



70 Series Utility Programs Programmer Reference

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CHANGE RECORD

Page Number	Issue Date	Change Description
Various	2/78	Deleted all references to Varian.

Change Procedure:

When changes occur to this manual, updated pages are issued to replace the obsolete pages. On each updated page, a vertical line is drawn in the margin to flag each change and a letter is added to the page number. When the manual is revised and completely reprinted, the vertical line and page-number letter are removed.

LIST OF EFFECTIVE PAGES

Page Number	Change in Effect
A11	Complete revision

SECTION 1 INTRODUCTION

Utility programs are system programs, used by system programmers to execute special tasks (such as debugging on-line user programs).

Three utility programs featured in SPERRY UNIVAC 70 series computers are discussed in this manual: the **Binary Load/Dump Program (BLD II)**, the **AID III Debugging Program**, and the **Source Program Editor (EDIT)**.

The **Binary Load/Dump Program (BLD II)** prepares the 70 series computer for the loading of object programs from a high-speed or Teletype paper-tape reader. It also allows the punching of the binary contents of memory on paper tape in a reloadable format.

The **AID III Debugging Program** facilitates on-line program checkout and correction. By entering AID III commands on the Teletype keyboard, the system programmer can:

- a. Display and alter the contents of registers and any memory address or group (block) of addresses.
- b. Transfer (trap) into or out of selected blocks of memory and search for specific conditions.
- c. Load, monitor, and alter any program.
- d. Transfer (dump) data from memory to magnetic tape, paper tape, punched cards, or to the Teletype printer. Object programs can thus be converted from one medium to another, simply and directly.

The **Source Program Editor (EDIT)** allows the system programmer to create and modify symbolic source programs on paper tape. Source programs can be loaded directly into computer memory from an on-line Teletype keyboards, listed with identifying line numbers on the Teletype printer, and modified using EDIT commands input from the Teletype keyboard. Source programs already formatted on paper tape can be loaded into memory, listed, and modified with EDIT to generate a paper tape copy of the modified program that is ready for assembly. EDIT can also search through the source program to find a specific character, group of characters, an entire line, or group of lines.

Although all three utility programs are available with any 70 series computer, the type of operating system employed by a given computer may obviate the need for certain of these programs. BLD II is not needed where a VORTEX I or VORTEX II operating system is implemented. The EDIT program runs without an operating system in one of its two modes of operation; but editing functions are included in the MOS, VORTEX I and VORTEX II operating systems.

Two main points of comparison and relation between the utility programs are:

- a. BLD II and EDIT are paper tape driven; whereas AID III handles paper tape, magnetic tape, and cards.
- b. Execution of either paper tape, AID III or EDIT requires the presence of BLD II.

SECTION 2 BINARY LOAD/DUMP PROGRAM (BLD II)

The Binary Load/Dump Program (BLD II) is loaded using the program (formerly termed the bootstrap) loader routine, which specifies the input reader. Once loaded, BLD II automatically relocates itself into the upper part of the highest 4K memory increment--unless the operator specifies another 4K increment. BLD II also dynamically adapts itself to load object program tapes from the input device specified in the program loader routine, and performs a checksum of object program records.

After BLD II has been loaded into memory, it need not be reloaded for the entering of subsequent object programs.

Initially, BLD II occupies addresses 007000 through 007755 of the first 8K memory increment, where it does not interfere with the program loader routine occupying addresses 007756 through 007776. Immediately after loading, BLD II relocates to occupy addresses 0x7400 through 0x7755, where x denotes the highest available 8K of memory. The size of memory increment in terms of x is given by the following table:

x	Memory Increment
1	8K
3	16K
5	24K
7	32K

Entry to BLD II for the purpose of loading object program tapes is always at address 0x7600. Entry to punch binary object tapes of memory contents is always at 0x7404.

Note: The reference manual of a given SPERRY UNIVAC 70 series computer system provides the procedures for execution, loading, and verification of loading of the program loader routine for that system.

