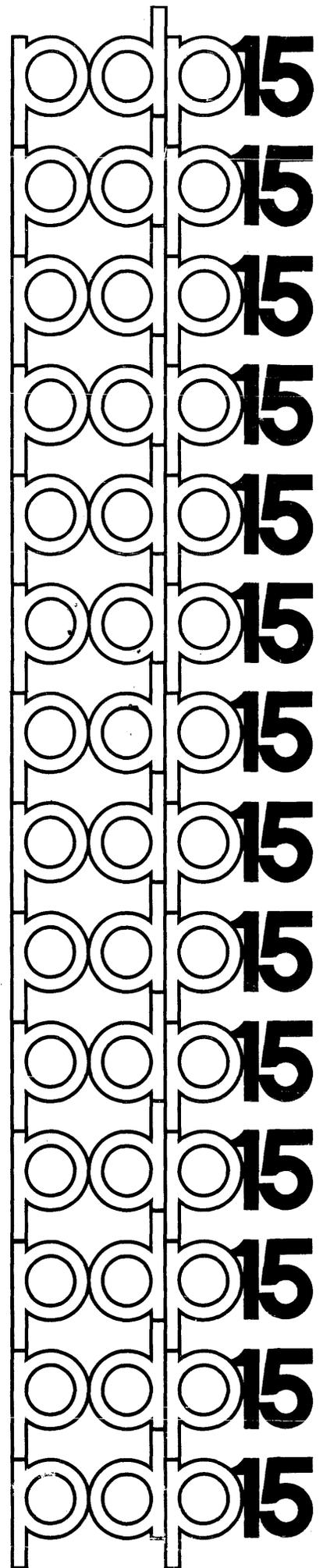


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PDP - 15

PATCH UTILITY PROGRAM

PROGRAMMER'S REFERENCE MANUAL

For additional copies of this manual, order No. DEC-15-YWZB-DN5 from the  
Program Library, Digital Equipment Corporation, Maynard, Massachusetts  
- 01754 Price \$3.50

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## PREFACE

This manual describes the operation and use of the PDP-15 PATCH Utility Program. The PATCH program may be operated in either the ADVANCED Software System (ADSS) or the Disk Operating System (DOS) environment.

### NOTE

In DOS systems, PATCH may be used only by the System Manager.

It was assumed in the preparation of this manual that the reader was familiar with the operation of the PDP-15 equipment and the contents of the software manual describing the features of the particular monitor system in which he was operating, that is:

- a) for ADSS users, PDP-15/20/30/40 ADVANCED Monitor Software System Manual, DEC-15-MR2B-D;
- b) for DOS users, DOS Software System User's Manual, DEC-15-MRDA-D.

### PDP-15 UTILITY PROGRAMS MANUAL, DEC-15-YWZB-D

The PDP-15 Utility Programs manual is comprised of a set of individual manuals, each of which describes the operation and use of a PDP-15 Utility Program. The manuals which make up the Utility Programs set are listed in the following Application Guide. In addition, the Application Guide also indicates the order number of each manual and the specific PDP-15 Monitor Software Systems in which the program described may be used.

The Utility Manuals may be ordered either individually, by using the title and order number given with each manual or as a set by referencing "PDP-15 Utility Programs Manual, DEC-15-YWZB-D".

APPLICATION GUIDE

PDP-15 UTILITY PROGRAM MANUALS

PDP-15 Utility Program Manuals and the Application of Each

Title	Manual Order Number (DEC-15-YWZB_)	Applies to Monitor:		
		DOS	ADV	B/F
DDT Utility Program	DN1	✓	✓	✓
CHAIN & EXECUTE Utility Program	DN2	✓	✓	✓
SGEN ADVANCED Monitor	DN3		✓	
MTDUMP Utility Program	DN4	✓	✓	
PATCH Utility Program	DN5	✓	✓	✓
EDIT Utility Program	DN6	✓	✓	✓
UPDATE Utility Program	DN7	✓	✓	✓
LINKING LOADER	DN8	✓	✓	✓
PIP ADVANCED Monitor	DN9		✓	✓
SRCCOM Utility Program	DN11	✓	✓	✓
SGEN DOS Monitor	DN12	✓		
PIP DOS Monitor	DN13	✓		
Disk SAVE/RESTORE Programs	DN14	✓	✓	✓

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## SECTION 1

### INTRODUCTION

#### 1.1 PATCH PROGRAM

The PATCH Utility program enables the PDP-15 user to view and modify System Programs and data on specific device data blocks. The commands provided by PATCH may be entered via the console keyboard or, in the monitor Batch mode, via either paper tape or card reader units. This manual is concerned only with user-controlled PATCH operations. The operation of PATCH under monitor Batch control is described in the applicable monitor (ADSS or DOS) reference manual (see Table 1-1).

#### 1.2 MANUAL ORGANIZATION AND USE

This manual is intended for users who are familiar with:

- a) the general operating procedures (i.e., use of equipment and startup procedures),
- b) the elements, structures and use of the particular monitor software system in which PATCH is to be used.

Introductory information and detailed descriptions of each PATCH function and their applications are given in Sections 2 through 5.

Section 6 summarizes the PATCH startup and operating procedures.

New users of PATCH should familiarize themselves with the contents of Sections 1 through 5; thereafter, they need only refer to Section 6 for concise information.

Two Appendices are included which contain supplementary System Block (SYSBLK) and System Program descriptions.

SYSBLK is described in Appendix A, System Programs are discussed in Appendix B.

### 1.3 SUPPORTING DOCUMENTS

Table 1-1 lists PDP-15 documents which either support directly or contain information useful in understanding PATCH and its functions.

Table 1-1

#### Supporting Documentation

<u>TITLE</u>	<u>ORDER NUMBER</u>
<u>ADSS Manuals</u>	
a) ADVANCED Monitor Software System for PDP-15/20/30/40	DEC-15-MR2B-D
b) PDP-15/20 User's Guide	DEC-15-MG2B-D
c) SGEN ADVANCED Monitor Utility Program	DEC-15-YWZB-DN3
<u>DOS Manuals</u>	
a) DOS User's Manual	DEC-15-MRDA-D
b) DOS Keyboard Command Guide	DEC-15-NGKA-D
c) SGEN-DOS Utility Program	DEC-15-YWZB-DN12
d) DOSPIP Monitor Utility Program	DEC-15-YWZB-DN13
<u>B/F Monitor Manual</u>	
a) PDP-15/30, PDP-15/40 B/F Monitor Software Systems	DEC-15-MR3A-D
<u>Common Manual</u>	
a) MACRO15 MACRO-Assembler Program	DEC-15-AMZC-D

### 1.4 MAJOR PATCH FUNCTIONS

The items on which PATCH functions may be performed together with a description of the commands and procedures needed for their selection are given in Section 2.

The major functions for which PATCH may be used are:

- a) the loading of relocatable programs into a system as a System Program (described in Section 3);
- b) the loading of absolute programs and data onto a System Program area (described in Section 4);
- c) the modification of registers located in
  - 1) System Programs,
  - 2) Data blocks,
  - 3) System SYSBLK (system block).

#### 1.5 PATCH, I/O DATA FLOW PATHS

Figure 1-1 illustrates the primary data flow paths employed during PATCH operations.

User command/response operations are carried out via a console/printer unit, Peripheral devices/UFD's containing the files to be patched must be assigned to .DAT-14, those devices containing auxiliary input files must be assigned to .DAT-10.

