7070-7074 DATA PROCESSING SYSTEM BULLETIN

IBM 1414 MODEL 6 INPUT-OUTPUT SYNCHRONIZER
IBM 7907 DATA CHANNEL SWITCH SPECIAL FEATURE

THE IBM 1414-6 Input-Output Synchronizer (Figure 1) attaches communication devices to the 7070-7074 Data Processing System. It contains six 80-character buffers, each assigned (with an adapter) to a specific input or output line of a specific device (or group of shared devices). Devices that can be attached through the 1414-6 are:

IBM 1009 Data Transmission Unit
IBM 1011 Paper Tape Reader
IBM 1014 Remote Inquiry Units
Telegraph Input-Output Units

The data transfer rate between the 1414-6 and the 7907 Data Channel of the 7070-7074 system is 11 microseconds per character. The data transfer rates between the 1414-6 and the communications devices to which it is attached depend on the capabilities of the devices and the remote terminals with which they are communicating.

The 1414-6 is under control of the 7070-7074 program and uses customary interrupt procedures.

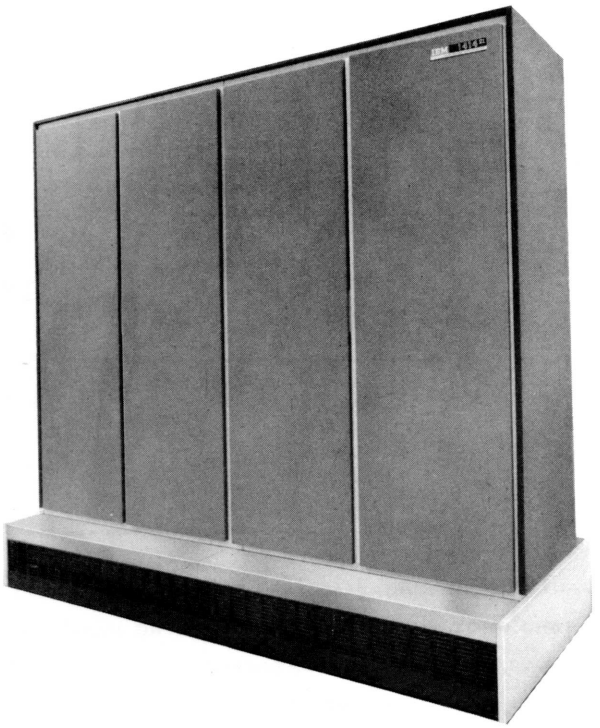

Figure 1. IBM 1414 Model 6 Input-Output Synchronizer

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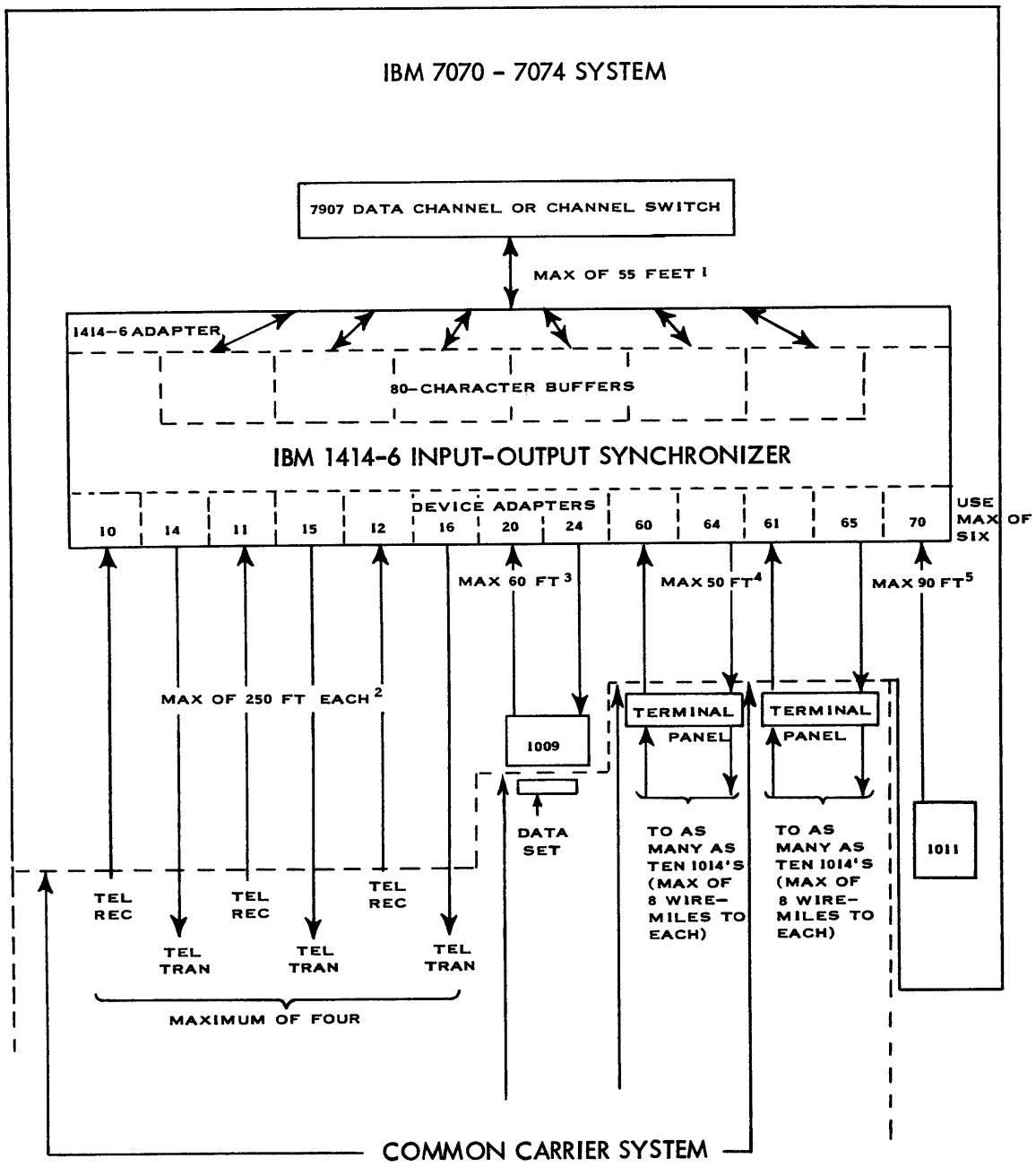

