SUPPLEMENT TO

Beneath Apple ProDOS

For ProDOS Version 1.1.1

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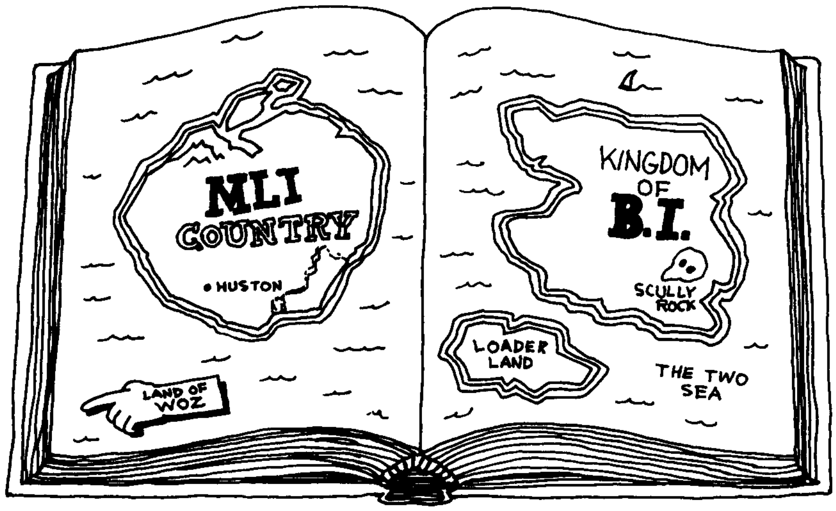


A ProDOS ATLAS

INTRODUCTION

This supplement documents the actual structure and logic of the ProDOS system at nearly a byte by byte level. It is intended to aid experienced programmers in designing customized interfaces to ProDOS, and to provide implicit documentation of ProDOS's functions. All assembly language programmers will find this supplement useful in learning about how an operating system works. This information is presented in the spirit of helping the user to better understand how ProDOS works. The authors do not endorse indiscriminant modification of the ProDOS components. Whenever possible, standardized interfaces to ProDOS should be used to avoid the uncontrolled modifications which plagued Apple's previous operating system, DOS 3.3.

External system programs and utilities such as the FILER and CONVERT are not covered here, nor are disk controller ROM's covered other than the 5.25" controllers sold by Apple.

The information presented here is for the release of the ProDOS operating system called Version 1.1.1. A previous supplement to Beneath Apple ProDOS documented the structure of Versions 1.Ø.1 and 1.Ø.2 of ProDOS.

UNDERSTANDING THE LISTINGS

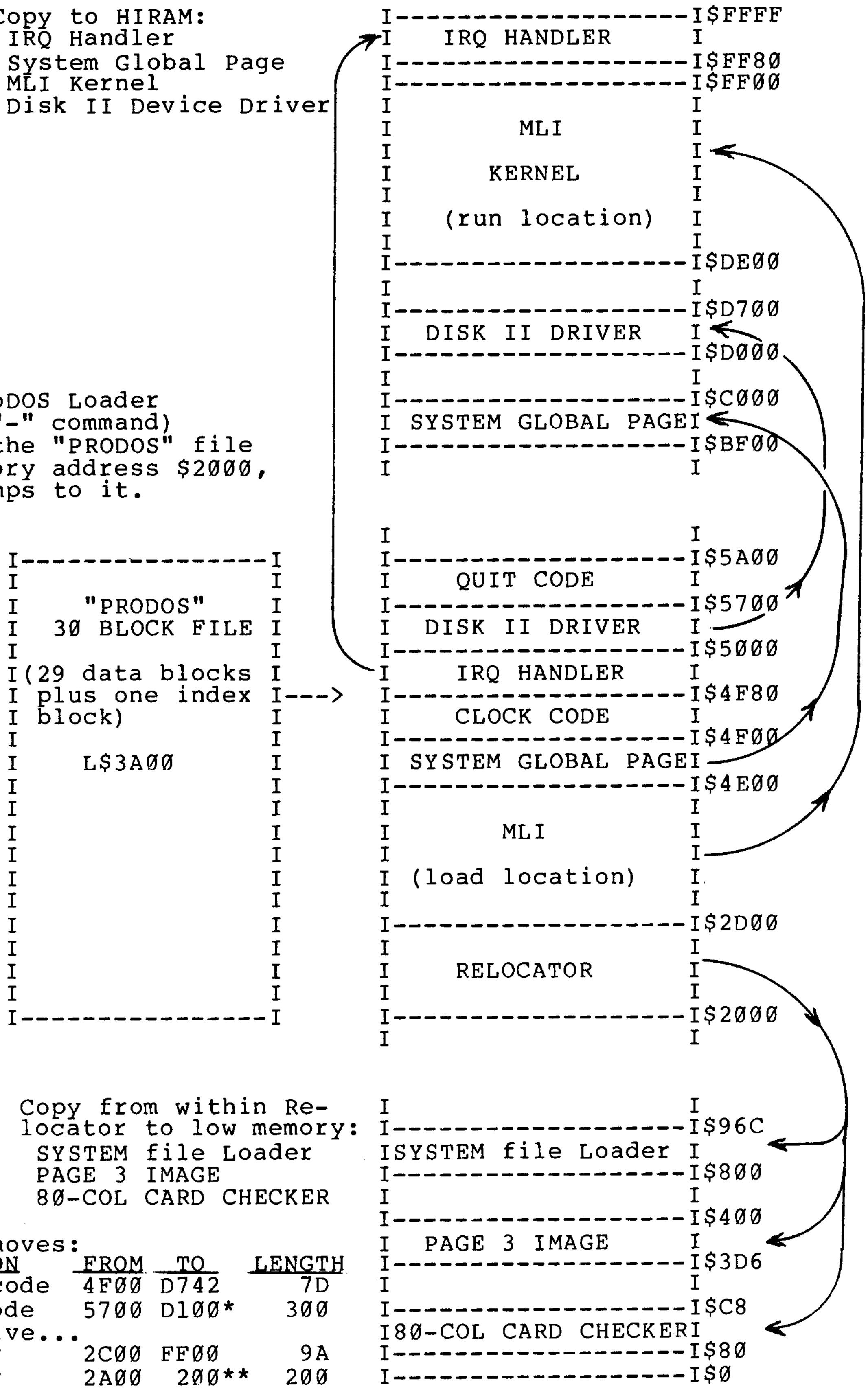
The listings which follow describe the major ProDOS components in great detail. Each module is presented separately and consists of a section defining external addresses referenced by the program (such as zero page usage, I/O select addresses, and global page fields) followed by a section describing the instructions and data in the module. Divisions between major sections and subroutines are indicated with a row of asterisks (*) and additional comments.

Each detail line gives the address of the instruction or data field being described, followed by comments. Within the comments, the following notation is used to indicate references by instructions:

(address)	A store or load reference to a memory or I/O location.
>>address	A branch or jump to an address.
<address>	A call to a subroutine at the indicated address.
-->address	A pointer to an address.

Page titles give the address of the next instruction or data area in the module to be described. These may be used to quickly locate a particular area within the component.

HOW "PRODOS" (Version 1.1.1) IS LOADED AND RELOCATED



(3) Copy to HIRAM:
 IRQ Handler
 System Global Page
 MLI Kernel
 Disk II Device Driver

```
I-------------------I$FFFF
I    IRQ HANDLER    I
I-------------------I$FF80
I-------------------I$FF00
I                   I
I        MLI        I
I                   I
I       KERNEL      I
I                   I
I   (run location)  I
I                   I
I-------------------I$DE00
I                   I
I-------------------I$D700
I   DISK II DRIVER  I
I-------------------I$D000
I                   I
I-------------------I$C000
I SYSTEM GLOBAL PAGEI
I-------------------I$BF00
I                   I

I                   I
I-------------------I$5A00
I     QUIT CODE     I
I-------------------I$5700
I   DISK II DRIVER  I
I-------------------I$5000
I    IRQ HANDLER    I
I-------------------I$4F80
I     CLOCK CODE    I
I-------------------I$4F00
I SYSTEM GLOBAL PAGEI
I-------------------I$4E00
I                   I
I        MLI        I
I                   I
I  (load location)  I
I                   I
I-------------------I$2D00
I                   I
I     RELOCATOR     I
I                   I
I-------------------I$2000
I                   I
```

(1) The ProDOS Loader
(or a "-" command)
loads the "PRODOS" file
to memory address $2000,
and jumps to it.

```
I---------------I
I               I
I    "PRODOS"   I
I  30 BLOCK FILE I
I               I
I(29 data blocks I
I plus one index I--->
I block)        I
I               I
I    L$3A00     I
I               I
I               I
I               I
I               I
I               I
I               I
I               I
I               I
I               I
I               I
I---------------I
```

(2) Copy from within Re-
locator to low memory:
 SYSTEM file Loader
 PAGE 3 IMAGE
 80-COL CARD CHECKER

```
I                   I
I-------------------I$96C
ISYSTEM file Loader I
I-------------------I$800
I                   I
I-------------------I$400
I   PAGE 3 IMAGE    I
I-------------------I$3D6
I                   I
I-------------------I$C8
I80-COL CARD CHECKERI
I-------------------I$80
I-------------------I$0
```

(4) Final moves:

FUNCTION	FROM	TO	LENGTH
Clock code	4F00	D742	7D
QUIT code	5700	D100*	300
RAM drive...			
Caller	2C00	FF00	9A
Driver	2A00	200**	200

*BANK2 **AUX MEMORY

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84            NEXT OBJECT ADDR: 0800
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

0800    MODULE STARTING ADDRESS
          ****************************************
          *                                      *
          *  PRODOS LOADER                       *
          *    THIS CODE IS LOADED FROM BLOCK 0  *
          *  INTO MEMORY AT $800.                *
          *  ITS PURPOSE IS TO LOAD THE "PRODOS" *
          *  FILE INTO $2000 AND JUMP TO IT.     *
          *  (PRODOS RELOCATOR IS AT $2000)      *
          *                                      *
          *  VERSION 1.1.1 -- 18 SEP 84          *
          *  (THE LOADER IS STILL THE SAME AS IT *
          *   WAS IN VERSION 1.0.1)              *
          *                                      *
          ****************************************

          *** EXTERNAL ADDRESSES ***

0027     ROM BOOT SUBRTN BUFFER PAGE ADDR
002B     ROM BOOT SUBRTN SLOT * 16
003D     ROM BOOT SUBRTN SECTOR TO READ
0040     ROM BOOT SUBRTN CURRENT TRACK
0041     ROM BOOT SUBRTN TRACK TO READ
           -- BLOCK READ PARAMETER LIST --
0042     COMMAND NUMBER (1 = READ)
0043     SLOT * 16
0044     I/O BUFFER ADDRESS ($44/$45)
0045
0046     BLOCK TO READ ($46/$47)
0047

           ------------------------------

0048     POINTER TO BLOCK READ ROUTINE
0049
004A     VOL DIR ENTRY POINTER/FIRST INDEX PAGE
004B
004C     ADDR OF SECOND PAGE OF INDEX BLOCK
004D
004E     INDEX INTO INDEX BLOCK PAGES
0050     TRACK SEEK PHASE-ON INDEX
0051     TRACK PHASE WANTED
0052     BLOCK READER RETRY COUNT
0053     CURRENT TRACK PHASE/PHASE-OFF INDEX
0054
0060     BUFFER POINTER
0061
05AE     SCREEN CENTER LINE
2000     LOAD POINT FOR RELOCATOR
C080     DISK ARM PHASE0
C088     TURN DISK DRIVE OFF
C089     TURN DISK DRIVE ON
C08C     SHIFT DATA REGISTER
```

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84            NEXT OBJECT ADDR: 0800
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

FC58     HOME CURSOR/CLEAR SCREEN

          **************************

0800    SIGNATURE BYTE ($01 MEANS BOOT ROUTINE FOLLOWS)
        (A $03 IS STORED HERE DURING A 5.25" FLOPPY BOOT)
                 --  APPLE /// BOOTING --
          THIS CODE (BLOCK 0) IS LOADED AT $A000 WHEN
          BOOTED ON AN APPLE ///.  THE APPLE /// BOOT
          ROM JUMPS TO $A000.  WHAT IS SHOWN HERE AS
          $800 ON AN APPLE II IS $A000 ON AN APPLE ///.
          THUS AN APPLE /// EXECUTES A HARMLESS
          INSTRUCTION (ORA $38,X), THEN DOES NOT BRANCH
          ON CARRY, AND JUMPS TO $A132 ($932 ON AN
          APPLE II).  MANY THANKS TO DAV HOLLE FOR
          PROVIDING US WITH THIS APPLE /// INFORMATION.

0801 *********** MAIN ENTRY ******************************************
             ON ENTRY, X = SLOT*16
                       A = SECTOR NUMBER

  0801  ENTRY POINT FOR APPLE II
  0802  ALWAYS TAKEN (APPLE II) >>0807
  0804  JUMP TO APPLE /// LOGIC  >>A132
  0807  SAVE SLOT*16
  0809  READING SECTOR 3 NEXT?
  080B  REMEMBER THIS...
  080D  MAKE $CX FROM SLOT*16
  0815  AND SAVE AT $49
  0819  $48/49 --> $CXFF IN ROM BOOT
  081C  CHECK $CXFF
  081D  BOOT ROM FOR DISK II?
  081F  NO, NOT A 5.25" FLOPPY >>085B
  0821  GOT BOTH SECTORS OF LOADER? >>0831
  0823  NO, STOP AT SECTOR 3
  0825  STORE ON PARM (0800)
  0828  SKIP SECTOR 1 (GET SEC 2)
  082A  DUMMY UP $CX5C AS RETURN ADDRESS
  0830  AND CALL ROM SECTOR READ SUBRTN

          ******** LOAD PRODOS *******************
          (ENTIRE LOADER IN MEMORY NOW)

  0831  CURRENT TRACK IS ZERO
  0833  $48/49 --> $CX00
  0837  COPY A PORTION OF DISKETTE BOOT ROM
  0839  TO MY BLOCK READER SUBROUTINE (0994)
  083D  FROM $9F7 TO $A7E
  0843  MODIFY SOME BRANCHES IN THE COPIED CODE (091D)
  0846  TO SUIT MY ERROR HANDLING TASTES (0924)
  084C  AND COPY SECTOR READ SUBROUTINE EXIT CODE (092B)
```

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: Ø84F
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  Ø84F   TO $A7F TO $A85 (ØA7F)
  Ø855   $48/49 --> DISKETTE BLOCK READER SUBRTN
  Ø859   AT $Ø986
  Ø85B   ---
  Ø85D   LEGAL DISK ROM?
  Ø85F   NO, ERROR >>Ø89Ø
  Ø861   STORE LSB OF BLOCK READER
  Ø863   STORE ZEROS IN SEVERAL THINGS
  Ø86E   COMMAND = 1 (READ BLOCK)
  Ø871   BLOCK NUMBER = 2 (VOL DIRECTORY)
  Ø875   $6Ø/61 --> $CØØ (BUFFER)
  Ø877   $4A/4B --> $CØØ (FIRST ENTRY)
  Ø879   READ VOLUME DIRECTORY BLOCKS <Ø912>
  Ø87C   ERROR? >>Ø8E6
  Ø87E   MOVE UP TWO PAGES IN MEMORY
  Ø882   NEXT BLOCK NUMBER
  Ø886   NOW AT BLOCK 6?
  Ø888   NO, GO READ NEXT ONE >>Ø879
  Ø88A   YES, CHECK LINK FOR VALIDITY (ØCØØ)
  Ø88D   IT SHOULD BE ZERO FOR VOL DIR (ØCØ1)
  Ø89Ø   BAD VOLUME DIR IF NOT ZERO >>Ø8FF
  Ø892   NO, INDEX PAST LINK AND VOL HDR
  Ø894   AND BEGIN >>Ø898
  Ø896   IF ALREADY PROCESSING, USE ENTRY LSB
  Ø898   ---
  Ø899   ADD ENTRY LENGTH TO FIND NEXT ENTRY (ØC23)
  Ø89D   STILL IN SAME PAGE? >>Ø8AC
  Ø89F   NO, BUMP ENTRY MSB
  Ø8A3   IS IT ODD? (SECOND PAGE OF A BLOCK?)
  Ø8A4   YES... >>Ø8AC
  Ø8A6   NO, JUST FINISHED LAST BLOCK?
  Ø8A8   YES, ERROR -- FILE NOT FOUND >>Ø8FF
  Ø8AA   ELSE, START JUST PAST LINKS
  Ø8AC   UPDATE LSB OF ENTRY POINTER
  Ø8AE   GET NAME LENGTH (Ø9Ø2)
  Ø8B1   MASK OFF STORAGE TYPE
  Ø8B4   COMPARE NAME WITH "PRODOS"
  Ø8B9   NOT A MATCH? >>Ø896
  Ø8BE   IF NAME MATCHES, IS IT A SAPLING FILE?
  Ø8C2   IF NOT, I CAN'T HANDLE IT >>Ø8FF
  Ø8C6   GET FILE TYPE
  Ø8C8   SHOULD BE A PRODOS SYS FILE
  Ø8CA   IF NOT, I GIVE UP >>Ø8FF
  Ø8CD   ALL IS WELL, COPY KEY BLOCK NUMBER
  Ø8CF   TO $46/47
  Ø8D6   $4A/4B AND $6Ø/61 --> $1EØØ
  Ø8D8   (BUFFER TO HOLD KEY BLOCK)
  Ø8E1   $4C/4D --> $1FØØ (SECOND PAGE)
  Ø8E3   READ A BLOCK <Ø912>
  Ø8E6   ERROR? >>Ø8FF
  Ø8EA   BUMP TO NEXT BLOCK BUFFER
```

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: Ø8EE
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  Ø8EE   $4E = OFFSET INTO INDEX BLOCK
  Ø8FØ   GET NEXT BLOCK NUMBER FROM INDEX BLOCK
  Ø8F8   BLOCK NUMBER = Ø? (END OF FILE)
  Ø8FA   NOT YET, READ A BLOCK >>Ø8E3
  Ø8FC   ELSE, JUMP TO RELOCATOR AT $2ØØØ >>2ØØØ

  Ø8FF   ERROR JUMP >>Ø93F

Ø9Ø2 *********** KERNEL NAME ******************************************

  Ø9Ø2   LENGTH OF KERNEL'S NAME
  Ø9Ø3   'PRODOS          ' "PRODOS" (KERNEL NAME)

Ø912 *********** COPY BLOCK READ BUFFER PTR ***************************

  Ø912   COPY $6Ø/61 --> $44/45
  Ø914   (BLOCK READ BUFFER POINTER)
  Ø91A   THEN GO TO BLOCK I/O ROUTINE >>ØØ48

Ø91D *********** ROM SECTOR READ OFFSETS ******************************
             OFFSETS INTO ROM SECTOR READ SUBROUTINE
             TO BRANCH DISPLACEMENTS WHICH NEED TO
             BE CHANGED FOR LOADER'S PURPOSES

  Ø91D   ---

           ******** NEW BRANCH OFFSETS FOR ABOVE ***

  Ø924   ---

Ø92B *********** SECTOR READ EXIT CODE ********************************
             COPIED TO END OF DISKETTE SECTOR READ CODE

  Ø92B   GET SLOT*16
  Ø92D   AND EXIT NORMALLY
  Ø92E   RETURN
  Ø92F   RESTART BLOCK READ OPERATION >>Ø9BC

Ø932 *********** APPLE /// BOOT CODE **********************************

A132     THIS IS $A132 WHEN BOOTED ON APPLE ///
  Ø932   MAKE IT LOOK LIKE A JSR FROM $AØØØ
  Ø938   LOAD IN BLOCK 1 (WE WANT SOS, NOT PRODOS)
  Ø93C   GO TO APPLE /// BLOCK READ ROUTINE >>F479

Ø93F *********** ERROR HANDLER ****************************************
```

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84           NEXT OBJECT ADDR: Ø93F
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  Ø93F  HOME CURSOR/CLEAR SCREEN <FC58>
  Ø944  COPY "UNABLE TO LOAD PRODOS" MESSAGE (Ø95Ø)
  Ø947  TO SCREEN (Ø5AE)
  Ø94D  THEN GO TO SLEEP FOREVER >>Ø94D

  Ø95Ø  ---
  Ø95Ø  '*** UNABLE TO LOAD PRODOS ***'

Ø96D *********** MOVE ARM TO NEXT PHASE ******************************

  Ø96D  GET CURRENT PHASE
  Ø96F  CONVERT TO NEXT ARM PHASE
  Ø972  ADD SLOT*16
  Ø975  SELECT NEXT ARM PHASE THIS DRIVE (CØ8Ø)
  Ø97A  ---
  Ø97C  DELAY LONG ENOUGH FOR ARM TO MOVE
  Ø983  WHEN FINISHED, RETURN WITH X = SLOT*16
  Ø985  RETURN

Ø986 *********** DISKETTE BLOCK READ ROUTINE *************************
            $44/$45 --> BUFFER
            $46/$47 = BLOCK NO.

  Ø986  GET BLOCK NO. LSB
  Ø988  ISOLATE SECTOR REMAINDER
  Ø98C  SKEW SECTOR BY 2
  Ø992  AND STORE SECTOR WANTED
  Ø994  GET MSB
  Ø996  AND HIGH BIT OF TRACK
  Ø999  MERGE WITH LOW PART OF TRACK
  Ø99C  STORE TRACK WANTED
  Ø99F  TRACK*2 IS PHASE WANTED
  Ø9A3  SET PAGE ADDRESS OF BUFFER
  Ø9A7  TURN DRIVE MOTOR ON (CØ89)
  Ø9AA  READ SECTOR <Ø9BC>
  Ø9AD  NEXT PAGE
  Ø9B1  SKEW TO NEXT SECTOR
  Ø9B5  READ SECOND SECTOR OF BLOCK <Ø9BC>
  Ø9B8  THEN TURN MOTOR OFF AND EXIT (CØ88)
  Ø9BB  RETURN

           ******** DISKETTE SECTOR READ ROUTINE ***

  Ø9BC  GET CURRENT TRACK
  Ø9BF  CONVERT TO PHASE
  Ø9C5  GET CURRENT PHASE
  Ø9C7  STORE FOR PHASE OFF
  Ø9CA  SUBTRACT PHASE WANTED TO DETERMINE...
  Ø9CC  DIRECTION -- ON CORRECT TRACK NOW? >>Ø9E2
  Ø9DØ  NO, ADJUST PHASE UP...
```

```
ProDOS Loader -- V1.1.1 -- 18 SEP 84           NEXT OBJECT ADDR: Ø9D4
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  Ø9D4  OR DOWN AND...
  Ø9D6  ---
  Ø9D7  SEEK ARM ONE PHASE... <Ø96D>
  Ø9DD  IN PROPER DIRECTION <Ø96F>
  Ø9EØ  UNTIL WE ARE THERE  >>Ø9C5
  Ø9E2  ---
  Ø9E4  RETRY COUNT OF 127
  Ø9E7  ---
  Ø9E9  LOWER RETRY COUNT
  Ø9EB  RETRIES EXHAUSTED? >>Ø9BB
  Ø9EF  RETRIES FOR A $D5 HEADER
  Ø9F2  CHECK DATA REGISTER (CØ8C)
  Ø9F5  LOOP UNTIL DATA IS VALID >>Ø9F2

          ******** SECTOR READ ROUTINES ***********

 Ø9F7     BEGINNING OF COPIED ROUTINES
          (SEE $C65E IN BOOT FIRMWARE DESCRIPTIONS)
          ($CX63-$CXEA IS COPIED TO $9F7-$A7E)

 ØA7F     EXIT CODE FOR READ ROUTINES
          (COPIED HERE FROM $92B-$93Ø)

 ØA86 *********** $A86-$BFF NOT USED **********************************
   ØA86   NOT USED

 ØCØØ *********** VOLUME DIRECTORY BUFFER *****************************

 ØCØØ     START OF VOLUME DIRECTORY BUFFER
 ØC23     OFFSET TO ENTRY LENGTH FIELD
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2ØØØ
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

2ØØØ    MODULE STARTING ADDRESS

          **********************************
          *                                *
          *  PRODOS RELOCATOR              *
          *       LOADED AS THE FIRST      *
          *       PORTION OF THE PRODOS    *
          *       IMAGE AT $2ØØØ.          *
          *                                *
          *  VERSION 1.1.1 -- 18 SEP 84    *
          *                                *
          **********************************

          ******** ZERO PAGE ADDRESSES ************

ØØØA    AUTOSTART ROM CHECKSUM POINTER
ØØØB
ØØØC    CONFIGURATION BYTE (MACHID TO BE)
ØØ1Ø    GENERAL PURPOSE POINTER
ØØ11
ØØ12    DISK TYPE (Ø=DISK II, 4=PROFILE)
ØØ13     AND INPUT RELOC RANGE POINTER
ØØ14    VOL DIR ENTRY POINTER FOR RELOCATOR
ØØ15     AND OUTPUT RANGE PTR
ØØ16    LENGTH OF RELOCATION RANGE
ØØ17
ØØ18    INPUT RELOCATION RANGE POINTER
ØØ19
ØØ1A    END OF INPUT RANGE
ØØ1B
ØØ3C    GENERAL PURPOSE POINTER
ØØ3D
ØØ3E    GENERAL PURPOSE POINTER
ØØ3F
ØØ4Ø    RAMDRIVE OUTPUT POINTER
ØØ41
ØØ42    VARIOUS USES: PARM TO AUXMOVE,
ØØ43     UNIT/SLOT PASSED TO RELOCATOR
ØØ46    BLOCK NUMBER TO RAMDRIVE
ØØ47

          ******** EXTERNAL ADDRESSES *************

ØØ8Ø    MACHID BUILD SUBRTN FOR 128K

Ø28Ø    GENERAL PURPOSE BUFFER
Ø281    BUFFER+1
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2ØØØ
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          ******** SCREEN LINE ADDRESSES **********

Ø4B8    SCREEN BUFFER LINE
Ø5A9    SCREEN BUFFER LINE
Ø5B1    SCREEN BUFFER LINE
Ø6A8    SCREEN BUFFER LINE
Ø7A8    SCREEN BUFFER LINE
Ø7AD    SCREEN BUFFER LINE
Ø7DØ    SCREEN BUFFER LINE

          ******** INTERP LOADER ADDRESSES ********

Ø8ØØ    ENTRY OF INTERP LOADER
Ø8E2    'UNABLE TO FIND SYSTEM FILE'
Ø9ØA    'INTERP FILE TOO LARGE'
Ø92A    'UNABLE TO LOAD ...'
Ø93B    INTERP FILE NAME ITSELF
Ø93C    +1
Ø94F    LENGTH OF MESSAGE
Ø95Ø    MLI: OPEN LIST
Ø956    MLI: GET EOF
Ø958    EOF MARK
Ø959    EOF MARK+1
Ø95A    EOF MARK+2 (MSB)
Ø95B    MLI: READ LIST
Ø95F    READ BUFFER ADDR
Ø96Ø    +1
Ø963    MLI: CLOSE LIST
Ø965    '.SYSTEM'

          ******** MISCELLANEOUS ADDRESSES *********

ØCØØ    VOLUME DIRECTORY BUFFER
ØC23    ENTRY LENGTH
          -- RAMDRIVE VOLUME DIRECTORY --
ØEØ4    VOLUME HDR, VOLUME NAME
ØE22    VOLUME HDR, ACCESS-TOTAL BLOCKS
2AØØ    RAMDRIVE DEVICE DRIVER LOAD ADDRESS
28ØØ    DIFFERENCE OF RAMDRIVE LOAD AND RUN LOCATIONS

          ******** SYSTEM GLOBAL PAGE *************

BFØØ    ENTRY POINT FOR MLI
BFØ3    QUIT VECTOR
BFØ6    DATE/TIME
BF1Ø    DEVICE HANDLER TABLES
BF3Ø    LAST DEVICE USED
BF31    NUMBER OF ACTIVE DISK DEVICES
BF32    ACTIVE DISKS SEARCH LIST
BF98    MACHINE TYPE FLAGS
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2ØØØ
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

BF99     SLOT WHICH CONTAIN CARDS WITH ROM
BFFF     TOP OF 48K RAM

           ******** I/O PORT ADDRESSES *************

CØØØ     8Ø STORE OFF
CØØ1     8Ø STORE ON
CØØ2     READ MAIN RAM
CØØ3     READ AUX RAM
CØØ4     WRITE MAIN RAM
CØØ5     WRITE AUX RAM
CØØ8     MAIN STACK/ZERO PAGE
CØØ9     ALTERNATE STACK/ZERO PAGE
CØØA     INTERNAL SLOT 3 ROM
CØØB     PERIPHERAL SLOT 3 ROM
CØØC     8Ø COLUMN DISPLAY OFF
CØØD     8Ø COLUMN DISPLAY ON
CØ18     READ 8ØSTORE SWITCH
CØ3Ø     SPEAKER
CØ54     USE MAIN MEMORY PART OF 8Ø-COL CARD
CØ55     USE AUX MEMORY PART OF 8Ø-COL CARD
CØ81     WRITE-ENABLE HIGH RAM
CØ82     MOTHERBOARD ROM READ ENABLE
CØ83     READ/WRITE RAM 2ND 4K BANK
CØ8B     READ/WRITE RAM 1ST 4K BANK

           ******** INTERNAL C3ROM ADDRESSES *******

C311     MOVE TO/FROM AUXMEM SUBROUTINE
C314     TRANSFER TO/FROM AUXMEM SUBROUTINE

           ******** SLOT ROM ADDRESSES *************

C3Ø5     SLOT3 I.D. BYTE
C3Ø7     SLOT3 I.D. BYTE
C3ØB     SLOT3 I.D. BYTE
C3ØC     SLOT3 I.D. BYTE
C3FA     SLOT3 I.D. BYTE
CFFF     RESET I/O CARD ROMS

           ******** PRODOS ADDRESSES ***************

DØØØ     START OF QUITCODE MEMORY AREA (BANK2)
DFD8     ENHANCED ROM FLAG
FFØØ     RAMDRIVE CALLER ADDRESS

           ******** MONITOR ROM ********************
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2ØØØ
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

FB1E     PADDLE READ SUBROUTINE
FB2F     MONITOR INIT ROUTINE
FBB3     ROM VERSION BYTE
FBCØ     SECONDARY VERSION BYTE (Ø-3)
FC58     CLEAR SCREEN
FE84     SET NORMAL VIDEO
FE89     IN#Ø
FE93     PR#Ø

2ØØØ *********** PRODOS RELOCATOR MAIN ENTRY *************************

  2ØØØ   STORE SLOT IN MLI ONLINE PARMS
  2ØØ5   PRINT "APPLE II PRODOS..." <2499>
  2ØØ8   SET UP FOR COMMON MOVES (22ØA)
  2ØØE   RELOCATE SOME ROUTINES & DATA TO LOW MEMORY <26A6>
  2Ø11   ERROR?  >>2Ø36
  2Ø13   NO, PROCEED...
  2Ø17   BE SURE 48K OF MAIN MEMORY EXISTS (BFFF)
  2Ø1E   IF NOT, ERROR >>2Ø8E
  2Ø26   MAKE DOUBLY SURE >>2Ø8E
  2Ø28   SELECT MOTHERBOARD ROMS (CØ82)
  2Ø2B   DETERMINE MACHINE TYPE <24Ø2>
  2Ø3Ø   PICK UP CONFIGURATION BYTE
  2Ø32   64K OR MORE MEMORY?
  2Ø34   YES, WE HAVE 64K RAM >>2Ø39
  2Ø36   ERROR.  MUST HAVE 64K FOR PRODOS 1.1.111 >>21C3

           ******** RELOCATE PRODOS ***************

  2Ø39   SET UP FOR MLI MOVE (22ØC)
  2Ø3F   COPY/RELOCATE PRODOS ITSELF <26A6>
  2Ø42   ERROR? >>2Ø8E
  2Ø44   ENABLE MOTHERBOARD ROMS AGAIN (CØ82)
  2Ø47   CHECK ROM I.D. BYTE (FBB3)
  2Ø4A   APPLE //e FAMILY?
  2Ø4C   NO, LEAVE I.D. BYTE AS IS >>2Ø6D
  2Ø5Ø   TEST ANOTHER ROM I.D. BYTE (FBCØ)
  2Ø53   SAVE BIT TEST RESULTS
  2Ø54   GET MACHID
  2Ø56   STRIP BITS THAT IDENTIFY MODEL
  2Ø5B   IT'S A //e IF BITS 6 & 7 ARE HIGH >>2Ø69
  2Ø5D   ---
  2Ø5E   EITHER A //c OR A FUTURE SYSTEM
  2Ø6Ø   CHECK HIGH BITS OF $FBCØ AGAIN
  2Ø61   BIT 7 ON? >>2Ø67
  2Ø63   YES, FUTURE SYSTEM.
  2Ø67   IF BIT 6 ON, IT'S A FUTURE SYSTEM. >>2Ø6B
  2Ø69   ---
  2Ø6B   REPLACE UPDATED MACHID
  2Ø6D   COPY BOOT DEVICE ID TO READ BLOCK PARMS (21FE)
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2073
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2Ø73   AND AS LAST DEVICE USED (BF3Ø)
  2Ø76   DETERMINE PERIPHERAL CARD CONFIGURATION <252A>
  2Ø79   BOOT DEVICE TO... (22Ø5)
  2Ø7C   GLOBAL PAGE LAST DEVICE USED (BF3Ø)
  2Ø82   WRITE ENABLE BANK1 OF HIGH RAM (CØ8B)
  2Ø8B   COPY CLOCK CODE TO DEVICE DRIVER AREA <26A6>
  2Ø8E   ERROR? >>2ØBF
  2Ø9Ø   CHECK MACHINE TYPE AGAIN (BF98)
  2Ø93   GOT 64K OR MORE?
  2Ø97   NO  >>2ØC2
  2Ø99   YES, QUIT VECTOR --> $FCE5
  2ØA3   WRITE TO HIGH RAM (BANK2) (CØ83)
  2ØAC   POINT TO QUIT CODE TABLE (2211)
  2ØAF   MOVE QUIT CODE TO HIGH RAM <26A6>
  2ØB4   STORE QUIT VECTOR START PAGE (DØØØ)
  2ØB7   WRITE TO HIGH RAM (BANK1) (CØ8B)
  2ØBA   AGAIN (CØ8B)
  2ØBF   RELOCATION ERROR >>21C3
  2ØC2   GET MACHID YET AGAIN (BF98)
  2ØC5   128K?
  2ØC9   NO... >>2ØD1
  2ØCE   YES, ESTABLISH RAM DRIVE IN UPPER 64K <28FF>