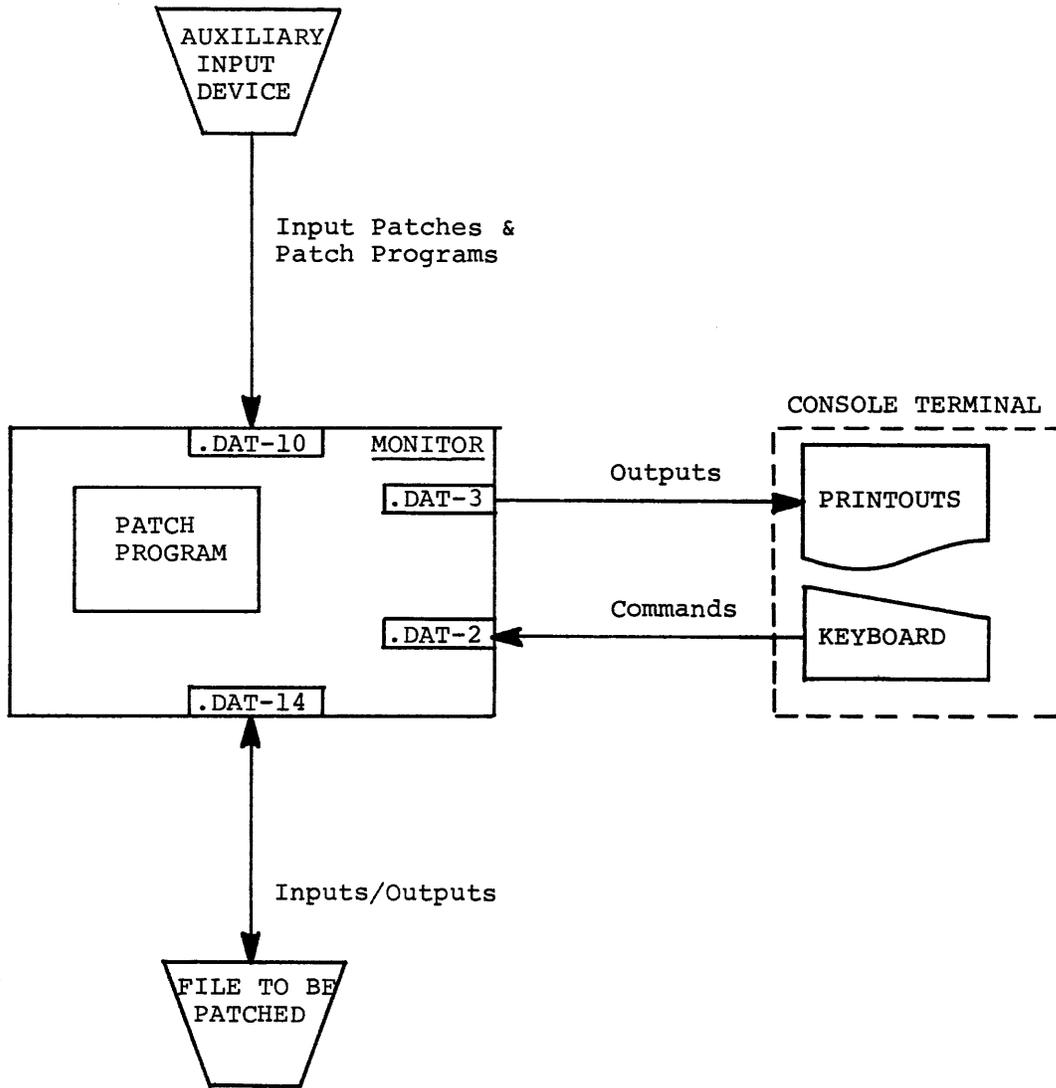


Figure 1-1 PATCH Operations, Information Flow Diagram

## SECTION 2

### SELECTION OF ITEM TO BE PATCHED

#### 2.1 SELECT FUNCTION

The first step required in any PATCH procedure is the selection of the item (.DAT -14) to be patched. Two basic commands "Program Select", and "Block Select" are provided for this purpose.

##### 2.1.1 Program Select Command

The System Programs located on the device assigned to .DAT -14 are selected for PATCH operations by the entry of a unique name which is stored in a monitor table; these unique names enable the monitor to identify the requested program.

The format for a Program Select command is:

```
>name )
```

For example, to select the Editor program the entry

```
>EDIT )
```

is entered.

The entry of a System Program name merely identifies the item to be operated upon; no further action is taken until a PATCH function is initiated by another command.

#### NOTE

The Program Select command may be used only if the device assigned to .DAT -14 contains a System Block (SYSBLK).

In addition to System Programs, system Device System Block (SYSBLK) and CTRL Q (↑QAREA) areas may also be selected for PATCH operations. Table 2-1 lists the unique names of the programs normally supplied as System Programs with ADSS and DOS software systems.

TABLE 2-1

## PATCH Accessible System Programs

PROGRAM	NAME	MONITOR	
		DOS	ADSS
1) Resident Monitor	RESMON	✓	
2) System Loader	.SYSLD	✓	✓
3) Control Q Area	↑QAREA	✓	✓
4) Standard Editor Program	EDIT	✓	✓
5) Text Editor for VT15 Graphics Display	EDITVT	✓	✓
6) Text Editor for VP15 Storage Tube Display Unit	EDITVP	✓	✓
7) Peripheral Interchange Program	PIP	✓	✓
8) Macro-Imbedded Assembler for 8K Systems Only	MACROI		✓
9) MACRO15, Macro-Assembler Program	MACRO	✓	✓
10) Cross Reference Program	CREF	✓	✓
11) CHAIN and EXECUTE Program	CHAIN	✓	✓
12) System Generator	SGEN	✓	✓
13) System Generator, Section 2	.SGEN2		✓
14) System Generator, Section 3	.SGEN3		✓
15) FORTRAN IV (16K)	F4	✓	✓
16) FORTRAN IV Imbedded (8K Systems Only)	F4I		✓
17) Core Dump Utility Program	QFILE	✓	
18) Dump Core Program	DUMP	✓	✓
19) DEctape Copy Program	DTCOPY	✓	✓
20) PATCH Program	PATCH	✓	✓
21) UPDATE Program	UPDATE	✓	✓
22) Source Compare Program	SRCCOM	✓	✓
23) Task Builder Program (RSX Only)	TKB	✓	
24) DOS Monitor	DOS15	✓	
25) Keyboard Monitor, KM-15	KM15		✓
26) 9-15 Keyboard Monitor, KM9-15	KM9-15		✓

### 2.1.2 Block Select (B)

A single 400<sub>8</sub>-word data block located on the device assigned to .DAT -14 is selected for PATCH operations, using a "B" Block Select command.

FORMATS: a) >B\_ n )  
          or  
          b) >B+ n ) (DECTape only)  
          or  
          c) >B- n ) (DECTape only)

where:

- 1) B identifies the Block Select command
- 2) + indicates the selected block should be read in the forward direction.
- 3) - indicates that the selected block should be read in the reverse direction
- 4) n represents an octal number which identifies a logical block on the PATCH I/O device (.DAT -14). The value of n must be greater than or equal to 0.

#### DESCRIPTION:

The entry of a "B" select command relocates the identified word block into a PATCH Block Buffer in core. In relocating the block, the load address is set to 0, the size is set to 400<sub>8</sub>, and the block number is as specified. If the block number (n) in any of the select commands is followed by a space, any data on the remainder of the input line is treated as a comment and is ignored. For example:

```
>B_1000_ COMMENT )
```

is permitted.



## SECTION 3

### LOADING RELOCATABLE PROGRAMS AS SYSTEM PROGRAMS

#### 3.1 PATCH LOAD FUNCTION

A PATCH load function enables the user to convert a relocatable file into an absolute SYS file format and load the converted file onto a system device as a System Program. The PATCH command used, the procedure required, the relocatable file requirements, and the operations performed by PATCH are described in detail in this Section.