NOTES

1. DATA TRANSFER RATE--11 MICROSECONDS/CHARACTER
2. MAXIMUM DATA TRANSFER RATE--UP TO 10 CHARACTERS/SECOND
3. POSSIBLE DATA TRANSFER RATES--75, 150, 250, 300 CHARACTERS/SECOND
4. MAXIMUM DATA TRANSFER RATES--12-1/2 CHARACTERS/SECOND (INQUIRY REQUEST)
   --15-1/2 CHARACTERS/SECOND (INQUIRY REPLY)
5. DATA TRANSFER RATE--500 CHARACTERS/SECOND

Figure 3. Configuration of the IBM 1414-6 and Telecommunications Devices

permitting variable-length messages to be processed. For a description of conditions in which data may be lost to the 1414-6, see "Telegraph Input-Output." A detailed description of the 1009 is contained in the General Information Manual, IBM 1009 Data Transmission Unit, Form D24-1039.

1011 Paper Tape Reader

The IBM 1011 Paper Tape Reader serves as an input device, controlled by the 7070-7074 program in the same manner as other devices attached through the 7907 Data Channel. The reader operates at 500 paper-tape characters per second, using either five-track telegraph tape or eight-track IBM tape. The tape can be chad or chadless and in the form of strips, reels, or rolls fed from the center.

The 1011 Paper Tape Reader uses one of the six buffers for its operation. One 1011 reader may be attached to the 1414-6. A detailed description of the 1011 is contained in the General Information Manual, IBM 1011 Paper Tape Reader, Form D24-1044.

1014 Remote Inquiry Unit

The IBM 1014 Remote Inquiry Unit, with typewriter input and output, may be used for system interrogation. The 1014 provides a visual record of information stored in, or transmitted from, the 7070-7074 system. Remote inquiry provides direct access to any record stored within the 7070-7074 system and furnishes a printed output under program control. The 1014 has a maximum data rate of 12-1/2 characters per second for inquiry request, and a maximum of 15-1/2 characters per second for inquiry reply. It permits as many as 78 characters per message--the first character of the 1414-6 buffer contains the address of the 1014 (0-9) being used, and the position adjacent to the last inquiry character in the buffer contains the group mark (≢).

The 1414-6 may have one or two adapters for attachment of 1014 units. Each adapter uses two of the six buffers, one for input and the other for output. As many as ten 1014 remote units are controlled by each adapter, on an exclusion basis.

The remote inquiry units are cable-connected to the 1414-6 and can be located up to eight wire-miles from the terminal board attached to the 1414-6. (A wire-mile is a distance of one mile spanned by a parallel set of four wires or two pairs of wires.) For a detailed description of the remote inquiry unit, refer to the "M" Bulletin, IBM 1014 Remote Inquiry Unit, Form G24-1444.

TELEGRAPH INPUT-OUTPUT

As many as four telegraph units [1] may be attached to the 1414-6 to communicate with remote input-output telegraph units. The data transmission rate of these connections can be up to approximately ten characters per second depending on the transmission rate of the common carrier equipment used. The number of buffers used for telegraph communication equals the number of attached input and output units.