          ******** SET UP FOR IRQ (ENHANCED ROM) **

  2ØD1   READ ROM (CØ81)
  2ØD4   GET IRQ VECTOR FROM ROM (FFFE)
  2ØDA   CARRY CLEAR IF IRQ VECTOR IN C3 ROM
  2ØDE   IT'S AN OLD ROM >>2ØFD
  2ØEØ   READ & WRITE RAM (BANK1) (CØ8B)
  2ØE6   SWITCH TO AUX HIGH RAM (CØØ9)
  2ØE9   PUT IRQ VECTOR IN AUX HIGH RAM (FFFF)
  2ØEF   BACK TO MAIN HIGH RAM, Z-PAGE (CØØ8)
  2ØF2   PUT IRQ VECTOR IN MAIN HIGH RAM (FFFF)
  2ØF8   SET FLAG INDICATING
  2ØFA   ENHANCED IRQ LOGIC ON BOARD (DFD8)

          ******** LOOK FOR SLOT 3 VIDEO CARD *****

  2ØFD   ENABLE INTERNAL VIDEO FIRMWARE (CØØA)
  21ØØ   CHECK FOR ROM (BF99)
  21Ø3   IN SLOT 3.
  21Ø5   NONE THERE >>216D
  21Ø7   LOOK AT THE SLOT 3 ROM (CØØB)
  21ØA   AT OFFSET +$Ø5 (C3Ø5)
  21ØD   THERE MUST BE A $38
  2111   AND AT OFFSET +$Ø7 (C3Ø7)
  2114   THERE MUST BE AN $18
  2118   AND AT OFFSET +$ØB (C3ØB)
  211B   THERE MUST BE A 1
  211F   AND AT OFFSET +$ØC (C3ØC)
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2124
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2124   INDICATE AN 8Ø-COL CARD.
  2128   CHECK MACHINE TYPE (BF98)
  212D   IS THIS AN APPLE III?
  212F   OK, IT'S GOT 8Ø-COL CAPABILITY >>2165
  2131   OTHER MANUFACTURERS MUST FOLLOW THE RULES! (C3FA)
  2134   MUST HAVE BIT INSTRUCTION AT $C3FA
  2136   GOOD BOY, YOU FOLLOWED THE RULES! >>2165
  2138   GIVE CONTROL BACK TO MOTHERBOARD ROM (CØØA)
  213B   TURN ON 8Ø-COL (CØØ1)
  213E   CHECK FOR AUX MEM. (CØ55)
  2143   PUT A BYTE AT AUX $4ØØ (Ø4ØØ)
  2146   THE ACCUMULATOR LEFT
  2147   AND DO THE SAME WITH $4ØØ (Ø4ØØ)
  214A   STILL THE SAME? (Ø4ØØ)
  214D   NO, NO 8Ø-COL MEMORY >>2156
  214F   SHIFT TO THE RIGHT
  2153   STILL THE SAME? (Ø4ØØ)
  2156   BACK TO MAIN MEMORY (CØ54)
  2159   TURN OFF 8Ø-COL (CØØ6)
  215C   WAS 8Ø-COL MEMORY FOUND? >>2165
  215E   NO, SO TURN OFF 8Ø-COL FLAG (BF98)
  2161   IN MACHINE I.D. BYTE.
  2163   ALWAYS BRANCH >>216A
  2165   TURN ON 8Ø-COL FLAG (BF98)

          ******** GET VOL LABEL ******************

  216D   MLI: ONLINE DEVICE CALL <BFØØ>
  2173   ERROR? >>21C3
  2178   VALID VOLUME NAME?
  217A   IF NOT, ERROR >>21C3
  217D   ELSE, BUMP LENGTH BY ONE
  2182   AND PREFIX NAME BY A "/"
  2187   MLI: SET PREFIX <BFØØ>
  218D   ERROR? >>21C3

          ******** READ VOLUME DIRECTORY **********

  218F   ---
  2191   $14/15 --> $CØØ
  2197   ---
  219C   BLOCK = 2 (VOLUME DIRECTORY) (22Ø8)
  21A2   MLI: READ BLOCK  <BFØØ>
  21A8   ERROR? >>21C3
  21AC   GET NEXT BLOCK NUMBER
  21B2   IF ZERO, END OF VOLUME DIRECTORY >>21CØ
  21BA   ADD TWO PAGES (ONE BLOCK) TO POINTER
  21BC   AND STOP AT $14ØØ IN ANY CASE
  21BE   ELSE, READ NEXT BLOCK AS WELL >>2197
  21CØ   WHEN DONE, JUMP TO SYSTEM FILE LOADER >>Ø8ØØ
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 21C0
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

21C3 *********** ERROR HANDLER ***************************************

  21C3  ENABLE MOTHERBOARD ROMS (C082)
  21C6  CLEAR SCREEN <FC58>
  21CB  PRINT "RELOCATION/CONFIG ERROR" (21D7)
  21D4  THEN SLEEP FOREVER >>21D4

21D7 *********** DATA ************************************************

  21D7  ---
  21D7  '** RELOCATION / CONFIGURATION ERROR **'

  21FD  MLI: ONLINE PARMS
  21FE          SLOT*16 AND DRIVE
  21FF          READ THEM TO $281

  2201  MLI: SET PREFIX PARMS
  2202          PREFIX IS AT $280

  2204  MLI: READ BLOCK PARMS
  2205          DEVICE
  2206          BUFFER
  2208          BLOCK NUMBER

  220A  ADDRESS OF COMMON MOVES RELOC TABLE
  220C  ADDRESS OF PRODOS RELOC TABLE
  220E  ADDRESS OF CLOCK DRIVER RELOC TABLE
  2210  ADDRESS OF QUIT CODE RELOC TABLE

2212 *********** RELOCATION TABLES ***********************************
          +0:     00 - ZERO BLOCK OF MEMORY
                  01 - COPY BLOCK
                  02 - RELOCATE MSB ADDRESSES
                  03 - RELOCATE 2 BYTE ADDRS
                  04 - RELOCATE INSTRUCTIONS
          +1/2:   ADDR OF OUTPUT BLOCK
          +3/4:   LENGTH OF BLOCK IN BYTES
          +5/6:   ADDR OF INPUT BLOCK (IF ANY)
          +7:     NUM RANGES TO CORRECT FOR (-1)
          +8:              START PAGES
          +8+COUNT:        END PAGE ADDRESSES
          +8+COUNT+COUNT:ADDITIVE CORRECTION FACTOR

          ******** COMMON MOVES TABLE *************

  2212  COPY (SYSTEM FILE LOADER)
  2213          TO =$800
  2215          LEN=$16C
  2217          FRM=$226C
  2219  COPY (PAGE 3 IMAGE)
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 221A
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  221A          TO =$3D6
  221C          LEN=$2A
  221E          FRM=$23D8
  2220  COPY (CHECKSUM)
  2221          TO =$0A
  2223          LEN=$02
  2225          FRM=$14
  2227  COPY (CHECK FOR 80-COL CARD)
  2228          TO =$80
  222A          LEN=$48
  222C          FRM=$2451
  222E  END OF TABLE

          ******** QUIT CODE MOVE TABLE ***********

  222F  COPY (QUIT CODE)
  2230          TO =$D100
  2232          LEN=$300
  2234          FRM=$5700
  2236  END OF TABLE

          ******** PRODOS RELOC TABLE *************

  2237  COPY (IRQ HANDLER)
  2238          TO =$FF80
  223A          LEN=$80
  223C          FRM=$4F80
  223E  COPY (SYSTEM GLOBAL PAGE)
  223F          TO =$BF00
  2241          LEN=$100
  2243          FRM=$4E00
  2245  ZERO (PRODOS KERNEL DATA AREA)
  2246          ADR=$D700
  2248          LEN=$700
  224A  COPY (PRODOS KERNEL)
  224B          TO =$DE00
  224D          LEN=$2100
  224F          FRM=$2D00
  2251  COPY (DISKETTE DRIVER)
  2252          TO =$D000
  2254          LEN=$700
  2256          FRM=$5000
  2258  END OF TABLE

          ******** PRODOS CLOCK TABLE *************

  2259  COPY (CLOCK CODE)
  225A          TO =$D742
  225C          LEN=$7D
  225E          FRM=$4F00
  2260  RELOCATE INSTRUCTIONS
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2261
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2261           TO =$D742
  2263           LEN=$69
  2265           FRM=$D742
  2267           FOR ADDRS=$C1XX-$C1XX
  226A           ADJUST BY=$SØ
  226B   END OF TABLE

226C *********** SYSTEM FILE LOADER **********************************
          (COPIED TO AND RUN AT $8ØØ)

  226C  $1Ø/11 --> VOLUME DIRECTORY ENTRIES
  226E  INITIALLY AT $CØØ
  227Ø  OFFSET BEYOND LINKS (+4)
  2272  (TURN NEXT INSTRUCTION INTO BIT)

          ******** SCAN DIRECTORY FOR SYSTEM FILE *

  2273  PICK UP LSB
  2276  BUMP BY ENTRY LENGTH (ØC23)
  2279  UPDATE LSB
  227B  PAGE OVERFLOW? >>228F
  227D  NO, ROOM FOR ONE MORE ENTRY? (ØC23)
  2282  NO, CHECK MSB
  2285  START OF A BLOCK? >>2291
  2287  NO, AT END OF DIRECTORY?
  2289  YES, FILE NOT FOUND IN DIRECTORY >>22A9
  228B  NO, START NEW BLOCK AT +4
  228D  AND UPDATE LSB
  228F  BUMP MSB
  2291  ---
  2295  CHECK FILE TYPE FOR PRODOS "SYS" FILE
  2297  NOT IT? >>2273
  229A  INACTIVE ENTRY?
  229C  IF SO, SKIP IT >>2273
  22AØ  SAVE NAME LENGTH AT $28Ø (Ø28Ø)
  22A5  MUST BE AT LEAST 8 CHARS LONG >>2273
  22A7  JUMP AROUND ERROR CODE  >>22AC
  22A9  ERROR - SYSTEM FILE NOT FOUND >>2319
  22AB  HARD BREAK IN THAT CASE
  22AC  ---
  22AF  IS THIS ".SYSTEM"?
  22B1  (SEE $23D1) (Ø965)
  22B5  NO, SKIP ENTRY >>2273
  22B9  CHECK ALL CHARACTERS IN NAME >>22AF

          ******** LOAD SYSTEM FILE AT $2ØØØ ******
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 22BB
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  22BB  ---
  22BD  ---
  22BE  COPY NAME TO $281
  22C5  AND TO "UNABLE TO LOAD" MSG (Ø93B)
  22CD  ADD BLANK AT END OF NAME
  22CF  IN MESSAGE (Ø93C)
  22D3  NAMELEN + ERRORMSGLEN
  22D5  SAVE AT $23BB (Ø94F)
  22D8  MLI: OPEN .SYSTEM FILE <BFØØ>
  22DC  (PARM LIST AT $24BC)
  22DE  ERROR? >>2326
  22EØ  MLI: GETEOF <BFØØ>
  22E4  (PARM LIST AT $23C2)
  22E6  ERROR? >>2326
  22E8  GET MSB (SEE $23C6) (Ø95A)
  22EB  BIGGER THAN 64K???? >>234Ø
  22FØ  MUST BE LESS THAN $98ØØ BYTES
  22F2  OR ERROR... >>234Ø
  22F4  STORE LENGTH IN MLI READ LIST (Ø96Ø)
  22FA  AND LSB TOO (Ø95F)
  22FD  MLI: READ SYSTEM FILE INTO $2ØØØ <BFØØ>
  23Ø1  (PARM LIST AT $23C7)
  23Ø3  NO ERRORS? >>23ØB
  23Ø5  ERROR, BAD BUFFER?
  23Ø7  YES, FILE WAS TOO LARGE >>234Ø
  23Ø9  ELSE, "UNABLE TO LOAD ..." >>2326
  23ØB  MLI: CLOSE SYSTEM FILE <BFØØ>
  23ØF  (PARM LIST AT $23CF)
  2311  ERROR? >>2326
  2313  NO, ENABLE MOTHERBOARD ROMS (CØ82)
  2316  AND JUMP TO BEGINNING OF FILE >>2ØØØ

2319 *********** ERROR HANDLERS **************************************

  2319  ---
  231B  PRINT "UNABLE TO FIND A .SYSTEM FILE" (Ø8E2)
  2324  THEN GO TO SLEEP >>234B

  2326  GET NAME LENGTH (Ø94F)
  2329  LINE LENGTH
  232C  LESS NAME LENGTH (Ø94F)
  232F  DIVIDED BY 2
  233Ø  GIVES OFFSET TO CENTER THE LINE (Ø94F)
  2334  PRINT "UNABLE TO LOAD ..." (Ø92A)
  233E  GO TO SLEEP FOREVER >>234B
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 233E
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  234Ø   ---
  2342   PRINT "SYSTEM PROGRAM TOO LARGE" (Ø9ØA)
  234B   GO TO SLEEP FOREVER >>234B

234E *********** DATA AREA *********************************************

  234E   '**  UNABLE TO FIND A ".SYSTEM" FILE  ** '
  2376   '**  SYSTEM PROGRAM TOO LARGE  **'
  2396   '** UNABLE TO LOAD X.SYSTEM **********'
  23BB   NAME LEN +13H (LEN OF MSG)

  23BC   MLI: OPEN PARM LIST
  23BD   PATHNAME IS AT $28Ø
  23BF   I/O BUFFER AT $14ØØ
  23C1   REFNUM=1

  23C2   MLI: GET EOF PARM LIST
  23C3   REFNUM=1
  23C4   EOF MARK POSITION

  23C7   MLI: READ LIST
  23C8   REFNUM=1
  23C9   READ TO $2ØØØ
  23CB   LENGTH (FROM EOF MARK)
  23CD   ACTUAL LENGTH READ

  23CF   MLI: CLOSE LIST
  23DØ   REFNUM=Ø, CLOSE ALL FILES

  23D1   '.SYSTEM'

23D8 *********** END OF SYSTEM FILE LOADER ****************************

23D8 *********** PAGE 3 VECTOR IMAGE **********************************
                      ($3D6-$3FF)
         (INCLUDES A ROUTINE AT $3D6 THAT COPIES
          CRITICAL ZERO PAGE VALUES TO AUX MEM)

  23D8   FROM MAIN Z-PAGE, (CØØ8)
  23DB   GET X+1 VALUES STARTING AT $42
  23DD   AND PUT IN AUX Z-PAGE (CØØ9)
  23EØ   AT SAME LOCATION.
  23E5   "NO DEVICE CONNECTED" ERROR
  23E8   BACK TO MAIN Z-PAGE (CØØ8)
  23EB   RETURN
  23EC   ADDRESS OF MLI ROUTINE
  23F2   BRK HANDLER AT $FA59
  23F4   RESET AT $FF59
  23F6   POWER UP BYTE
  23F7   & VECTOR TO $FF59 >>FF59
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 23FA
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  23FA   CTL-Y VECTOR TO $FF59 >>FF59
  23FD   NMI VECTOR TO $FF59 >>FF59
  24ØØ   IRQ HANDLER AT $BFEB (PRODOS)

24Ø2 *********** DETERMINE MACHINE ID *********************************
                   $ØC=ØØ.. Ø... APPLE II
                       Ø1.. Ø... APPLE II+
                       1Ø.. Ø... APPLE IIe
                       1Ø.. 1... APPLE IIc
                       11.. Ø... APPLE /// EMULAT.
                       ..Ø1 .... 48K RAM
                       ..1Ø .... 64K RAM
                       ..11 .... 128K RAM
                       .... ..1. 8Ø COL CARD
                       .... ...1 THUNDER CLOCK

  24Ø2   ASSUME NOTHING AT FIRST
  24Ø6   GET A ROM BYTE (FBB3)
  24Ø9   APPLE II?
  24ØB   YES, SET BIT >>242E
  24ØD   NO,
  24ØF   APPLE IIE?
  2411   YES, SET BIT >>242E
  2413   NO,
  2415   APPLE II+?
  2417   NO, WHAT IS IT? >>2428
  241C   REALLY A II+?
  241E   YES >>242E
  2422   /// EMULATION MODE?
  2426   ---
  2427   RETURN
  2428   OTHERWISE, UNKNOWN MACHINE
  242A   CREATE INVALID INSTR AT $8Ø
  242C   AND GO THERE >>244E
  242E   UPDATE MACHID
  2433   READ/WRITE ENABLE HIGH RAM (BANK1) (CØ8B)
  2438   SEE IF HIGH RAM EXISTS (DØØØ)
  244A   IF PRESENT, MARK IN MACHID

2451 *********** LOOK FOR 64K OF AUX RAM ******************************
           (CODE MOVED TO $8Ø TO ALLOW BANK SWITCH)
           (ENTERED WITH MACHID IN ACCUMULATOR)

  2451   UPDATE MACHID
  2453   IIE? >>248A
  2455   YES,
  2457   BANK TO AUX MEMORY (CØØ5)
  245D   STORE A PATTERN AT $CØØ (ØCØØ)
  246Ø   AND AT $8ØØ (Ø8ØØ)
  2466   MAKE SURE PATTERN STAYS THERE
  2468   IT DIDN'T! >>2478
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 246A
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  246A   NOW SHIFT $CØØ TO THE LEFT (ØCØØ)
  246D   AND SHIFT THE ACCUM TO THE LEFT
  246E   ARE THEY STILL THE SAME? (ØCØØ)
  2471   NO, AUX RAM NOT THERE.  >>2478
  2473   DID $8ØØ MOVE TOO? (Ø8ØØ)
  2476   NO, SO WE HAVE FULL 128K! >>247B
  2478    DON'T HAVE 128K
  247B   ---
  247C   BANK BACK TO MAIN MEMORY (CØØ4)
  2482   64K? >>248A
  2486   NO, INDICATE 128K
  2488   IN MACHID
  248A   SET UP $A/B --> "APPLE II"
  248D   IN MOTHERBOARD ROM
  248F   AT $FBØ9
  2491   BUT DO IT IN A CONVOLUTED WAY
  2498   RETURN TO CALLER

2499 *********** DISPLAY LOAD MESSAGE *******************************

  2499   CLICK SPEAKER (CØ3Ø)
  249C   STORE IN MAIN MEMORY  (CØØC)
  249F   8Ø COL DISPLAY OFF (CØØØ)
  24A2   SET NORMAL VIDEO <FE84>
  24A5   CALL MONITOR INITIALIZATION <FB2F>
  24A8   SET VIDEO PR#Ø <FE93>
  24AB   SET KEYBD IN#Ø <FE89>
  24AE   OUT OF DECIMAL MODE
  24AF   DISABLE FOR INTERRUPTS
  24BØ   CLEAR SCREEN <FC58>
  24B5   PRINT "APPLE //" (24E3)
  24CØ   PRINT "PRODOS 1.1.1 ETC." (24EB)
  24CB   PRINT A BLANK AT $6A8 (25Ø2)
  24D6   PRINT "COPYRIGHT ETC." (25Ø3)
  24DF   CLICK SPEAKER AGAIN (CØ3Ø)
  24E2   DONE

24E3 *********** DATA AREA ******************************************

  24E3   'APPLE //'
  24EB   'PRODOS 1.1.1  18-SEP-84'
  25Ø2   ' '
  25Ø3   'COPYRIGHT APPLE COMPUTER, INC., 1983-84'

252A *********** DETERMINE SLOT CONFIGURATION ***********************

  252A   ---
  252C   ZERO SOME THINGS
  2533   NO DISKS ACTIVE YET (BF31)
  2538   $1Ø/11 --> $C7ØØ (LOOP THRU ALL SLOTS)
  253A   RESET I/O CARD ROMS (CFFF)
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 253F
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  253F   CHECK SIGNATURE ON CARD FOR DISK DEVICE
  2545   NOT DISK? >>25AD
  254B   GET $CSFF BYTE (TYPE OF DISK)
  254D   DISK II? >>256F
  254F   NO, PROFILE?
  2551   NO? THEN NOT A DISK >>25AD

           ******** PROFILE FOUND ******************

  2553   ELSE, SAVE AS LSB OF BLOCK READ SUBRTN
  2555   GET $CSFE (STATUS BYTE)
  2558   CAN WE AT LEAST READ STATUS AND DATA?
  255C   YES? >>2563
  255E   NO,
  2561   NOT A DISK AFTER ALL >>25AD
  2563   GET STATUS BYTE AGAIN
  2567   TOP NIBBLE IS DEVICE ID
  2568   PROFILE SHOULD BE $Ø4
  256A   CHECK NUMBER OF VOLS (SHOULD BE Ø)
  256B   GET SLOT NO. FOR DEVICE DRIVER LOC.
  256D   AND GO DO COMMON PROCESSING FOR DISK >>2579

           ******** DISK II FOUND ******************

  256F   $12 ZERO FOR DISK II
  2571   GET DISK II DEVICE DRIVER LOCATION (266A)
  2575   ($F8ØØ OR $B8ØØ) (266B)
  2578   DISK II HAS 2 DRIVES

           ******** DISK FOUND *********************

  2579   SAVE DEVICE ADDRESS
  257B   SET UP INDEX OF SLOT*2
  2583   BUILD ST (S=SLOT, T=Ø DISKII,4 PROFILE)
  2586   BUMP DEVICE COUNT BY ONE (BF31)
  258A   AND ADD DRIVE TO SYSTEM SEARCH LIST (BF32)
  258E   NUMBER OF DRIVES
  259Ø   ONLY ONE? >>2596
  2592   NO, BUMP INDEX
  2593   AND MARK SECOND DRIVE IN SEARCH LIST (BF32)
  2596   STORE FINAL DEVICE COUNT (BF31)
  259B   SET UP DISK DEVICE DRIVER VECTORS (BF11)
  259E   IN SYSTEM GLOBAL PAGE >>25A8
  25AØ   (SET UP TWO VECTORS FOR A DISK II) (BF21)
  25A8   ---
  25AC   I RECOGNIZE THIS CARD
  25AD   GO MARK SLTBYT TO SHOW ROMS IN SLOT <25FA>
  25B4   DO ALL CARDS EXCEPT
  25B6   SLOT Ø ($CØØØ) >>253A
  25BC   GET LAST DISK DEVICE IN SEARCH LIST (BF32)
  25C2   BOOT DRIVE?  (BF3Ø)
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84         NEXT OBJECT ADDR: 25C6
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  25C6  NO, KEEP LOOKING >>25CA
  25CA  ---
  25CD  GET DEVICE COUNT (BF31)
  25D1  IS BOOT DRIVE IN LIST? >>25E7
  25D3  SO IT WILL BE SEARCHED FIRST... (BF3Ø)
  25D6  STORE BOOT AT END OF SEARCH LIST (BF32)
  25DA  ANY OTHERS? >>25EE
  25DD  YES, SECOND DRIVE? >>25E7
  25E1  STORE IT RIGHT BEHIND BOOT DRIVE (BF32)
  25E5  NOW ANY MORE? >>25EE
  25E7  ---
  25E8  YES, MOVE OTHERS AHEAD IN LIST (BF32)
  25EE  DO CHECKSUM ON ROM <267C>
  25F1  NOT AN AUTOSTART ROM? >>25F7
  25F3  AUTOSTART, STORE FINISHED MACHID (BF98)
  25F6  AND LEAVE
  25F7  NONAUTOSTART, UNKNOWN MACHINE, SO CRASH! >>2428

25FA *********** IDENTIFY I/O CARD ***********************************

  25FA  DO WE ALREADY RECOGNIZE THIS CARD? >>265B
  25FC  NO,
  25FE  CHECK SIGNATURE ON CARD FOR THUNDER CLOCK
  26Ø3  NOT IT? >>261F
  26Ø9  THUNDER CLOCK, WHICH SLOT?
  26ØB  SAVE SLOT NUMBER (LESS 1)
  26ØD  IN CLOCK CODE RELOCATION TABLE (226A)
  2612  ENABLE CLOCK/CALENDAR JUMP IN GLOBALS (BFØ6)
  2617  IS THERE A MACHID? >>25EE
  2619  IF SO, MARK THAT A CLOCK IS PRESENT
  261B  AND UPDATE MACHID
  261D  GO MARK ROM IN THIS SLOT >>265B
  261F  ---
  2621  CHECK SIGNATURE OF MYSTERY CARD
  2623  STANDARD BASIC SUPPORTED?
  2625  NO, UNKNOWN CARD >>264A
  2629  YES,
  262B  DOUBLE CHECK BASIC SUPPORTED
  262D  NO, UNKNOWN CARD >>264A
  2631  YES,
  2633  GENERIC SIGNATURE?
  2635  NO, UNKNOWN CARD >>264A
  2638  YES,
  263C  8Ø COLUMN CARD?
  263E  NO, UNKNOWN CARD >>264A
  2642  GET MACHID IF WE HAVE ONE >>25EE
  2644  MARK 8Ø COLUMN CARD PRESENT
  2646  AND UPDATE MACHID
  2648  GO MARK ROM ON CARD PRESENT >>265B
  264A  UNKNOWN CARD, CHECK ROM TO...
  264E  SEE IF IT WILL HOLD A VALUE...
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84         NEXT OBJECT ADDR: 2654
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2654  FOR SOME TIME.
  265B  IF SO, WE HAVE A CARD IN SLOT
  265D  CONVERT SLOT NUMBER...
  266Ø  TO A BIT POSITION (2674)
  2663  AND OR INTO SLTBYT (BF99)
  2669  RETURN TO CALLER

266A *********** DATA AREA *******************************************

  266A  DISK DEVICE DRIVER ENTRY POINT
  266B  (2 BYTE ADDRESS)

  266C  DEVICE SIGNATURE FOR:
  266E  +Ø,+2,+4,+6 = THUNDERCLOCK
  267Ø  +1,+3,+5,+7 = DISK
  2672  (+7 NOT CHECKED)

  2674  BIT POSITION TABLE FOR SLOTS
  2677   (ALSO USED IN CHECKSUM CALCS)

267C *********** COMPUTE AUTOSTART ROM CHECKSUM *********************

  267C  ---
  267D  GET ZERO IN INDEX REGISTER (2674)
  268Ø  SUM $FBØ9 ("APPLE II") IN ROM
  2687  UPDATE CHECKSUM (2674)
  268E  DO 8 BYTES IN ALL (2677)
  2694  MOVE LENGTH TO HIGH NIBBLE
  2699  AND COMBINE WITH CHECKSUM (2674)
  269C  FUDGE FACTOR
  269E  SHOULD COME OUT ZERO >>26A3
  26AØ  IT DID...RETURN WITH MACHID
  26A2  RETURN
  26A3  ELSE, RETURN WITH ZERO MACHID
  26A5  RETURN

26A6 *********** RELOCATION ROUTINE **********************************
            (X/Y REGS CONTAIN TABLE ADDR)

  26A6  SAVE PASSED TABLE ADDRESS
  26AA  ---
  26AC  GET OPERATION CODE
  26AE  VALID OPERATION? (4 OR LESS)
  26BØ  NO, ERROR >>2724
  26B4  $14/15 --> OUTPUT BLOCK
  26BE  $16/17 --> LENGTH
  26C7  NEGATIVE LENGTH? >>2726
  26C9  CHECK OPERATION CODE
  26CA  ZERO BLOCK? >>272F
  26CD  NO, $12/13 = $18/19 --> INPUT BLOCK
  26D7  $1A/1B --> END OF INPUT BLOCK
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 26E4
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  26E4  COPY BLOCK ONLY? >>2753
  26E6  SAVE RELOCATION OPERATION CODE (287F)
  26EC  SAVE NUMBER OF RANGES TO CHECK (2880)
  26F0  ---
  26F1  COPY START PAGES TO TABLE
  26FC  ---
  26FD  AND END PAGES
  2708  ---
  2709  AND FINALLY, RELOCATION FACTORS
  2711  BUMP TO NEXT TABLE ENTRY <2759>
  2714  RESTORE OPERATION CODE (287F)
  2719  RELOCATE INSTRUCTIONS? >>2729

271B *********** 2/3 - RELOCATE ADDRESSES ***************************

  271B  NO, RELOCATE ADDRESS <27BD>
  271E  COPY BLOCK <2766>
  2721  AND CONTINUE IF ALL WENT WELL >>26AA
  2724  NORMAL EXIT
  2725  RETURN
  2726  JUMP TO ERROR EXIT >>27F3

2729 *********** 4 - RELOCATE INSTRUCTIONS **************************

  2729  RELOCATE INSTRUCTIONS <27CF>
  272C  AND THEN COPY BLOCK >>271E

272F *********** 0 - ZERO BLOCK *************************************

  272F  BUMP TABLE POINTER TO NEXT ENTRY <2759>
  2734  GET NUMBER OF PAGES TO DO
  2736  NO FULL PAGES? >>2744
  2739  ZERO AN ENTIRE PAGE
  273E  BUMP PAGE POINTER
  2740  AND DECREMENT LENGTH
  2744  GET LENGTH OF PARTIAL LAST PAGE
  2746  NO PARTIAL PAGE? >>2750
  2749  ZERO PARTIAL PAGE TOO
  2750  DONE, GET NEXT TABLE ENTRY >>26AA

2753 *********** 1 - COPY BLOCK *************************************

  2753  BUMP TABLE POINTER <2759>
  2756  AND GO COPY BLOCK >>271E

2759 *********** ADVANCE TABLE POINTER ******************************
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2759
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2759  ADD FINAL ENTRY INDEX..
  275D  TO TABLE ENTRY ADDRESS
  2765  RETURN

2766 *********** COPY BLOCK *****************************************

  2766  ---
  276A  INPTR < OUTPTR? >>2777
  276C  NO, GREATER? >>279A
  276E  MSB'S ARE EQUAL, CHECK LSB'S ALSO
  2776  EXIT IF EQUAL
  2777  INPTR < OUTPTR, COPY LAST PAGES FIRST
  277B  BUMP BOTH INPTR AND OUTPTR BY...
  277D  LENGTH-1 TO POINT AT LAST BYTE
  2785  START WITH SHORT LAST PAGE LENGTH
  2789  ---
  278A  COPY BYTES BACKWARDS THROUGH MEMORY
  2791  DROP ADDRESSES AND LENGTH BY 256
  2797  AND CONTINUE UNTIL FINISHED >>2789
  2799  RETURN

  279A  INPTR > OUTPTR, COPY PAGES FORWARD
  279C  HOW MANY FULL PAGES LEFT?
  279E  NONE? >>27AF
  27A0  COPY A FULL PAGE
  27A7  AND BUMP ADDRESSES
  27AB  DECREMENT LENGTH BY 256
  27AD  AND DO ALL PAGES >>27A0
  27AF  GET LENGTH OF LAST PAGE
  27B1  EVEN PAGE BOUNDARY? >>27BC
  27B3  NO, COPY SHORT LAST PAGE
  27BC  RETURN

27BD *********** ADDR/PAGE RELOCATE ********************************

  27BD  GET TABLE ENTRY TYPE (287F)
  27C1  GET PAGE TO RELOCATE
  27C3  RELOCATE A SINGLE ADDRESS <27FB>
  27C6  BUMP BY 1 OR 2 BYTES (287F)
  27C9  ADVANCE POINTER <2817>
  27CC  AND CONTINUE UNTIL COMPLETE >>27BD
  27CE  RETURN

27CF *********** INSTRUCTIONS RELOCATE *****************************

  27CF  ---
  27D1  GET 6502 OPCODE
  27D3  COMPUTE INSTRUCTION LENGTH <282A>
  27D6  INVALID OPCODE? >>27E9
  27D8  3 BYTE INSTRUCTIONS?
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 27DA
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  27DA  NO >>27E3
  27DC  YES, 3 BYTE ADDRESS TO CORRECT
  27DE  RELOCATE ADDRESS <27FB>
  27E1  AND ADVANCE BY 3 BYTES
  27E3  NEXT INSTRUCTION <2817>
  27E6  CONTINUE UNTIL FINISHED >>27CF
  27E8  RETURN

          ******** INVALID OPCODE *****************

  27E9  POP THE STACK
  27EB  RETURN WITH POINTER TO BAD INSTRUC.
  27EF  DIE HORRIBLY
  27F2  RETURN

27F3 *********** ERROR RETURN ****************************************

  27F3  RETURN WITH POINTER
  27F7  EXIT WITH ERROR CODE
  27FA  RETURN

27FB *********** RELOCATE ABSOLUTE ADDRESS ***************************

  27FB  GET PAGE NUMBER TO CHECK
  27FD  GET NUMBER OF RANGES (LESS ONE) (288Ø)
  28ØØ  IS IT PRIOR TO START OF THIS RANGE? (2881)
  28Ø3  YES? >>28ØC
  28Ø5  NO, IS IS AFTER END OF RANGE? (2889)
  28Ø8  NO? >>281Ø
  28ØC  ---
  28ØD  CHECK EACH RANGE >>28ØØ
  28ØF  RETURN

  281Ø  ---
  2811  ADD FUDGE FACTOR TO ADDRESS (2891)
  2814  AND UPDATE IT
  2816  RETURN

2817 *********** BUMP POINTER TO NEXT ADDR ***************************

  2817  ---
  2818  ADD LENGTH TO POINTER
  281F  CHECK TO SEE IF WE ARE DONE
  2825  ---
  2829  RETURN
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 282A
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

282A *********** COMPUTE INSTRUCTION LENGTH **************************

  282A  A-REG CONTAINS OPCODE
  282B  ISOLATE LAST TWO BITS FOR LATER
  283Ø  USE LAST 6 BITS AS TABLE INDEX
  2832  GET BYTE WITH 4 LENGTHS IN IT (283F)
  2835  ---
  2836  USING TOP TWO BITS AS INDEX... >>283C
  2838  SHIFT DOWN THE PROPER LENGTH
  283C  AND ISOLATE IT IN A-REG
  283E  RETURN

283F *********** 65Ø2 OP LENGTH TABLE ********************************
            EACH BYTE CONTAINS FOUR 2 BIT LENGTHS

  283F  ---

287F *********** RELOCATION DATA *************************************

  287F  RELOCATION CODE (3,2,1)
  288Ø  NUMBER OF RANGES
  2881  START OF RANGE PAGES
  2889  END OF RANGE PAGES +1
  2891  ADDITIVE FACTORS

2899 ********** 2899-28FE NOT USED ***********************************

  2899  NOT USED

28FF *********** SET UP RAMDRIVE IN AUXMEM **************************
           (THIS ROUTINE PUTS THE RAMDRIVE DEVICE DRIVER
            IN MEMORY, PUTS THE ADDRESS OF THE DRIVER
            IN THE DEVICE DRIVER ADDRESS LIST, AND
            ADDS THE RAMDRIVE TO THE ONLINE DEVICE LIST.)

