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IBM

General Information Manual

IBM 1301 Disk Storage with

IBM 7000 Series Data Processing Systems



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Preface

This manual is intended to provide general introductory information on the use of the IBM 1301 Disk Storage with IBM 7000 series Data Processing Systems. Since the 7000 systems include both the fixed word length systems (7070, 7074, 7090) and a variable word length system (7080), minor variations occur in the addressing schemes, track capacity, core storage layout, and data transmission. This manual does not attempt to give specific details for these areas; the variations are described in a separate IBM 1301 Disk Storage bulletin for each system. Information common to 7000 systems in the operation of the 1301 Disk Storage and the 7631 File Control has been included in the Operations section of this manual. It is assumed that the reader has a practical working knowledge of one of the major IBM data processing systems.

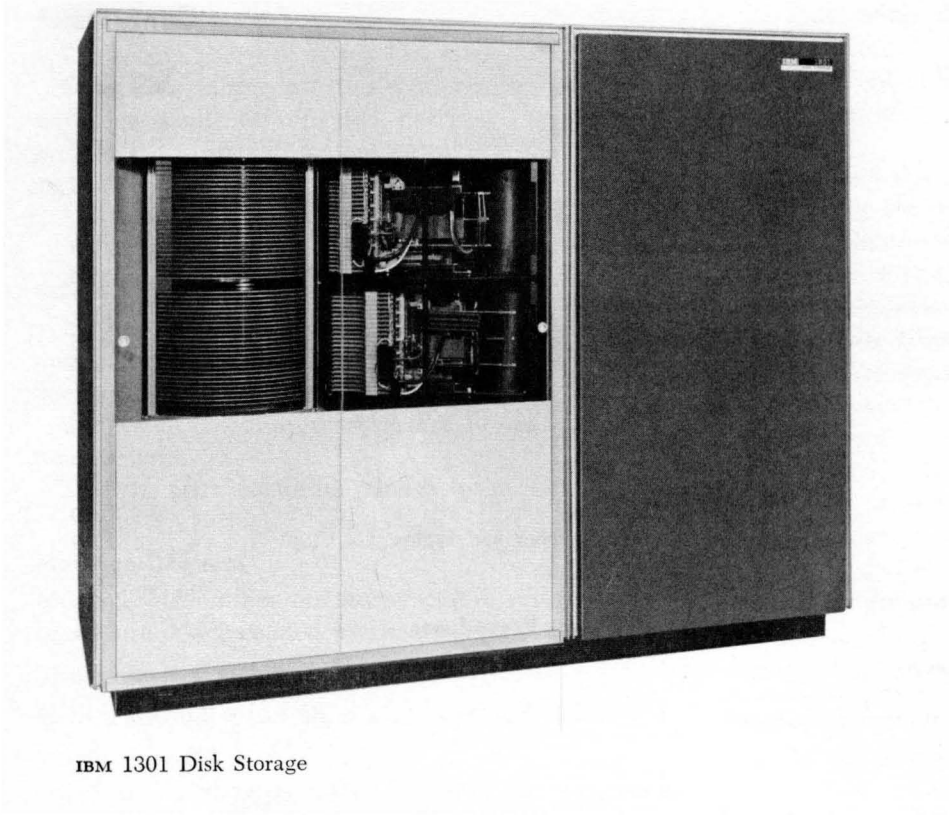
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IBM 1301 Disk Storage

High-speed magnetic disk storage provides large external storage capacity to supplement internal core storage of a computer system. The IBM 1301 Disk Storage and its associated IBM 7631 File Control provide very large storage capacity, fast access time to data recorded on the disks, and the ability to handle fixed or variable length records.

Significant advantages are:

1. Lower cost per character of storage.
2. Entire program libraries contained in readily accessible form.
3. Access to any program or active file in 50-180 milliseconds.
4. Table storage.
5. Simplification of program scheduling.
6. Ability to dump and recover files into or from core storage rapidly.
7. Customer control of addressing schemes and record length format.
8. Improved checking techniques – more reliable data recording.

The 1301 Disk Storage and the 7631 File Control are available for use with the IBM 7070, 7074, 7080, 7090, and 1410 Data Processing Systems.

The 1301 Disk Storage is available in two models:

Model 1 – single module, providing capacity for 28,000,000 (7080) characters—or, using packed format, 43,300,000 digits.

Model 2 – two modules, providing capacity for 56,000,000 (7080) characters – or, using packed format, 86,600,000 digits.

The 7631 File Control is available in four models:

Model 1 – for use with a 1410 system

Model 2 – for use with a 7000 system (7070, 7074, 7080, 7090)

Model 3 – for shared use with a 7000 system and a 1410 system

Model 4 – for shared use with two 7000 systems

Magnetic Disk Recording

The magnetic disk is a thin metal disk coated on both sides with magnetic recording material. Twenty-five disks are mounted on a vertical shaft; they are slightly separated from each other to provide space for the movement of read-write assemblies. The shaft revolves, spinning the disks at a maximum of 1790 revolutions per minute.

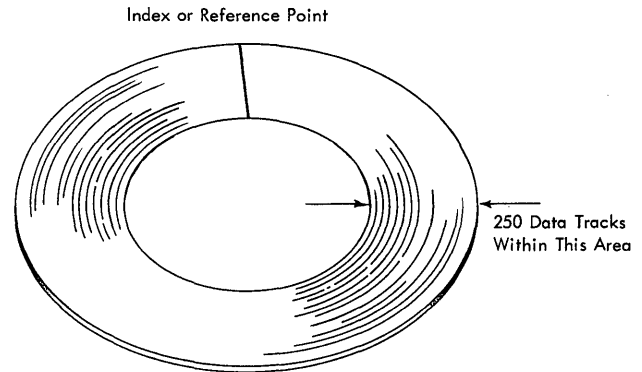


Figure 1. Magnetically Coated Disk

Data are stored as magnetized spots in concentric tracks on each surface of the disk (Figure 1). There are 250 tracks for the storing of data on each surface. The tracks are accessible for reading and writing by positioning the read-write heads between the spinning disks.

The read-write heads are mounted on an access mechanism which has 24 arms, arranged like teeth on a comb (Figure 2), that move horizontally between the disks. (No vertical motion is involved.) Two read-write heads are mounted on each arm. One of the heads services the bottom surface of the upper disk while the other head services the top surface of the lower disk.

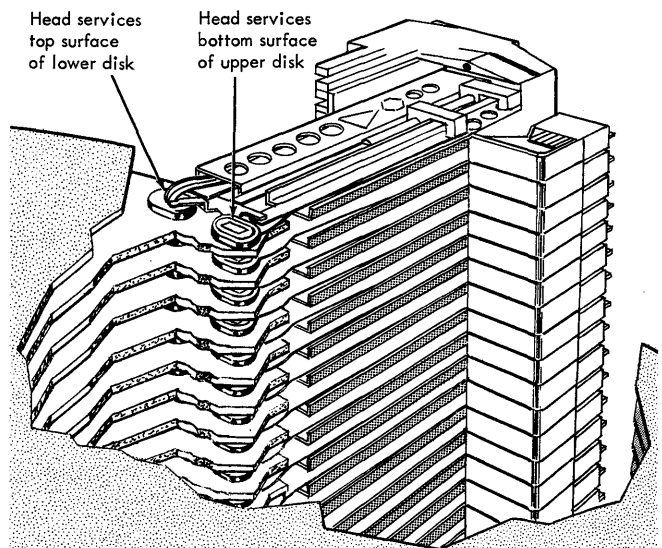


Figure 2. Head Arrangement

The magnetic disk data surface can be used repetitively. Each time new information is stored on a track, the old is erased as the new information is recorded. The recorded data may be read as often as desired; data remain recorded in the tracks of a disk until written over.