[1] One unit must be a transmitter and one a receiver; the other units may consist of a transmitter-receiver, one or two transmitters, or one or two receivers.

In receive operation, the telegraph units communicate with the 1414-6 by means of five-bit telegraph code. The 1414-6 translates this into standard BCD characters. The telegraph message is divided into two parts, the administrative portion (destination, sending station, date, time, and so on) and the data portion (body of the message). The data portion to be stored in the 7070-7074 must be enclosed by parentheses. It should not exceed eighty BCD characters. With normal 7070-7074 input-output programming, the possibility of the data channel being occupied with disk records or the possibility of combinations of other priority-sequenced operations makes it impossible to insure that subsequent buffer-loads of input characters will receive computer attention within the 100 milliseconds (time between telegraph characters) allotted for servicing the buffer after it is filled. Therefore, it is strongly recommended that data portions (to be stored) be limited to 80 characters. Input messages will overrun only when they encounter a buffer not transferred since a previous input message. In addition, the IBM 1009 Data Transmission Unit must be serviced within 260 milliseconds after the buffer is filled if operating at 300 characters per second, within 316 milliseconds if operating at 250 characters per second, within 521 milliseconds if operating at 150 characters per second, within 1,042 milliseconds if operating at 75 characters per second. (Administrative traffic can continue without regard to the status of the input buffer.) It is extremely important to note that typing during periods in which the 7070-7074 is to receive telegraph or 1009 input may cause the input to be lost to the 1414-6. The typing of one ten-character word requires one second. Typing cannot be interrupted and prevents the computer from honoring an attention from the 1414-6.

The 1414-6 stores only one data portion in one buffer-load. Any additional parenthetic sections occurring within the message will be loaded in the buffer only if the previous data portion has been transferred to the 7907. If typing, disk operations on the same channel, or a combination of stacked priority latches have prevented the transfer, the new data are not received by the 1414-6.

Before the data go to the buffer, the 1414-6 automatically deletes the letters-shift, figures-shift, line-feed, and blank characters from the incoming message; these characters do not enter the buffer. Optionally, the carriage return and parentheses may be deleted.

In transmit operation, a reverse procedure is followed. Letters shift and figures shift are the only automatically inserted characters. The output message is brought from core storage to the buffer of the 1414-6, translated into telegraph code, and sent to the selected telegraph unit when the line is ready to receive it.

ADDRESSES

Addressing Input-Output Devices

Each of the adapters to the 1414-6 is assigned a two-digit address to identify it to the 7070-7074 program. The first digit identifies the type of adapter; the second digit is the number of that particular adapter. The address also indicates whether it is an input or output (read or write) operation. Figure 4 shows possible input-output adapters, the assigned address, and the number of buffers required for attachment. Any combination of adapters shown may be attached to the 1414-6, if the combined buffer requirements do not exceed six.

Adapter	Operation	Adapter Address	No. of Buffers Required
Telegraph	Read Write	10, 11, 12 14, 15, 16	2, 3, or 4
IBM 1009	Read Write	20 24	2
IBM 1014	Read Write	60, 61 64, 65	2 or 4
IBM 1011	Read	70	1

Any combination of the above adapters may be attached to the 1414-6, if the combined buffer requirements do not exceed six.

Figure 4. IBM 1414-6 Address and Buffer Specifications

Address Register

The address register is a two-digit register that stores the address of the selected device input or output. The register is set as the result of a control operation (order) or a 1414-6 internal polling operation to designate a particular device requiring service. This requirement for service is called an "attention." Attentions are caused by one of two conditions: (1) a write buffer becoming empty [1] (the empty buffer gives only one attention signal which remains until honored), or (2) a read buffer being full. The register remains set until the input or output line is deselected (the address register is reset). Resetting the register results from:

1. End of read between the 7907 and the 1414-6 buffer (no error).
2. End of write between the 7907 and the 1414-6 buffer (no error).
3. End of sense between the 7907 and the 1414-6.
4. Start of control operation between the 7907 and the 1414-6.

If read-write operation is terminated with an unusual-end signal, the register is not reset and the 1414-6 retains the status information that caused the unusual end. If the program does not interrogate the unusual condition at this time, the information is lost when the next command takes place. While the 1414-6 is retaining status information, attention requests will pile up, possibly leading to overrun conditions in which input information will be lost. A sense instruction should be given immediately after an attention or an unusual end to avoid this possibility.

For proper conditioning of the address register, these rules should be followed:

1. A read command or a write command must always be preceded by a control command.

[1] For 1009 write operation, a delay occurs while accuracy of transmission is checked.