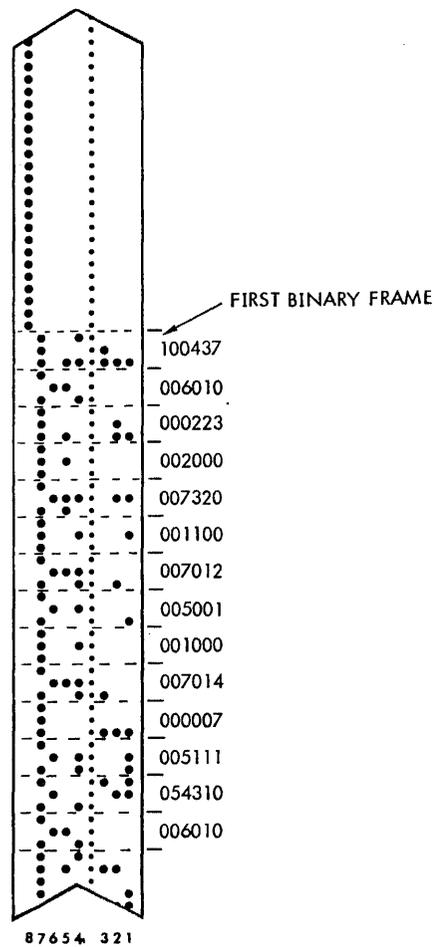
2.1. LOADING THE BLD II PROGRAM

After the program loader routine has been successfully loaded into memory:

- a. Clear the instruction register.
- b. Load 000212 into the P register.
- c. Load 007000 into the X register.
- d. Set the SENSE switch(es) for the desired program option (see section 2.2).
- e. Turn on the paper tape reader specified by the program loader routine.

BINARY LOAD/DUMP PROGRAM (BLD II)

- f. Position the BLD II program tape in the reader with the first data frame after the position-8-only punches (figure 2-1) under the high-speed reader head or over the reading station of the Teletype reader.
- g. To load tape, press RUN, then START. Loading is complete when the computer changes to step mode.



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Figure 2-1. BLD II Tape Format

BINARY LOAD/DUMP PROGRAM (BLD II)

If SENSE switch 1 was set:

- a. Reset SENSE switch 1.
- b. Clear the A register.
- c. Load the appropriate values, as defined in section 2.2, in the A and/or B registers.
- d. Press START.

When BLD II loading is complete, the computer halts with 0x7600 in the P register unless SENSE switch 3 was set (see section 2.2), in which case the computer implements loading and execution of the spliced object program.

Remove the BLD II program tape from the reader after loading, and reset SENSE switch 2, if applicable.

Object programs can be loaded from the program loader routine specified device immediately after BLD II. For all subsequent loadings, make sure that the P register is set to 0x7600.

2.2 BLD II SENSE SWITCH OPTIONS

If no SENSE switches are set, the BLD II program is loaded and automatically relocates to the highest 8K memory increment. The computer then halts with the entry address for reading object program tapes in the P register (0x7600) and zeros in the A, B, and X registers.

2.2.1 SENSE Switch 1

If SENSE Switch 1 is set, then the 8K memory increment in which BLD II is to operate may be selected and a nonstandard device address for the high-speed paper tape punch may be specified.

After BLD II is loaded, the computer halts with 07014 in the P register.

The method for specifying an 8K memory increment is as follows:

To specify ...	load ...	in the A register.
First 8K	000001	
Second 8K	000003	
Third 8K	000005	
Fourth 8K	000007	

The standard high-speed paper tape punch device address is 037. To specify a nonstandard device address, load it into the B register.

BINARY LOAD/DUMP PROGRAM (BLD II)

With SENSE Switch 1 set, pressing START initiates the relocation at BLD II from the first 8K memory increment and implements the punch address. The computer halts with zeros in the A, B, and X registers; and with 0x7600 in the P register, where x denotes the specified increment (described above). Object program tapes can then be loaded.

2.2.2 SENSE Switch 2

If SENSE Switch 2 is set, then the program for Teletype paper tape punch output is selected (for use when input is from a high-speed reader but a high-speed punch is unavailable).

With SENSE Switch 2 set, BLD II and the object program can be loaded and executed without further operator intervention.

2.2.3 SENSE Switch 3

If SENSE Switch 3 is set, then the splicing of an object program to the BLD II program tape is allowed. This program can then be loaded and executed.