Disk storage, like trays of cards or magnetic tape, provides external storage capacity to supplement internal core storage of a computer. Disk storage has a major advantage, however, in that all records contained in the 1301 are program-addressable, providing random access to any record or group of records (that is, faster access to any record).

Although the total number of character positions of the track is fixed, the arrangement as to the number of records and the number of characters per record can be arranged to suit the needs of the using system. Thus, data can be stored on the track in any convenient arrangement within the limitations of track requirements. Addresses must be provided to identify the track and the individual records to the computer; also, space must be provided in the form of gaps to separate address and record areas, as well as the areas for the records.

A format track is used to provide a means of defining and monitoring the address, record, and gap areas for the data tracks. In the 1301, one format track monitors 40 associated data tracks. The format track can be written and rewritten to describe the desired data track format as often as required to suit the needs of the user.

A disk storage module is comprised of the stack of 25 magnetic disks and its associated access mechanism. Of the 25 disks, 20 disks (40 surfaces) are used to store data; of the other ten surfaces, six are used as alternate surfaces, one is a format surface, one is a clock surface (Figure 3). The other two are not used. The data storage surfaces and the format surface each contain 250 concentric tracks that are accessible for reading and writing.

Cylinder Concept

Since the heads and disk tracks are mechanically aligned one above the other, the vertical alignment of the tracks can be considered as a cylinder of tracks (Figure 4). Thus, with the access mechanism placed in any one of the 250 cylinders, 40 tracks of data are available without any further access motion; only electronic head switching is necessary. For example, for one access mechanism setting, as many as 112,000 characters (7080) are available.

The tracks are numbered sequentially, from the bottom to the top of the cylinder (corresponding to the

DISK	SURFACE	MODULE 0	MODULE 1
24	40	Not Used	Not Used
	39		
23	38		
	37		
22	36		
	35		
21	34		
	33		
20	32		
	31		
10	30		
6-19		2-29	
5	1		
4	0	Alternate	Alternate
	1		
3	2		
	3		
2	4		
	5		
1	6	Alternate Format	Alternate Format
	-		
0	-	Spare Clock	Spare Not Used
	-		

Figure 3. Disk Surfaces

40 heads, 00 to 39), starting at the outermost cylinder (000) to the innermost cylinder (249). Thus with large storage areas for reference tables, the data can be conveniently stored in a cylinder of tracks or in a number of adjacent cylinders. This technique will reduce access time to a minimum.

The cylinder arrangement of tracks also permits the optional feature, *the cylinder mode of operation*, to read or write a cylinder, (or part of a cylinder) of tracks in one operation.

Data Tracks

The basic fixed recording area of the 1301 is the data track. The physical make-up of the track limits the track to a specific overall recording capacity. All data tracks are equal in overall storage capacity. The entire recording area cannot be used to store data, however; a number of character positions must be set aside to provide a means of identifying the track to the using system, or a home address (HA). To provide random

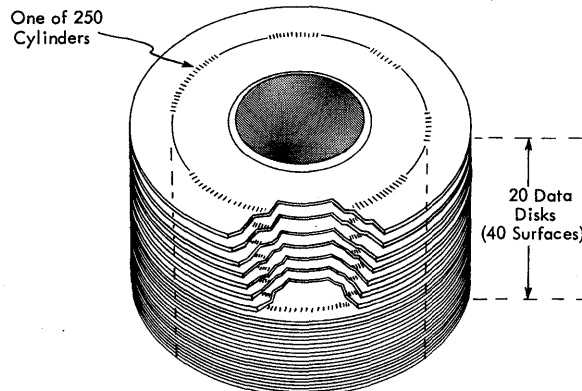


Figure 4. Cylinder Concept

access to any record on the track, additional character positions must be used for each record on the track, or a record address (RA). Additional character positions are required for gaps (G) to separate addresses and records. Since the tracks are circular, an index point (I) must be used to indicate the beginning or the end of the track. Therefore, each of the 10,000 data tracks must have an index point, one home address, a record address for each record stored on the track, and the necessary gaps to separate the address and the records (Figure 5).

INDEX POINT

The index point of the track is the reference point of the track, that is, it indicates both the beginning and the end of the track. The index point is used by the file control in conjunction with its various modes of operation.

HOME ADDRESS (HA)

There is one home address for each of the 10,000 tracks. The home address follows the index point and consists of two parts called home address one (HA1) and home address two (HA2).

HA1: This portion of the home address is the track number. HA1 is prerecorded; *it cannot be written by the customer*. The track number is a four-digit number (0000-9999) indicating the physical location of the track within the module. The tracks are numbered sequentially, beginning at the lowest track of the outermost cylinder, track number 0000, and continuing up through the cylinder to track number 0039, representing the 40 data tracks of the outermost cylinder. The numbers continue with the lowest track of the adjacent cylinder, track number 0040, up the cylinder to track number 0079. Continuing through each of the cylinders in a like manner, the last track number, 9999, is the top track of the innermost cylinder. With this method of numbering, adjacent tracks on the same disk always differ by 40. This provides a means of determining the track number for any track within any cylinder by the simple formula: Given the head number and the cylinder number, the track number is the product of the cylinder number and 40, plus the head number. For example, for cylinder number 241 and head number 20 the track number is:

$$241 \times 40 = 9640; 9640 + 20 = 9660.$$

Also, with the track number known, the cylinder number and head number can be determined by dividing the track number by 40; the quotient is the cylinder number; the remainder is the head number. For example, given the track number, 0590,

$$0590 \div 40 = 014 \text{ with a remainder of } 30.$$

Thus, the cylinder number is 014 and the head number is 30.

HA2: The second portion of the home address is called the home address identifier. This portion of the address further identifies the track to the using system. HA2 is written by the user and consists of two or more characters that can be numeric, alphabetic, or special characters, depending upon the requirements of the using system. Two characters are required for HA2; even though only two characters are compared during address verification operations, additional characters can be used as a convenience for fixed word length systems.

HA2 can be written to serve any convenient purpose. It can be used as a coded file protect device or it can be used to identify or tag a category of records, such as receipts, withdrawals, payments, inventory, etc.

HA1 and HA2 can be treated as one six-position address that corresponds to a six-position key of record, part number, policy number, account number, etc.

RECORD ADDRESS

The record address consists of six or more characters that can be numeric, alphabetic, or special characters. It is used to identify the individual record on the track to the using system. A record address is assigned and written by the user to fit any convenient addressing scheme; it need not have any relationship to the home address of the track where it is written, since an address is transmitted to the file control for each functional order. The home address, used for seek orders, and the record address, used in the prepare to verify (single record) order, need not be related in any way.

The record address normally consists of six characters and even though the first four (high-order positions) can be alphabetic or special characters with the 7080 and 7090, only the numeric bit positions of these characters are compared during address verification operations. All bits of the fifth and sixth characters are compared during address verification. The

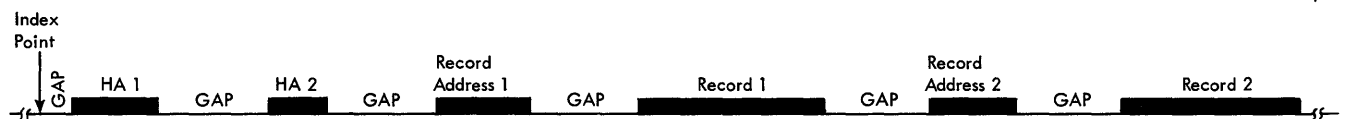


Figure 5. Track Layout

7070 and 7074 use ten digits for record addresses, but only the first six digits (high order) are verified.

GAP

To distinguish between addresses and records, gaps are written between address and record areas. The gaps contain check characters and internal synchronization information required for proper machine operation.

Data are read and written on a track in 6-bit or 8-bit characters or "bytes" serially by bit and serially by character. The 8-bit mode permits the use of packed format feature (packing two 4-bit digits into one 8-bit character) on the 1301 by any system using that feature. Data characteristics of disk storage are shown in Figure 6.

