USER MANUAL

KEYBOARD MONITOR

An Operating Guide
for the
PDP-9 Monitor System

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1.0 INTRODUCTION

The Keyboard Monitor (KM9) system for the PDP-9 is an executive program which provides for automatic storing, calling, loading, and executing of system and user programs; executes all I/O operations; provides error detection, error messages, and error recovery; and provides for program pause and saving of the status of all relevant registers. This write-up describes the input-output conventions and operation of the Keyboard Monitor.

1.1 PROGRAM FLOW

Figure 1 illustrates the normal sequence of operations of the PDP-9. If the Keyboard Monitor is not already loaded into core memory, the PDP-9 must be initialized with the System Bootstrap (see section 3.0). The Keyboard Monitor accepts commands to load any system or user program (see sections 4.6 and 5.0). The control of all system programs is of a conversational, on-line nature. When execution of any system or user program is terminated, control is automatically returned to the Keyboard Monitor.

1.2 SYSTEM TAPE

The Keyboard Monitor System Tape is a file-structured DECtape permanently mounted on DECtape unit 0(8), WRITE LOCK. This system tape contains all system programs (including the Keyboard Monitor itself) as well as a system library file which contains all necessary system subroutines. The system library file is so ordered that only one pass through the system library loads all necessary subroutines, the subroutines that they might require, and all necessary I/O device handlers.

FIGURE 1.   PDP-9 Program Flow   PAGE 5

FIGURE 1.   PDP-9 Program Flow
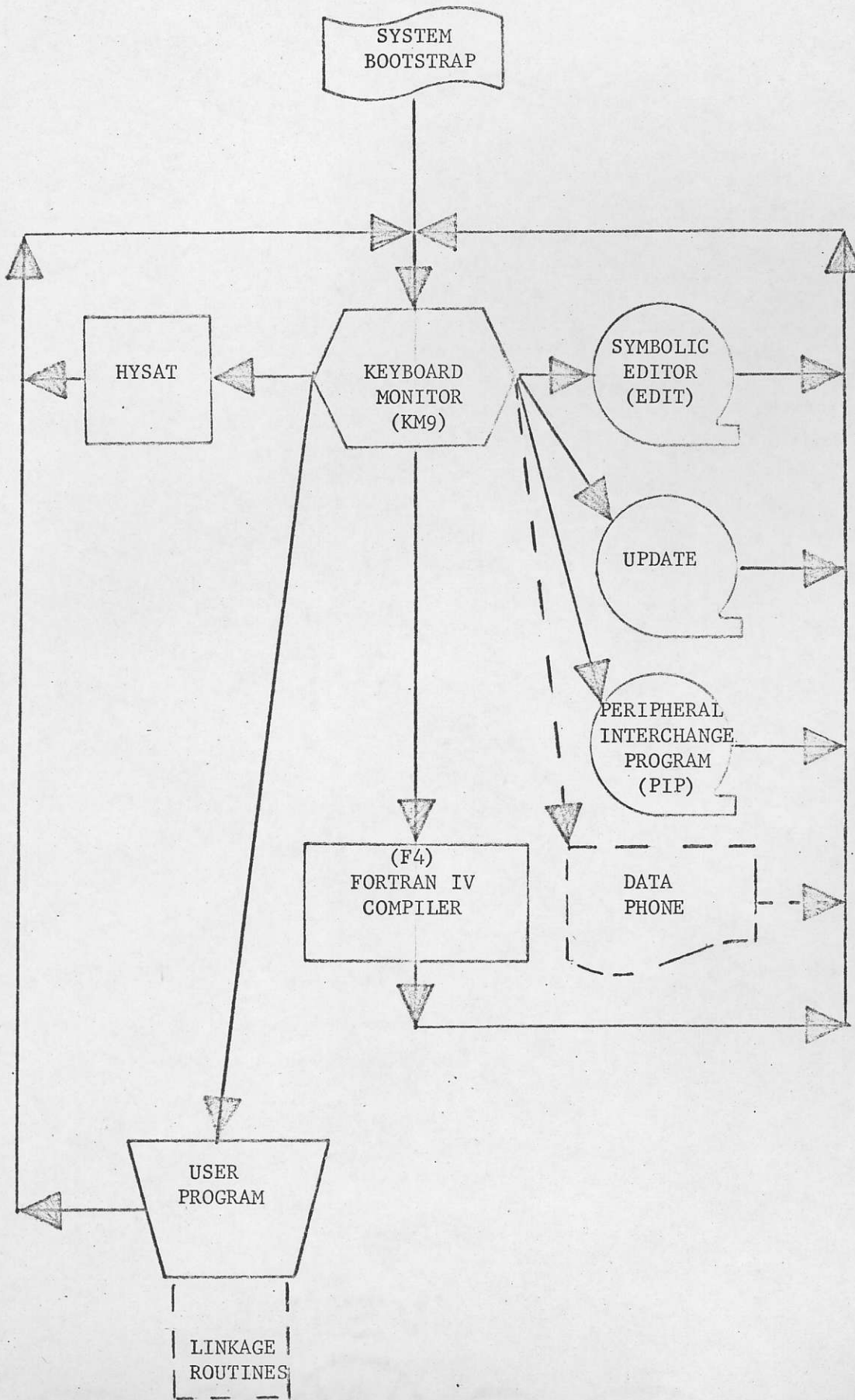
2.0 I/O CONVENTIONS

Input-output operations in the PDP-9 Keyboard Monitor system are file-oriented and device-independent. This section describes the I/O conventions of the KM-9 I/O system.

