy the tape to the disk.
5. When the Despool command completes, the controller will perform one of the two operations defined below:

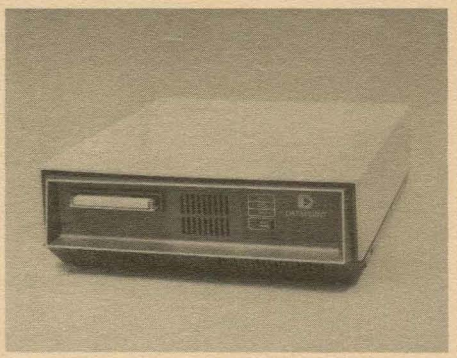
- Set the Command Complete Interrupt status indicating that there were no errors during the operation.
- Set the Data Available Interrupt status indicating that there is one or more entries in the spool log. The host processor should read in the spool log at this time and take the appropriate action.

3.4.2.3 Selective Spool Disk To Tape

The Selective Spool Disk To Tape command copies the number of cylinders starting at the specified cylinder to the tape. The spool operation starts at the current position on the tape. The operation does not start at the beginning of the tape. The operation is terminated with a file mark. The first tape record is identical to the tape record produced when spooling an entire disk.

3.4.2.4 Selective Spool Tape to Disk

The Selective Spool Tape to Disk command reads data from the tape starting at the current tape position. That data is stored on the disk starting in the cylinder specified as the target drive and start cylinder in the command string. The first record on the tape is the same as the first record described in Section 3.4.2.1. The target drive and start cylinder used are the arguments in the command string initiating the operation. They do not have to be identical to the ones specified when the tape was written.



3.4.2.5 Read Tape Record

The Read Tape Record command reads a record from the tape to the host processor's memory. The tape is read from the current tape position.

The tape record consists of a variable amount of user data. However, the record cannot be smaller than 256 bytes and must not be larger than 24 sectors or 6144 bytes in size.

3.4.2.6 Write Tape Record

The Write Tape Record command writes data from the host processor's memory to the tape. The record size restrictions described in Section 3.4.2.5 must be maintained.

3.4.2.7 Write Tape File Mark

The Write Tape File Mark command writes a file mark to the tape at the current tape position.

3.4.2.8 Search For Tape File Mark

The Search For Tape File Mark command searches the tape for a file mark starting at the current tape position. End of track crossings and tape turn-around are transparent to the host processor. The search will continue until either a tape mark is found or the end of the tape on the last tape track is found.

3.4.2.9 Rewind

The Rewind command positions the tape at the beginning of the tape and the tape head over track zero (0).

3.5 Programming Considerations

3.5.1 Peripheral I/O Bus Command Formats

The Peripheral I/O Bus Commands are used by the host processor to control the disk system via the Peripheral I/O bus. These commands must be sent from the host processor with the control bit true. The commands are encoded in the four most significant bits of the command byte. The four least significant bits in the command byte are ignored except for the address compare command, in which case the four least significant bits specify the address.

BITS D7 - D4	I/O COMMANDS
0000	Reset Parity Error
0001	Reset Interrupt Pending
0010	ETX (End of Transmission)
0011	De-Address
0100	I/O Interrupt Status Request
0101	Address Compare
0110	Interface Type Status Request
0111	Undefined
1000	Load DMA Counters
1001	Enable Receive DMA (Host to Transmit)
1010	System Restart
1011	Undefined
1100	Enable Trasmit DMA (Host to Receive)
1101	Undefined
1110	Undefined
1111	Undefined

Peripheral I/O Bus Command Definitions

RESET PARITY ERROR 0000XXXX

Bit 6 of the I/O Interrupt Status byte is cleared.

RESET INTERRUPT PENDING 0001XXXX

Bit 7 of the I/O Interrrupt Status is cleared.

ETX (End of Transmission) 0010XXXX

Disables receive DMA mode. This command is sent by the host processor to the disk to terminate a block of data or status being transfered before the specified number of bytes have been received by the disk.

DE-ADDRESS 0011XXXX

The disk is deselected and will not respond to any commands until it is addressed again.