2.3. PROGRAM VERIFICATION

To ensure that an object program tape contains no errors before it is loaded into memory, BLD II has a checksum error-checking option. To use this option:

- a. Turn on the reader specified by the program loader routine.
- b. Position the object program tape in the reader with leader at the reading head (figure 2-2).
- c. Load minus value (0100000) into the A register.
- d. Clear the instruction register.
- e. Set RUN indicator on and press START.

No errors are indicated by the computer halting with:

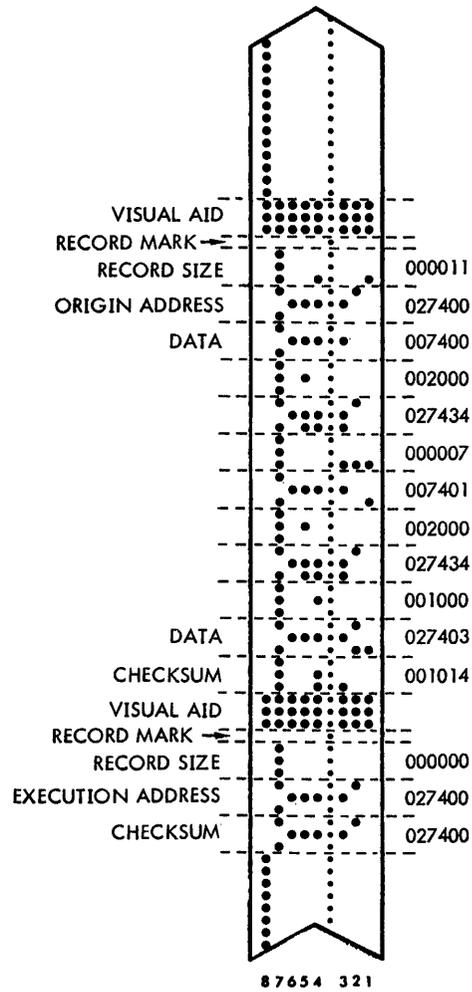
P register = 0x7600
A register = 0100000
B register = 000000
X register = execution address

If a checksum error occurs, the computer halts with:

P register = 0x7600
A register = 0100000
B register = 0177777
X register = Address of last record

BINARY LOAD/DUMP PROGRAM (BLD II)

To retry a checksum error record, reposition the object program tape at the previous visual aid and press START. If a checksum error is again read, visually check each character in the record for an error in punching or damaged tape.



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Figure 2-2. Object Program Tape Format

BINARY LOAD/DUMP PROGRAM (BLD II)

To load the object program and halt before execution:

- a. Turn on the reader and position the tape in the reading station.
- b. Clear the A, B, X, and instruction registers.
- c. Load 0x7600 into the P register.
- d. Set indicator on and press START.

Correct loading is indicated when the computer halts with:

P register = 0x7600
A register = 000000
B register = 000000
X register = execution address

A checksum error is indicated by the conditions described for object program tape verification described previously.

Programs can be loaded and immediately executed using the steps described above for the load-and-halt option, except in step b load 000001 (or any positive number) in the A register.

2.4 PUNCHING PROGRAM TAPES

The BLD II program adapts to the input reader and the output punch devices by interrogating the program loader routine. Setting SENSE switch 2 (see section 2.2) prior to loading BLD II program adjusts the program for Teletype punch output regardless of type of devices specified by the program loader routine.

To punch reloadable object program tapes after the programs have been loaded into memory, turn on the punch and

- a. Load the beginning address of the area to be punched into the A register,
- b. Load the final address to be punched into the B register,
- c. Load the first instruction to be executed at load time into the X register,

OR

If noncontiguous memory areas are to be punched, load minus one (177777) into the X register,

- d. Load 0x7404 (entry address to BLD II to punch object tapes) into the P register,
- e. Clear the instruction register,
- f. Press (system) RESET, set RUN indicator on and press START.

BINARY LOAD/DUMP PROGRAM (BLD II)

The program punches the object tape and the computer halts with all registers unaltered.

If noncontiguous areas are to be punched, perform steps a through f. Prior to punching the last area, load the first instruction to be executed at load time into the X register.