2.1 DEVICE ASSIGNMENT

Device-independent I/O operations in system or user programs are related to a specific I/O device by referencing a slot in the device assignment table (.DAT). Each slot in the .DAT contains the name of the specific I/O device handler to be associated with this .DAT slot. The standard .DAT associations are listed in Tables 1 and 2. Note that all .DAT system references are to negative slots and all .DAT user references are to positive slots. Note also that .DAT slot numbers are in octal radix. Altering .DAT device associations is covered in section 4.5.

2.2 DECTAPE

DECtapes may be either file-structured or non file-structured; all other peripheral devices are by definition non file-structured. Non file-structured DECtapes are analogous in use to standard magnetic tapes; they may be manipulated in user Fortran IV programs with the REWIND, END FILE, and BACKSPACE commands.*

The term "file-structured" means simply that a directory exists on the DECtape to identify by name and location the files which are recorded on it. A directory listing of any DECtape so recorded is available via the (L)ist command in PIP on the D(IRECT) command in KM-9. A directory may be cleared via the S or N switch in PIP or the N(EWDIR) command in KM-9 (use of the PIP S switch is recommended in order to assure regeneration of

---

*DTD is the only DECtape I/O handler which will process magnetic tape type commands.

TABLE 1. System .DAT Associations.

.DAT Slot	I/O Device	Unit	Handler	Use
-15	DECtape	3	DTA	Output (EDIT, UPDATE)
-14	DECtape	2	DTA	Input (EDIT, UPDATE)
-13	DECtape	3	DTA	Output (FORTRAN IV)
-12	teleprinter		TTA	Listing (FORTRAN IV, UPDATE)
-11	DECtape	2	DTA	Input (FORTRAN IV)
-10	paper-tape reader		PRA	Secondary Input (EDIT, UPDATE)
- 7	DECtape	0	DTC	*System Device (system loader)
- 6	none			Reserved (dataphone input and output)
- 5	DECtape	0	DTC	User Library Tape
- 4	DECtape	3	DTC	Input (Linking Loader)
- 3	teleprinter		TTA	*Output ⎫ All system programs
- 2	keyboard		TTA	*Input ⎭
- 1	DECtape	0	DTC	System Library

*These device assignments cannot be altered.

TABLE 2. User .DAT Associations.

.DAT Slot	I/O Device	Unit	Handler	Use
1	DECtape	1	DTA	Input and Output
2	DECtape	2	DTA	Input and Output
3	DECtape	3	DTA	Input and Output
4	teletype		TTA	Input and Output
5	paper-tape reader		PRA	Input
6	paper-tape punch		PPA	Output
7	none			Reserved (dataphone input)
10	none			Reserved (dataphone output)

system blocks on the tape.) File-structured DECtapes may be manipulated in user Fortran IV programs by use of the SEEK, ENTER, and CLOSE subroutines.

Standard directory information is recorded on DECtape blocks 71-100 and provides for up to 56 files per DECtape. A file is identified by a 6-character file name* and an optional 3 character file-name extension,* or 9 characters in all. Short file-names and short (or non-existent) file-name extensions are left-justified and zero-filled. System programs use predetermined file-name extensions in their operation. For example, if the FORTRAN IV compiler wishes to seek program ABCDEF as source input, it searches for ABCDEF SRC (ABCDEF, Source). The binary output produced would be named ABCDEF BIN (ABCDEF, Relocatable Binary), while the listing produced would be name ABCDEF LST (ABCDEF, Listing). The Linking Loader, if told to load ABCDEF, would seek ABCDEF BIN.

2.3 TELETYPE

Whenever the teletype keyboard is used for input to the monitor, system programs or user programs, the following error correction characters may be used:

RUBOUT(RO) - delete the previous character typed and echo a reverse slash (\).

↑U (CTRL U) - delete the entire line typed so far and echo a commercial at sign (@).

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*any printing characters in the ASCII set may be used with the exception of :;,(and).

3.0 SYSTEM BOOTSTRAP

The only function of the System Bootstrap is to initial load and then transfer control to the Keyboard Monitor.

To load the System Bootstrap:

    A. Position the System Bootstrap paper tape* in the high-speed reader.

    B. Mount the System Tape on DECtape unit 0, WRITE LOCK.

    C. Position REPT SPEED control at position 3, 4, or 5.

    D. Set the ADDRESS switches to 37637.

    E. Depress the I/O RESET switch.

    F. Depress the READIN switch.

The Keyboard Monitor will then be automatically loaded into core memory.

If the System Bootstrap has not been inadvertently destroyed, it may be restarted as follows:

    A. Set the ADDRESS switches to 37646.

    B. Depress the I/O RESET switch.

    C. Depress START.

See figures 2 and 3 for memory maps of the System Bootstrap and Keyboard Monitor.

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*located just above the paper tape reader.