Since there are 250 tracks on each of the 40 disk storage surfaces in a module, 10,000 addressable data tracks are available in each module.

Format Track

Before the disk module can be used for reading or writing, certain preparative activities are necessary. These activities can be likened to the wiring of a control panel for unit record machines or to the house-keeping preparations for a program. Preparations involve writing a format track (by means of a command or instruction) for each cylinder of the module. The format track permits the user to designate, within certain limits, how the storage space of the tracks of a cylinder is to be allocated, identified, and used. Once established, the format track provides a fixed format and control for the subsequent reading or writing of data for that cylinder. To alter the fixed format and

control for any one of the 250 cylinders requires that a new format track be written for that cylinder.

The data used to create a format track must first be organized in core storage as a data record. Programming is used to transmit the data from core storage to the addressed format track. Details on writing a format track are given under Write Format Track Operation.

The writing of and the layout of the format track is under complete control of the user. Once written, the format remains fixed until it is rewritten. To prevent unintentional changes to the format tracks, each module is provided with a two-position key-lock switch. A format track cannot be written unless the key-lock switch is placed in the WRITE position; normally the switch is in the READ position.

Track Capacity

Each track in a module has 2840 six-bit or 2205 eight-bit character positions available for the recording of information. Character positions necessary for home address two, the record addresses, and gaps must be considered, however, in determining the number of character positions available for the records. In general, the track area available to store the records is the total track capacity less the character positions necessary for addresses and gaps.

The track capacity for any system is at the maximum when writing a single record on the track. For tracks containing a single record, the track capacity for each system is:

System	6-Bit	8-Bit	Packed
7070 and 7074	2,780	2,150	4,310
7080	2,800	2,165	4,330
7090	2,796	2,160	Does not apply

Characteristics*	Six-Bit Mode			Eight-Bit Mode				
	7070-7074	7080	7090	7070-7074		7080		7090
				Packed	Unpacked	Packed	Unpacked	
Maximum Characters per Track	2,780	2,800	2,796	4,310	2,150	4,330	2,165	2,160
Maximum Characters per Cylinder	111,200	112,000	111,840	172,400	86,000	173,200	86,600	86,400
Maximum Characters per Disk Storage (2 Modules)	55,600,000	56,000,000	55,920,000	86,200,000	43,000,000	86,600,000	43,300,000	43,200,000
Maximum Characters per File Control (5-1301's)	278,000,000	280,000,000	279,600,000	430,000,000	215,000,000	433,000,000	216,500,000	216,000,000
Character Rate	90,100 char/sec			140,200 digit/sec	70,100 char/sec	140,200 digit/sec	70,100 char/sec	70,100 char/sec

* Figures represent maximum utilization of space (each track written with a single record)

Figure 6. Data Characteristics of Disk Storage

Functions

The function performed by the 7631 File Control, 1301 Disk Storage, and the using system's data channel are based on the execution of instructions, commands, and orders, defined as follows:

Instruction: An instruction is system-coded information that is decoded and executed by the central processing unit to perform a specific function.

Command: A command is system-coded information that is decoded and executed by the data channel to perform a specific function. (The 7080 system does not use the term *commands*.)

Order: An order is control-coded information that is decoded and executed by a control unit (file control, in this case) to perform a specific function.

In the following description the word "command" means "instruction" when applied to the 7080 system.

The file control can execute any one of four commands (read, write, sense, and control). The applicable data processing system defines the method by which the four commands are issued to the file control. Read and write commands set up necessary control circuits in the connecting data channel to permit transmission of data between disk storage and the computer system through the file control. The sense command causes transmission of status data from the file control to the computer to indicate status of disk storage and file control. The control command is used to transmit orders to the file control.

Orders

Orders are transmitted to the file control by a control command of the computer in the same manner as data are normally transmitted. The file control recognizes the information as an order, decodes it, and executes it.

Transmission of orders to the file control as a result of the command is the same for all computer systems using this file control, although the method by which they are initiated may be different.

Orders normally consist of a two digit operation code and eight characters to define addresses. When address information is not required, the order consists of the operation code only. Figure 7 shows the make-up of the order.

Orders are transmitted from the computer's data channel as BCD characters. The 7631 File Control accepts the digit portion of the first eight characters of the order (operation code, access and module number,

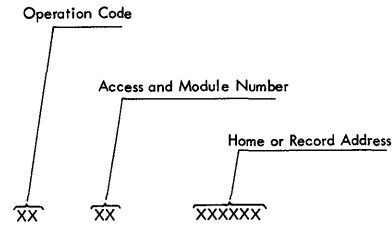


Figure 7. Order

and the first four positions of the address) and all bits in the ninth and tenth characters of the order.

Operation Code: A two-digit code that specifies the operation to be performed. This portion of the order is always numeric. The operation code is all that is required for the following orders: no operation, six-bit mode, eight-bit mode, and release.

Access and Module Number: These two positions of the order, always numeric, specify the module in which the operation will take place.

Record or Home Address: This portion of the order gives the home or record address, depending upon the type of operation that is to take place.

Operation Signals

Since disk storage operation takes advantage of the interrupt feature of the 7000 series systems, signals are generated to provide a communication link between the file control and the computer. The signals, generated to indicate a specific condition exists, are:

Attention: Indicates that a previously given seek operation has successfully positioned the access mechanism at the specified location and selected the desired head.

End: Indicates the successful completion of an operation. This signal can indicate the successful transmission of an order to the file control, or it can indicate the successful completion of a read or write operation.

Unusual End: Always indicates an unsuccessful operation. This signal can indicate that an error has been sensed during a read or write operation, or any other check condition has occurred, or it might indicate that an unsuccessful attempt to transmit data has occurred.

Stop: Indicates that the computer has sensed the end of a read or write field. The stop signal results from the record definition word in a 7070 or 7074 system; from the sensing of a group mark in a 7080 system; and from word count equal zero in a 7090 system.

Operations

The four basic commands used to perform all disk storage and file control operations are: control, sense, write and read.

Control

The 7631 File Control will decode and execute any of 13 orders transmitted from the computer by the control command. The 7631 decodes the transmitted order, accepts address information, performs the designated function, and then transmits an END OF UNUSUAL END signal to the computer. In the case of a seek order, the file control sends the END signal after decoding the order. It then performs the seek, and at the completion of the seek operation, sends an ATTENTION signal to the computer.

The orders consists of two or ten characters. For operations where addresses are not required, only a two-digit operation code is sent to the file control. Orders requiring the two digit operation code only are: no operation, release, six-bit mode, and eight-bit mode. The orders, with their mnemonic code and their numeric operation code are shown in Figure 8.

No Operation (DNOP—00)

This order requires only the two-digit operation code. The order is accepted by the 7631 as a programming convenience only. No function is performed by the 7631 for this order.

Release (DREL—04)

This order requires only the two-digit operation code. The order has meaning only for shared system operation. Whenever either system selects and gains control of the 7631, it remains in control of that system until the release order is issued, permitting the file control to be available for either system.

Eight-Bit Mode (DEBM—08)

This order requires only the two-digit operation code. The order conditions the file control to operate in the eight-bit mode. This mode of operation is required when the using system is operating in the packed format mode. Packed format is the packing of two numeric digits into one eight-bit character. The normal data rate of the file control in the eight-bit mode is 70, 100 characters per second with a maximum of 2,165 data characters for data track capacity; when using packed format, however, data rate is 140, 200 digits per second with a maximum of 4,330 digits for a data track capacity.

Six-Bit Mode (DSBM—09)

This order requires the two-digit operation code only. The order conditions the file control to operate in the six-bit mode. The data rate for the file control when operating in the six-bit mode is 90, 100 characters per second with a maximum track capacity of 2,800 characters.

