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IBM 1410 Priority Feature

This bulletin describes the operation, switches, and
lights of the Priority Feature (Special Feature 5620)
and Priority Feature Extension (Special Feature 5621)
for the IBM 1410 Data Processing System. Also
described are the Priority Test and Branch and
Input-Output NOP instructions.

This publication obsoletes the 1410 Priority Feature
Bulletin, A22-0530-0.

PRIORITY FEATURE

The Priority Feature is an interrupt system that provides an automatic branch to a
fixed storage location (00101) when certain conditions of the I-O channels or devices
occur. These conditions are stored in indicators, which may be tested to determine
the specific cause of the interrupt.

Two modes of operation, priority alert mode and normal mode, enable the programmer
to control whether a given sequence of instructions may be interrupted or not. One or
other of these modes is in effect at all times. In normal mode, no interrupts are per-
mitted to occur. In priority alert mode, interrupts to the program are permitted.

Five priority test and branch instructions for each channel, two priority branch un-
conditional instructions, and the input-output NOP instruction are provided for use
with the priority feature.

PRIORITY ALERT MODE

The priority alert mode is determined by the status of the priority alert mode indicator.
If the priority alert mode indicator is on, the system is in the priority alert mode and
is capable of accepting an interrupt. If the priority alert mode indicator is off, the sys-
tem is in a normal mode and cannot accept an interrupt. A priority alert mode light,
located on the 1415 Console, indicates the status of the priority alert mode indicator.

Priority alert mode can be entered by the branch unconditionally and enter priority
alert mode instruction Y(I)E. The Y(I)E instruction turns on the priority alert mode
indicator and causes an unconditional branch to the I address of the instruction.

The priority alert mode indicator is turned off by the following two ways:

1. A priority interrupt.
2. A branch unconditionally and exit from the priority alert mode instruction, Y(I)X.

PROGRAM INTERRUPTION

Not all instructions can be interrupted. Also, some instructions of one length can be
interrupted, while the same instruction of another length cannot. If an interrupt occurs,
it takes place during the time an instruction is being read, before the actual execution
of the instruction. Only unchained operations can be interrupted. Figure 1 shows the
operation codes that can be interrupted.

The main routine interrupt occurs when: the operation code being read can be inter-
rupted, the channel to be used is not busy, and the following additional conditions are
present:

