DOS

HANDOUTS

PDP-11 DISK OPERATING SYSTEM SOFTWARE (DOS)

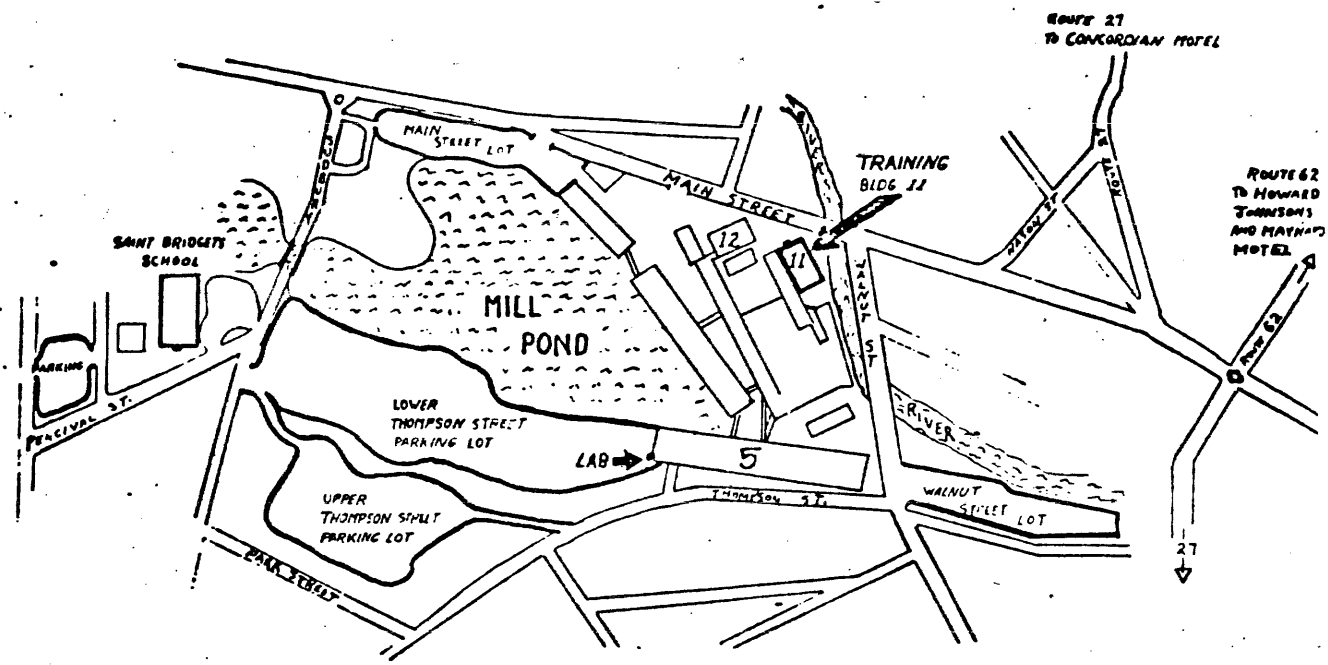
This course is designed to teach the student how to:

1. Generate a Disk Operating System from DECtape or paper tape.
2. Write, run, and modify programs using programmed monitor requests and the DOS software programs.
3. Communicate with the system by means of keyboard commands.

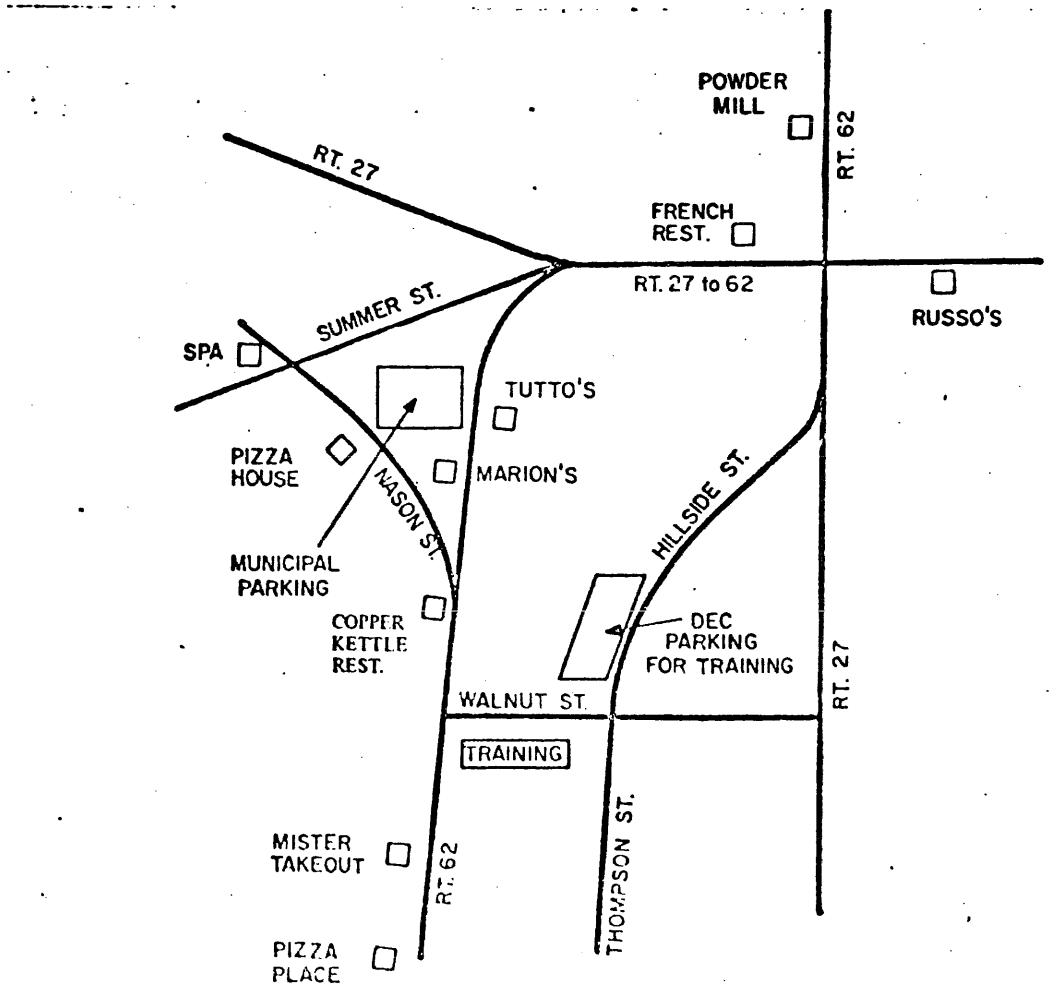
LENGTH: 5 Days

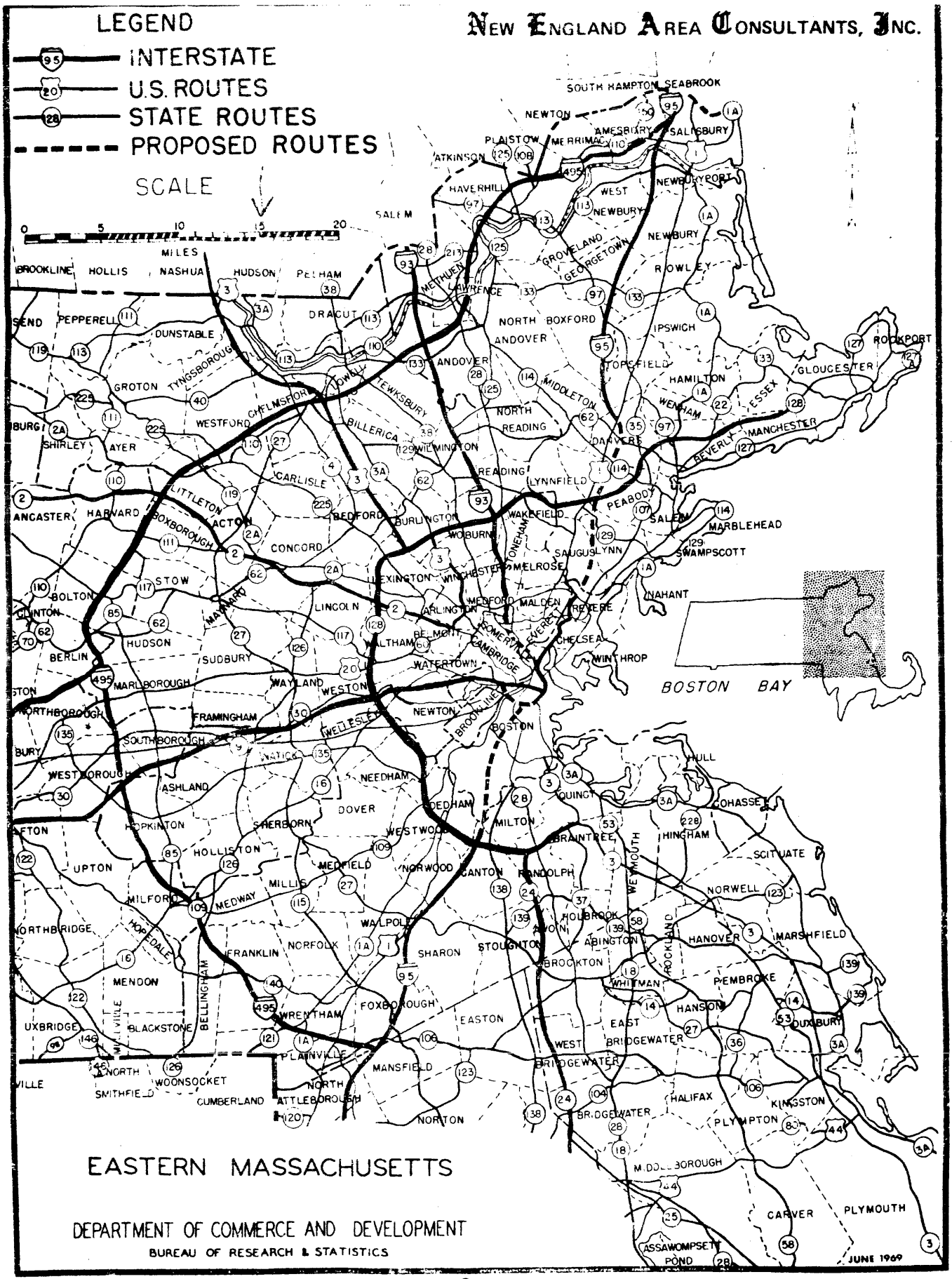
PREREQUISITES: The student must be thoroughly familiar with the PDP-11 instruction set and programming techniques, and the following PDP-11 paper tape software programs: Assembler (PAL-11), Text Editor (ED-11), On-line Debugging Technique (ODT-11), Extended On-line Debugging Technique (ODT-11X), Core Memory Dumps (DUMPTT) (DUMPAB), Input-Output Executive (IOX), Floating Point Math Package (FPP-11). Formal training in these areas can be obtained by attending any of the following courses: PDP-11 PAPER TAPE SOFTWARE (STANDARD), PDP-11 PAPER TAPE SOFTWARE (ACCELERATED), or PROGRAMMING THE PDP-11.

CONTENT: This is designed to be a *user* course, and does not present a detailed examination of the DOS monitor. It contains an overview of the monitor program and file structure, and covers the use of programmed monitor requests, keyboard commands, and the following DOS software programs: BATCH-11, MACRO-11 Assembler, Text Editor (EDIT-11), Relocatable On-line Debugging Technique (ODT-11R), Linker (LINK-11), Librarian (LIBR-11), File Utility Program (PIP), and system generation (CILUS, SYSLOD, ROLLIN). A portion of the course time is allotted to supervised laboratory sessions.



DIGITAL EQUIPMENT CORPORATION TRAINING




LEGEND
INTERSTATE
U.S. ROUTES
STATE ROUTES
PROPOSED ROUTES
SCALE
0 5 10 15 20
MILES
NEW ENGLAND AREA CONSULTANTS, INC.
EASTERN MASSACHUSETTS
DEPARTMENT OF COMMERCE AND DEVELOPMENT
BUREAU OF RESEARCH & STATISTICS
JUNE 1969
BOSTON BAY

DOS VERSION 8 1 WEEK

MONDAY
- I. INTROUDCTION
- II. DOS OVERVIEW W/FILE LAYOUTS
- III. INPUT/OUTPUT PROCESSING OVERVIEW

TUESDAY
- I. MACRO-11
- II. TRAN LEVEL PROCESSING
- III. CREATION OF A CONTIGUOUS FILE

WEDNESDAY
- I. BLOCK LEVEL PROCESSING
- II. CREATION OF A LINKED FILE
- III. RECORD LEVEL PROCESSING
- IV. EDITOR AND PIP OPERATIONS
- V. LAB

THURSDAY
- I. READ/WRITE PROCESSING
- II. PROGRAMMED MONITOP REQUESTS
- III. SYSTEM SOFTWARE-LINKER, LIBR, ODT, FILDMP
- IV. OVERLAY BUILDING AND EXECUTION
- V. LAB

FRIDAY
- I. SYSGEN W/ROLLIN
- II. BATCH
- III. CILUS
- IV. LAB (SYSTEM GENERATION)

LOCATION	CONTENT	CONTENT SYMBOL
40	START ADDRESS OF THE SYSTEM VECTOR TABLE.	SVT.
42	BASE ADDRESS FOR THE GENERAL SYSTEM EXIT.	S.XIT
44	START ADDRESS FOR THE REGISTER-SAVE SUBROUTINE	S.RSAV
46	START ADDRESS FOR THE REGISTER-RESTORE SUBRTN.	S.RRES
50	START ADDRESS FOR THE DRIVER QUEUE SUBROUTINE	S.CDB
52	START ADDRESS FOR THE DRIVER DEQUEUE SUBRTN.	S.CDQ
54	START ADDRESS FOR THE GET-BUFFER SUBROUTINE	S.GTB
56	START ADDRESS FOR THE RELEASE-BUFFER SUBRTN.	S.RLB