The PATCH load function can only be used when the system on .DAT -14 has been prepared by SGEN to receive the converted file. During SGEN procedures (refer to appropriate SGEN manual) the user must enter the name of each program to be installed, specify .DAT slot usage, and indicate the order in which the System Programs are to appear in the newly generated system. The program name, size, and .DAT slot usage information entered during SGEN is stored in the system device SYSBLK.

#### 3.2 PATCH READR LOAD COMMAND

The command "READR" initiates the PATCH relocatable-to-SYS file program load function. The general format of this command is as follows:

```
>READR [nnnnn] [filename] [ext] [comments] )
```

where:

nnnnn = the highest 13-bit core address to be occupied by the relocated file when it is loaded into core as a SYS file. If an address is not specified, the first free register below the bootstrap is assumed by PATCH. If specified, the value of nnnnn must be  $\leq 17636_8$ ; a larger value will cause an error.

filename the name of the relocatable file.<sup>1</sup>

ext = filename extension; if not given, BIN is assumed.

comments if desired, a comment may be added to the command string, but only if the extension is given explicitly.

---

<sup>1</sup>NOTE: FILE name may be omitted for non-file oriented auxiliary devices (.DAT -10).

### 3.2.1 Procedures

The READR command must be preceded by a program select command which identifies the system device area (named in SGEN) into which the modified file is to be written. For example, the sequence:

```
>8TRN )  
>READR 8TRAN )
```

must be entered to install the file 8TRAN onto a prepared system device at .DAT-14, given the name 8TRN.

On the execution of a READR command, PATCH obtains the named file from .DAT-10 and checks it for required size and program characteristics (see paragraph 3.2.2). If the file is not acceptable, the load operation is halted and an appropriate error message is output to the user.

If the file is acceptable, PATCH relocates addresses within the input file, builds a table of the transfer vectors contained by the file, and appends the table and a Bank Bit Initialization routine to the file. The modified file and its appended routine and vector table are then loaded as a unit, in core image form, onto the system device at .DAT-14.

PATCH automatically changes the patch parameters in SYSBLK. Relocation and the Bank Bit Initialization routines are described in paragraphs 3.3 and 3.4, respectively.

### 3.2.2 Input File Requirements

In order to be installed onto a system as a SYS file, a relocatable file at .DAT-10 must:

- 1) not contain more than 256 transfer vectors;
- 2) not contain external .GLOBL references;
- 3) not use indexed instructions
- 4) not have a core image size greater than the number of system blocks allocated multiplied by 4096.
- 5) not cause the total program size to exceed 8K.
- 6) not contain COMMON references

## NOTE

The total installed size of a program may be computed by adding 1) the size of the binary program, 2) the number of transfer vectors, and 3)  $32_8$  word locations which are occupied by the Bank Bit Initialization routine.

### 3.3 RELOCATION

MACRO-15 outputs relocatable programs addressed as if they were assembled starting in location  $0$  of core. Relocatable programs are normally loaded into core for execution by the Linking Loader System Program which, at load time, computes the difference between the MACRO-assigned addresses and the addresses of the actual core area into which the program is to be loaded for execution. This computed difference, called the relocation factor, is then added to each location address contained by the program as it is loaded into memory. The relocation factor properly orients the relocatable program within memory.

#### 3.3.1 PATCH READR File Relocation

During the execution of a READR command, PATCH calculates the required 13-bit relocation factor by subtracting the program size from the final (highest) address the program is to occupy. The final address is either specified in the READR command by the user or, by default,  $17636_8$  is assumed.

The relocation factor, recognized by PATCH as the symbol #, is then incremented by 1 for each word location and the resulting value assigned as the address of the location. For example, the relocation factor (#) for a relocatable program  $4000_8$  words in size with no address specified in the READR command would be calculated:

$$\# = 17636_8 - 4000_8 + 1 = 17237_8$$

In order to relocate the program addresses ( $0$  through 377) for conversion to the absolute values required for SYS files, PATCH then increments the relocation factor by 1 for each position and assigns each value obtained as an address to the corresponding program word location; i.e.,



the vector words from the Transfer Vector table developed during PATCH READR operations.

On completion of its initialization function, this routine sets the contents of the .SCOM+3 pointer to the address of the last word location occupied by the routine and turns control over to the System Program.

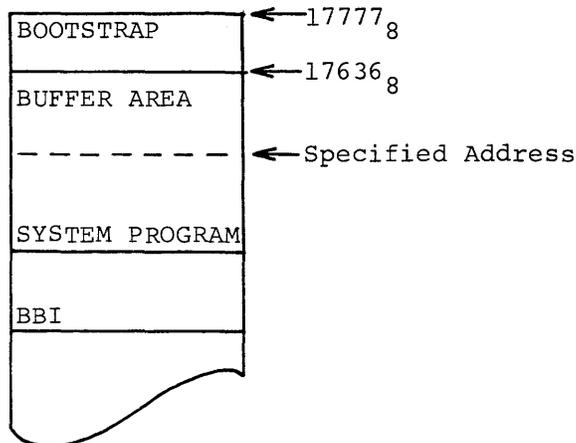
The modification of .SCOM+3 at the end of BBI functions frees the core occupied by this routine for use by the System Program.

The basic portion of the BBI routine requires  $32_8$  word locations. The routine Transfer Vector table requires an additional location for each Vector in the program. A maximum of  $400_8$  vectors is permitted.

The PATCH appended BBI routine relieves the user of the responsibility of including a routine to perform this function.

### 3.5 READR ESTABLISHED SYSTEM COMMUNICATIONS AREA

The ability to specify in the READR command the highest load address for the program being loaded permits a buffer area to be set up between the last program address and the first address of the bootstrap. Such a buffer would provide READR-loaded programs with a common core-resident buffer for intra-program communications and/or common data storage.



### 3.6 LOADING PATCH-RELOCATED CORE IMAGE SYSTEM PROGRAMS

READR-installed Systems Programs and their associated Device Handlers are loaded into core from the system device by the System Loader (.SYSLD) program.

The placement of READR-installed System Programs and their device handlers in core is illustrated in Figure 3-1.