I/O INTERRUPT STATUS REQUEST
0100XXXX

Bit	Name	Definition
7	Interrupt Pending	This bit will be set to one by the controller when it wishes to interrupt the host processor. It is cleared by the I/O command reset interrupt pending.
6	Bus Parity Error	This bit is set to one when the serial I/O is selected and receives a data command byte with bad parity. All command bytes received with bad parity are ignored. This bit is reset by the reset parity error I/O command.
5	Diagnostic Mode	This bit is set by the controller before executing power on diagnostics. It indicates to the host processor that the disk has been reset and is doing internal checking. When the disk is ready to receive more commands, this bit will be reset. While this bit is set, all memory accesses (DMA enables) by the host to the disk will be inhibited. This bit may also be set by diagnostics executing from RAM.
4	Memory Parity Error	This bit is set to one when a parity error has been detected in the memory.
3	Device Address (MSB)	These four bytes give the logical address of the disk host processor's bus.
2	Device Address	
1	Device Address	
0	Device Address (LSB)	

Continued....

ADDRESS COMPARE 0101AAAA

The disk controller compares "AAAA" with its own device address and if it matches, the disk becomes selected. The disk reponds to becoming selected by transmitting its Interrupt Status byte to the host processor.

LOAD DIRECT MEMORY ACCESS COUNTERS 1000XXXX

The interface "type" status byte is sent to the host processor. The bits of this byte are defined below.

Bit	Name	Description
7	Diag Cnt Bit 2	The diagnostic count bits are a counter that is initialized to zero upon power up or a system reset. The counter is advanced by the controller upon completion of steps in its power on initialization routines and/or its internal diagnostics. If any of these functions fail, this counter will indicate the failure point and aid in repair. When the controller is ready, the count will be 7.
6	Diag Cnt Bit 1	
5	Diag Cnt Bit 0	
4	Intrf Type Bit 4	This five bit code defines the type of interface implemented in the system. This code is hardwired with jumpers on the I/O interface boards. The system interface type code is 00001.
3	Intrf Type Bit 3	
2	Intrf Type Bit 2	
1	Intrf Type Bit 1	
0	Intrf Type Bit 0	

LOAD DIRECT MEMBER ACCESS COUNTERS 1000XXXX

This command prepares the disk to receive from the host four bytes of data that will be loaded into the 9301 hardware registers. This command must be followed by these data bytes in this order:

DMA Address LSB
DMA Address MSB
DMA Byte Count LSB
DMA Byte Count MSB

Every transmit of a DMA receive command must be preceded by the load DMA counter command. The DMA address bytes refer to address space in the controller buffer memory. The byte count refers to the number of bytes the host processor wishes to transfer in or out of the controller buffer memory.

ENABLE RECEIVE DMA (Host to 1001XXXX XMT)

This command precedes a block of data that is received from the host processor and put into the 9301 memory starting at the address specified by a load DMA counter command. The 9301 will stay in the DMA receive mode until the specified number of bytes have been received or terminated by an ETX command.

SYSTEM RESTART 1010XXXX

This command forces the controller to its nonmaskable Interrupt program location. The processor will eventually cause a hardware reset.

ENABLE TRANSMIT DMA (Host to 1100XXXXX RCV)

This command transmits the specified number of data bytes starting from the address in the controller buffer memory. The byte count and starting address must be previously specified by a load DMA counter command.

3.5.2 Buffer Memory Configuration

The host processor requests data transfers by specifying unique addresses in the buffer memory where data of interest is located. The buffer memory has fixed address assignments. The first 1024 bytes in the buffer memory are protected from host processor access and contain information used only by the 9301 controller.

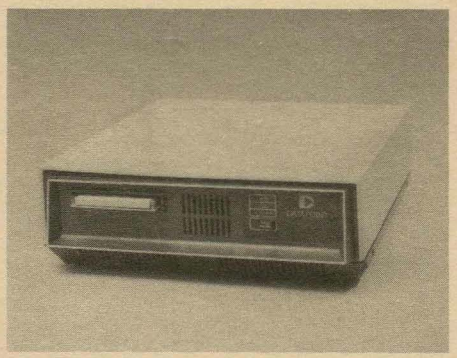
A maximum of eight control blocks in the buffer memory may be active at any one time. These control blocks are numbered 0 through 7. The Control Block, Interrupt Status Block, Data Interrupt Acknowlege Block, and Buffer Memory Address Block each contain information for all control blocks. The information for a particular control block is accessed by reading with an offset into the block equal to the number of the control block (0-7) times the number of bytes of information. The number of bytes for each block is summarized below.