USAGE OF THE FIXED VECTOR LOCATIONS.

```
SVT:
EOM:     .WORD   Ø          ;  END OF PERMANENT MONITOR
TOB:     .WORD              ;  END OF BUFFER AREA
CSA:     .WORD   37776      ;  LAST ADDRESS IN AVAILABLE CORE
PLA:     .WORD   Ø          ;  PROGRAM LOAD ADDRESS
SCW:     .WORD   Ø          ;  SYSTEM CONFIGURATION INDICATORS
                            ;  BIT Ø CLOCK CYCLE INDICATOR, USED BY C
                            ;        6Ø CLCLE = Ø, 5Ø CYCLE = 1
                            ;  BIT 6 CLOCK TYPE INDICATOR
                            ;        KW11-L = Ø,  KW11-P = 1
                            ;  BIT 7 NO CLOCK. INDICATOR
                            ;        NO CLOCK = Ø,  CLOCK = 1
                            ;  BIT 13 SYSTEM LOAD BIT
                            ;         LOAD = 1 OTHERWISE = Ø
                            ;  BIT 14 PRIVILEGED USER BIT
                            ;  BIT 15 AC INDICATOR, USED BY BATCH SYSTEM
BAT:     .WORD   Ø          ;  POINTS TO DYNAMIC ASSIGNMENT TABLE
DCO:     .WORD   Ø          ;  CHAIN OF INITIED DDBS
MUS:     .BYTE   Ø,Ø        ;  MONITOR USER SWITCH
OSW:     .WORD   Ø          ;  OTHER SWITCH
PSA:     .WORD   Ø          ;  PROGRAM START ADDRESS
DSA:     .WORD   Ø          ;  ODT STARTING ADDRESS
RSA:     .WORD   Ø          ;  RESTART ADDRESS
WRA:     .WORD   WTL        ;  WAIT RETURN ADDRESS
DAT:     .WORD   Ø          ;  DATE IN JULIAN - 7Ø,ØØØ
TOD:     .WORD   Ø,Ø        ;  TIME OF DAY CLOCK CELLS
UIC:     .WORD   Ø          ;  USER IDENTIFICATION CODE
PGN:     .WORD   Ø,Ø        ;  PROGRAM NAME (MOD 4Ø)
MRT:     .WORD   MRT.       ;  START OF RESIDENCY TABLE
DDL:     .WORD   Ø          ;  START OF DEVICE LIST
SSP:     .WORD   Ø          ;  STACK POINTER SAVE (DUMP)
BFS:     .WORD   Ø          ;  START OF BUFFER ALLOC. TABLE
BFE:     .WORD   Ø          ;  END OF BUFFER ALLOC TABLE
WTL:     BR      .          ;  WAIT LOOP FOR WAITS
KBA:     .WCRO   Ø          ;  POINTER TO KB IN DDL
MSB:     .WORD   MSB.       ;  POINTER TO MAIN SWAP AREA
STR:     .WORD   Ø          ;  STACK BASE (BASE + 2)
DFU:     .BYTE   2,1        ;  SCRATCH UIC
KBP:     .WORD   KBFTR      ;  KEYBOARD POINTER
CIL:     .WORD   Ø          ;  CIL BASE
KSP:     .WORD   KBI.-2     ;  POINTER TO KEYBOARD SWAP BUFFER
BKZ:     .WORD   Ø          ;  DISK BLOCK SIZE INDICATOR
                            ;  4 = 64 WORD BLOCKS, 2 = 256 WORD BLOCKS
M.IOMX:  .BYTE   Ø          ;  MAXIMUM I/O EMT
M.EMAX:  .BYTE   Ø          ;  MAXIMUM EMT IPERMITTED
TPNPRT:  .WORD   Ø          ;  ABSOLUTE DISK ADDRESS OF MRT COPY USED BY TMOI
MUOTBL:  .WORD   Ø          ;  FOR MUO
```

Low Byte: 1 - Program Loaded, −1 Program Stopped

High Byte: 1 Running, −1 Waiting

.RESTART - LOADS this address

Multi User Dos

System Vector TABLE (Address Location 40)

MONITOR RESIDENCY TABLE

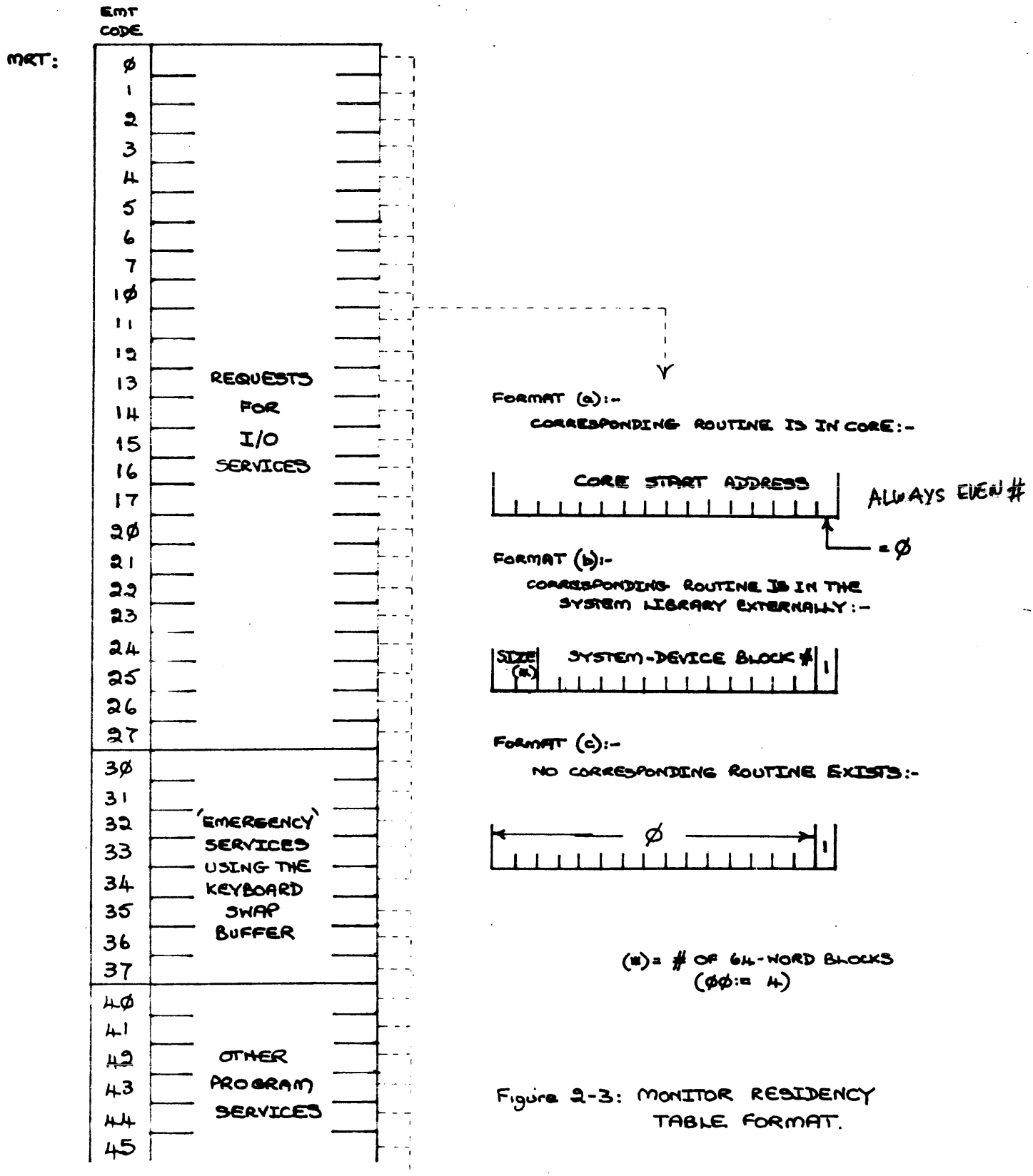
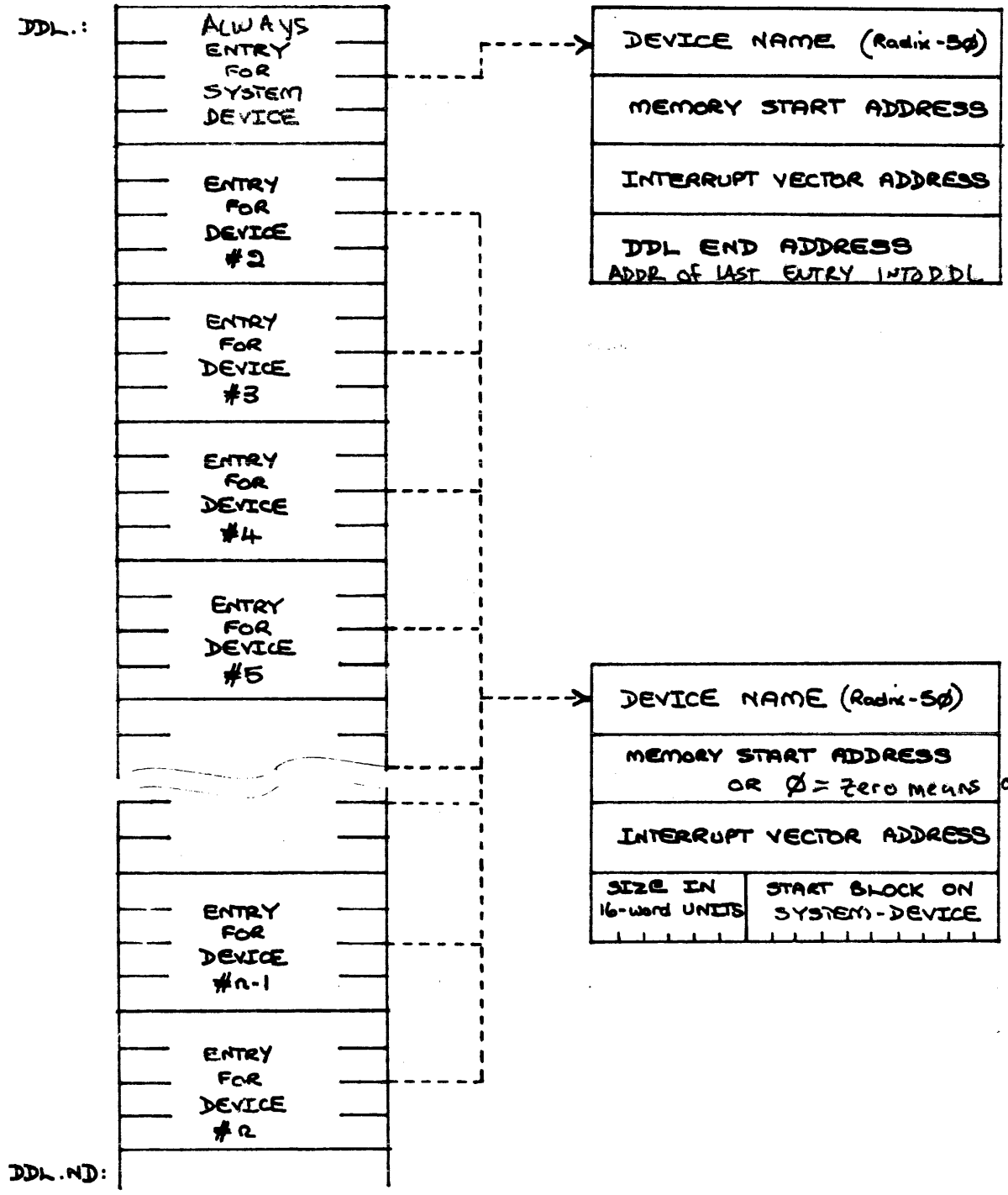


Figure 2-3: MONITOR RESIDENCY TABLE FORMAT.

Set up when system is built



.: DEVICE DRIVER LIST FORMAT.

The resulting format of the DDL is illustrated at Page 8. The significance of each item is as follows:

1. Device name - is the radix-5Ø form for the alphanumeric code assigned to each device. The only way an entry in the list can be found is by a search. This item therefore enables its identification.

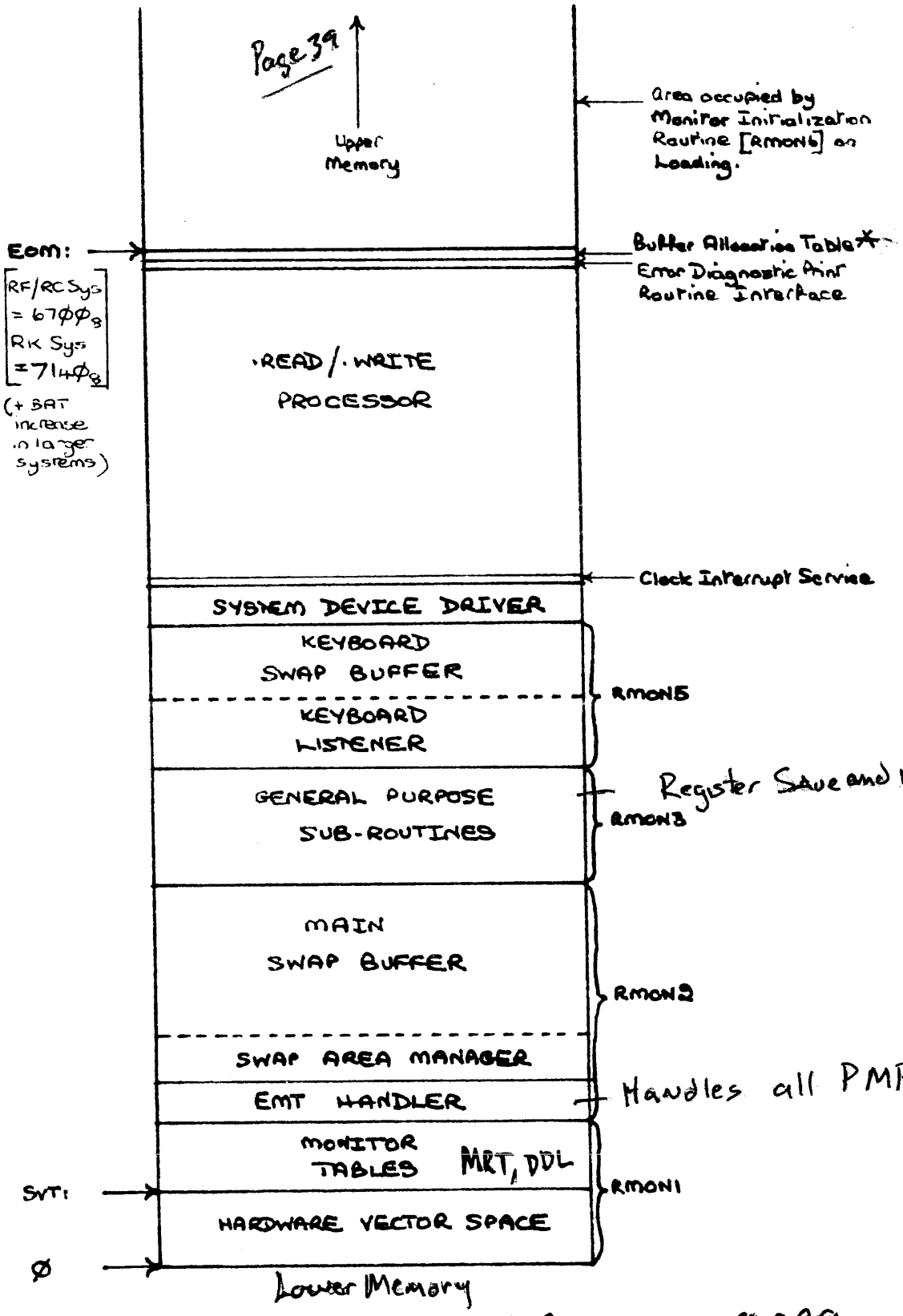
2. Core load address - contains the start of the device driver when in core. Otherwise Ø indicates the driver's current non-residency.

3. Interrupt vector address - is the start address of the two-word vector assigned to the device within memory locations Ø-377 (or as otherwise provided) and is needed to permit the linkage of the driver's interrupt service routine to the vector when loaded. (See Section 3.2.1) it is held within the DDL rather than the driver itself, because the user can physically reassign devices to different vectors. This obviates reassembly of the driver and also allows in-core modification, even though the driver at the time is available only in the external Monitor Library.

4. System-device start block - gives the actual device address for the driver within the Monitor Library. As for the MRT, no driver is expected to start beyond block #1777(8).