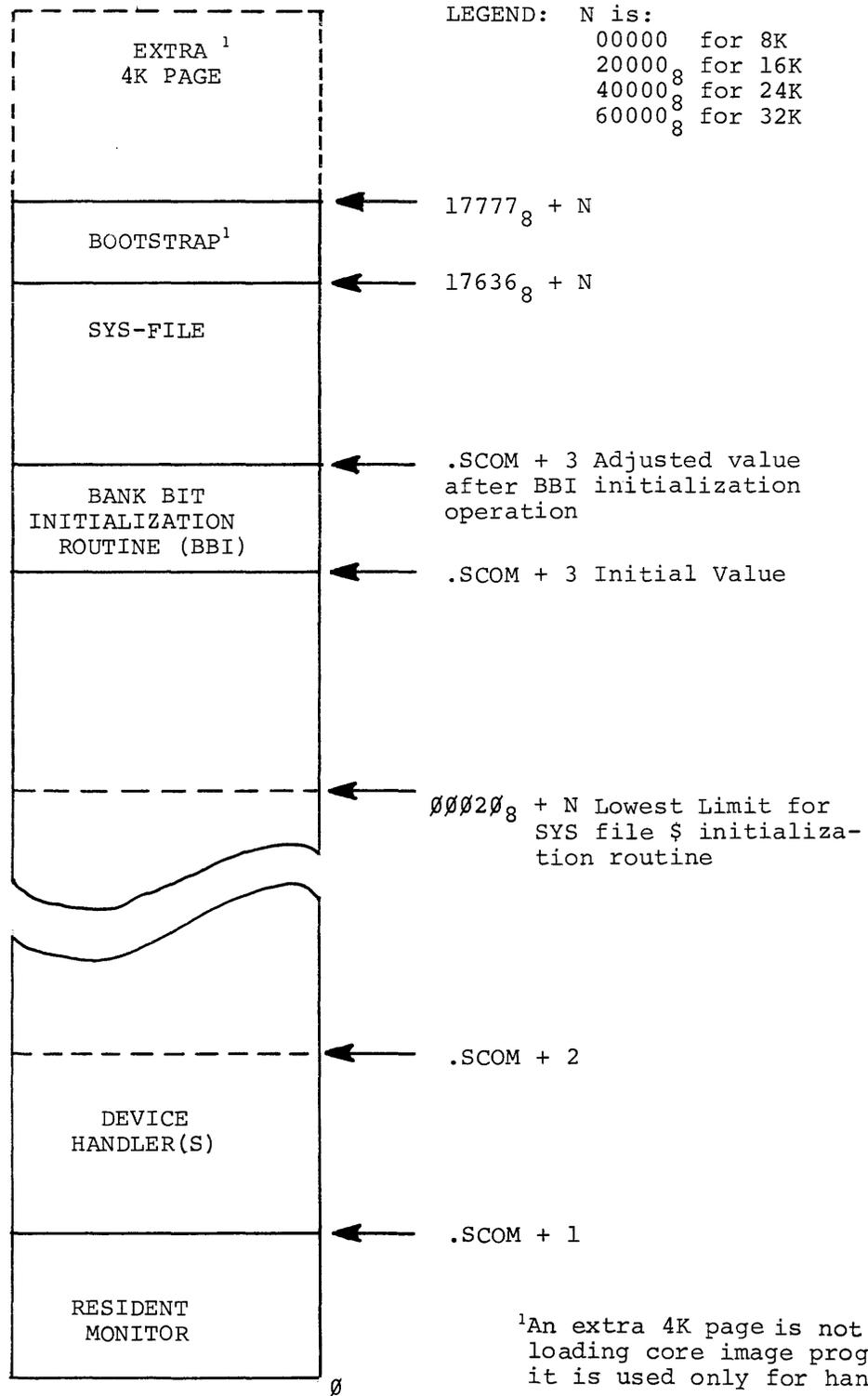


Figure 3-1, Memory Map, Loading a READR-Installed SYS-file on the ADSS Monitor



## SECTION 4

### LOADING ABSOLUTE PROGRAMS AND DATA

#### 4.1 READ AND PATCH FILE FUNCTIONS

This section contains detailed descriptions of the READ load function, the function user commands, and the load operation. Patch files, the input sources to PATCH during READ load function, are also described in detail.

#### 4.2 READ LOAD FUNCTION

The "READ" load function enables the user to transfer absolute "Patch files" from the auxiliary input device (.DAT-10) into a user-selected program or data block located on the device at .DAT -14.

A Patch file is an absolute program written by the user to operate with the PATCH READ load function; its purpose is to direct the PATCH program in loading information contained by the file into a specific register or series of registers located within a program or data block of the device on .DAT-14. Entire programs or data blocks, as well as selected items, may be loaded from Patch files onto the device at .DAT-14, using the PATCH READ load function.

Patch files are used as a means of making changes (i.e. patches) to SYS files or a device data block or of installing a new version of a System Program onto a system device. They are particularly useful when the same patches are to be made to a SYS file contained by more than one system device.

#### NOTE

When patching or replacing a System Program, care must be taken to ensure either that the existing SYSBLK parameters are not affected or that they are changed to comply with the characteristics of the replacement version of the program (see paragraph 4.5).

#### 4.3 READ COMMAND

The command READ initiates the performance of the absolute load function. This command may have any of the following formats:

- a) >READ) (for non-directoried devices only )
- b) >READ┘[filename])
- c) >READ┘[filename]┘[ext])

- where:
- 1) filename is the name of the Patch file to be input from .DAT-10. The use of a filename extension (format c) is optional. If not given, the extension is assumed to be ABS.
  - 2) Comments may be added to command strings having the format shown in item c.
  - 3) Patch files on paper tapes do not require a filename (see item a).

NOTE

The READ command must be preceded by either a Program Select or Block Select command. The patch file read must be a .ABS macro program.

#### 4.3.1 READ Load Operation

During READ command load operations, PATCH loads into core one 400<sub>8</sub>-word block at a time from both the Patch File and the selected program or data block. Once both blocks are loaded, PATCH processes in sequence each word of the Patch File block. Using reference data supplied in the Patch File, PATCH determines the address within the user selected program or data block which corresponds to that addressed by the Patch File word being processed. If the addressed register is within the selected program or data block currently in core, the contents of the Patch File word are loaded into that register by PATCH.

If the addressed register is not in the block currently in core, the block in core is written back into the device at .DAT-14 and the block containing the addressed register is loaded. After the new block is loaded, PATCH locates the addressed register and writes the contents of the Patch File word into it.

A user-selected data block is handled, during READ operations, as if it were an absolute program having addresses ranging from 000000 through 00377<sub>8</sub>. If more than one data block is to be patched, a separate Patch File is required for each block and individual Select . Block and READ commands must be issued for each.

If a Patch File word addresses a location not within the limits of the selected program or block, PATCH outputs an ADDRESS OUT OF RANGE error to the user console teleprinter (refer to Section 6 for description of error messages).

#### 4.4 WRITING PATCH PROGRAMS

The following is an example of the proper format for a PATCH assembly source program to be assembled and output by MACRO-15:

<u>PATCH FILE</u>		<u>MEANING AND OPERATION PERFORMED</u>
.TITLE	anything	
.ABS	NLD	No Loader.
.LOC	234	Set location counter to address 234.
734777		Set contents of 234 to 734777, and go to next location.
600261		Set contents of 235 to 600261.
.LOC	350	Advance counter to location 350.
-3		Set contents of 350 to -3.
.LOC	371	Advance location counter to address 371.
040674		Write 040674 into LOC 371
.		.
.		.
.		.
.END		End program.

As illustrated in the above example, .LOC statements in the patch program are recognized by PATCH as pointers. These pointers direct PATCH to start a replacement operation at a specified address in the program or data block being patched. In the replacement (overwrite) operation, the contents of the Patch File location immediately following the .LOC statement is written, by PATCH, into the selected program or data block location pointed to by the .LOC address. PATCH then writes, in sequence, the contents of the following Patch File locations into the registers of the file being patched immediately following the one pointed to by the patch file .LOC statement. All patches are written as if the program is to be loaded into the first bank (13 bit addresses). All transfer vectors in a .ABS program must be bank-bit initialized before use.

The current replacement operation continues until another .LOC statement is reached in the input Patch File. The new .LOC statement ends the current replacement operation and directs PATCH to go to a new start location and to start another replacement operation.

--  
The Patch File operations are terminated when PATCH reaches the PATCH File .END statement.

#### 4.4.1 Partial Overlay Patch Programs

A Patch Program written to change the contents of specific locations or groups of contiguous locations throughout a selected program or data block acts as a partial patch to the file being modified; only those items specified in the Patch Program are affected. The Patch Program in example in paragraph 4.4 represents a partial patch.

Patch programs may only be used to change the contents of registers already existing within a selected program or data block; they cannot be used to insert information between existing program lines.

#### 4.4.2 Replacing Complete Programs or Data Blocks

Patch Programs may be written to replace an entire absolute System Program or 400<sub>8</sub>-word data block. To accomplish this, the user sets the first Patch File .LOC statement to point to the first location of the program or data block to be replaced and follows it with the replacement program or data block. For example:

```
.TITLE          (Patch Program name)
.ABS           NLD
.LOC           (First Location of selected program or
               ↓
Replacement   data block)
Program or
Block
               ↓
.END
```

#### 4.5 PRECAUTIONS TO BE OBSERVED FOR PATCH READ OPERATIONS

The PATCH READ load operation does not modify (i.e., update) SYSBLK on completion of the function. If any changes are made to a System Program which affect the parameters stored for it in SYSBLK, the user must

change these parameters using the PATCH List function (described in Section 5). Indexed instructions are not permitted.

