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Service Routines



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LDDOI , LOADING ROUTINE (LOAD DEBUGGING 01)

PURPOSE

Clears the memory area and loads a standard debugging program deck into memory from the High-Speed Reader.¹

DESCRIPTION

This routine is composed of two parts: 1) the Pre-load routine, and 2) the Load routine. The Pre-load routine stores the Load routine in band 0000 using the High-Speed Reader interlace positions of band 4000. After the Load routine has been stored initially, it may be used on subsequent loadings without the execution of the Pre-load routine. The Load routine first clears memory locations 0200 through 4999 with a stop instruction word, 67 mmmm 0000, where mmmm is the memory address. Next it reads the deck to be loaded into the High-Speed interlace positions of the 4000 band (as in the High-Speed Reader routine), read checks each card, and loads the instructions contained into the specified memory address according to the following designations of the loading key:

LOADING KEY	LOADING ACTION
1	Translate and store positive
2	Translate and store negative
3	Store unprimed word positive
4	Store unprimed word negative
5	Store primed word positive
6	Store primed word negative

Upon finding the sentinel card of the deck being loaded a check is made of the indicated card count against the computer count. The instruction in the sentinel card is loaded into rX and the computer stops. Depressing the Start button will initiate the operation of the program just loaded.

¹The cards of the program to be loaded need not be in any specific sequence. However, the sentinel card must be the last.

INPUT FORMAT¹

Each instruction card in a standard debugging deck must be arranged and keypunched in the following format:

COLUMN	INFORMATION	EXPLANATION
1-5	Customer I.D.	
6-10	Routine name	Name assigned to subject routine.
11-13	Page number	Reference to a standard
14-15	Line number	coding page.
16	Suffix	Used for insertion of instructions.
17-20	Memory location	
21-30	Instruction word or constant	
31	Loading key	Directs loading routine as to handling of the word.

A sentinel card must be prepared in the following format:

COLUMN	INFORMATION	EXPLANATION
1-10	As above	
11-16	KKKKKK	Indicates sentinel
17-20	Card count	Total number of cards in deck, count should include the sentinel card.
21-31	The instruction word and loading key for the instruction to be executed to enter this routine.	

In addition to the preparation of the debugging deck, it is recommended that the following listings be made. These will be of aid during both the desk checking and machine debugging phases.

- List A A list of all the program cards in page, line number, and suffix sequence.
- List B A list of all program cards in memory address sequence.
- List C A list of all program cards in m address, page, and line number sequence.
- List D A list of all program cards in c address, page, and line number sequence.

OPERATING INSTRUCTIONS

A. Pre-load routine

1. Normal procedure.
 - a. Set computer on one instruction.
 - b. Type 72 0000 0000 into rC.
 - c. Set next instruction at c.
 - d. Press Start button.
 - e. Type 96 4000 4011 into rC.
 - f. Set computer on continuous.
 - g. Press Start button.
2. If the computer stops on a 67 0001 0000, an error has been detected in the High-Speed Reader. Restart the routine.
3. If the computer stops on a 67 0000 000K, the pre-load is complete. Set next instruction at c and press Start button to enter the Load routine.

B. Load routine

1. The Load routine is entered automatically from the Pre-load routine. If the Load routine is already stored in memory band 0000, the following procedure is necessary:
 - a. Set computer on one instruction.
 - b. Type 00 0002 0000 into rC.
 - c. Set next instruction at c.
 - d. Set computer on continuous.
 - e. Press Start button.
2. If the computer stops on 67 0001 0149, an error has been detected in the High-Speed Reader.
 - a. To continue loading:
 - (1) Remove cards from Output Stacker 1 and place in the Input Magazine preceding the sentinel card.

- (2) Set next instruction at c.
 - (3) Set computer on continuous.
 - (4) Press Start button.
 - b. To restart:
 - (1) Place entire deck in the Input Magazine.
 - (2) Set next instruction at c.
 - (3) Set computer on continuous.
 - (4) Press Start button.
3. If the computer stops on a 67 0002 000T, an error in card count has been detected.
- rA contains the card count in the form, 00 cccc 0000.
- rL contains the computer count in the form, 00 cccc 0000.
- a. If it is desired to ignore this discrepancy and continue:
 - (1) Set next instruction at c.
 - (2) Press Start button to enter the program just loaded.
 - b. If it desired to reload the program, return to step 2.b.

HSR01 , HIGH - SPEED READER ROUTINE

PURPOSE

Integrates the main program and input-output control routines providing a steady flow of input to the main program.