1. The system is in the priority alert mode.
2. The priority request indicator is turned on.

Priority Request Indicators

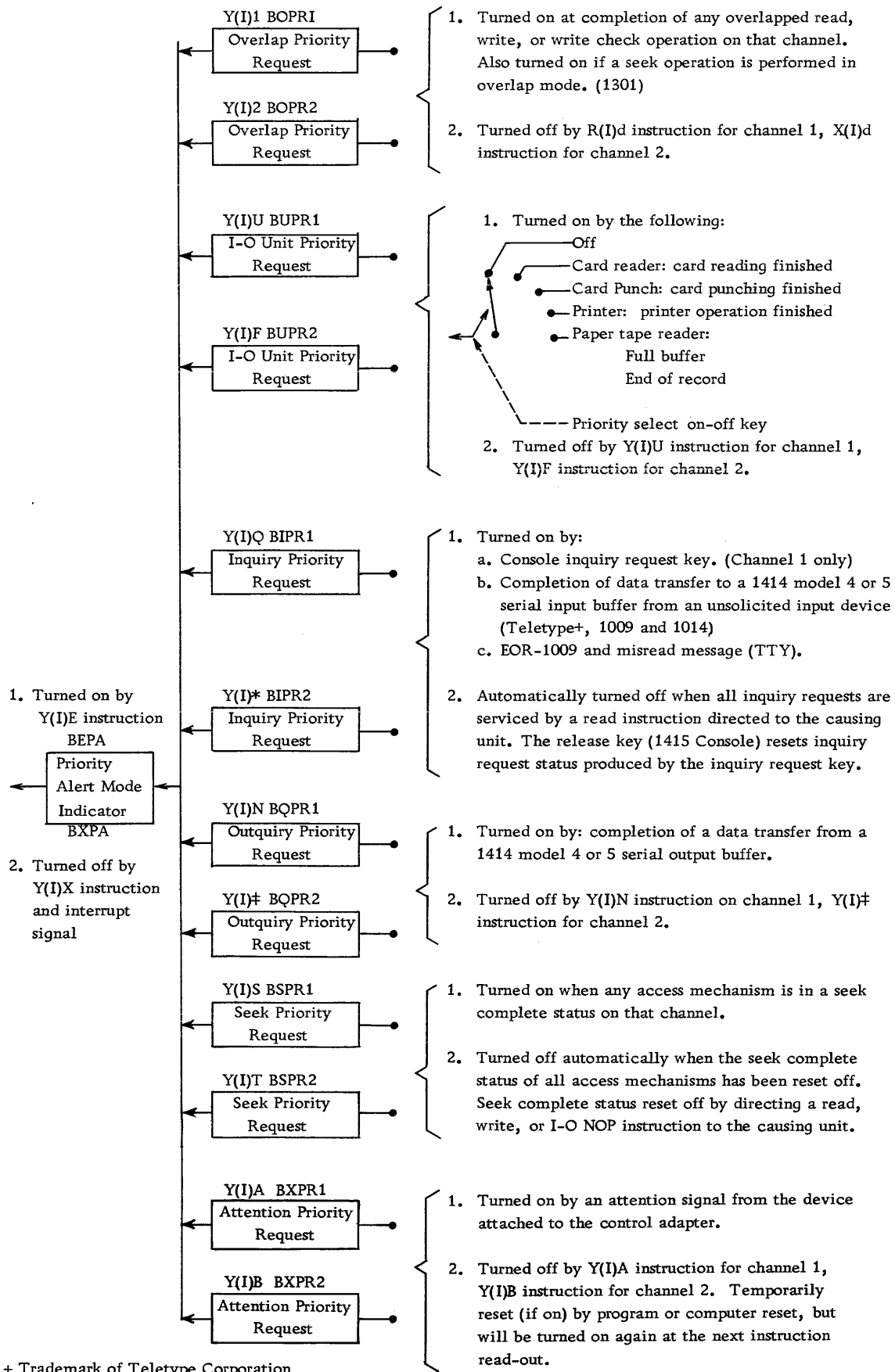| Operation	Interruptible Op Code	Interruptible Length	Non-interruptible Length
Zero and Add	?	11	1,6
Zero and Subtract	!	11	1,6
Add	A	11	1,6
Subtract	S	11	1,6
Multiply	@	11	1,6
Divide	%	11	1,6
Move Characters and Edit	E	11	1,6
Move Characters and Suppress Zeros	Z	11	1,6
Compare	C	11	1,6
Clear Storage and Branch	/	11	1,6
Set Word Mark	'	11	1,6
Clear Word Mark	□	11	1,6
Branch if Bit Equal	W	12	1,6
Branch on Word Mark or Zone Equal	V	12	1,6
Move Data	D	12	1,6
Branch if Character Equal	B	12	1,6
Table Lookup	T	12	1,6
Test and Branch	J	7	1
Branch if I-O Channel Status Indicator On (CH 1)	R	7	--
Branch if I-O Channel Status Indicator On (CH 2)	X	7	--
Priority Test Branch	Y	--	1,7
No Operation	N	--	Any
Move (I-O Operation)	M	--	10
Load (I-O Operation)	L	--	10
Store Address Register	G	--	7
Halt	.	--	1,6
Control Unit	U	--	2
Control Carriage	F	--	2
Stacker Select Feed	K	--	2

Figure 1. Interruptible and Non-interruptible Operation Codes

Priority Request Indicators

Each channel can have six different priority request indicators: overlap, I-O unit, inquiry, outquiry, seek, and attention. I-O unit, inquiry and outquiry priority request indicators for channel 2 are available only with the I-O Adapter (Special Feature 4660) and Priority Feature Extension (Special Feature 5621) for channel two.

Interrupt conditions occurring in a channel or various I-O devices are signaled by turning on a particular priority request indicator. A priority request indicator turned on, turns off the priority alert mode indicator (if on), removes the system from the priority alert mode, and causes the system to branch to storage location 00101. (Refer to Figure 2.)