Control Block	16 Bytes
Interrupt Status Block	1 byte
Data/Interrupt Acknowledge	1 byte
Buffer Memory Address	2 bytes

The contents of the 1024 bytes of protected memory is listed below. See Figure 3-7 for a map of the controller memory.

The contents of the buffer memory accessible by the host processor is shown below.

ADDRESS		CONTENT
Octal	Hex	
102,000	8400	16 bytes of Device Status. These bytes contain the current operational status of each individual device in the 9301 system.
102,020	8410	8 bytes of Control Block Interrupt Status, one byte per Control Block. Each byte is bit position encoded to indicate reason for interrupting the processor such as operation complete, data input required, data input ready, or device error.
102,030	8418	128 bytes of Control Block Buffer, 16 bytes per Control Block. Eight Control Blocks maximum.
102,230	8498	16 bytes of Buffer Memory Addresses, 2 bytes per command string. Tells the host where data that is to be read from or written to the disk in the data buffer area.
102,250	84A8	8 bytes of Data/Interrupt Acknowlege, 1 byte per Control Block. The host processor indicates that either data or interrupt have been either received or transmitted to or from the buffer memory for a control block.



102,260	84B0	32 bytes of operational statistics
102,300	84D0	Power on Reset flag. Set non-zero whenever a Power on Reset sequence is executed. Cleared by the processor.

3.5.3 Controller Operation

There are two basic modes of controller operation: the Interrupt mode and the Poll mode. If the interrupt mode is selected and data is needed from or available for the host processor, or the command is complete, the Interrupt pending bit in the I/O Interrupt Status byte is set and the interrupt is generated. In the poll mode, the host processor must constantly read the Interrupt Status block to determine whether any action should be taken.

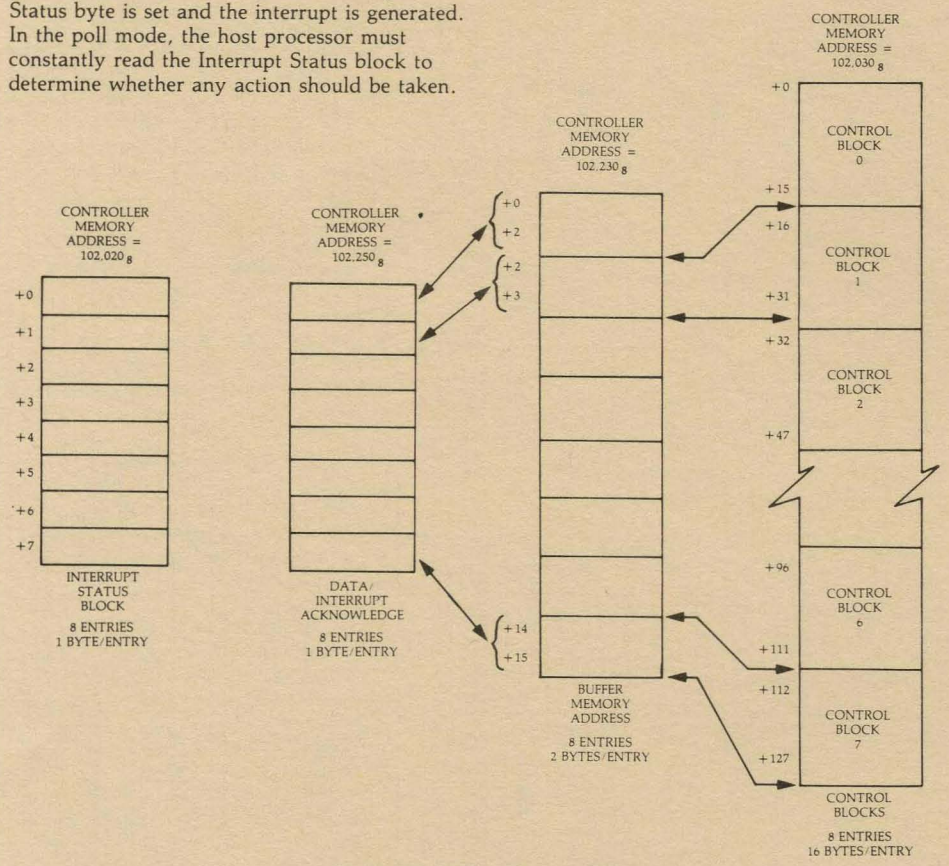


Figure 3-7 Buffer Memory Map

Controller operations are started by writing a control block into the controller memory. The control block contains the following information:

- Command type (read, write, spool) and device type (disk, tape)
- Device number
- Disk location on disk commands
- Amount of data to be transferred

3.5.3.1 Control Block Write Operation

To write a control block into the controller memory, the following steps must be taken:

1) An I/O address command must be issued to the controller. The I/O interrupt status byte is returned immediately to the host processor.
2) The Acknowledge block is read. Each byte containing zero indicates that the corresponding control block is free.
3) The Control Block is sent to the controller via a DMA operation.
4) The host processor reads the I/O Interrupt Status byte to determine if a parity error has occurred.
5) If no parity errors occurred, another control block may be sent, or the device may be de-addressed.

3.5.3.2 Control Block Execution Operation

The same protocol for the control block execution is used whether in the interrupt or poll mode. Below are listed the steps in control block execution.

1) An I/O Address command must be issued to the controller. The I/O Interrupt Status is returned immediately and bit 7 (Interrupt Pending) is set if the controller interrupted.
2) The Control Block Interrupt Status is read via a DMA operation to determine which command string was being used and for what reason the interrupt occurred.
3) If no errors have occurred, there are four reasons for an interrupt. Either data is needed, data is available, the operation is complete, or a sequence error has occurred.

- Data is needed.
  The host processor reads an octal 04 in the Interrupt Status block. Next, the host reads the starting memory address in the controller memory from the Buffer Memory Address block. The host processor then receives the data via a DMA operation and sends an octal 04 to the Acknowlege block.
- Data is available.
  The host processor reads an octal 02 in the Interrupt Status block. Next, the host reads the starting memory address from the Buffer Memory Address block. The host processor then receives the data via a DMA operation and sends an octal 02 to the Acknowlege block.
- The command operation is complete.
  The host processor reads an octal 01 in the Interrupt Status block and then sends an octal 01 to the Acknowlege block.
- A sequence error has occurred.
  If the sequence of handshake bytes is incorrect, the host processor reads an octal 010 in the Interrupt Status block to indicate a sequence error.

Continued....

4) If the command completes normally, bits 7 and 6 of byte 06 of the control block will both be zero. If the command completes and an error has occurred, bits 7 and 6 of byte 06 of the control block will be 0 and 1, respectively. All error information will be contained in bytes 07 through 15.

5) The controller is de-addressed.

3.5.3.3 Control Block Format

The host processor starts an operation by putting a control block in the controller buffer memory. The controller performs the operation as internal resources are available to respond to the request. The format of the control block is shown below:

BYTE NO.	MEANING
00	Drive Address (0-N)
01	Cylinder Number LSB
02	Cylinder Number MSB
03	Head Address (0-N)
04	Starting Sector Number (0-N)
05	Number of Sectors to Transfer (1-24)
06	Command and flag bits

The first seven (7) bytes of the sixteen (16) byte control block are all that the Host need set up. The remaining nine (9) contain information for the host processsor.

07	Disk Drive Status
08	Disk Drive Error Code
09	Cylinder No. of Error (LSB)
10	Cylinder No. of Error (MSB)
11	Head Number of Error
12	Sector Number of Error
13	Tape Drive Status
14	Tape Error Code
15	Control Block Error Code

3.5.3.4 Control Block Definition

The drive address is the drive number, 0 through 4, on which the operation is to be performed. The double precision cylinder number can be any value in the range 0 through 548. Cylinder 549 is reserved for diagnostic use by the controller.

The head address is the surface which is to be accessed. The head can be any value from 0 through 5. Each track consists of 24 sectors of 256 usable bytes each. The starting sector number (0 - 23) indicates where the operation is to start.

The number of sectors indicates how much data is to be transferred. The host processor can request from 1 to a maximum of 24 sectors of data. A value of either zero or greater than 24 is invalid and the operation is not performed.