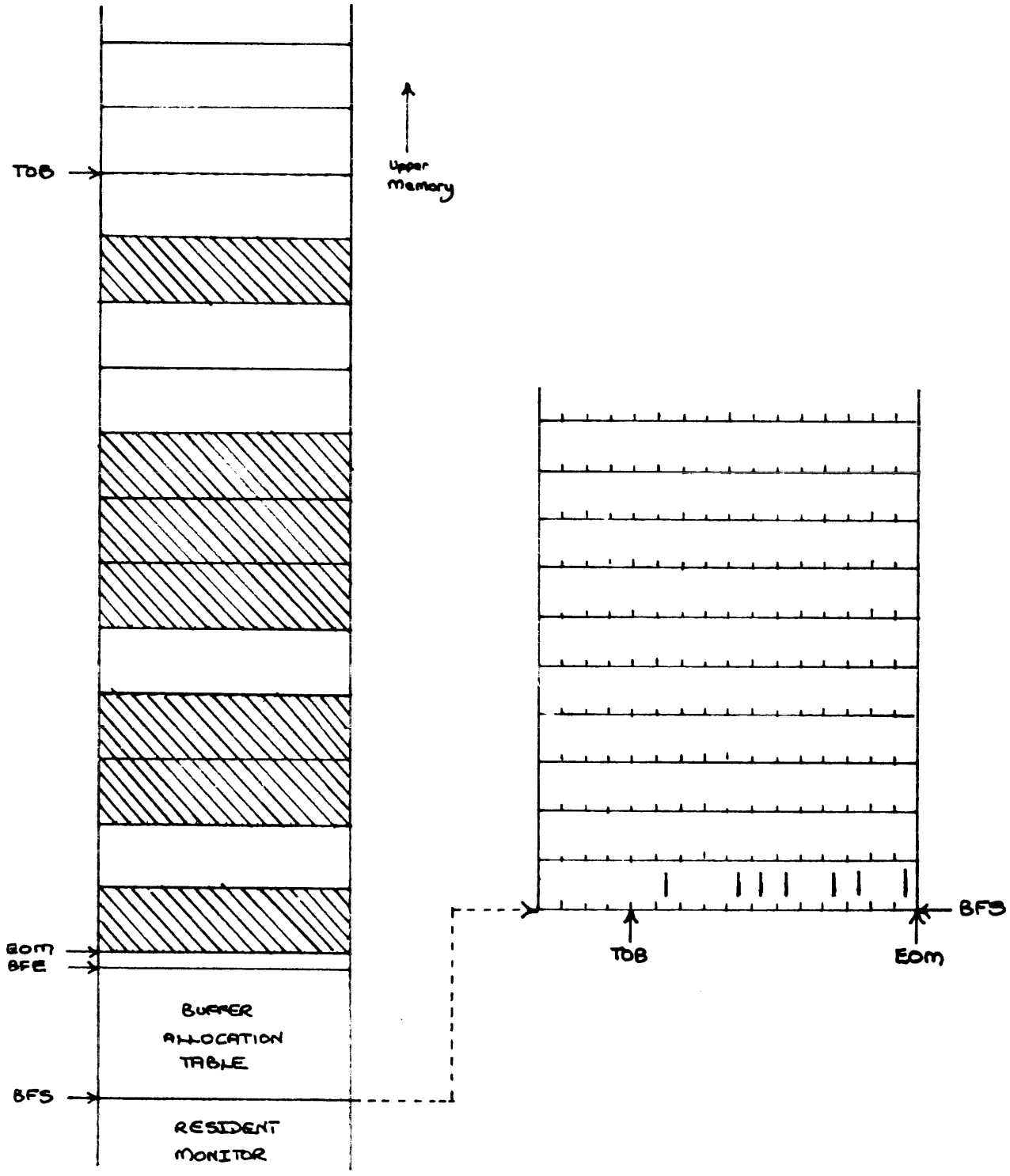
5. # of 16-word blocks - enables determination of the size of the driver for claiming and releasing the buffer it occupies while in core and for specifying of # of words to be read, in order to perform the necessary load (see Section 3.2.1). The six-bit capacity of the field allows a maximum driver length of 1K, which is more than ample in most cases.

6. DDL end - replaces the external address data in the system-device entry in the table since the latter information is irrelevant when, by its purpose, the driver for such device can never leave memory. The provision of this item instead allows the DDL to be of variable size and hence contain only the drivers needed to support the particular configuration being used. However it is essential that the system device entry is alway the first in the DDL as shown in the diagram.

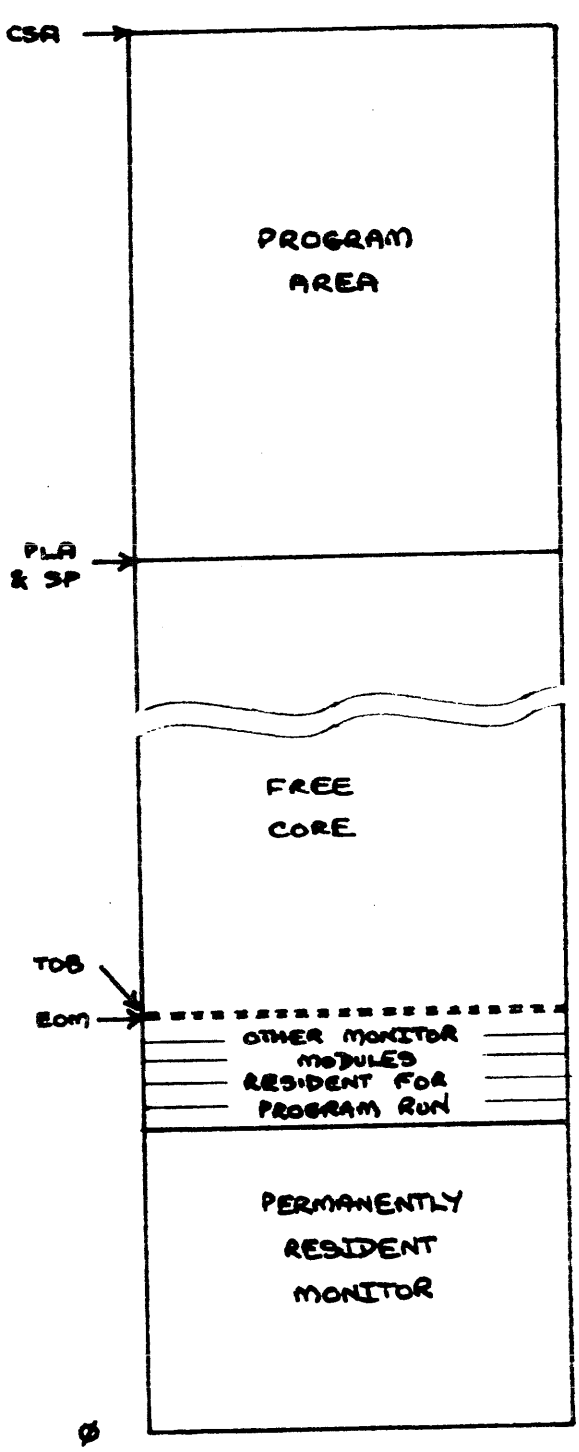


* Each bit controls 16 words of free core area

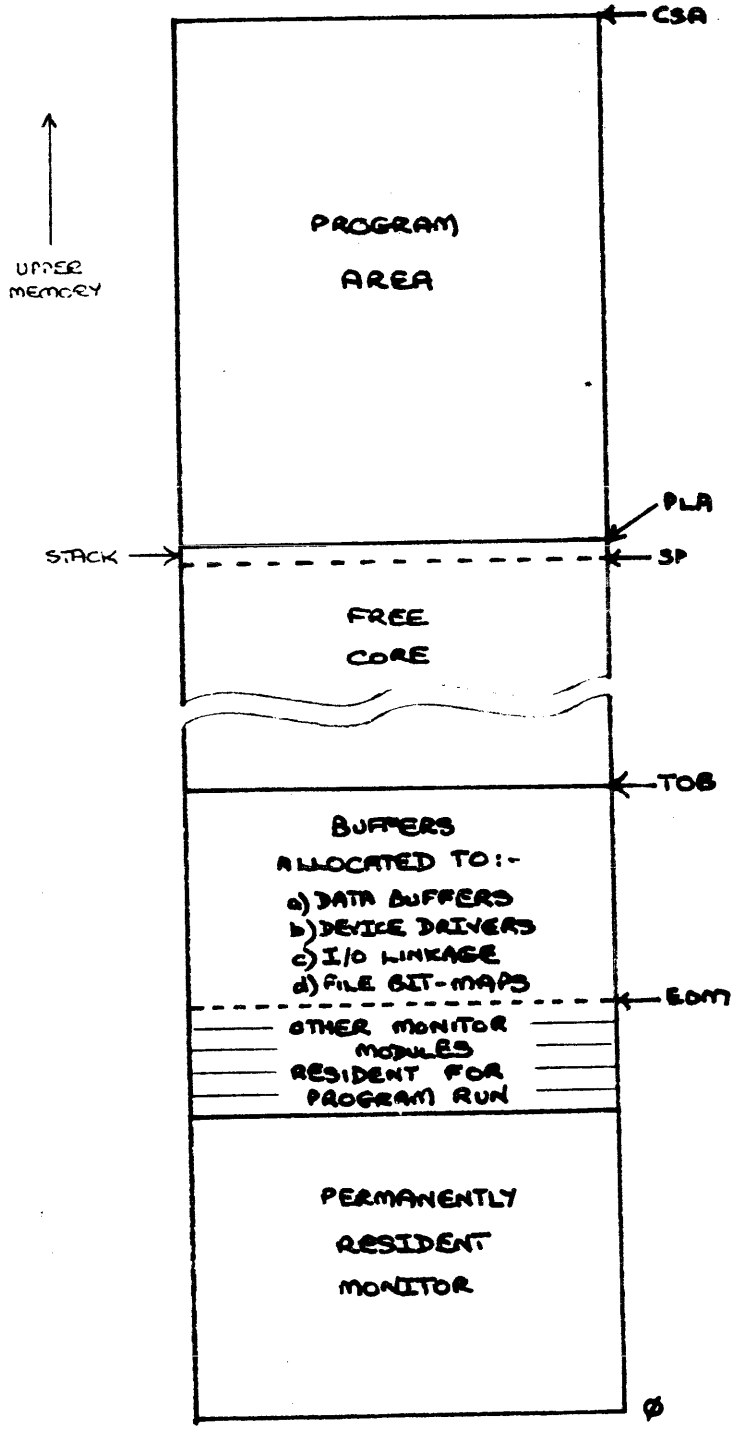
THE BASIC RESIDENT MONITOR in MEMORY



Buffer Allocation Management



Memory after Program Load



Memory during Program Run.