Interrupt requests occur on a real-time basis. For this reason it is possible for a request to occur too late during instruction read-out time, of an interruptible instruction, to effect an interrupt. However, the priority request indicator, related to the type of interrupt, will be turned on. In these instances the interrupt will occur, during

Y(I)1 BOPRI

| Overlap Priority Request |

1. Turned on at completion of any overlapped read, write, or write check operation on that channel. Also turned on if a seek operation is performed in overlap mode. (1301)

Y(I)2 BOPR2

| Overlap Priority Request |

2. Turned off by R(I)d instruction for channel 1, X(I)d instruction for channel 2.

Y(I)U BUPR1

| I-O Unit Priority Request |

1. Turned on by the following:
   Off
   Card reader: card reading finished
   Card Punch: card punching finished
   Printer: printer operation finished
   Paper tape reader:
      Full buffer
      End of record

Y(I)F BUPR2

| I-O Unit Priority Request |

   Priority select on-off key
2. Turned off by Y(I)U instruction for channel 1, Y(I)F instruction for channel 2.

Y(I)Q BIPR1

| Inquiry Priority Request |

1. Turned on by:
   a. Console inquiry request key. (Channel 1 only)
   b. Completion of data transfer to a 1414 model 4 or 5 serial input buffer from an unsolicited input device (Teletype+, 1009 and 1014)
   c. EOR-1009 and misread message (TTY).

1. Turned on by Y(I)E instruction
   BEPA

| Priority Alert Mode Indicator |

   BXPA

2. Turned off by Y(I)X instruction and interrupt signal

Y(I)* BIPR2

| Inquiry Priority Request |

2. Automatically turned off when all inquiry requests are serviced by a read instruction directed to the causing unit. The release key (1415 Console) resets inquiry request status produced by the inquiry request key.

Y(I)N BQPR1

| Outquiry Priority Request |

1. Turned on by: completion of a data transfer from a 1414 model 4 or 5 serial output buffer.

Y(I)‡ BQPR2

| Outquiry Priority Request |

2. Turned off by Y(I)N instruction on channel 1, Y(I)‡ instruction for channel 2.

Y(I)S BSPR1

| Seek Priority Request |

1. Turned on when any access mechanism is in a seek complete status on that channel.

Y(I)T BSPR2

| Seek Priority Request |

2. Turned off automatically when the seek complete status of all access mechanisms has been reset off. Seek complete status reset off by directing a read, write, or I-O NOP instruction to the causing unit.

Y(I)A BXPR1

| Attention Priority Request |

1. Turned on by an attention signal from the device attached to the control adapter.

Y(I)B BXPR2

| Attention Priority Request |

2. Turned off by Y(I)A instruction for channel 1, Y(I)B instruction for channel 2. Temporarily reset (if on) by program or computer reset, but will be turned on again at the next instruction read-out.

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Figure 2. Priority Request Indicators

instruction read-out time, of the next interruptible instruction with the following exception:

When an overlap priority request occurs too late to interrupt and the next instruction is a Branch if I/O Status Indicator On, the priority request indicator previously turned on is reset and no interrupt occurs. The resetting of the overlap priority request indicator under these circumstances is a normal function of the Branch if I/O Status Indicator On instruction.

Channel 1 or 2 Overlap Priority Request Indicator is turned on at the completion of an overlapped read, write, or write check operation on that channel. The indicator also can be turned on by performing a seek operation in the overlap mode (7631-1301). In this case, the indicator turns on at the completion of the address transfer to the 7631 File Control prior to the actual movement of the access mechanism. Status of the indicator is determined by the priority test and branch instruction, Y(I)1 for channel 1 or Y(I)2 for channel 2. The indicator is turned off by the R(I)d instruction for channel 1 or X(I)d instruction for channel 2.

Channel 1 or 2 I-O Unit Priority Request Indicator is operated under control of a priority select switch (1415 Console) and one of the I-O devices indicated by the switch setting. Each switch has five positions: off, card reader, card punch, printer, and paper tape reader. Associated with each priority select switch is a priority select on-off key (1415 Console). This double-action key, when on, allows the I-O device designated by its related priority request switch to turn on the I-O unit priority request indicator. When a priority select on-off key is turned on, the I-O unit priority request indicator is automatically turned on, regardless of the setting of either priority select switch. This may be used to enter the interrupt routine initially. The priority select switch and associated priority select on-off key for channel 2 are available only with the Priority Feature Extension (Special Feature 5621).