Seek (DSEK—80)

The order for this operation causes the specified access mechanism of the addressed module to locate itself at the proper cylinder and to select the desired head. When the order has been received by the file control, it signals END and allows the computer to continue with its own routine while disk storage executes the seek operation. A seek may be directed to other access mechanisms on the disk storage units attached to the same file control. An UNUSUAL END signal results if a seek is given to an access mechanism in motion or if the access mechanism is inoperative.

Upon completion of a seek operation, an ATTENTION signal is sent to the computer. In addition, a bit associated with the access mechanism is set in status data to indicate this condition. This indication is sent as part of the status data transmitted in response to a sense command. The attention indicator is reset when the access is serviced by either a prepare to verify order or another seek order.

The seek order, preceding a cylinder or full track order, is not necessary when the current setting of the

Order	Mnemonic Code	Numeric Code
No Operation	DNOP	00
Release	DREL	04
Eight-Bit Mode	DEBM	08
Six-Bit Mode	DSBM	09
Seek	DSEK	80
Prepare to Verify, Single Record	DVSR	82
Prepare to Write, Format	DWRF	83
Prepare to Verify, Track with No Addresses	DVTN	84
Prepare to Verify, Cylinder Operation (Optional Feature)	DVCY	85
Prepare to Write Check	DWRC	86
Set Access Inoperative	DSA1	87
Prepare to Verify, Track with Addresses	DVTA	88
Prepare to Verify, Home Address	DVHA	89

Figure 8. Table of Orders

access mechanism corresponds to the desired address. Also, a seek order need not be repeated for consecutive single-record operations on the same track.

Prepare to Verify, Single Record (DVSR—82)

The order for this operation conditions the file control for a single-record type of operation and to perform the following functions:

1. Select the desired module and access mechanism.
2. Specify the address to be verified.
3. Prepare to transmit data from or to the addressed record in response to a subsequent read or write command.

The order sent to the file control is used in conjunction with the command. Access and module number specify the unit to be selected. Since the access mechanism is already located and held in the track position and the desired head is selected by the previous seek operation, the remainder of the order is used for verification purposes only.

The file control (in single-record mode) compares each record address as it comes under the read head against the address furnished by the order until the desired address is found.

Information can be read from or written into record areas only as defined by format tracks. Reading or writing continues until either a STOP signal is issued by the computer or the file control recognizes the end of record, depending upon whether a read or write command is being executed.

Prepare to Write, Format (DWRF—83)

This order conditions the file control to write a format track for the cylinder specified by the address portion of the order (the last two positions of this order are insignificant). To address a format track, the format two-position key-lock switch must be in the WRITE position; the track address must be one of the track addresses of the cylinder. To write a format track, this order must precede the write command.

Prepare to Verify, Track with No Addresses (DVTN—84)

This order, followed by a read or write command, permits the reading or writing of only the records on a particular track; all addresses are skipped over. The address portion of this order must specify the home address.

This order instructs the file control to do the following:

1. Select the desired module and access mechanism.
2. Supply the home address to be verified.

3. To receive or transmit only the records in response to a subsequent read or write command.

Reading or writing begins at the first record following the home address, and continues through the records skipping over addresses until the computer signals STOP or the file control recognizes the index point. Non-verification of the home address results in an UNUSUAL END signal, with no transmission of data to or from disk storage.

Prepare to Verify, Cylinder Operation (DVCY—85)

This is an *optional feature*. It permits reading or writing of data (skipping over addresses), beginning at the first record after the home address of the addressed track and continuing through successive record locations and the tracks of the cylinder until either the end of cylinder is reached or the computer signals STOP. This order is always followed by a read or write command. The following functions are performed in the cylinder operation mode:

1. Select desired module and access mechanism.
2. Specify desired home address to be verified.
3. Transmit data after the subsequent read or write command has been given.

Prepare to Write Check (DWRC—86)

This order is used with a write command to check any record, track, or cylinder of tracks of information. This order performs a bit-for-bit comparison, comparing the information recorded on the disk with the same information stored in core storage of the computer. If data agree, the order terminates with an END signal; if data disagree, the order terminates with an UNUSUAL END signal. The sequence of commands and orders to write and check recorded data is:

Seek	-----
Prepare to Verify	
(Single, Track, Cylinder)	XXXXXXXX*
Write	-----
Prepare to Write Check	XXXXXXXX*
Write	-----
*Must be same address	

It is not necessary to follow a write command with a write check operation.

Set Access Inoperative (DSAI—87)

This file control order causes the file control to disconnect the addressed access unit from the file control. (It permits the programmed disconnection of a faulty access unit from the system.) Any subsequent command to this access will result in an UNUSUAL END.

Reactivation of the inoperative access unit is accomplished manually by the customer engineer after the fault has been corrected.

Prepare to Verify, Track with Addresses (DVTA-88)

This order, followed by a read or write command, permits the reading or writing of a full track of information, including record addresses and records. It makes use of the home address that defines the track address.

This order instructs the file control to do the following.

1. Select the desired module and access mechanism.
2. Supply the home address to be verified.
3. Condition the file control to operate on a full-track basis and receive and transmit both record addresses and record areas in response to a subsequent read or write command.

The order is used whenever changes are to be made to record addresses and insertions, or deletions are to be made on a track that contains randomly distributed records.

The execution of this order is similar to that performed by the prepare to verify (cylinder operation) in that only the home address is verified. If verification is successful, reading or writing will begin at the following record address and continue through the records and the record addresses until the computer signals STOP or the file control recognizes the end of format area. Non-verification of the home address results in an UNUSUAL END signal with no transmission of data to or from the disk storage.

Prepare to Verify, Home Address (DVHA-89)

This order prepares the file control to read or write an entire track of data and addresses including the home address identifier. The home address must be supplied for subsequent verification. For execution of this order, the home address switch must be on. (The switch is located on the 7631.)

This operation is terminated by a STOP signal from the computer or when the file control recognizes the index point.

Sense

The sense command instructs the file control to transmit status data to the computer to indicate error and unusual conditions as well as attention conditions. This operation is similar to a read command except that only the ten 4-bit characters are transmitted to

the computer. The status data are transmitted to the data channel of the using system over the BCD A, 4, 2, and 1 bit lines. From the data channel, the 4-bit characters are converted to either the BCD 6-bit character (7080 and 7090) or the two-of-five code (7070/7074), and sent to the computer.

Status data are set in bit form for each read, write, and control operation performed by the file control and are available to the computer by means of the sense command. The status data should be called for by the computer before the initiation of the next read, write, or control command. (The initiation of the next command resets all error indications of the status data.)

Figure 9 shows the make-up of the status data transmitted to the data channel of the using system.

Status character 0 summarizes the type of check or condition. Characters 1 and 2 give the type of check encountered. (Invalid address check has been added.) Character 3 gives the different, exceptional conditions; character 4 gives the data mode; characters 5, 6, and 7 give attention conditions; and characters 8 and 9 are reserved.

Status Char	Bit No.	BCD Bit	Assignment	Comment
0	3	A	Reserved	Summary Byte
	5	4	Program Check	
	6	2	Data Check	
	7	1	Exceptional Condition	
1	3	A	Invalid Sequence	Program Check
	5	4	Invalid Code	
	6	2	Format Check	
	7	1	No Record Found	
2	3	A	Invalid Address	Data Check
	5	4	Response Check	
	6	2	Data Compare Check	
	7	1	Parity or Check Char Code Check	
3	3	A	Access Inoperative	Exceptional Condition
	5	4	Access Note Ready	
	6	2	Disk Storage Circuit Check	
	7	1	File Control Circuit Check	
4	3	A	Reserved	Data Mode
	5	4	Six-Bit Mode	
	6	2	Reserved	
	7	1	Reserved	
5	3	A	Module 0	Attention
	5	4	Module 1	
	6	2	Module 2	
	7	1	Module 3	
6	3	A	Module 4	
	5	4	Module 5	
	6	2	Module 6	
	7	1	Module 7	
7	3	A	Module 8	
	5	4	Module 9	
	6	2	Reserved	
	7	1	Reserved	
8,9			Reserved	

Figure 9. Status Data Bit Assignment

Write

A write command must always be preceded by a prepare to write check, prepare to write format, or a prepare to verify order. A write command, not preceded by one of these orders, is terminated with an UNUSUAL END signal with no transmission of data to the file control. (A no operation order can be inserted between the prepare to . . . and the write command.)