63 UIC's

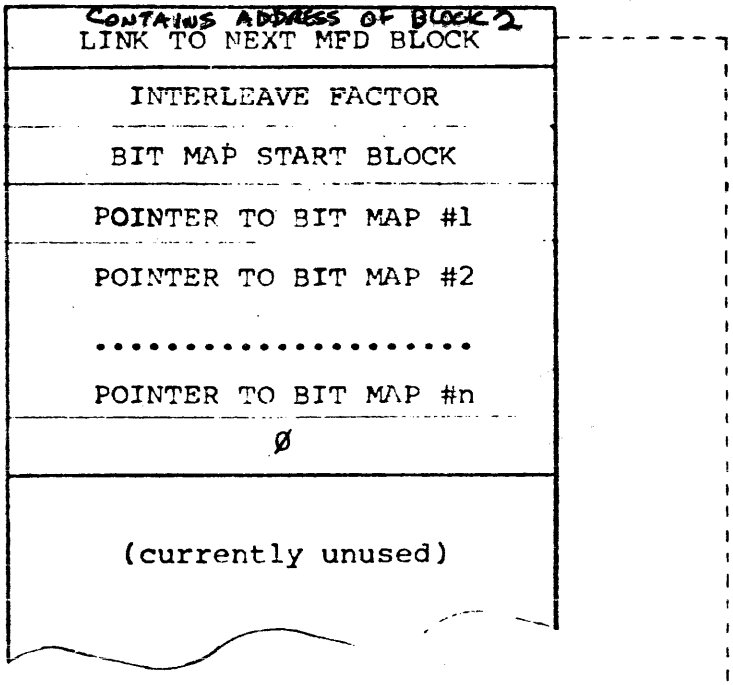


Fig.4-3: Master File Directory Block #1

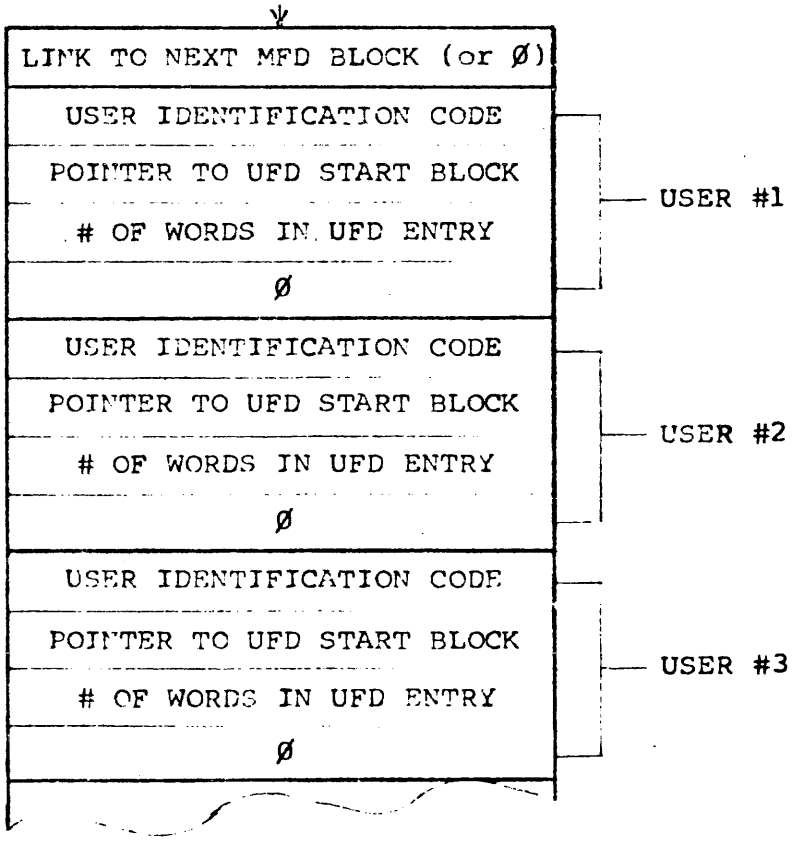
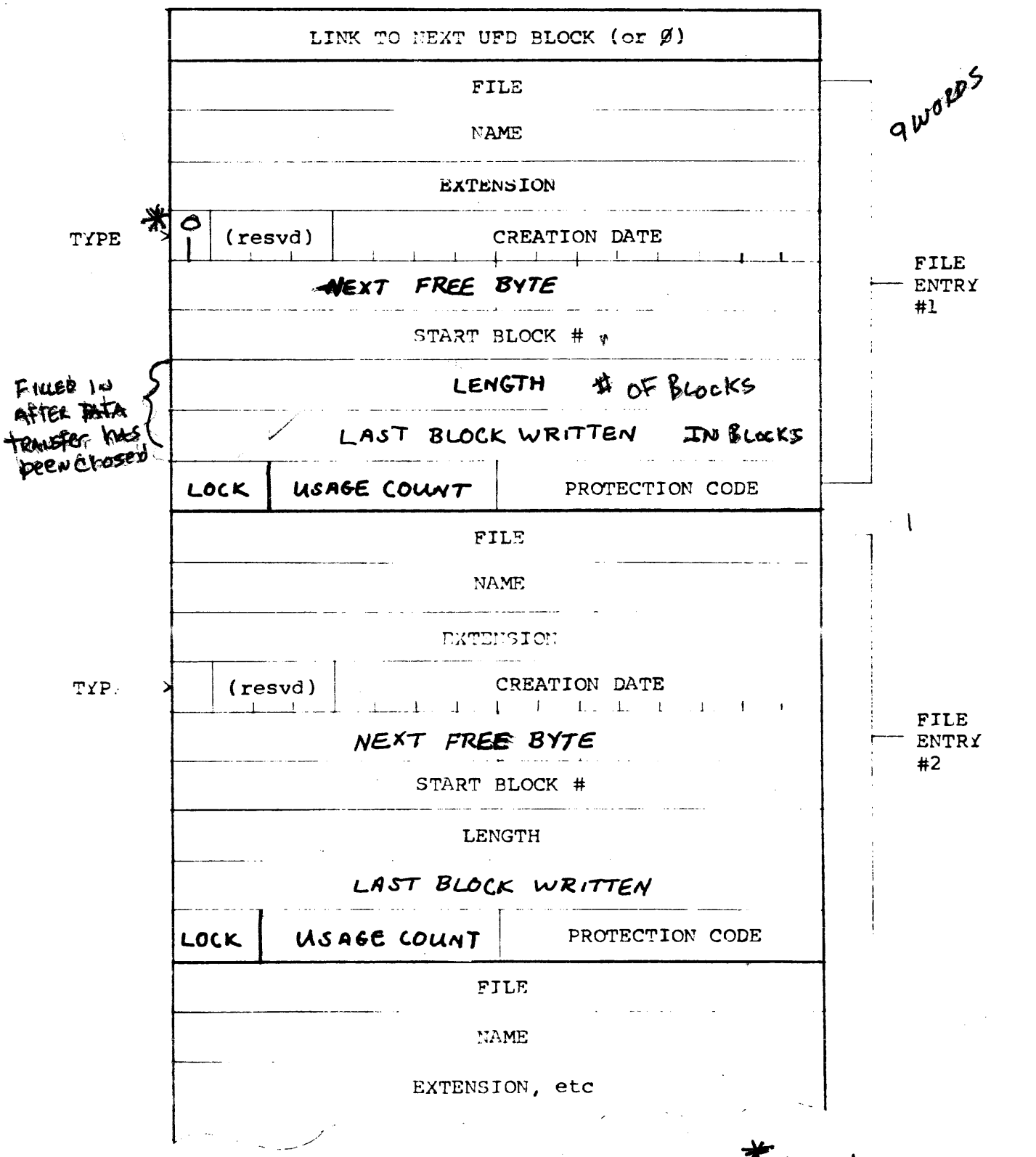
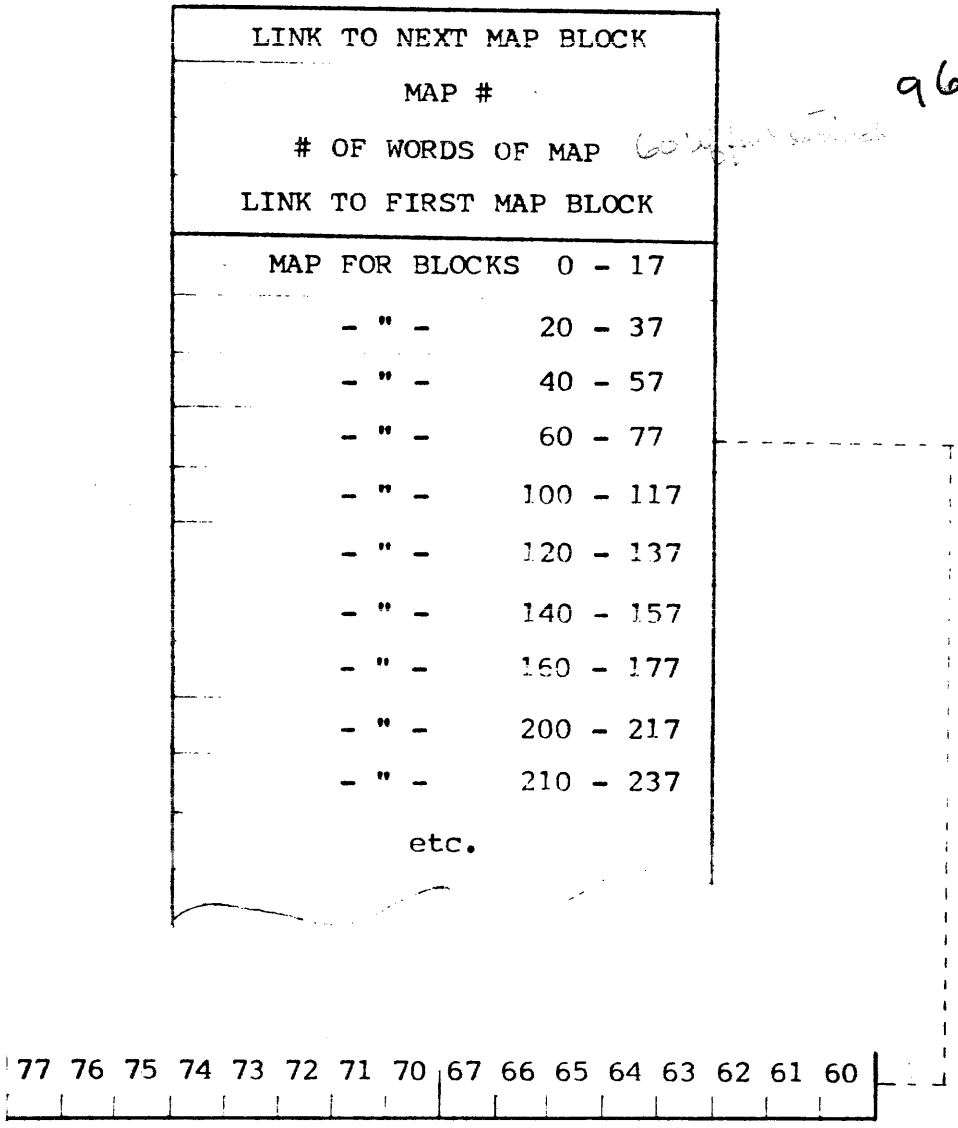


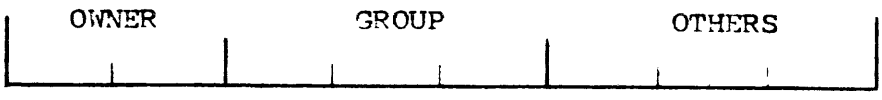
Fig.4-4: Master File Directory Block #2



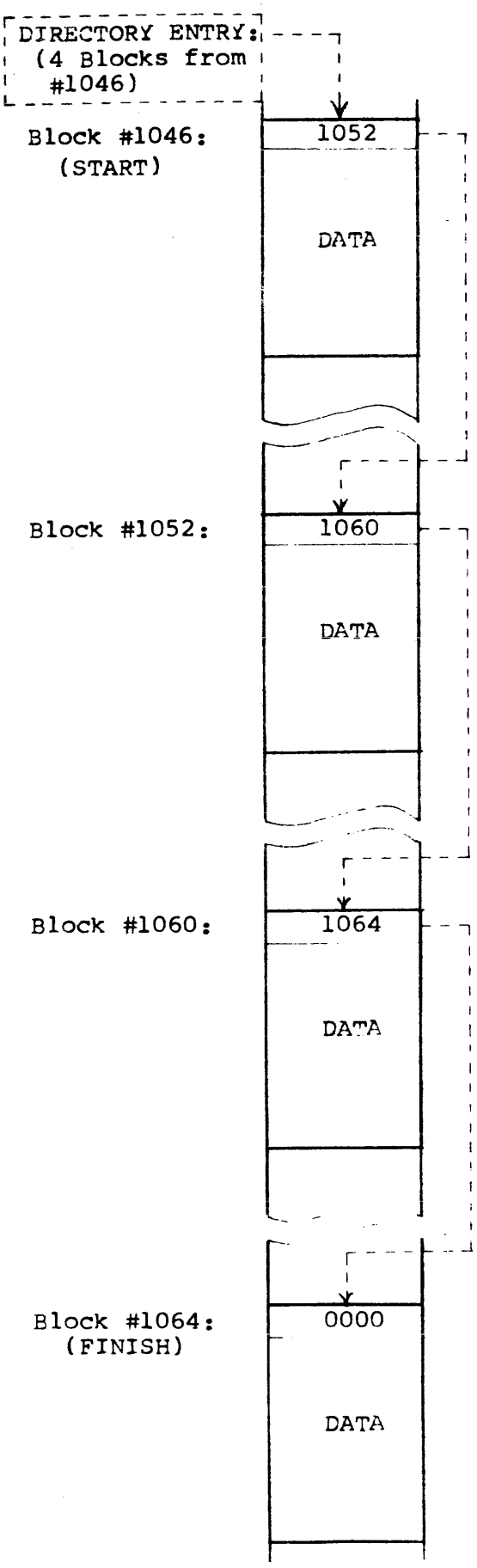
User File Directory Block



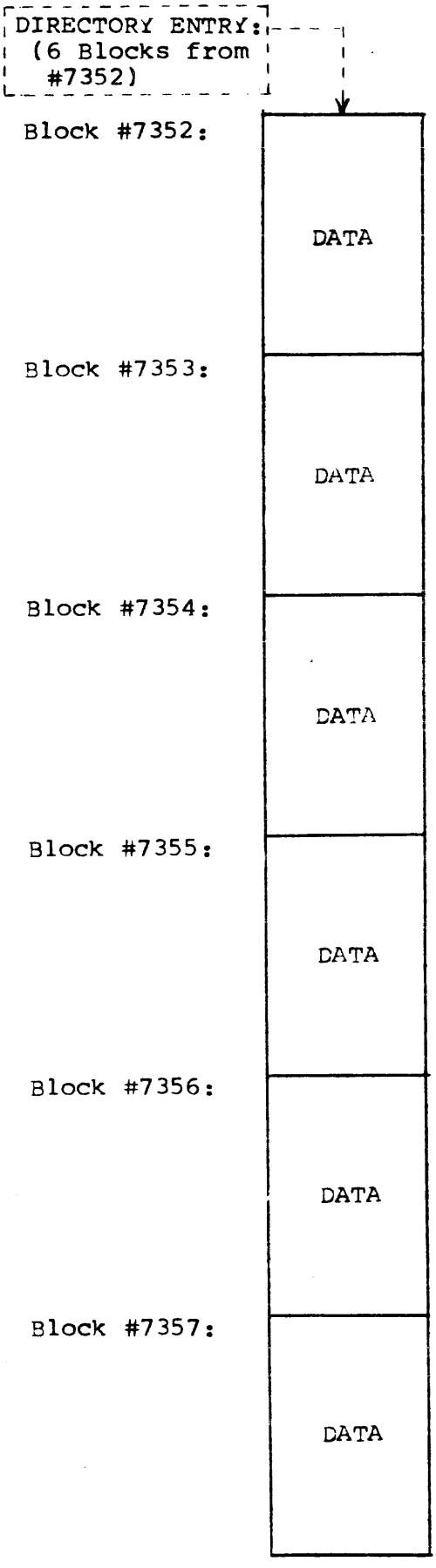
Bit-map Segment Format



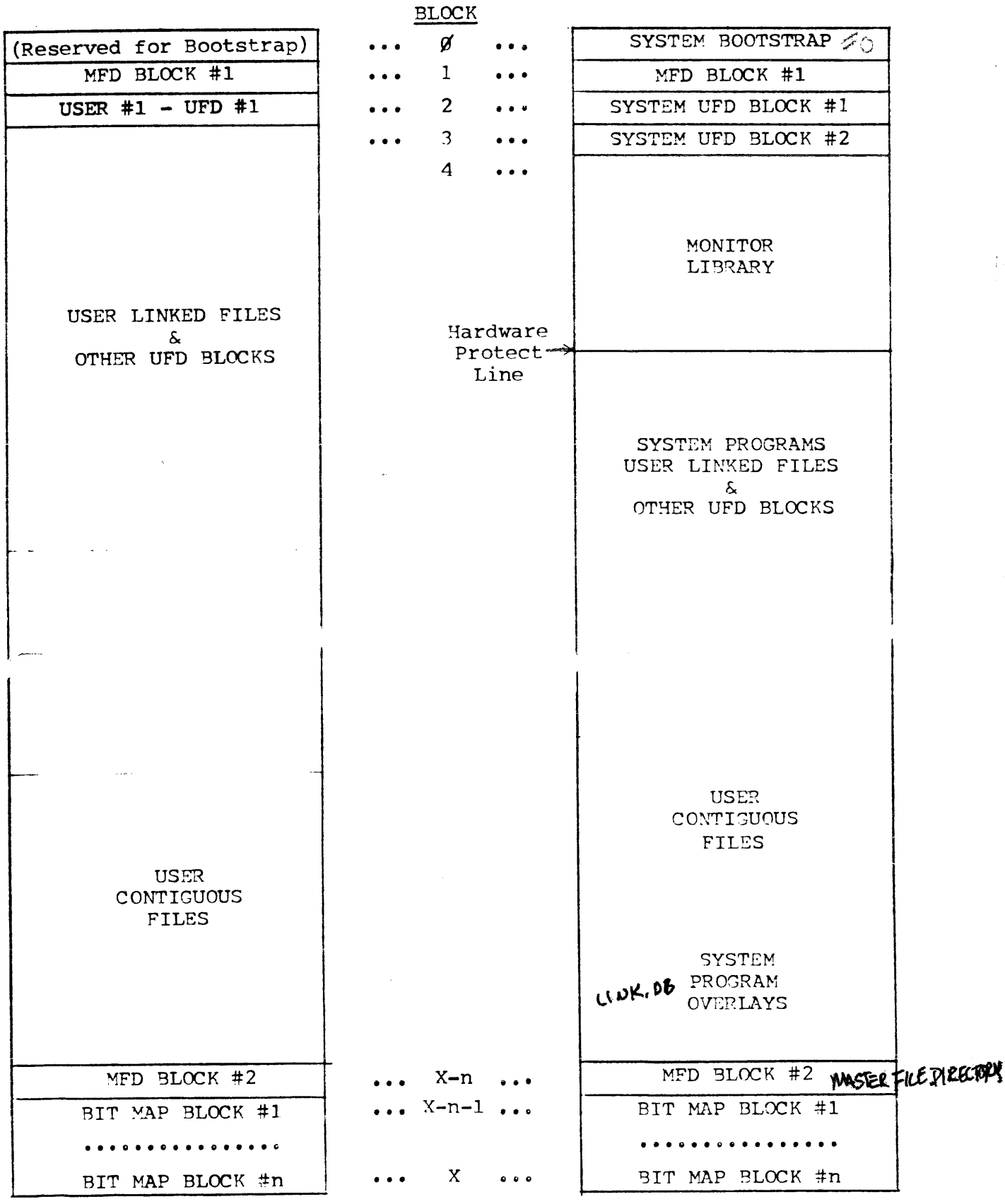
Protection Code Format



Linked File Format.