The I-O unit priority request indicator is also turned on when the I-O device selected by the priority select switch for a channel, finishes an operation:

1. Card reader -- card reading finished
2. Card punch -- card punching finished
3. Printer -- line of print printed
4. Paper tape reader -- full buffer or end of record

The indicator is tested and turned off, if on, by the Y(I)U instruction for channel 1 or Y(I)F for channel 2. Note that the card reader, card punch, and printer can each produce two types of priority requests: I-O unit priority request and overlap priority request.

Channel 1 or 2 Inquiry Request Indicator is turned on by use of the console inquiry request key (channel 1 only) completion of a data transfer from a 1414 model 4 or 5 serial input buffer, an end of record (EOR) for the 1009, or a misread telegraph message on that channel. The indicator is turned off automatically when all inquiry requests are serviced by a proper read operation directed to the unit or units in inquiry request status. The release key (1415 Console) resets inquiry request status produced by the

inquiry request key. An inquiry request interrupt caused by either the console or the 1414 TP buffer can be differentiated as follows:

1. An I-O NOP instruction is issued to the console.
2. If the inquiry request was not caused by the console, the no transfer indicator will be set.
3. If the inquiry was caused by the console, no indicator will be set.

Channel 1 or 2 Outquiry Request Indicator is turned on at the completion of a data transfer from a 1414 model 4 or 5 serial output buffer on that channel. The indicator is tested and turned off, if on, by the Y(I)N instruction for channel 1 and Y(I) ǂ for channel 2.

Channel 1 or 2 Seek Priority Request Indicator is turned on when any access mechanism, for that channel, is in a seek complete status. The indicator is tested by the Y(I)S instruction for channel 1 and Y(I)T for channel 2 and is turned off automatically when the seek complete status of all access mechanisms is reset off. Seek complete status is reset off by a read, write, or I-O NOP instruction directed to the unit or units in a seek complete status.

Channel 1 or 2 Attention Interrupt Request Indicator is turned on by an attention signal from the device attached to the channel control adapter. The indicator is turned off by the Y(I)A instruction for channel 1 and the Y(I)B instruction for channel 2.

PRIORITY ROUTINE PROGRAM

When an interrupt branch has occurred, the priority routine program must make provision for returning to the interrupted instruction of the main routine. This is accomplished by storing and decrementing by six the address in the B-address register (BAR), following the interrupt. The decremented B-address is the address specified in the branch unconditionally and enter instruction, Y(I)E, located at the end of the priority routine.

If the status of arithmetic and logic indicators will be changed by operations in the priority routine, their status must be saved. If the status is saved, it must be restored before branching back to the main routine program.

The cause of the main routine interrupt and any priority for processing interrupts is determined in the priority routine program. Testing for the cause of the interrupt is done by using the operation code, priority test and branch, Y(I)d.

Priority Test and Branch Instructions, Y(I)d

The six priority test and branch operations, for each channel, and the two priority test and branch unconditional operations with the respective d-characters are:

Mnemonic	Instruction	
BUPR1	Y(I)U	Branch if channel 1 I-O unit priority request.
BUPR2	Y(I)F	*Branch if channel 2 I-O unit priority request.
BOPR1	Y(I)1	Branch if channel 1 overlap priority request.

Mnemonic	Instruction	
BOPR2	Y(I)2	Branch if channel 2 overlap priority request.
BIPR1	Y(I)Q	Branch if channel 1 inquiry priority request.
BIPR2	Y(I)*	*Branch if channel 2 inquiry priority request.
BQPR1	Y(I)N	Branch if channel 1 outquiry priority request.
BQPR2	Y(I)‡	*Branch if channel 2 outquiry priority request.
BSPR1	Y(I)S	Branch if channel 1 seek priority request.
BSPR2	Y(I)T	Branch if channel 2 seek priority request.
BXPA	Y(I)X	Branch unconditionally and exit from priority alert mode.
BEPA	Y(I)E	Branch unconditionally and enter priority alert mode.
BXPR1	Y(I)A	Branch if channel 1 attention
BXPR2	Y(I)B	Branch if channel 2 attention

* Available only with I-O Adapter (Special Feature 4660) and Priority Feature Extension (Special Feature 5621) for channel 2.

INPUT-OUTPUT NOP INSTRUCTION (Available Only With Priority Feature)

The I-O NOP instruction (Figure 3) is used to determine the status of any I-O device attached to the 1410 system. The operation is identical to a normal read or write operation except that no data transfer occurs. (File addresses in file address tests, however, will be transferred.)