2.5 PUNCHING MEMORY CONTENTS

To punch a tape of the binary memory contents via the high-speed paper tape punch, SENSE switch 2 must not be set when BLD II is loaded. To punch a tape from memory on the Teletype punch, SENSE switch 2 must be set (if the input reader is a high-speed paper tape device).

The operator can specify that tapes be punched in binary format for reloading using the BLD II, or that the BLD II program be punched in bootstrap-loadable format.

To punch a tape in binary format, use the procedures described above for punching program tapes.

To punch a bootstrap-loadable tape of BLD II itself:

- a. Load 0x7400 into the P register.
- b. Clear the A and B registers.
- c. Load a nonzero value into the X register.
- d. Press (system) RESET, set RUN indicator on and press START.

SECTION 3 AID III DEBUGGING PROGRAM

The Binary Load/Dump Program (BLD II), detailed in the preceding section, is used to load the paper tape AID III Debugging Program. Once loaded, AID III resides in memory addresses 0x6000 through 0x7377, where x denotes the highest available 8K memory increment (see the table giving size of memory increment in terms of x at the beginning of section 2).

The programmer is responsible for ensuring that a program to be debugged does not interfere with those areas of memory containing BLD II and AID III.

AID III handles paper tape, magnetic tape, and punched cards.

The Teletype paper tape reader and punch can be controlled through AID III to read object program tapes into, and punch program tapes from, computer memory. With AID III entered, the computer in run mode, and the Teletype and its paper tape facility operational, the Teletype keyboard entries summarized in table 3-1 yield the indicated results.

Data can be manipulated to and from magnetic tape via AID III commands. With AID III entered, the computer in run mode, the Teletype keyboard on-line, and the selected magnetic tape unit operational, the Teletype keyboard entries summarized in table 3-2 yield the indicated results. Magnetic tape AID III is to be used on systems featuring magnetic tape I/O only. In this form, all paper tape directives and also the magnetic tape buffer directive (M) are inapplicable. Magnetic tape AID III has its own loader and is to be loaded with the magnetic tape bootstrap routine depicted in table 3-3.

Card AID III is to be used on systems with only a card reader and card punch as the I/O facility. All magnetic tape directives are inapplicable to the card medium, whereas all paper tape directives do apply. Card AID III has its own loader and is to be loaded with the card bootstrap routine depicted in table 3-4.

Table 3.1 AID III Paper Tape Commands

Command	Operation
Dx,y,z.	Punches a program tape from the contents of address x through address y, specifying execution address z.
Lm.	<p>Reads an object program paper tape into memory.</p> <p>If the value of m is 1 and no checksum errors are encountered, the program is executed.</p> <p>If the value of m is 0 and no checksum errors are encountered, the contents of the A, B, and X registers, respectively, are output on the Teletype printer: A register = 000000, B register = 000000, and X register = execution address.</p>

AID III DEBUGGING PROGRAM

If m is -1 , the operation is the same as zero except the object tape is verified but not loaded into core.

If the program detects a checksum error, the printout is the same as $m = 0$ with 0177777 (minus one) in the B register and the address of the last record read from the tape in the X register.

Note: AID III utilizes BLD II to effect loading and punching. For proper operation, BLD II must reside in the same 4K increment of memory as AID III.

Table 3.2. AID III Magnetic Tape Commands

Command*	Operation
Ex.	Writes a file mark on the specified unit tape.
F n,x .	Skips to file n on the specified unit tape.
N.	Skips to the next file on the previously designated unit tape.
P x .	Backspaces one record on the specified unit tape.
R x	Reads an object magnetic tape into memory from the specified magnetic tape unit. Terminating the command with a period causes the program to be loaded and control returned to AID III. If the command is terminated with a comma, the program is loaded and executed.
	If AID III outputs an uparrow (↑) on the Teletype printer, a file mark was read on the tape.
	The output of an octal number indicates the address of a parity error.
W a,b,c,x .	Writes an object magnetic tape from memory, starting at address a and ending at address b with an execution address of c , on the specified magnetic tape unit.

* x specifies the magnetic tape controller device address coded as 0, 1, 2, or 3. 0 is the first system magnetic tape controller, 1 is the second, 2 is the third, and 3 is the fourth. Note that each magnetic tape controller monitors up to four magnetic tape units and that AID III communicates only with the first unit on each controller.