Contiguous File Format.


BLOCK
(Reserved for Bootstrap)
MFD BLOCK #1
USER #1 - UFD #1
USER LINKED FILES
&
OTHER UFD BLOCKS
USER
CONTIGUOUS
FILES
MFD BLOCK #2
BIT MAP BLOCK #1
BIT MAP BLOCK #n
Non-system Disk Format
... Ø ...
... 1 ...
... 2 ...
... 3 ...
4 ...
Hardware
Protect
Line
... X-n ...
... X-n-1 ...
... X ...
SYSTEM BOOTSTRAP
MFD BLOCK #1
SYSTEM UFD BLOCK #1
SYSTEM UFD BLOCK #2
MONITOR
LIBRARY
SYSTEM PROGRAMS
USER LINKED FILES
&
OTHER UFD BLOCKS
USER
CONTIGUOUS
FILES
SYSTEM
PROGRAM
OVERLAYS
LINK.DB
MFD BLOCK #2
MASTER FILE DIRECTORY
BIT MAP BLOCK #1
BIT MAP BLOCK #n
System Disk Format

Only 56 unique file names on a DECtape

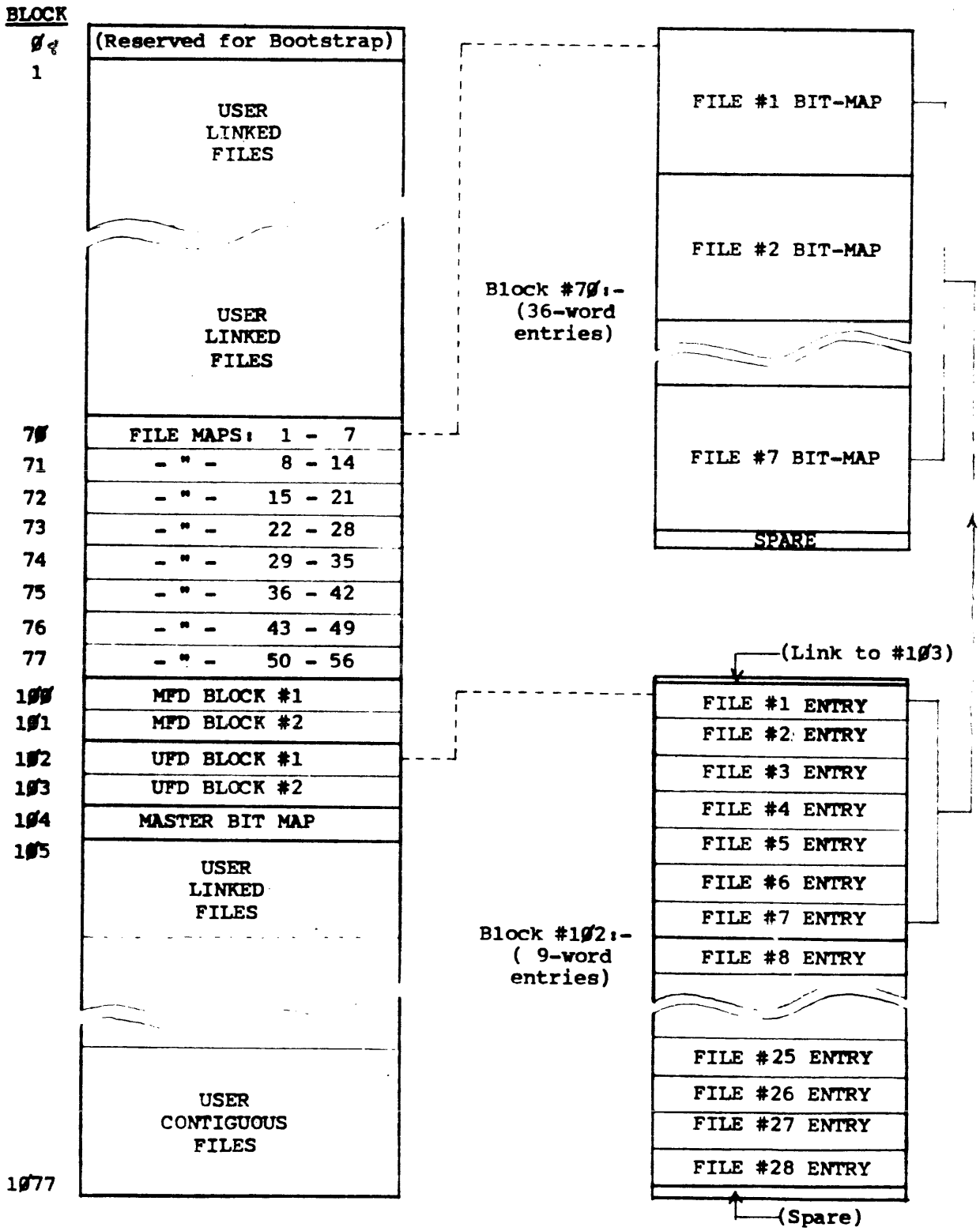


Fig.4-11: DECtape Format

576 Blocks on a DECTAPE

I. General Assembler Directives

A. Listing Control Direc tives

1. .LIST arg
2. .NLIST arg

Arguments:	Controls listing of:
SEQ	source line sequence numbers
LOC	location counter
BIN	Binary output
BEX	binary extensions of instructions
SRC	Source code
COM	comments
MD	macro definitions and repeat range expansions
MC	macro calls and repeat range expansions
* ME	macro expansions
* MEB	macro expansion binary code
CND	unsatisfied conditions, .IF and .ENDC statements
* LD	listing directives without arguments
TOC	table of contents on assembly pass 1
TTM	listing output format
SYM	symbol table for the assembly

*Default = NOLIST

3. Switches on the listing file specification during assembly:

/LI:arg
/NL arg

B. Page Headings

1. TITLE
2. .SBTTL
3. .IDENT
4. .PAGE

C. Functions

1. .ENABL arg
2. .DSABL arg

Arguments	Description
ABS	outputs in absolute binary
AMA	converts all mode 67's to 37
CDR	columns 73+ are treated as comments
FPT	causes floating point truncation
LC	accepts lower case and converts to upper case
LSB	enables or disables a local symbol block
PNC	enables or disables binary output

3. Switches:

/EN: arg
/DS: arg

D. Data Storage

1. .BYTE
2. .WORD
3. '
4. "
5. .ASCII
6. .ASCIZ
7. .RAD50

E. Radix Control

1. .RADIX
2. ↑D
3. ↑O
4. ↑B

F. Location Counter Control

1. .EVEN
2. .ODD
3. .BLKB
4. .BLKW

G. Numeric Control

1. .FLT2
2. .FLT4
3. ↑F
4. ↑C

H. Terminating Directives

1. .END
2. .EOT

I. Program Boundaries

1. .LIMIT

J. Program Sectioning

1. .ASECT
2. .CSECT
3. .CSECT Symbol

K. Symbol Contol

1. .GLOBL

L. Conditional Assemblies

1. IF ...

II. MACRO Directives

A. MACRO Definition

1. .MACRO name, dummy arg...
2. .ENDM
3. .MEXIT
4. MACRO calls
5. Concatenation
6. .NARG
7. .NCHR
8. .TYPE
9. .ERROR
10. .PRINT
11. .IRP
12. .IRPC
13. .REPT
14. .MCALL

```
DEMO    MACRO VR05A 08-DEC-72 06:41 PAGE 1


1                               .TITLE  DEMO
2
3               000000 R0=      %0
4               000001 R1=      %1
5               000002 R2=      %2
6               000003 R3=      %3
7               000004 R4=      %4
8               000005 R5=      %5
9               000006 SP=      %6
10              000007 PC=      %7
11
12                              .LIST   MEB             ;LIST MACRO EXPANSIONS OF LINES
13                                                      ;WHICH GENERATE BINARY CODE
14
15                      ;SIMPLIFY INSTRUCTION
16
17                              .MACRO  CALL    ADDR
18                              .GLOBL  ADDR
19                              JSR     PC,ADDR
20                              .ENDM
21
22  00000                       CALL    SUBR
    00000 004767                JSR     PC,SUBR
          000000G
23
24                      ;HANDLE ARGUMENT LISTS
25
26                              .MACRO  FUNCT   ARG1,   ARG2,   ARG3
27                              .GLOBL  SUBR
28                              JSR     PC,SUBR
29                              .WORD   ARG1,   ARG2,   ARG3
30                              .ENDM
31
32  00004                       FUNCT   1,2,3
    00004 004767                JSR     PC,SUBR
          000000G
    00010 000001                .WORD   1,      2,      3
    00012 000002
    00014 000003
33
34                      ;THIS COULD BE REDEFINED AT A LATER DATE TO:
35
36                              .MACRO  FUNCT   ARG1,   ARG2,   ARG3
37                              MOV     #ARG3,-(SP)
38                              MOV     #ARG2,-(SP)
39                              MOV     #ARG1,-(SP)
40                              TRAP    10
41                              .ENDM
42
43  00016                       FUNCT   4,5,6
    00016 012746                MOV     #6,-(SP)
          000006
    00022 012746                MOV     #5,-(SP)
          000005
    00026 012746                MOV     #4,-(SP)
          000004
    00032 104410                TRAP    10
```

```
1                       ;ESTABLISH DEFAULT VALUES WHICH CAN BE
2                       ;OVER-RIDDEN IN A PAREMETER FILE
3
4                               .MACRO  PARAM   MNE,VALUE
5                               .IIF NDF MNE,   MNE=    VALUE
6                               .LIST                   ;FORCE LISTING OF FINAL VALUE
7                       MNE=    MNE
8                               .NLIST
9                               .ENDM
10
11 00034                        PARAM   ALPHA,  1000.
        001750 ALPHA=   ALPHA
12
13      000200 BETA=    200
14 00034                        PARAM   BETA,120
        000200 BETA=    BETA
15
16                      ;GENERATE MESSAGE
17
18                              .MACRO  GENMSG  STRING,?LABEL
19                              .WORD   LABEL-.-2
20                              .ASCII  ◊STRING◊
21                              .LIST                   ;LIST FOR EXAMPLE
22                      LABEL:  .EVEN
23                              .NLIST                  ;RETURN TO NORMAL LEVEL
24                              .ENDM
25
26 00034                        GENMSG  <NOW IS>
   00034 000006                 .WORD   64$-.-2
   00036    116                 .ASCII  ◊NOW IS◊
   00037    117
   00040    127
   00041    040
   00042    111
   00043    123
   00044            64$:        .EVEN
27
28                              .MACRO  GENMSG  STRING,LABEL
29                              .ASCIZ  ◊STRING◊
30                              .EVEN
31                              .ENDM
32
33 00044                        GENMSG  <THE TIME>
   00044    124                 .ASCIZ  ◊THE TIME◊
   00045    110
   00046    105
   00047    040
   00050    124
   00051    111
   00052    115
   00053    105
   00054    000
```

```
                        .MACRO  .PARAM
                R0=%^O0
                R1=%^O1
                R2=%^O2
                R3=%^O3
                R4=%^O4
                R5=%^O5
                R6=%^O6
                R7=%^O7
                SP=%^O6
                PC=%^O7
                PSW=^O177776
                SWR=^O177570
                        .ENDM
                        .MACRO  .INIT   .LBLCK
                        .MCALL  .AMODE
                        .AMODE  .LBLCK
                        EMT <^O6>
                        .ENDM

                        .MACRO  .RLSE   .LBLCK
                        .MCALL  .AMODE
                        .AMODE  .LBLCK
                        EMT <^O7>
                        .ENDM

                        .MACRO  .CLOSE  .LBLCK
                        .MCALL  .AMODE
                        .AMODE  .LBLCK
                        EMT <^O17>
                        .ENDM

                        .MACRO  .READ   .LBLCK,.LBUFF
                        .MCALL  .AMODE
                        .AMODE  .LBUFF
                        .AMODE  .LBLCK
                        EMT <^O4>
                        .ENDM

                        .MACRO  .WRITE  .LBLCK,.LBUFF
                        .MCALL  .AMODE
                        .AMODE  .LBUFF
                        .AMODE  .LBLCK
                        EMT <^O2>
                        .ENDM

                        .MACRO  .OPENO  .LBLCK,.FBLCK
                        .MCALL  .CODE,.OPEN
                        .CODE   .FBLCK,<^O2>
                        .OPEN   .LBLCK,.FBLCK
                        .ENDM

                        .MACRO  .OPENI  .LBLCK,.FBLCK
                        .MCALL  .CODE,.OPEN
                        .CODE   .FBLCK,<^O4>
                        .OPEN   .LBLCK,.FBLCK
                        .ENDM
```

```
58
59                              .MACRO  .OPENU  .LBLCK,.FBLCK
60                              .MCALL  .CODE,.OPEN
61                              .CODE   .FBLCK,<^O1>
62                              .OPEN   .LBLCK,.FBLCK
63                              .ENDM
64
65                              .MACRO  .OPENC  .LBLCK,.FBLCK
66                              .MCALL  .CODE,.OPEN
67                              .CODE   .FBLCK,<^O13>
68                              .OPEN   .LBLCK,.FBLCK
69                              .ENDM
70
71                              .MACRO  .OPENE  .LBLCK,.FBLCK
72                              .MCALL  .CODE,.OPEN
73                              .CODE   .FBLCK,<^O3>
74                              .OPEN   .LBLCK,.FBLCK
75                              .ENDM
76
77                              .MACRO  .OPEN   .LBLCK,.FBLCK
78                              .MCALL  .AMODE
79                              .AMODE  .FBLCK
80                              .AMODE  .LBLCK
81                              EMT <^O16>
82                              .ENDM
83
84
```

```
1
2                       .MACRO  .WAIT   .LBLCK
3                       .MCALL  .AMODE
4                       .AMODE  .LBLCK
5                       EMT <^O1>
6                       .ENDM
7
8                       .MACRO  .WAITR  .LBLCK,.ADDR
9                       .MCALL  .AMODE
10                      .AMODE  .ADDR
11                      .AMODE  .LBLCK
12                      EMT <^O0>
13                      .ENDM
14
15                      .MACRO  .BLOCK  .LBLCK,.BBLCK
16                      .MCALL  .AMODE
17                      .AMODE  .BBLCK
18                      .AMODE  .LBLCK
19                      EMT <^O11>
20                      .ENDM
21
22                      .MACRO  .TRAN   .LBLCK,.TBLCK
23                      .MCALL  .AMODE
24                      .AMODE  .TBLCK
25                      .AMODE  .LBLCK
26                      EMT <^O10>
27                      .ENDM
28
29                      .MACRO  .SPEC   .LBLCK,.SARG
30                      .MCALL  .AMODE
31                      .AMODE  .SARG
32                      .AMODE  .LBLCK
33                      EMT <^O12>
34                      .ENDM
35
36                      .MACRO  .STAT   .LBLCK
37                      .MCALL  .AMODE
38                      .AMODE  .LBLCK
39                      EMT <^O13>
40                      .ENDM
41
42                      .MACRO  .ALLOC  .LBLCK,.FBLCK,.N
43                      .MCALL  .AMODE
44                      .AMODE  .N
45                      .AMODE  .FBLCK
46                      .AMODE  .LBLCK
47                      EMT <^O15>
48                      .ENDM
49
50                      .MACRO  .DELET  .LBLCK,.FBLCK
51                      .MCALL  .AMODE
52                      .AMODE  .FBLCK
53                      .AMODE  .LBLCK
54                      EMT <^O21>
55                      .ENDM
56
57                      .MACRO  .RENAM  .LBLCK,.OFB,.NFB
```

```
58                      .MCALL  .AMODE
59                      .AMODE  .NFB
60                      .AMODE  .OFB
61                      .AMODE  ,LBLCK
62                      EMT <A020>
63                      .ENDM
```

```
1
2                       .MACRO  .APPND  .LBLCK,.1FB,.2FB
3                       .MCALL  .AMODE
4                       .AMODE  .2FB
5                       .AMODE  .1FB
6                       .AMODE  .LBLCK
7                       EMT <^O22>
8                       .ENDM
9
10                      .MACRO  .LOOK   .LBLCK,.FBLCK,.OP
11                      .MCALL  .AMODE
12                      .AMODE  .FBLCK
13                      .IIF NB,.OP,CLR -(SP)
14                      .AMODE  .LBLCK
15                      EMT <^O14>
16                      .ENDM
17
18                      .MACRO  .KEEP   .LBLCK,.FBLCK
19                      .MCALL  .AMODE
20                      .AMODE  .FBLCK
21                      .AMODE  .LBLCK
22                      EMT <^O24>
23                      .ENDM
24
25                      .MACRO  .EXIT
26                      EMT <^O60>
27                      .ENDM
28
29                      .MACRO  .TRAP   .STUS,.ADDR
30                      .MCALL  .AMODE
31                      .AMODE  .ADDR
32                      .AMODE  .STUS
33                      MOV     #^O1,-(SP)
34                      EMT <^O41>
35                      .ENDM
36
37                      .MACRO  .STFPU  .STUS,.ADDR
38                      .MCALL  .AMODE
39                      .AMODE  .ADDR
40                      .AMODE  .STUS
41                      MOV     #^O3,-(SP)
42                      EMT <^O41>
43                      .ENDM
44
45                      .MACRO  .RECRD  .LBLCK,.RBLCK
46                      .MCALL  .AMODE
47                      .AMODE  .RBLCK
48                      .AMODE  .LBLCK
49                      EMT <^O25>
50                      .ENDM
51
52                      .MACRO  .DUMP   .LOW,.HIGH,.CDE
53                      .MCALL  .AMODE
54                      .AMODE  .LOW
55                      .AMODE  .HIGH
56                      .AMODE  .CDE
57                      EMT <^O64>
```

```
58                      .ENDM
59
60                      .MACRO  .RSTRT  .ADDR
61                      .MCALL  .AMODE
62                      .AMODE  .ADDR
63                      MOV     #^O2,-(SP)
64                      EMT <^O41>
65                      .ENDM
66
67                      .MACRO  .CORE
68                      MOV     #^O100,-(SP)
69                      EMT <^O41>
70                      .ENDM
71
72                      .MACRO  .MONR
73                      MOV     #^O101,-(SP)
74                      EMT <^O41>
75                      .ENDM
76
77                      .MACRO  .MONF
78                      MOV     #^O102,-(SP)
79                      EMT <^O41>
80                      .ENDM
81
82                      .MACRO  .DATE
83                      MOV     #^O103,-(SP)
84                      EMT <^O41>
85                      .ENDM
```

```
1
2                               .MACRO  .TIME
3                               MOV     #^O104,-(SP)
4                               EMT <^O41>
5                               .ENDM
6
7                               .MACRO  .GTUIC
8                               MOV     #^O105,-(SP)
9                               EMT <^O41>
10                              .ENDM
11
12                              .MACRO  .SYSDV
13                              MOV     #^O106,-(SP)
14                              EMT <^O41>
15                              .ENDM
16
17                              .MACRO  .RADPK  .ADDR
18                              .MCALL  .AMODE
19                              .AMODE  .ADDR
20                              CLR     -(SP)
21                              EMT <^O42>
22                              .ENDM
23
24                              .MACRO  .RADUP  .ADDR,.WRD
25                              .MCALL  .AMODE
26                              .AMODE  .WRD
27                              .AMODE  .ADDR
28                              MOV     #^O1,-(SP)
29                              EMT <^O42>
30                              .ENDM
31
32                              .MACRO  .D2BIN  .ADDR
33                              .MCALL  .AMODE
34                              .AMODE  .ADDR
35                              MOV     #^O2,-(SP)
36                              EMT <^O42>
37                              .ENDM
38
39                              .MACRO  .BIN2D  .ADDR,.WRD
40                              .MCALL  .AMODE
41                              .AMODE  .WRD
42                              .AMODE  .ADDR
43                              MOV     #^O3,-(SP)
44                              EMT <^O42>
45                              .ENDM
46
47                              .MACRO  .O2BIN  .ADDR
48                              .MCALL  .AMODE
49                              .AMODE  .ADDR
50                              MOV     #^O4,-(SP)
51                              EMT <^O42>
52                              .ENDM
53
54                              .MACRO  .BIN2O  .ADDR,.WRD
55                              .MCALL  .AMODE
56                              .AMODE  .WRD
57                              .AMODE  .ADDR
```