FIGURE 2 Memory Map: System Bootstrap
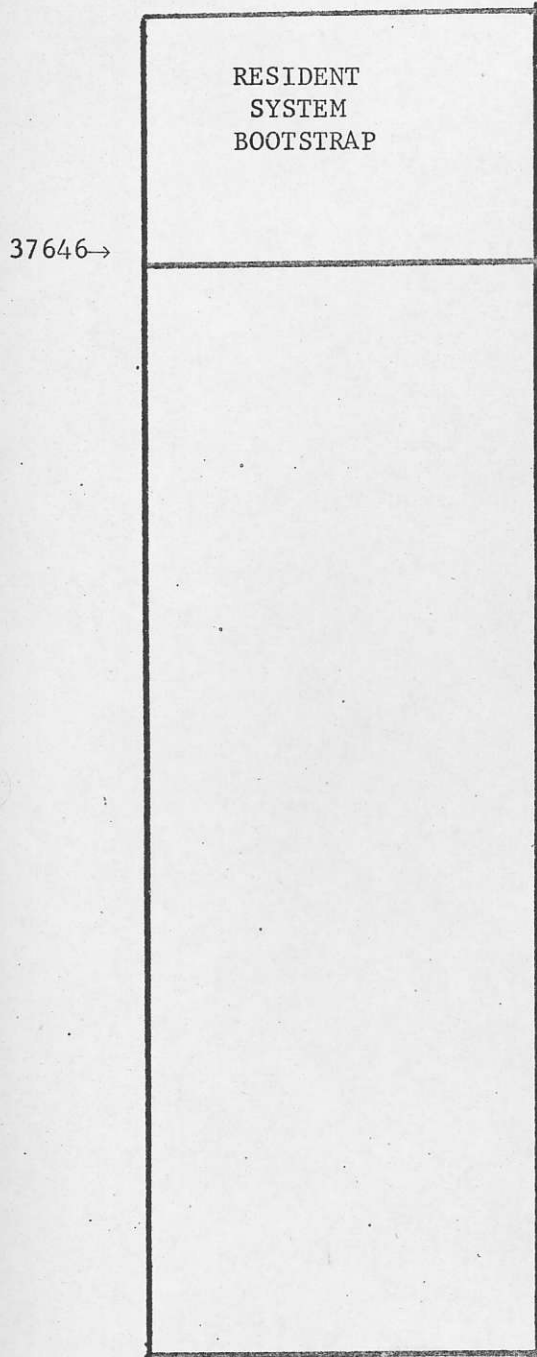
FIGURE 3 Memory Map: Keyboard Monitor

```
                    +----------------------+
                    |      RESIDENT        |
                    |      SYSTEM          |
                    |      BOOTSTRAP       |
          37646→    +----------------------+
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    +----------------------+
```

(Addresses are in octal radix.)

```
                    +----------------------+  ⎫
                    |      RESIDENT        |  ⎬ SYSTEM
          37646→    +----------------------+  ⎮ BOOTSTRAP
                    |    NON-RESIDENT      |  ⎭
          37637→    +----------------------+
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    |                      |
                    +----------------------+  ⎫
                    |    NON-RESIDENT:     |  ⎮
                    |                      |  ⎮
                    | INITIALIZATION AND   |  ⎮
                    | KEYBOARD COMMAND     |  ⎮
                    |      DECODER         |  ⎮
          01510→    +----------------------+  ⎬ KEYBOARD
                    |      RESIDENT        |  ⎮ MONITOR
                    |                      |  ⎮
                    |     ( INCLUDING      |  ⎮
                    |       TELETYPE       |  ⎮
                    |       HANDLER )      |  ⎮
                    +----------------------+  ⎭
```
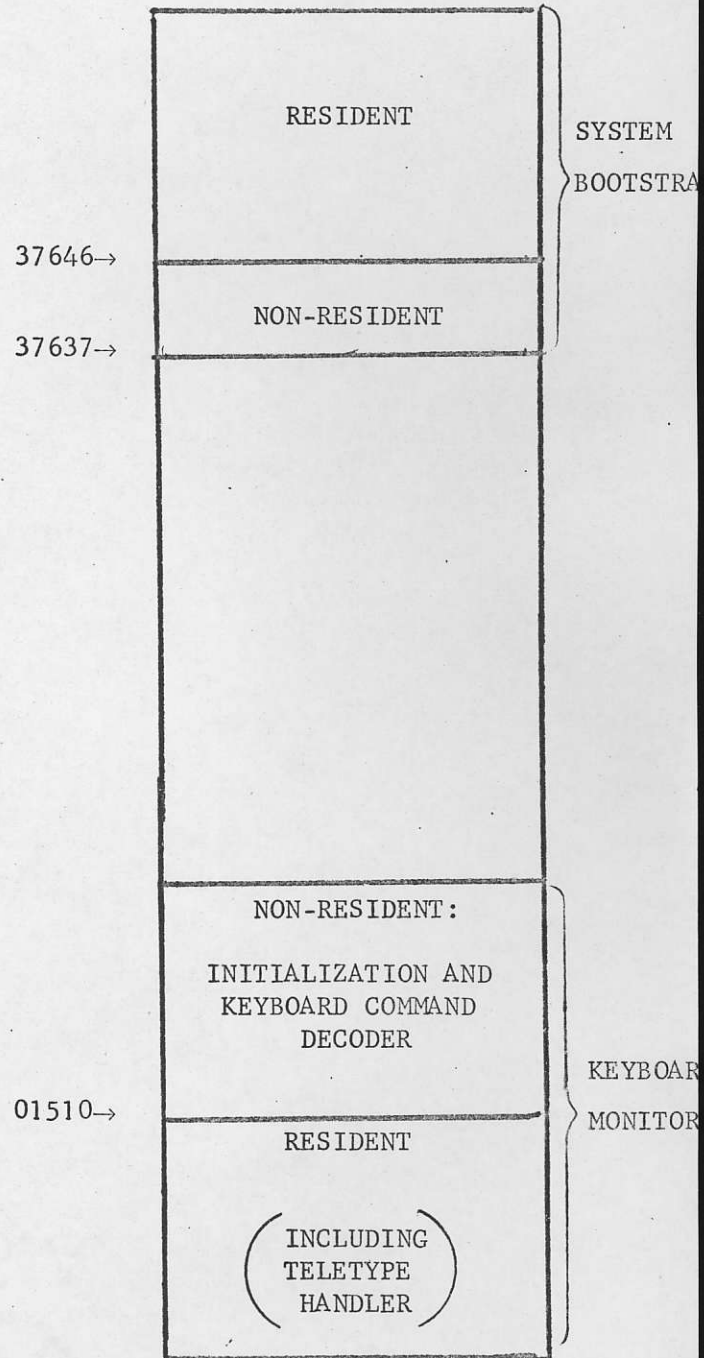
(Addresses are an octal radix.)