Table 3.3. The Magnetic Tape Bootstrap Routine

Address	Instructions Code	Symbolic Coding
		1 * MAGNETIC TAPE BOOTSTRAP
		2 *
* 000200	0000ZZ	3 MT SET ZZ
* 000201	00000Y	4 TU SET Y
000200		5 ORG 0200
*000200	1012ZZ	6 MTS SEN 0200+MT,07002 SENSE IF DONE
000201	007002	
*000202	1011ZZ	7 SEN 0100+MT,MTST SENSE IF DATA IN
000203	000206	
000204	001000	8 JMP MTS SENSE DATA IN
000205	000200	
*000206	1025ZZ	9 MTST CIA MT GET WORD
000207	055000	10 STA 0, 1 STORE WORD
000210	001000	11 JMP MTSA
000211	000214	
		12 *
		13 * START HERE WITH X=07000
		14 *
*000212	104YZZ	15 ENTR EXC2 (TU*64)+MT SELECT UNIT
000213	1000ZZ	16 EXC MT READ ONE RECORD BINARY
000214	005144	17 MTSA IXR STEP INDEX
000215	001000	18 JMP MTS LOOP
000216	000200	

* = where

Y = Drive number 1, 2, 3, or 4

Z = Device address, (normally 010)

Table 3.4. The Card Bootstrap Routine

Address	Instruction Code	Symbolic Coding
		1 * CARD BOOTSTRAP
		2 * ZZ
* 000200	0000ZZ	3 CR SET
000200		4 ORG 0200
*000200	1025ZZ	5 BOOR CIA CR INPUT ODD COLUMN
000201	004250	6 LRLA 8 MOVE TO HIGH ORDER
*000202	1011ZZ	7 SEN 0100+CR,BOOS SENSE CHARACTER READY
000203	000221	
000204	001000	8 JMP *-2 LOOP
000205	000202	
000206	001010	9 BOOT JAZ 07000 END OF PRELIM
000207	007000	
000210	001000	10 JMP ENTR
000211	000212	
		11 *
		12 * START HERE WITH X=07000
		13 *
*000212	1002ZZ	14 ENTR EXC 0200+CR READ A CARD
*000213	1011ZZ	15 BOOU SEN 0100+CR,BOOR SENSE CHARACTER READY

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000214	000200				
*000215	1016ZZ	16	SEN	0600+CR,BOOT	SENSE END OF CARD
000216	000206				
000217	001000	17	JMP	*-4	LOOP
000220	000213				
*000221	1021ZZ	18	BOOS	INA CR	MERGE EVEN COLUMN INTO A
000222	055000	19	STA	0,1	STORE WORD
000223	005144	20	IXR		STEP INDEX
000224	001000	21	JMP	BOOU	MORE ON CARD
000225	000213				

* = where

Z = Device address, (normally 030)

3.1 LOADING THE AID III PROGRAM

To load AID III into memory:

- Ensure that BLD II (section 2) are correctly loaded.
- Turn on the reader used to load BLD II and position the AID III program tape with leader at the reading station.
- Clear the B, X, and instruction registers, and load 000001 into the A register.
- Load 0x7600 into the P register (i.e., the BLD II entry address for loading program tapes).
- Set the RUN indicator on and press START.

Loading is complete when the program outputs a carriage return (CR) and line feed (LF) and rings the Teletype bell.

Programs to be debugged can be loaded either before or after AID III loading.

3.2 AID III COMMANDS

With AID III and the program to be debugged entered, the computer in run mode, and the Teletype operating on-line, the Teletype keyboard entries summarized in table 3-6 produce the indicated results.

The pseudoregisters referred to in the following descriptions denote software buffers that duplicate the actual contents of the computer's operation registers. A command to change register contents, in effect, changes the specified pseudoregister contents, which are then transferred to the corresponding operation register.