Write Format Track Operation

To write a format track, three conditions must be met:

1. The format switch must be in the WRITE position; if not, no writing of the format track will take place.
2. A prepare to write format order with a track address of one of the tracks of the cylinder must be received and normally terminated by the file control.
3. The prepare to write format order must be followed by a write command specifying a core storage location that contains the field of special characters that are used to write a format track.

During a format write operation, the 7631 will legally accept only four characters: BCD 1, BCD 2, BCD 3, and BCD 4. For operation in the 6-bit mode, BCD 1's are used to write the special character of seven one bits; BCD 2's are used to write the special character of seven zero bits. Seven bit positions are required for each 6-bit character; the extra bit position is required for a space bit used to separate characters. For operation in the 8-bit mode, BCD 3's are used to write the special character of nine one bits; BCD 4's are used to write the special character of nine zero bits. Nine bit positions are required for each 8-bit character; the extra bit position is required for a space bit used to separate characters.

A typical core storage layout for n records in both the 6-bit mode and the 8-bit mode is shown in Figure 10. When organizing a data track in core storage, only the information that is to be recorded must be provided for; however, when organizing a format track

in core storage, the special BCD characters must be provided to write every character position. This includes the HA1 area, as well as all other addresses and gap areas that are to be used to define the related areas for the associated data tracks.

When laying out a format track, the following considerations must be given:

Format Track Capacity: The maximum character positions available when writing a format track is:

Six-Bit Mode: 2,869 character positions

Eight-Bit Mode: 2,234 character positions

These figures represent the total data track capacity (2,840 character positions for 6-bit; 2,205 character positions for 8-bit) plus HA1 area (24 character positions) plus the HA2 gap (16 character positions), minus 11 character positions (space only, user does not provide characters for this area), that must be provided for at the end of the track that are to be automatically written by the 7631 File Control. Exceeding the track capacity results in a format check.

Track Identification: This area immediately follows the index point and corresponds to the HA1 pre-recorded data track area and consists of three parts: Gap 1 must contain three BCD 4's; HA1 must contain nine BCD 3's; Gap 2 must contain a BCD 4 followed by ten BCD 3's and a BCD 4. The track identification area is always written in the 8-bit mode and will be the same for all format track layouts.

Home Address Two (HA2): This area must contain four more BCD 1's (6-bit mode) than the number of characters assigned for HA2. The four character positions are needed for each record and each address area to provide space for internal synchronization information. For example, if HA2 is a two character home address identifier, then, six BCD 1's must be used in this area. For operation in the 8-bit mode, BCD 3's must be used instead of the BCD 1's.

X Gap: An X gap must precede every record address (RA). This gap is made up of 12 BCD 2's or 12 BCD 4's, depending upon the mode of operation.

Record Address (RA): This area must contain four more BCD 1's than the number of characters assigned

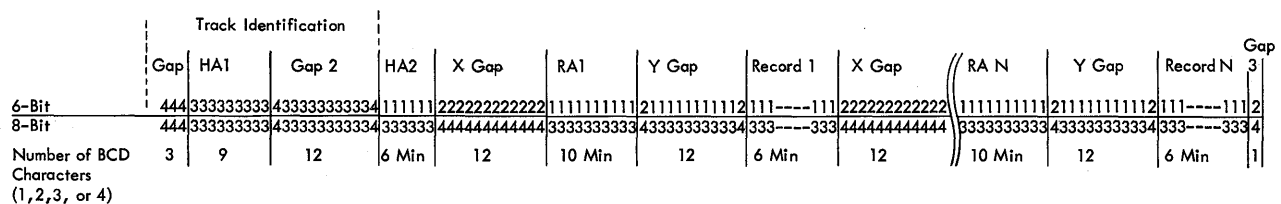


Figure 10. Format Track Layout

for RA. For example, if RA contains ten digits, then 14 BCD 1's must be used. For operation in the eight-bit mode, BCD 3's must be used instead of BCD 1. There must be as many record address areas on the format track as there are records.

Y Gap: A Y gap must follow every RA. This gap is made up of one BCD 2, followed by 10 BCD 1's and a BCD 2 for the 6-bit mode of operation. For the 8-bit mode, the Y gap is made up of one BCD 4 followed by 10 BCD 3's and another BCD 4.

Record Areas: There must be four more BCD 1's than there are characters in the record, for the 6-bit mode of operation. For example, for an 80 character record, 84 BCD 1's must be provided. For the 8-bit mode, BCD 3's are to be used instead of the BCD 1's. This area must contain at least six characters, that is, a two character record plus the four extra BCD characters.

Gap 3: Gap 3 is a one character gap that follows the last record area on the track. This character is either a BCD 2 or a BCD 4, depending upon the mode of operation.

Format tracks can be written for one mode of operation or the other, never, as a mixture of both modes, excepting the track identification area, which is always written in the 8-bit mode.

Write Home Address Operation

The conditions necessary for this operation are that the home address switch on the 7631 be on, that a prepare to verify (home address) operation order be issued to the file control, and that the write command immediately follow. The file control compares the physical address portion of the home address on the particular track and begins the write operation at the beginning of the HA2 area. The first characters must be the home address identifier of the particular track. The home address identifier must be a minimum of two characters. If desired, this area may be extended to match the word length of the using system. The number of characters requested by the 7631 for the HA identifier is determined by the number of ones that were previously written on the format. All characters of the HA identifier after the second are non-significant and will not be a part of address compare.

This operation continues with the file control detecting the gap between the HA2 and the first record address. On detection of the gap, the file control then writes the three-digit check character. The operation continues writing record addresses and records to the end of the track.

If a stop signal occurs before sensing the end of track, data transmission stops, but the file control continues writing blanks to the end of the track.

Write Track with Addresses Operation

Conditions necessary for this operation are a prepare to verify (track with addresses) order, followed by a write command. Under control of the prepare to verify (track) order, the file control searches the data track for a home address and compares this address bit for bit against the address that was previously issued with the prepare to verify (track) command. If the home address fails to compare, the file control issues an immediate UNUSUAL END and indicates in its status word a no record found bit. Upon a successful home address compare the file control will transfer the record address and proceed in the usual manner. The file control continues filling the record area with data from the computer. This includes both records and addresses. The file control also supplies the check characters to be written at the end of each area. When the last check character area is reached, a NORMAL END will be issued to the computer providing no error conditions have been detected. Otherwise, UNUSUAL END results. If the computer signals STOP in the middle of a record, data transmission stops, but file control writes blanks to end of record area, then writes the check characters.

Write Single Record Operation

Conditions necessary for this operation are that a prepare to verify (single record operation) order be issued to the file control and that a write command follow. The record address area is recognized in the file control by sensing the end of a long gap in the format. Upon finding a record address area, the file control reads off the address contained in the area and compares it bit by bit with the address previously supplied to the adapter during prepare to verify (single record). If the address does not compare, the file control continues searching succeeding address areas and comparing the address contained in each. If the file control passes the index point twice without comparing the address, it will register the no-record-found status bit and issue an UNUSUAL END to the computer without transmission of data. Upon an address compare true, the file control will cause the 1301 to write over the record immediately following the compared address. Data are furnished by the system. The file control automatically transmits the code check characters following the end of the record area as defined by the format track.

If a stop signal is received at a midpoint in the record area the file control will continue to write the record, with blanks until the end of the formatted area is reached. After the check characters are recorded, a NORMAL END is issued to the system unless a data check has occurred, in which case UNUSUAL END would result.