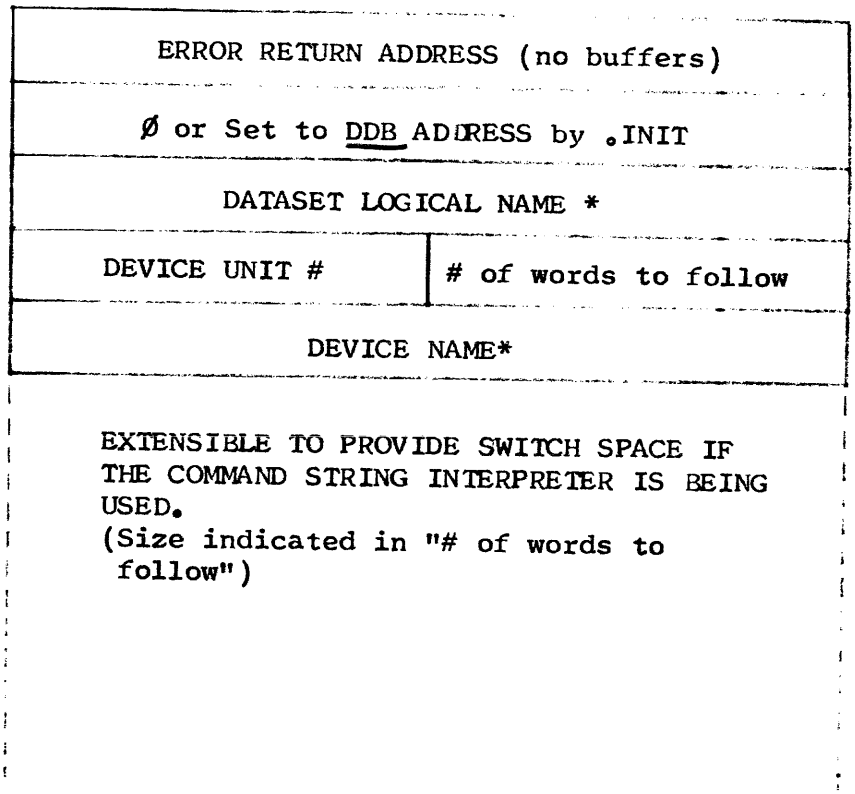
```
58                      MOV     #^O5,-(SP)
59                      EMT <^O42>
60                      .ENDM
```

```
1
2                       .MACRO  .CSI1   .CMDBF
3                       .MCALL  .AMODE
4                       .AMODE  .CMDBF
5                       EMT <^O56>
6                       .ENDM
7
8                       .MACRO  .CSI2   .CSBLK
9                       .MCALL  .AMODE
10                      .AMODE  .CSBLK
11                      EMT <^O57>
12                      .ENDM
13
14                      .MACRO  .DTCVT  .ADDR
15                      .MCALL  .CVTDT
16                      .CVTDT  #^O0,.ADDR
17                      .ENDM
18
19                      .MACRO  .TMCVT  .ADDR
20                      .MCALL  .CVTDT
21                      .CVTDT  #^O1,.ADDR
22                      .ENDM
23
24                      .MACRO  .CVTDT  .CDE,.ADDR,.VAL1,.VAL2
25                      .MCALL  .AMODE
26                      .IF     NB,.VAL2
27                      .AMODE  .VAL2
28                      .ENDC
29                      .IF     NB,.VAL1
30                      .AMODE  .VAL1
31                      .ENDC
32                      .AMODE  .ADDR
33                      .AMODE  .CDE
34                      EMT <^O66>
35                      .ENDM
36
37                      .MACRO  .GTPLA
38                      CLR     -(SP)
39                      MOV     #^O5,-(SP)
40                      EMT <^O41>
41                      .ENDM
42
43                      .MACRO  .STPLA  .ADDR
44                      .MCALL  .AMODE
45                      .AMODE  .ADDR
46                      MOV     #^O5,-(SP)
47                      EMT <^O41>
48                      .ENDM
49
50                      .MACRO  .GTCIL
51                      MOV     #^O111,-(SP)
52                      EMT <^O41>
53                      .ENDM
54
55                      .MACRO  .GTSTK
56                      CLR     -(SP)
57                      MOV     #^O4,-(SP)
```

```
58                      EMT <^O41>
59                      .ENDM
60
61                      .MACRO  .STSTK  .ADDR
62                      .MCALL  .AMODE
63                      .AMODE  .ADDR
64                      MOV     #^O4,-(SP)
65                      EMT <^O41>
66                      .ENDM
67
68                      .MACRO  .RUN    .RNBLK
69                      .MCALL  .AMODE
70                      .AMODE  .RNBLK
71                      EMT <^O65>
72                      .ENDM
73
74                      .MACRO  .FLUSH  .CDE
75                      .MCALL  .AMODE
76                      .AMODE  .CDE
77                      EMT <^O67>
78                      .ENDM
79
80              ; THE MACRO .AMODE ACCEPTS ONE ARGUMENT AND
81              ; AS A FUNCTION OF THE ADDRESSING MODE OF
82              ; THE ARGUMENT GENERATES THE APPROPRIATE
83              ; MOV TO -(SP).
84              ; ADDRESS MODES THAT ARE TROUBLESOME (E.G.
85              ; X(SP)) OR UNLIKELY (E.G. SP) WILL RESULT
86              ; IN A .ERROR TO CMO INCLUDING THE
87              ; VALUE OF THE ADDRESS MODE (E.G. X(SP)
88              ; IS REPRESENTED AS 000066), THE ARGUMENT ITSELF
89              ; AND THE TEXT "ADDRESSING MODE ILLEGAL AS SYSTEM
90              ; MACRO ARGUMENT".
91              ;
92                      .MACRO  .AMODE  .ARG
93              SP=%^O6
94                      .NTYPE  .SYM,.ARG       ;.SYM=ADDRESS MODE.
95
96                      .IF LE,.SYM-^O5
97                      MOV     .ARG,-(SP)      ;R0 TO R5
98                      .MEXIT
99                      .ENDC
100
101                     .IF EQ,.SYM&^O70-^O10
102                     .IF LE,.SYM&^O7-^O6
103                     MOV     .ARG,-(SP)      ;@R0 TO @R6
104                     .MEXIT
105                     .ENDC
106                     .ENDC
107
108                     .IF EQ,.SYM&^O60-^O20
109                     MOV     .ARG,-(SP)      ;[@](R0)+ TO [@](R7)+
110                     .MEXIT                  ; #N,@#ADDR
111                     .ENDC
112
113                     .IF EQ,.SYM&^O40-^O40
114                     .IF LE,.SYM&^O7-^O5
```

```
                        MOV     .ARG,-(SP)      ;[0]-(R0) TO [0]-(R5)
                        .MEXIT                  ;[0]X(R0) TO [0]X(R5)
                        .ENDC
                        .ENDC

                        .IF EQ,.SYM&^O67-^O67
                        MOV     .ARG,-(SP)      ;ADDR AND @ADDR
                        .MEXIT
                        .ENDC

                        .ERROR .SYM             ;.ARG ADDRESSING MODE ILLEGAL
                        .PRINT                  ;AS SYSTEM MACRO ARGUMENT.
                        .ENDM

                ; THE MACRO .CODE SETS UP THE FILEBLOCK
                ; WITH THE HOW OPEN CODE.
                ; THE ADDRESS OF THE FILEBLOCK MUST
                ; BE IN A REGISTER (R0 TO R5)

                        .MACRO  .CODE   .FBLK,.N
                        .NTYPE  .SYM,.FBLK

                        .IF LE,.SYM-^O5
                        MOVB    #.N,-^O2(.FBLK) ;R0 TO R5
                        .MEXIT
                        .ENDC

                        .ERROR .SYM             ;.FBLK ADDRESSING MODE ILLEGAL
                        .PRINT                  ;FOR .OPEN FILE BLOCK
                        .ENDM

****** E
```

LNKBLK:



*=Packed in Radix-5Ø format

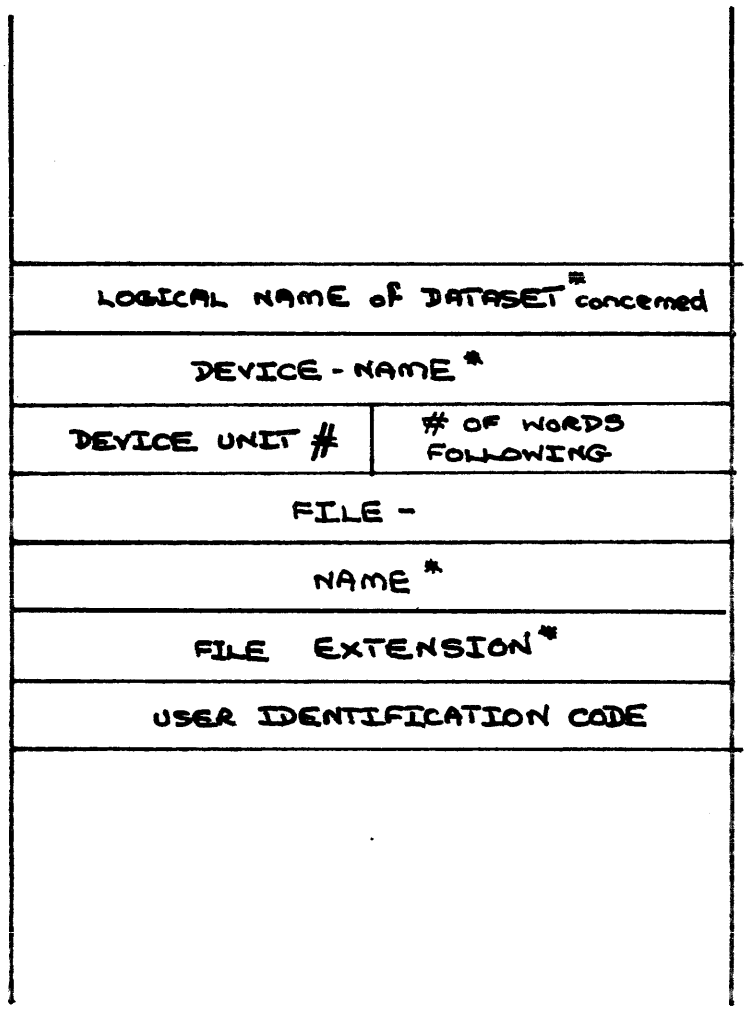
EXAMPLE

```
        .WORD Ø
LNKBLK :Ø
        .RAD50 /ABC/
        .BYTE 1, Ø
        .RAD50  /DT/
```

P.35 DDB: FROM LINKBLOCK

MONITOR LINK = Points to next DDB in CHAIN	IF CAST will equal ∅
DRIVER QUEUE LINK -	
DRIVER ROUTINE INDEX	PRIORITY LEVEL IN Q
Associated DRIVER ADDRESS SET UP INIT	
BUSY FLAG (∅ = Idle) CALLS TO WAIT	
USER LINE ADDRESS TENBIT ADDR OR	LINE BUFFER ADDR
DEVICE BLOCK #	
MEMORY BUFFER ADDRESS INTERNAL	
BUFFER WORD COUNT 2's COMPLIMENT # of WORDS	to transfer
STATUS FORMAT	
COMPLETION RETURN CLEAN UP ROUTINE	
DRIVER WORD COUNT # OF WORDS NOT transferred	IN 2's complement
BYTE COUNT	
CHECKSUM STORE FORMATTED BINARY	
POINTER TO DAT ADDRESS of ASSIGNMENT ENTRY	
F.I.B. LINK FILE STRUCTURED OPERATIONS	

DATASET DATA-BLOCK
(DDB)



* = PACKED in Radix-50 format

DEVICE ASSIGNMENT
TABLE ENTRY FORMAT

Dataset Data Block

The Monitor has no knowledge of the program's I/O requirements until the program itself identifies these by requesting initialization of the datasets to be used. Hence, as stated in the Programmer's Handbook, .INIT must be the first function called in each case. In response to such call, the Monitor sets up its own control block for the dataset within a 16-word buffer unit claimed from free core and stores its address in the link-word of the user Link-block. This block known as the Dataset Data Block (DDB), is used thereafter as the means by which different Monitor routines pass information to each other and also communicate with the driver servicing the dataset. It is retained in memory until the program releases the dataset from further I/O action, its buffer space is then returned to free core.