  28FF   SUBROUTINE STARTS WITH NOP
  29Ø2  RELOCATE RAMDRIVE CALLER NOW AT.. (2CØØ)
  29Ø5  TO HIGH RAM AT.. (FFØØ)
  29ØD  NOW PREPARE TO MOVE
  29ØF  RAMDRIVE DEVICE DRIVER
  2911  INTO AUX RAM AT $2ØØ.
  2914  $3C/$3D --> $2AØØ
  2918  $3E/$3F --> $2BFF
  291D  $42/43 --> $2ØØ
  2923  COPY MAIN MEM TO AUX MEM
  2924  USE AUXMOVE TO COPY IT <C311>
  2929  SLOT 3, DRIVE 2 DEVICE DRIVER.. (BF26)
  292C  IS AT $FFØØ
  2931  BUMP DEVICE COUNT (BF31)
  2937  ADD DEVICE TO ONLINE DEVICE LIST
  293C  RETURN
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 293C
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

293D ********** 293D-29FF NOT USED ***********************************

  293D  ---
  2989

2A00 ******* RAMDRIVE (/RAM) DEVICE DRIVER **************************
          (COPIED TO AND RUN AT $200 IN AUX RAM)
          (THIS IS THE MAIN PART OF THE DEVICE DRIVER.
           IT IS CALLED BY THE RAMDRIVE CALLER
           WHICH IS LOCATED AT $FF00 IN MAIN MEMORY.)

  2A00  SAVE THE 80STORE SETTING (C018)
  2A04  FORCE RAM READ/WRITE (C000)
  2A09  COPY INPUT PARAMETERS
  2A0B  TO AUX PAGE 3. (03BD)
  2A11  FIRST TIME IN OR FORMAT COMMAND? (03BC)
  2A14  NO, SKIP FORMAT LOGIC >>2A4F

          ******** FORMAT RAMDRIVE ****************

  2A16  YES, SAVE BLOCK WANTED
  2A18  PAGES $E AND $F ARE ACTUAL DIRECTORY
  2A1A  ZERO THE DIRECTORY BLOCK <0333>
  2A1F  COPY VOLUME NAME ($F3,"RAM") (03D2)
  2A22  TO VOLUME DIRECTORY BLOCK (0E04)
  2A28  LAST BYTE IN VOLUME BITMAP
  2A2A  IS AN $FE (03D1)
  2A2D  $FF TO ACCUM.
  2A30  14 $FF'S TO BITMAP (03C2)
  2A36  SET FIRST BITMAP BYTE TO ZERO (03C2)
  2A39  COPY 8 BYTES
  2A3B  OF DIRECTORY DATA (03D6)
  2A3E  TO VOLUME DIRECTORY BLOCK (0E22)
  2A44  WAS THIS A FORMAT COMMAND? (03BC)
  2A47  YES, DONE. >>2AAA
  2A49  NO, SET FLAG & CONTINUE WITH READ/WRITE (03BC)
  2A4C  RESTORE BLOCK NUMBER (03C1)

          ******** READ/WRITE RAMDRIVE BLOCK ******

  2A4F  CONVERT BLOCK NUMBER TO PAGE NUMBER (03C1)
  2A55  THIS PAGE IN HIGH RAM?
  2A57  YES >>2A63
  2A59  NO, IS IT BLOCK 3? (VOLUME BIT MAP)
  2A5B  NO >>2A60
  2A5D  YES, DUMMY UP A PHONY BITMAP BLOCK >>038C
  2A60  ELSE, NORMAL READ/WRITE >>0342
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2A60
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          ******** READ/WRITE IN AUX HIGH RAM *****

  2A63  SAVE PAGE NUMBER
  2A64  FIND IT IN MEMORY <02E5>
  2A67  REMEMBER READ/WRITE STATUS
  2A68  WRITING? >>2AB8
  2A6A  GET SAVED PAGE NUMBER
  2A6B  DOES OPERATION INVOLVE BANK1?
  2A6D  NO, USE BANK2 >>2A73
  2A6F  YES, FORCE IT TO $DXXX
  2A71  AND USE BANK1 OF AUX HIGH RAM >>2A79
  2A73  USE BANK2 OF AUX HIGH RAM (C083)
  2A76  AND WRITE ENABLE IT (C083)
  2A79  SAVE PAGE NUMBER IN BLOCK (03C1)
  2A7C  PRESERVE HIS BUFFER ADDR (03C0)
  2A80  DURING THE FOLLOWING TRANSFER... (03BF)
  2A83  SELECT AUX HIGH RAM (C009)
  2A88  USE RAMDRIVE BUFFER AS AN "IN BETWEEN" (03C0)
  2A8B  AREA WHEN TRANSFERING TO/FROM AUX HIGH RAM.
  2A8D  PRETEND THAT WAS CALLER'S BUFFER (03BF)
  2A90  AND SET UP POINTERS AGAIN <02E5>
  2A94  COPY BLOCK TO OR FROM RAMDRIVE BUFFER
  2A9F  THEN BACK TO MAIN ZERO PAGE  (C008)
  2AA2  RESTORE CALLER'S BUFFER ADDRESS (03BF)
  2AA9  READING OR WRITING?
  2AAA  IF WRITING, DONE >>2AB5
  2AAC  IF READING, WRITE ENABLE HIGH RAM (BANK1) (C08B)
  2AB2  AND COPY RAMDRIVE BUFFER TO HIS BUFFER <02BE>
  2AB5  THEN EXIT >>03DE
  2AB8  IF WRITING, COPY HIS BLOCK TO RAMDRIVE BUFFER <02BE>
  2ABB  THEN COPY RAMDRIVE BUFFER TO AUX HIGH RAM >>026A

2ABE *********** COPY BLOCK IN MAIN 48K *****************************

  2ABE  THIS ENTRY IS FOR THE RAMDRIVE BUFFER
  2AC0  THIS ENTRY ASSUMES AUX MEM PAGE NUMBER IN ACCUM (03C1)
  2AC3  THIS ENTRY ASSUMES PAGE NUMBER ALREADY SET <02E5>
  2AC6  WRITING TO RAMDISK? >>2ADB
  2AC8  NO, WRITE TO MAIN 48K RAM (C004)
  2ACC  COPY BLOCK AUX MEM --> MAIN MEM
  2AD7  WRITE TO AUX MEM AGAIN (C005)
  2ADA  DONE (RETURN HERE AFTER FOLLOWING JUMP)
  2ADB  ---
  2ADD  GO BACK TO MAIN MEM PART OF DRIVER (03ED)
  2AE0  TO COPY MAIN MEM --> AUX MEM
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2AE2
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

2AE5 *********** SET BUFFER AND BLOCK ADDRESSES **********************

  2AE5  GET COMMAND (Ø3BD)
  2AE8  READ OR WRITE?
  2AE9  WRITE? >>2BØ8
  2AEB  NO, GET HIGH BYTE OF BUFFER TO BE READ (Ø3CØ)
  2AF2  AND LOW BYTE OF BUFF ADDRESS (Ø3BF)
  2AF5  $42/43 --> FIRST PAGE OF BUFFER
  2AF7  $4Ø/41 --> SECOND PAGE OF BUFFER
  2AF9  GET PAGE NUMBER (Ø3C1)
  2AFE  $3C/3D --> BLOCK IN RAMDRIVE
  2BØØ  $3E/3F --> SECOND PAGE OF SAME
  2BØ6  ALWAYS BRANCH AROUND WRITE CODE >>2B23

  2BØ8  WRITE,  (Ø3CØ)
  2BØF  $3C/3D --> MAIN MEMORY ADDRESS OF BUFFER TO BE WRITTEN (Ø3BF)
  2B12  $3E/3F --> SECOND PAGE OF SAME
  2B19  $42/43 --> BLOCK IN RAMDRIVE
  2B1B  $4Ø/41 --> SECOND PAGE OF SAME
  2B23  SET SECOND PAGE ADDRESSES
  2B27  EXIT

2B28 *********** SEND HIM A DUMMY BLOCK OF ZEROES********************

  2B28  ZERO RAMDRIVE BUFFER IN CASE READING <Ø331>
  2B2B  COPY BETWEEN RAMDRIVE BUFFER AND HIS BUFFER <Ø2C3>
  2B2E  AND EXIT >>Ø3DE

2B31 *********** ZERO BLOCK BUFFER ***********************************

  2B31  ZERO RAMDRIVE BUFFER
  2B33  ZERO BLOCK INDICATED BY ACCUM. (Ø3C1)
  2B36  SET UP BUFFER POINTERS <Ø2E5>
  2B3A  ZERO BOTH PAGES OF BLOCK
  2B41  AND EXIT

2B42 *********** READ/WRITE IN LOW 48K *******************************

  2B42  BLOCK 2 (VOLUME DIRECTORY)?
  2B44  NO >>2B4A
  2B46  YES, CONVERT IT BLOCK 7
  2B48  AND GO DO I/O NOW >>2B58
  2B4A  ELSE, LESS THAN BLOCK 8? (BUG--$D SHOULD BE $F!!!)
  2B4C  YES, RETURN WITH DUMMY ZERO BLOCK. >>2B28
  2B4E  START MSB AT ZERO
  2B5Ø  GET ORIGINAL BLOCK NUMBER
  2B52  BLOCK $5D THROUGH $5F?
  2B54  NO >>2B5B
  2B56  YES, ADJUST TO $D THROUGH $F
  2B58  AND USE $1AØØ THRU $1FFF IN RAMDRIVE. >>Ø385
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2B5B
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  2B5B  ELSE, FOR BLOCKS $8 THRU $5C
  2B5C  SUBTRACT 8
  2B5E  AND DIVIDE BY 17 ($11)
  2B64  XREG IS QUOTIENT
  2B65  HAS TO BRANCH!! >>2B5E
  2B68  AND AREG IS REMAINDER
  2B69  REMAINDER OF 1?
  2B6B  NO >>2B73
  2B6D  YES, EVERY 17TH BLOCK GOES
  2B6E  IN $1ØØØ-$1BFF AREA
  2B6F  BY ADDING 8 TO QUOTIENT
  2B71  AND GO DO IT >>2B85
  2B73  BUMP QUOTIENT (START AT $2XXX)
  2B75  SHIFT IT TO TOP NIBBLE OF BYTE
  2B7D  GOT A REMAINDER? >>2B81
  2B7F  IF SO, DECREMENT IT (NOT USING 1)
  2B81  THEN ADD INTO TOP NIBBLE
  2B82  TO FORM $1Ø THRU $5F (Ø3C1)
  2B85  BLOCK*2 FOR PAGE NUMBER
  2B86  COPY THE BLOCK <Ø2CØ>
  2B89  THEN EXIT >>Ø3DE

2B8C *********** READ/WRITE BITMAP BLOCK *****************************

  2B8C  USE RAMDRIVE BUFFER (NO ACTUAL BITMAP BLOCK)
  2B91  SET UP BUFFER POINTERS <Ø2E5>
  2B94  WRITING? >>2BA9
  2B96  NO, READING - ZERO THE RAMDRIVE BUFFER <Ø336>
  2B9B  COPY BITMAP IMAGE TO RAMDRIVE BUFFER (Ø3C2)
  2BA3  COPY BLOCK BACK TO CALLER'S BUFFER <Ø2C3>
  2BA6  THEN EXIT >>Ø3DE

  2BA9  WRITING, COPY HIS BUFFER TO RAMDRIVE BUFFER <Ø2C3>
  2BAC  SET UP BUFFER POINTERS <Ø2E5>
  2BB1  COPY 16 BITMAP BYTES FROM RAMDRIVE BUFFER
  2BB3  INTO PAGE 3 BITMAP IMAGE (Ø3C2)
  2BB9  THEN EXIT >>Ø3DE

2BBC *********** RAM DRIVE DATA (AT $3BC) ****************************

  2BBC  FIRST TIME ENTRY FLAG
  2BBD  COMMAND FROM PARM LIST
  2BBE  UNIT NUMBER FROM PARM LIST
  2BBF  BUFFER ADDRESS FROM PARM LIST
  2BC1  BLOCK NUMBER FROM PARM LIST
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NLXT OBJECT ADDR: 2BC1
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2BC2  BIT MAP IMAGE FOR RAM DRIVE

  2BD2  RAMDRIVE VOLUME NAME
  2BD3  'RAM'
  2BD6  ACCESS, ENTRY LENGTH
  2BD8  NUMBER OF ENTRIES
  2BD9  FILE COUNT
  2BDB  BIT MAP BLOCK POINTER
  2BDD  BLOCKS ON DISK

2BDE *********** EXIT TO MAIN MEMORY ********************************

  2BDE  WRITE ENABLE HIGH RAM (BANK1) (C08B)
  2BE5  RESTORE 80STORE STATUS >>2BEA
  2BE7  80STORE WAS ON (C001)
  2BEA  GO AROUND MEMORY USED BY XFER >>03EF
  2BED  LOW-ORDER BYTE AND
  2BEE  HIGH-ORDER BYTE USED BY XFER ROUTINE
  2BEF  RETURN TO $FF44 (NORMAL EXIT)
  2BFB  USE ROM XFER ROUTINE TO DO IT >>C314
  2BFE  TWO BYTES NOT USED

2C00 ******* RAMDRIVE CALLER (RUNS AT $FF00) ************************
          (USED TO CALL MAIN PART OF RAMDRIVE DEVICE
           DRIVER WHICH IS AT $200 IN AUX MEMORY.
           ROUTINE AT $FF62 IS USED TO TRANSFER DATA
           FROM MAIN TO AUX MEM.)

  2C00  ---
  2C03  SAVE ZPAGE STUFF I WILL CLOBBER
  2C05  FROM $3C THRU $47 (FF81)
  2C0D  SAVE $3ED/E THAT XFER ROUTINE WILL CLOBBER (03ED)
  2C16  COMMAND = STATUS?
  2C18  IF SO, SIMPLE EXIT WILL DO >>2C44
  2C1A  ELSE, TOO BIG A COMMAND NUM?
  2C1C  IF SO, ERROR >>2C3B
  2C1E  ELSE, INVERT BITS OF CMD
  2C20  AND SAVE IT
  2C22  FORMAT? >>2C2C
  2C24  NO, CHECK BLOCK NUMBER
  2C28  MUST BE <128 FOR RAMDRIVE
  2C2C  GOING TO $200 IN AUX MEMORY
FF33
  2C38  USE XFER ROUTINE TO GET THERE >>C314

  2C3B  I/O ERROR RETURN CODE
  2C3D  EXIT >>2C41
  2C3F  WRITE PROTECTED RETURN CODE
  2C41  ---
  2C42  ERROR EXIT >>2C47
```

```
ProDOS Relocator -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 2C44
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2C44  NORMAL EXIT, RETURN CODE IS 0
  2C47  ---
  2C4B  RESTORE ZERO PAGE (FF81)
  2C53  AND $3ED/E (FF7F)
  2C61   AND EXIT TO CALLER WHEN THRU

2C62 *********** COPY MAIN TO AUX BLOCK ******************************
           (CALLED FROM AUX MEM HANDLER)

FF62
  2C62  WRITE IN AUX 48K (C005)
  2C67  COPY BOTH PAGES OF BLOCK
  2C72  WRITE IN MAIN 48K AGAIN (C004)
  2C77  GO TO $2DA IN AUX MEMORY TO RETURN (03ED)
  2C7C  RETURN TO AUX MEM HANDLER AGAIN >>FF33

2C7F *********** DATA AREA ******************************************

FF7F
  2C7F  SAVE $3ED,$3EE
FF80

FF81
  2C81   ZERO PAGE SAVE AREA

2C8D *********** $2C8D-$2CFF NOT USED *******************************

  2C8D  NOT USED
  2CA0

2D00 *********** START OF PRODOS LOAD IMAGE *************************

2D00     LOAD IMAGE AT $2D00
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: D7ØØ
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

D7ØØ     MODULE STARTING ADDRESS

           *****************************************
           *                                       *
           *  PRODOS MACHINE LANGUAGE INTERFACE    *
           *       THIS CODE IS MOVED INTO HIGH    *
           *       RAM ($DEØØ-$FEFF) BY THE        *
           *       PRODOS RELOCATOR.               *
           *       IT PERFORMS ALL FILE MANAGEMENT *
           *       AND OTHER SYSTEM FUNCTIONS AND  *
           *       SUPPORTS THE HARDWARE IN A      *
           *       DEVICE INDEPENDENT WAY.         *
           *                                       *
           *  VERSION 1.1.1 -- 18 SEP 84           *
           *                                       *
           *****************************************

D7ØØ ********** ZERO PAGE USAGE *************************************

ØØ4Ø     Pointer to callers parmlist
ØØ41
           -- device driver parmlist --
ØØ42     Command
ØØ43     Unit Number
ØØ44     Buffer Pointer
ØØ45
ØØ46     Block Number
ØØ47
           ----------------------------
ØØ48     I/O Pointer - Index Block or..
ØØ48     pointer into $F6ØØ work buffer or..
ØØ48     caller's pathname buffer pointer
ØØ49
ØØ4A     I/O Pointer - Data Block
ØØ4B
ØØ4C     I/O Pointer - Data Block
ØØ4D
ØØ4E     I/O Pointer - Caller's Data or..
ØØ4E     buffer pointer passed in parmlist or..
ØØ4E     old I/O buffer
ØØ4F

D7ØØ ********** MLI ERROR CODES *************************************

ØØØØ     No Error
ØØØ1     Bad call type
ØØØ4     Bad parameter count
ØØ25     Interrupt Table full
ØØ27     I/O Error
ØØ28     No device connected
ØØ2B     Write protected
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: D7ØØ
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

ØØ2E     Volume switched
ØØ4Ø     Invalid pathname syntax
ØØ42     Too many files open
ØØ43     Invalid REF NUM
ØØ44     Nonexistent path
ØØ45     Volume not mounted
ØØ46     File not found
ØØ47     Duplicate file name
ØØ48     Disk full
ØØ49     Volume Directory full
ØØ4A     Incompatible ProDOS version
ØØ4B     Unsupported file type
ØØ4C     End of file
ØØ4D     Position past EOF
ØØ4E     Access error
ØØ5Ø     File already open
ØØ51     File count bad
ØØ52     Not a ProDOS disk
ØØ53     Bad parameter
ØØ55     VCB overflow
ØØ56     Bad buffer address
ØØ57     Duplicate volume mounted
ØØ5A     Bad volume bit map

D7ØØ ********** SCREEN LOCATIONS ************************************

Ø75Ø     For direct movement of text to screen
Ø7DØ
Ø7F1
Ø7F2
Ø7F3
Ø7F4
Ø7F5
Ø7F6
Ø7F7
Ø7F8     Slot in use

D7ØØ ********** SYSTEM GLOBAL PAGE EQUATES **************************

BFØØ     Jump to MLI entry point
BFØ3     JSPARE (Jump to $EECF, QUIT code)
BFØ6     DATETIME vector
BFØ9     Jump to System Error
BFØC     Jump to System Death Handler
BFØF     System Error number
BF1Ø     Device Driver address table
BF3Ø     Slot/Drive last device
BF31     Count (-1) active devices
BF32     List of active devices by DEVID
BF58     Memory BITMAP for low 48K
BF7Ø     Open file 1 buffer address
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: D700
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

BF7E     Open file 8 buffer address
BF80     Interrupt handler 1
BF82     Interrupt handler 2
BF84     Interrupt handler 3
BF86     Interrupt handler 4
BF88     A reg save during interrupt
BF89     X reg save during interrupt
BF8A     Y reg save during interrupt
BF8B     S reg save during interrupt
BF8C     P reg save during interrupt
BF8E     Interrupt return address
BF90     Date/Time
BF94     File open LEVEL
BF95     Backup bit
BF9A     Prefix flag (0 = no prefix)
BF9B     MLI active flag
BF9C     Last MLI call return address
BF9E     MLI X reg savearea
BF9F     MLI Y reg savearea
BFA0     HIGH RAM entry/exit routines
BFD0     Interrupt entry/exit routines
BFF4     Bank switch saved state ($E000 byte)

D700 ********** SOFT SWITCHES ****************************************

C00C     Reset 80 column mode
C051     Set TEXT mode
C053     Set Mixed text/graphics
C054     Display Primary page
C056     Set LORES graphics mode
CFFF     Reset alternate I/O ROMs

D700 ********** PATHNAME - DATA AREA *********************************
            -----------------------------------
            | L1 | NAME1 | L2 | NAME2 | .. | 00
            -----------------------------------
          Prefix is at top of buffer such that a
          negative index may be used to use it,
          wrapping around to the pathname again.

  D700   pathname buffer

D800 ********* FILE CONTROL BLOCKS ***********************************

          FCB0 starts here..
  D800   Reference Number
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: D800
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

           THE FOLLOWING 6 BYTES ARE THE FILE ID
  D801   Device Number
  D802   Dir Block HDR for Dir describing this File
  D804   Dir Block containing entry itself
  D806   File entry # in this Directory

  D807   Storage Type
           Flags
           1XXX XXXX   Index Block Buffer Changed
           X1XX XXXX   Data Block Buffer Changed
           XX1X XXXX   Unused
           XXX1 XXXX   Directory entry needs update
           XXXX 1XXX   Storage Type Changed
           XXXX X1XX   Allocate new Master Index Block
           XXXX XX1X   Allocate new Sub Index Block
  D808   XXXX XXX1   Allocate new Data Block
  D809   Access Byte
  D80A   Newline Character
  D80B   Buffer Number  (REF_NUM * 2)
  D80C   Master Index/Key Block Number
  D80E   Current Index Block
  D810   Current Data Block
  D812   Mark
  D815   End of File
  D818   Blocks Used
  D81A   not used
  D81B   Level
  D81C   Flag - Write occurred if MSB on
  D81D   not used
  D81F   Newline Enable Mask

  D820   FCB1 through FCB7

D900 ********** VOLUME CONTROL BLOCKS ********************************

           VCB0 starts here..
  D900   Length  (0000LLLL)
  D901   File Name (Max 15)
  D910   Unit Number
  D911   Files Open Flag (if $FF)
  D912   Total Blocks
  D914   Blocks Free
  D916   Block Number of Vol Dir Key Block
  D918   not used
  D919   not used
  D91A   Bit Map Pointer
           Block offset into multi-block bitmap of
  D91C   next free bit.
  D91E   Count of open files
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: D91E
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------


  D920  VCB1 through VCB7

DA00 ********** BITMAP BUFFER ****************************************

  DA00  Buffer 1st half

  DB00  Buffer 2nd half

DC00 ********** PRIMARY BUFFER ***************************************
          (Used for several things. VOL DIR HDR is
          mapped into it below)

  DC00  Pointer Fields
          *** VOLUME DIRECTORY HEADER ***
  DC04  Type/Length  (TTTTLLLL)
  DC05  Volume Name  (Max 15)
  DC14  Reserved
  DC1C  Creation Datetime
  DC20  Version
  DC21  Min Version
  DC22  Access Byte
  DC23  Entry Length
  DC24  Entries per Block
  DC25  File Count
  DC27  Bitmap Pointer
  DC29  Total Blocks
  DC2B  (remainder of first page of block)
  DD00  (second page of block)
DE00 ********** MLI MAIN ENTRY POINT *********************************

  DE00  Clear decimal mode
  DE01  Save Registers (BF9F)
  DE07  Set ($40) -> Address of function code -1
  DE0B  Set CMDADR -> True return address
  DE1A  Init Global Page System error to 0 (BF0F)
  DE1E  Get Function Code
  DE21  Build hash index into Command Table (X reg)
  DE2A  Is this code valid?
  DE2F  No >>DEA7
  DE32  Set ($40) -> Parameter list
  DE3F  Get parameter count required (FD85)
  DE42  None? >>DE60
  DE44  No - is parameter count correct?
  DE46  No >>DEAB
  DE48  Check class of function (FD65)
  DE4B  Quit?
  DE4D  yes >>DE5D
  DE4F  no,
  DE50  $8X - Calls to I/O Drivers >>DE66
  DE52  $CX/DX - Non System calls >>DE71
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: DE54
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

  DE54  Else, $4X - Interrupt support
  DE55  Isolate type (DEALLOC = 1, ALLOC = 0)
  DE57  Call Interrupt Support <DEF3>
  DE5A  Then Exit to Caller >>DE78
  DE5D  Go to quit code via global page >>BF03

DE60 *****************************************************************
          ****** MLI GET_TIME CALL ******
          ******************************

  DE60  Call Date/Time driver <BF06>
  DE63  and exit to caller >>DE78

DE66 *****************************************************************
          ****** MLI READ_BLOCK CALL *******
          ****** MLI WRITE_BLOCK CALL ******
          *********************************
          $80 - Read Block
          $81 - Write Block

  DE66  ---
  DE67  Set $42 -> 1 for READ, 2 for WRITE
  DE6B  Do Block I/O <DEB2>
  DE6E  Then Exit to Caller >>DE78

DE71 ********** $CX and $DX CALLS ************************************

  DE71  ---
  DE72  Isolate function Index
  DE75  Perform function and exit to caller <E047>

DE78 ********** EXIT TO CALLER ***************************************

  DE78  Clear Backup
  DE80  Error occurred?
  DE83  Save test results
  DE84  Disable interrupts
  DE85  MLI no longer active (BF9B)
  DE88  Get test results back
  DE89  Store in X reg
  DE8A  Set up Return Address on stack (BF9D)
  DE92  Put test results on stack
  DE94  Put error code in A reg
  DE95  Restore X reg (BF9E)
  DE98  Restore Y reg (BF9F)
  DE9B  Put error code on stack
  DE9C  Get RAM/ROM orientation (BFF4)
  DE9F  Exit via RAM Global Page >>BFA0
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                    NEXT OBJECT ADDR: DE9F
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

DEA2 ********** NO DEVICE CONNECTED ***********************************

  DEA2  ---
  DEA4  Call System Error Handler (Global Page) <BFØ9>

DEA7 ********** BAD SYSTEM CALL NUMBER ******************************

  DEA7  ---
  DEA9  Branch always taken >>DEAD

DEAB ********** BAD PARAMETER COUNT *********************************

  DEAB  ---
  DEAD  Call System Error Handler <DED7>
  DEBØ  Exit to Caller >>DE78

DEB2 ********** BLOCK I/O SETUP ***************************************

  DEB2  ---
  DEB4  Save Old Processor Flags
  DEB5  Disable Interrupts
  DEB6  Copy Parameters to $43-$47
  DEBE  Save Starting Buffer Page in $4F
  DEC3  Find last page + 1
  DEC6  Round up if Buffer not page aligned >>DEC9
  DEC9  Is this Memory already in use? <FC9F>
  DECC  Yes, then exit with error >>DED6
  DECE  No, do Block I/O <DEDA>
  DED1  Error? >>DED6
  DED3  No, then exit normally
  DED5  RETURN
  DED6  Error Exit
  DED7  Call System Error Handler <BFØ9>

DEDA ********** Block I/O *********************************************

  DEDA  ---
  DEDC  Force off unused UNIT bits
  DEE3  Put Drive number in X reg
  DEE7  Put Device Handler Address in Jump Vector (FEF5)
  DEFØ  Exit through Device Handler >>FEF5

DEF3 ********** Interrupt Handler ************************************
          ALLOC/DEALLOC

  DEF3  Save Call Type
  DEF5  Which Type?
  DEF6  DEALLOC? >>DF24
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                    NEXT OBJECT ADDR: DEF6
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

           ALLOC

  DEF8  ---
  DEFA  Look for empty slot (BF7E)
  DFØ1  His Address better be non-zero
  DFØ5  Store Address of His routine in Global Page (BF7E)
  DFØE  And return the position number we used
  DF14  Exit
  DF15  Skip this Vector
  DF17  Last one?
  DF19  No, check another >>DEFA
  DF1B  Yes, Table Full Error
  DF1D  Always taken >>DF21
  DF1F  Bad Parameter Error
  DF21  Call System Error Handler <BFØ9>

           DEALLOC

  DF24  ---
  DF26  Get Position Number
  DF28  Can't be zero >>DF1F
  DF2C  Or greater than 4 >>DF1F
  DF2F  Make Index into Table from it
  DF32  And zero His Vector (BF7E)
  DF39  Then Exit

DF3A ********** IRQ Handler ******************************************

  DF3A  ---
  DF3C  Save A reg from Monitor (BF88)
  DF3F  And X,Y,S and P (BF89)
  DF49  Is this ROM enhanced? (DFD8)
  DF4C  Yes, skip three pulls >>DF5A
  DF53  And RTI Address (BF8E)
  DF5A  Replace stack to original condition
  DF5E  Save active slot index (DFCE)
  DF61  In bottom half of stack?
  DF64  Yes, pop off 16 bytes and save them
  DF66  ---
  DF6D  Save $FA - $FF (top of zero page)
  DF6F  ---
  DF77  Is there a User Vector #1 (BF81)
  DF7A  No >>DF81
  DF7C  Yes, call it <DFD9>
  DF7F  His interrupt? >>DFA4
  DF81  Is there a User Vector #2 (BF83)
  DF84  No >>DF8B
  DF86  Yes, call it <DFDC>
  DF89  His interrupt? >>DFA4
  DF8B  Is there a User Vector #3 (BF85)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: DF8E
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  DF8E   No >>DF95
  DF90   Yes, call it <DFDF>
  DF93   His interrupt? >>DFA4
  DF95   Is there a User Vector #4 (BF87)
  DF98   No >>DF9F
  DF9A   Yes, call it <DFE2>
  DF9D   His interrupt? >>DFA4
  DF9F   Indicate error type 1
  DFA1   Call System Death Handler <BF0C>
  DFA4   Interrupt Serviced
  DFA6   Restore zero page (FDF5)
  DFAE   And stack (BF8B)
  DFBE   Is this enhanced ROM? (DFD8)
  DFC1   Yes, skip some stuff we used to have to do >>DFD5
  DFC3   Reload X and Y (BF8A)
  DFC9   Disable I/O ROMS (CFFF)
  DFCC   Replace active slot number (C100)
  DFD5   Exit from Interrupt >>BFD0
  DFD8   ENHANCE FLAG. Set to 1 by RELOCATOR if new type ROM found.
          (That is, if ROM IRQ Vector jumps below $D000)

  DFD9   User Interrupt Handlers (#1 - #4) >>BF80

DFE5 ********** SYSTEM ERROR HANDLER **********************************

  DFE5   Save Error Code (BF0F)
  DFE9   Pop out of subroutine
  DFEA   Exit to caller with Error Code (BF0F)
  DFEE   RETURN

DFEF ********** SYSTEM DEATH HANDLER **********************************

  DFEF   ---
  DFF1   Entry from System Global Page here
  DFF2   Turn off 80 column card (C00C)
  DFF5   Select standard Text display (C051)
  E001   Blank out a line
  E003   ---
  E008   Print "INSERT SYSTEM DISK AND RESTART" (FE1E)
  E012   Go into infinite loop if no error code >>E044
  E016   "-" (07F1)
  E01B   "E" (07F2)
  E020   "R" (07F3)
  E023   "R" (07F4)
  E027   Convert error code to Hex
  E033   And print it (07F6)
  E037   Second digit also
  E044   Infinite loop >>E044
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: E044
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

E047 ********** PERFORM FILING OR ************************************
          ******* HOUSEKEEPING FUNCTIONS ******

  E047   Save function index (FEB7)
  E04A   Get INFO flags for this command (FDCD)
  E04D   Times 2
  E04E   Store Command Number times 2 (FEB3)
  E053   And use it to index into Address Table
  E057   Set up Jump Vector with this function's (FEF5)
  E05A   ..handler address (FDA6)
  E060   Signal Backup required after call
  E065   PATHNAME not required? >>E06C
  E067   Required - parse and validity check <E08A>
  E06A   Bad Name? >>E083
  E06C   Reference Number in list? (FEB3)
  E06F   No >>E076
  E071   Yes - check it out <E1D0>
  E074   Bad Number? >>E083
  E076   Date/Time in list? (FEB3)
  E079   No >>E07E
  E07B   Yes - set System date just in case <BF06>
  E07E   Call Function Handler <E087>
  E081   If no errors then exit >>E086
  E083   Else - call System error handler <BF09>
  E086   Return to caller
  E087   Indirect JUMP to Handler >>FEF5

E08A ********* CHECK CALLER'S PATHNAME   *****************************
         ****** COPY TO MY AREA          ******

  E08A   Set ($48) -> Pathname
  E095   ---
  E099   Assume partial Pathname (FEBC)
  E09C   No Pathname in my area yet (D700)
  E09F   Check length of caller's Pathname
  E0A1   Zero is no good >>E0FB
  E0A5   Nor is 65 or more >>E0FB
  E0A7   Save length (FE9E)
  E0AA   Length + 1 (FE9E)
  E0AE   Get first character of his name
  E0B2   Is it "/"?
  E0B4   No >>E0BA
  E0B6   Yes - indicate fully qualified name (FEBC)
  E0B9   Bump past "/"
  E0BA   ---
  E0BC   Length of Index level is -1 initially (D700)
  E0BF   First character of Index level (counter) (FEB8)
  E0C2   Start of upcoming Index level in name (FEBA)
  E0C5   At end of name yet? (FE9E)
  E0C8   Yes >>E0FF
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: EØCA
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  EØCA  No - get next character in his name
  EØDØ  Is it "/"?
  EØD2  Yes >>E114
  EØD4  No - lower case?
  EØD6  No >>EØDA
  EØD8  Yes - force upper case
  EØDA  Copy to my Pathname buffer (D7ØØ)
  EØDD  Increment Index level counter (FEB8)
  EØEØ  Subsequent characters may be A-Z,Ø-9 or . >>EØE7
  EØE2  Increment Index level counter (FEB8)
  EØE5  First character must be alphabetic >>EØF3
  EØE7  Is it "."?
  EØE9  Yes - get next character >>EØC5
  EØEB  No - is it special or control character
  EØED  Yes - Bad Pathname then >>EØFB
  EØEF  Is it numeric?
  EØF1  Yes - get next character >>EØC5
  EØF3  Is it Alphabetic?
  EØF9  If so get next character >>EØC5
  EØFB  Else
  EØFC  Bad Pathname
  EØFE  RETURN
  EØFF  ---
  E1Ø1  Any characters in last Index level? (FEB8)
  E1Ø4  Yes >>E1ØA
  E1Ø6  No, zero characters in it  (FEB8)
  E1Ø9  And toss out last "/"
  E1ØA  ---
  E1ØB  Mark end of name with $ØØ (D7ØØ)
  E1ØE  Name too long? >>EØFB
  E11Ø  No - save final length (FE9E)
  E113  Set X -> Ø
  E117  Last Index more than 15 characters?
  E119  Yes - then no good >>EØFB
  E11B  Save output Index (FEBD)
  E11E  Store length of previous Index level (FEBA)
  E121  Just before it in buffer (D7ØØ)
  E124  Restore output index (FEBD)
  E127  And continue >>EØBA
  E129  End of Name
  E12A  Fully qualified name? (FEBC)
  E12D  Yes >>E134
  E12F  No - Got a Prefix (BF9A)
  E132  No - error >>EØFB
  E134  Else, okay to exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: E135
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

E135 *****************************************************************
          ****** MLI SET_PREFIX CALL ******
          *********************************