When overlaying a complete program with a new version, the user must ensure that the new version will fit into the area allotted to that program during SGEN. All .ABS program transfer vectors must be bank-bit initialized by the program itself before it uses them if the core image is loaded above 8K.



## SECTION 5

### LISTING AND MODIFYING PROGRAM AND DATA BLOCK REGISTERS

#### 5.1 REGISTER MODIFICATION FUNCTIONS

This section describes the functions, commands and procedures which enable the user to select and modify individual registers within:

- a) SYS files initially written as absolute programs,
- b) READR-installed SYS files,
- c) a system device SYSBLK Program Parameter Table, and
- d) a system save, ↑QAREA, area.

#### 5.2 PATCH LIST FUNCTION

PATCH register modification is carried out as a list operation in which the address and contents of each register selected by the user are listed (printed) on the user's console teleprinter. On completion of the print operation, the user may enter, if desired, an expression to replace the contents of the currently listed register. When the user is through with the currently selected register, he terminates that operation and either terminates the function or directs PATCH to list the contents and address of another register. The program or data block containing the register(s) to be modified must be identified by the entry of a Select command (see Section 2); the specific register to be viewed and modified (if desired) is selected by the user with a "List" command. Three types of List commands are provided by PATCH:

- a) L command, used to select and initiate the list operation for registers within any selected SYS-file, data block, SYSBLK or QAREA contained by the device on .DAT -14.
- b) LR command, used only for the selection and listing of registers within READR-installed SYSfiles.
- c) SYSBLK Program Parameter Commands, five separate commands, each of which initiates the list operation for a specific SYSBLK parameter for the currently selected SYSfile. Used only with SYS files.

The format and use of the above List commands are described in paragraphs 5-3, 5-4, and 5-5, respectively.

### 5.2.1 List Operation

The PATCH operations performed during a List operation are:

- a) On the entry of a list command, PATCH loads the 400<sub>8</sub> word data block or selected Program block containing the user identified register into core. The selected register is opened by PATCH and its address and contents are printed on the console teleprinter unit.
- b) PATCH waits for the entry of a modifier and/or a terminator.
- c) PATCH writes the input modifier (if made) into the opened register and examines the line terminator to determine the next operation to be performed. Depending on the terminator entered (see 5.2.3) PATCH terminates the List function or opens another register.

### 5.2.2 Expressions

Expressions, as defined for MACRO-15 (see DEC-15-AMZA-D), are strings of symbols and numbers separated by arithmetic or Boolean operators. Octal numbers of from one to six digits (0 to 77777<sub>8</sub>) or alphanumeric symbols of from one to three characters may be used as expressions or as components of an expression.

In PATCH List operations, expressions are entered as replacements for the contents of a program or data block register. Expressions entered to change or modify a data word consist of up to six octal digits, originally preceded by a minus sign; those entered for an instruction word consist of an instruction operation code and an operand. PATCH contains symbol tables for all of the PDP-15 basic instructions op-codes and the operate group instructions with the octal values of each. The user can, therefore, patch registers using symbolic rather than octal representations of MACRO instructions (e.g., an expression may be entered as LAC 17536 instead of its octal form, 217536).

The operators recognized by PATCH are listed in Table 5-1.

TABLE 5-1

Operators Recognized by PATCH

<u>OPERATOR</u>	<u>FUNCTION</u>
-	Two's complement subtraction
!	Inclusive OR
+ -> (tab) *	} Two's complement addition

The asterisk (\*) in addition to its use as an operator, also sets the indirect bit of the expression by causing 200000<sub>8</sub> to be XORed into the value of the expression. The XOR operation occurs each time that the symbol (\*) is encountered; two sequential asterisks negate the setting of the indirect bit.

$$** = 200000 \text{ XOR } 200000 = 0$$

The value of a PATCH expression is null (no modification is made to the opened register) unless the expression contains a number, symbol or an asterisk.

Expressions are evaluated from left to right assuming an initial value of zero followed by a + operator (i.e., 0 + User's expression). Leading and trailing operators are legal in an expression but the latter are ignored. Whenever a string of consecutive operators is used, only the last one in the string is used by PATCH in evaluating the expression.

NOTE

The LAW symbol is a special case in PATCH; it should be used only in the following ways:

- a) LAW    n which is equivalent to 760000+n
- b) LAW    -n which is equivalent to -n.

The use of LAW in any manner other than that described below will result in an error.

### 5.2.3 List Operation, Line Terminator

When all list operations for an opened register are completed, one of four possible Line Terminators is entered to close the register and indicate the next list operation. The line terminators are described in Table 5-2.

Table 5-2 List Operations, Command String Terminators

ENTRY	DESCRIPTION	OPERATION
)	Carriage Return	Open and list the next sequential register
↑ )	Up Arrow and Carriage Return	Open and List the register which precedes the current register. Treat any entries after ↑ as a comment.
← )	Back Arrow and Carriage Return	Open and list the contents of the register pointed to by the address portion of the word contained in the currently opened register. Treat any entries after ← as a comment.
@	ALT MODE	Terminate current list operation; write PATCH buffer block onto .DAT -14 and wait for next entry.

### 5.3 L List Command

The L List command has the following format:

L\_n)

where

- a) L initiates the list operation, and
- b) n represents the octal form of the 13-bit address of the location to be opened. When the L command is used to open registers of READR-installed SYS files the address n must be the relocated (i.e., address after relocation) value.

The response to an L command is a printout having the following format:

```
>address of opened location) / (contents of opened location)>
```

EXAMPLE

```
>L 132
>00132/777435> (location 132g; contents 777435g)
```

After outputting the address and contents of the accessed location, PATCH prints its go-ahead symbol (>) and waits for:

- 1) the entry of an expression to replace the current contents, to modify the opened location.

For example:

```
>(address)/(current contents)>(expression-new contents)
```

- 2) the entry of selected string terminator to indicate the next sequential list operation.

### 5.3.1 Example: Select, List and Modification Procedures

The following illustrates the use of PATCH select and list commands in the modification of a hypothetical system program named JOVE.

<u>PROCEDURE</u>	<u>DESCRIPTION</u>
>JOVE	Select System Program JOVE.
>L 100	Initiate List operation starting at location 100
00100/777435	PATCH prints address and contents of opened location; user enters ) to go to and open next sequential location.
00101/600200>213775	Address and contents of location 101 are printed, user changes contents from 600200 to 213775 and opens the next sequential location.
00102/111215>00300+	User modifies contents of location 102 and commands PATCH to go to and open the location addressed by the contents of location 102 (i.e., location 300).
00300/000110>↑	User enters ↑ to open and examine contents of preceding location (i.e., 277).
00277/703112>@	User terminates current list operation by entering ALT MODE (symbol @).
>	PATCH prints a go-ahead symbol to indicate that it is ready for the next operation.

## 5.4 LR LIST COMMAND

The LR List command has the following format:

```
>LR_n)
```

where LR initiates the listing operation for a previously selected READR-installed Systems Program, and n represents the 13 bit "unrelocated" address (in octal) of the program location to be opened.

### NOTE

PATCH automatically calculates and adds the needed relocation factor to the user's entry (i.e., n). This enables the user to work directly from original unrelocated listings.

The major difference between the "L" and "LR" list operations is that in L operations only absolute address information is output in responses and is required in modification procedures. In LR operations, however, the user must deal with both relocated and unrelocated addresses in list printouts and in register modification procedures.