Write Track With No Addresses

The conditions necessary for this operation are that a prepare to verify (track without addresses) order be followed by a write command. The address received with the prepare to verify (track without addresses) order is compared with the home address transmitted from the 1301. If the home address fails to compare, the no-record-found bit is registered and UNUSUAL END is issued to the system. If the address compares true, the file control skips the first address area into the record area and writes the record. The file control continues skipping addresses and writing the records until the index point is sensed. A NORMAL END is issued to the system, providing no error conditions occur during data transfer. In the event of a parity error, the operation will be terminated at the end of the record in which the error was detected and UNUSUAL END issued.

If computer signals stop in the middle of a record, data transmission stops, but the file control continues writing blanks to end of record area, then writes the check characters.

Read or Write Cylinder Operation

Operation in the cylinder mode is an optional feature of the 7631. A cylinder mode read or write is set up by having the computer send a prepare to verify (cylinder operation) order to the file control. The address issued with the order is the home address of the track on which the operation is to start. The home address is compared bit by bit in the 7631 after the read or write is received.

On a compare equal, the data transfer operation begins with all of the records on the addressed track being read or written and with the record addresses ignored in the same manner as a track-without-addresses operation. Rather than causing END when the last record of the track has been processed, the 7631 sends a new head address to the 1301 and reading or writing continues. The head address sent to the 1301 is one address higher than the previous head address. By indexing one head address on each disk revolution, the 7631 continues reading or writing until the entire cylinder of information has been processed. The END signal is generated in the 7631 when the highest order head of the cylinder has been operated on.

If the computer signals STOP in the middle of a record, data transmission stops; but, if reading, file control continues to read to end of record, and then compares check characters; if writing, the file control writes blanks to end of record, then writes the check characters.

No wrap-around feature is included in cylinder operation to cause operation to begin again at the

low-order head after the high-order head has completed its reading or writing.

Write Check Operation

Each of the write operations has a companion write check operation which is optional and under program control. The operation requires the following sequence of orders and commands:

Prepare to Verify . . .	XXXXXXXX
Write	-----
Prepare to Write Check	XXXXXXXX
Write	-----

The 7631 will compare the data recorded in the addressed record, bit by bit, with the write data from the system, at the same time generating check characters that will be compared with those previously generated and recorded on the track, following the record. The end of this operation is the same as a true write operation. A compare error during a write check will set the data compare check bit in the status data.

During a write check operation on a format track the format gap detector circuits in the 7631 are checked to determine if they are within their specified tolerance. A file control circuit check is noted if the circuits do not meet specifications.

On reception of a STOP signal the 7631 continues comparing data already received, then continues till end of the present record area and issues a NORMAL END signal.

Read

Read Home Address Operation

This operation requires that a prepare to verify (home address) is sent to the 7631 and that a read command follows. The read (home address) is analogous to the write home address. The most useful application of this operation is to recover tracks of information in a file dump operation. This operation does not depend on the format track for recognition of data and address areas. With this operation and assuming that a proper gap is provided between index point and the beginning of the home address area, the computer can restore a file to normal operation after a major mechanical change. The 7631 compares the physical address portion of the home address and begins reading with the home address identifier. All address and record data of the track are read. The termination of this operation occurs when the 7631 senses the index point. At that time either NORMAL or UNUSUAL END is issued, depending on the state of the data check. The computer may terminate the opera-

tion earlier by issuing a STOP. Upon receipt of STOP, the 7631 will terminate data transmission and internally complete reading of the record on which it was operating at the time of the STOP. At the end of the particular record, the 7631 will send either NORMAL or UNUSUAL END, depending on the state of data check.

Read Track with Addresses Operation

Conditions necessary for this operation are that a prepare to verify (track) order be issued to the 7631, followed by a read command. The file control begins the operation by comparing the home address which accompanied the prepare to verify (track) order against the recorded home address on the selected track. A failure to compare will cause "no record found" to be set in the status data and causes UNUSUAL END to be issued to the system. A successful compare permits the 7631 to begin reading at the first record address area. The record address is read out in its entirety and sent to the system, followed by the record and then the next address and record, etc. The operation terminates when the 7631 senses that it has completed comparing the check characters of the last record of a track. At that time a NORMAL END or UNUSUAL END is issued, depending upon the state of data check. A STOP signal prior to the logical end of this operation will cause the 7631 to stop data transmission and signal a NORMAL END at the end of the record on which it is operating at the time of the STOP signal.

Read Single Record Operation

This operation requires the completion of a prepare to verify (single record) order and read command. As with write (single record) operation, the read (single record) operation has no predetermined starting point on the disk, that is, when the instruction is received by the 7631, it immediately begins searching for a record address. Upon finding one, the 7631 does a bit-by-bit comparison. A failure to compare causes the control to continue searching on the next record address. "No record found" is registered if the 7631 passes the index point twice in its search for a particular record. Upon obtaining an address compare true the 7631 causes the record immediately following that address to be read and the data to be sent to the system. The 7631 verifies the legality of the check characters following the end of the record and sends the NORMAL or UNUSUAL END at that time. A STOP signal prior to the logical end of this operation will cause the 7631 to stop data transmission and to signal a NORMAL END at the end of the record.

Read Track with No Addresses

This operation requires that a prepare to verify (track) and a read command, in that sequence, be executed.

The 7631 waits for the home address area before beginning to compare the address supplied with the prepare to verify order against the recorded home address. A compare failure causes the 7631 to register "no record found" in the status word. If the address compares successfully, the 7631 carries out the read-track operation by skipping over the first record address and reading the first record. The operation continues with addresses ignored by the 7631 and only record data being sent to the system. The operation ends when the 7631 finishes the last record of the track. At that time the appropriate END signal is issued. An EARLY END may occur because of a system STOP signal. In that case, the 7631 finishes the record on which it is operating and issues a NORMAL or UNUSUAL END as the case may be.

Checking

The 7631 File Control checks for twelve individual error conditions possible in the operation of disk storage. The sensing of any one of these conditions causes an UNUSUAL END signal to be sent to the computer.

Parity or Character Check

The 7631 is an odd-parity machine. As characters are transferred from the computer, the bit count of each is checked. If an even number is detected, this check bit as well as the summary data check bit, will be set into the status data.

The character code check is made by generating three check characters for each address and record, as bits are read from the disk surface during a read operation. These newly generated characters are then compared bit by bit with those previously generated and recorded, in the gap following each address and each record during the write operation. Failure to compare will indicate the occurrence of an error.

Invalid Address Check

If a seek operation is attempted using an invalid address, the access mechanism may be moved to a customer engineer track (a data track for customer engineering use). If this happens, and a read or write command is given, an invalid address check occurs and an immediate UNUSUAL END signal results.

Response Check

The response check indicates that a character was not received by the 7631 within the allotted time. Response check can only occur as a result of a read or write operation.

Data Compare Check

Data compare check can occur only during a write check operation. The condition indicates that a compare error was detected somewhere during write check. During a write check operation, data are read from the disk surface and compared bit by bit with those transferred from the computer.

Format Check

The format check occurs during either format write or a write check of a format track. The cause may be either an illegal code (any but a BCD one, two, three, or four) or because STOP signal was not sent to the file control prior to sensing the index point.

No Record Found

The "no record found" indication occurs if the file control fails to locate the track address that was issued it on a prepare to verify order.

Invalid Sequence

The invalid sequence condition can occur during write operations in two ways. In one case, it occurs when a write command is received by the file control without a preceding and properly executed prepare to verify or prepare to write format order. In the second case, invalid sequence occurs when a write check order is preceded by other than a prepare to verify order, prepare to write format order, and properly executed write command. When reading, a prepare to verify is the only legal order that can precede a read command.

Invalid Code

The invalid code indication occurs when the file control is given an order that cannot be performed.

Access Inoperative

This indication occurs when the access mechanism fails to respond to a seek order. The access may be mechanically out of order or may not exist.