4.0 KEYBOARD MONITOR COMMANDS

When the Keyboard Monitor initially gets control it outputs

MONITOR V3C

$

to the teleprinter to indicate readiness to accept a keyboard command.
Subsequently, it outputs "$" to indicate readiness. In both cases,
keyboard commands should be typed on the same line as the dollar sign
($). The first letter of the command is sufficient for the first five
commands described in this section. V3C is the Keyboard Monitor version
identification number.

4.1 LOG

The LOG command is used to make hard copy records of the user's
comments on the teletype. Upon encountering the LOG command, the
Keyboard Monitor ignores all typing up to and including the next ALT MODE.
EXAMPLE 1: $LOG THIS IS A SAMPLE LOG COMMAND.(ALT MODE)

4.2 DIRECT

The DIRECT command causes a printout of the directory of any file-
structured DECtape. The command takes the following form:

DIRECT n

where n is the unit number $\emptyset$-7, with $\emptyset$ as the default assumption.

EXAMPLE 2: $DIRECT
            DIRECTORY LISTING
            .LOAD BIN 31
            .LIBR BIN 52
             EDIT SYS 217
             72 FREE BLOCKS

The third column in the printout is the number of the first DECtape block

occupied by the file; all numbers in the printout are in octal radix.

4.3 NEWDIR

The command NEWDIR n will clear the directory blocks on DECtape

unit n, n=∅ being illegal. (Caution is urged in the use of this command;

make absolutely certain that n is correct before typing carriage-return.)

4.4 REQUEST

The REQUEST command allows examination of selected .DAT dot

associations. The command takes the form:

REQUEST XXXXXX

where XXXXXX is the system program name (EDIT, F4, UPDATE, PIP, or LOAD),

USER for all positive .DAT slots, or blank for the entire .DAT table.

EXAMPLE 3: $REQUEST F4

.DAT	DEVICE	USE
-13	DTA3	OUTPUT
-12	TTA∅	LISTING
-11	DTA2	INPUT
-3	TTA∅	CONTROL AND ERROR MESSAGES
-2	TTA∅	COMMAND STRING

4.5 ASSIGN

The ASSIGN command may be used to alter .DAT I/O device handler

associations whenever it is necessary to use I/O device assignments other

than the standard assignments (see Tables 1 and 2). The change of assign-

ment is only effective for the current job, since the standard assignments

are restored whenever control is returned to the Keyboard Monitor. The

command takes the following form:

ASSIGN DEVm a,b,.../DEVn x,y,...

where DEV is the device handler name (see Table 3); m,n,... are unit numbers if DEV refers to DECtape; and a,b,...x,y,... are .DAT slot numbers. DEVm can be replaced by NONE to clear .DAT slots. .DAT slots -2, -3, and -7 cannot be modified. .DAT slot -1 should not be modified. One and only one I/O handler for a device should be in use at any given time since there is no communication between redundant handlers. The ASSIGN command must be executed immediately before the system or user program which is to reference the newly assigned .DAT slots is loaded.

EXAMPLE 4: $ASSIGN DTA1 -11/DTA2 -12/DTA3 -13

result: DECtape I/O handler A is assigned to DECtape unit 1 on .DAT slot -11, DECtape unit 2 on .DAT slot -12, and DECtape unit 3 on .DAT slot -13.

EXAMPLE 5: $ASSIGN NONE 4, 5, -12

result: .DAT slots 4, 5, and -12 are cleared.

EXAMPLE 6: $ASSIGN DTC1 -11/PPA -12, -13

result: DECtape I/O handler C is assigned to DECtape unit 1 on .DAT slot -11, paper-tape punch I/O handler A is assigned to .DAT slots -12 and -13.

TABLE 3. Available I/O Device Handlers

I/O Device	Handler Name	Handler Size*	Use
teletype	TTA	(in Keyboard Monitor)	input & output
paper-tape reader	PRA	436	input, all data modes
	PRB	287	input, symbolic ASCII tapes only
paper-tape punch	PPA	374	output, all data modes
	PPB	267	output, all data modes except ASCII
	PPC	207	output, binary tapes only
DECtape	DTA	2316	3 files, input & output, all data modes
	DTB	1547	2 files, input & output, symbolic ASCII or binary files only
	DTC	674	1 file, input only, symbolic ASCII or binary files only
	DTD	1564	1 file, input & output, all data modes, magnetic tape functions

*in decimal radix

EXAMPLE 7: $ASSIGN DTC1 -11/DTA2 -12/DTB3 -13
               result: DECtape I/O handler C is assigned to DECtape unit 1 on .DAT
               slot -11, DECtape I/O handler A is assigned to DECtape unit 2
               on .DAT slot -12, DECtape I/O handler B is assigned to DECtape
               unit 3 on .DAT slot -13. This command would result in havoc
               (if the FORTRAN IV compiler is subsequently used) because
               three different DECtape I/O handlers would then be in use
               simultaneously.

4.6 LOADING SYSTEM PROGRAMS

        The commands available to the user for loading system programs

via the Keyboard Monitor are:

        $LOAD   Linking Loader
        $GLOAD Linking Loader and Go
        $EDIT   Symbolic Editor
        $PIP   Peripheral Interchange Program
        $F4   Fortran IV Compiler
        $UPDATE Library File Utility Program

All of these commands should be terminated by a carriage-return or ALT MODE.