The sixth byte of the control block contains two flag bits which must be set to a one when the control block is sent to the controller memory by the host processor. The remaining bits of the first byte contain a numeric command value. The command values and resulting operations are listed below:

0 Illegal

1 Reset - Terminate any or all operations. Clears error flags and restarts the firmware program.

2 Read Header - The sector header is read from the disk. This command implies a seek be performed, but will not cross track boundaries. Only a single header sector at a time can be read.

3 Write Header - The sector header is written to the disk. This command implies a seek be performed but will not cross sector boundaries. Only a single header sector at a time can be written.

4 Read Data - The data from a sector on the disk is transferred to the host memory. This command implies a seek be performed. The disk operation can cross track and cylinder boundaries on multiple sector operations.

5 Write Data - The data from the host memory is transferred to the disk address specified in the command string. Multiple sector transfers can cross track and cylinder boundaries.

6 Write/Verify - Identical to the write command with a read performed without any data transfer. The ECC is verified on the read.

7 Seek - A seek to the specified cylinder is performed.

8 Spool Disk to Tape - The entire disk is copied to the tape. During the spool operation, the entire system is unavailable for use. A file mark is written as the last entry on the tape. This operation always starts at BOT.

9 Spool Tape to Disk - The number of cylinders starting at the specified cylinder are copied to tape. The spool operation starts at the current position on the tape. It is not positioned at the BOT and it is terminated with a file mark.

10 Selective Spool Disk to Tape - The number of cylinders starting at the specified cylinder are copied to tape. The spool operation starts at the current position on tape. It is not positioned at BOT. It is terminated with a file mark.

11 Selective Spool Tape tc Disk - Data is read from tape starting at the current tape position and stored on the disk starting at the specified cylinder.

12 Rewind - The tape is positioned at the beginning of tape (BOT) and the head is positioned over track 0.

13 Read Tape Record - A record is read from tape to the host memory. Tape is read from current tape position.

14 Write Tape Record - Data from memory is written to the tape.

15 Write Tape File Mark - A file mark is written to the tape at the current tape position.

16 Search for Tape File Mark - The tape is searched for a file mark from the current tape position. End of track crossings and tape turn around are taken care of. The search will continue until either a tape mark or end of tape on the last tape track is found.

17 ROM Resident Firmware Diagnostics - An internal diagnostic test is performed. The test checks the RAM and ROM.

18 Loop Tape Write to Read - The tape write is looped back through the read after write for diagnostic testing purposes.

19 Execute Host Based Diagnostics - A program is executed out of RAM at the starting address specified in the command string. This provides a means of performing extensive controller firmware diagnostics.

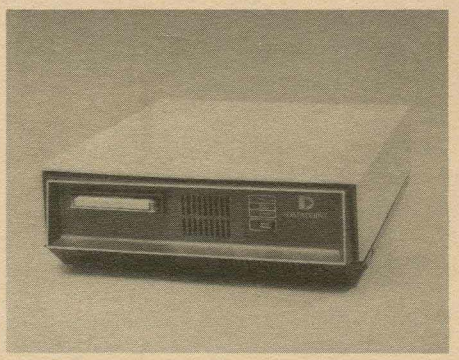
20 Controller Firmware Lockup - The controller will stop the control block scan until an I/O system restart is issued.

21 Diagnostic Program Mode - This command is used to enable or disable interrupts. The non-interrupt mode requires that the host poll for detecting command completion, data transfer requests, etc.

22 Interrupt Mode Select - This command is used to enable or disable interrupts. The non-interrupt mode requires that the host poll for detecting command completion, data transfer requests, etc.

23 Long Read - The data plus ECC is read from the disk to the controller buffer memory. This command is used for diagnostic checking of the ECC logic.

24 Long Write - The 256 bytes of data plus 6 bytes of ECC are written from buffer memory to disk. The normal ECC generation logic is not used. This command is used for diagnostic checking of the ECC logic.



When the operation has been completed the remaining nine bytes will contain status information if an error has occurred. The content of each byte is given below.

Byte 07 - The format of the drive status byte is shown below.

BIT	MEANING
7	Soft (correctable) error
6	Spare. Returns a zero.
5	CAP - Cable and Power 0 = OK (cable is connected to drive; power is applied).
4	Drive Write Protected
3	Inner Guard Band
2	Outer Guard Band
1	Off Track Error
0	Drive Fault

Byte 08 - The contents of the disk drive error code byte is described in Figure 3-9.