  E135  Copy Pathname <EØ8A>
  E138  It's okay >>E144
  E13A  Check length of Volume name (D7ØØ)
  E13F  If zero - no Prefix wanted (BF9A)
  E142  Exit with no error
  E143  RETURN

  E144  Get File entry for last index <E5A3>
  E147  Okay? >>E14D
  E149  Invalid Pathname?
  E14B  No - Out now! >>E18B
  E14D  Sub Directory file? (FE5F)
  E154  No, error >>E189
  E156  Fully qualified path? (FEBC)
  E159  Yes >>E15E
  E15B  No - use old Prefix also (BF9A)
  E15E  ---
  E16Ø  Compute new Prefix Index (FE9E)
  E163  Does new Prefix exceed 64 characters?
  E165  Yes - Bad Path error >>EØFB
  E168  Store new Prefix pointer (BF9A)
  E16E  Set Device Number of Prefix Directory (FE9F)
  E174  Save Keyblock for Prefix Directory (FEAØ)
  E17D  Copy Prefix to top of Path buffer (D7ØØ)
  E18Ø  (preceded by old Prefix if one exists) (D7ØØ)
  E188  Exit normally

  E189  Bad File Type Error
  E18B  ---
  E18C  RETURN

E18D *****************************************************************
          ****** MLI GET_PREFIX CALL ******
          *********************************

  E18D  Set ($4E) -> Data Buffer
  E199  Set Length = 64 (max)
  E1A3  Validity check buffer storage <FC82>
  E1A6  Error? >>E18B
  E1AA  Get Prefix index (BF9A)
  E1AE  No Prefix? - Length = Ø >>E1B4
  E1BØ  Complement for length
  E1B4  Store in first byte of buffer
  E1B6  If null Prefix exit >>E1CE
  E1B8  ---
  E1B9  Copy Prefix to caller's buffer replacing (D7ØØ)
  E1BC  index level name length bytes with "/"
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: E1C6
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  E1C6   ---
  E1CA   End it with a "/"
  E1CE   ---
  E1CF   Exit normally

E1DØ ********** VALIDITY CHECK REFERENCE NUMBER **********************
                    (PASSED BY CALLER)

  E1DØ   Get Reference Number
  E1D4   If zero then no good >>E231
  E1D8   If > 8 then no good >>E231
  E1DA   Save Reference Number
  E1DB   Multiply by 32
  E1E1   Result gives offset into FCB's (FE92)
  E1E5   Get back Reference Number
  E1E6   File Control Block active this Reference? (D8ØØ)
  E1E9   No - Bad Reference Number >>E22C
  E1EB   Get Buffer Number (D8ØB)
  E1EE   Find Buffer address in Global Page <FC3C>
  E1F4   No Buffer? >>E21D
  E1F6   Buffer okay, save Page Pointer in $48
  E1FA   Second block in $49
  E1FC   Set last Device used in Global Page (D8Ø1)
  E2Ø2   Finish setting up pointers (FEDD)
  E2Ø5   ($4A) -> 1st Block of Buffer (data)
  E2Ø7   ($48) -> 2nd Block of Buffer (index)
  E2Ø9   ---
  E2ØA   Search all Volume Control Blocks (D91Ø)
  E2ØD   for the one which goes with requested unit (D8Ø1)
  E212   ---
  E218   Can't find matching Volume Control Block
  E21A   So die with error type $ØA <BFØC>
  E21D   No Buffer in open File Control Block
  E21F   So die with error type $ØB <BFØC>
  E222   Is Volume mounted? (D9ØØ)
  E225   No, keep looking >>E212
  E227   Save Volume Control Block index (FE91)
  E22B   Exit normally

  E22C   ---
  E22E   This looks wrong!!!! (FE92)
  E231   Bad Reference Number error
  E234   RETURN

E235 *****************************************************************
          ****** MLI ONLINE CALL ******
          ****************************
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: E235
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  E235   Set ($4E) -> Data Buffer <F2ØD>
  E238   Set Length = Ø
  E242   Get Unit Number
  E244   Do all Units? >>E24D
  E246   No, just one
  E248   Set length = 16 (FEDA)
  E24B   Always taken >>E252
  E24D   If all Units
  E24F   Set Length = 256 (maximum) (FEDB)
  E252   Is Buffer in main RAM? <FC82>
  E255   No, then exit >>E28A
  E257   Yes, zero out Buffer
  E25C   ---
  E261   Index into Data Buffer = $ØØ (FEBA)
  E266   Get Unit Number again
  E268   Isolate valid bits
  E26A   Specific Unit requested? >>E28B
  E26C   No, copy Device List from Global Page <E864>
  E26F   Save Device Count (FEBD)
  E272   Get last Device (FECA)
  E275   Generate return data for it <E28B>
  E278   Bump data buffer index by 16 (FEBA)
  E281   Get next Device (FEBD)
  E285   And go do it >>E26F
  E287   When done, exit
  E28A   RETURN

  E28B   Save Device Number (BF3Ø)
  E28E   Scan for the Volume Control Block <E876>
  E291   Error? >>E2C3
  E293   We need Block 2 (Key Block of VolDir)
  E29B   Read Volume Directory Key Block <EBEE>
  E29E   Error? >>E2C3
  E2AØ   Was something already mounted? (FE91)
  E2A6   No >>E2AD
  E2A8   Yes, Files open? (D911)
  E2AB   Yes >>E2B9
  E2AD   No, set up Volume Control Block for new VOL <E8D1>
  E2BØ   Error? >>E2C3
  E2B2   No
  E2B4   Was a duplicate Volume Control Block found? (FEB5)
  E2B7   Yes, then error >>E2C3
  E2B9   See if the same Volume is still there (FE91)
  E2BF   If not, Disk Switch Error
  E2C1   Else, all is well - continue >>E2E1
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: E2C3
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

E2C3 ********** ERROR **************************************************
          Store code in data buffer entry

  E2C3   ---
  E2C4   Store Device Number in entry  <E2F6>
  E2C9   Store error code next
  E2CB   Duplicate Volume error?
  E2CD   No - done >>E2DF
  E2DØ   Store Device Number for duplicate next (FEB6)
  E2D8   No Duplicate now
  E2DF   Exit with error
  E2EØ   RETURN

E2E1 ********** MAKE ONLINE VOLUME ENTRY *****************************

  E2E1   Get name length for loop index (D9ØØ)
  E2EA   Copy name to Buffer entry (D9ØØ)
  E2F1   Done yet? (FEB8)
  E2F4   No, do another >>E2EA
  E2F6   Yes, find current Buffer entry (FEBA)
  E2F9   Store Device number (BF3Ø)
  E3Ø1   Return to caller

E3Ø2 ****************************************************************
          ****** MLI CREATE CALL ******
          *****************************

  E3Ø2   Follow Path to File <E5B6>
  E3Ø5   Error? - I'm expecting one >>E3ØB
  E3Ø7   If File was found - Duplicate error
  E3Ø9   ---
  E3ØA   Return to caller

  E3ØB   File not found?
  E3ØD   No, then a real error occurred >>E3Ø9
  E3ØF   Yes, get requested storage type
  E313   Is it ØØ, $Ø1, $Ø2 or $Ø3?
  E315   Yes, carry on >>E31B
  E317   Is it $ØD?
  E319   No, then exit with error >>E32B
  E31B   Get status of this device (BF3Ø)
  E321   Exit on error >>E32E
  E323   Is there a free Directory entry? (FE9B)
  E326   No >>E32F
  E328   Yes - continue >>E3C1
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: E328
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

  E32B   Indicate Bad Storage Type
  E32E   Return to caller

  E32F   Is this the Volume Directory? (FE46)
  E335   No, we can extgnd it >>E33B
  E337   Yes, indicate Volume Directory Full error
  E33A   Return to caller

           * EXTEND DIRECTORY FILE *

  E33B   Save old current Block number
  E341   Allocate a Block on Disk <EAB6>
  E344   Save the number
  E345   Replace BLKNUM
  E34B   Was there a free Block?
  E34C   No, then exit >>E32E
  E34E   Yes, set up forward pointer in old one (DCØ2)
  E351   to point to it (DCØ3)
  E354   and Write old Directory Block <EBEA>
  E357   Error? Yes, then exit >>E32E
  E35B   Set BLKNUM -> new Block number
  E36Ø   Back point to old Directory Block (DCØ2)
  E366   Loop until done >>E35B
  E36A   Zero remainder of Block Buffer (DCØ2)
  E36D   (including forward pointer) (DDØØ)
  E371   Loop until done >>E36A
  E373   Write new Directory Block <EBEA>
  E376   Error? Yes, then exit >>E32E
  E378   Set BLKNUM -> Parent Directory number (FE46)
  E382   Read Block with my entry <EBEE>
  E385   Entry number of my Directory (FE48)
  E388   None relocatable!!
  E38A   Set ($48) -> Buffer
  E38C   Skip link pointers
  E38E   ---
  E38F   Count entries
  E392   Skip to next (FE49)
  E39B   Save LSB
  E39F   Add 1 to Blocks used
  E3A1   and $2ØØ to EOF mark (FDCE)
  E3A4   in entry
  E3AA   Loop until done >>E39F
  E3AC   Write back Block to Parent Directory <EBEA>
  E3AF   Error? then exit >>E3CØ
  E3B1   Start all over now that there's room >>E3Ø2
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: E3B1
---------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------

E3B4 ********** ZERO $F600 *******************************************

  E3B4   Zero $F600 Block Buffer
  E3C0   Return to caller

E3C1 ********** BUILD NEW FILE ***************************************

  E3C1   Call Zero $F600 routine <E3B4>
  E3C4   Copy Datetime (Creation)
  E3C6   to my variables
  E3D2   Loop until done >>E3C6
  E3D4   Did he give Datetime (Creation)?
  E3D5   Yes, carry on >>E3E2
  E3D7   No, then use
  E3D9   System Datetime instead (BF90)
  E3E2   If Storage type is $00, $01, $02 or $03
  E3E4   force it to $10
  E3EA   else use a $D0
  E3EC   Find File name (FEBA)
  E3EF   OR Storage type to name length (D700)
  E3F2   Store Type/Length (FE5F)
  E3F5   Isolate name length
  E3F9   Copy File name to File Entry Buffer (FEBA)
  E407   Copy caller's Access Byte
           NOTE: This should be validity checked!!!
  E40F   and copy File type
  E414   ---
  E415   and AUX_TYPE
  E41E   Copy Version and Min_Version (0,0) (FDF0)
  E421   constants to entry (FE7B)
  E42A   Indicate 1 Block used
  E42F   Copy Directory Header Block number (FE5A)
  E43E   Is this a Seedling file?
  E440   Yes >>E479
  E442   No, Directory file - Build Header in $F600
  E444   Copy completed Directory entry (FE5F)
  E447   to $F600 buffer first (DC04)
  E44B   Loop until done >>E444
  E44D   Make Storage type $E in Header itself
  E452   Put "HUSTON" (Author) in Reserved area
  E45A   and Version, Min_Version, Access, (FDF0)
  E45D   Entry-length, File count and (DC20)
  E460   Parent pointer from constants
  E461   Loop until done >>E454
  E465   Copy Parent Block entry number (FE5C)
  E46C   Loop until done >>E465
  E46E   Copy Parent entry Length (FE51)
  E476   EOF = $200 (FE75)
  E479   Allocate a new disk block <EAB6>
  E47C   error? >>E4B5
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: E47E
---------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------

  E47E   Store it in key pointer of entry (FE70)
  E484   and in BLKNUM for I/O
  E488   Write zeroed (or DIR HDR) key block <EBEA>
  E48B   error? >>E4B5
  E48D   Bump parent's file count (FE53)
  E495   Go update directory <E4B6>
  E498   error? >>E4B5
  E49A   Checkpoint Volume Bit Map and exit. >>EB93

E49D ********** POINT $48/49 AT DIRECTORY ENTRY **********************

  E49D   $48/$49 --> Entry
  E4A1   Skip link pointers (+4)
  E4A3   File entry number counter (FE5E)
  E4A6   ---
  E4A7   Skip to proper entry
  E4AA   Add entry length (FE51)
  E4AF   (bump MSB)
  E4B3   (store LSB)
  E4B5   RETURN

E4B6 ********** UPDATE DIRECTORY(S) **********************************

  E4B6   System date available? (BF90)
  E4B9   no, forget it >>E4C6
  E4BD   yes, copy to last modified date field (BF90)
  E4C6   turn on BUBIT (backup) if appropriate (FE7D)
  E4CF   set DEVNUM of parent (FE59)
  E4D5   and BLKNUM (FE5C)
  E4DF   reread DIR block containing entry <EBEE>
  E4E2   error? >>E4B5
  E4E4   Point to proper entry in buffer <E49D>
  E4EB   Copy constructed entry to buffer (FE5F)
  E4F6   Is this block the DIR HDR block?
  E501   no, write back new entry <EBEA>
  E504   error? >>E4B5
  E510   and then read DIR HDR block <EBEE>
  E513   error? >>E4B5
  E515   in any case..
  E517   copy back update file count to HDR  (FE53)
  E520   and ACCESS byte (with Backup) (FE50)
  E526   write back HDR block <EBEA>
  E529   error? >>E583
  E52B   is this the VOL DIR? (DC04)
  E532   yes, all done -- exit >>E5A1
  E534   no, subdirectory.. (DC27)
  E537   get parent pointer
  E53E   get parent entry no.. (DC29)
  E544   and entry len (DC2A)
  E54A   read parent DIR block <EBEE>
  E54D   error? >>E583
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: E54F
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  E54F  find entry for this subdirectory <E49D>
  E552  system date available? (BF90)
  E555  no >>E564
  E557  yes,
  E55B  copy system date/time to... (BF90)
  E55E  modified date/time in entry
  E564  write it back <EBEA>
  E567  error? >>E583
  E56B  BLKNUM = HDR block number
  E574  same block we have now?
  E578  yes, go back and date stamp >>E52B
  E57A  no,
  E57E  read HDR block <EBEE>
  E581  and go back to date stamp parent DIR >>E52B
  E583  error? then exit

E584 ********** NOT ProDOS VOLUME ERROR ******************************

  E584  ---
  E587  RETURN

E588 ********** IS THIS ProDOS VOLUME? *******************************

  E588  Does previous block ptr = 0? (DC00)
  E596  no, not a ProDOS volume >>E584
  E598  else, (DC04)
  E59D  does VOL DIR's STORAGE TYPE = $E or $F?
  E59F  no, error >>E584
  E5A1  else, ok
  E5A2  RETURN

E5A3 ********** GET FILE ENTRY ***************************************

  E5A3  follow path to it's end <E5B6>
  E5A6  error? >>E5B5
  E5AB  copy file entry
  E5B3  and exit
  E5B5  RETURN

E5B6 ********** FOLLOW PATH TO A FILE ********************************

  E5B6  get base dir's data <E73A>
  E5B9  error? >>E60D
  E5BB  another subdirectory in the path? >>E5E5
  E5BD  no, at end of path (E635)
  E5C0  $48/$49 --> $F604 (HDR)
  E5C8  copy part of HDR to file entry
  E5D2  File type = $F (Directory) (FDE8)
  E5D5  BLOCK = 2 (FE5F)
  E5D8  No. blocks used = 4
  E5D9  EOF = $800
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: E5DD
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  E5DD  TYPE = subdirectory ($D0)
  E5E2  return to caller
  E5E4  RETURN

          *** SCAN DIRECTORY FOR FILE ***

  E5E5  indicate no free entry found as yet
  E5EA  signal in HDR block
  E5EB  zero count of names examined
  E5F0  find name in block <E6E3>
  E5F3  got it! >>E65A
  E5F5  not yet, how many entries expected? (FE98)
  E5F8  less entry no. I just searched  (FE97)
  E5FD  more file entries left to search? >>E60F
  E60B  no, directory error
  E60D  ---
  E60E  RETURN

  E60F  yes, update entries left counter (FE98)
  E615  back to first buffer page ($49)
  E617  check next block pointer (DC02)
  E61F  if zero, directory error >>E60B
  E621  BLKNUM = next directory block
  E628  read next block <EBEE>
  E62B  no errors, loop back for more >>E5EB
  E62D  exit if error

          *** NO MORE FILE ENTRIES ***

  E62E  free entry found in directory? (FE9B)
  E631  yes >>E64E
  E633  no, check pointers (DC02)
  E636  is there another block after this one? >>E63D
  E63B  no... >>E64E
  E63D  yes, free entry will be.. (FE5C)
  E646  first in that block
  E64B  indicate free entry available (FE9B)
  E64E  find next index name <E77B>
  E651  exiting with error
  E652  no more indicies in path, file not found >>E657
  E654  else, path not found
  E656  RETURN

  E657  file not found error
  E659  RETURN

          *** FOUND FILE ENTRY ***
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: E65A
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  E65A  advance to next subdir in path <E774>
  E65D  end -- save entry no. and exit >>E6CB
  E661  get type of entry
  E665  subdir?
  E667  no, bad path then >>E651
  E66B  copy key block no...
  E66D  to BLKNUM
  E670  and to current DIR block no (FE5A)
  E67A  go read key block of subdirectory <EBEE>
  E67D  error? >>E6A3
  E682  new file count (FE98)
  E68B  check minimum version (DC21)
  E68E  too new? >>E6A1
  E696  count bits in reserved field of DIR hdr
  E697  --- >>E69A
  E69A  ---
  E69D  there must be 5 bits on (normally $75)
  E69F  (there are) >>E6A5
  E6A1  or else, incompatible file format
  E6A3  ---
  E6A4  RETURN

  E6A5  copy DIR HDR <E6AB>
  E6A8  and go scan for next level >>E5E5

E6AB ********* COPY DIRECTORY HDR ************************************

  E6AB  Copy:
  E6AD  CREATION, VERSION, MIN_VERS, ACCESS, (DC1C)
  E6B0  ENTRY_LEN, ENTRIES_PER_BLK, FILE_COUNT (FE4A)
  E6B6  volume directory? (DC04)
  E6BD  if so, exit now >>E6CA
  E6C1  else, copy PARENT_POINTER, (DC27)
  E6C4  PARENT_ENTRY_NO., and PARENT_ENTRY_LEN (FE46)
  E6CA  RETURN

E6CB ********* SAVE DIR ENTRY NO. & BLOCK ****************************

  E6CB  compute entry number (FE52)
  E6D4  save it (FE5E)
  E6D9  and the block it's in (FE5C)
  E6E2  exit

E6E3 ********* SEARCH ONE DIR BLOCK FOR FILE *************************

  E6E3  get entries in this block (FE52)
  E6E9  $48/$49 --> first entry (E635)
  E6F0  ---
  E6F2  skip HDR? >>E727
  E6F4  no, non empty entry?
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: E6F8
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  E6F8  yes >>E707
  E6FA  no, do we need one? (FE9B)
  E6FD  no >>E727
  E6FF  yes, remember it <E6CB>
  E702  don't need another one now (FE9B)
  E705  skip to next entry >>E727
  E707  get length of name
  E709  count it (FE97)
  E70C  save it for loop (FEB8)
  E712  same len as we are wanting? (D700)
  E715  no, skip it >>E727
  E717  ---
  E71B  compare names (D700)
  E725  we found it! exit
  E726  RETURN

  E727  skip to next entry (FE9A)
  E72B  end of block? if so, exit >>E726
  E731  bump $48/$49 by entry len
  E738  and go check next >>E6F0

E73A ********* GET DIRECTORY DATA ************************************

  E73A  find base directory <E793>
  E73D  error? >>E792
  E743  zero out my variables (FE46)
  E749  set up device number (BF30)
  E74F  copy DIR HDR to my variables <E6AB>
  E758  copy TOTAL BLOCKS from VCB (D912)
  E75E  copy BIT MAP Pointer from VCB (D91A)
  E764  copy Block No. of this directory (0046)
  E76A  make second copy of file count (FE53)
  E774  advance to next subdir in path <E77B>
  E777  and update index (FEBA)
  E77A  RETURN

E77B ********* ADVANCE TO NEXT DIR NAME ******************************

  E77B  get this DIR's index (FEBA)
  E782  add len of name to move index to next name (FEBA)
  E786  still in prefix portion? >>E78E
  E788  no, now starting caller's path suffix (BF30)
  E78B  save last DEVNUM accessed (FE9F)
  E78E  return with len of next dir in path (D700)
  E792  RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: E793
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

E793 ********* FIND BASE DIRECTORY ***********************************

  E793   ---
  E795   get old PFIXPTR (BF9A)
  E798   fully qualified pathname? (FEBC)
  E79B   no >>E79E
  E79D   yes, no old PFIXPTR anymore
  E79E   save old prefix index (FEBB)
  E7A1   DEVNUM=Ø (BF3Ø)
  E7A4   ---

          *** SCAN VCB'S FOR A MOUNTED VOLUME ***

  E7A6   scan (D9ØØ)
  E7A9   got one >>E7B7
  E7BØ   else, bump to next VCB
  E7B4   no mounted vols? remount them >>E8Ø8

          *** FIND LAST DIR IN PREFIX OR TOL DIR ***

  E7B7   store name length (FEB8)
  E7BA   same name as in pathname? (D7ØØ)
  E7BD   no -- skip it >>E7AB
  E7CB   save VCB index (FE91)
  E7CE   DEVNUM = VCB's unit no. (D91Ø)
  E7D4   BLOCK = 2 (read VOLDIR if no old PFIX)
  E7DC   get old prefix index (FEBB)
  E7DF   ---
  E7EØ   accumulate a new index (FEBA)
  E7E3   no previous prefix? >>E7F5
  E7E6   find last name in prefix (D7ØØ)
  E7EB   read prefix directory instead of vol dir (FEAØ)
  E7F5   read block <EBEE>
  E7F8   error? >>E8ØØ
  E7FA   is this the right directory? <E89E>
  E7FD   no >>E8ØØ
  E7FF   yes -- exit!

          *** IF NOT THERE, REMOUNT ALL VOLS ***
          *** AND CHECK THEM                 ***

  E8ØØ   open files? (FE91)
  E8Ø6   yes, give up now >>E821
  E8Ø8   else, (FEBB)
  E8ØB   put back old prefix length (FEBA)
  E8ØE   copy DVCLST from global page <E864>
  E814   use last device accessed first >>E825
  E816   if none, get last in my device table (BF31)
  E821   volume not found error
  E824   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: E824
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  E825   ---
  E828   search for device in device table (FECA)
  E83Ø   device not found >>E821
  E832   when found, make it active device (BF3Ø)
  E837   remove it from table (FECA)
  E83A   find its VCB <E876>
  E83D   not found?  >>E863
  E83F   volume mounted there? (FE91)
  E845   no >>E84C
  E847   yes, open files here? (D911)
  E84A   yes, skip it -- get next unit >>E816
  E84C   else,
  E84E   BLKNUM = 2 (vol dir)
  E854   read volume directory <EBEE>
  E857   error? >>E816
  E859   mount volume on VCB <E8C4>
  E85C   error? >>E816
  E85E   is this his chosen volume? <E89E>
  E861   no, try again >>E816
  E863   yes, exit

E864 ********* COPY GLBL DEVLST TO MY TABLE **************************

  E864   start with last device (BF31)
  E867   get a unit number (BF32)
  E86C   copy it to device table (FECA)
  E872   return count of devices (BF31)
  E875   RETURN

E876 ********* SCAN VCB'S FOR DEVICE NO. *****************************

  E876   ---
  E87A   scan VCB's for a given device number
  E881   not it? >>E888
  E883   is it, save VCB index (FE91)
  E886   and exit normally
  E887   RETURN

  E888   else, volume mounted here? (D9ØØ)
  E88B   yes >>E891
  E88E   no, save VCB index to empty unit (FE91)
  E891   ---
  E893   bump to next VCB
  E895   and go look at it >>E87A
  E897   not found...
  E898   any free entries? if not, error >>E89B
  E89A   else, all is well -- return empty VCB
  E89B   VCB table full error
  E89D   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: E89D
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

E89E ********* COMPARE DIR NAME WITH PATH LVL ************************

  E89E  ---
  E8A3  check DIR type (DC04)
  E8A6  VOL DIR or SUB DIR?
  E8A8  neither >>E8B1
  E8AA  yes..
  E8AC  store len of its name (FEB8)
  E8AF  and go on >>E8B6
  E8B1  error exit
  E8B2  RETURN

  E8B3  compare directory names (DC04)
  E8B9  no match? >>E8B1
  E8C2  they match! exit
  E8C3  RETURN

E8C4 ********* MOUNT NEW VOLUME **************************************

  E8C4  volume mounted? (FE91)
  E8CA  no, continue >>E8D1
  E8CC  yes, same one as one wanted? <E929>
  E8CF  if so exit, else fall thru >>E928

E8D1 ********* SET UP VCB FROM VOLDIR ********************************

  E8D1  zero out VCB
  E8DC  is this a ProDOS volume? <E588>
  E8DF  no -- exit >>E928
  E8E1  duplicate vol in VCB's? <E94A>
  E8E4  yes -- exit with that one instead >>E927
  E8E6  get new volume's name length (DC04)
  E8ED  add to VCB index (FE91)
  E8F1  and copy to VCB name field in empty VCB (DC04)
  E8FC  store in VCB name len field (D900)
  E8FF  copy DEVNUM to VCB unit field (BF30)
  E905  copy total blocks to VCB (DC29)
  E911  copy block no. of vol dir to VCB
  E91B  copy bit map block no. to VCB (DC27)
  E927  exit
  E928  RETURN

E929 ********* COMPARE VOL NAMES TO MAKE *****************************
          ****** SURE THEY MATCH           ******

  E929  get length (DC04)
  E92E  same in VCB? (D900)
  E931  no >>E941
  E934  yes, add len to VCB index to point at (FE90)
  E937  last char of name in VCB (FE90)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: E93E
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  E93E  compare names (D900)
  E941  SEC if no match
  E948  CLC if match
  E949  RETURN

E94A ********* LOOK FOR DUPLICATE VOL ********************************

  E94A  start with first VCB
  E94C  ---
  E94D  this VCB has same name? <E929>
  E950  no >>E961
  E952  yes, files open? (D911)
  E955  yes >>E96B
  E959  no, mark VCB empty (NAME=0) (D900)
  E95C  (UNIT=0) (D910)
  E95F  and exit with no error >>E969
  E961  else,
  E963  bump to next VCB
  E967  and loop >>E94C
  E969  exit no errors
  E96A  RETURN

  E96B  save flag (FEB5)
  E96E  and VCB index of duplicate vol (FEB6)
  E971  exit with error
  E972  RETURN

E973 ********* SEE IF A QUANTITY OF FREE  ****************************
          ****** BLOCKS IS AVAILABLE ON VOL ******

  E973  any free blocks counted in VCB?  (FE91)
  E97C  yes >>E9D0

          *** COMPUTE VCB FREE BLOCK COUNT ***

  E97E  no, how many bit map blocks are there? <EA22>
  E981  save it (less 1) (FE9C)
  E986  zero scratch (will count free blocks) (FE86)
  E98C  no block found yet
  E991  checkpoint bit map buffer <EB93>
  E994  error? >>E9E4
  E999  BLKNUM = bit map pointer (D91A)
  E9A3  read block to buffer <EBEE>
  E9A6  error? >>E9E4
  E9A8  count free blocks marked <E9E5>
  E9AB  drop no. remaining to do (FE9C)
  E9AE  none left? >>E9B9
  E9B0  some, BLKNUM = BLKNUM + 1
  E9B6  go process that >>E9A3
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: E9B6
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  E9B9  did we find a free bit? (FE91)
  E9BF  no -- volume full >>E9E1
  E9C1  save VCB bitmap block offset (D91C)
  E9C4  save free block count in VCB also (FE87)
  E9DØ  are there enough to satisfy request? (D914)
  E9DF  yes, exit
  E9EØ  RETURN

  E9E1  volume full error
  E9E4  RETURN

E9E5 ********* SCAN AND COUNT BITMAP BLOCKS *************************

  E9E5  scan through both buffer pages
  E9EC  counting one bits <EA12>
  E9F7  ---
  E9FA  found free block already? (FE9B)
  E9FD  if so -- done >>EA11
  E9FF  any blocks found yet? (FE86)
  EAØ5  no >>EA11
  EAØ7  yes, compute total no. of bitmap blocks <EA22>
  EAØB  less number remaining (FE9C)
  EAØE  gives bitmap block with first free bit (FE9B)
  EA11  exit

EA12 ********* COUNT ONE BITS IN A BYTE *****************************

  EA12  shift and...
  EA15  count bits that are on (FE86)
  EA1D  exit when byte goes to zero
  EA21  RETURN

EA22 ********* COMPUTE NO. BITMAP BLKS -1 ***************************

  EA22  get blocks on vol count (-1) (FE91)
  EA2E  ---
  EA2F  isolate top nibble of block count
  EA3Ø  for bit map block count
  EA33  RETURN

EA34 ********* FREE A BLOCK ON DISK *********************************

  EA34  save MSB (FE9C)
  EA37  and LSB
  EA3B  block number passed too big for (D913)
  EA3E  volume size? (FE9C)
  EA42  yes, error >>EAB2
  EA45  no, get bit position for block no.
  EA4B  save it (FE9B)
  EA4F  divide block no. by 8 (FE9C)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: EA52
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  EA52  giving byte offset as remainder
  EA5B  save byte offset  (FEA2)
  EA5E  make quotient/2 into block index (FE9C)
  EA61  remember which page in that block (FEA4)
  EA64  read bit map block (after checkpoint) <EB64>
  EA67  error? >>EAB1
  EA69  are we at proper block of bitmap yet? (FEA9)
  EA6F  yes! >>EA87
  EA71  no -- checkpoint <EB93>
  EA74  error? >>EAB1
  EA76  indicate block wanted in VCB (FE9C)
  EA7F  DEVNUM of bitmap (FEA6)
  EA82  read actual block directly <EBA4>
  EA85  error? >>EAB1
  EA87  get byte offset into page (FEA2)
  EA8A  which page? (FEA4)
  EA8D  get bit pattern to set (FE9B)
  EA9Ø  page Ø? >>EA9A
  EA92  no, turn bit on in page 1 (DBØØ)
  EA98  and continue >>EAAØ
  EA9A  turn bit on in page Ø (DAØØ)
  EAAØ  mark bitmap needs checkpoint
  EAA8  count block freed (FEC2)
  EABØ  exit normally
  EAB1  RETURN

  EAB2  bad bitmap error
  EAB5  RETURN

EAB6 ********* FIND A FREE DISK BLOCK AND ****************************
          ****** AND ALLOCATE IT            ******

  EAB6  go read bitmap <EB64>
  EAB9  error? >>EADE
  EABB  first page Ø
  EACØ  scan 1st page of bitmap for free block(s) (DAØØ)
  EAC8  bump tm page 1 of buffer (FEA4)
  EACB  bump page offset (FEA3)
  EACE  scan 2nd page too (DBØØ)
  EAD6  bump page (FEA3)
  EAD9  get next block <EB42>
  EADC  continue >>EABB
  EADE  error exit

  EADF  save byte index  (FEA2)
  EAE2  shift combination of page no. and (FEA3)
  EAE5  byte offset left 3 bits to make (FE87)
  EAE8  room for bit position.
  EAF7  depending on buffer page ... (FEA4)
  EAFC  reload bit pattern from page Ø... (DBØØ)
  EBØ1  or page 1 (DAØØ)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 34              NEXT OBJECT ADDR: EB04
---------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
---------------------------------------------------------------------

  EB04  shift bit pattern, bumping block no. LSB
  EB05  until a one bit is found >>EB0A
  EB0A  then shift it back the way it was
  EB0B  (with that bit turned off) >>EB0A
  EB0D  store LSB of block no. (FE86)
  EB10  store updated byte back in proper page (FEA4)
  EB1D  indicate bitmap needs checkpoint
  EB25  one less block available in VCB (FE91)
  EB3A  ---
  EB3B  return with new block no. (FE86)
  EB41  RETURN

EB42 ********* GET NEXT BITMAP BLOCK **********************************

  EB42  use blocks of vol to compute (FE91)
  EB45  number of blocks in bitmap (D913)
  EB4C  just scanned last block? (D91C)
  EB4F  yes, no space >>EB60
  EB51  no, get next block (D91C)
  EB5A  checkpoint old one <EB93>
  EB5D  go read block  >>EB64

  EB60  disk full error
  EB63  RETURN

EB64 ********* READ BITMAP BLOCK **************************************

  EB64  have we read bitmap for this unit yet? (FE91)
  EB6D  yes >>EB7D
  EB6F  no, checkpoint bitmap of some other unit <EB93>
  EB72  error? >>EB92
  EB77  get new bitmap unit no. (D910)
  EB7D  was bitmap modified? (FEA5)
  EB80  yes >>EB87
  EB82  no, read it <EBA4>
  EB85  error? >>EB92
  EB87  save bitmap block offset times 2 (FE91)
  EB8A  (page number) (D91C)
  EB91  exit
  EB92  RETURN

EB93 ********* CHECKPOINT VOLUME BITMAP *******************************

  EB93  ---
  EB94  needs checkpoint? (FEA5)
  EB97  no >>EB92
  EB99  yes, write it <EBE6>
  EB9C  error? >>EB92
  EB9E  doesn't need checkpoint now
  EBA3  exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: EBA3
---------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
---------------------------------------------------------------------

EBA4 ********* READ BITMAP ********************************************

  EBA4  save DEVNUM (FEA6)
  EBA7  copy block offset wanted (FE91)
  EBB1  BITMAP BLOCK = BITMAP PTR + BLOCK OFFSET (D91A)
  EBBF  set up read command

           *** READ OR WRITE BITMAP ***

  EBC1  save I/O command
  EBC7  device = bitmap device (FEA6)
  EBCD  block = bitmap block  (FEA7)
  EBD7  point to bitmap buffer (EA9C)
  EBDA  do the I/O <EBF5>
  EBDF  restore old DEVNUM (BF30)
  EBE2  ok? >>EBE5
  EBE4  no, error exit
  EBE5  RETURN

EBE6 ********* WRITE BITMAP *******************************************

  EBE6  set up write command
  EBE8  and go do it >>EBC1

EBEA ********* WRITE BLOCK ********************************************

  EBEA  set up write command
  EBEC  and go do it >>EBF0

EBEE ********* READ BLOCK *********************************************

  EBEE  set up read command

EBF0 ********* READ OR WRITE BLOCK ************************************

  EBF0  save I/O command
  EBF2  where is my buffer? (E635)
  EBF5  save flags
  EBF6  and disable
  EBF9  Set low byte of Buffer pointer
  EBFB  to zero
  EBFD  Initialize Global Page System error to 0 (BF0F)
  EC00  set I/O transfer occured flag
  EC05  set unit to do I/O on (BF30)
  EC0A  do block I/O <DEDA>
  EC0D  error? >>EC12
  EC0F  no errors, restore things and exit
  EC11  RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: EC11
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  EC12   error exit
  EC14   RETURN