2. A sense command must always be preceded by an unusual end, attention or a control command.

3. An attention or unusual end should be immediately followed by a sense command to avoid losing real-time data that may be waiting for attention on another line. If the data are lost, the loss occurs because the computer is executing a non-interruptive operation so that attentions may not be honored immediately.

FUNCTIONS

The functions performed by the IBM 1414-6 Input-Output Synchronizer result from execution of orders sent to the 1414-6 as the result of any one of four types of channel commands: read, write, control, and sense. Note: In this and following sections, "order" is defined as data decoded and executed by the 1414-6, just as an "instruction" is data decoded and executed by the central processing unit, and "command" is data decoded and executed by the data channel.

The read and write commands set up the necessary control lines between the 7907 Data Channel and the 1414-6 to permit the transfer of data between the 7070-7074 and the input-output units. The control command is used to transmit orders to the 1414-6 in the form of data; the 1414-6 interprets these orders as select addresses and selects the desired unit. The sense command is used to transmit the status and identification of the device whose address is in the address register.

PROGRAMMING

Channel Select Instruction

This instruction performs six functions:

1. It specifies whether a normal priority signal will occur at completion of the operation that follows.
2. It selects the input-output channel.
3. It selects the channel switch position.
4. It specifies the coding format.
5. It furnishes the address of the initial channel command for the 7907 Data Channel.
6. It forms and stores an initial status word.

After executing the channel select instruction, the 7070-7074 proceeds immediately to the next instruction of its stored program.

The channel select instruction (DCS or PDCS) format is:

S Plus sign--priority signal at completion of 1414-6 operation. Minus sign--no priority signal at completion of the operation, unless an unusual condition occurs.

0,1 Input-output channel of the 7907
93--Channel 1
94--Channel 2
96--Channel 3
97--Channel 4

2,3 Index word

4 Channel switch position number
1--Switch Position 1
2--Switch Position 2

5 Coding format, starting mode in unpacked format, and record mark control
1--Packed*
2--Unpacked alpha start
3--Unpacked with record-mark-control alpha start*
4--Packed with record mark control*
6--Unpacked numeric start*

6-9 Core storage address of initial channel command

Channel Commands

These are commands that initiate read, write, control, sense, store-command-status-word, and branch operations. The 7907 executes channel commands and does so independently of the 7070-7074 stored program. If the system is equipped with the Additional Core Storage Optional Feature, the channel commands must be located in the first 10,000 positions of core storage. Channel commands remain in core storage until called for by the 7907. Once begun, execution of channel commands by the 7907 can continue indefinitely without intervention by the 7070-7074. The sign of a channel command tells the 7907 whether another command is to follow: a plus sign means yes; a minus sign, no. The 7907 determines the address of the next channel command by adding plus one to the present command address or, if the present one is the branch command, by extracting the branch address.

The channel command format is:

S Sign. A plus sign instructs the 7907 Data Channel to get another channel command from core storage after the present one has been executed. The address of the next command is either: (1) one higher than the address of the present command, or (2) the branch address, if the present command is branch. A minus sign instructs the 7907 that the present channel command is the last one. Because branch or store-command-status-word commands must have a plus sign, they cannot terminate a string of commands.

* Not applicable to the 1414-6

0 Channel operation
0--Store command status word
1--Read
2--Read backward (applicable only to IBM 7640 Hypertape Control)
3--Write
4--Control
5--Sense
6--Branch

1 Always the digit 0 for branch operations and in normal storage mode; combines with positions 2-5 in additional storage mode to form a five-digit address.

2-5 Core storage address that:

For read and write commands, is the start address.
For a sense command, is the address of the first word of sense data.
For a control command, is the address of the first order-word associated with the command.
For a branch command, is the branch address. (This address is also located in positions 6-9.)
For a command to store command status word, contains the address where the command status word is stored. (This address is also located in positions 6-9.)

6-9 Core storage address that:

For read and write commands, is the stop address.
For a sense command, is the address of the last word of sense data.
For a control command, is the address of the last order-word associated with the command.
For a branch command, is the branch address. (This address is also located in positions 2-5.)
For a command to store the command status word, contains the address where the command status word is stored. (This address is also located in positions 2-5.)

Orders

An order is a ten-digit word. The first two digits specify the address of the adapter to be selected. The remaining eight digits are not used and can be any valid characters. The order format is:

S Sign. Always plus.
0,1 Control operation (address of adapter to be selected, see Figure 4).
2-9 Not used.

Read and Write Operations

The digit 1 or 2 in position 0 of the read command specifies the read operation: read (digit 1) or read backward (digit 2--applicable only to 7640 Hypertape Control, not to the 1414-6). The channel select instruction that precedes one or a chain of read commands determines coding format (unpacked) and the starting mode (alphameric) in unpacked format.