Byte 09, 10, 11, 12 - These four bytes contain the physical location on the disk drive where the error occurred.

Byte 13 - The tape drive status byte is set on tape or spooling operations. The format of the byte is shown below:

BIT	MEANING
7	Soft-(correctable) Error
6	ECC Error
5	End of File
4	Tape Drive Fault
3	End of Tape
2	Beginning of Tape
1	Write Protected
0	Tape Off-Line or Cartridge Not in Place

Byte 14 - The content of the tape drive error code byte is described in Figure 3-8.

Byte 15 - Control block error code

Octal Code	Description
0341	A write command was issued to a write protected drive.
0342	Error in spooling arguments. Last cylinder was less than the first cylinder.
0343	File mark search and the end of tape has been reached.
0344	Uncorrectable ECC error on a tape read.
0345	ECC error detected on a tape read-after-write. After five write retries, a write operation cannot be performed.
0346	Cartridge not in place.
0347	Tape motion problems.
0350	Tape did not start at all - no tachometer signal.
0351	Tape started but is running too slow.
0352	No ECC data detected.
0353	ECC data detected signal was true too long.
0354	Data drop out detected.
0355	Short read - record shorter than the number of blocks required.
0356	Not a load point for a spool/despool.
0357	Error in reading/writing label for spool/despool.
0360	Error in tape positioning during spool/despool.
0361	Error in head stepping prior to spooling.
0362	Error in head stepping during despool
0363	Record sequence error during despool.
0364	Tape write/read signal loss.
0365	Cannot write/read in reverse position.
0366	Tape hole sequence wrong.
0367	Tape motion over speed.
0370	Unable to write reference track.
0371	Too many soft write errors (tape defects) during the spool operation.

Figure 3-8: Tape Drive Related Error Codes

Octal Code	Description
02	Disk drive not ready - CAP.
03	Drive fault detected.
04	Seek error occurred.
05	Read error detected by ECC logic.
06	Spool command issued with other active command strings.
07	Error time out - no data output from the host processor for the start of a spool operation.
010	Unable to get out of guard band.
012	Software time out occurred while disk drive was performing a seek.
013	Sector parity error was detected.
015	Sector N-1 was not found from the hardware sector counter after one rotation.
016	Sector N was not found from the hardware sector counter after one rotation.
017	Write command issued on a write protected drive.
020	Error timeout waiting for off cylinder status after starting a seek.
021	Did not find index in disk firmware.
022	Did not receive outer guard band status in firmware dianostics.
023	Did not receive inner guard band status in firmware diagnostics.
024	Cannot get out of a guard band.
025	Write fault detected - unrecoverable error.
026	Off track error detected.
031	Software time out occurred while waiting for a header read to start.
032	Cannot read headers without a software CRC error.
034	Disk operation crosses over disk boundary.
035	Read/Write active bit in Read/Write status.
036	Spool log full (more than 64 bad tracks) - use selective spool.

Figure 3-9: Disk Drive Related Error Codes

Octal Code	Description
0300	Invalid command value in command status.
0301	Invalid disk drive address in command string.
0302	Invalid cylinder address in command string.
0303	Invalid head address in command string.
0304	Invalid sector address in command string.
0305	Number of sectors to be transferred exceeds 24 or is zero.
0306	Invalid number of cylinders in spooling/despooling command.
0310	Command string terminated due to device error.
0312	Firmware error.
0377	One or more entries in the spool/despool log.

Figure 3-10: Firmware Related Error Codes

3.5.3.5 Control Block Format Exceptions

The control block format varies from that shown above for some commands. The commands which deviate from the normal format are discussed below.

BIT	MEANING
1	Reset- No arguments other than the command byte are required.

Continued....

8,9 Spool Commands - Only the command byte and drive address are relevant.

10,11 Selective Spool Commands - The starting sector number and the number of sector bytes are used for a count of the number of cylinders to either spool or despool.

12-16 Tape Commands - The command byte is required and byte six (the number of sectors) is required for commands 13 and 14.

17,18 The command byte is the only argument required. The content of other provided arguments is irrelevant.

19 Execute RAM Firmware - The drive address and cylinder number LSB bytes contain a RAM address at which program execution is to start.