When the LR command is used to open word locations containing either data or non-memory reference instructions, the responses output are similar to those described for the L command. The only difference is that in the LR responses the address of the accessed location is given in relocated form relative to the original MACRO-assigned address.

### NOTE

In the following paragraphs the symbol # is used to denote the relocation factor used by PATCH in the conversion of an unrelocated program into a system program.

To illustrate, assume that 6 is the unrelocated address of a user-selected location containing a non-memory reference instruction or data and that the relocation factor (#) is 17344. The response to the command:

>LR\_6 )

is printed in the following form:

>17344 + 6 / nnnnnn >

Relocated      Contents of location (6 digits)  
Address        Op-Code and Operand or Data

For example:

>17352/017206>

To illustrate, assume that a relocation factor of 17642 is current and that the selected program location 101 contains a JMP .+1 instruction. The response to the command:

LR\_101 )

is printed in the following form:

17743/617744<00102>

Relocated Location Address	Contents, Op-Code + # + Operand	Unrelocated Operand, Referenced Address (i.e., 00102)
(177642+101)	(600000 + 17642 + 102 JMP=600000 .+1 = 101+1 = 102	

Printing an address operand in its unrelocated form enables the user to easily recognize the instruction containing it, and the referenced location without calculating and subtracting the PATCH relocation factor (#).

The unrelocated referenced address within a memory-reference type instruction is not printed by PATCH if it is less than the first address of the program; the address printed in angle brackets is always positive, though it may be zero.

#### 5.4.1 LR, Register Modification Procedure

The contents of registers opened during LR operation are changed, as for L list operations, by the entry of an expression which is to replace the contents of the current location. New contents are entered immediately after the listed response and replace the current contents on termination of the response/user-input line.

Input expressions are formed using:

- a. Octal numbers up to six digits in length; PATCH always assume a six-digit input and right-justifies all numeric inputs (e.g., an entry of  $300_8$  is recognized as  $000300_8$ ).
- b. Operators (symbols) as listed in Table 5-1.
- c. Symbolic representation of all PDP-15 basic instruction op-codes and operate group instructions.
- d. The symbol # to represent the relocation factor of the currently selected, READR-installed System Program.

Command string terminators indicate the next sequential operation to be carried out (refer to Table 5-2).

#### 5.4.2 Relocation and LR List Operation Examples

The following examples use a single memory reference instruction to illustrate the relocation operations performed by READR in the installation of a SYS file and the manner in which the instruction may subsequently be examined using the LR command.

##### EXAMPLE:

- a. Assume the instruction  $LAC_{\underline{\quad}}300$  located in MACRO assigned location 200 of an unrelocated  $400_8$ -word program.
- b. The program is selected by the user and is patched onto a prepared system device medium as a SYS file using the READR function/command.

```
Program      >Filename (name given at SGEN time)
Name         >READR Filename (current name of program)
```

- c. During READR operations, a relocation factor is calculated and added to all location addresses contained by the program. For a  $400_8$ -word program,  $\# = 17237_8$ . Therefore, the relocatable input memory reference instruction

```
2008    LAC 300
```

is relocated as

```
(#+200)    (LAC #+300)
```

which equals

```
174378    LAC 175378
```

or, in full octal form:

```
17437    217537
```

The relocated instruction is then output to the system device.

- d. To examine the instruction given in step c. in a READR-installed SYS file, the user calls PATCH, selects the program, and uses the LR command

```
$PATCH  
>Filename  
>LR_200)
```

The responses output at the I/O console will be:

```
>17437/217537<003000>
```

- e. To change the contents of the location, the user enters the desired expression and terminates the command string. If the contents contain an address, the relocation factor must be added to the new entry.

For example, to change the address references in the contents of the location opened in step d from the 300<sub>8</sub> to 305<sub>8</sub> (unrelocated values), the user must enter the expression:

```
2175448
```

if he knows the value of the relocation factor # (i.e., 17237 + 305).

or

```
LAC #+3058
```

EXAMPLE:

```
>17436/217537<003000> LAC#+305 )
```

changes the location to

```
17436/217544
```

and the terminator ) causes the next sequential location to be opened and a response output.

## 5.5 SYSTEM PROGRAM SYSBLK PARAMETER COMMANDS

PATCH provides, as a convenient for the user, five separate commands which obtain and modify, if desired, SYSBLK parameters for the user selected program currently in core. By entering the appropriate command from the following list and using suitable terminators as listed in Table 5-2, the user may start the listing at any specific point and proceed subsequently through the desired parameters.

The commands, the parameters opened, and the word positions are as follows:

<u>Command</u>	<u>SYSBLK Parameter Opened</u>	<u>Word Position</u>
a) FB ↵	Number of first block used	3
b) NB ↵	Number of blocks allotted to program	4
c) FA ↵	First core address occupied when the SYSfile is loaded into core (13-bits)	5
d) PS ↵	Program Size	6
e) SA ↵	Starting Address (13-bits)	7

When examining the parameter group of a READR-installed System Program, the user must remember that:

FA	will give the address of the first (lowest) core locations occupied by the <u>System Program/BBI</u> combination when it is loaded.
PS	will give the <u>TOTAL</u> size of the <u>System Program/BBI</u> combination.
SA	will give the starting address of the BBI routine (first address above Transfer Vector address table).

### NOTE

The program system parameter commands may not be used:

- when a program has not been selected or the command CTRL P (↑F) has been entered;
- when SYSBLK has been selected;
- when the commands B, B+, or B- are in effect.

The five SYSBLK Parameter commands operate in a manner similar to the List (L) command. When entered, the corresponding parameter location address and contents are printed out followed by a go-ahead symbol (>) as for the L command. As in other list operations, the user may, according to the manner in which terminators are used: 1) modify the opened register, 2) view the next sequential register, 3) view the preceding register, 4) jump to and view the location addressed by the contents of the last opened register, or 5) terminate the operation.

The operations initiated by a Parameter command are carried out on the SYSBLK information contained by the PATCH command table. This SYSBLK data is obtained by PATCH when it is first loaded into core and prior to the start of user PATCH operations. On completion of each SYSBLK Parameter command operation (ALT MODE terminator used), the modified (or unchanged) command table SYSBLK is copied onto the system at .DAT-14.

Five separate commands are provided by PATCH as a convenience for the user; they permit the user to obtain a specific parameter or to start listing operations at a specific point with a simple straightforward command. The complete series of five program parameters may be obtained simply by starting with the FB command and advancing the listing operation through the next four sequential word locations. This method is the only way to modify .SYSBLK parameters without reloading PATCH since it also modifies the PATCH command table.

EXAMPLE:

The following example illustrates the use of a PATCH SYSBLK parameter command to obtain and modify the first address occupied, program size and starting address parameters for the system program currently in core.

<pre>&gt; FA ↵ 00066/013670&gt;13660 ↵ 00067/003747&gt;3757 ↵ 00070/013671&gt;13661(ALT MODE) &gt;</pre>	<pre>parameter command first address opened and modified program size opened and modified starting address opened and modified and operation terminated.</pre>
--	--



## SECTION 6

### SUMMARY, OPERATING PROCEDURES AND ERROR MESSAGES

#### 6.1 CONTENTS

Brief procedural descriptions of the operations needed before loading the PATCH program and for the performance of each PATCH function are given in this Section. Error detection and error messages are also described.

#### 6.2 PRE-LOAD OPERATIONS

##### 6.2.1 .DAT Slot Assignments

The user must make the .DAT slot assignments given in Table 6-1 immediately prior to loading the PATCH program.