The digit 3 in position 0 of a channel command specifies a write operation. The channel select instruction preceding one or a chain of write commands determines the coding format (unpacked) and the starting mode (alphameric) in unpacked format.

Read Command

The first of a chain of one or more read commands must be preceded by a control command whose associated order contains the adapter address. Positions 2-5 (start address) and 6-9 (stop address) of the read channel command define the core storage block that is to receive information. The first word from the 1414-6 fills the first word of the block (located at the start address); succeeding words from the 1414-6 fill storage words at ascending addresses within the block; the last word from the 1414-6 fills the last word of the block (located at the stop address).

The storage block does not have to accommodate a full buffer. In a scatter read operation, the record can be scattered into several core storage blocks by having a chain of read commands, one for each of the blocks.

After the last word of a block is filled, the read operation continues or terminates, depending on the sign of the read command. If the sign is plus and more storage blocks are to be filled, the 7907 Data Channel obtains another read command from storage and reading continues. If the sign of the read command is minus, the read operation terminates, the 7907 does not get another command from storage, and the 7070 or 7074 forms and stores a final status word. The sign of the channel select instruction preceding one or a chain of read channel commands determines whether the normal stacking latch for the channel will turn on at completion of the read operation(s); a plus sign causes the latch to turn on.

Write Command

The first of a chain of one or more write channel commands must be preceded by a control channel command whose associated order contains the adapter address. Positions 2-5 (start address) and 6-9 (stop address) of the write channel command define the core storage block from which information will be written in the buffer. The first word written comes from the first word of the block (located at the start address); succeeding words come from storage words at ascending addresses within the block; the last word written in the buffer comes from the last word of the block (located at the stop address).

The words from one storage block do not necessarily make a full buffer. In a gather write operation, the buffer is written by gathering words from several storage blocks. The gather write operation requires a chain of write commands, one for each of the blocks.

After the last word from a storage block is written in the buffer of the 1414-6, the write operation continues or terminates, depending on the sign of the write command. If the sign is plus and more words are to be written in the buffer, the 7907 Data Channel obtains another write command from storage, and writing continues. If the sign is plus, but a complete buffer has been written, a control command must precede a write command for another buffer. If the sign of the write command is minus, the write operation terminates, the 7907 does not get another command from storage, and the 7070-7074 forms and stores a final status word. The sign of the channel select instruction preceding one or a chain of write commands determines whether the normal stacking latch for the channel will turn on at completion of the write operation(s); a plus sign causes the latch to turn on.

Procedural Sequence for Read and Write Operations

A read command transfers a record (80 characters or less) from the assigned input buffer to the 7070-7074. The 7070-7074 proceeds with its program while the input buffer is being filled at the data rate of the input device. When the buffer is filled, the data can then be transferred to the 7070-7074, if no buffer condition has arisen to prevent the transfer.

A write command transfers a record or part of a record (up to 80 characters) to the assigned 1414-6 output buffer. After the buffer is filled from the 7070-7074, the selected device output line can accept these characters from its buffer at its own data rate.

The following is the normal sequence for the data transfer. These steps are equally applicable to read or write operation unless otherwise noted.

1. Whenever the 1414-6 is not busy (no order to process), it continuously searches for a device ready to transfer data.
2. When the device that is ready to transfer data is found, its address is automatically set in the address register. Note: A write buffer in the 1414-6 signals that it is ready to transfer data only as it becomes empty.
3. With the device identified, the 1414-6 sends an attention signal to the 7907. If the signal for turning on the attention stacking latch occurs while the normal stacking latch is on, or while the 7907 channel is busy, the signal waits until the normal latch turns off and the channel becomes free before turning on the attention stacking latch.
4. The attention stacking latch, when honored, causes a branch to a location containing a channel select instruction. This instruction contains the address of the first channel command.
5. A 7907 sense command reads a sense word (described in "Sense Operations") into 7070-7074 core storage. The sense information determines whether the channel switch position that was sensed by the command has an attention. If it has, the sense

information contains the identification of the adapter that caused the attention. If the command sensed a channel switch position with no attention, the program must give a sense command to the other channel switch position.

If the data channel contains the optional switch feature, the first channel select instruction should contain the address of the sense command for switch position 1 (connected to the 7631 File Control). If this position does not have the attention, the next channel select instruction senses the channel switch 2 position (connected to the 1414-6).

As soon as the sense word containing the adapter identification has been brought into 7070-7074 storage, the address register in the 1414-6 is reset so that new attention signals can be sent to the 7907 from other devices.

6. A 7907 control command sends an order to the 1414-6 to select the unit.

7. A 7907 read command initiates an internal (1414-6) test to verify that the selected unit is prepared to operate. The write command causes an internal test to verify that the selected buffer is empty and is in condition for use.