DESCRIPTION

The routine controls the feeding of cards in the HSR and will maintain, dependent on the main program, high card speed. An equality check of card images, as they are read at the first and second Read Stations, is performed and the valid images are transferred to Reserve Storage in the memory until called for processing by the main program. Four Reserve Storage areas (the number is optional) are used to permit the maximum feeding rate with simple controls.

Under control of this routine a steady flow of cards is committed to the HSR, however, the number of cards in motion at any given time will not exceed the number of available Reserve Storage areas.

The routine consists of three sections (Read, Transfer, and Stop) and the controls to tie these sections, the control routine for the RPU, and the main program together.

A. Read Section (HSR buffer unload)

When the main program determines that the HSR buffer is loaded, control is transferred to the Read Section of the HSR routine. The following functions are performed:

1. Unload buffer to the HSR interlace (band 4000).
2. Compare the first and second read images of each card.
3. Control the feeding of cards in the HSR. If the number of cards committed to the HSR is less than the storage areas currently available, a feed order (72) is executed.
4. Transfer the HSR interlace to Reserve Storage.

The image of a sensed card is available on the buffer for 19.8 ms. However, because of the latency time that may be involved in transferring control to the Read section, the time the image is accessible on the buffer is reduced to approximately 4.5 drum revolutions. The main program

must, therefore, execute a buffer test (42) instruction at intervals of no longer than 4.5 drum revolutions.

The Read section is entered through the m address of the buffer tests. This address should be 4288. Nothing of value should be in register A at the time of the buffer tests. Registers L and X, however, are restored after the execution of the section.

In determining where to place the HSR buffer tests, the programmer must consider the length of time all paths, branches, and subroutines of the main program will take. If the time to execute any of these functions is greater than the allowable 4.5 drum revolutions, a buffer test must be included as part of their coding. A second consideration is the RPU and HSP routines. The programmer should insure that the interlocking of the RPU and/or HSP will not prevent the reading of the HSR buffer during the buffer loaded range. A test to determine whether the RPU and HSP orders can be executed without interlock should precede all such orders.

After the images of a card have been check-read, control is transferred to location 0303. Starting at this location, coding may be inserted for Output Stacker selection and/or any audit routines to be performed on the card just verified. The image is available for testing in the second Read Station interlace positions of the HSR interlace. The location of the Reserve Storage area against which the check-read was just performed is available in memory location 4268. It is in the form of an instruction, 25 xx22 0224, where xx is the number of the band of the Reserve Storage area. If an error is detected, the invalid image can be eliminated by transferring control to location 0468 where the image will be overlaid by the next card image and normal processing continued. The error card can be segregated by selecting the error stacker.

After execution of the optional coding, control should be transferred to 0661 to continue with the Read section. If no optional coding is to be inserted, location 0303 would contain a skip to 0661.

The HSR routine assumes the presence of a RPU buffer unload sub-routine and contains all the controls to integrate the RPU routine with its own coding. The following information must be supplied by the programmer to tie the two routines together:

LOCATION	CONTENTS	REMARKS
0378	22 aaaa 0783	aaaa=memory location at which the RPU routine begins.
4310	25 4362 aaaa	
0769	22 aaaa 0773	
0481	42 xxxx xxxx	Because of the length of the RPU routine it contains a HSR buffer test. This constant must be the same as that for the HSR buffer test instruction.
0321	42 4288 xxxx	The exit of the RPU routine is a variable connector (D). This connector is provided to cover the possibility of an error being detected during an execution of the HSR routine which was entered through the buffer test instruction in the RPU routine. In this case the stacker selection has not been executed for the card cycle in progress in the RPU. The second setting (D_2) of the connector will handle this situation by transferring control to the Stop section upon completion of the RPU routine. There are two settings for the connector, D_1, and D_2. D_1 = Normal setting. D_2 = Set in the Stop section if entrance to the HSR routine was made through the HSR buffer test instruction in the RPU routine. xxxx=Start of D_1.
0304	xx xxxx xxxx	The RPU routine uses a sentinel to signal whether or not a card cycle has been initiated for which a stacker has yet to be selected. This constant must read the same as the signal appears when no card is in motion in the RPU (no stacker need be selected).

LOCATION	CONTENTS	REMARKS
0446	25 xxxx 0501	xxxx=Storage address for sentinel described above.
0552	xx xxxx xxxx	D ₁ setting of connector D.
0531	xx xxxx 0766	D ₂ setting of connector D.
0554	60 xxxx 0408	This instruction sets D ₁ . xxxx=D memory location.
0343	50 xxxx 0201	This instruction sets D ₂ . xxxx=D memory location.