Following an interrupt by some I-O device, the I-O NOP instruction is used to set the I-O channel status indicators on. The status of the I-O device causing the interrupt can be determined by a branch if I-O channel status indicator on instruction -- R(I)d or X(I)d. Charts following Figure 3 show the conditions that set the I-O channel status indicators on, for various I-O devices.

The bit configuration of the d-character of the branch if I-O channel status indicator on instruction determines which indicator will be tested.

    d-character bit
    1 Not ready
    2 Busy
    4 Data check
    8 Condition
    A No transfer
    B Wrong length record

One to six of the channel status indicators can be tested by a single R(I)d or X(I)d instruction by having the proper bit configuration composing the d-character. For example, an R(I)3 -- (1 and 2 bits) tests the not ready and busy indicators; an R(I)7 -- (1, 2, and 4 bits) tests the not ready, busy, and data check indicators and the R(I)‡ -- (1, 2, 4, 8, A, and B bits) tests all six indicators.

Each of the I-O channels is interlocked to prevent a second operation on the same channel until the status of the first operation has been tested. The interlock on channel 1 is removed by an R(I)‡ instruction or an R(I)d instruction which results in a branch. The channel 2 interlock is removed by an X(I)‡ instruction or an X(I)d instruction which results in a branch.
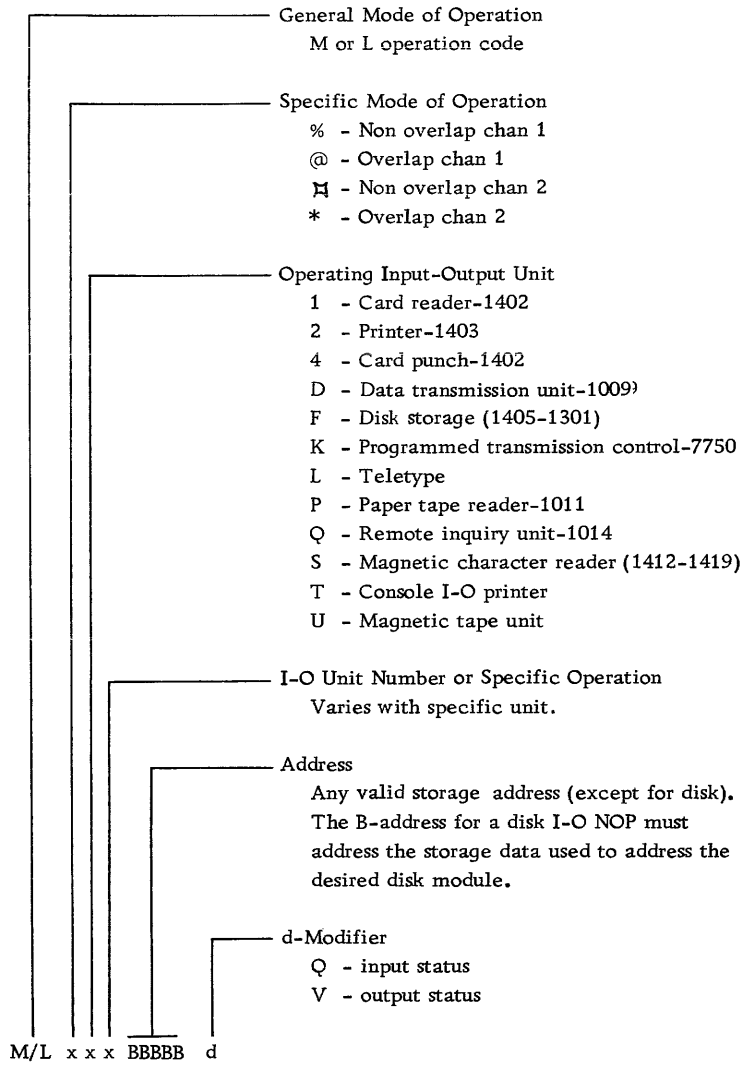
General Mode of Operation
    M or L operation code

Specific Mode of Operation
    % - Non overlap chan 1
    @ - Overlap chan 1
    ⌗ - Non overlap chan 2
    * - Overlap chan 2

Operating Input-Output Unit
    1   - Card reader-1402
    2   - Printer-1403
    4   - Card punch-1402
    D   - Data transmission unit-1009)
    F   - Disk storage (1405-1301)
    K   - Programmed transmission control-7750
    L   - Teletype
    P   - Paper tape reader-1011
    Q   - Remote inquiry unit-1014
    S   - Magnetic character reader (1412-1419)
    T   - Console I-O printer
    U   - Magnetic tape unit

I-O Unit Number or Specific Operation
    Varies with specific unit.