EC15 *******************************************************************
          ****** MLI GET_MARK CALL ******
          ******************************

  EC15   copy mark to caller's list from FCB (FE92)
  EC25   exit with no errors
  EC26   RETURN

  EC27   bad position error
  EC2A   RETURN

EC2B *******************************************************************
          ****** MLI SET_MARK CALL ******
          ******************************

  EC2B   set up to...
  EC33   copy user's mark to temporary
  EC35   new mark variable (FEA8)
  EC3A   make sure it will not exceed EOF (D815)
  EC3F   else, error >>EC27   .
  EC42   ---

          *** STILL IN SAME DATA BLOCK? ***

  EC48   get old mark (FE92)
  EC4B   find its block no. (*2) (D813)
  EC53   compute distance in pages from old mark's (FEAB)
  EC57   block to new mark (FE86)
  EC5D   earlier -- need new data block >>EC6E
  EC61   too far forward -- need new block >>EC6E
  EC66   MSB's match? (D814)
  EC6B   then mark is still in this block >>ED89

  EC6E   check storage type (D807)
  EC71   zero? >>EC7A
  EC73   seedling, sapling or tree?
  EC77   no, special handling for DIR files >>EDBB

  EC7A   stomp on FCB2's mark??? (F300+$52)
  EC7C   (this should never happen anyway) (D800)
  EC7F   and return with bad REFNUM error
  EC82   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: EC82
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

          *** NEED DIFFERENT DATA BLOCK ***

  EC83   copy storage type (D807)
  EC89   old data block needs writing? (D808)
  EC8E   no >>EC95
  EC90   yes, do so <EE94>
  EC93   error? >>ECFE
  EC95   see if new mark is outside the range of (FE92)
  EC98   the current index block (D814)
  ECA7   yes >>ECC7
  ECAB   yes >>ECC7
  ECAD   no, same index block (FE96)
  ECB0   check storage type
  ECB1   sapling or tree are ok >>ED2D

          *** SEEDLING ***

  ECB3   seedling, check position (FEAB)
  ECB6   if position is outside of block 0..
  ECBA   promote to sapling >>ED1B
  ECBC   else, (D80C)
  ECC4   go get key block (seedling data block) >>ED7F

          *** NEED TO CHANGE DATA BLOCKS ***

  ECC7   does old index block need dumping? (D808)
  ECCC   no >>ECD3
  ECCE   yes, do so <EEA8>
  ECD1   error? >>ECFE
  ECD3   check storage type (FE96)
  ECD6   tree file?
  ECD8   yes >>ED00
  ECDA   no, sapling (FEAC)
  ECDF   is position in first index block?
  ECE2   no, need master index, subindex and data >>ED46
  ECE4   yes, first index, reset flags <EDAF>
  ECE7   is this a seedling?
  ECE8   if so, see if in first block >>ECB3

          *** SAPLING ***

  ECEA   no, sapling, read its only index block  <EE3B>
  ECED   error? >>ECFE
  ECF2   set block no. of index block
  ECFC   and continue below >>ED2D
  ECFE   error exit
  ECFF   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: ECFF
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          *** TREE FILE/NEED ANOTHER INDEX BLOCK ***

 ED00   reset flags <EDAF>
 ED03   read master index block <EE3B>
 ED06   error? >>ECFE
 ED08   make index into block from (FEAC)
 ED0B   MSB_of_position/2
 ED11   is there a subindex there?
 ED13   yes! >>ED20
 ED19   no, fall thru to make one

          *** GET NEW INDEX BLOCK ***

 ED1B   need an index and data block
 ED1D   go allocate them >>ED46

 ED20   set up block no. of subindex
 ED28   read it <EE1D>
 ED2B   error? >>ECFE

          *** SAPLING/TREE - THIS INDEX BLOCK ***

 ED2D   make block no. out of position (FEAC)
 ED36   use as an index to examine index block
 ED38   entry
 ED3E   if its zero...
 ED42   need new data block
 ED46   set flags for what to allocate (FE92)
 ED4F   new index block being created?
 ED51   zero data block in any case <ED67>
 ED54   if not index block that's it  >>ED89
 ED56   else,
 ED5D   zero out index block I/O buffer
 ED64   and continue >>ED89

ED67 ********* ZERO OUT DATA BLK I/O BUFFER **************************

 ED67   ---
 ED6A   zero both pages of buffer
 ED71   ---
 ED78   RETURN

ED79 ********* READ FILE DATA BLOCK ***********************************

 ED79   set block no. LSB
 ED7B   copy MSB drom index entry
 ED7F   ---
 ED81   read new data block <EE04>
 ED84   error? >>EDAE
 ED86   reset block allocation flags <EDAF>
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: ED86
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          *** GOT DATA BLOCK WANTED ***

 ED89   ---
 ED90   save previous mark in my variables (D812)
 ED96   set new mark in the FCB (FEAA)
 EDA1   ($4A/$4B --> data block buffer)
 EDA3   $4C/$4D --> start of the page in
 EDA5   the data block buffer which contains (FEAB)
 EDA8   the mark.
 EDAE   exit

EDAF ********* RESET BLOCK ALLOC FLAGS *******************************

 EDAF   get flags (FE92)
 EDB5   turn off low 3 bits (allocate no new
 EDB7   blocks to file) (D808)
 EDBA   RETURN

EDBB ********* SET DIR FILE POSITION *********************************

 EDBB   DIR file?
 EDBD   yes! >>EDC4
 EDBF   no, bad storage type error
 EDC1   go to SYSERR <BF09>
 EDC4   else, get page distance (FE86)
 EDC7   make it into blocks (divide by 2)
 EDCE   new position beyond old? (FEAB)
 EDD1   yes >>EDE1
 EDD3   else, use previous mark
 EDD5   copy to BLKNUM <EDEF>
 EDD8   error? >>EDFE
 EDDA   count it (FE9A)
 EDDD   more to skip? >>EDD3
 EDDF   no, got it >>ED89
 EDE1   use next_block pointer in DIR block
 EDE3   copy to BLKNUM <EDEF>
 EDE6   error? >>EDFE
 EDE8   count it (FE9A)
 EDEB   more to skip >>EDE1
 EDED   got it now! >>ED89

          *** COPY LINK TO BLKNUM ***

 EDEF   copy block number link
 EDF1   to BLKNUM
 EDF4   if non zero,
 EDFA   then go read block. >>EE00
 EDFC   else, EOF error
 EDFE   ---
 EDFF   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: EDFF
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

EE00 ********* READ FILE BLOCK ***************************************

  EE00  set block number to read
  EE04  store read I/O command
  EE08  read to $48/$49 buffer
  EE0A  read the block <EE61>
  EE0D  error? >>EE1C
  EE12  copy block no. just read to FCB
  EE1C  exit

EE1D ********* READ SUB-INDEX BLOCK **********************************

  EE1D  set read I/O command
  EE21  read to $48/$49 buffer
  EE23  read the block <EE61>
  EE26  error? >>EE36
  EE2B  save BLKNUM in FCB as current index
  EE2D  block. (D80E)
  EE36  exit

EE37 ********* WRITE KEY INDEX BLOCK *********************************

  EE37  set write I/O command
  EE39  and go do the I/O >>EE3D

EE3B ********* READ KEY INDEX BLOCK **********************************

  EE3B  set read I/O command
  EE3D  common code, save command
  EE40  block no. is key block in FCB (FE92)
  EE45  use $48/$49 buffer

          *** I/O BLOCK ***

  EE47  set I/O command
  EE49  and block no. (D800)
  EE53  must be non-zero block number
  EE57  or horrible death!
  EE5C  fall through to read/write block (D801)

          *** SET UP AND DO FILE BLOCK I/O ***

  EE61  (xreg = buff ptr in zero page)
  EE62  disable
  EE63  set up buffer pointer
  EE6E  get DEVNUM from FCB (D801)
  EE74  set I/O transfer has occurred flag
  EE79  set unit no. from DEVNUM (BF30)
  EE7E  no errors have occurred yet
  EE83  do block I/O  <DEDA>
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: EE86
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  EE86  error? >>EE8B
  EE88  no, exit normally
  EE8A  RETURN

  EE8B  else, exit with error
  EE8D  RETURN

EE8E ********* CHECKPOINT BITMAP & KEY BLOCK ************************

  EE8E  checkpoint bitmap buffer <EB93>
  EE91  go write key block for file >>EE37

EE94 ********* CHECKPOINT DATA BLOCK BUFFER *************************

  EE94  buffer pointer at $4A/$4B
  EE96  point to block no. in FCB
  EE9E  go write buffer to disk <EE47>
  EEA1  error? >>EEC5
  EEA5  go turn off $40 flag in FCB and exit >>EEBC

EEA8 ********* CHECKPOINT INDEX BLOCK BUFFER ************************

  EEA8  checkpoint volume bitmap <EB93>
  EEAB  use $48/$49 buffer
  EEAD  block no. is current index block in FCB
  EEB3  set to write
  EEB5  go write it to disk <EE47>
  EEB8  error? >>EEC5
  EEBA  no longer needs checkpoint
  EEBC  set flags accordingly (FE92)
  EEC5  and exit

EEC6 ***************************************************************
            ****** MLI OPEN CALL ******
            ***************************

  EEC6  search path for file <E5A3>
  EEC9  found it? >>EECF
  EECB  no, bad path error
  EECD  exit >>EED6
  EECF  else, see if FCB already open on file <EFB3>
  EED2  for write. if not, continue. >>EED8
  EED4  else, file already open error
  EED6  ---
  EED7  RETURN

  EED8  get FCB index  (FE92)
  EEDE  free FCB found? >>EEE4
  EEE0  no, all FCB's in use error
  EEE3  RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: EEE3
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EEE4  zero out unused FCB
  EEEF  copy file ID fields to FCB
  EEF2  (DEVNUM, DIR HDR BLK, DIR BLK, (FE92)
  EEF5  DIR ENTRY NO.)
  EF00  isolate storage type (FE5F)
  EF08  and copy to FCB (D807)
  EF0B  get access (FE7D)
  EF10  DIR file?
  EF12  no >>EF16
  EF14  yes, we are only reading (I hope)
  EF16  update access flag in FCB (D809)
  EF1B  write protected? >>EF22
  EF1D  no, another FCB open on this file? (FE97)
  EF20  yes, no touchie >>EED4
  EF22  This line left over from version 1.0.1! (FE7C)
  EF27  Now always jumps over error exit. >>EF2D
  EF29  if bad, unsupported version error
  EF2C  RETURN

  EF2D  storage type must be < $4
  EF31  or equal to $D
  EF33  else, compatibility error >>EF29
  EF35  ---
  EF37  copy key block, blocks used, and
  EF39  EOF mark to FCB (FE92)
  EF49  BLKNUM = key block number
  EF4E  store REFNUM in FCB (FE9A)
  EF54  go check and assign I/O buffer <FBED>
  EF57  error? >>EF7D
  EF59  go find VCB and set buff ptrs <E1EB>
  EF5C  set current level in FCB (BF94)
  EF62  seedling, sapling or tree? (D807)
  EF67  no, skip next stuff >>EF94
  EF69  yes, make current mark in FCB outside
  EF6B  first index block to force a read of all (D814)
  EF6E  index blocks and BLOCK 0.
  EF72  zero mark wanted, however (FEAA)
  EF78  go set mark to zero <EC48>
  EF7B  ok? >>EF99
  EF7D  no, save the error code
  EF81  got and I/O buffer? (D80B)
  EF84  no >>EF8C
  EF86  yes, free it <FC4A>
  EF8C  mark FCB not in use
  EF92  exit with error
  EF93  RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                 NEXT OBJECT ADDR: EF93
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  EF94  else, read key block to I/O buffer <EE04>
  EF97  error? >>EF7D
  EF99  bump open file count in VCB (FE91)
  EF9F  indicate files are open in VCB (D911)
  EFA7  put REF NUM in caller's parmlist (FE92)
  EFB1  exit with no errors
  EFB2  RETURN

EFB3 ********* FIND A FCB *********************************************

  EFB3  clear flags and index byte
  EFBE  ---
  EFBF  found a free FCB yet? (FE93)
  EFC2  yes >>EFC7
  EFC4  no, bump entry count (FE9A)
  EFC7  FCB in use? (D800)
  EFCA  yes >>EFD9
  EFCC  no,
  EFCF  save index to free FCB  (FE92)
  EFD2  flag that we found one
  EFD7  and skip this FCB >>EFF7
  EFD9  ---
  EFDF  compare file ID's to see if this FCB (D8J0)
  EFE2  is open on the requested file. (FE58)
  EFE5  no match? >>EFF7
  EFEB  indicate FCB already open on file (FE97)
  EFEE  write enabled? (D809)
  EFF3  if not, allow multiple open access to file >>EFF7
  EFF5  else, error exit
  EFF6  RETURN

  EFF7  return index to start of FCB
  EFFB  bump to next FCB
  EFFD  and loop >>EFBE
  EFFF  when done, exit normally
  F000  RETURN

F001 ******************************************************************
        ****** MLI READ CALL ******
        ***************************

  F001  point to data buffer <F20D>
  F004  copy request length <F1F2>
  F007  save access
  F008  set up marks <F21F>
  F00C  read access permitted?
  F00E  yes >>F014
  F010  no, access error
  F014  will we read past EOF? >>F03B
  F016  yes, (FE92)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FØ19
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FØ19   LENGTH = EOF - current_mark (D815)
  FØ31   are we already at EOF? (FEDA)
  FØ34   no >>FØ46
  FØ36   yes, EOF error

  FØ3B   else, zero length request? (FEDA)
  FØ41   no >>FØ46
  FØ43   yes, set mark and exit  >>FØF9

  FØ46   validity check data buffer <FC82>
  FØ49   no good? >>FØ38
  FØ4B   ok, get storage type for file <F218>
  FØ4E   standard kind of file?
  FØ5Ø   yes >>FØ55
  FØ52   no, DIR file >>F1BB

  FØ55   else, set mark (to read proper buffers) <EC48>
  FØ58   error? >>FØ38
  FØ5A   set up buffer indexing <F11Ø>
  FØ5D   move all that can be moved out of data buff <F13A>
  FØ6Ø   newline or len=Ø: exit now! >>FØ43
  FØ62   newline enabled? continue block by block >>FØ55
  FØ64   at least 1 block's worth left to be read? (FEAE)
  FØ68   if not, never mind >>FØ55
  FØ6A   if so, store block count wanted (FEAF)
  FØ6D   get FCB flags <F6Ø6>
  FØ7Ø   data block modified?
  FØ72   yes, continue block by block for now >>FØ55

           *** FAST DIRECT READ ROUTINE ***

  FØ74   signal no read occurred yet (FEB2)
  FØ77   read directly into caller's data buffer
  FØ7F   set mark/read data block to caller's buff <EC48>
  FØ82   error? >>FØED
  FØ84   bump buffer pointer to next location
  FØ88   drop length remaining by 512 bytes (FEAE)
  FØ8E   bump mark (FEAB)
  FØ96   and mark's MSB as necessary (FEAC)
  FØ99   check if we are out of index block (FEAC)
  FØ9F   drop counter of multi-blocks (FEAF)
  FØA2   and keep on >>FØB1
  FØA4   end of multi-block read, put ptrs back <F1AD>
  FØA7   more to read? (FEAD)
  FØAD   no, exit through finish-up >>FØF9
  FØAF   yes, conventional block by block read then >>FØ55
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FØAF
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FØB1   crossed index block? go do set mark >>FØ7F
  FØB3   make index block offset from mark (FEAC)
  FØBC   BLKNUM = next block in index block
  FØC2   zero entry?
  FØCA   if so, no direct read can occur until next (FEB2)
  FØCD   set-mark/read >>FØD2
  FØCF   get MSB of BLKNUM
  FØD2   (put index ptr back)
  FØD6   finish setting BLKNUM MSB
  FØD8   if no read occurred within setmark, (FEB2)
  FØDB   go back to setmark call >>FØ7F
  FØDF   disable
  FØEØ   do I/O to caller's buffer directly
  FØE4   do block I/O directly <DEDA>
  FØE7   error? >>FØEC
  FØEA   go back for more >>FØ84

           *** ERROR CLEANUP ***

  FØEC   ---
  FØED   ---
  FØEE   set buffer ptrs/VCB <F1AD>
  FØF2   ---
  FØF3   finish up I/O <FØF9>
  FØF7   exit with error
  FØF8   RETURN

FØF9 ********* I/O FINISH UP ******************************************

  FØF9   ---
  FØFC   return actual length read in caller's list (FEDA)
  F1ØD   and exit by setting new mark >>EC48

F11Ø ********* SET UP BUFFER INDEXING *********************************

  F11Ø   ---
  F114   back up pointer to data buffer by an
  F116   amount equal to the LSB of the mark (FEAA)
  F119   (which makes indexing easier)
  F11F   newline mode enabled? (D81F)
  F123   no, CLC >>F12F
  F125   yes, SEC
  F126   copy newline mask (FEB1)
  F129   and newline character (D8ØA)
  F12F   first char index is LSB of mark in YREG (FEAA)
  F132   $4C/$4D --> page containing mark
  F136   request count LSB in XREG (FEAD)
  F139   exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: F139
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------


F13A ********* COPY FROM I/O BLOCK BUFF ******************************
          ****** TO DATA BUFFER              ******
          EXITS IF:   LENGTH GOES TO ZERO
                      NEXT BLOCK IS NEEDED
                      NEWLINE IS FOUND
          ON EXIT: OVERFLOW FLAG SET IF DONE
                   OVERFLOW ZERO IF NEXT BLOCK NEEDED

  F13A  ---
  F13B  partial page to move? >>F145
  F13D  no, any full pages left? (FEAE)
  F14Ø  no, read complete >>F194
  F142  yes, drop MSB of request length (FEAE)
  F145  ---
  F146  copy one byte $4C --> $4E
  F14B  end of requested chunk? >>F168
  F14D  no, newline enabled? >>F17D
  F14F  ---
  F151  no, loop for more >>F146
  F153  end of page, bump pointers
  F157  bump new mark (FEAB)
  F15F  finished first page of block buffer?
  F163  if so, continue >>F146
  F166  no, need another block from disk >>F197
  F168  another page in request length? (FEAE)
  F16B  no >>F187
  F16E  more in this block-page? >>F176
  F17Ø  no, on last page of block?
  F174  no >>F179
  F176  yes, drop request len by one page (FEAE)
  F179  back up to next byte again
  F17A  go copy next page >>F14D

  F17D  check for newline
  F185  not it, never mind! >>F14F
  F187  else, were we done with page?
  F188  no >>F194
  F18A  yes, bump pointer
  F18C  and mark (FEAB)
  F194  set overflow flag (read completed) (F1AC)

  F197  update mark LSB (FEAA)
  F19C  bump request count if necessary
  F19D  update count LSB (FEAD)
  F1A3  point beyond data in caller's buffer
  F1AB  ---
  F1AC  and exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: F1AC
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

F1AD ********* CLEANUP AFTER DIRECT I/O ******************************

  F1AD  restore caller's data buffer pointer
  F1B8  go set buffers/find VCB and exit >>E1EB

F1BB ********* DIRECTORY FILE READ ***********************************

  F1BB  set mark/read <EC48>
  F1BE  error? >>F1EF
  F1CØ  set up buffer indexing <F11Ø>
  F1C3  move data from I/O buffer <F13A>
  F1C6  need next block? >>F1BB
  F1C8  no, finish up I/O <FØF9>
  F1CB  ok? exit >>F1ED
  F1CD  not ok. EOF error?
  F1DØ  no, out now >>F1EE
  F1D2  yes, point beyond EOF anyway? <ED89>
  F1D5  zero out data block I/O buffer <ED67>
  F1DD  dummy up an empty DIR block with previous (D81Ø)
  F1EØ  pointer and no forward pointer in I/O
  F1E2  buffer.
  F1E4  zero out current block no. (D81Ø)
  F1ED  return to caller
  F1EE  RETURN

  F1EF  finish up and error exit >>FØF2

F1F2 ********* COPY CALLER'S I/O LENGTH ******************************

  F1F2  copy request length to LENGTH and
  F1F4  a temporary variable
  F2Ø5  pick up ACCESS flcgs for file (FE92)
  F2ØB  exit to caller
  F2ØC  RETURN

F2ØD ********* POINT $4E/$4F TO CALLER'S ******************************
          ****** DATA BUFFER                    ******

  F2ØD  set up pointer
  F218  YREG --> FCB (FE92)
  F21B  AREG = storage type (D8Ø7)
  F21E  exit

F21F ********* COPY FILE MARK AND COMPUTE *****************************
          ****** AND COMPARE END MARK         ******
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: F21F
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  F21F   ---
  F225   copy file mark (D812)
  F22B   and set previous mark also (FE8D)
  F22E   add length giving new mark in scratch area (FEDA)
  F235   (3 byte addition)
  F23D   will new mark exceed EOF? (FE86)
  F24B   return with carry set accordingly

F24C ********* SET NEW MARK & EOF ***********************************

  F24C   set up indexes <F27E>
  F24F   set new EOF in FCB (FE8A)
  F255   and new mark (FE8D)
  F25B   save new mark in scratch variable too (FE86)
  F262   does mark exceed EOF? <F27E>
  F265   if so, we must extend EOF <F23D>
  F26B   save old EOF (D815)
  F273   set new EOF to mark if necessary (FE86)
  F279   ---
  F27D   exit

  F27E   subroutine to set 3 byte indexes
  F285   RETURN

F286 *****************************************************************
          ****** MLI WRITE CALL ******
          ****************************

  F286   copy request length <F1F2>
  F28A   copy file mark <F21F>
  F28D   extend EOF if needed <F268>
  F291   write access enabled?
  F293   yes >>F299
  F295   no, access error
  F299   check status of this device <F458>
  F29C   error? >>F2D9
  F29E   request length = Ø? (FEDA)
  F2A4   no >>F2A9
  F2A6   yes, exit through finish-up >>FØF9

  F2A9   find caller's data buffer <F2ØD>
  F2AC   check storage type
  F2AE   if DIR file, error >>F295
  F2BØ   set mark/read blocks <EC48>
  F2B3   error? >>F2D9
  F2B5   get FCB flags <F6Ø6>
  F2B8   any new blocks needed?
  F2BA   no >>F31E
  F2BC   yes, allocating them
  F2BE   ---
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: F2BF
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  F2BF   count number of blocks needed
  F2C2   store number needed (FE94)
  F2C8   see if the blocks are available <E973>
  F2CB   no, disk full >>F2D9
  F2CD   yes, get FCB flags  <F6Ø6>
  F2DØ   master index block needed?
  F2D2   no >>F2E1
  F2D4   yes, go add it <F399>
  F2D7   and go on if no errors >>F2ED

  F2D9   error,
  F2DA   set new mark/EOF <F24C>
  F2DE   and finish I/O, exit with error >>FØF2

  F2E1   check FCB flags again <F6Ø6>
  F2E4   need sub-index block?
  F2E6   no >>F2ED
  F2E8   yes, go do it <F3E4>
  F2EB   error? >>F2D9
  F2ED   buy a new block for data <F438>
  F2FØ   error? >>F2D9
  F2F2   get FCB flags <F6Ø6>
  F2F5   indicate index buffer changed
  F2F7   no new blocks needed now
  F2F9   update FCB dlags (D8Ø8)
  F2FF   make index block offset from mark
  F3Ø7   store new block no. in index block (FE87)
  F314   and store it as current data block (FE92)
  F31E   set up buffer indexing <F11Ø>
  F321   start writing <F329>
  F324   go see if more blocks are needed >>F2BØ
  F326   I/O finish up when done >>FØF9

F329 ********* COPY WRITE DATA TO I/O BLOCK **************************

  F329   ---
  F32C   lower request count by 1 (FEAE)
  F334   ---
  F335   copy partial page from caller's data
  F337   to I/O block buffer
  F33C   ---
  F33F   next page in caller's area
  F343   bump mark by $1ØØ (FEAB)
  F34B   still in same I/O block page?
  F34F   yes >>F334
  F352   no, clear overflow (I/O incomplete) >>F379
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: F352
--------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------

  F354  any complete pages left to write? (FEAE)
  F357  no >>F369
  F359  yes, more in this page?
  F35A  yes >>F362
  F35C  no, first block-page?
  F36Ø  no >>F365
  F362  yes, one less complete page to do (FEAE)
  F365  readjust index
  F366  continue with full page >>F33C

  F369  ---
  F36A  a few bytes left to write? >>F376
  F36C  no, bump data buffer by $1ØØ
  F36E  and mark (FEAB)
  F376  set overflow (I/O complete) (F1AC)
  F379  store LSB of mark (FEAA)
  F37C  and of request count (FEAD)
  F38Ø  indicate data block modifed <F6Ø6>
  F383  and DIR entry needs update
  F389  advance pointer into caller's buffer (FEAA)
  F394  set FCB flag to indicate write occurred <FA66>
  F398  exit

F399 ********* ADD NEW MASTER INDEX BLOCK ***************************
          (MAKE A TREE FILE)

  F399  add higher level <F3F1>
  F39C  error? >>F3FØ
  F39E  get storage type <F218>
  F3A1  tree?
  F3A3  yes >>F3AA
  F3A5  no, add another level <F3F1>
  F3A8  error? >>F3FØ
  F3AA  buy another block <F438>
  F3AD  error? >>F3FØ
  F3AF  maie offset into current index block (FEAC)
  F3B2  from current mark
  F3B4  point index to new block (FE86)
  F3C3  also save as current data block (FE92)
  F3CD  checkpoint bitmap & key block <EE8E>
  F3DØ  error? >>F3FØ
  F3D5  zero out new index block
  F3DC  ---
  F3E3  and exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: F3E4
--------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------

F3E4 ********* ADD NEW INDEX BLOCK **********************************

  F3E4  check storage type <F218>
  F3E9  seedling? >>F3F1
  F3EB  no, read key index block <EE3B>
  F3EE  and go add data block >>F3AA
  F3FØ  exit if error occurs

        *** ADD A HIGHER INDEX LEVEL TO FILE ***

  F3F1  buy a block <F438>
  F3F4  error? >>F437
  F3F9  save old key block number (D8ØC)
  F4Ø1  make new block the key block (D8ØC)
  F4ØE  and current index block in FCB (D8ØF)
  F417  store pointer to old key block
  F41A  in first position of new index
  F421  checkpoint bitmap and new key block <EE8E>
  F424  error? >>F437
  F426  get storage type <F218>
  F42B  upgrade it to next higher type (D8Ø7)
  F42E  indicate DIR entry needs update  (D8Ø8)
  F437  exit

F438 ********* BUY A DISK BLOCK *************************************

  F438  allocate a disk block <EAB6>
  F43B  error? >>F457
  F43D  get FCB flags <F6Ø6>
  F44Ø  indicate DIR entry needs update
  F449  add 1 to blocks in use for file
  F456  ---
  F457  exit

F458 ********* DO STATUS IF NO I/O YET ******************************

  F458  get FCB flags <F6Ø6>
  F45B  any buffers in use? (I/O activity)
  F45D  if so, assume its ok >>F456
  F45F  no, (D8Ø1)
  F462  select new device (BF3Ø)

        *** STATUS CALL ***

  F465  Save Unit Number
  F467  Save Block Number on stack
  F46D  Indicate Status call
  F471  Indicate Block Ø
  F475  Go do I/O <DEDA>
  F478   Restore Block Number to original value
  F48Ø   Exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                    NEXT OBJECT ADDR: F481
-----------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------------

F481 ***********************************************************************
          ****** MLI CLOSE CALL ******
          ****************************

  F481  check REF NUM
  F485  specific close?  >>F4BC

          *** CLOSE ALL OPEN FILES ***

  F487  no errors yet (FEBE)
  F48C  store FCB index (FE92)
  F490  get its level (D81B)
  F493  if below system LEVEL, skip it (BF94)
  F496  yes, skip it >>F4AD
  F498  no, active FCB? (D800)
  F49B  no >>F4AD
  F49D  yes, flush it and update directory <F51E>
  F4A0  error? >>F4EF
  F4A2  no, close specific FCB <F4C1>
  F4A7  is this a close-all?
  F4A9  yes, ignore errors >>F4AD
  F4AB  no, stop on error >>F4EF
  F4AD  bump FCB index to ngxt one (FE92)
  F4B3  and continue >>F48C
  F4B5  when done, load error number (FEBE)
  F4BB  and exit

          *** CLOSE SPECIFIC FILE ***

  F4BC  flush it <F526>
  F4BF  error? >>F4EF
  F4C1  get buffer number (FE92)
  F4C7  free its pages <FC4A>
  F4CA  error? >>F4EF
  F4CC  release FCB
  F4D4  set DEVNUM (D801)
  F4DA  find VCB for device <E876>
  F4DD  decrement count of open files in VCB (FE91)
  F4E3  some are open... >>F4ED
  F4E5  if all are closed, turn off (D911)
  F4E8  "files open" flag
  F4ED  ---
  F4EE  exit

  F4EF  jump to handle close error >>F5F7
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                    NEXT OBJECT ADDR: F4EF
-----------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------------

F4F2 ***********************************************************************
          ****** MLI FLUSH CALL ******
          ****************************

  F4F2  flush specific file?
  F4F6  yes  >>F526
  F4F8  no, clear flush-all error code (FEBE)
  F4FB  do all FCBs
  F4FD  set FCB index for next FCB (FE92)
  F501  is this file open? (D800)
  F504  no >>F50B
  F506  yes, flush it <F51E>
  F509  error? >>F51B
  F50B  bump to next FCB (FE92)
  F511  and go flush it too >>F4FD
  F513  ---
  F514  return with error code if any (FEBE)
  F51A  RETURN

  F51B  ---

F51E ********** FLUSH A FILE & UPDATE DIRECTORY **********************

  F51E  find buffer/VCB <E1EB>
  F521  no error? >>F530
  F523  error - exit >>F5F7

  F526  zero out close-all error
  F52B  validity check REF NUM <E1D0>
  F52E  error? >>F51B
  F530  is write access allowed? (D809)
  F535  no, exit >>F513
  F537  has a write occured since last flush? (D81C)
  F53A  yes >>F543
  F53C  no, <F606>
  F53F  does anything need flushing anyway?
  F541  no, then exit now >>F513
  F543  else, get FCB flags <F606>
  F546  has data buffer changed?
  F548  no >>F54F
  F54A  yes, checkpoint it <EE94>
  F54D  error? >>F51B
  F54F  get flags again <F606>
  F552  has index buffer changed?
  F554  nm >>F55B
  F556  yes, checkpoint it <EEA8>
  F559  error? >>F51B
  F55B  ---
  F562  copy file identifier data to my variables (D800)
  F56C  set DEVNUM (BF30)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: F56F
--------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------

  F56F   BLKNUM = current DIR block (FE5A)
  F579   read DIR block <EBEE>
  F57C   error? >>F51B
  F57E   copy directory header <E6AB>
  F581   are we in block with this file's entry? (FE5C)
  F58A   no >>F591
  F58F   yes >>F598
  F591   no, set new block number
  F595   read it <EBEE>
  F598   point at directory entry in block <E49D>
  F59B   copy file entry from directory <E5A8>
  F5A1   copy blocks_used count to entry (D818)
  F5AF   copy new EOF (D815)
  F5BA   and new key block no. (D80C)
  F5C3   isolate new storage type (D805)
  F5CD   combine it with name length (FE5F)
  F5D5   and update type/len field in entry (FE5F)
  F5D8   write entry back to directory <E4B6>
  F5DB   error? >>F5F7
  F5E0   turn off "write occurred" flag (D81C)
  F5E8   same bitmap in memory (FE59)
  F5EE   no, exit now >>F5F5
  F5F0   yes, checkpoint it also <EB93>
  F5F5   no errors, exit
  F5F6   RETURN

F5F7 ********** CLOSE ERROR *******************************************

  F5F7   is this a close or flush all?
  F5FC   no >>F604
  F600   yes, save error code (FEBE)
  F603   RETURN

  F604   else, real error right now
  F605   RETURN

F606 ********** GET FCB FLAGS *****************************************

  F606   load FCB flags (FE92)
  F609   from FCB (D808)
  F60C   and exit

F60D ********** FILE ACCESS ERROR *************************************

  F60D   exit with file access error code
  F610   RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: F610
--------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------

F611 *****************************************************************
           ****** MLI SET EOF CALL ******
           ******************************

  F611   get storage type <F218>
  F614   if DIR file...
  F616   its an access error >>F60D
  F618   else, save type for truncate to
  F619   mess with.
  F61F   write access permitted? (D809)
  F624   no, error >>F60D
  F626   check device status <F458>
  F629   error? >>F60D
  F632   copy EOF from FCB (D815)
  F640   copy caller's new EOF
  F64B   compare old EOF to new (FE8A)
  F651   if less than or equal to... >>F658
  F653   if greater... >>F66D

           *** OLD EOF <= NEW EOF ***
           *** NO TRUNCATE NEEDED ***

  F658   new eof beyond old
  F65F   copy caller's EOF to FCB
  F66A   exit by indicating flush needed >>FA66

           *** OLD EOF > NEW EOF ***
           (** TRUNCATE FILE     ***

  F66D   flush first <F526>
  F670   error? >>F610
  F672   $43/$49 --> end of data block I/O buffer
  F67C   compare current mark to new EOF (FE92)
  F689   it is prior to EOF >>F6A2
  F691   if past EOF, force mark back to EOF (FE92)
  F6A2   construct EOF block number and (FEAA)
  F6A5   byte offset into block from new (FEC6)
  F6A8   EOF mark. (FEAB)
  F6C0   on a block boundary? (FEC7)
  F6C3   yes  >>F6E2
  F6C5   no, (FEC5)
  F6C9   decrement block by 1
  F6D7   but don't let it fall below 0
  F6E2   copy key block number (FE92)
  F6F1   set blocks freed to zero
  F6F9   truncate file at new EOF <FA78>
  F6FC   save status
  F704   set new key block in FCB (FEBF)
  F70A   drop FCB block count by number (D818)
  F70D   of blocks freed in truncate routine. (FEC2)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: F71A
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  F71A  copy new storage type (FEC1)
  F727  turn off all block allocation flags <EDAF>
  F72A  update VCB free block count <F9F3>
  F734  copy mark (D812)
  F73C  force current mark to infinity (D812)
  F743  go set mark <EC48>
  F746  no errors? >>F74F
  F748  if error, indicate in saved status
  F74E  but continue
  F74F  copy caller's EOF to FCB <F658>
  F752  Flush and update <F526>
  F755  no errors? >>F75E
  F757  if error, indicate in saved status
  F75D  but continue
  F75E  ---
  F760  exit

F761 *******************************************************************
         ****** MLI GET_EOF CALL ******
         *******************************