8. In read operation: if the 1414-6 is prepared to operate, the 1414-6 transfers the filled buffer to the 7907 and follows with an end signal. If the input device is not prepared to operate, or an error has occurred during the transfer, an unusual-end signal results. The final status word is formed and stored and the normal interrupt stacking latch is set.

In write operation: if the buffer is empty, the 7907 transfers the data to fill the 1414-6 buffer. (The number of characters must not exceed 80. If there are fewer than 80, the last character is followed by a stop signal to enable the 1414-6 to fill the remaining portion of the buffer with blanks and to disconnect.) When the buffer is full, the 1414-6 sends an end signal to the 7907. If the buffer is not empty, or if an error has occurred in the transfer, an unusual-end signal is sent to the 7907. The final status word is formed and stored and the normal interrupt stacking latch is set.

9. The normal interrupt stacking latch, being set, causes a branch to a priority routine in which the sense command interrogates the status data in the 1414-6. The sense command must be used when an error condition occurs during the operation. This command resets the 1414-6 address register and transfers its contents to the computer.

Branch Operations

The branch command permits channel commands to be scattered throughout the first 10,000 positions of storage. This enables the channel command program to branch to frequently used routines. The sign of a branch command must be plus. (It cannot terminate a string of commands.) The branch address must be in positions 2-5 and 6-9.

Store-Command-Status-Word Operations

The command for store-command-status-word provides a means of keeping track of the progress of the channel command program. (See format of command status word under "Status Words.") Its use is not mandatory. If an error occurs, the command status

word (in a location specified by the programmer) contains the address plus one of the store-command-status-word command. This information enhances the efficiency of error routine operations.

The sign of the store-command-status-word command must be plus. (It cannot terminate a string of commands.) The address where the command status word is to be stored must be in positions 2-5 and 6-9.

Control Operations

A control command initiates one control operation by transferring one order-word (containing the address of the adapter to be selected) from core storage to the 1414-6. If the control command has a plus sign and is executed successfully, the 7907 Data Channel obtains the next channel command from storage and proceeds to execute it. The next command can be another control command or a read, write, sense, or branch command. If the sign of the control command is minus, the 7907 does not get another command from storage, and the 7070-7074 forms and stores a final status word. The sign of the channel select instruction preceding the control command determines whether the normal stacking latch for the channel will turn on when the final status word is formed; a plus sign causes the latch to turn on.

Sense Operations

A sense command assembles the identification and status for a selected device of the 1414-6 into one ten-digit word. The device could be selected either by a control command or an attention requirement. Positions 2-5 and 6-9 of the sense command define the core storage location for the sense word. The sign of the channel select instruction determines whether the normal stacking latch for the channel will turn on at completion of the sense operation; a plus sign causes the latch to turn on. If the sense command has a plus sign and is executed successfully, the 7907 Data Channel obtains the next channel command from storage and executes it; if the sign is minus, the 7907 does not get another command, and the 7070-7074 forms and stores a final status word.

The format for the word of sense information is:

S Sign. The sign is plus when the selected channel switch position has an attention signal. It is minus when the selected channel switch position does not have an attention signal.

0,1 These positions indicate a normal operation (digits 44), a program check (64), a data check (46), the presence of one or more exceptional conditions (45) more fully defined in positions 2, 3 of the sense word, or a combination of a data check and one or more exceptional conditions (47). The sense information contained in positions 0-7 of the sense word comes from the 1414-6 in the form of four BCD characters, of which only the A, 4, 2, 1 bits contain information (Figure 5). These BCD characters are translated in the 7907 Data Channel into the digits appearing in positions 0-7 (Figure 6).