Access Not Ready

The access not ready indication shows that the addressed access is in motion from some prior seek order.

Disk Storage Circuit Check

This check indicates a circuit failure in the 1301 Disk Storage.

File Control Circuit Check

This check occurs due to malfunctioning of the gap detection circuit, address comparison circuit, or the check character code generator in the file control.

Shared System Operation

The 7631 File Control, Models 3 and 4, permit two different Data Processing Systems to share a common random access storage. The 7631, Models 3 and 4, have a three-way switch as shown in Figure 11.

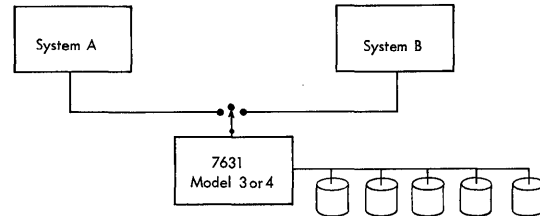


Figure 11. Shared System Three-Way Switch

When the switch is in the neutral position (as shown), the first system to issue an order (instruction, if a 1410) to the file control gains control of the 7631. Control is retained until the controlling system issues a release order, restoring the three-way switch to neutral. Assume that System A has control of the 7631:

1. If System B is a 1410 and tries to issue a disk storage instruction, the 1410 will receive a busy indication.
2. If System B is a 7090 and tries to issue a disk storage order, a channel interrupt will result.
3. If System B is a 7080 and tries to issue a disk storage order, but does not use a transfer ready instruction (TRR 01) before issuing the order, the channel will wait until the 7631 is available.
4. If System B is a 7070 or 7074 and tries to issue a disk storage order, the channel will wait until the 7631 is available.

Two 7000 Series Systems Sharing a 7631 File Control

At the completion of any seek operation, an attention signal (seek complete) is sent to both systems. Both systems will, in time, respond to the seek complete signal. Depending on a number of timing factors, one system (assume system A) responds first and issues a sense command. This command gains control of the 7631 as previously described. On examination of available sense data, system A determines whether it caused the seek complete signal. If system A caused the signal, the seek order is serviced. If system A did not cause the signal, system A releases the 7631 and allows system B to respond to the attention signal and service the seek order.

IBM 1410 and 7000 Series Systems Sharing a 7631 File Control

At completion of any seek operation, an attention signal is sent to both using systems with the following restrictions:

1. A prevent seek complete instruction (M/L X F 4 XXXXX W) is used to turn on a latch in the IBM 1411 Processing Unit, which blocks seek complete signals from reaching the 1410 system. This latch is turned off (allowing seek complete signals to be serviced) when the 1410 issues a seek command.

2. Reception of a seek complete by the 1410 is further conditioned by previous use of the 7631. If the 7631 is disconnected from both systems or is connected to the 1410, seek complete signals are sent to the 1410. If the 7631 is connected to the 7000 series system, seek complete signals are not sent to the 1410 until the 7000 system releases the 7631.

Subject to these restrictions, operation of the 1410/7000 shared disk storage system is essentially the same as described for the 7000/7000 shared disk storage systems, except for the 1410 method of determining whether an interrupt was caused by a seek command which the 1410 initiated. This method consists of a series of Y(I)d tests to determine the nature of the interrupt. Having found that the interrupt was caused by a seek complete, each access mechanism that is seeking because of a 1410 command must then be tested by issuing an input-output no-operation instruction to set status indicators for the access mechanism and then an R(I)≡ to test for a busy condition.

Programming Shared Disk Storage

In programming a shared disk storage system, one of two methods may be used:

1. System A issues one or more seek orders and retains control of the 7631 (by not issuing a release command) until all seek commands have been completed.

2. Two or more seeks issued by either or both systems may be in simultaneous operation. Seek execution times may thus be effectively overlapped. Operation is as follows:

- a. System A issues one or more seek commands and then a release.
- b. System B issues one or more seek commands and then a release.
- c. Control of the 7631 is now logically disconnected from both systems. Operation from this point depends on which systems are sharing

the 7631. If one of the systems is a 1410, the priority processing feature, which allows interrupts to be processed by the system, must be available.

Instruction Times

Ten digit orders require 148 microseconds in 6-bit mode and 190 microseconds in 8-bit mode. Two-digit orders demand 55 microseconds in 6-bit mode and 75 microseconds in 8-bit mode. A sense command requires 123 microseconds in 6-bit mode and 158 microseconds in 8-bit mode. Read and write commands vary in time duration depending on the length of record (for single record operations) and rotational coincidence of starting points. A cylinder operation involving all 40 tracks within a cylinder will take about 1.5 seconds.

Access time to position access mechanism is 50 to 180 milliseconds and average rotational delay is 17 milliseconds.

Access Motion Time

The access mechanism requires time to move from one cylinder to another. The time required depends on how far the arm moves within certain machine-defined limits. To calculate how much time will be required, consider the 250 cylinders of a module organized into five areas of 50 cylinders per area (Figure 12). If each area of cylinders is further divided into six sections, access motion time for any one access is:

1. 50 milliseconds, to move the access arm within a section of any one area.

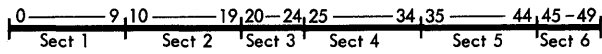
2. 120 milliseconds, to move the access arm from one section to another section of an area.

3. 180 milliseconds, to move the access arm from one area to another area (crossing an area boundary). For example, to move the access arm from track 0000 to 1960 requires 120 milliseconds of access motion time. To move the access arm from track 1960 to 2000 requires 180 milliseconds.

Access time from one track to another can be determined by the use of Figure 13. The point of intersection of two lines on a coded area of the figure, one drawn horizontally from a FROM track address and one drawn vertically from a TO address, indicates access time in milliseconds.