When the requested system program has been loaded and is waiting for

keyboard input, an indication is given on the teleprinter with an

appropriate message, such as

        EDITOR V2A

            >

or   FORTRAN 4 V2A
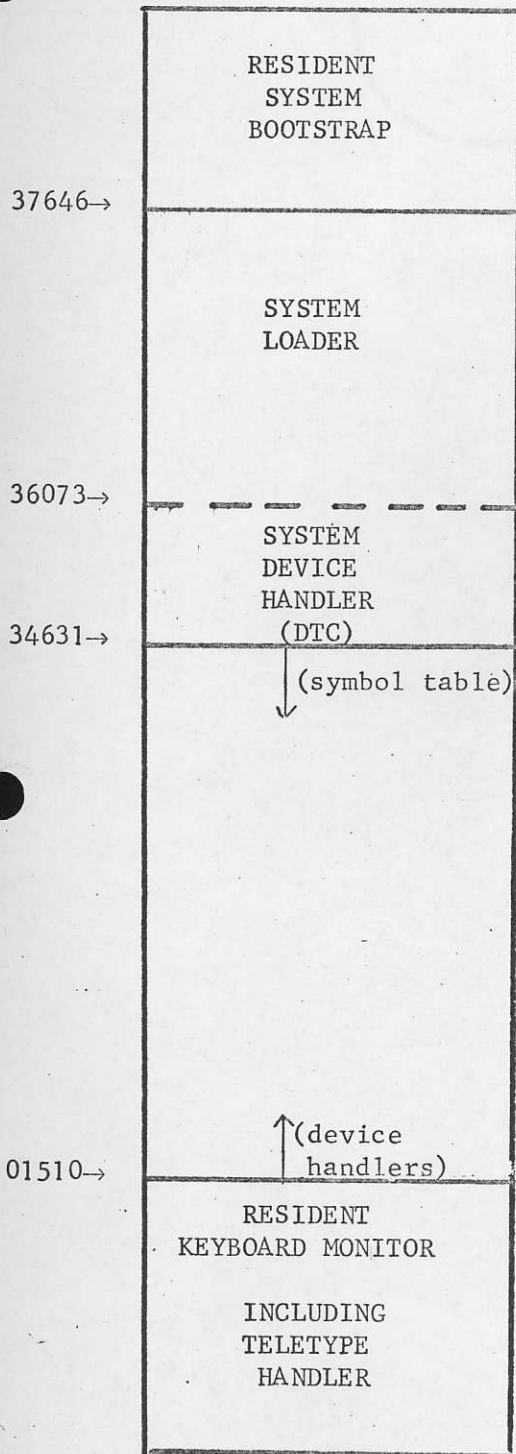
            >

etc. V2A is the system program version identification number.

        See Figure 4 and 5 for memory maps of system program loading and

operation.

FIGURE 4 Memory Map: System Loader   FIGURE 5 Memory Map: System Programs

```
              ┌────────────────────┐                            ┌────────────────────┐
              │    RESIDENT        │                            │    RESIDENT        │
              │    SYSTEM          │                            │    SYSTEM          │
              │    BOOTSTRAP       │                            │    BOOTSTRAP       │
37646→  ─────├────────────────────┤            37646→ ─────────├────────────────────┤
              │                    │                            │    SYSTEM          │
              │                    │                            │    PROGRAM:        │
              │    SYSTEM          │                            │                    │
              │    LOADER          │                            │    FORTRAN IV      │
              │                    │                            │    EDITOR          │
              │                    │                            │    PIP             │
              │                    │                            │    UPDATE          │
36073→  ─ ─ ─├─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┤                            ├────────────────────┤
              │    SYSTEM          │                            │                    │
              │    DEVICE          │                            │         ↑          │
              │    HANDLER         │                            │    SYSTEM PROGRAM  │
34631→  ─────│    (DTC)           │                            │    TABLE SPACE     │
              │                    │                   I.E:     │    FORTRAN IV      │
              │      (symbol table)│                            │    SYMBOL TABLE    │
              │          ↓         │                            │                    │
              │                    │                            │         ↓          │
              │                    │                            ├────────────────────┤
              │                    │                            │  SYSTEM PROGRAM    │
              │                    │                            │                    │
              │                    │                            │  DEVICE HANDLER    │
              │                    │                            ├────────────────────┤
              │                    │                            │  SYSTEM PROGRAM    │
              │      ↑(device      │                            │                    │
01510→  ─────│       handlers)    │            01510→ ─────────│  DEVICE HANDLER    │
              │    RESIDENT        │                            ├────────────────────┤
              │    KEYBOARD MONITOR│                            │    RESIDENT        │
              │                    │                            │    KEYBOARD MONITOR│
              │    INCLUDING       │                            │                    │
              │    TELETYPE        │                            │    INCLUDING       │
              │    HANDLER         │                            │    TELETYPE        │
              └────────────────────┘                            │    HANDLER        │
                                                                └────────────────────┘
```