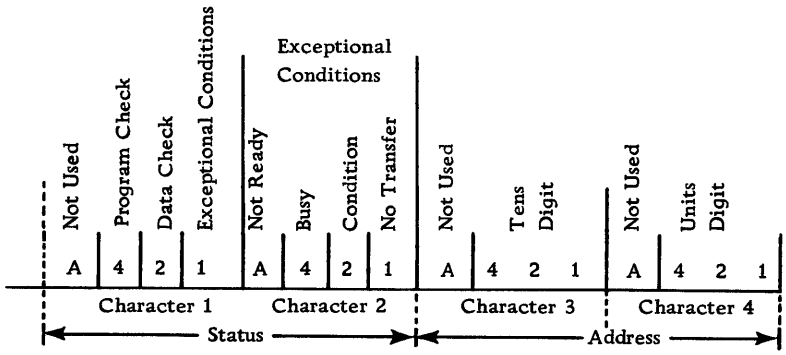

Figure 5. IBM 1414-6 BCD Sense Characters

BCD Char Bits	BCD Char No.	Sense Word Pos	Digits in the Sense Word Pos	Interpretation
A 4 2 1	1	0,1		
0 0 0 0			4 4	Normal Operation.
0 1 0 0			6 4	Program check caused by selecting a write adapter followed by a read command or vice versa, or giving a sense command not preceded by: (1) a control command or (2) either an unusual end or attention signal from the 1414-6.
0 0 1 0			4 6	Data check caused by either: (1) a character parity check in the 1414-6 or (2) a 1414-6 machine check.
0 0 0 1			4 5	Presence of an exceptional condition defined in positions 2, 3 of the sense word.
0 0 1 1			4 7	Combination of data check and exceptional condition.
A 4 2 1	2	2,3		
0 0 0 0			4 4	Normal Condition
1 0 0 0			5 4	Device not ready. This indication overrides all others from this character.
0 1 0 0			6 4	Addressed buffer is busy.
0 0 1 0			4 6	Error condition.
0 0 0 1			4 5	No transfer.
0 0 1 1			4 7	Combination of error condition and no transfer.
0 1 0 1			6 5	Combination of a busy buffer and no transfer.
			(See further interpretations of sense word positions 2, 3 in Figure 7.)	
A 4 2 1	3	4,5		
0 0 0 1			4 5	Address tens-digit is 1 (telegraph).
0 0 1 0			4 6	Address tens-digit is 2 (IBM 1009).
0 1 1 0			6 6	Address tens-digit is 6 (IBM 1014).
0 1 1 1			6 7	Address tens-digit is 7 (IBM 1011).
A 4 2 1	4	6,7		
0 0 0 0			4 4	Address units-digit is 0 (read).
0 0 0 1			4 5	Address units-digit is 1 (read).
0 0 1 0			4 6	Address units-digit is 2 (read).
0 1 0 0			6 4	Address units-digit is 4 (write).
0 1 0 1			6 5	Address units-digit is 5 (write).
0 1 1 0			6 6	Address units-digit is 6 (write).

Figure 6. Interpretation of Sense Information in Positions 0-7 of the Sense Word

Address Tens Digit	Device	STATUS DATA INFORMATION					
		A bit - Not Ready Digits 5 4 in Pos 2, 3	4 bit - Busy Digits 6 4 in Pos 2,3	2 bit - Condition Digits 4 6 in Pos 2, 3	1 bit - No Transfer Digits 4 5 in Pos 2, 3	Combinations BCD bits	Digits
1	Telegraph Read	Buffer not on line or power off	Buffer is being filled	Missed message	No request		
1	Telegraph Write	Buffer not on line or power off	Buffer is being emptied	Last message in error; not transmitted to remote telegraph*	Last message transmitted but received incorrectly	2&1	4 7
2	IBM 1009 DTU Read	DTU not on line or power off	Buffer is being filled	Missed message	No request		
2	IBM 1009 DTU Write	DTU not on line or power off	Buffer is being emptied	Last message in error; transmitted to local 1009, but not to remote 1009	Last message transmitted but received incorrectly	2&1 4&1	4 7 6 5
6	IBM 1014 Read	Buffer not on line or buffer power off	Not applicable	Not applicable	No request or buffer being filled		
6	IBM 1014 Write	Buffer not on line or power off	Buffer being emptied	Last message in error;not transmitted	Last message not transmitted; station inoperative	2&1	4 7
7	IBM 1011 Read	Paper tape power off--out of tape	Buffer being filled	Not applicable	Not applicable		

* May be transmitted to local telegraph

Figure 7. Interpretation of Exceptional Conditions Sense Information in Positions 2 and 3 of the Sense Word

2,3 These positions indicate any exceptional conditions that have arisen within the 1414-6 (or beyond the 1414-6 in the device or the transmission system) preventing normal transfer of data. These digits, with their interpretations, are shown in Figure 7.

4,5 These positions indicate the tens digit of the adapter address, as shown in Figure 6.

6,7 These positions indicate the units address of the adapter address, as shown in Figure 6.

8,9 These positions are not used. They contain the digits 44.

Status Words

Every time that the 7070-7074 executes the channel select instruction, it forms an initial status word and stores the word in a core storage location corresponding to the input-output channel being used. The locations reserved for initial status words are:

0351--Channel 1
0352--Channel 2
0353--Channel 3
0354--Channel 4

Initial-Status-Word Format

S Sign. Same as sign of channel select instruction.
0,1 Same as positions 0, 1 of the channel select instruction.
2-5 Address plus one of the channel select instruction (instruction counter contents).
6-9 Same as positions 6-9 of the channel select instruction.