Table 3-6 AID III Register/Memory Modification Commands

Command	Operation
A B X	Displays (prints) the contents of the indicated pseudo register on the Teletype printer. To change the contents, type the desired octal number and a period; otherwise, type only a period.
Cx	Displays (prints) the contents of memory address x on the Teletype printer. To change the contents, type the desired octal number, followed by a period to execute the command or by a comma to request display of the next sequential address contents. Otherwise, type only a period.
Gx.	Loads the contents of the pseudo registers into the respective hardware registers and starts program execution at address x.
Ix,y,z.	Stores the value of z in all memory addresses starting at address x and ending at address y.
M	Displays (or prints) the starting location of the 64-word Magnetic Tape Buffer. To change the buffer location, type in the desired address and then terminate with a period. The default location is the starting location of AID minus 64, expressed in octal; that is, 0x6000 minus 0100 (octal).
Q0 through Q7 (for expanded instruction set)	Displays (prints) the contents of the eight indicated pseudo-registers (R0 through R7) for computers with the expanded instruction set. The AID III commands Q0 through Q7 are used to specify registers R0 through R7, respectively. Registers R0 through R2 correspond to the A, B, and X registers, respectively. To change the contents of a register, type in the desired octal number and then terminate with a period.
Sx,y,z,m.	Searches through memory starting at address x and ending at address y for the value of z masked by the value of m. A masked-search compares the value of z with each bit corresponding to a one in the m value. Each time the values compare, the address and value are printed on the Teletype printer. If an N is typed instead of a mask value, the program searches for the negated value of z. Omission of m assumes an all-ones mask.

AID III DEBUGGING PROGRAM

Table 3-6. AID III Register/Memory Modification Commands (continued)

Command	Operation
Ty,x.	Loads the contents of the pseudoregisters into the respective hardware registers and starts program execution at address x. If and when location y is reached, save and display (print) location y, the contents of y, and the current values of the registers. 4
Ty,.	Continues trap from last break point.
Vx.	Displays the contents of memory on the Teletype printer beginning at address x, continuing until a RUBOUT character is typed. The display (dump) is printed in columns; the left column is the octal base address, and the contents of eight memory addresses, in ascending order, appear in the next eight columns. The first number in succeeding lines indicates the base address for the next eight memory address contents.

3.3 USAGE EXAMPLES

Note: In the following examples, operator inputs are represented in bold type. Other entries are program responses output to the Teletype printer.

Display the contents of a pseudo register:

```
A (000000).  
B (000000).  
X (000000).
```

Display and change the contents of a pseudo register:

```
A (000000) 10406.  
B (000000) 10406.  
X (000000) 10406.
```

Display the contents of memory address 002050:

```
C2050  
002050 (000600).
```

Display and change the contents of memory address 002050, then display the next two addresses:

```
C2050  
002050 (103402) 103402,  
002051 (065047).  
002052 (006010).
```

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Display memory contents starting at address 006000:

V6000.

```
006000 000000 000000 000000 000000
006010 000000 000000 000000 000000
006020 000000 000
```

Note: When memory contents are displayed, eight columns of data actually follow the base address in the first column. (Space limitations prohibit an actual representation here.)

(Display terminated by entering RUBOUT.)

Execute the program beginning at address 000500:

G500.

Store 0177777 in memory addresses 000200 through 00210:

```
I200,210,177777,.
I200,210,- 1,.
```

Search memory addresses 000200 through 000240 for a content of 0106213 masked by 0177777 and display addresses that compare:

```
S200,240,106213,177777.
000220      106213
000235      106213
```

Trap to memory address 00204; start execution from address 0001000; and display the contents of the trap address and the A, B, and X register contents if the trap is reached. **If not, reload the original contents into both trap locations. (i.e., locations 204 and 205).**

T204,100.

```
000204 (000167) 142340 002000 010405
```

Display the magnetic tape buffer starting address:

M (075700).

Display and change the magnetic tape buffer address:

M (075700) 500.

Display a pseudo register or register in computers with the expanded instruction set:

```
Q0.      (142340).
Q1.      (142340).
Q2.      (001000).
Q3.      (001000).
```

AID III DEBUGGING PROGRAM

Q4. (006003).
Q5. (006003).
Q6. (142340).
Q7. (142340).

Display and change the contents of a pseudo register in computers with the expanded instruction set:

Q0.	(010454)	10406.
Q1.	(010454)	10406.
Q2.	(010454)	10406.
Q3.	(006016)	0.
Q4.	(006016)	0.
Q5.	(006016)	1.
Q6.	(007413)	10405.
Q7.	(007413)	10431.