Address
    Any valid storage address (except for disk).
    The B-address for a disk I-O NOP must
    address the storage data used to address the
    desired disk module.

d-Modifier
    Q   - input status
    V   - output status

M/L x x x BBBBB d

Figure 3.   I-O No-OP Instruction Format

INDICATOR	1402 CARD READER	1402 CARD PUNCH
Not Ready	Card jam Reader out of cards (not EOF) Reader not on line Reader power off Reader stacker full Cover interlock open Feed clutch failure (clutch check) Joggle switch open (file feed door) Input-Output synchronizer off line Input-Output synchronizer power off	Card jam Punch out of cards Punch stacker full Punch power off Punch not on line Chip basket full or not in place Cover interlock open
Busy	Read synchronizer being filled Card being stacked	Previous card still being punched
Data Check	Hole count check Input-Output synchronizer detects parity error Input-Output synchronizer detects timing error Processing unit detects parity error Never set on stacker select and feed instruction	Input-Output synchronizer detects parity error (card not punched)
Condition	EOF (last card has been stacked) (EOF latch turned off as this indicator turned on) Never set on stacker select and feed instruction	Hole count check-detected during the punch cycle of the following card. If error card is stacked, a blank card (second card behind error card) is fed. Parity error detected during punching.
No Transfer	Card has been transferred previously. This indicator will be set ON if two select stacker and feed instructions are given without an intervening read a card instruction with a 9 in the units position (n) of the X-control field. It will also be set ON if two read a card instructions with a 9 in the units position of the X-control field are given without an intervening select stacker and feed instruction.	Never set
Wrong Length Record	Wrong length record Never set on stacker select and feed instruction	Wrong length record (this card not punched)

INDICATOR	1403 PRINTER	
	M/L OP	F/2 OP
Not Ready	Printer not ready, printer not on line, printer power off, printer out of forms	Printer not ready, printer not on line, printer power off, printer out of forms
Busy	Previous line still being printed	Forms in motion, forms instruction waiting to be executed
Data Check	Print synchronizer detects parity error (line is not printed)	Never set
Condition	Print synchronizer detects timing error, print synchronizer detects hammer fire check (line is not printed)	Never set
No Transfer	Never set	Never set
Wrong Length Record	Wrong length record (line is not printed)	Never set

INDICATOR	1415 CONSOLE OPERATIONS
Not Ready	Never set
Busy	Never set (read operation) Carriage returning (write operation)
Data Check	Processing unit detects input character validity error (read) I-O printer detects output character validity error (write)
Condition	Cancel key operated during inquiry (read) Never set (write)
No Transfer	No message request -- cancel key operated before inquiry (read) Never set (write)
Wrong Length Record	Wrong length record (read) Never set (write)

INDICATOR	729-7330 TAPE OPERATIONS	
Not Ready	Tape unit not ready No such tape unit selected Tape adapter unit not on line Tape adapter unit power off	Read, Write, and Unit Control
Busy	Tape unit rewinding Tape adapter unit busy (backspace of 7330 read-write not finished)	Read, Write, and Unit Control
Data Check	Processing unit received wrong parity character Tape adapter unit sent wrong parity character Tape mark read in odd parity mode Tape adapter unit received wrong parity character Tape adapter unit detects rbc parity error Set if write tape mark in odd parity	Read Read Read Write Write Unit Control
Condition	1st character of record was tape mark Foil strip detected Never set (unless tape mark read)	Read Write Unit Control
No Transfer	Never set	Read Write, and Unit Control
Wrong Length Record	Wrong length record (~~always~~ usually set when d-character is $) Never Set	Read, Write, and Unit Control

Indicator	7750 Programmed Transmission Control
Not Ready	7750 not ready
Busy	Not used
Data Check	1. Unusual end signal from 7750 2. Input parity error in 1410
Condition	1. 7750 failed to terminate previous operation correctly. 2. 7750 unable to initiate operation
No Transfer	Data transfer incomplete. 7750 became inoperative during data transfer.
Wrong Length Record	Data field actually transferred was different in length from either the field in storage or field in 7750. On input data is stored to $\pm$ – remainder lost.