  F761  ---
  F766  copy EOF to caller's list (D815)
  F772  exit -- no errors

F773 *******************************************************************
         ****** MLI NEW_LINE CALL ******
         ********************************

  F773  ---
  F775  copy newline mask
  F77E  and newline character
  F784  return, no errors

F785 *******************************************************************
         ****** MLI GET FILE INFO CALL ******
         ************************************

  F785  get the file entry <E5A3>
  F788  ok? >>F7CC
  F78A  no, bad path?
  F78D  no, real error  >>F7E9
  F78F  else, make it VOL DIR type
  F791  with name length = Ø (FE5F)
  F796  no free blocks needed (FE94)
  F79C  go through the motions to update the (FE91)
  F79F  VCB block count. <E97E>
  F7A5  copy blocks free from VCB (D915)
  F7B1  copy total blocks on volume to AUX_ID (D913)
  F7BF  total - free = blocks_used (FE94)
  F7CC  shift type down from high nibble (FE5F)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: F7D8
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  F7D8  copy the data to caller's parmlist (FEØC)
  F7E9  and exit

F7EA *******************************************************************
         ****** MLI SET FILE INFO CALL ******
         ************************************

  F7EA  get the file entry <E5A3>
  F7ED  error? >>F814
  F7EF  indicate backup needed now (BF95)
  F7FE  copy 13 parms from caller's list to (FEØC)
  F8Ø1  file entry staging area >>F8Ø8
  F8Ø8  ---
  F8ØD  if any spurious access bits are on...
  F811  access error!
  F814  RETURN

  F815  else, anything in his modification date?
  F819  no >>F81E
  F81B  yes, go update directory >>E4C6

  F81E  no, use system date then update directory >>E4B6

F821 *******************************************************************
         ****** MLI RENAME CALL ******
         *****************************

  F821  follow path to file <E5B6>
  F824  ok? >>F863
  F826  no, bad name?
  F828  no, real error >>F842

         *** RENAME VOLUME ***

  F82A  yes, copy new name <F94B>
  F82D  error? >>F842
  F82F  get first length (D7ØØ)
  F833  get next (D7ØØ)
  F836  bad path if more than one name for vol >>F8B7
  F83B  files open on volume? (D911)
  F83E  no, continue >>F844
  F84Ø  yes, file open error
  F842  ---
  F843  RETURN

  F844  make type/len for a VOL DIR HDR
  F84B  write new name to VOL HDR <F93C>
  F84E  error? >>F8B9
  F855  copy new name to device's VCB (D7ØØ)
  F861  exit, no errors
  F862  RETURN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: F862
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          *** RENAME FILE ***

 F863  get path index <F959>
 F866  copy old name with prefix to my buffer (D700)
 F872  copy new name to buffer <F94B>
 F875  error? >>F8B9
 F877  get path index <F959>
 F87D  compare all levels of names up to and (DC00)
 F880  including the last. Find first which
 F881  differ.
 F885  save indicies into names which point to (FEB9)
 F888  final name. (FEBA)
 F88B  ---
 F895  exit if they match completely
 F896  RETURN

 F897  index to differing new name (FEB9)
 F89A  point past it (D700)
 F8A2  must be the last! (D700)
 F8A5  it isn't >>F8B7
 F8A7  it is, (FEBA)
 F8AA  do the same with the old name (DC00)
 F8B5  difference is only in last index? >>F8BB
 F8B7  no, bad path error
 F8B9  ---
 F8BA  RETURN

 F8BB  names good. follow path to new file <E5B6>
 F8BE  better get an error >>F8C4
 F8C0  if found, duplicate name in directory
 F8C3  RETURN

 F8C4  if error, better be file not found
 F8C6  or else its really an error... >>F8B9
 F8C8  copy old pathname again <E08A>
 F8CB  get its file entry <E5A3>
 F8CE  error? >>F8B9
 F8D0  search FCB's <EFB3>
 F8D5  exit if the file is open for write >>F8B9
 F8DA  does ACCESS permit rename?
 F8DC  yes >>F8E2
 F8DE  no, access error
 F8E0  ---
 F8E1  RETURN

 F8E2  get type/len from entry (FE5F)
 F8E7  DIR file?
 F8E9  yes, ok >>F8F3
 F8EB  seedling, sapling or tree?
 F8ED  yes, ok >>F8F3
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: F8EF
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

 F8EF  else, compatibility error
 F8F3  copy new path again <F94B>
 F8F6  error? >>F8B9
 F8F8  get length of last name (FEB9)
 F903  copy it and name to file entry buffer (D700)
 F913  combine new len with type (D700)
 F919  DIR file?
 F91B  no, go update entry and exit >>F939
 F91D  yes, (FE70)
 F927  read key block of this subdirectory <EBEE>
 F92A  error? >>F8B9
 F92F  copy new name to DIR HDR (D700)
 F934  and update directory's key block <F93C>
 F937  error? >>F8B9
 F939  go update directory entry and exit >>E4C6

F93C ********* COPY PATH TO BUFF & WRITE ****************************

 F93C  copy type/len and path to my buffer
 F948  go write the block >>EBEA

F94B ********* POINT TO NEW NAME ************************************
            COPY TO BUFFER

 F94B  $48/$49 --> second pathname
 F956  go copy it  >>E095

F959 ********* LOAD PATH INDEX **************************************

 F959  load pathname index
 F960  (including prefix if any) (BF9A)
 F963  ---
 F965  RETURN

F966 ****************************************************************
            ****** MLI DESTROY CALL ******
            ******************************

 F966  get file entry <E5A3>
 F969  error? >>F9B5
 F96B  find FCB if any <EFB3>
 F96E  FCB open? (FE97)
 F971  no >>F977
 F973  yes, file open error
 F976  RETURN

 F977  no free blocks needed
 F97F  go compute VCB free block count <E973>
 F982  ok? >>F989
 F984  error, disk full?
 F987  no, real error >>F9B5
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: F989
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

 F989   DESTROY enabled in ACCESS? (FE7D)
 F98E   yes >>F995
 F99Ø   no, access error
 F995   check status of device (BF3Ø)
 F99B   error? >>F9B5
 F99D   point to key block (FE7Ø)
 F9AC   DIR file?
 F9BØ   no >>F9B6
 F9B2   yes, handle differently >>FAØE

 F9B5   RETURN

          *** DESTROY NON-DIRECTORY FILE ***

 F9B6   set new storage type (FEC1)
 F9BD   zero EOF mark (FEC1)
 F9C3   byte offset = $2ØØ
 F9C8   free all blocks in file <FA78>
 F9CB   error? >>F9B5
 F9CD   free key block of seedling (FECØ)
 F9D6   error? >>F9B5
 F9D8   mark DIR entry free
 F9DD   decrement DIR file count (FE53)
 F9E8   checkpoint volume bit map <EB93>
 F9EB   error? >>F9B5
 F9ED   update free block count in VCB <F9F3>
 F9FØ   and go update the directory >>E4B6

          *** SUBROUTINE TO UPDATE FREE BLOCK ***
          *** COUNT IN VCB                    ***

 F9F3   add blocks freed to total free blocks (FE91)
 F9F6   in VCB. (FEC2)
 FAØ8   start next search for free blocks at
 FAØA   start of bitmap. (D91C)
 FAØD   exit

          *** DESTROY DIRECTORY FILE ***

 FAØE   DIR file?
 FA1Ø   no, error >>FA61
 FA12   read volume bitmap block <EB64>
 FA15   error? >>FA6Ø
 FA17   BLKNUM = key block pointer (FE7Ø)
 FA21   read it <EBEE>
 FA24   errors? >>FA6Ø
 FA26   if DIR has any files... (DC25)
 FA3Ø   access error
 FA35   write back block marking entry free (DCØ4)
 FA3B   error? >>FA6Ø
 FA3D   if "next_pointer" is zero.... (DCØ2)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: FA47
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

 FA47   go back and pretend it's a seedling >>F9CD
 FA49   else, (DCØ3)
 FA4C   free next block  <EA34>
 FA4F   error? >>FA6Ø
 FA51   BLKNUM = next block (DCØ2)
 FA5B   read it <EBEE>
 FA5E   if ok, continue in loop >>FA3D
 FA6Ø   else, error exit

 FA61   incompatible file format error

FA66 ********* SET WRITE OCCURRED FLAG ********************************

 FA66   save some registers
 FA69   indicate write occured (FE92)
 FA74   restore registers and exit
 FA77   RETURN

FA78 ********** TRUNCATE FILE AT EOF **********************************

 FA78   check storage type*16 (FEC1)
 FA7B   seedling?
 FA7D   yes >>FA8A
 FA7F   no, sapling?
 FA81   yes >>FA8D
 FA83   no, tree?
 FA85   yes >>FA9Ø
 FA87   no, die horribly <BFØC>
 FA8A   go to seedling truncate >>FB5C

 FA8D   go to sapling truncate >>FB23

 FA9Ø   truncate tree,
 FA92   at most 128 blocks in master index (FEC8)
 FA95   read the master index <FB87>
 FA98   error? >>FAF5
 FA9A   at EOF yet? (FEC8)
 FAAØ   yes >>FAF6

           *** FREE WHOLE INDEX BLOCKS AFTER EOF ***
           (free 8 subindex blocks each time the
           master index block is read since we must
           qhare its buffer)

 FAA2   copy up to 8 non-zero index bnock
 FAA4   numbers to (DCØØ)
 FAA7   a handy table (FECA)
 FAB8   ---
 FAC1   if there weren't 8 left to do, zero (FECA)
 FAC4   remainder of the table (FED2)
 FACA   ---
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: FACB
--------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------

  FACB  update master index counter (FEC8)
  FADØ  for all 8 entries: (FEC9)
  FAD3  set BLKNUM (FECA)
  FADB  (exit when a Ø entry is found) >>FA95
  FAE2  read the sub-index block <EBEE>
  FAE5  error? >>FAF5
  FAE7  free all its blocks <FBB6>
  FAEA  error? >>FAF5
  FAFØ  and loop to do all 8 >>FADØ
  FAF2  then go back and reread master index >>FA95
  FAF4  normal exit
  FAF5  RETURN

  FAF6  now go free all the sub-index blocks (FEC4)
  FAFA  which follow EOF <FBB8>
  FAFD  error? >>FAF5
  FAFF  write back master index <EBEA>
  FBØ2  error? >>FAF5
  FBØ4  EOF in first subindex? (FEC4)
  FBØ7  if so, demote to sapling fkle >>FB1E
  FBØ9  else, BLKNUM = subindex block which (DCØØ)
  FBØC  contains the EOF mark
  FB11  (exit if none there) >>FAF4
  FB18  else, read subindex block <EBEE>
  FB1B  and continue below >>FB28
  FB1D  unless there is an error

  FB1E  demote tree to sapling <FB94>
  FB21  error? >>FAF5

            *** TRUNCATE SAPLING FILE ***

  FB23  read key block <FB87>
  FB26  error?  >>FAF5
  FB28  get LSB of block number (FEC5)
  FB2C  if zero, no blocks to free >>FB38
  FB2E  else, free rest of blocks in index <FBB8>
  FB31  following the EOF. check for error >>FAF5
  FB33  write index block back <EBEA>
  FB36  error? >>FAF5
  FB38  get LSB of block number (FEC5)
  FB3B  might be block Ø? >>FB52
  FB3D  no, get BLKNUM of data block (DCØØ)
  FB4Ø  from index block
  FB45  (no block allocated?) >>FAF4
  FB4C  read data block <EBEE>
  FB4F  and continue below >>FB61
  FB51  unless error occured
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84             NEXT OBJECT ADDR: FB51
--------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
--------------------------------------------------------------------

  FB52  back to block Ø? (FEC4)
  FB55  no >>FB3D
  FB57  yes, demote to seedling <FB94>
  FB5A  error? >>FB86

            *** TRUNCATE SEEDLING FILE ***

  FB5C  read key block <FB87>
  FB5F  error? >>FB86
  FB61  first page? (FEC7)
  FB64  yes >>FB6C
  FB67  no, better be second >>FB85
  FB69  get byte offset (FEC6)
  FB6C  ---
  FB6E  zero beyond EOF mark (DDØØ)
  FB7C  in both pages if necessary (DCØØ)
  FB82  then write block back and exit >>EBEA

  FB85  exit normally
  FB86  RETURN

FB87 ********** READ KEY BLOCK ***************************************

  FB87  BLKNUM = key block number (FEBF)
  FB91  exit by reading the block >>EBEE

FB94 ********** DEMOTE FILE TO SMALLER FILE TYPE*********************

  FB94  free block (FECØ)
  FB9D  error? >>FBB5
  FB9F  get block from old index (DCØØ)
  FBAC  reduce storage type by one (FEC1)
  FBB4  and exit
  FBB5  RETURN

FBB6 ********** FREE ALL BLOCKS IN AN INDEX BLK *********************

  FBB6  ---
  FBB8  save BLKNUM
  FBBE  for each index entry after mark, (FE9D)
  FBC9  if it is non-zero....
  FBDØ  free the block <EA34>
  FBD3  error? >>FBE4
  FBD5  zero the index entry now (FE9D)
  FBEØ  ---
  FBE1  loop through all entries >>FBBE
  FBE4  ---
  FBE6  restore old BLKNUM
  FBEC  and exit
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: FBEC
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

FBED ********** ALLOCATE I/O BUFFER **********************************

  FBED  ---
  FBEF  get I/O buffer page number
  FBF2  can't be below $800
  FBF4  else, error >>FC38
  FBF6  can't be above $BC00
  FBF8  else, error >>FC38
  FBFD  $4A/$4B --> I/O buffer
  FC01  must be page aligned! >>FC38
  FC07  ---
  FC08  check each page of I/O buffer for <FC73>
  FC0B  prior allocation in system bit map (BF58)
  FC18  ---
  FC19  if ok, mark each page as allocated <FC73>
  FC1C  in system memory bit map (BF58)
  FC29  assign buffer number (REFNUM*2) in FCB (D800)
  FC31  and save buffer location in buffer list
  FC36  exit
  FC37  RETURN

  FC38  bad I/O buffer error
  FC3B  RETURN

FC3C ********** LOCATE I/O BUFFER ************************************

  FC3C  ---
  FC3D  AREG contains buffer number *2 (BF6E)
  FC40  move buffer pointer to NXTBUF variable (FEDD)
  FC49  exit

FC4A ********** FREE I/O BUFFER **************************************

  FC4A  is buffer already free? <FC3C>
  FC4F  yes, exit >>FC71
  FC53  zero its address in system global page (BF6F)
  FC60  ---
  FC61  free each page in buffer <FC73>
  FC64  by marking system bit map
  FC71  exit
  FC72  RETURN

FC73 ********** LOCATE BIT MAP POSITION ******************************
         (GIVEN PAGE NUMBER)

  FC73  XREG contains page number
  FC74  compute page number times 8
  FC77  use as offset for bitmask (FE00)
  FC7E  page number / 8 = byte offset
  FC7F  into bitmap
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                NEXT OBJECT ADDR: FC81
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  FC81  exit

FC82 ********** CHECK BUFFER VALIDITY ********************************
                  START > $200     END < $BF00

  FC82  get buffer address (MSB)
  FC86  must be >$200 else error >>FC38
  FC88  get length (FEDB)
  FC8E  compute last page no. of buffer
  FC93  ---
  FC9A  may not extend into $BF00
  FC9C  else, error >>FC38

            *** CHECK IF BLOCK OF MEMORY IS FREE ***

  FC9F  ---
  FCA0  see if this page is allocated <FC73>
  FCA6  if so, error >>FC38
  FCA8  else, check other paee also
  FCAC  then exit if both have been checked
  FCAD  RETURN

FCAE *****************************************************************
            ****** MLI GET_BUFF CALL ******
            ******************************

  FCAE  get next available buffer
  FCB3  put its address in caller's parmlist
  FCBB  and exit
  FCBC  RETURN

FCBD *****************************************************************
            ****** MLI SET_BUFF CALL ******
            ******************************

  FCBD  mark his buffer allocated
  FCC2  error? >>FCE4
  FCC4  get old buffer address (FEDE)
  FCCE  free old buffer's pages in map <FC59>
  FCD5  copy old buffer contents
  FCD7  to new buffer
  FCE3  then exit
  FCE4  RETURN

FCE5 ********* GO TO QUIT CODE HANDLER *******************************

  FCE5  enable 2nd 4K bank of language card (C083)
  FCE8  (it lives at $D100-$D3FF) (C083)
  FCEB  Save zeropage $00 through $03 on stack
  FCF7  Set ($00) -> $D100
  FCF9  Set ($02) -> $1000
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FDØ5
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

  FDØ5    Set Y = Ø
  FDØ6   3 pages of code to copy
  FDØ8   ---
  FDØ9   copy quit code handler to $1ØØØ
  FD17    Restore zero page to original state
  FD23   enable HIGH RAM BANK1 (CØ8B)
  FD26   (MLI) (CØ8B)
  FD2B   point RESET vector at $1ØØØ (Ø3F2)
  FD33   set power-up byte properly
  FD38   go to quit code handler at $1ØØØ >>1ØØØ

FD3B *********** NEW ROUTINE ******************************************
           THE ADDRESS OF THIS ROUTINE IS AT $3EA.
            WE COULD NOT DETERMINE ITS PURPOSE.

  FD3B   ---
  FD3C   get current P-reg in accumulator
  FD3D   save current P-reg
  FD3E   clear overflow flag
  FD3F   interrupts disabled?
  FD41   no >>FD46
  FD43   yes, set overflow flag (FD64)
  FD46   disable interrupts
  FD47   enable RAM, BANK2 (CØ83)
  FD4D   set carry, indicating error
  FD4E   pass a 5 to page 3 subroutine
  FD5Ø   call a page 3 subroutine <Ø3D6>
  FD53   store error number (BFØF)
  FD56   enable RAM, BANK1 (CØ8B)
  FD5C   restore original P-reg
  FD5E   if error number is zero, (BFØF)
  FD61   then indicate no error; >>FD64
  FD63   otherwise indicate error
  FD64   RETURN

FD65 ******************************************************************
          *       DATA AREA                 *
          ***********************************

FD65 ********** MLI COMMAND TABLE ************************************
          IN HASH CODE ORDER: IF COMMAND IS...
          ABCD EFGH (IN BINARY BITS)
          INDEX IS COMPUTED AS:
             ØØØD EFGH
            +ØØØØ ABCD

  FD65   GET BUF
  FD66   UNUSED
  FD67   UNUSED
  FD68   UNUSED
  FD69   ALLOC INTERRUPT
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FD6A
---------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
---------------------------------------------------------------------------

  FD6A   DEALLOC INTERRUPT
  FD6B   UNUSED
  FD6C   UNUSED
  FD6D   READ BLOCK
  FD6E   WRITE BLOCK
  FD6F   GET TIME
  FD7Ø   EXIT
  FD71   CREATE
  FD72   DESTROY
  FD73   RENAME
  FD74   SET FILE INFO
  FD75   GET FILE INFO
  FD76   ON LINE
  FD77   SET PREFIX
  FD78   GET PREFIX
  FD79   OPEN
  FD7A   NEWLINE
  FD7B   READ
  FD7C   WRITE
  FD7D   CLOSE
  FD7E   FLUSH
  FD7F   SET MARK
  FD8Ø   GET MARK
  FD81   UNUSED
  FD82   SET EOF
  FD83   GET EOF
  FD84   SET BUF

FD85 ********** PARAMETER COUNT TABLE ********************************

  FD85   GET BUF
  FD86   UNUSED
  FD87   UNUSED
  FD88   UNUSED
  FD89   ALLOC INTERRUPT
  FD8A   DEALLOC INTERRUPT
  FD8B   UNUSED
  FD8C   UNUSED
  FD8D   READ BLOCK
  FD8E   WRITE BLOCK
  FD8F   GET TIME
  FD9Ø   EXIT
  FD91   CREATE
  FD92   DESTROY
  FD93   RENAME
  FD94   SET FILE INFO
  FD95   GET FILE INFO
  FD96   ON LINE
  FD97   SET PREFIX
  FD98   GET PREFIX
  FD99   OPEN
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                   NEXT OBJECT ADDR: FD9A
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

  FD9A  NEWLINE
  FD9B  READ
  FD9C  WRITE
  FD9D  CLOSE
  FD9E  FLUSH
  FD9F  SET MARK
  FDA0  GET MARK
  FDA1  UNUSED
  FDA2  SET EOF
  FDA3  GET EOF
  FDA4  SET BUF

FDA5 ********** MLI COMMAND ADDRESS TABLE ***************************

  FDA5  CREATE
  FDA7  DESTROY
  FDA9  RENAME
  FDAB  SET FILE INFO
  FDAD  GET FILE INFO
  FDAF  ON LINE
  FDB1  SET PREFIX
  FDB3  GET PREFIX
  FDB5  OPEN
  FDB7  NEWLINE
  FDB9  READ
  FDBB  WRITE
  FDBD  CLOSE
  FDBF  FLUSH
  FDC1  SET MARK
  FDC3  GET MARK
  FDC5  SET EOF
  FDC7  GET EOF
  FDC9  SET BUF
  FDCB  GET BUF

FDCD ********** MLI COMMAND INFO BYTE ********************************

          PATHNAME FLAG
          | REFERENCE NUMBER FLAG
          | | DATETIME STAMP FLAG
          | | |     COMMAND NUMBER
          | | |     |
  FDCD    1 0 1  - 00
  FDCE    1 0 1  - 01
  FDCF    1 0 1  - 02
  FDD0    1 0 1  - 03
  FDD1    1 0 0  - 04
  FDD2    0 0 0  - 05
  FDD3    0 0 0  - 06
  FDD4    0 0 0  - 07
  FDD5    1 0 0  - 08
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                   NEXT OBJECT ADDR: FDD6
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

  FDD6    0 1 0  - 09
  FDD7    0 1 0  - 0A
  FDD8    0 1 0  - 0B
  FDD9    0 0 1  - 0C
  FDDA    0 0 1  - 0D
  FDDB    0 1 0  - 0E
  FDDC    0 1 0  - 0F
  FDDD    0 1 0  - 10
  FDDE    0 1 0  - 11
  FDDF    0 1 0  - 12
  FDE0    0 1 0  - 13

FDE1 ********** CONSTANTS - DATA AREA ********************************

  FDE1  Blocks Used
  FDE3  End of File
  FDE6  Special ID (Must be 5 bits on)
  FDE7  'HUSTON!'        Author's name
  FDEE  Previous Block of Vol Dir Key Block
          ---
          THE FOLLOWING IS COPIED TO SUBDIR HDR+$20
  FDF0  Version of ProDOS
  FDF1  Minimum Version
  FDF2  Access Byte  (D|Rn|B|000|W|R)
  FDF3  Entry Length
  FDF4  Entries per Block
  FDF5  File Count
  FDF7  Parent LSB (copied to SUBDIR HDR +$20)
          ---
  FDF8  File Type  (Directory)
  FDF9  Block Number
  FDFB  Number of Blocks
  FDFD  End of File

FE00 ********** BITMASK TABLE ****************************************

  FE00  10000000
  FE01  01000000
  FE02  00100000
  FE03  00010000
  FE04  00001000
  FE05  00000100
  FE06  00000010
  FE07  00000001

FE08 ********** OFFSETS TO DATA AT $F300 *****************************
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: FE08
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  FE08  Key Block

  FE0A  # Blocks Used

  FE0C  End of File

FE0F ********** SET/GET FILE_INFO OFFSETS ****************************

  FE0F  Access
  FE10  File Type
  FE11  Aux Type
  FE13  Storage Type
  FE14  Blocks Used (MSB on means GET only no SET)

  FE16  Datetime (Last Mod)

  FE1A  Datetime (Creation)

FE1E ********** FATAL ERROR MESSAGE **********************************

  FE1E    INSERT SYSTEM DISK AND RESTART

  FE46  ---

FE46 ********** VARIABLES - DATA AREA ********************************

  FE46  Parent Pointer Block
  FE48  Parent Entry Number
  FE49  Parent Entry Length
  FE4A  Datetime (Creation)
  FE4E  Version
  FE4F  Min Version
  FE50  Access Byte
  FE51  Entry Length
  FE52  Entries per Block
  FE53  File Count
  FE55  Bit Map Pointer
  FE57  Total Blocks
          THE FOLLOWING 6 BYTES UNIQUELY IDENTIFY
          A FILE:
  FE59  Device Number
  FE5A  Current Directory Block Number (HDR)
  FE5C  Block Number of File Entry in Directory
  FE5E  File Entry Number in Directory
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84               NEXT OBJECT ADDR: FE5F
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

FE5F ********** FILE ENTRY BUFFER ************************************

  FE5F  Type/Length  (TTTTLLLL)
  FE60  File Name (Max 15) >>000F
  FE6F  File Type
  FE70  Key Pointer
  FE72  Blocks Used
  FE74  End of File
  FE77  Datetime (Creation)
  FE7B  Version
  FE7C  Min Version
  FE7D  Access Attribute
  FE7E  Aux Type (Load Address/Record Length)
  FE80  Datetime (Last Mod)

  FE84  Header Pointer

FE86 ********** Variable Work Area ***********************************

  FE86  3 Byte Scratch

  FE89  ---

  FE8A  End of File

  FE8D  Previous Mark

  FE90  Compare Vol Name Scratch
  FE91  Offset into VCB Table ($D900)
  FE92  Offset into FCB Table ($D800)
  FE93  Free FCB found Flag

  FE94  Number of Free Blocks needed

  FE96  Storage Type
          Number of Entries Examined or..
  FE97  FCB already open flag
  FE98  File Count

  FE9A  Entries/Block Loop Count/Free FCB's refnum
          Free Entry Found Flag (if > 0) or..
          # of 1st bitmap block with free bit on or..
  FE9B  bit for free
  FE9C  # Blocks in Bitmap left to search
  FE9D  Y Register temp
  FE9E  Pathname Length
  FE9F  Devnum for Prefix Directory Header
  FEA0  Block of Prefix Directory Header
  FEA2  Bitmap Byte Offset in Page
  FEA3  Bitmap Page Offset
  FEA4  Bitmap Buffer Page (0 or 1)
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FEA5
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

  FEA5   Bitmap Flag (if $8Ø, needs writing)
  FEA6   Bitmap DEVNUM
  FEA7   Bitmap Block Number
  FEA9   Bitmap Block offset for Multiblock Bitmaps

           New Mark to be Positioned to for Set Mark
           or New Moving Mark (for READ)
  FEAA   or New EOF for SET_EOF

  FEAD   Request Count (Read/Write etc.)
  FEAF   Multi-Block I/O count
  FEBØ   Newline character
  FEB1   Newline mask
  FEB2   I/O Transfer occurred flag
  FEB3   MLI Command * 2
  FEB4   ORed into Access Flags ($2Ø - Backup)
  FEB5   Duplicate Volume Flag (if $FF)
  FEB6   Duplicate Volume's VCB index
  FEB7   MLI function code (low 5 bits)
           Characters in current Pathname indx lvl or
  FEB8   ONLINE: volname len - loop index
  FEB9   new pathname: index to last name
           old pathname: index to last name or..
  FEBA   ONLINE: index to data buffer
  FEBB   Old PFIXPTR value
  FEBC   Pathname fully qualified flag (if $FF)
           Pathname: temp save area for index or..
  FEBD   ONLINE: DEVCNT
  FEBE   close-all error code
  FEBF   Set EOF: new Key Block pointer
  FEC1   New storage type (SET_EOF)
  FEC2   Freed Blocks count
  FEC4   EOF Block number (MSB then LSB)
  FEC6   EOF byte offset into Block
  FEC8   EOF - Master index counter
  FEC9   Save area for index into table below

FECA ********** DEVICE TABLE BUILT BY ONLINE *************************
           (also used by SET_EOF to keep track of
           8 blocks to be freed at a time)

  FECA   device table part one
  FED2   device table part two

  FEDA   length of path, etc.
  FEDD   next buffer address
  FEDF   16 byte stack save area
  FEEF   6 byte zero page save area
  FEF5   Jump Vector, used for indirect jumps
```

```
ProDOS MLI -- V1.1.1 -- 18 SEP 84                  NEXT OBJECT ADDR: FEF5
-------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-------------------------------------------------------------------------

FEF7 *********** $FEF7-$FEFF NOT USED ********************************
  FEF7   not used
```

ProDOS SYSTEM GLOBAL PAGE--MLI Global Page

Portions of this page of memory are rigidly defined by the MLI and are unlikely to move in later versions of ProDOS. However, some portions are less stable and could change in future releases.

```
ProDOS System Global Page           NEXT OBJECT ADDRESS: BFØØ
--------------------------------------------------------------
ADDR        LABEL       CONTENTS
--------------------------------------------------------------

                          Jump Vectors
BFØØ-BFØ2   ENTRY       JMP to MLI.
BFØ3-BFØ5   JSPARE      JMP to system death code (via $BFF6).
BFØ6-BFØ8   DATETIME    JMP to Date/Time routine (RTS if no
                        clock).
BFØ9-BFØB   SYSERR      JMP to system error handler.
BFØC-BFØE   SYSDEATH    JMP to system death handler.
BFØF        SERR        System error number.
                       Device Information
BF1Ø-BF11   DEVADRØ1    Slot Ø reserved
BF12-BF13   DEVADR11    Slot 1, drive 1 device driver address.
BF14-BF15   DEVADR21    Slot 2, drive 1 device driver address.
BF16-BF17   DEVADR31    Slot 3, drive 1 device driver address.
BF18-BF19   DEVADR41    Slot 4, drive 1 device driver address.
BF1A-BF1B   DEVADR51    Slot 5, drive 1 device driver address.
BF1C-BF1D   DEVADR61    Slot 6, drive 1 device driver address.
BF1E-BF1F   DEVADR71    Slot 7, drive 1 device driver address.
BF2Ø-BF21   DEVADRØ2    Slot Ø reserved.
BF22-BF23   DEVADR12    Slot 1, drive 2 device driver address.
BF24-BF25   DEVADR22    Slot 2, drive 2 device driver address.
BF26-BF27   DEVADR32    /RAM device driver address (need extra
                        64K).
BF28-BF29   DEVADR42    Slot 4, drive 2 device driver address.
BF2A-BF2B   DEVADR52    Slot 5, drive 2 device driver address.
BF2C-BF2D   DEVADR62    Slot 6, drive 2 device driver address.
BF2E-BF2F   DEVADR72    Slot 7, drive 2 device driver address.
BF3Ø        DEVNUM      Slot and drive (DSSSØØØØ) of last device.
BF31        DEVCNT      Count (minus 1) of active devices.
BF32-BF3F   DEVLST      List of active devices (slot, drive and
                        identification--DSSSIIII).
BF4Ø-BF4F               Copyright notice.
BF5Ø-BF55   IRQXITX     Switch in language card and call IRQ
                        handler at $FFD8.
BF56-BF57   TEMP        Temporary storage for IRQ code.
BF58-BF6F   BITMAP      Bitmap of low 48K of memory.
BF7Ø-BF71   BUFFER1     Open file 1 buffer address.
BF72-BF73   BUFFER2     Open file 2 buffer address.
BF74-BF75   BUFFER3     Open file 3 buffer address.
BF76-BF77   BUFFER4     Open file 4 buffer address.
BF78-BF79   BUFFER5     Open file 5 buffer address.
BF7A-BF7B   BUFFER6     Open file 6 buffer address.
BF7C-BF7D   BUFFER7     Open file 7 buffer address.
BF7E-BF7F   BUFFER8     Open file 8 buffer address.
```

```
ProDOS System Global Page           NEXT OBJECT ADDRESS: BF8Ø
-------------------------------------------------------------
ADDR          LABEL         CONTENTS
-------------------------------------------------------------

                          Interrupt Information
BF8Ø-BF81     INTRUPT1      Interrupt handler address (highest
                            priority).
BF82-BF83     INTRUPT2      Interrupt handler address.
BF84-BF85     INTRUPT3      Interrupt handler address.
BF86-BF87     INTRUPT4      Interrupt handler address (lowest
                            priority).
BF88          INTAREG       A-register savearea.
BF89          INTXREG       X-register savearea.
BF8A          INTYREG       Y-register savearea.
BF8B          INTSREG       S-register savearea.
BF8C          INTPREG       P-register savearea.
BF8D          INTBANKID     Bank ID byte (ROM, RAM1, or RAM2).
BF8E-BF8F     INTADDR       Interrupt return address.
                           General System Info
BF9Ø-BF91     DATE          YYYYYYYM MMMDDDDD.
BF92-BF93     TIME          ...HHHHH ..MMMMMM.
BF94          LEVEL         Current file level.
BF95          BUBIT         Backup bit.
BF96-BF97     SPARE1        Currently unused.
BF98          MACHID        Machine ID byte.
                            ØØ.. Ø...   II
                            Ø1.. Ø...   II+
                            1Ø.. Ø...   IIe
                            11.. Ø...   III emulation
                            ØØ.. 1...   Future expansion
                            Ø1.. 1...   Future expansion
                            1Ø.. 1...   IIc
                            11.. 1...   Future expansion
                            ..ØØ ....   Unused
                            ..Ø1 ....   48K
                            ..1Ø ....   64K
                            ..11 ....   128K
                            .... .X..   Reserved
                            .... ..Ø.   No 8Ø-column card
                            .... ..1.   8Ø-column card present
                            .... ...Ø   No compatible clock
                            .... ...1   Compatible clock present
BF99          SLTBYT        Slot ROM map (bit on indicates ROM
                            present).
BF9A          PFIXPTR       Prefix flag (Ø indicates no active
                            prefix).
BF9B          MLIACTV       MLI active flag (1... .... indicates
                            active).
BF9C-BF9D     CMDADR        Last MLI call return address.
BF9E          SAVEX         X-register savearea for MLI calls.
BF9F          SAVEY         Y-register savearea for MLI calls.
```

```
ProDOS System Global Page           NEXT OBJECT ADDRESS: BFAØ
-------------------------------------------------------------
ADDR          LABEL         CONTENTS
-------------------------------------------------------------

                  Language Card Bank Switching Routines
BFAØ-BFCF                   Language card entry and exit routines.
  BFAØ        EXIT
  BFAA        EXIT1
  BFB5        EXIT2
  BFB7        MLIENT1
                            Interrupt Routines
BFDØ-BFF3                   Interrupt entry and exit routines.
  BFDØ        IRQXIT
  BFDF        IRQXIT1
  BFE2        IRQXIT2
  BFE7        ROMXIT
  BFEB        IRQENT
                                   Data
BFF4          BNKBYT1       Storage for byte at $EØØØ.
BFF5          BNKBYT2       Storage for byte at $DØØØ.
BFF6-BFFB                   Switch on language card and call system
                            death handler ($D1E4).
                           Version Information
BFFC          IBAKVER       Minimum version of Kernel needed for this
                            interpreter.
BFFD          IVERSION      Version number of this interpreter.
BFFE          KBAKVER       Minimum version of Kernel compatible with
                            this Kernel.
BFFF          KVERSION      Version number of this Kernel.
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 1000
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