3.4 ERROR DETECTION AND CORRECTION

If an AID III command is input incorrectly, AID III terminates further input by outputting a CR and LF and ringing the Teletype bell. An example of incorrect input is an attempt to type a nonoctal number (i.e., a decimal 8 or 9). Note that octal numbers need not be preceded by a zero. To recover, correctly retype the entry.

An input command can be aborted before termination by the backslash (\) character.

Magnetic and paper tape error descriptions are included in table 3-2 and 3-3.

SECTION 4 SOURCE PROGRAM EDITOR (EDIT)

EDIT has two modes of operation: command and text. In command mode, EDIT accepts inputs from the Teletype keyboard specifying the EDIT function and, optionally, line numbers and searching parameters. In text mode, characters typed on the Teletype keyboard or read from paper tape are stored in a text buffer for subsequent manipulation and/or output. The text buffer represents available memory, i.e., those memory addresses not occupied by the program loader routine, the Binary Load/Dump Program (BLD II, section 2) and the EDIT program routines.

In text mode, EDIT runs without an operating system. Both MOS and VORTEX include editing functions which are an alternative in their environments.

EDIT operates in the minimum configuration of a SPERRY UNIVAC 70 Series system (8K to 32K of memory) and 33/35 ASR Teletype. However, EDIT determines the size of memory and uses of all available memory for the editing buffer. Only the binary loader at the top of memory is served. Use of the high-speed paper tape reader and/or punch for input/output is optional.

4.1 LOADING THE EDIT PROGRAM

To load the EDIT program into memory.

- a. Ensure that BLD II is correctly loaded (section 2).
- b. Turn on the reader used to load BLD II and position the EDIT program tape with leader at the reading station.
- c. Clear the B, X, and instruction registers.
- d. Load 000001 into the A register.
- e. Load 0x7600 into the P register (i.e., the BLD II entry address for loading object program tapes).
- f. Set RUN indicator on and press RUN or START.

Loading is complete when the EDIT program outputs the message:

SOURCE PAPER TAPE PROGRAM

INPUT DEVICE (H OR T)

If the high-speed paper tape system is to be used for text input to EDIT, type H on the keyboard, and type T if the Teletype is the input device. The program then outputs

OUTPUT DEVICE (H OR T)

SOURCE PROGRAM EDITOR (EDIT)

Respond as described above for defining the input device. EDIT dynamically adapts to use the specified equipment and enters the command mode, outputting a carriage return (CR) and line feed (LF), followed by an asterisk (*).

Once entered, EDIT can be restarted at any time by clearing all registers and pressing RUN or START.

Note: To change input and output devices from those initially specified, EDIT must be reloaded using the procedures described above.

4.2 EDIT COMMANDS

With EDIT loaded, the computer in run mode, and the I/O device (whether CRT or Teletype) operating on-line, the keyboard entries summarized in table 4-1 yield the indicated results. Pressing the RETURN key terminates and executes all EDIT commands.

Table 4-2 lists EDIT functions that are controlled by the use of I/O device special-purpose keys. Note that their use differs in the two modes of operation.

Table 4-1. EDIT Commands

Command	Operation
A	Enter text mode and add the following text input from the I/O device keyboard to the contents of the text buffer.
nC	Delete the line specified by n, and replace it with new text.
m,nC	Delete and replace lines m through n.
nD	Delete line n.
m,nD	Delete lines m through n.
F xxxx	Search the entire contents of the text buffer for character string xxxx (maximum number of characters, 72). Output the line on which it appears. If the string is not found, return to command mode, and output CR, LF, and *.
nF xxxx	Go to line n and search it and succeeding lines for character string xxxx (see above).
G	List the next sequential line whose first character is alphabetic.
nG	Go to line n and list the next line whose first character is alphabetic.