INDICATOR	1014 READ	1014 WRITE	1011 READ
Not Ready	Power off in 1414 or buffer not on line. (No data transfer)	Power off in 1414 or buffer not on line. (No data transfer)	Power off in 1414, buffer not on line. 1011 out of tape or tape is broken, or 1011 not attached to 1414 (no data transfer)
Busy	Not applicable	Buffer emptying	Buffer filling
Data Check	79 characters entered or parity error between 1414 and core storage. If parity error, incorrect data stored as * if asterisk switch is on.	Parity error between core storage and 1414. No transfer to 1014.	Parity error between 1414 and core storage. Incorrect data stored as an * if asterisk switch is on.
Condition	Machine check within 1414	Preceding message in error as received at station. Current message not transmitted.	Not applicable
No Transfer	Buffer not full	Preceding message not transmitted; station inoperative (non-existent station power off, station out of forms, or station didn't acknowledge preceding message).	Not applicable
Wrong Length Record	Incorrectly placed GM-WM. Data stored only to GM-WM. Remainder lost.	Incorrectly placed GM-WM. Data transfer up to GM-WM, but only to 1414.	Incorrectly placed GM-WM. Data stored only to GM-WM. Remainder lost.

INDICATOR	TELEGRAPH READ	TELEGRAPH WRITE	1009 READ	1009 WRITE
Not Ready	Power off in 1414 or buffer not on line. (No data transfer)	Power off in 1414, buffer not on line, or local telegraph not ready. (No transfer of data)	Power off in 1414, buffer not on line, 1009 not on line, or power off. No transfer of data.	Power off in 1414, buffer not on line, 1009 not on line or power off. No transfer of data.
Busy	Buffer filling	Buffer emptying	Buffer filling	Both buffers have data; one is emptying. Or, last segment of message is in 1 buffer.
Data Check	Parity error, format check, or character pile-up between telegraph unit and 1414 or parity error between 1414 and 1410. Incorrect data stored as *, if asterisk switch is on.	Parity error between 1410 core storage and 1414. No transfer to telegraph.	Parity error between 1414 and core storage. Incorrect data stored as * if asterisk switch is on.	Parity error between core storage and the 1414. Incorrect data arrived in 1414. (No transfer to local 1009)
Condition	Missed message. Buffer not emptied in time.	Preceding message had parity or translate error between 1414 and telegraph.	Missed message (buffer not emptied in time) or transmission error. (Indicator comes on only after end-of-message condition is recognized by the 1414)	Current message in error. Transmitted to local 1009, but not successfully to remote 1009.
No Transfer	No request. No message in buffer to be read.	Preceding message transmitted but received incorrectly or not at all because of invalid format line failure, or excessive delay in getting characters to the output line, or no group mark following the EOM sequence.	End of message	End of message. (This comes on only after busy goes off.)
Wrong Length Record	Incorrectly placed GM-WM. Data stored only to GM-WM. Remainder lost.	Incorrectly placed GM-WM. Data transfer up to GM-WM, but only to the 1414 (not to telegraph).	Incorrectly placed GM-WM. Data stored only to GM-WM. Remainder lost.	Incorrectly placed GM-WM. Data transfer up to GM-WM, but only to 1414, not to local 1009.

INDICATOR	7631/1301
Not Ready	Access inoperative or 7631 off-line 7631 power off Home address switch check
Busy	Access in motion 7631 not available (model 3)
Data Check	Parity check Check character code check Write disk check Format character check Invalid track number
Condition	Wrong length format No record found Write check without mode setting Disk storage circuit check File control circuit check Invalid operation code
No Transfer	No read or write operation performed (No data or address is transferred)
Wrong Length Record	Short or long record

INDICATOR	1412 MAGNETIC CHARACTER READER, MODEL 1
Not Ready	Not feeding documents
Busy	Document in wrong position for reading
Data Check	Any I-O 3, 4, 5, 6, or 7 indicator on I-O 3 read check indicator I-O 4 amount field indicator I-O 5 control field indicator I-O 6 account number indicator I-O routing field indicator
No Transfer	Late read condition
Wrong Length Record	Wrong length record condition

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