After the 7907 Data Channel executes a minus-signed channel command, the 7070-7074 forms a final status word and stores the word in a core storage location corresponding to the input-output channel. The locations reserved for final status words are:

0301--Channel 1
0302--Channel 2
0303--Channel 3
0304--Channel 4

Final-Status-Word Format

S Sign. Always plus.

0 Condition code.
1--Channel error (information bus validity check, address bus validity check, inhibit validity check, translation error, data error, control error).
2--Correct length record.
3--Short length record
4--Long length record
5--Unusual end (error in 1414-6)

1 Always contains the digit 0 in normal storage mode; combines with positions 2-5 in additional storage mode to form a five-digit address.

2-5 Working address at completion of a read or write operation.

6-9 Address plus one of the last channel command.

Command-Status-Word Format

S Sign. Always plus.

0 Always 2

1 Always the digit 0 in normal storage mode; combines with positions 2-5 in additional storage mode to form a five-digit address.

2-5 Address where the command status word is to be stored.

6-9 Address plus one of the store-command-status-word command that formed this command status word. In case of an error, these positions provide the address plus one of the last store-command-status-word command. A programming example of this would be:

7070-7074 Storage Location	Contents
1000	Contains the address 2005 when the command sequence is between 2004 and 2008. It contains address 2009 when the command sequence is between 2008 and 2012.

Assume that a channel-select instruction gives an initial address of 2000.

2000	Control command (+)
2001	Read command (+)
2002	Read command (+)
2003	Read command (+)
2004	Store command-status-word in location 1000 (+)
2005	Control (+)
2006	Write* (+)
2007	Write (+)
2008	Store command-status-word in location 1000 (+)
2009	Control (+)
2010	Write (+)
2011	Write (+)
2012	Store command-status-word in location 1000 (+)

* Assume that an error is detected at this point. The 7907 would form and store a final status word. This would cause a normal interrupt with a branch to a priority routine to determine the nature of the error. Assume that the program desires to rewrite the record in error. The priority routine makes a new channel-select instruction using the address contained in position 1000. Because a store-command-status-word command was placed in location 2004, the address at location 1000 is now 2005 (2004 plus 1), which brings the program back to the control command to prepare the 1414-6 for writing the desired record.

Error Correction Procedures

Data Check. This check occurs if the message in or out contains one or more character errors. It also can signify a 1414-6 machine check. Procedure suggestions: On write, rewrite; on read, the application and the nature of the data and the device being read will have to determine the procedure to be used.

Program Check. This check occurs whenever there is an error in programming the sequence of operations. Examples: selecting a read line and following with a write command or vice versa, or giving a sense command that has not been preceded by an unusual end or attention from the 1414-6 or by a control command by the program. Procedure recommendation: Correct the program.

Stacking Latches

A 7070-7074 Data Processing System has two stacking latches, normal and attention, associated with each input-output channel of the 7907 Data Channel. If the channel-select instruction that preceded one or a series of channel commands had a plus sign,

the normal latch for a channel turns on after successful completion of the commands, before the channel goes "not busy." If the instruction had a minus sign, the latch turns on only if an error occurs. The attention stacking latch for a channel turns on with any attention signal from the 1414-6. Note: If the signal for turning on the attention stacking latch occurs while the normal stacking latch is on or while the input-output channel is busy, the signal will wait until the normal latch turns off and the channel becomes free before turning on the attention stacking latch.

The priority branch addresses associated with normal and attention stacking latches are:

0311--Normal branch address, channel 1
0321--Attention branch address, channel 1
0312--Normal branch address, channel 2
0322--Attention branch address, channel 2
0313--Normal branch address, channel 3
0323--Attention branch address, channel 3
0314--Normal branch address, channel 4
0324--Attention branch address, channel 4

Changes to 7070-7074 Instructions

The following list contains 7070-7074 instructions modified to include 7907 Data Channel operations.

Branch if Channel Busy (+51)

Position 4	Input-output channel (1-4)
Position 5	Always the digit 2 (specifying the 7907)

Stacking Latch Test (+60), Stacking Latch Set (-61), and Stacking Latch Reset (-62)

Positions 4,5	Stacking latch: 81-84 for normal latches; 91-94 for attention latches.

Priority Control (+55)

Positions 4,5	Priority mask register. 00 for present input-output channels in the 7604 Tape Control; 01 for channels 1-4 in the 7907 Data Channel.

The format of the priority mask word for channels 1-4 of the 7907 Data Channel is:

S	Sign. Always plus.
0	Normal latch, channel 1
1	Attention latch, channel 1
2	Normal latch, channel 2
3	Attention latch, channel 2
4	Normal latch, channel 3
5	Attention latch, channel 3
6	Normal latch, channel 4
7	Attention latch, channel 4
8,9	Not used. Digits 00.

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