The format of the DDB is illustrated on Page 35. The purpose of the items is as follows:

1. Monitor link - enables the Monitor to maintain a control chain of the DDB's currently established. as illustrated. The chain originates at a DDB Chain Origin (DCO) word in the SVT.

2. Q link - is used to chain the DDB's for datasets waiting upon the services of the same device as described in the next section.

3. Priority level - stores the level at which a queued call to the driver is made.

4. Driver routine index - is normally Ø unless a driver call is queued: a pointer to the driver routine required is then saved here instead.

5. Driver address - contains the address from which the driver associated with the dataset is loaded. This also serves to identify the driver when compared with entries in the DDL.

6. Busy flag - is set by the EMT Handler to the address of the program I/O call when accepted. This forces any subsequent call to wait until the current request has been satisfied - when it is reset to Ø. The address of this word is the one stored in the user Link-block as the DDB connection to its dataset.

7. User line address - in general is used to save the second parameter passed by most I/O calls (normally the address of a data-block in the program, e.g. Line Buffer in .READ/.WRITE, TRA-block in .TRAN, etc.

8. Device block - points to the device address of a block on a bulk storage medium.

9. Buffer address - shows the start of a memory area for transfer - normally this is an internal Monitor buffer; thus this word is also used as an indication of the current assignment of such buffer (cleared to Ø if none).

10. Word count - gives the number of words to be transferred by the device as a two's complement value.

11. Status - is used to direct the driver on the type of transfer required, allows the driver to return error indicators and stores other control information on a bit-basis.

12. Completion return - shows the address at which a calling routine requires the driver to return when a requested service has been satisfied.

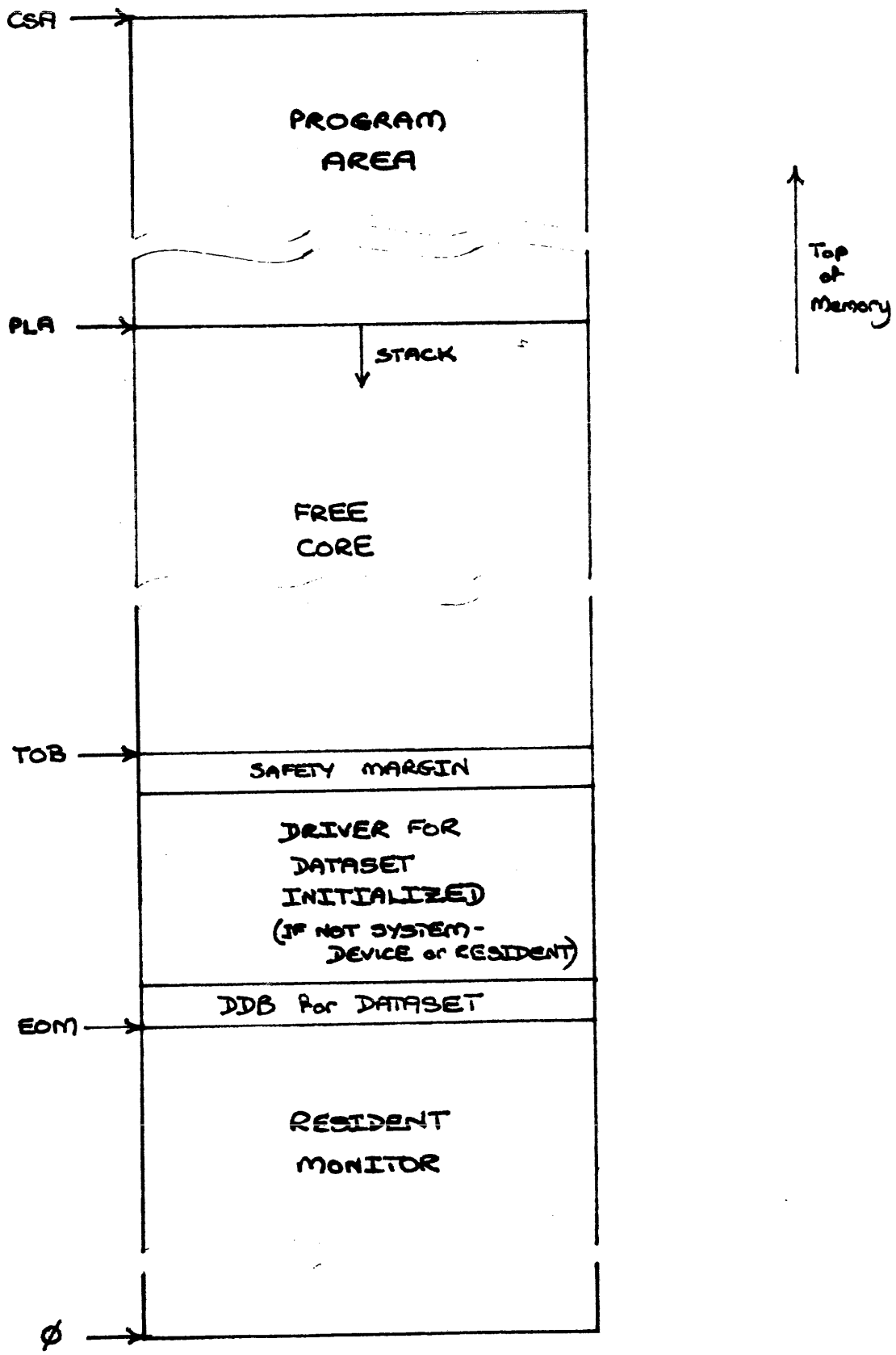
13. Driver word count - allows the driver to indicate (again as two's complement) how many words are not transferred because an end of data point is reached. This word is also used to store a variable pointer to the next byte to be processed in the internal Monitor buffer. (No device action can be underway at this time).

14. Byte count - is used during .READ/.WRITE processing to control bytes passed between the program line and the internal Monitor buffer.

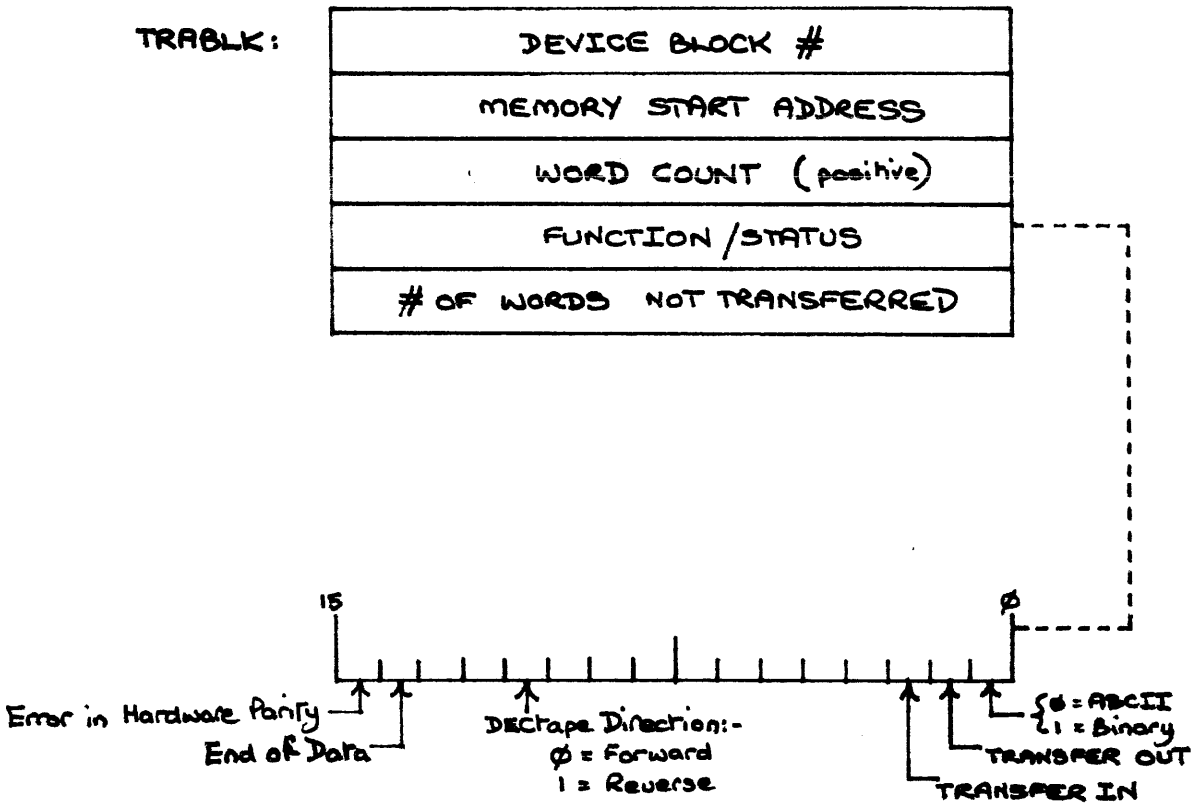
15. Checksum - is mainly provided for the processing of formatted binary data.

16. DAT pointer - is set during dataset initialization to the address of an entry in the Device Assignment Table corresponding to the dataset, if such exists (see previous section).

17. FIB link - connects the DDB to a 16-word buffer extension whenever file-structured operations are underway on the dataset. It is set to Ø otherwise.



Memory after Dataset Initialization



- TRAN·block. Format.

1. UPDATE

   a. HOW OPEN CODE 1.
   b. Contiguous file only
   c. One block is input from contiguous file into Monitor buffer or output from Monitor buffer to contiguous file.
   d. IO allowed:
      (1) .BLOCK IN
      (2) .BLOCK OUT

2. OUTPUT

   a. HOW OPEN CODE 2.
   b. Linked File only
   c. Creates starting block of a linked file.
   d. IO allowed: .WRITE

3. EXTENSION

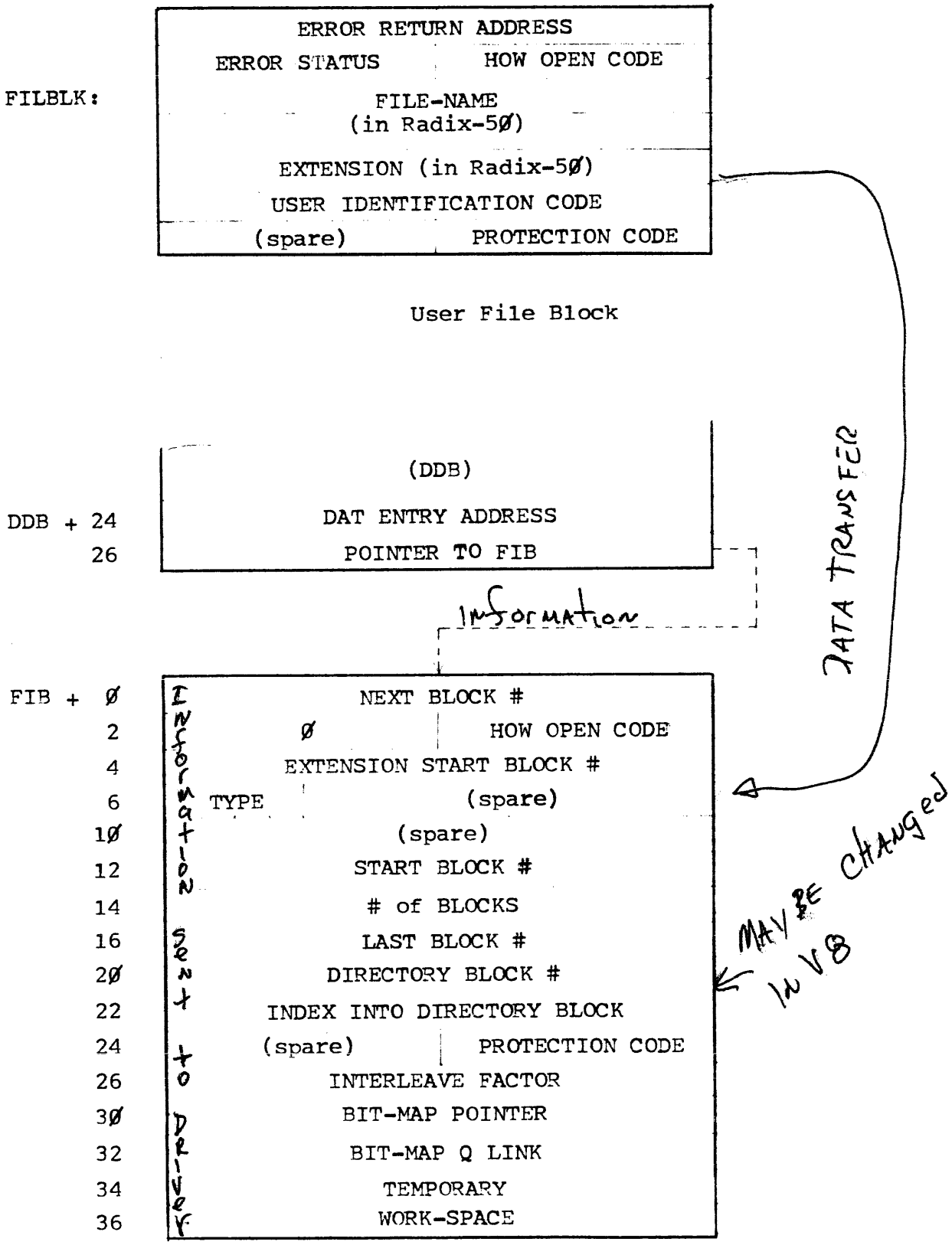
   a. HOW OPEN CODE 3.
   b. Linked file only
   c. Last Block is Input and New Data is Added Starting in the Next Free Byte. This and ensuing blocks are written into via .WRITE At .CLOSE the Directory is updated to Reflect File Size and New Last Block.
   d. IO allowed: .WRITE