The System Loader determines which I/O handlers are required by the requested system program, loads the handlers relocatably just above the resident Keyboard Monitor, and then modifies the System Bootstrap to bring in the system program in dump mode just below the Bootstrap.
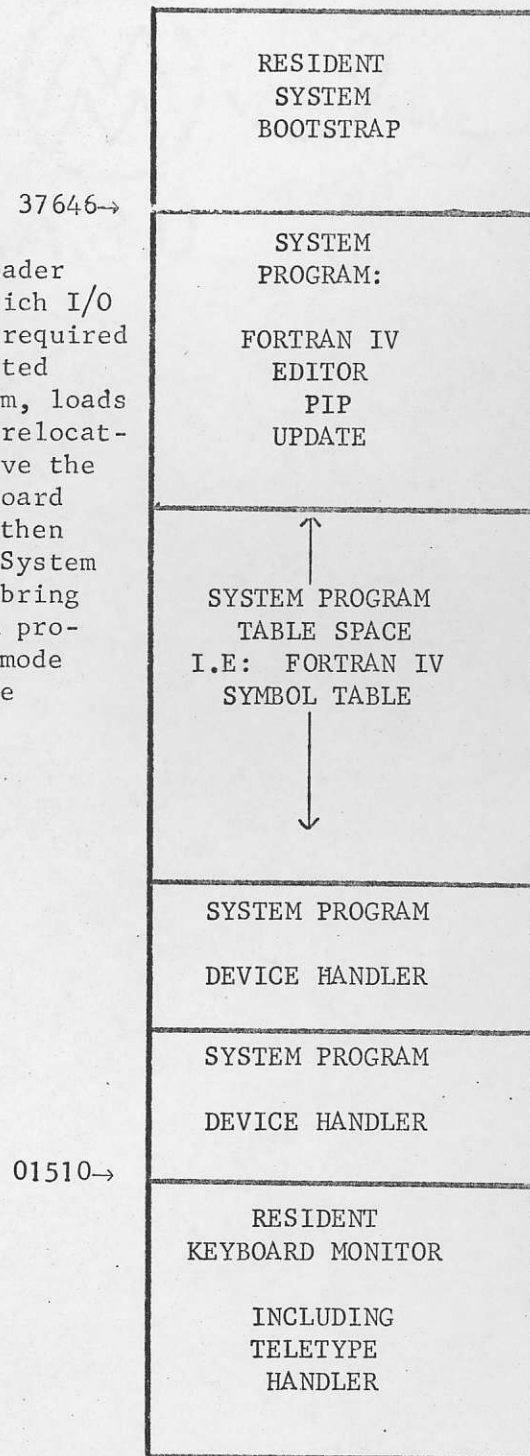
(Addressed are in octal radix.)   (Addresses are in octal radix.)

4.7 ↑C

Depressing CTRL and C simultaneously on the teletype keyboard (Monitor echoes ↑C) <u>at any time</u> forces re-initialization of the Keyboard Monitor which types

MONITOR V3C

$

to indicate that it is waiting for a keyboard command.

4.8 ↑P

Depressing CTRL and P simultaneously on the teletype keyboard (Monitor echoes ↑P) is used for the following functions: 1) to reinitialize or restart system programs, 2) to signal the paper-tape reader I/O handlers that the next tape in a series of tapes to be loaded is now ready in the high-speed reader, or 3) to signify termination of a Fortran PAUSE.

4.9 ↑S

Depressing CTRL and S simultaneously on the teletype keyboard (Monitor echoes ↑S) will start a user program after the Linking Loader has brought it into core via a $LOAD command.

4.10 ↑R

When the Keyboard Monitor detects a not-ready condition on a requested I/O device, it types .IOPS 4 on the teleprinter and halts. The user may then ready the device and continue by depressing CTRL and R simultaneously on the teletype keyboard (Monitor echoes ↑R).

4.11 ↑Q

A user may, at any time, pause and save the status of any running program by depressing CTRL and Q simultaneously on the teletype keyboard. After the Keyboard Monitor echoes ↑Q, type a DECtape unit number n, $0 < n \leq 7$. The current job will then be dumped, in core-image, onto blocks 101-200 of DECtape unit n (be sure to WRITE ENABLE DECtape unit n before requesting the dump). No error checking is performed on the unit number n. (It is important that the S switch in PIP be used to reserve blocks 101-200 on the file-structured DECtape prior to employing ↑Q. Previously saved information may be lost if this area is not reserved). Control returns to the Keyboard Monitor after the core-image dump is completed.

4.12 GET

The GET command retrieves the core-image dump stored on blocks 101-200 of DECtape unit n by a previous ↑Q command, and restores it to operation. The GET command has three forms: GET n will cause the job stored on DECtape unit n to be restarted where it was terminated; GET n XXXXX will cause the job stored on DECtape unit n to be restarted from location XXXXX; GET n HALT will cause the PDP-9 to halt after the job stored on DECtape unit n is restored to memory.

4.13 HALT

The HALT command sets a switch in the Keyboard Monitor which will cause the Keyboard Monitor to halt after occurrence of any unrecoverable error and typing of the associated error message (see section 6.0). The

HALT command must be given prior to the LOAD or GLOAD command used to load the user program (a HALT command issued prior to a GET has no effect as the Keyboard Monitor at ↑Q time overlays the Keyboard Monitor primed by HALT). Depressing CONTINUE after a Keyboard Monitor HALT will reload the Keyboard Monitor.

5.0 LOADING USER PROGRAMS

All user programs are initially loaded via the Linking Loader.
When the Linking Loader is loaded into core and is ready to accept an
input command string from the keyboard, it will type:

LOADER

>

on the teleprinter. At this point, the input devices should be set up;
if the paper-tape reader is being used, the tape-feed control button
should be depressed momentarily, after the paper tape is loaded, to clear
the reader-out-of-tape flag.

5.1 SPECIFYING USER PROGRAMS

If the user's binary program(s) are on a file-structured DECtape,
the input command string to the Linking Loader should consist of the list
of all file-names of all programs to be unconditionally loaded from the
DECtape associated with .DAT slot -4. The main program must be requested
first, followed by any desired subprograms. The file-names specified to
the Linking Loader should agree with the names originally used in the
compilation of the programs. The file-names should be one to six
characters in length, with any characters over six being ignored. Only
the file-names should be specified; the Linking Loader will automatically
assume that the file-name extension is BIN (relocatable binary) and will
search on both file-name and extension. A file-name, in the input command
string, is terminated by a comma, a carriage-return, or an ALT MODE. ALT
MODE terminates the input command string.

```
EXAMPLE 8:   LOADER V2A
             >MAIN
             >SUB1
             >SUB2 (ALT MODE)

EXAMPLE 9:   LOADER V2A
             >MAIN,SUB1,SUB2 (ALT MODE)
```

When the input device is not file-structured, n commas, followed by the ALT MODE character, prepares the Linking Loader to load n+1 programs from the input device.

```
EXAMPLE 1∅: (three programs to be loaded)
            LOADER V2A
            >,,(ALT MODE)
```

In either case, the subprograms should be loaded in order of decreasing size in order to take advantage of the Linking Loader's ability to fit programs into available memory space.