If the RPU routine is not to be used, the HSR routine references to it can be eliminated through the following changes:

LOCATION	CONTENTS
0323	00 0766 0000
0378	00 0783 0000
0446	00 0511 0000
0541	00 0408 0000
0769	00 0773 0000
4394	00 4248 0000

Except for the special considerations mentioned above, the programmer's concern with the use of the Read section is directed only to insuring the HSR buffer is tested within the limits of the buffer loaded range.

B. Transfer Section

When the main program is ready for the next image, control should be transferred to the Transfer section of the HSR routine. This section:

1. Feeds a card.
2. Transfers a checked card image from Reserve to Working Storage. Through this transfer a Reserve Storage area is made available; the number of cards committed to the HSR must therefore be less than the storage area available and a feed order can be executed.

The normal entrance to the Transfer section is 0717. It is important that nothing of value be in registers A, L, and X when entering this section, for no registers are restored upon execution of the transfer. The exit of the section is in memory location 0533, where control is returned to the main program.

A second entrance (0633) is provided in the transfer section to start or rerun the program. This entrance will set the controls of the HSR routine to their initial condition and, after transfer of the first checked image, to Working Storage, will go to location 0782 where the programmer can perform operations associated with the start or rerun of his program.

C. Stop Section

The final section of the HSR routine, the Stop section, is provided to permit a computer stop without the loss of cards committed to the HSR and RPU but not yet stored in memory.

When a program determines a computer stop is necessary, there may be cards in motion in the HSR. These cards will continue through the HSR and to the stackers even if the computer stops. The Stop section provides for sensing, checking and storing the cards. Similarly, it will allow the completion of any RPU card cycles in progress:

The section is a loop consisting of:

1. A HSR buffer test (referencing the Read section).
2. A timer or counter to determine when the HSR is empty.
3. Controls to test for and close-out RPU cycles.

Its function is to transfer control to the Read section of the HSR routine and the RPU buffer unload routine until the buffers are not to be loaded again and stackers are selected for all cards, then stop the computer.

Entrance to and the results of the Stop section vary according to where the error is detected.

1. When an error is detected outside the Read section of the HSR routine the programmer should bring a stop instruction to register X and transfer control to 0674. When all card cycles already initiated in the HSR and RPU have been completed the stop order is executed. The programmer should be prepared to designate what action should be taken.

2. An abnormal (c+1) condition in the HSR is recognized by a timer in the Transfer section (the timer consists of a counter that overflows when seven card cycles have elapsed without a buffer loaded test passing; normal processing will have continued until all input admitted was exhausted). A stop instruction, 67 1000 0717, is brought to register X and control transferred to the Stop section. When the computer is restored, control is sent to the c address of the stop instruction leading in this case to the Transfer section where the HSR is filled, a checked image is transferred to Working Storage, and processing continues. In the case of a card jam the program should be started over or picked up at a rerun point.
3. When an error is detected in the optional coding area, no more HSR card images are stored in memory. Upon detection of such an error, the programmer should bring a stop instruction, in the form 67 ccc1 0218, to register X and transfer control to 0212 c? the Stop section. The Stop section will count the cards passing through the HSR in the least significant digit position of the m address of the stop order. This position must contain a 1 when brought to register X. When the computer stops, this digit can be interrogated to determine the number of cards to be re-fed to the HSR. The remainder of the m address of the stop order (ccc) can be used by the programmer for error identification or any such code he desires.

When the computer is restarted, control is transferred to 0218 where a feed order is executed and normal processing continues.

4. If a read-check discrepancy occurs, the HSR routine is coded to follow the procedure outlined in (3) above.

The two images that did not agree are available if desired. The first image is in location 0313; the second is in 0308. The position of the image on the card can be determined in the following manner. Location 0326 contains the 25 instruction which brought the image from Reserve Storage. The c address of this 25 order shows the location of the 30 instruction used to bring the image from the HSR interlace. The m address of the 30 order indicates the interlace position involved and therefore the position of the card involved.

As described in (3), the least significant digit position of the m address of the stop order is

used by the Stop section to count the cards passed through the HSR. Therefore, if the stop instruction reads 67 cccx 0218, the mis-read card is the xth card from the top of Stacker 2.

If desired the read-check error routine can be modified to eliminate the image error rather than stop the computer. The only change necessary is to insert a stacker select instruction (if desired) in location 0305 and transfer control to 0468.