20 Controller Firmware Lockup - No argument other than the command byte are required.

21 Diagnostic Program Mode - To enable access to cylinder 549 byte 00 of the Control Block should contain a 01. To disable access to cylinder 549, byte 00 should be 00. No other arguments are required.

22 Interrupt Mode Select - If byte 00 of the Control BLock is 00, the Interrupt mode is selected. If byte 00 is 01, then the Poll mode is selected.

3.5.4 Interrupt Status and Data/Interrupt Acknowledge

During the execution of a Control Block certain protocol has been established for the transfer of data and communication. Two eight byte areas (one byte per Control Block) in the buffer memory have been set aside for this purpose. The Interrupt Status Block is written to only by the controller, and conveys the current state of the Control Block. The Data/Interrupt Acknowlege Block is written to by the host processor. This block tells the controller that any action needed to be taken has been done. The controller clears the Data/Interrupt Acknowlege bytes as it detects them, so the host processor should only update a byte if it is zero. The bit definition is shown below.

BIT	MEANING
7	Spare
6	Spare
5	Spare
4	Spare
3	Sequence Error
2	Data Output Ready (to controller)
1	Data Input Ready (to processor)
0	Command Complete

4.0 Physical Description

Figure 4-1 shows the dimensions of the 9301 20MB Disk and 20MB Tape Drive, which weighs approximately 75 pounds (34.02 kg).

Height	7.5 inches (19.05 cm)
Width	21.88 inches (55.56 cm)
Depth	24.0 inches (60.96 cm)

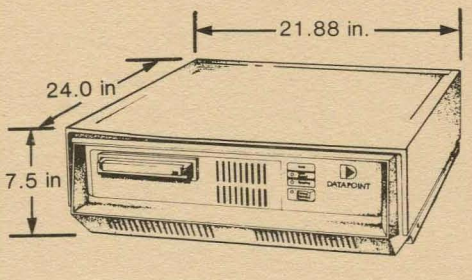


Figure 3-7: Buffer Memory Map

5.0 Environmental Requirements

Temperature:	50 to 100 degrees F 10 to 38 degrees C
Humidity:	20 to 80% relative, non-condensing
Heat Dissipation:	1023.9 BTU

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

6.0 Interface Requirements

6.1 Serial I/O Connector Pin Assignment

PIN	SIGNAL	FORMAT	SOURCE
1	Data Out (+)	pulse	host processor
2	DC Ground	-----	-----
3	Data In (+)	pulse	9301
4	DC Ground	-----	-----
5	Interrupt(-)	level	9301
6	DC Ground	-----	-----
7	Spare	-----	-----
8	No Connection	pulse	host processor
9	Data Out (-)	pulse	host processor
10	No Connection	-----	-----
11	Data In (-)	pulse	9301
12	No Connection	-----	-----
13	Power On Ind (+)	level	host processor
14	No Connection	-----	-----
15	No Connection	-----	-----

6.2 Primary Power

The 9301 Disk and Tape Drive, as supplied from Datapoint, is designed to operate at 115 VAC (+10/-30 VAC), 60 Hz (+/- 3 Hz) or 230 VAC (+/- 10 VAC), 50 Hz (+/- 3 Hz).

Power consumption is 300 Watts (maximum).

Current in amps @ 115 VAC: 3.0 Amps
Current in amps @ 230 VAC: 1.5 Amps

7.0 Options

7.1 Model Options

9301	One 20MB disk and one 20MB tape cartridge in diskette cabinet.
9302	Two 20MB disks in diskette cabinet.
9303	One 20MB disk in cabinet with space for another disk.
9304	One 20MB disk field upgrade kit for 9303 cabinet.

8.0 Shipping List

Quantity	Item
1	9301 20MB Disk and 20MB Tape Cartridge
1	9301 Product Specification
1	I/O Cable

Note: This shipping list is provided for information purposes only and may be amended from time to time by Datapoint Corporation.

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DATAPOINT

Datapoint recommends that its customers use Datapoint Customer Supplies. These disks, diskettes, cassettes, tape cartridges and ribbons are certified by Datapoint to meet all Datapoint hardware specifications for consistent optimum performance. Reference Document No. 80000, the Customer Supplies Catalog, for ordering information.