5.2 PROGRAM LOADING

After detection of an ALT MODE character, the LINKING LOADER will begin loading the user-specified program(s). If the input device is the paper-tape reader and the Linking Loader detects an end-of-tape condition, it will type ↑P on the teleprinter. Additional input should be placed in the paper-tape reader and the tape feed control button depressed momentarily to clear the reader-out-of-tape flag. Then, to continue, the user should type ↑P (CTRL P) on the keyboard.

After loading all programs requested in the keyboard input command string, the Linking Loader will attempt to resolve all unsatisfied sub-routine requests by scanning the external user library (.DAT slot -5) and system library (.DAT slot -1), in that order. The external user library, if required, must be named .LIBR BIN; it can be constructed using the UPDATE system program.

When all requested programs are loaded and all library requests

(explicit and implicit) are satisfied, the Linking Loader will either:

a. (If the Linking loader was called via LOAD) output ↑S and
   wait for the user to type ↑S (CTRL S) on the keyboard, then
   transfer control to the starting address of the user's main
   program, or

b. (If the Linking Loader was called via GLOAD) immediately trans-
   fer control to the starting address of the user's main program.

See figures 6 and 7 for memory maps of the Linking Loader and user

programs.

5.3 MEMORY MAP

The Linking Loader prints a memory map on the teleprinter during

loading which consists of a list of names of programs loaded, a list of

library subroutines loaded, and their starting load addresses (in octal

radix). Any programs or subroutines required but not found, whether

called explicitly or implicitly, are indicated with an address of

00000.

EXAMPLE 11: LOADER V2A
             >MAIN,SUB1,SUB2
             MAIN   36421
             SUB1   36350
             SUB2   35112
             BCDIO   32114
             STOP   32103
             FIOPS   31347
             OTSER   31253
             INTEGE 31123

If any of the entries in the memory map have a 00000 address,

loading was not successful; the cause of the trouble should be remedied

and the loading procedure repeated.

FIGURE 6 Memory Map: Linking Loader   FIGURE 7 Memory Map: User Programs

```
                                                    
         ┌──────────────────┐                 ┌──────────────────┐
         │    RESIDENT      │                 │    RESIDENT      │
         │    SYSTEM        │                 │    SYSTEM        │
         │    BOOTSTRAP     │                 │    BOOTSTRAP     │
 37646→  ├──────────────────┤         37646→  ├──────────────────┤
         │   │(user program)│                 │                  │
         │   ↓              │                 │      USER        │
         │                  │                 │    PROGRAM(S)    │
         │                  │                 │                  │
         │                  │                 │                  │
         │                  │                 ├──────────────────┤
         │                  │                 │      USER        │
         │   ↑              │                 │    DEVICE        │
         │   │(symbol table)│                 │    HANDLER       │
 05066→  ├──────────────────┤                 ├──────────────────┤
         │    LINKING       │                 │      USER        │
         │    LOADER        │                 │    DEVICE        │
         │                  │                 │    HANDLER       │
         │                  │                 ├──────────────────┤
         │                  │                 │      USER        │
         │                  │                 │    DEVICE        │
 02752→  ├──────────────────┤                 │    HANDLER       │
         │  LINKING LOADER  │                 ├──────────────────┤
         │  DEVICE HANDLER  │                 │                  │
         │      (DTC)       │                 │                  │
 01510→  ├──────────────────┤         01510→  ├──────────────────┤
         │    RESIDENT      │                 │    RESIDENT      │
         │ KEYBOARD MONITOR │                 │ KEYBOARD MONITOR │
         │   ⌢INCLUDING⌢    │                 │   ⌢INCLUDING⌢    │
         │   (TELETYPE )    │                 │   (TELETYPE )    │
         │   ⌣HANDLER ⌣    │                 │   ⌣HANDLER ⌣    │
         └──────────────────┘                 └──────────────────┘
```
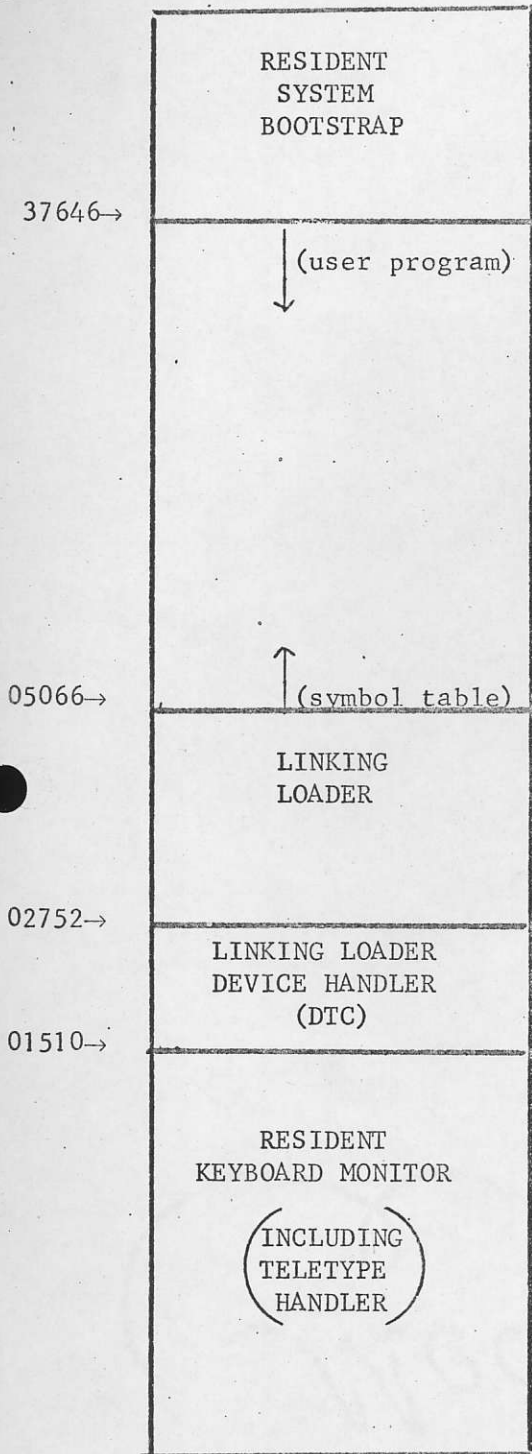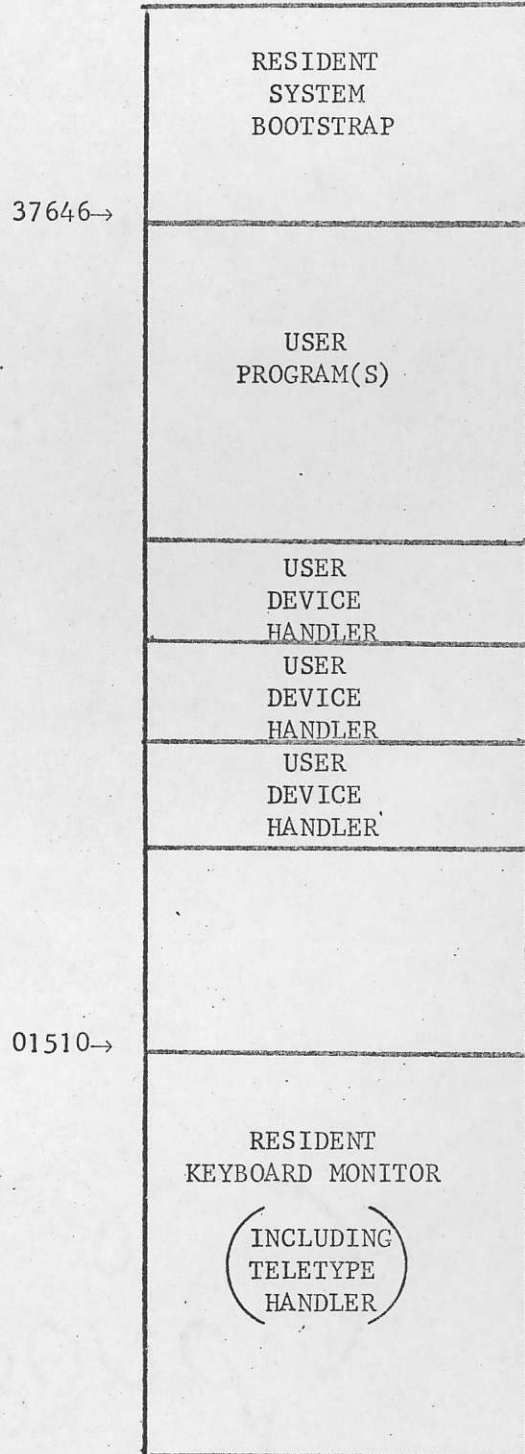
(Addresses are in octal radix.)   (Addresses are in octal radix.)