Table 4-1. EDIT Commands (continued)

I	Insert the following text before the first line in the text buffer.
nI	Insert the following text before line n.
K	Delete the entire contents of the text buffer.
L	List the entire contents of the text buffer, assigning sequential line numbers (decimal).
nL	List line n.
m,nL	List lines m through n.
P	Punch the contents of the text buffer on paper tape using the output device specified at edit loading time.
nP	Punch line n.
m,nP	Punch lines m through n.
R	Read (append) the following text input from the device specified at EDIT loading time to the contents of the text buffer.
S	Search the contents of the text buffer for the character input after RETURN. Output sequential text lines until the line in which the character appears is printed. If the character is not found, return to command mode, and output CR, LF, and *.
nS	Go to line n and search for the character input after RETURN (see above).
m,nS	Search lines m through n for the character input after RETURN (see above).
T	Punch approximately 20 inches of leader/trailer on paper tape using the output device specified at EDIT loading time.

Notes: Line numbers when specified in EDIT commands are decimal integers derived from the output of a listing command. The value of n must be greater than that of m.

Execution of all EDIT commands begins when the RETURN key is pressed.

SOURCE PROGRAM EDITOR (EDIT)

Table 4-2. Teletype Key Edit Functions

Teletype Key	Command Mode	Test Mode
RETURN	Execute the instruction	Load the input line into the text buffer
-	Illegal	Delete one character to the left and output -
RUBOUT	Cancel the instruction	Delete all the line to the left and output
CTRL and C (simultaneously)	Remain in instruction mode and output an asterisk (*)	Return to instruction mode and output an asterisk (*)
. (period)	Current line number (used alone or with the minus sign and number, e.g., 1, -8 refers to the eighth line preceding the current line)	Legal text character
/ (slash)	Number of the last line in the text buffer	Legal text character
=	Used with . and / to obtain their values	Legal text character
ESCAPE (ESC)*	List the next line	Ignored
CTRL and TAB (simultaneously)	Illegal	Interpreted as seven space on the Teletype printer output

* On the ASR35 keyboard, simultaneously press SHIFT, CTRL, and K.

4.3 USAGE EXAMPLES

To illustrate the use of EDIT commands and I/O device key functions, assume we wish to search line 20 for the character A and replace it with the character X. Note that the keys are shown enclosed in parentheses where they are applicable and that the simultaneous pressing of two or more keys is illustrated as follows: (SHIFT)(CTRL)(K).

- a. To ensure that EDIT is in command mode, type

(CTRL)(C)

- b. EDIT responds with a CR, LF, and *. Type

20S (RETURN)

- c. EDIT enters a delay loop and waits for input of the character for which it is to search. Type

A (RETURN)

- d. EDIT goes to line 20 and types it until an A is found:

XYZ LDA

then waits for input. Type

-X (RETURN)

Other editing options available for use in step d are:

- a. To delete the line to the left, type RUBOUT.
- b. To delete the line to the right, type RETURN.
- c. To delete the entire line, type the appropriate deletion command (table 4-1).
- d. To delete characters from right to left, type- once for each character.

4.4 ERROR DETECTION AND CORRECTION

EDIT checks all commands input to it for valid parameters and correct formatting. When an error is detected, EDIT:

- a. Types a question mark on the Teletype printer.
- b. Issues a CR and LF.
- c. Types an asterisk.
- d. Waits for a valid command.

The following conditions are recognized as errors:

- a. Incorrect response to the I/O device queries at loading time.
- b. A nonexistent command code.
- c. Commands terminated with any character other than RETURN.
- d. A starting line number that is greater than an ending line number.

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- e. Transposition of command parameters.
- f. Specifying a line number whose value is greater than the last line in the buffer.
- g. A deletion command that does not specify a line number.
- h. Pressing the ESCAPE (ESC) key to list the next line in the buffer when the buffer is empty.

When text being loaded into the text buffer from the keyboard exceeds the capacity of the buffer, EDIT outputs the message

VDM FULL

and enters the command mode. The last line entered at the keyboard is lost. When text being read from tape (R command) exceeds the allotted space, reading stops and the program enters the command mode. In this case no input data is lost (tape reading stops with approximately 1600 characters of text buffer remaining to allow for editing). To save the buffer contents and continued processing:

- a. Type a punch (P) command (table 4-1) and RETURN.
- b. After punching is complete, clear the text buffer using the K command.

The following options are also available:

- a. List, modify, and punch the buffer contents before clearing the text buffer.
- b. Abort the current source program edit and continued processing with a new program.