5. During the Stop section, control is transferred to the Read section of the HSR routine and the RPU buffer unload sub-routine. An additional error which requires a stop may occur. If this happens, a stop instruction will be brought to register X and control will be sent again to the Stop section. When such an error occurs a multiple error condition is present. This condition is handled in the following manner:
 - a. The Stop section stores the second, and if applicable, succeeding stop instructions at fixed intervals in the memory (maximum number of stop orders is 5).
 - b. When the card cycles in progress in the HSR and RPU are completed the Stop section places the stop instruction, consecutively, in registers C, A, L, X, and memory location 0545.

When the computer stops, registers C and A should be exhibited to determine what the first error was and if a multiple error condition is present. If multiple errors were involved the stop orders and their order of occurrence can be determined by displaying the storages in the order mentioned.

The programmer should indicate the action to be taken in the event of a combination of errors. Before restarting the computer, the last storage area, location 0545, should be set to zeros.

ADDITIONAL INFORMATION

A. Memory Allocation

1. The HSR interlace of the 4000 band is used for unloading the buffer.
2. Working Storage is as follows:

STORAGE	LOCATION	STORAGE	LOCATION
W ₁₀	4211	W' ₁₀	4216
W ₁₁	4231	W' ₁₁	4236
W ₁₂	4251	W' ₁₂	4256
W ₁₃	4271	W' ₁₃	4276
W ₁₄	4291	W' ₁₄	4296
W ₁₅	4311	W' ₁₅	4316
W ₁₆	4331	W' ₁₆	4336
W ₁₇	4351	W' ₁₇	4356
W ₁₈	4371	W' ₁₈	4376
W ₁₉	4391	W' ₁₉	4396

3. The Reserve Storage areas are on bands 02, 04, 06, and 08 on the following drum levels:

STORAGE	LOCATION	STORAGE	LOCATION
R ₁₀	0007	R' ₁₀	0112
R ₁₁	0127	R' ₁₁	0082
R ₁₂	0097	R' ₁₂	0052
R ₁₃	0067	R' ₁₃	0022
R ₁₄	0037	R' ₁₄	0142
R ₁₅	0157	R' ₁₅	0062
R ₁₆	0077	R' ₁₆	0032
R ₁₇	0047	R' ₁₇	0002
R ₁₈	0017	R' ₁₈	0172
R ₁₉	0187	R' ₁₉	0092

B. Time

1. The time for execution of the Read section is as follows:

- a. Both read station full 1524 wt's
- b. Read station one empty 1224 wt's
- c. Read Station two empty 724 wt's

These figures include 158 wt's allowed for the optional coding that may be inserted. If optional coding requires a longer time, the first two figures will be increased by a multiple of 200 wt's.

2. The Transfer section takes 416 wt's when a checked image is available in Reserve Storage. If a Reserve Storage area is not full and the Read section must be referenced, the time is, of course, increased.

C. Options for Modifications.

1. The HSR routine is coded to use four Reserve Storage areas. To increase or reduce the number of areas the following changes should be made:

LOCATION	CONTENTS	REMARKS
4280	99 99 <u>6</u> 0 0000	The underlined digit must be the ten's complement of the number of areas used.
0538	99 99 <u>5</u> 0 0000	These two locations must contain a number 100,000 less than the contents of 4280.
0546	99 99 <u>5</u> 0 0000	
0702	05 <u>0</u> 892 0694	The underlined digits must be the number of the last Reserve Storage band used.
0663	25 <u>0</u> 822 0224	
0479	99 9400 0000	Each of these numbers must be increased by 2,000,000 for each area deleted and reduced by 2,000,000 for each area added.
0488	39 9385 0185	

Storage areas should be deleted from consecutive bands beginning with band 08 and added to consecutive bands beginning with band 10.

2. If, in a given problem, certain sections of the input cards are blank, it may not be necessary to check-read and store the entire card. As an example there follows a description of the necessary changes.

a. To eliminate top half of card:

LOCATION	PRESENT CONTENTS	CHANGE TO
0599	05 4001 000K	70 0409 0549
0409	70 000Y 0414	00 0150 0150
0224	30 4076 4234	25 0254 4261
0254	30 4056 4264	00 0135 0135
0395	25 000T 000K	25 0409 0613
0613	70 000Y 000K	70 000T 000K

b. To eliminate bottom half of card:

LOCATION	PRESENT CONTENTS	CHANGE TO
0544	70 000Y 0549	00 4394 0000
0329	30 4031 4234	30 4031 0549
0549	05 4102 000K	82 0559 0305
0748	70 000Y 000K	00 0700 0000
0702	05 0892 0694	05 0942 0744

Instructions referring to the fast access bands during the read-check cannot be eliminated for they refer to both halves of the card.