5.4 ERROR MESSAGES

If a loading error occurs, the Linking Loader types:

.LOAD n

on the teleprinter and returns control to the Keyboard Monitor. The type of error is indicated by n (see Table 4).

TABLE 4. Linking Loader Error Messages

Error Code	Meaning	Explanation
1	memory overflow	The Linking Loader's symbol table and and the user's program have overlapped. At this point the Linking Loader memory map will show the addresses of all programs loaded successfully before the overflow. Increased use of COMMON storage may allow the program to be loaded as COMMON storage can overlay the Linking Loader and its symbol table, since COMMON is not loaded into until run time.
2	input data error	parity error, checksum error, illegal data codes, or buffer overflow
3	unsatisfied global symbol	missing program
4	illegal .DAT slot request	A .DAT slot requested for use by a user program referenced an illegal .DAT slot number.

6.0 ERROR DETECTION

When the Keyboard Monitor (or one of its I/O device handlers) detects an illegal situation, the Monitor Error Diagnostic routine assumes control, outputs an appropriate error message on the teleprinter, and transfers control to the System Bootstrap to re-initialize the Keyboard Monitor (unless the $HALT has been issued since the last Monitor load, in which case the Monitor Error Diagnostic routine will halt after outputting the error message. Unrecoverable error messages are output in the following format:

.IOPS nn XXXXXX

where nn is the error code (see Table 5) and XXXXXX is additional related system information.

If the Keyboard Monitor detects a "not ready" condition on an I/O device for which I/O has been requested, it will type:

.IOPS 4

on the teleprinter and halt. The user should make the device ready and type ↑R (CTRL R) on the keyboard to continue.

TABLE 5. Keyboard Monitor Error Codes.

Error Code	Meaning
00	Illegal Keyboard Monitor call
01	Illegal Keyboard Monitor call
02	.DAT slot error
03	Illegal interrupt
(04	Device not ready)
05	Illegal Keyboard Monitor call
06	Illegal I/O handler function requested
07	Illegal data mode requested
10	Old file still active when new file requested on same .DAT slot
11	SEEK/ENTER not executed prior to READ/WRITE on file-structured DECtape
12	Unrecoverable DECtape error
13	File not found during SEEK
14	Directory full on ENTER
15	DECtape full on WRITE
16	Output buffer overflow (too large for device)
17	Too many files active for this handler