1000    MODULE STARTING ADDRESS

            ****************************************
            *                                      *
            * QUIT Code                            *
            *     Stored in BANK2 of High RAM      *
            *     at $D100 and moved to $1000      *
            *     by an MLI routine at $FC35,      *
            *     which JMPs to $1000.             *
            *                                      *
            * VERSION 1.1.1 -- 18 SEP 84           *
            * (The QUIT code is still the same     *
            *  as it was in Version 1.0.1)         *
            *                                      *
            ****************************************

1000 ********** ZERO PAGE EQUATES ************************************

0024    Cursor Horizontal
0025    Cursor Vertical

1000 ********** EXTERNAL EQUATES *************************************

0280    Prefix Buffer
1800    Buffer
2000    Buffer
BF00    MLI Entry
BF58    Bitmap

1000 ********** SOFT SWITCHES ****************************************

C000    Keyboard
C000    Disable 80 column store
C00C    Disable 80 column card
C00F    Select alternate character set
C010    Keyboard Strobe
C082    ROM select

1000 ********** MONITOR EQUATES **************************************

FC58    Home
FC9C    Clear to end of line
FD0C    Read a key
FD8E    Output a Carriage Return
FDED    Output a Character
FE89    Set Keyboard
FE93    Set Video
FF3A    Sound Bell
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 1000
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

1000 ********** INITIALIZATION ***************************************

  1000  Select ROM (C082)
  1003  Set Video <FE93>
  1006  Set Keyboard <FE89>
  1009  Disable 80 column card (C00C)
  100C  Select Alternate character set  (C00F)
  100F  Disable 80 column store (C000)

1012 ********** INITIALIZE MEMORY BITMAP *****************************

  1012  Mark pages $0, $1, $4 through $7
  1014  and $BF as in use

1027 ********** DISPLAY CURRENT PREFIX *******************************

  1027  Clear Screen and Home cursor <FC58>
  102A  Go down 1 line <FD8E>
  102D  Get Pointer to Prompt1 (Prefix)
  102F  and store it in Print Routine (11E9)
  1037  Call Print Routine <11E6>
  103A  Position to line 3
  1041  Call MLI (GET_PREFIX) <BF00>
  1044  Data: GET_PREFIX command number
  1045  Data: Pointer to Parameter list
  1047  Terminate Prefix with 0 (0280)
  104A  for Print routine
  104F  Get Pointer to Prefix
  1051  and store it in Print Routine (11E9)
  1059  And Print it <11E6>

105C ********** GET PREFIX NAME **************************************

  105C  Initialize counter
  1063  Read a key <FD0C>
  1066  Is it CARRIAGE RETURN?
  1068  Yes, then accept Prefix >>10B8
  106A  No, then save character
  106B  Clear to end of line <FC9C>
  106E  Retrieve character
  106F  Is it ESCAPE?
  1071  Yes, then start all over again >>1027
  1073  Is it CANCEL?
  1075  Yes, then start all over again >>1027
  1077  Is it TAB?
  1079  Yes, then sound Bell, get another character >>108E
  107B  Is it BACKSPACE?
  107D  No, then keep checking >>108C
  107F  Yes, then is there room to move back?
  1081  No, then don't try  >>1086
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 1Ø83
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  1Ø83   Decrement cursor horizontal position
  1Ø85   Decrement counter
  1Ø86   Clear to end of line <FC9C>
  1Ø89   Try again >>1Ø63

  1Ø8C   Continue if greater than or equal to BACKSPACE >>1Ø94
  1Ø8E   Else, sound Bell <FF3A>
  1Ø91   Try again >>1Ø63

  1Ø94   Is it less than or equal to "Z"?
  1Ø96   Yes, keep checking >>1Ø9A
  1Ø98   Turn off lowercase
  1Ø9A   Is it less than "."?
  1Ø9C   Yes, Invalid - try again >>1Ø8E
  1Ø9E   Is it greater than "Z"?
  1ØAØ   Yes, Invalid - try again >>1Ø8E
  1ØA2   Is it less than or equal to "9"?
  1ØA4   Yes, keep checking >>1ØAA
  1ØA6   Is it less than "A"?
  1ØA8   Yes, Invalid - try again >>1Ø8E
  1ØAA   Else, valid character - increment counter
  1ØAB   Found 39 characters?
  1ØAD   Yes, then start all over >>1Ø75
  1ØAF   Put valid character in buffer (Ø28Ø)
  1ØB2   and Print it <FDED>
  1ØB5   Go back for more >>1Ø63

  1ØB8   Check counter
  1ØBA   If Ø then go on >>1ØCE
  1ØBC   Else, save length (Ø28Ø)
  1ØBF   Call MLI (SET_PREFIX) <BFØØ>
  1ØC2   Data: SET_PREFIX command number
  1ØC3   Data: Pointer to Parameter list
  1ØC5   Carry on if no error >>1ØCE
  1ØC7   Sound Bell <FF3A>
  1ØCA   Force branch to
  1ØCC   always be taken >>1Ø75

1ØCE ********** GET APPLICATION NAME **********************************

  1ØCE   Clear Screen and Home cursor <FC58>
  1ØD1   Go down 1 line <FD8E>
  1ØD4   Get Pointer to Prompt2 (Application)
  1ØD6   and store it in Print Routine (11E9)
  1ØDE   Print it <11E6>
  1ØE1   Position to line 3
  1ØE8   Initialize counter
  1ØEA   Output a RUB
  1ØF1   Poll Keyboard latch (CØØØ)
  1ØF4   Loop until keypress found >>1ØF1
  1ØF6   Clear latch (CØ1Ø)
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 1ØF9
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  1ØF9   Is it ESCAPE?
  1ØFB   No, keep checking >>11Ø3
  1ØFD   Yes, get Cursor horizontal position
  1ØFF   If not Ø try again >>1ØCE
  11Ø1   If Ø start all over again >>1ØCC
  11Ø3   Is it CANCEL?
  11Ø5   Yes, try again >>1ØCE
  11Ø7   Is it TAB?
  11Ø9   Yes, sound Bell - try again >>1114
  11ØB   Is it BACKSPACE?
  11ØD   No, keep checking >>1112
  11ØF   Yes, then handle it >>11DØ

  1112   Continue if greater than or equal to BACKSPACE >>111A
  1114   Sound Bell <FF3A>
  1117   Go back and try again >>1ØEA

  111A   Is it CARRIAGE RETURN?
  111C   Yes, then go load Application >>1147
  111E   Is it less than or equal to "Z"?
  112Ø   Yes, keep checking >>1124
  1122   Turn off lower case
  1124   Is it less than "."?
  1126   Yes, Invalid - try again >>1114
  1128   Is it greater than "Z"?
  112A   Yes, Invalid - try again >>1114
  112C   Is it less than or equal to "9"?
  112E   Yes, keep checking >>1134
  113Ø   Is it less than "A"?
  1132   Yes, Invalid - try again >>1114
  1134   Else, valid character - save it
  1135   Clear to end of line <FC9C>
  1138   Retrieve character
  1139   and Print it <FDED>
  113C   Increment counter
  113D   Found 39 characters?
  113F   Yes, start again >>11Ø5
  1141   No, save character in buffer (Ø28Ø)
  1144   and go get another >>1ØEA

1147 ********** LOAD AND EXECUTE APPLICATION **************************

  1147   Output a blank
  114C   Store length of Application name (Ø28Ø)
  114F   Call MLI (GET_FILE_INFO) <BFØØ>
  1152   Data: GET_FILE_INFO command number
  1153   Data: Pointer to Parameter list
  1155   Continue if no error >>115A
  1157   Else, go to Error Handler >>11F6
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 1157
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  115A   Get File Type (12D5)
  115D   Is it ProDOS System file?
  115F   Yes, continue >>1166
  1161   No, indicate Error $Ø1
  1163   Go to Error Handler >>11F6

  1166   Set Reference number to Ø
  116B   Call MLI (CLOSE) <BFØØ>
  116E   Data: CLOSE command number
  116F   Data: Pointer to Parameter list
  1171   Continue if no error >>1176
  1173   Else, go to Error Handler >>11F6
  1176   Get Access Byte (12D4)
  117B   Yes, >>1182
  117D   No, Indicate Error $27
  117F   Go to Error Handler >>11F6

  1182   Call MLI (OPEN) <BFØØ>
  1185   Data: OPEN command number
  1186   Data: Pointer to Parameter list
  1188   Continue if no error >>118D
  118A   Else, go to Error Handler >>11F6

  118D   Get Reference Number (12E8)
  119Ø   and update READ and (12EC)
  1193   GET_EOF parameter lists (12F4)
  1196   Call MLI (GET_EOF) <BFØØ>
  1199   Data: GET_EOF command number
  119A   Data: Pointer to Parameter list
  119C   Continue if no error >>11A1
  119E   Else, go to Error Handler >>11F6

  11A1   Is EOF mark less than $1ØØØØ (12F7)
  11A4   Yes, continue on >>11AB
  11A6   No, Indicate Error $27
  11A8   Go to Error Handler >>11F6

  11AB   Transfer EOF to Request count (12F5)
  11AE   in READ parameter list (12EF)
  11B7   Call MLI (READ) <BFØØ>
  11BA   Data: READ command number
  11BB   Data: Pointer to Parameter list
  11BD   Save status of READ
  11BE   Call MLI (CLOSE) <BFØØ>
  11C1   Data: Get_Prefix command number
  11C2   Data: Pointer to Parameter list
  11C4   Continue if no error >>11CA
  11C6   Else, retrieve status
  11C7   and go to Error Handler >>11F6
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84          NEXT OBJECT ADDR: 11C7
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  11CA   Was READ good?
  11CB   No, go to Error Handler >>11C7
  11CD   Yes, execute application >>2ØØØ

11DØ ********** BACKSPACE ROUTINE ***********************************

  11DØ   Get cursor position horizontal
  11D2   If Ø exit routine >>11E3
  11D4   Decrement counter
  11D5   Output a space
  11DA   Move cursor back 2 spaces
  11DE   Output a space <FDED>
  11E1   Move cursor back 1 space
  11E3   Return to get another character   >>1ØEA

11E6 ********** PRINT TEXT ROUTINE **********************************

  11E6   Initialize offset
  11E8   Get a character (11E8)
  11EB   If it is Ø then exit >>11F5
  11EF   Output it <FDED>
  11F2   Increment offset
  11F3   Get another character unless we've done 256 >>11E8
  11F5   Return to caller

11F6 ********** PRINT ERROR MESSAGE *********************************

  11F6   Save Accumulator (Error Number)
  11F8   Position to line 12
  11FF   Get Error number
  12Ø1   Is it $Ø1?
  12Ø3   No, then keep checking >>1211
  12Ø5   Get Pointer to Error1 (Not System file)
  12Ø7   and store it in Print Routine (11E9)
  12ØF   Branch always taken >>1237
  1211   Is it $4Ø?
  1213   Yes, then indicate Error3 >>122D
  1215   Is it $44?
  1217   Yes, then indicate Error3 >>122D
  1219   Is it $45?
  121B   Yes, then indicate Error3 >>122D
  121D   Is it $46?
  121F   Yes, then indicate Error3 >>122D
  1221   Else, Get Pointer to Error2 (I/O Error)
  1223   and store it in Print Routine (11E9)
  122B   Branch always taken >>1237
  122D   Get Pointer to Error3 (Path not found)
  122F   and store it in Print Routine (11E9)
  1237   Print Error message <11E6>
  123A   Position to line Ø
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84         NEXT OBJECT ADDR: 123E
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  123E  Return to Get Application code >>10D1

1241 ********** ASCII TEXT *******************************************

          Prompt1
  1241  'ENTER PREFIX (PRESS "RETURN" TO ACCEPT)'

          Prompt2
  1269  'ENTER PATHNAME OF NEXT APPLICATION'

          Error1
  128C  Ring Bell
  128D  'NOT A TYPE "SYS" FILE'

          Error2
  12A3  Ring Bell
  12A4  'I/O ERROR

          Error3
  12BA  Ring Bell
  12BB  'FILE/PATH NOT FOUND

12D1 ********** PARAMETER LISTS **************************************

          GET_FILE_INFO Parmlist
  12D1  Parmcount
  12D2  Pathname
  12D4  Access
  12D5  File Type
  12D6  Aux Type
  12D8  Storage Type
  12D9  Blocks Used
  12DB  Datetime (modified)
  12DF  Datetime (creation)

          OPEN Parmlist

  12E3  Parmcount
  12E4  Pathname
  12E6  I/O Buffer
  12E8  Reference Number

          CLOSE Parmlist

  12E9  Parmcount
  12EA  Reference Number
```

```
ProDOS QUIT Code -- V1.1.1 -- 18 SEP 84         NEXT OBJECT ADDR: 12EA
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

          READ Parmlist

  12EB  Parmcount
  12EC  Reference Number
  12ED  Data Buffer
  12EF  Request Count
  12F1  Transfer Count

          GET_EOF Parmlist

  12F3  Parmcount
  12F4  Reference Number
  12F5  EOF Mark

          GET/SET_PREFIX Parmlist

  12F8  Parmcount
  12F9  Pathname

12FB *********** $12FB-$12FF UNUSED **********************************

  12FB  These unused bytes are $D3FB-$D3FF in high RAM
  12FF  and $59FB-$59FF when loaded as part of "PRODOS" file.
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: DØØØ
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

DØØØ     MODULE STARTING ADDRESS

              *************************************
              *                                   *
              *  5.25" DISK DEVICE DRIVER         *
              *                                   *
              *      RESIDES AT $DØØØ-$D6FF       *
              *                                   *
              *                                   *
              *  VERSION 1.1.1 -- 18 SEP 84       *
              *                                   *
              *************************************

DØØØ ********** ZERO PAGE EQUATES ***********************************

ØØ3A     Checksum
ØØ3A     Workbyte
ØØ3E     Slot (Temporary)
ØØ42     Command
ØØ43     Unit Number
ØØ44     I/O Buffer Pointer (low)
ØØ45     I/O Buffer Pointer (high)
ØØ46     Block Number (low)
ØØ47     Block Number (high)

DØØØ ********** INTERNAL EQUATES ************************************

1ØØØ     Dummy Block Buffer (1st half)
11ØØ     Dummy Block Buffer (2nd half)

DØØØ ********** EXTERNAL EQUATES ************************************

CØ8Ø     Phase Zero Off
CØ88     Motor Off
CØ89     Motor On
CØ8A     Drive Select
CØ8C     Read Data Register
CØ8D     Write Data Register
CØ8E     Set Read Mode
CØ8F     Set Write Mode
CØEC     Read Data Register (slot 6)

DØØØ ********** 5.25" DISK DRIVER ENTRY *****************************

  DØØØ   Clear decimal mode
  DØØ1   Clear phases in case IWM device in this slot <D6BE>
  DØØ4   Five NOP's so code below will
  DØØ5   fit up against Table at $D196
  DØØ9   Check validity of calling parameters <D6DØ>
  DØØC   If not valid exit with error >>DØ34
  DØØE   Convert Block Number to a Track and Sector
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: DØ1Ø
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  DØ1Ø   ---
  DØ14   ØØØØØØØT TTTTTABC
  DØ15          .      . >>DØ1Ø
  DØ17        .        .
  DØ18      .          . >>DØ1C
  DØ1A   ØØTTTTTT ØØØØBCØA
  DØ1C   ---
  DØ2Ø   Preserve Sector Number
  DØ21   Execute command <DØ38>
  DØ24   Restore Sector Number - Was prior action ok?
  DØ25   No, then exit >>DØ3Ø
  DØ27   Increment Buffer Pointer
  DØ29   Increment Sector Number by 2 for rest of Block
  DØ2B   Execute command <DØ38>
  DØ2E   Decrement Buffer Pointer (to start of block)
  DØ3Ø   Get error number (if any - Ø indicates no error) (D358)
  DØ33   Return to caller

DØ34 ********** I/O ERROR ROUTINE ***********************************

  DØ34   Indicate "I/O Error"
  DØ36   Set Carry flag
  DØ37   Return to caller

DØ38 ********** MAIN CODE *******************************************

  DØ38   Set recalibration count to 1
  DØ3D   Preserve sector number (D357)
  DØ4Ø   Get "Unitnum"   DSSSØØØØ
  DØ42   Strip out Drive ØSSSØØØØ
  DØ44   Preserve slot number
  DØ46   Check for slot change, turn off motor if so <D69B>
  DØ49   See if motor is on <D4DA>
  DØ4C   Save test results
  DØ4F   Initialize counter for delay routine (D37Ø)
  DØ54   See if slot or drive has changed (D359)
  DØ57   Update "current" unit number (D359)
  DØ5A   Save test results
  DØ5B   Put drive number in Carry flag
  DØ5C   Turn motor on (CØ89)
  DØ62   Select appropriate drive (CØ8A)
  DØ65   Check test results - Same slot/drive?
  DØ66   Yes, then skip delay >>DØ72
  DØ69   Wait for new Drive
  DØ6B   to come up to speed <D385>
  DØ72   Is command a status request?
  DØ74   Yes, then do not move disk arm >>DØ7C
  DØ76   Get track number for current request  (D356)
  DØ79   And go there <D1ØC>
  DØ7C   Check test results - Was motor on?
  DØ7D   Yes, then skip delay >>DØ8E
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D07F
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  D07F  Wait for Drive to
  D081  come up to speed <D385>
  D089  Is motor on yet? <D4DA>
  D08C  No, then exit with error >>D0EA
  D08E  Is command a "status" request?
  D090  Yes, then determine status >>D0FD
  D092  Is command a "read" request?
  D093  Yes, then continue on >>D098
  D095  Prepare data for write (prenibblize) <D5F0>
  D098  ---
  D09A  Initialize "retry" count at 64 (D369)
  D09D  ---
  D09F  Read an address field - Good read? <D398>
  D0A2  Yes, then continue on >>D0BE
  D0A4  Decrement "retry" count - More to try? (D369)
  D0A7  Yes, then try again >>D09D
  D0A9  No, just in case indicate "I/O Error"
  D0AB  Decrement "recalibration" count - More to try? (D36A)
  D0AE  No, then exit with error >>D0EA
  D0B0  Get "current" track (D35A)
  D0B3  Preserve it
  D0B4  Double it and
  D0B5  add 16 to it for recalibration
  D0B7  Reinitialize Retry Count
  D0BC  Branch always taken >>D0CC
  D0C1  Was the right track found? (D35A)
  D0C4  Yes, then continue on >>D0D5
  D0C6  Get "current" track (D35A)
  D0C9  Preserve it
  D0CA  Get track we found
  D0CB  Double it
  D0CC  Put new value in Device Track Table <D4D3>
  D0CF  Get track we want
  D0D0  And go there <D10C>
  D0D3  Branch always taken >>D09D
  D0D8  Was the right sector found? (D357)
  D0DB  No, then try again >>D0A4
  D0DF  Is command a "write" request?
  D0E0  Yes, then go do it >>D0F4
  D0E2  Read the data - Good read? <D3FD>
  D0E5  No, then try again >>D0A4
  D0E7  Indicate no errors
  D0E9  BNE Instruction, never taken
  D0EA  Indicate error
  D0EB  Preserve error number (D358)
  D0EE  Get Slot
  D0F0  Turn motor off (C088)
  D0F3  Return to caller
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D0F3
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------


D0F4 ********** HANDLE WRITE REQUEST **********************************

  D0F4  Write data - Good write? <D500>
  D0F7  Yes, then exit >>D0E7
  D0F9  Indicate "Write-protect error"
  D0FB  Branch always taken >>D0EA

D0FD ********** GET STATUS ********************************************

  D0FD  Get Slot number
  D102  Check "write-protect" status (C08E)
  D105  Put result in Carry flag
  D106  Select read mode (C08C)
  D109  Exit with appropriate status >>D0F7

D10C ********** LOCATE DESIRED TRACK **********************************

  D10C  Double the track number for proper phase
  D10D  Preserve destination track * 2 (D36F)
  D110  Turn all phases off <D125>
  D113  Get offset into Device Track Table <D4F1>
  D116  Get track (D359)
  D119  Update "current" track (D35A)
  D11C  Get destination track (D36F)
  D11F  Update Device Track Table (D359)
  D122  Move arm to desired track <D133>
  D125  Initialize phase number, starting with 3
  D127  ---
  D128  Clear a phase <D18A>
  D12B  Decrement phase number - More to do?
  D12C  Yes, then continue until all phases done >>D127
  D12E  Divide track number by 2 (D35A)
  D132  Return to caller

D133 ********** ARM MOVE ROUTINE **************************************

  D133  Preserve track to find (D372)
  D136  Are we already there? (D35A)
  D139  Yes, then set appropriate phase and exit >>D187
  D13D  Initialize phase count (halftracks) (D36B)
  D143  Preserve "current" track for comparisons (D371)
  D146  Subtract track to find to compute delta-tracks
  D147  Are we already there? (D372)
  D14A  Yes, then clear prior phase and exit >>D183
  D14C  Positive delta-tracks - go move arm out >>D155
  D14E  Negative delta-tracks - Get absolute value delta-tracks less 1
  D150  Increment current phase to move in (D35A)
  D153  Branch always taken >>D15A
  D155  Compute absolute value delta-tracks less 1
  D157  Decrement current phase to move out (D35A)
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D15A
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  D15A   Compare delta-tracks with phases moved (D36B)
  D15D   Use smaller value for offset to delay tables >>D162
  D162   Are we pointing at last table value yet?
  D164   Yes, then continue to use current offset >>D168
  D166   Else, use new offset
  D167   Set Carry flag for set phase operation
  D168   Set a phase  <D187>
  D16B   Get delay value from table (D373)
  D16E   Delay <D385>
  D171   Get prior phase number (D371)
  D174   Clear Carry flag for clear phase operation
  D175   Clear a phase <D18A>
  D178   Get delay value from table (D37C)
  D17B   Delay <D385>
  D17E   Increment phases moved (D36B)
  D183   Delay <D385>
  D187   Get "current" phase number (D35A)
  D18A   Use low two bits only, zero to three - ØØØØØØPP
  D18C   Multiply by two and bring in Carry   - ØØØØØPPC
  D18D   Merge in slot number                 - ØSSSØPPC
  D18F   Put in X-reg for following operation
  D19Ø   Toggle appropriate phase (CØ8Ø)
  D193   Restore slot number to X-reg
  D195   Return to caller

D196 ********** TABLE 1 **********************************************
          Read Translate Table with Prenibblize
          Bit mask Tables and Epliog Table in
          unused areas

  D196    Read Translate

          Bit Mask 1
  D1AØ  ØØØØØØØØ
  D1A1  1ØØØØØØØ
  D1A2  Ø1ØØØØØØ
  D1A3  11ØØØØØØ

          Read Translate

          Bit Mask 2
  D1CØ  ØØØØØØØØ
  D1C1  ØØ1ØØØØØ
  D1C2  ØØØ1ØØØØ
  D1C3  ØØ11ØØØØ

          Epilog Table ($DE,$AA,$EB)
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D1C4
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

          Read Translate

          Bit Mask 3
  D1EØ  ØØØØØØØØ
  D1E1  ØØØØ1ØØØ
  D1E2  ØØØØØ1ØØ
  D1E3  ØØØØ11ØØ

          Read Translate

D2ØØ ********** TABLE 2 **********************************************

          Write Translate Table
                  Every 4th byte starting at $D2Ø3

          Postnibblize Bit mask Tables
                  Bit mask 1 (Every 4th byte starting at $D2ØØ
                  Bit mask 2 (Every 4th byte starting at $D2Ø1
                  Bit mask 3 (Every 4th byte starting at $D2Ø2

  D2ØØ  Entry for Bit Mask 1
  D2Ø1  Entry for Bit Mask 2
  D2Ø2  Entry for Bit Mask 3
  D2Ø3  Entry for Write Translate

D3ØØ ********** AUXILIARY BUFFER *************************************

  D3ØØ  Auxiliary Buffer ($56 bytes) >>ØØ56

D356 ********** VARIABLE AREA ****************************************

  D356  Track number
  D357  Sector number
  D358  Error number

          Disk Device Track Table
D359    Table Entry
  D359  Current Unit
  D35A  Current Track
  D35B  Slot 1, Devices 1 & 2
  D35D  Slot 2, Devices 1 & 2
  D35F  Slot 3, Devices 1 & 2
  D361  Slot 4, Devices 1 & 2
  D363  Slot 5, Devices 1 & 2
  D365  Slot 6, Devices 1 & 2
  D367  Slot 7, Devices 1 & 2
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: D367
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D369   Retry count (initially 64)
  D36A   Recalibration count (initially 1)
D36B     Counter for Read Address routine
D36B     Temporary storage for Read Address routine
  D36B   Track counter for Arm Move routine
  D36C   Checksum computation
  D36D   Volume found
  D36E   Sector found
D36F     Delay counter (low byte)
  D36F   Track found
D37Ø     Checksum found
  D37Ø   Delay counter (high byte)
  D371   Prior Track
  D372   Track number for Arm Move routine

D373 ********** PHASEON/PHASEOFF TABLES ******************************

  D373   Phase on table (delays for disk head acceleration)

  D37C   Phase off table (delays for disk head deacceleration)

D385 ********** WAIT ROUTINE ******************************************

  D385   Wait about 1ØØ times A-register (microseconds)
  D387   ---
  D392   ---
  D397   Return to caller

D398 ********** READ ADDRESS FIELD ************************************

  D398   Initialize "must find" count to $FCFC
  D39D   Increment count (low order byte) - Zero yet?
  D39E   No, skip ahead >>D3A5
  D3AØ   Increment count (high order byte) - Zero yet? (D36B)
  D3A3   Yes, exit and indicate Read Error >>D3FB
  D3A5   Read data register  (CØ8C)
  D3A8   Loop until data valid >>D3A5
  D3AA   Is it first address mark ($D5)?
  D3AC   No, then increment "must find" count >>D39D
  D3AE   Delay for data latch to clear
  D3AF   Read data register (CØ8C)
  D3B2   Loop until data valid >>D3AF
  D3B4   Is it second address mark ($AA)?
  D3B6   No, then see if it's first address mark >>D3AA
  D3B8   Initialize count for four byte read
  D3BA   Read data register (CØ8C)
  D3BD   Loop until data valid >>D3BA
  D3BF   Is it third address mark ($96)?
  D3C1   No, then see if it's first address mark >>D3AA
  D3C3   Set Interupt flag
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: D3C4
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  D3C4   Initialize checksum
  D3C9   Read "odd" encoded byte     1X1X1X1X (CØ8C)
  D3CE   Align "odd" bits            X1X1X1X1
  D3CF   Save for later (D36B)
  D3D2   Read "even" encoded byte    1X1X1X1X (CØ8C)
  D3D7   Combine bytes               XXXXXXXX (D36B)
  D3DA   Preserve data (Volume,Track,Sector,Checksum) (D36D)
  D3DD   Do checksum computation (D36C)
  D3EØ   Decrement counter - Finished field yet?
  D3E1   No, do some more >>D3C6
  D3E3   Is checksum computation zero?
  D3E4   No, then exit with carry set >>D3FB
  D3E6   Read data register (CØ8C)
  D3E9   Loop until data valid >>D3E6
  D3EB   Is it first trailing byte ($DE)?
  D3ED   No, then exit with carry set >>D3FB
  D3EF   Delay for data latch to clear
  D3FØ   Read data register (CØ8C)
  D3F3   Loop until data vaild >>D3FØ
  D3F5   Is it second trailing byte ($AA)?
  D3F7   No, then exit with carry set >>D3FB
  D3F9   Clear the Carry flag (no error)
  D3FA   Return to caller
  D3FB   Set the Carry flag (error occured)
  D3FC   Return to caller

D3FD ********** READ DATA (ON THE FLY) ROUTINE  **********************

  D3FD   Convert slot number to an
  D3FE   absolute reference (i.e. $6Ø -> $EC)
  D4ØØ   Modify code for current slot number (D45A)
  D4Ø3   (i.e. $CØ8C,X -> $CØEC) (D473)
  D4ØF   Get data buffer pointers
  D413   Modify code for current Buffer address (D4AF)
  D416   Provides access to top 3rd of Buffer (D4BØ)
  D41A   Subtract $54 from current address
  D41F   Modify code for current address - $54 (D497)
  D422   Provides access to middle 3rd of Buffer (D498)
  D426   Subtract $57 from current address
  D42B   Modify code for current address - $AB (D47Ø)
  D42E   Provides access to bottom 3rd of Buffer (D471)

  D431   Initialize must find count at $2Ø
  D433   Decrement count - More to do?
  D434   No, then exit >>D46D
  D436   Read data register (CØ8C)
  D439   Loop until data valid >>D436
  D43B   Is is 1st header mark ($D5)?
  D43D   No, then try again >>D433
  D43F   Delay for register to clear
  D44Ø   Read data register (CØ8C)
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D443
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  D443  Loop until data valid >>D44Ø
  D445  Is is 2nd header mark ($AA)?
  D447  No, then see if it is 1st header mark >>D43B
  D449  Delay for register to clear
  D44A  Read data register (CØ8C)
  D44D  Loop until data valid >>D44A
  D44F  Is is 3rd header mark ($AD)?
  D451  No, then see if it is 1st header mark >>D43B
  D453  Initialize offset into data buffer
  D457  Initialize checksum
  D459  Read a data byte (CØEC)
  D45E  Translate it (D1ØØ)
  D461  Store it in Auxiliary buffer (D256)
  D464  Compute running checksum
  D466  Increment offset - More to do?
  D467  Yes, then continue >>D457
  D469  Reinitialize offset into data buffer
  D46B  Branch always taken >>D472
  D46D  Set carry flag indicating error
  D46E  Return to caller
  D46F  Store byte in Primary buffer (bottom third) (1ØØØ)
  D472  Read a data byte (CØEC)
  D477  Translate it and merge in (D1ØØ)
  D47A  bits from Auxiliary buffer (D256)
  D48Ø  Increment offset - done yet?
  D481  No, then do another >>D46F
  D483  Save last byte for later, no time now
  D484  Strip off last two bits   XXXXXXØØ
  D486  Reinitialize offset
  D488  Read a byte (CØEC)
  D48D  Translate it and merge in (D1ØØ)
  D49Ø  bits from Auxiliary buffer (D256)
  D496  Store byte in Primary buffer (middle third) (1ØØØ)
  D499  Increment offset - done yet?
  D49A  No, then do another >>D488
  D49C  Read a byte  (CØEC)
  D4A1  Strip off last two bits   XXXXXXØØ
  D4A3  Reinitialize offset
  D4A5  Translate byte and merge in (D1ØØ)
  D4A8  bits from Auxiliary buffer (D254)
  D4AE  Store byte in Primary buffer (top third) (1ØØØ)
  D4B1  Read a byte (CØEC)
  D4B6  Increment offset - done yet?
  D4B7  No, then do another >>D4A5
  D4B9  Strip off last two bits   XXXXXXØØ
  D4BB  Is checksum valid? (D1ØØ)
  D4BE  No, then exit with error >>D4CC
  D4CØ  Get slot number
  D4C2  Read data register (CØ8C)
  D4C5  Loop until data valid >>D4C2
  D4C7  Is is 1st trailing mark ($DE)?
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D4CA
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  D4CA  Yes, then continue with carry clear >>D4CD
  D4CC  Set Carry flag indicating error
  D4CD  Get byte we stored away, we have time now
  D4CE  Set proper offset
  D4DØ  Store byte in Primary buffer (offset $55)
  D4D2  Return to caller

D4D3 ********** UPDATE DEVICE TRACK TABLE ****************************

  D4D3  Get offset into Device Track Table <D4F1>
  D4D6  Update Device Track Table (D359)
  D4D9  Return to caller

D4DA ********** DETERMINE IF DRIVE IS ON (DATA CHANGING)**************

  D4DA  Get slot number
  D4DC  Initialize counter
  D4DE  Read data register (CØ8C)
  D4E1  Delay 25 cycles <D4FØ>
  D4E6  Has data register changed? (CØ8C)
  D4E9  Yes, then exit >>D4FØ
  D4EB  Just in case indicate No Device Connected Error
  D4ED  Decrement count - 256 tries yet?
  D4EE  No, try again >>D4DE
  D4FØ  Return to caller

D4F1 ********** CONVERT SLOT/DRIVE TO TABLE OFFSET *******************

  D4F1  Preserve A-register
  D4F2  Get Unit number        DSSSØØØØ
  D4F4  Divide by 16           ØØØØDSSS
  D4F8  Put Drive into Carry   ØØØØDSSS  D
  D4FA  Strip out Drive        ØØØØØSSS  D
  D4FC  Roll left              ØØØØSSSD
  D4FD  Put result in X-register
  D4FE  Restore A-register
  D4FF  Return to caller