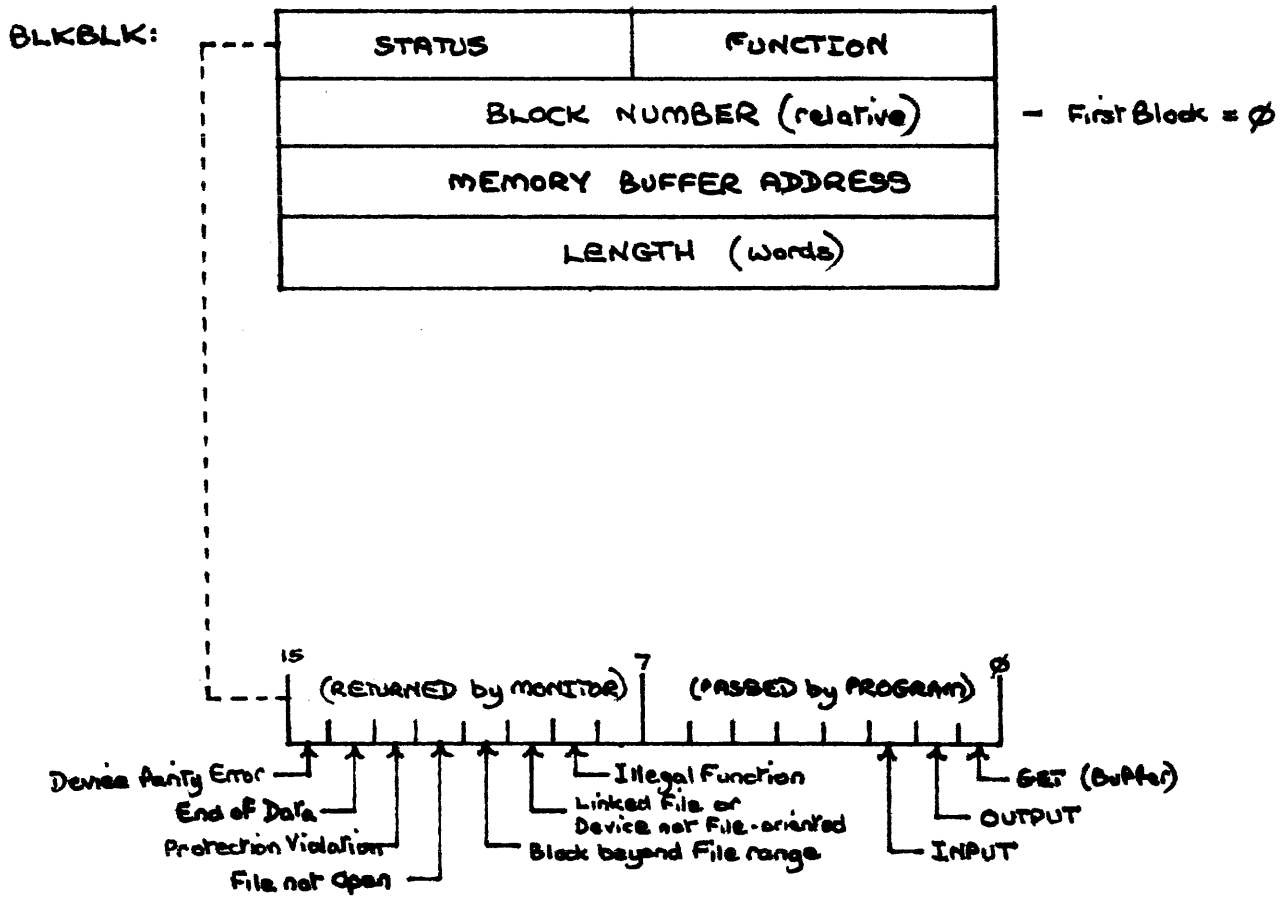
4. INPUT

   a. HOW OPEN CODE 4.
   b. Linked or contiguous file.
   c. First block of specified file is read into Monitor buffer anticipating .READ.
   d. IO allowed:
      (1) .READ
      (2) .BLOCK IN

5. CONTIGUOUS

   a. HOW OPEN CODE 13.
   b. Contiguous file only.
   c. Opens a previously created contiguous file for sequential output (.WRITE) so that you may enter data sequentially into physically contiguous blocks.
   d. IO allowed: .WRITE


FILBLK:
ERROR RETURN ADDRESS
ERROR STATUS
HOW OPEN CODE
FILE-NAME
(in Radix-50)
EXTENSION (in Radix-50)
USER IDENTIFICATION CODE
(spare)
PROTECTION CODE
User File Block
DATA TRANSFER
(DDB)
DDB + 24
DAT ENTRY ADDRESS
26
POINTER TO FIB
Information
FIB + 0
2
4
6
10
12
14
16
20
22
24
26
30
32
34
36
Information Sent to Driver
NEXT BLOCK #
0
HOW OPEN CODE
EXTENSION START BLOCK #
TYPE
(spare)
(spare)
START BLOCK #
# of BLOCKS
LAST BLOCK #
DIRECTORY BLOCK #
INDEX INTO DIRECTORY BLOCK
(spare)
PROTECTION CODE
INTERLEAVE FACTOR
BIT-MAP POINTER
BIT-MAP Q LINK
TEMPORARY
WORK-SPACE
MAY BE CHANGED IN V8
File Information Block



The BLOCK-block

The RECORD Block

RECBLK:

FUNCTION / STATUS
BUFFER ADDRESS
RECORD LENGTH
HI ORDER, RECORD #
LO ORDER, RECORD #

Figure 3-12 The Record Block

ADDRESS FUNCTION

RECBLK FUNCTION / STATUS WORD

BIT

Ø - Not used
1 - Record Output - Set by user
2 - Record Input - Set by user
3-8 - Not used

(Following bits set by Monitor)

9 - Illegal Function
1Ø - File is linked or device is not File structured.
11 - Record requested lies outside the file.
12 - File not OPEN
13 - Protect code violation, Incorrect Open
14 - Not used
15 - Device parity error

The user may set only bits 1 or 2; error bits are set by the Monitor, and should be tested for by the user upon return from the request. The error bits are cleared by the Monitor when a .RECRD request is issued and are set as appropriate upon return from the Monitor.

RECBLK+2 BUFFER ADDRESS

The address of the user's buffer. The buffer must be large enough to contain a record of the length indicated in the next word, as the Monitor assumes that sufficient space is available and will overlay data stored below a buffer of insufficient length.

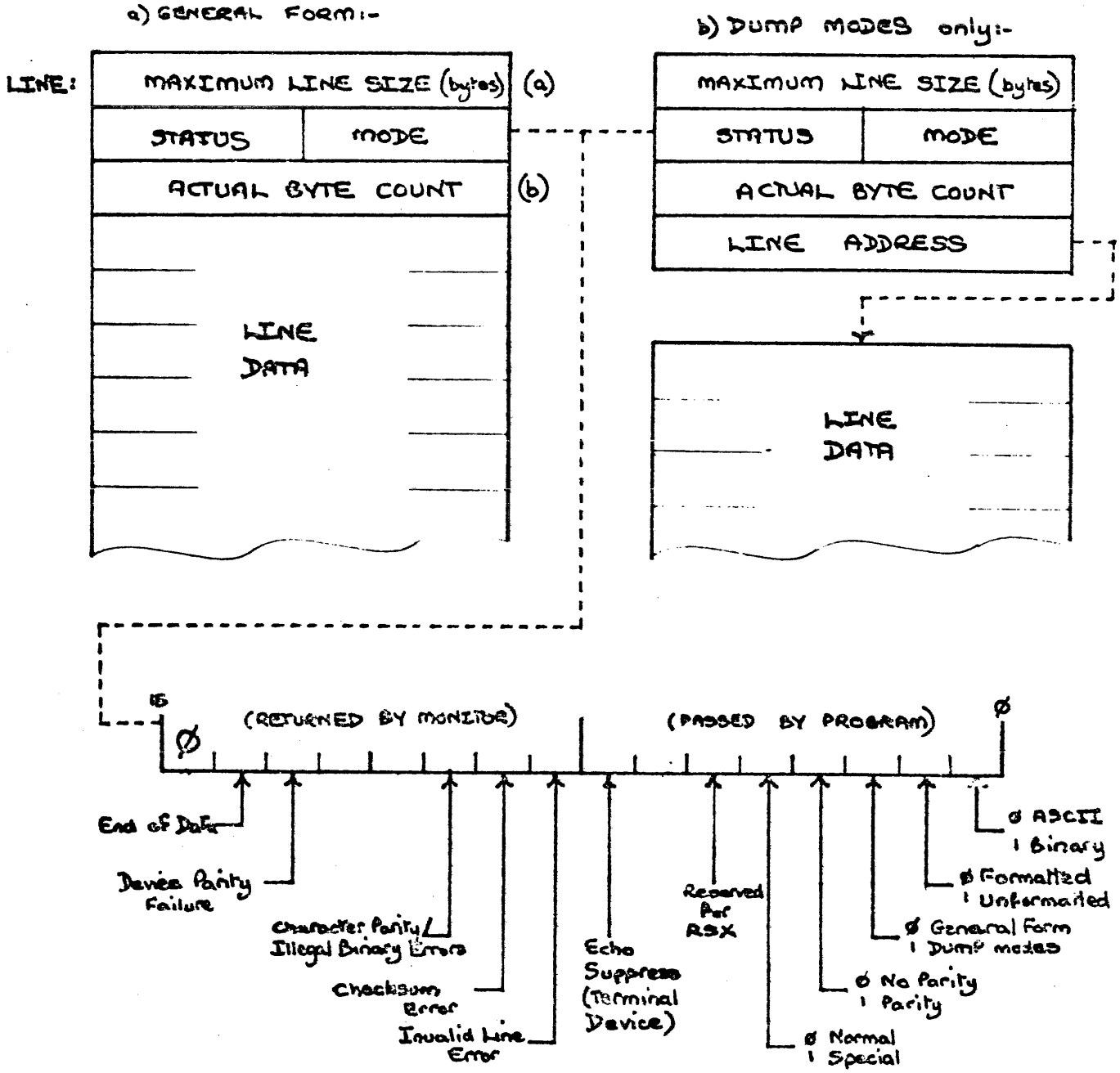
RECBLK+4 RECORD LENGTH

The number of bytes of a Record. This value, which must remain the same for all records in the file, is supplied by the user.

RECBLK+6 High Order - Record Number
RECBLK+1Ø Low Order - Record Number

This entry identifies the record to be read or written. Two words are provided in anticipation of files with more than 65,536 records.

First Record of File is number Ø.



Notes:-

a) must be program-supplied for INPUT

b) must be program-supplied for OUTPUT

Valid Modes:-

Formatted ASCII Parity (Normal & Special)
Formatted ASCII Non-parity (Normal & Special)
Unformatted ASCII Parity / Non-parity (Normal)
Formatted Binary Non-parity (Normal & Special)
Unformatted Binary Non-parity (Normal)
(Dump valid in all above modes)

User LINE Format.

MODE	READ TERMINATION	MAX BYTE COUNT	ACTUAL BYTE COUNT	WRITE TERMINATION	DISCARDED CHARACTERS	BITS
FORMATTED ASCII NORMAL	Line feed, form feed vertical tab, or max Byte count is reached	Invalid line error if max Byte before terminator	Max count plus excess	Actual Byte count-previous terminators out as normal	Rubouts and nulls excess char.	7
FORMATTED ASCII SPECIAL	Line feed, form feed V.T.or max Byte count	Invalid line error if max bytes before terminator	=Max count or less (terminated)	First terminator or actual byte count	Rubouts and nulls	7
FORMATTED BINARY NORMAL	Actual Byte count or maximum Byte count	If max. before actual invalid line error	Max count plus excess	Actual Byte count includes words 2+4- checksum calc + output	After max - overlaid in last byte (Read)	8 Bit Transfer
FORMATTED BINARY SPECIAL	Actual Byte count	If max before actual remainder retained	Max count plus excess	Actual Byte count includes words 2 + 4- checksum calc + output		8 Bit Transfer
UNFORMATTED ASCII NORMAL OR SPECIAL	Maximum byte count			Actual byte count	Nulls only	7 bit transfer Bit 8 set to Ø
UNFORMATTED BINARY NORMAL OR SPECIAL	Maximum Byte			Actual byte count no checksum		8 Bit Transfer
FORMATTED ASCII PARITY Ascii Even Parity	Line feed, form feed vertical tab, or max byte count is reached	Invalid line error if max byte before terminator	See formatted ASCII normal or special	Actual byte count-previous terminators out as normal	See formatted ASCII normal or special	Checks for even parity 7 bit Xfer BAD 8=1
UNFORMATTED ASCII PARITY	Maximum byte count			Actual Byte count	Nulls only	8 Bit transfer

9h

1.Ø ABSTRACT

The TC11 DECtape Formatter is a program for marking DECtapes on Unit Ø with a standard format of $578_{1Ø}$ blocks of $256_{1Ø}$ words each.

2.Ø REQUIREMENTS

A. Minimum configuration PDP-11

B. TC11 DECtape control and at least one transport.

C. DECtape(s)

3.Ø LOADING PROCEDURE

The normal procedure for loading Absolute Binary tapes should be followed.

4.Ø PRELIMINARY OPERATIONS

A. Mount a DECtape on Unit Ø, wrapping enough turns to insure tension - if not enough. Tape will run off reel - Also can have hung read.

B. Set the transport On-line with Write Enable on.

C. Set the TC11 WALL and WRTM switches (up). Must Remove Top Cover.

5.Ø STARTING PROCEDURE

Load Address $6ØØ_8$ and press START.

6.Ø OPERATING PROCEDURE

A. Once started the program writes all Timing and Mark Track information in one forward pass and then halts at address $1Ø5Ø_8$.

B. If the tape has run off the reel, remount it. Reset the WRTM switch (down) and press CONTINUE. The tape will back out for three blocks, then turn around and write the complement obverse of the last block number ($11\emptyset1_8$) in Writeall in all data slots until the End Zone is sensed. The tape then reverses and writes relevant information in all blocks down through $\emptyset$ in Writeall.

C. The tape then reverses and alternately searches for each block number in sequence then changes to Readall to check each block for correct data ($\emptyset$'s).

D. After all blocks have been verified forward, the tape is reversed again and alternately searches for each block number in reverse sequence then writes each block to $\emptyset$'s in Write Data mode. This insures parity conservation if the tape is to be read before being rewritten.

E. The program then halts at address 2316_8. To format another tape, perform the operations in section 4.$\emptyset$ then press CONTINUE.

7.$\emptyset$ ERRORS

7.1 ERROR HALT

Address $3\emptyset12_8$ is the common error halt. Press CONTINUE to proceed from it.

DIGITAL EQUIPMENT CORPORATION
MAYNARD, MASSACHUSETTS 01754