Table 6-1 Required .DAT Slot Assignments

<u>.DAT Slot</u>	<u>Used to</u>
-14	Input from and output to the device on which patches are to be made. The device handler is required only to perform .TRAN.
-10	Input from the auxiliary device. The device handler must handle Dump Mode input and, if it is for a non-file oriented device, must handle image alpha mode.
Permanently Assigned {	-3 Output to the teleprinter.
	-2 Input from the console keyboard or batch processing device.

.DAT slot -10 can be assigned no device handler (NONE) if auxiliary input is not required. .DAT slots -3 and -2 cannot be changed.

##### 6.2.2 I/O Device Preparation

The user must ensure that the I/O device assigned to .DAT-14 (material to be patched) is WRITE ENABLED before starting PATCH operations.

If the device is a

1. DECTape unit - set the unit's WRITE ENABLED/WRITE LOCK switch to the WRITE ENABLED position.
2. DECdisk - set the assigned logical disk unit's WRITE LOCKOUT switches to their ENABLED positions. (RF Disk units only)

### 6.3 CALLING PATCH

PATCH is called by issuing the command PATCH from the system I/O console. When PATCH is loaded and running, it outputs its name and version number. For example:

```
KM15 V5A
$PATCH)
PATCH Vnn
>
```

### 6.4 PATCH OPERATIONS

The operations which may be performed using PATCH fall into four (4) functional groups. Procedures, in table form, are given for the List "L" and "LR" functions.

#### 6.4.1 Examination and Modification of Registers in Absolute Programs and Data Blocks

See Table 6-2.

#### 6.4.2 Examination and Modification of Registers in PATCH-READR-installed System Programs

See Table 6-3.

#### 6.4.3 Replacing Absolute Programs from External PATCH Files

The required procedure is to:

- a. Select Program or data block to be patched (e.g. >EDIT)).
- b. Specify READ operation and input file with the command string

```
>READ _[filename]) (e.g., >READ _EDPCH))
```

#### 6.4.4 Installation of Relocatable Programs as Absolute SYS Files

The required procedure is:

- a. Select the system device area prepared (by SGEN) to receive the new SYS file (e.g., >NUFIL)).
- b. Enter the PATCH READR command using the following format:

```
>READR,nnnnn,[filename]) (e.g., >READR,17600,NUFIL))
```

##### NOTE

nnnnn represents the highest register the new SYS file will occupy when loaded into core. In the example, this is specified as 17600<sub>8</sub> which would leave a 36<sub>8</sub>-word buffer between the top of the SYS file and the first Bootstrap location.

#### 6.5 ERROR DETECTION

PATCH, on the detection of an error, causes the following:

- 1) the current function is terminated;
- 2) the data block (program or selected block) current in the PATCH Block Buffer is output to the device at .DAT-14 if modifications had been made to the block;
- 3) an appropriate error message is output at the user's I/O terminal.

In the event of an .IOPS error, control is not automatically returned to the monitor. PATCH can be restarted by the entry of a CTRL P (†P) command. CTRL P is also useful in terminating a read operation in the event of an equipment malfunction (e.g., paper tape reader jams).

In the event of an "I/O device not ready" error (IOPS4), CTRL R may be used to continue the current operation after the device involved has been made ready. CTRL C may also be used to return control to the monitor; however, care must be taken not to use this command when a register is open since any modification made to the current block in core will be lost.

#### 6.6 ERROR MESSAGES

The error messages output by PATCH are listed and described in Table 6-4.

Operation	Item to be Patched		
	BLOCK	PROGRAM	PROGRAM SYSBLK PARAMETERS
SELECT ITEM TO BE PATCHED	>B <u>  </u> n) or >B+ <u>  </u> n) or >B- <u>  </u> n)	>Prog. Name)	>Prog. Name)
SELECT REGISTER OR PARAMETER	>L <u>  </u> n)	>L <u>  </u> n)	>FA) or >FB) or >NB) or >PS) or >SA)
MODIFY OPENED ITEM	ENTER NEW CONTENTS IMMEDIATELY AFTER RESPONSE OUTPUT WHEN LOCATION WAS OPENED.  e.g., >Address/ Old Contents > <u>New Contents</u>		
SELECT NEXT OPERATION	TERMINATE RESPONSE LINE ACCORDING TO DESIRED NEXT OPERATION:  ) go to next sequential location open and list address and contents ↑) go to preceding register, open and list address and contents ←) go to register identified by contents of current register, open and list address and contents  ALT terminate current list operations MODE		

Table 6-2, Procedure for Modifying Registers in Absolute System Programs

Operation	Item To Be Patched	
	PROGRAM	PROGRAM SYSBLK PARAMETERS
SELECT ITEM	>Prog. Name ↵	>Prog. Name ↵
SELECT REGISTER OR PARAMETER	>LR <u>  </u> n ↵	>PA ↵ or >FB ↵ or >NB ↵ or >PS ↵ or >SA ↵
MODIFY OPENED ITEM	<p>ENTER NEW CONTENTS IMMEDIATELY AFTER RESPONSE OUTPUT WHEN LOCATION WAS OPENED. USE RELOCATION FACTOR (#) WHEN CHANGING MEMORY REFERENCE OR TRANSFER VECTOR REGISTERS.</p> <p>e.g., <u>standard register</u></p> <p style="padding-left: 40px;">&gt; relocated address / old contents &gt; new contents</p> <p style="padding-left: 40px;"><u>memory reference instruction or transfer vector</u></p> <p style="padding-left: 40px;">&gt; relocated address / old contents &lt; unrelocated address of contents &gt; new contents + #</p>	
SELECT NEXT OPERATION	<p>TERMINATE RESPONSE LINE ACCORDING TO DESIRED NEXT OPERATION:</p> <p style="padding-left: 40px;">↵ go to next sequential location open and list address and contents</p> <p style="padding-left: 40px;">↑↵ go to preceding register, open and list address and contents</p> <p style="padding-left: 40px;">↵↵ go to register identified by contents of current register, open and list address and contents.</p> <p style="padding-left: 40px;">ALT MODE terminate current list operations</p>	

Table 6-3. Procedure for Modifying Registers in PATCH-Installed System Programs

Table 6-4

## ERROR MESSAGES

<u>Printout</u>	<u>Meaning</u>
ILLEGAL COMMAND	<ul style="list-style-type: none"> <li>a. An attempt was made to issue a command before a file or block was selected.</li> <li>b. Command unrecognizable.</li> </ul>
NOT OCTAL DIGIT	A character other than an octal digit was encountered where an octal digit was expected.
TOO MANY DIGITS	The command string contains an octal number with more than 6 digits.
ADDRESS OUT OF RANGE	<ul style="list-style-type: none"> <li>a. The address requested is not within the legal range of the currently selected program or block.</li> <li>b. Address or size argument of a SYSBLK command is greater than <math>17645_8</math> or is negative.</li> </ul>
CHECKSUM ERROR	Bad data read in from auxiliary input device (checksum, parity, or validity bits) - try again.
FILE NOT FOUND	The file named in a READ or READR command does not exist on the auxiliary device.
ILLEGAL BLOCK #	The block number specified in a Block Selection command was less than $\emptyset$ .
ILLEGAL SIZE	<ul style="list-style-type: none"> <li>a. The program size (PS command) exceeds the number of blocks allotted for the current program.</li> <li>b. The size of the program (including the bank bit initialization routine supplied by PATCH) input by a READR command exceeds the number of blocks allotted (during system generation) for the SYS file or is greater than <math>nnnnn-2\emptyset_8</math>.</li> </ul>
MORE THAN 256 TRANSFER VECTORS	The program being input by a READR command contains more than 256 transfer vectors.
NOT RELOCATABLE BINARY	The program being input by a READR command is not a relocatable binary file.
.GLOBL NOT ALLOWED	The program being input by a READR command contains an external .GLOBL (internal .GLOBL ignored).
LAST ADDRESS GREATER THAN 17636	The last address of the program input by a READR command is greater than $17636_8$ .