Area	Cylinder
A	0 - 49
B	50 - 99
C	100 - 149
D	150 - 199
E	200 - 249

Cylinder Areas



Sections within a Cylinder Area

Figure 12. Access Motion Areas and Sections

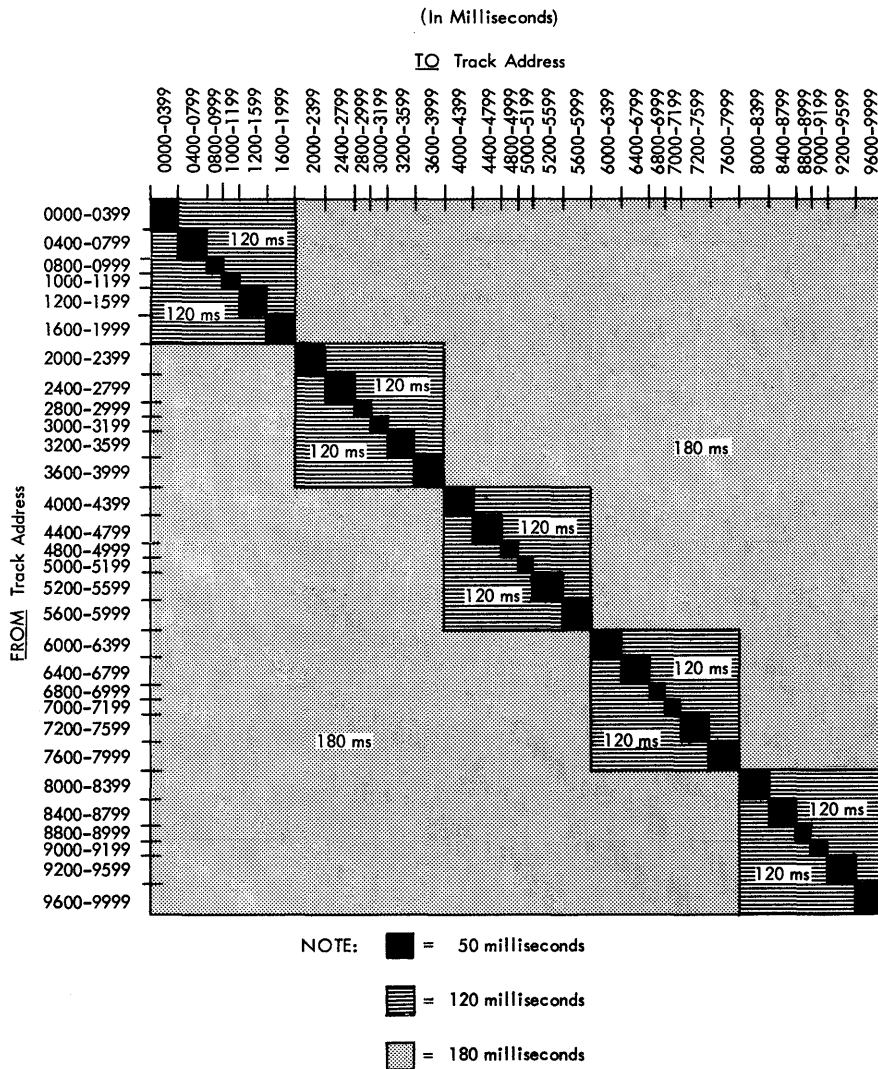


Figure 13. 1301 Disk Storage Access Time

Control Panel

The control panel of the 7631 is primarily intended for maintenance simulation purposes. The panel is mounted on the right front cover. The control panel has an exposed section and a hidden section, intended only for customer engineering usage. On the exposed segment there are 122 indicator lights which reflect the status of data and controls within the 7631. Operator switches are available in a light and switch assembly above the indicator section of the control panel. The customer engineer section of the panel is covered and contains 35 switches for simulation of data, commands and responses from the channel, and responses from the files.

Power-On Switches and Lights

Power-On Key supplies DC voltages to the 7631 and the 1301's and AC voltages to the disk storage motors and blowers. When the switch is pressed, power is supplied to the first disk storage for a power-on sequence. When the first disk storage has completed its power-on sequencing, a signal is sent to the next one to start the power-on sequence, and so on.

Power-On Light, when on, indicates that power is supplied to the 7631 and the 1301's.

Power-Off Key removes DC and AC operating voltages from the 7631 and the 1301's and initiates a power-off sequence for the 1301's.

DC-Off Key removes DC operating voltages from the 7631 and the 1301's.

DC-On Light, when on, indicates that DC operating voltages are present on the 7631 and the 1301's.

HAO Switch: This switch must be on for logical execution of a home address operation.

Write Inhibit Switch and Light: The write inhibit toggle switch allows the CE or diagnostic programmer to perform a write sequence of operations without the actual writing, thus not disturbing the customer's data. The associated light indicates this write inhibit condition present.

Thermal Light: This light is energized in the 7631 if the temperature in the gates exceeds 115° F. While the light is on, the power-on switch of the 7631 is not effective. Power is down until the temperature returns to specified limits.

Fuse Light: The fuse light indicates a blown fuse or tripped circuit breaker in the 7631.

Test Mode Light: For customer engineering use. When this light is on, it indicates that the 7631 and the attached 1301's are not available for normal customer use.

Error Recovery Procedures

The following procedures form the basis of the error recovery routines used in input-output programming for IBM Programming Systems packages. For efficient utilization of data processing systems, the use of these procedures is recommended in writing input-output routines.

Figure 14 shows the 7631-1301 error conditions that can occur with 7000 series systems and specifies the minimum action required. Data check errors should be examined and handled before program check or exceptional condition errors.

The actions referred to in Figure 14 are:

Action 1

1. Repeat the operation once (for example, prepare to verify and read or write. When a response check occurs on a read, or a response check or a format check occurs on a write or write check, the prepare to verify is not required except on the IBM 7090-94 System.

2. If the error condition persists, print message 1 (see below).

Action 2

1. Execute part 1 of action 1 as many as four times.
2. After a fifth error indication, recalibrate the access mechanism with a seek to the outer customer

engineering track. Use 9@00 to 9@39 for the seek address.

For the 7070-7074, the control command must specify two alpha order words for the seek. For example, R@WC -40 2-5 6-9, where 2-5 contains the address of the first order word and 6-9 contains the address of the second order word.

The two alpha order words are as follows:

First word: α 800x9 x=0-9
(module number)

Second word: α @xx00 xx=00-39

In two digit representation the order words appear as follows:

α 9890909x99 α 469x9x9090

3. Seek to any track address. This moves the access mechanism to cylinder zero.

4. Seek to the desired track.

5. Execute part 1 of action 1 as many as four times.

6. After a ninth error indication, print message 1.

NOTE: In IBM 1301 IOCS routines, a no-record-found condition causes an exit to the user. A return to the IOCS routine with the same record address causes execution of a no-record-found error routine. The user may have an overflow indication that must be interrogated on the track that caused the no-record-found indication.

Sense Bit Assignment			Assignment	Comment	When Encountered During A Read Operation	When Encountered During a Write or Write Check Operation	When Encountered During a Control Operation
Status Char.	Bit No.	BCD Bit					
0	3	A	Reserved Program Check Data Check Exceptional Condition	Summary Byte			
	5	4					
	6	2					
	7	1					
1	3	A	Invalid Sequence Invalid Code Format Check No Record Found	Program Check Program Check Program Check Program Check	Action 1 Not applicable Not applicable Action 2	Action 1 Not applicable Action 1 Action 2	Not applicable Action 1 Not applicable Not applicable
	5	4					
	6	2					
	7	1					
2	3	A	Invalid Address Response Check Data Compare Check Parity or Check Char Code Check	Program Check Data Check Data Check Data Check	Action 4 Action 1 Not applicable Action 3	Action 4 Action 1 Action 3 Action 3	Not applicable Not applicable Not applicable Action 1
	5	4					
	6	2					
	7	1					
3	3	A	Access Inoperative Access Not Ready 1301 Circuit Check 7631 Circuit Check	Exceptional Condition Exceptional Condition Exceptional Condition Exceptional Condition	Action 1 Action 1 Action 1 Action 1	Action 1 Action 1 Action 1 Action 1	Action 1 Action 1 Action 1 Not applicable
	5	4					
	6	2					
	7	1					

Figure 14. Error Conditions and Actions Required

Action 3

1. Execute part 1 of action 1 as many as four times.

Exception: In the case of a write check, the original sequence should be repeated, not part 1 of action 1: prepare to verify, subsequent write, prepare to verify, and write check.

2. After a fifth error indication, print message 1.

Action 4

1. Seek to any track address (0000-9999). This moves the access mechanism from the customer engineering track to cylinder zero.

2. Seek to the desired track. Prepare to verify and read or write.

3. If the error condition persists, print message 1.

Message 1 Format

Message 1 identifies an uncorrectable error. Further procedure is determined by the application.

Minimum: 1-4, inclusive

Recommended, if core storage permits: 1-8 inclusive

Maximum: 1-10

1. xxxx: a message code used when the message is associated with a halt or waiting loop.

2. Type of Error: read, write, write check, or control.

3. Unit Involved: access number, module number, track number.

4. File Control Status Word: bytes 0-4 inclusive; an examination of byte 0 will reveal any multiple error conditions.

5. Channel designation and final status or control word for the channel at the time of the error.

6. File Control Status Word: bytes 5-9 inclusive.

7. Nature of Data: packed or unpacked.

8. Preceding control orders.

9. Previous Unit Involved: access number, module number, track number; FROM address, the previous address sought on the module in error.

10. Current Unit Involved: access number, module number, track number; TO address, the address to which the access mechanism was going, or had reached, at error time.

Statistical Print-out

At the end of a program segment or run, or at a convenient time interval, a Message 2 should be printed.

Message 2 Format

1. Access number, module number.

2. Number of entries into error routine.

3. Number of Message 1's printed (uncorrectable errors).