Note: (1) If the bottom half of the card is eliminated, the optional coding section will begin in 0559 instead of 0303.

(2) The m address of location 0702 will change if the number of Reserve Storage areas used is changed. It refers to the band of the last Reserve Storage area.

D. Use

1. Read Section

- Allow a maximum of 4.5 drum revolutions between buffer loaded tests.
- The entrance of the Read section is 4288 (the m address of the buffer tests).

- c. Have nothing of value in register A. Registers L and X will be restored before returning to processing.
- d. Stacker selection and input audit routines can be inserted starting in memory location 0303. The last instruction of this optional coding should transfer control to 0661. If an error is detected and the image is to be eliminated, transfer control to 0468 instead of 0661. If no optional coding is to be inserted, memory location 0303 should contain a skip to 0661.
- e. Supply the information to handle the relationship between the RPU routine and the HSR routine (described in Read section).

2. Transfer Section

- a. The entrance of the Transfer section is 0717. The exit is 0533.
- b. Have nothing of value in registers A, L, and X, as no registers are restored upon completion of section.
- c. A special entrance (0633) is provided to start or rerun the program. Control is transferred to 0782 after moving the first checked image to Working Storage. The programmer should provide any special run beginning coding at this address.

3. Stop Section

- a. To stop the computer, the programmer should bring a stop instruction to register X and transfer control to 0674.
- b. If the computer is to be stopped due to an error detected during execution of the Read section, the stop order should be brought to register X and control transferred to 0212. The stop instruction should be of the form, 67 cccx 0218, where:

ccc = code for programmer use.

x = 1 and will indicate upon completion of the section the number of cards in Stacker 2 that have not been read.

MPR01 , MEMORY PRINT ROUTINE

PURPOSE

Prints the contents of memory one line at a time on the High-Speed Printer.

DESCRIPTION

The routine lists each location address and its contents beginning with location 0000 and continues in sequence until a limit established by a type-in is reached. Only one entry will be printed per line; each having the format:

xxxx mmmm mmmm

where x = Location Address
m = Contents

Non-Standard Digits will be printed as follows:

BINARY CODE	PRINTED EQUIVALENT
0101	Y
0110	Y
0111	4
1101	9
1110	8
1111	8

OPERATING INSTRUCTIONS

1. General Procedures

- a. Load MPR01.
- b. Set computer on one instruction.
- c. Type the limit into rL in the following format:

25mmmm+1 3076

where mmmm is the address of the last location to be printed.

- d. Set the next instruction at c.
- e. Set computer on continuous.
- f. Press Start button.

2. If the computer stops on a 67 3001 3177, an abnormal printer condition has been detected.
 - a. Set the next instruction at c to attempt to print again.
 - b. Set the next instruction at m to restart.
3. When the computer stops on a 67 0000 0000, the printing is complete.

MSC01 , MEMORY SEARCH ROUTINE

PURPOSE

Searches the memory for specified full words, m address fields, or c address fields.

DESCRIPTION

The routine performs a sequential search of the memory according to the option selected. When a match for a given field is found, the entire word is placed in rA and its address in rX. Options are available to either continue searching or to initiate a new search.

OPERATING INSTRUCTIONS

1. Load MSC01.
2. Set the computer on one instruction.
3. Type the field to be located into rA in the form:
 - a. 00 mmmm 0000 for an m address field
 - b. 00 0000 cccc for an c address field
 - c. xx xxxx xxxx for a full word
4. Type a corresponding option selector into rC in the form:
 - a. 00 0000 0005 for option 3.a
 - b. 00 0000 0006 for option 3.b
 - c. 00 0000 0007 for option 3.c
5. Set next instruction at c.
6. Set computer on continuous.
7. Press Start button.
8. The computer will stop on either a 67 0177 0000 or a 67 TTTT TTTT.

- a. 67 0177 0000 indicates that a match has been found.
 - rX contains the address of the matched word.
 - rA contains the entire word.
- (1) To continue search:
 - (a) Set next instruction at m.
 - (b) Press Start button.
- (2) To initiate a search for another field return to step 2.
- b. 67 TTTT TTTT indicates that the search has been completed and no match found. To initiate a search for another field return to step 2.



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