## APPENDIX A

### SYSTEM BLOCK (SYSBLK) DESCRIPTION

#### A.1 SYSTEM BLOCK (SYSBLK)

In each of the primary PDP-15 monitor systems (ADSS, DOS) the monitor contains a System Block table (abbreviated as SYSBLK) which contains the name, physical parameters and I/O information for each system program in the software system.

The information contained by SYSBLK in the initial operating system is determined during System Generation procedures (refer to the appropriate SGEN manual - Table 1-1). SYSBLK is used by the system loader programs in locating and loading selected (called) System Programs into core.

PATCH, when first loaded into core, checks for a SYSBLK at .DAT -14 and, if one is present, it loads the SYSBLK Parameter Table into core as a PATCH Command Table. This command table is used unchanged during all subsequent PATCH System Program operations, including SYSBLK modification operations.

SYSBLK, itself, is divided into two distinct areas (see Figure 2-1), a Parameter Table, and a Communications Table (named COMBLK in DOS systems). PATCH operations normally concern only the SYSBLK Parameter Table.

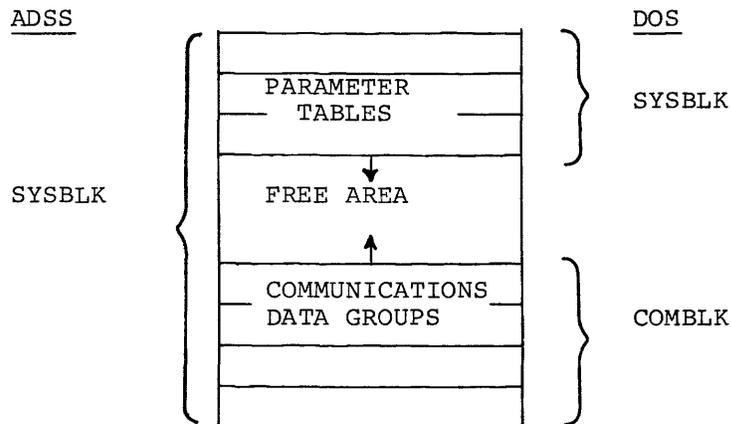


Figure A-1

System Block, Overall Configuration

### A.1.1 SYSBLK Parameter Table

Both the ADSS and DOS SYSBLK parameter tables contain separate seven-word parameter groups for each System Program in the operating system. Each parameter group consists of the following:

<u>WORD</u>	<u>CONTENTS</u>
1 & 2	Name of the System Program or overlay (i.e., PATCH, DDT, EDIT, etc.) in .SIXBT.
3	The number of the first system device block occupied by this System Program or overlay.
4	The amount of system device blocks allotted to contain the program. For PATCH-installed programs, this number is allotted during user SGEN procedures.
5	The address (13-bit) of the first core locations that will be occupied by the System Program when it is loaded.
6	The size of the program.
7	The program starting address (13-bit).

An example of an ADSS System Program parameter table is given in Figure 2-2.

<u>OCTAL PRINTOUT</u>		
<u>WORD</u>	<u>CONTENT</u>	<u>INTERPRETATION</u>
00010	050411	Program name "EDIT" in .SIXBT code.
00011	240000	
00012	000630	The first block occupied by EDIT is 630 <sub>8</sub> .
00013	000012	Twelve blocks (octal) are allotted to hold the program EDIT.
00014	013000	The first core location <sup>1</sup> occupied by EDIT is 13000 <sub>8</sub> .
00015	004636	EDIT consists of 4636 <sub>8</sub> words.
00016	013000	Program start address <sup>1</sup> is at core location 13000 <sub>8</sub> .

Figure A-2

#### System Program EDIT SYSBLK Parameter Group

<sup>1</sup>At load time, the bank bits of the highest 8K system bank are added to this address to properly locate the program in the highest bank.

### A.1.2 Communications Table

ADSS system block communication areas contain individual .DAT slot lists for each system program and a master .DAT slot list pointer table.

DOS system block COMBLK area contains individual communication data groups which store .DAT slot, buffer, and overlay information for each system program.



## APPENDIX B

### SYSTEM PROGRAMS, GENERAL DESCRIPTION

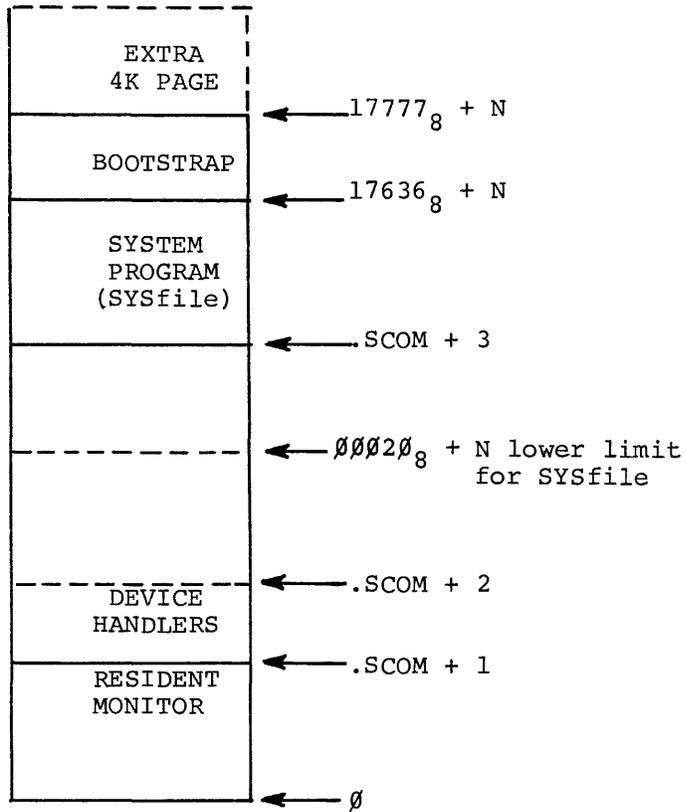
System Programs have a unique feature in that they are loaded into core and are started by only the entry of a single user command (i.e., program name) at the system console keyboard. This feature is implemented by name, control parameters, and I/O device information contained for each System Program in the system SYSBLK Parameter and Communication (COMBLK) tables. The information contained in SYSBLK enables the Keyboard Monitor to recognize System Program names (as stored in SYSBLK) and causes it to initiate the loading of the identified program into core.

System Programs and their associated Device Handlers are loaded into core from the system device by the System Loader (.SYSLD) program.

The placement of System Programs and their device handlers in core is illustrated in Figure 2-3. As shown:

- 1) System Programs are always loaded immediately below the Bootstrap in the highest portion of the highest 8K bank in the system.
- 2) In systems which include an extra 4K page (e.g., 12K, 20K, 28K, etc.) the extra 4K portion is used, during loading operations, only for handlers.
- 3) The lowest register which a System Program may occupy is 20<sub>8</sub> in the highest 8K bank of the system; handlers and free core may be located anywhere in the system.

System Programs are stored on the system device as absolute executable files identified by the file name extension "SYS" and are commonly referred to as "SYS files". Software is supplied to the user and contains a standard group of commonly used utility and language programs installed on some medium (e.g., DECTape) as SYS files. The SGEN and PATCH utility programs can be used to delete the supplied SYS files or replace them with other Digital-supplied programs or with user programs. Table 2-1 lists the names and SYSBLK entry names of the System Programs supplied with PDP-15 software systems.



LEGEND:    N = 00000 for 8K systems  
               = 20000 for 16K systems  
               = 40000 for 24K systems  
               = 60000 for 32K systems

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