D5ØØ ********** WRITE DATA ROUTINE ***********************************

  D5ØØ  Set Carry flag (anticipate error)
  D5Ø4  Is diskette "write-protected"? (CØ8E)
  D5Ø7  No, then continue on >>D5ØC
  D5Ø9  Go to error routine >>D5DF
  D5ØC  Put transition byte from secondary buffer (D3ØØ)
  D5ØF  into zero page for timing
  D511  Use $FF for "sync" byte
  D513  Write first "sync" byte (CØ8F)
  D519  Set counter for four more
  D51C  Delay so that writes occur
  D51D  Exactly on 4Ø cycle loops
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: D51E
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  D51E   ---
  D52Ø   Write "sync" byte <D5E7>
  D523   Decrement counter, done yet?
  D524   No, then do another >>D51E
  D526   Write first data mark ($D5)
  D52B   Write second data mark ($AA)
  D53Ø   Write third data mark ($AD)
  D535   Initialize checksum
  D536   Initialize index into Auxiliary buffer
  D538   Branch always taken >>D53D
  D53A   Get data byte (Auxiliary buffer) (D3ØØ)
  D53D   Exclusive-or with previous data byte (D2FF)
  D54Ø   Put result in X-reg for table lookup
  D541   Lookup "disk byte" in table (D2Ø3)
  D544   Get slot
  D546   Write "disk byte" (CØ8D)
  D54C   Decrement index - Done with Auxiliary buffer?
  D54D   No, then another byte >>D53A
  D54F   Get last byte of Auxiliary buffer
  D551   Initialize index into Primary buffer
  D553   Exclusive-or with next data byte (1ØØØ)
  D556   Strip out last two bits  XXXXXXØØ
  D558   Put result in X-reg for table lookup
  D559   Lookup "disk byte" in table (D2Ø3)
  D55C   Get slot
  D55E   Write "disk byte" (CØ8D)
  D564   Get data byte (Primary buffer) (1ØØØ)
  D567   Increment offset, end of this page?
  D568   No, then continue on >>D553
  D56A   Did buffer start on page boundary?
  D56C   Yes, then go write checksum >>D5CØ
  D56E   Did buffer start one past page boundary?
  D57Ø   Yes, then go write last byte >>D5B3
  D572   Carry indicates odd or even buffer end
  D573   Get transition byte
  D575   Write it  (CØ8D)
  D57B   Get second transition byte
  D57D   Delay 2 cycles for correct timing
  D57E   Increment offset, buffer end on odd byte?
  D57F   Yes, go see if we're done then >>D599
  D581   Exclusive-or with next data byte (11ØØ)
  D584   Strip out last two bits  XXXXXXØØ
  D586   Put result in X-reg for table lookup
  D587   Lookup "disk byte" in table (D2Ø3)
  D58A   Get slot
  D58C   Write "disk byte" (CØ8D)
  D592   Get data byte (Primary buffer - page 2) (11ØØ)
  D595   Increment offset
  D596   Exclusive-or with next data byte (11ØØ)
  D599   End of buffer? - Put result in carry
  D59B   Strip out last two bits  XXXXXXØØ
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84     NEXT OBJECT ADDR: D59D
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  D59D   Put result in X-reg for table lookup
  D59E   Lookup "disk byte" in table (D2Ø3)
  D5A1   Get slot
  D5A3   Write "disk byte" (CØ8D)
  D5A9   Get data byte (Primary buffer - page 2) (11ØØ)
  D5AC   Increment offset - Done yet?
  D5AD   No, then do another >>D581
  D5AF   Yes, then go write checksum >>D5B1
  D5B1   --- >>D5CØ
  D5B3   Get last byte
  D5B6   Write it (CØ8D)
  D5BC   Delay 14 cycles for correct timing
  D5CØ   Use last byte in Primary buffer as checksum
  D5C2   Lookup "disk byte" (D2Ø3)
  D5C5   Get slot
  D5C7   Write "disk byte" (CØ8D)
  D5CD   Initialize offset into "epilog" table
  D5CF   Delay 11 cycles for correct timing
  D5D3   Load "epilog" from table ($DE,$AA,$EB,$FF) (D1C4)
  D5D6   Go write it <D5E9>
  D5D9   Increment offset
  D5DA   Done all four yet?
  D5DC   No, then do another >>D5D3
  D5DE   Clear Carry flag (no error)
  D5DF   Select read mode (CØ8E)
  D5E5   Return to caller

D5E6 ********** WRITE A BYTE SUBROUTINE ******************************

  D5E6   Wait 9 cycles before write
  D5E7   Wait 7 cycles before write
  D5E9   Put A-register in data register (CØ8D)
  D5EC   And write data register (CØ8C)
  D5EF   Return to caller

D5FØ ********** PRENIBLIZE BLOCK ROUTINE *****************************

  D5FØ   Get buffer pointer
  D5F5   Add $2 to buffer address
  D5F7   To access top third of buffer >>D5FA
  D5FA   Store result in code below (D63Ø)
  D6Ø1   Subtract $54 from buffer address
  D6Ø3   To access middle third of buffer >>D6Ø6
  D6Ø6   Store result in code below (D625)
  D6ØD   Subtract $AA from buffer address
  D6ØF   To access bottom third of buffer >>D612
  D612   Store result in code below (D61B)
  D618   Initialize offset
  D61A   Get data byte (bottom third)     XXXXXXXX (1ØØØ)
  D61D   Get last two bits                ØØØØØØAB
  D61F   Put in X-reg for table lookup
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D62Ø
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 D62Ø   Use lookup to reposition bits    ØØØØBAØØ (D1EØ)
 D623   Save result on stack
 D624   Get data byte (middle third)     XXXXXXXX (1Ø56)
 D627   Get last two bits                ØØØØØØCD
 D629   Put in X-reg for table lookup
 D62A   Get current value from stack     ØØØØBAØØ
 D62B   Merge in new bits using table    ØØDCBAØØ (D1CØ)
 D62E   Save result on stack
 D62F   Get data byte (top third)        XXXXXXXX (1ØAC)
 D632   Get last two bits                ØØØØØØEF
 D634   Put in X-reg for table lookup
 D635   Get current value from stack     ØØDCBAØØ
 D636   Merge in new bits using table    FEDCBAØØ (D1AØ)
 D639   Save result on stack
 D63A   Get offset into primary buffer
 D63B   Compute offset into Auxiliary buffer
 D63D   Put in X-reg
 D63E   Get data byte just created       FEDCBAØØ
 D63F   Store it in Auxiliary buffer (D3ØØ)
 D642   Increment offset primary buffer, done yet?
 D643   No, then do another >>D61A
 D645   Get low order byte of buffer
 D647   Subtract 1 (offset to last byte in buffer)
 D648   Save it for later
 D64A   Get low order byte of buffer
 D64C   Modify code in Write Data Routine (offset) (D552)
 D64F   Buffer on page boundary? - Yes, skip ahead >>D65F
 D651   Else, compute offset to last byte
 D653   Before page boundary
 D654   Get byte (page boundary -1)
 D656   Point at next byte (page boundary)
 D657   Exclusive-or them together       XXXXXXXX
 D659   Strip off last two bits          XXXXXXØØ
 D65B   Put in X-reg for table lookup
 D65C   Get "disk byte" from table (transition byte) (D2Ø3)
 D65F   Save result (Ø indicates page boundary)
 D661   Buffer on page boundary? - Yes skip ahead >>D66F
 D663   Get offset to last byte in buffer
 D665   Carry indicates odd or even buffer start
 D666   Get byte (page boundary)
 D668   Did buffer start on odd byte? - Yes skip >>D66D
 D66A   Point at next byte (page boundary +1)
 D66B   Exclusive-or them together
 D66D   Save result
 D66F   Point at last byte in buffer
 D671   Get last byte in buffer          XXXXXXXX
 D673   Strip off last two bits          XXXXXXØØ
 D675   Save result ("checksum byte")
 D677   Get high order byte of buffer
 D679   Modify code in Write Data Routine (D555)
 D68C   Get slot number for this operation
```

```
Disk II Device Driver -- V1.1.1 -- 18 SEP 84    NEXT OBJECT ADDR: D68E
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 D68E   Modify code in Write Data Routine (D55D)
 D69A   Return to caller

D69B ********** DETERMINE IF SLOT/DRIVE HAS CHANGED *****************

 D69B   Compare unit number with "current" unit number (D359)
 D69E   Put "current" drive in Carry
 D69F   Has slot changed? - No, then exit >>D6BD
 D6A9   Get "current" slot
 D6AB   Put in X-register
 D6AC   Exit if Slot Ø >>D6BD
 D6AE   Is "current" motor is on? <D4DC>
 D6B1   No, then exit >>D6BD
 D6B8   Wait until "current" motor is off (D37Ø)
 D6BB   Or else timeout >>D6A6
 D6BD   Return to caller

D6BE *********** CLEAR IWM PHASES ************************************

 D6BE   Get unit number
 D6CØ   Strip drive bit
 D6C2   Put slot*16 in X-Register
 D6C3   Clear phases in case there is (CØ8Ø)
 D6C6   one of them new-fangled storage  (CØ82)
 D6C9   devices sharing this slot (CØ84)
 D6CC   with my (t)rusty old Disk II. (CØ86)
 D6CF   Return to caller

D6DØ *********** CHECK CALLING PARAMETERS ****************************

 D6DØ   Check command code
 D6D2   Is it greater or equal to 4?
 D6D6   Get Block Number
 D6DA   Is Block Number good? (D356)
 D6DD   Yes, if less than $1ØØ >>D6E8
 D6EØ   No, if greater than or equal to $2ØØ >>D6E6
 D6E4   No, if greater than or equal to $118 >>D6E8
 D6E6   Indicate error
 D6E7   Return to caller
 D6E8   All is well
 D6E9   Return to caller

D6EA *********** $D6EA-$D6FF NOT USED ********************************

 D6EA   Not used
```

```
IRQ Handler -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: FF9B
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

FF9B     MODULE STARTING ADDRESS
            *************************************
            *                                   *
            * IRQ Handler                       *
            *     Resides at $FF9B.  Put        *
            *     there by ProDOS Relocator.    *
            *                                   *
            * VERSION 1.1.1 -- 18 SEP 84        *
            * (The IRQ Handler is still the     *
            *  same as it was in Version 1.Ø.1) *
            *                                   *
            *************************************

FF9B ********** GLOBAL PAGE EQUATES **********************************

BF56     Temporary storage 1
BF57     Temporary storage 2
BF88     A register savearea
BF8D     Bank ID byte
BFD3     IRQ exit code

FF9B ********** EXTERNAL EQUATES *************************************

DØØØ     RAM/ROM test byte
CØ82     ROM Select
CØ8B     BANK1 Select

FF9B ********** IRQ CODE *********************************************

  FF9B   Put A-Register on stack
  FF9C   Get Accumulator value from $45
  FF9E   and save it (BF56)
  FFA1   Replace $45 with A-Register
  FFA2   since it may have been destroyed
  FFA4   Load Status register
  FFA5   Restore onto stack
  FFA6   Isolate B flag - Was it a BRK?
  FFA8   Yes, skip Interrupt stuff >>FFC2
  FFAA   Else, Check location $DØØØ (DØØØ)
  FFAD   Do we have RAM active
  FFAF   Yes, indicate so >>FFB3
  FFB1   Else, indicate ROM
  FFB3   Update Bank ID byte (BF8D)
  FFB6   Also save temporarily (BF57)
  FFB9   Push ($BF5Ø) address of
  FFBB   routine to bank in Ram and
  FFBC   call IRQ on the stack
  FFBF   Push a new P-Register on stack with
  FFC1   the Interrupt Disable flag set
  FFC2   Push ($FA41) address less 1 of
  FFC4   Monitor IRQ on the stack
```

```
IRQ Handler -- V1.1.1 -- 18 SEP 84              NEXT OBJECT ADDR: FFC8
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  FFC8   Select ROM - execution continues in ROM (CØ82)

             ******* RESET CODE ****************

  FFCB   Push ($FA61) address less 1 of (FFD7)
  FFCE   Hardware Reset routine on to stack
  FFD3   Exit via select ROM code above >>FFC8

  FFD6   Address (-1) of Hardware Reset routine

             ******* IRQ CODE ******************
           Called via $BF5Ø in System Global Page

  FFD8   Save Accumulator in Global page (BF88)
  FFDB   Restore $45 with original value (BF56)
  FFEØ   Select RAM (read & write) (CØ8B)
  FFE3   use BANK1 (CØ8B)
  FFE6   Get Bank ID byte (BF57)
  FFE9   Leave via Global Page IRQ exit code >>BFD3

FFEC *********** $FFEC-$FFF9 UNUSED **********************************

  FFEC   These unused bytes are at $4FEC-$4FF9 when
  FFF9   loaded as part of the "PRODOS" file.

FFFA ********** VECTORS **********************************************

  FFFA   NMI Vector
  FFFC   Reset Vector
  FFFE   IRQ Vector
```

HOW "BASIC.SYSTEM" IS LOADED AND RELOCATED

② The BI Relocator moves the Interpreter to $9A00-$BCFF, and the BI Global Page to $BE00-$BEFF.

```
I                   I
I-------------------I$BF00
I  BI GLOBAL PAGE   I
I-------------------I$BE00
INAMES OF OPEN FILESI
I-------------------I$BD00
I                   I
I       BASIC       I
I                   I
I    INTERPRETER    I
I                   I
I   (run location)  I
I                   I
I-------------------I$9A00
I                   I
```

① The "BASIC.SYSTEM" file is loaded to memory address $2000 by the SYSTEM file loader (or a "-" command) which then jumps to $2000 (the BI Relocator).

```
                         I                   I
I----------------I       I-------------------I$4800
I                I       I  BI GLOBAL PAGE   I
I "BASIC.SYSTEM" I       I-------------------I$4700
I  21 BLOCK FILE I       I                   I
I                I       I       BASIC       I
I(20 data blocks I       I                   I
I plus one index I--->   I    INTERPRETER    I
I block)         I       I                   I
I                I       I  (load location)  I
I    L$2800      I       I                   I
I                I       I-------------------I$2400
I                I       I   BI RELOCATOR    I
I----------------I       I-------------------I$2000
                         I                   I
```

③ The BI Relocator searches for a "STARTUP" file in the same directory as "BASIC.SYSTEM". If found, it loads and executes the "STARTUP" program. Otherwise, it prints out a greeting and cold starts BASIC by jumping to the BASIC entry point at $BE00.

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 2000
---------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
---------------------------------------------------------------------

2000    MODULE STARTING ADDRESS

          *****************************************
          *                                       *
          *  PRODOS BASIC INTERPRETER RELOCATOR   *
          *       LOADED AS THE FIRST TWO BLOCKS  *
          *       OF BASIC.SYSTEM AT $2000.       *
          *       THIS ROUTINE MOVES THE BASIC    *
          *       INTERPRETER TO $9A00-$BCFF.     *
          *                                       *
          *  FOR PRODOS VERSION 1.1.1             *
          *  (BASIC Version Number is 1.1,        *
          *   Modify date is 18 JUN 84)           *
          *                                       *
          *****************************************

          ******** ZERO PAGE ADDRESSES ************

0000    "FROM" POINTER FOR COPY
0001
0002    "TO" POINTER FOR COPY
0003
0036    CSWL VECTOR
0038    KSWL VECTOR
006F    APPLESOFT START OF STRINGS
0073    APPLESOFT HIMEM
00F2    APPLESOFT TRACE FLAG

          ******** EXTERNAL ADDRESSES *************

0200    PATHNAME BUFFER
0280    PREFIX BUFFER
0281    START OF PREFIX NAME

03D0    WARMSTART VECTOR
03D3    COLDSTART VECTOR
03F0    BRK HANDLER ADDRESS
03F1
03F2    RESET HANDLER ADDRESS
03F3
03F4    POWER-UP BYTE
03F5    APPLESOFT & VECTOR
03F8    CTL-Y VECTOR

          ******** SCREEN LINE ADDRESSES **********

0400    FIRST SCREEN BUFFER LINE
0480    SCREEN BUFFER LINE
0628    SCREEN BUFFER LINE
```

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 2000
---------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
---------------------------------------------------------------------

          ******** BASIC GLOBAL PAGE **************

BC7A    BASIC INTERPRETER VERSION NUMBER
BE00    BASIC INTERPRETER ENTRY POINT
BE03    BI COMMAND SCANNER (SYNTAX)
BE10    COUT VECTORS FOR EACH SLOT
BE20    KSWL VECTORS FOR EACH SLOT
BE3C    DEFAULT SLOT NO.
BE3D    DEFAULT DRIVE NO.
BEFB    HIMEM

          ******** SYSTEM GLOBAL PAGE *************

BF00    MACHINE LANGUAGE INTERFACE ENTRY
BF30    LAST DEVICE USED
BF58    MEMORY MAP
BF98    MACHINE TYPE FLAGS
BF99    SLOTS WHICH CONTAINS CARDS WITH ROM
BF9A    IF 0, NO PREFIX ACTIVE
BFFD    INTERPRETER VERSION NUMBER

          ******** ROM ADDRESSES ******************

E000    APPLESOFT ENTRY POINT
FA59    BRK HANDLER
FB2F    INIT SCREEN, MONITOR, ETC.
FC58    CLEAR SCREEN, HOME CURSOR
FDED    STANDARD CHARACTER OUT
FDF0    CHARACTER OUTPUT TO SCREEN
FE84    SET NORMAL CHARACTER ATTRIBUTE

2000 *********** BASIC INTERP RELOCATOR ENTRY ***********************

  2000  JUMP OVER STARTUP FILENAME >>2047
  2006  STARTUP FILENAME LENGTH (7)
  2007  'STARTUP'
  200E  ALLOW FOR 64 CHAR FILENAME

  2047  $00 --> $2400
  204B  $02 --> $9A00
  2055  COPY 35 PAGES
  2058  COPY INTERP TO HIGH MEMORY AT $9A00 <20C4>
  205D  PAGE FOLLOWING INTERP IMAGE IS...
  205F  BASIC GLOBAL PAGE IMAGE
  2061  COPY THAT TO $BE00 <20C4>
  2064  TO GET 40-COL DISPLAY, SEND A CTRL-U
  2066  OUT THE NORMAL OUTPUT VECTOR. <FDED>
  2069  SET NORMAL CHARACTER ATTRIBUTE <FE84>
  206C  INITIALIZE SCREEN/WINDOW <FB2F>
  206F  CLEAR SCREEN/HOME CURSOR <FC58>
```

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 2Ø76
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2Ø76  SET BITMAP TO MARK LOWER 48K FREE (BF58)
  2Ø7C  EXCEPT PAGES Ø AND 1 AND
  2Ø7E   TEXT PAGES 4 THROUGH 7 (BF58)
  2Ø86  MARK $9ØØØ-$BFFF IN USE..
  2Ø91  EXCEPT FOR $BAØØ-$BDFF ARE FREE
  2Ø96  LOOK AT LANGUAGE IN ROM (EØØØ)
  2Ø99  IS IT APPLESOFT?
  2Ø9B  NO, THEN CAN'T RUN INTERP >>2ØB1
  2ØAØ  GOT AT LEAST 64K?
  2ØA2  NO, THIS ONLY WORKS IN 64K >>2ØB1
  2ØA6  SET MY CSWL/KSWL FOR INTERP INIT (221A)
  2ØAC  COPY ALL 4 BYTES >>2ØA6
  2ØAE  THEN GO TO BASIC COLDSTART >>EØØØ
          (WE WILL GET CONTROL AT $2ØD4 AGAIN)

2ØB1 *********** ERROR EXIT *******************************************

  2ØB1  ---
  2ØB3  PRINT "UNABLE TO EXECUTE BASIC SYSTEM" (223F)
  2ØBC  ALLOW REBOOT IF RESET PRESSED (Ø3F4)
  2ØC2  GO TO SLEEP FOREVER >>2ØC2

2ØC4 *********** COPY PAGES ($Ø/1-->$2/3) ****************************

  2ØC4  ---
  2ØC5  COPY FROM $Ø/1
  2ØC7  TO $2/3
  2ØCA  A PAGE AT A TIME >>2ØC4
  2ØDØ  COUNT PAGES
  2ØD3  RETURN

2ØD4 *********** CSWL INTERCEPT / CONTINUE ***************************

  2ØD4  "]" APPLESOFT PROMPT?
  2ØD6  NO...DON'T PRINT WHATEVER IT IS >>2ØD3
  2ØD8  YES, APPLESOFT DONE SETTING UP (BE1Ø)
  2ØDB  POINT CSWL TO STANDARD OUTPUT
  2ØE2  CHECK LAST DEVICE USED (BF3Ø)
  2ØE5  SET ONLINE PARAMETER TO THIS (2238)
  2ØEB  DRIVE ONE OR TWO? >>2ØEE
  2ØEE  STORE DEFAULT DRIVE (D) (BE3D)
  2ØF2  ISOLATE SLOT FROM DEVICE NO.
  2ØF7  AND STORE DEFAULT SLOT (S) (BE3C)
  2ØFE  GET SLOT BYTE SHOWING CARDS PRESENT (BF99)
  21Ø2  PICK OFF ITS BITS ONE BY ONE
  21Ø8  SET OUTVECS AND INVECS TO $CSØØ (BE1Ø)
  21ØB  FOR ALL SLOTS WITH ROMS IN THEM (BE2Ø)
  2115  ---
  211B  SET HIMEM TO $96ØØ
  211D  IN VARIOUS PLACES
  2124  GOT A DEFAULT PREFIX? (BF9A)
```

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 2127
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  2127  NO >>214E
  2129  YES, MLI: GET PREFIX <BFØØ>
  212F  ERROR? >>218B
  2136  BACKSCAN PREFIX FOR "/"'S (Ø28Ø)
  213B  AND COUNT THEM IN $21EE (223E)
  213E  ---
  213F  FOR A COUNT OF SUBLEVELS >>2136
  2146  MORE THAN JUST VOLUME NAME? >>216F
  2148  NO, MLI: SET PREFIX <BFØØ>
  214E  MLI: ONLINE <BFØØ>
  2154  ERROR? >>218B
  2156  GET VOL NAME LENGTH (Ø281)
  215B  NONE THERE? >>218B
  215F  ADD ONE TO NAME LENGTH (Ø28Ø)
  2164  AND PREFIX IT WITH A "/" (Ø281)
  2167  MLI: SET PREFIX <BFØØ>
  216D  ERROR? >>218B

         ******** FIND STARTUP FILE **************

  216F  MLI: GET_FILE_INFO <BFØØ>
  2172  FIND "STARTUP" FILE
  2175  ERROR? >>218B
  217A  SAVE LENGTH OF STARTUP FILE NAME (2236)
  217D  COPY NAME TO $2ØØ (2ØØ6)
  2186  FIRST COMMAND WILL BE "-STARTUP"
  218B  CHECK NUMBER OF SUBLEVELS (223E)
  219Ø  MORE THAN JUST VOL? >>2198
  2192  MLI: SET PREFIX <BFØØ>
  2198  ANY STARTUP FILE NAME? (2236)
  219B  YES, SKIP MESSAGE >>21C1
  219D  SET TRUE KSWL <22Ø9>
  21A2  PRINT '          PRODOS BASIC 1.1' (2267)
  21AD  PRINT '        COPYRIGHT ... (2283)
  21B6  SKIP THREE LINES

         ******** FINISH UP AND GO TO BI *********

  21C1  ---
  21C3  COPY WARMSTART JMP TO PAGE 3 (21FF)
  21C9  AND COLDSTART (Ø3D3)
  21CC  AND CTL-Y (Ø3F8)
  21CF  POINT & VECTOR (22Ø6)
  21D2  TO $BEØ3 (CMD SCANNER) (Ø3F5)
  21D8  COPY BRK HANDLER JMP ALSO (22Ø2)
  21E7  AND RESET JMP (Ø3F2)
  21F2  SET POWER-UP BYTE ACCORDINGLY (Ø3F4)
  21F7  SET APPLESOFT IN NON-TRACE MODE
  21F9  GET INTERPRETER VERSION NUMBER, (BC7A)
  21FC  PUT IT IN SYSTEM GLOBAL PAGE. (BFFD)
  21FF  GO TO INTERPRETER >>BEØØ
```

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 21FF
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

          ******** VECTOR ADDRESSES ***************

  2202  BREAK HANDLER ADDRESS FOR PAGE 3
  2204  RESET HANDLER IS BASIC INTERP
  2206  APPLESOFT & GOES TO BI CMD SCANNER >>BE03

2209 *********** FIRST KSWL INTERCEPT ********************************

  2209  SET KSWL TO CURRENT DEVICE HANDLER (BE20)
  2213  RETURN LENGTH OF FIRST COMMAND (2006)
  2217  FOLLOWED BY A RETURN
  2219  RETURN

221A *********** DATA ************************************************

  221A  CSWL (20D4) INTERCEPT ADDR
  221C  KSWL (2209) INTERCEPT ADDR

  221E  GET FILE INFO PARMLIST
  221F  FILE NAME IS AT $2006
  2221  15 BYTES RESERVED FOR OTHER GET_FILE PARMS (NOT USED)
  2230  THIS BYTE NOT USED

  2231  SET PREFIX PARM LIST
  2232  FOR PREFIX AT $2234

  2234  NULL PREFIX
  2235  "/"

  2236  SAVED LENGTH OF STARTUP FILE NAME

  2237  ONLINE PARM LIST
  2239  PUT VOLUME NAME AT $281

  223B  SET PREFIX PARMLIST
  223C  PREFIX IS AT $280

  223E  NUMBER OF SUBLEVELS IN PREFIX +1

  223F  '***  UNABLE TO EXECUTE BASIC SYSTEM  ***'
  2267  '            PRODOS BASIC 1.1'
  2283  '         COPYRIGHT APPLE, 1983-84'

22A3 *********** $22A3-$23FF NOT USED ********************************

  22A3  NOT USED
```

```
BI Relocator -- V1.1.1 -- 18 JUN 84            NEXT OBJECT ADDR: 22A5
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

2400 *********** START OF BI IMAGE ***********************************

2400    BASIC INTERP IMAGE
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9A00
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

9A00    MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  PRODOS BASIC INTERPRETER (BI)       *
          *       THIS CODE STARTS IN THE THIRD  *
          *       BLOCK OF THE FILE BASIC.SYSTEM. *
          *       IT PERFORMS COMMAND HANDLING   *
          *       FOR ALL BUILT-IN PRODOS COM-   *
          *       MANDS AND SUPPORTS BASIC'S FILE *
          *       HANDLING.                      *
          *                                      *
          *  VERSION 1.1 -- 18 JUN 84            *
          *    DISTRIBUTED WITH PRODOS V1.1.1    *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

0024    CURSOR HORIZONTAL
0028    SCREEN LINE BASE ADDR
0029
0033    MONITOR PROMPT CHARACTER
0036    CRT DISPLAY VECTOR (CSWL)
0037
0038    KEYBOARD INPUT VECTOR (KSWL)
0039
003A    SCRATCH POINTER AND LOOP COUNTER
003B
003C    SCRATCH POINTER AND LOOP COUNTER
003D
003E    POINTER TO APPLESOFT VARIABLES
003F
0050    APPLESOFT: LINE NUMBER
0051
0067    APPLESOFT: START OF PROGRAM PTR
0068
0069    APPLESOFT: LOMEM (START OF VARS)
006A
006B    APPLESOFT: START OF ARRAY VARS PTR
006C
006E    APPLESOFT: START OF FREEAREA PTR
006D
006F    APPLESOFT: START OF STRINGS PTR
0070
0073    APPLESOFT: HIMEM (END OF STRINGS)
0074
0075    APPLESOFT: CURRENT LINE BEING EXECUTED
0076
009B    APPLESOFT: ADDR OF LINE AFTER FINDLINE
009C
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9A00
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

00AF    APPLESOFT: END OF PROGRAM PTR
00B0
00B8    APPLESOFT: START OF PROGRAM PTR
00B9
00D6    APPLESOFT: PROGRAM LOCKED (PROTECTED)
00D8    APPLESOFT: ONERR ACTIVE FLAG
00DE    APPLESOFT: ONERR CODE
00F2    APPLESOFT: TRACE ACTIVE FLAG
00F8    APPLESOFT: INTERNAL STACK

          ******** EXTERNAL ADDRESSES *************

0100    START OF 6502 STACK
0200    KEYBOARD INPUT LINE BUFFER
03F4    POWERON RESET FLAG

          ******** BI GLOBAL PAGE *****************

BE06    EXTERNAL COMMAND ENTRY TO BI
BE0C    PRINT ERROR MESSAGE ENTRY TO BI
BE0F    PRODOS ERROR CODE
BE10    OUTPUT VECTORS FOR ALL SLOTS
BE30    CURRENT OUTPUT VECTOR
BE32    CURRENT INPUT VECTOR
BE34    PRODOS INTERCEPT VECTORS (INPUT/OUTPUT)
BE38    BI'S INTERNAL REDIRECTION VECTORS
BE3C    DEFAULT SLOT
BE3D    DEFAULT DRIVE
BE3E    A REGISTER SAVE AREA
BE3F    X REGISTER SAVE AREA
BE40    Y REGISTER SAVE AREA
BE41    TRACE FLAG (APPLESOFT TRACE ON/OFF)
BE42    IMMEDIATE COMMANDS=0, DEFERRED=1
BE43    EXEC FILE ACTIVE=$80
BE44    READ FILE ACTIVE=$80
BE45    WRITE FILE ACTIVE=$80
BE46    READING PREFIX ACTIVE=$80
BE47    DIRECTORY FILE BEING ACCESSED
BE49    FREE STRING SPACE DURING GARBAGE COLLECT
BE4A    BUFFERED I/O BYTE COUNT
BE4B    INDEX INTO INPUT COMMAND LINE
BE4C    LAST OUTPUT CHAR TO PREVENT RECURSION
BE4D    NUMBER OF OPEN NON-EXEC FILES
BE4E    EXEC FILE BEING CLOSED FLAG
BE4F    READ FILE IS TRANSLATED DIRECTORY
BE50    VECTOR TO EXTERNAL COMMAND HANDLER
BE52    LENGTH-1 OF EXTERNAL COMMAND STRING
BE53    COMMAND NUMBER
BE54    PARAMETERS ALLOWED FOR THIS COMMAND
          (SEE BIT DEFINITIONS IN TABLE LATER)
BE56    PARAMETERS FOUND WITH THIS COMMAND
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9AØØ
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

          (SAME BIT DEFINITIONS AS FOR PBITS)
BE58    A KEYWORD VALUE
BE5A    B KEYWORD VALUE
BE5D    E KEYWORD VALUE
BE5F    L KEYWORD VALUE
BE61    S KEYWORD VALUE
BE62    D KEYWORD VALUE
BE63    F KEYWORD VALUE
BE65    R KEYWORD VALUE
BE68    @ KEYWORD VALUE
BE6A    T KEYWORD VALUE
BE6B    SLOT NUMBER FROM IN# OR PR#
BE7Ø    ISSUE MLI CALL AND XLATE ERROR CODES
          MLI PARM LIST FIELDS
BEA3    CREATE: ACCESS CODE
BEA4    CREATE: FILE ID
BEA5    CREATE: AUX ID
BEA7    CREATE: FILE KIND
BEB4    SET/GET FILE INFO: PARM COUNT
BEB7    SET/GET FILE INFO: ACCESS CODE
BEB8    SET/GET FILE INFO: FILE ID
BEB9    SET/GET FILE INFO: AUX ID
BEBB    SET/GET FILE INFO: FILE KIND
BEBC    SET/GET FILE INFO: BLOCKS USED
BEBE    SET/GET FILE INFO: MODIFY DATE/TIME
BEC7    ONLINE/GET/SET MARK/EOF/BUF: REF NUM
BEC8    ONLINE/GET/SET MARK/EOF/BUF: MARK/BUF
BECE    OPEN: SYSTEM BUFFER
BEDØ    OPEN: REF NUM RETURNED
BED2    NEWLINE: REF NUM
BED3    NEWLINE: NEW LINE CHAR (ALWAYS CR)
BED6    READ/WRITE: REF NUM
BED7    READ/WRITE: DATA ADDRESS
BED9    READ/WRITE: LENGTH OF DATA
BEDB    READ/WRITE: ACTUAL LENGTH TRANSMITTED
BEDE    CLOSE/FLUSH: REF NUM
BEFB    BASIC HIMEM VALUE

          ******** SYSTEM GLOBAL PAGE *************

BFØ3    QUIT VECTOR
BF3Ø    LAST DEVICE USED
BF58    MEMORY UTILIZATION BIT MAP
BF94    OPEN FILE LEVEL
BF9A    PREFIX ACTIVE FLAG (IF NONZERO)

          ******** INPUT/OUTPUT LOCATIONS *********
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9AØØ
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

CØØØ    KEYBOARD STROBE
CØ1Ø    KEYBOARD STROBE CLEAR
CFFF    RESET I/O ROMS

          ******** APPLESOFT ROM LOCATIONS ********

D43F    APPLESOFT RESTART ENTRY
D61A    FIND LINE BY NUMBER IN APPLESOFT
D665    SET POINTERS IN APPLESOFT
D7D2    EXECUTE NEW APPLESOFT STATEMENT
D82Ø    APPLESOFT CMD EXECUTE
D865    APPLESOFT SIGNAL ERROR
ED24    APPLESOFT PRINT DECIMAL NUMBER
F273    APPLESOFT SET NORMAL CHARS

          ******** MONITOR ROM LOCATIONS **********

FC58    MONITOR CLEAR SCREEN/HOME CURSOR
FC9C    MONITOR CLEAR TO EOL
FD1Ø    MONITOR READ KEY (NO CURSOR)
FDED    COUT VECTOR

9AØØ *********** BASIC INTERPRETER LOAD POINT ************************
          (ENTRY POINT IS AT $ABF1, WARMDOS)

9AØØ *********** REMOVE KSWL/CSWL INTERCEPTS *************************

  9AØØ  ---
  9AØ1  REPLACE CSWL/KSWL WITH CURRENT (BE3Ø)
  9AØ4  ACTUAL DEVICE DRIVER VECTORS
  9A16  RETURN

9A17 *********** RESET MODE/SET BI INTERCEPTS ************************

  9A17  SET IMMEDIATE COMMAND MODE
  9A19  AND GO SET I/O VECTORS <9F76>
  9A1C  KSWL/H ALREADY SET?
  9A21  NO? THEN CHECK CSWL >>9A26
  9A23  YES, CONTINUE >>9AA3
  9A26  CSWL/H ALREADY SET?
  9A2B  YES, CONTINUE >>9AA3
  9A2D  NO, SAVE CURRENT INTERCEPTS FIRST >>9A8D

9A2F *********** OUTPUT INTERCEPT: MODE = Ø **************************
          (IMMEDIATE MODE)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9A2F
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------


  9A2F  "#" CHARACTER? (9F61)
  9A32  NO... >>9A54
  9A34  ELSE, SAVE X REG (BE3F)
  9A38  CHECK STACK FOR $D812 AS RETURN ADDR (Ø1Ø3)
  9A3B  (APPLESOFT TRACE, PRINTING #LINENO)
  9A44  NOT TRACING? >>9A6E
  9A46  ELSE, SET DEFERED MODE=4
  9A4B  GET SET TO PRINT THE "#" (9F61)
  9A4E  RESTORE X REG (BE3F)
  9A51  AND GO TO OTHER OUTPUT HANDLER >>B7F1

  9A54  NOT A #, SAME AS LAST OUTPUT THO? (BE4C)
  9A57  (SAVE FOR NEXT TIME THRU) (BE4C)
  9A5A  NO, ALL IS WELL >>9A74
  9A5C  TWO RETURNS IN A ROW?
  9A5E  NO, ALL IS WELL >>9A74
  9A6Ø  HAS HORIZONTAL CURSOR POSN CHANGED?
  9A62  YES...  >>9A69
  9A64  ELSE, ANYTHING IN PATHNAME BUFFER? (BCBD)
  9A67  (MUST BE ALPHA)
  9A69  RESTORE A REG
  9A6B  PATHNAME IS THERE... >>9A74
  9A6D  ELSE, WE ARE RECURSING INFINITELY, EXIT!
  9A6E  WE WERE'NT TRACING AFTER ALL, RESTORE X (BE3F)
  9A71  AND A REGS, THEN FALL THRU TO EXIT (9F61)

9A74 *********** ECHO OUTPUT CHAR AND EXIT **************************

  9A74  PUT BACK REAL CSWL/KSWL VECTORS <9AØØ>
  9A77  OUTPUT THE CHARACTER <FDED>
  9A7A  WAS IT A RETURN?
  9A7C  NO, EXIT NOW >>9A8D
  9A7E  ELSE, WAS APPLESOFT TRACING?
  9A82  YES >>9A8B
  9A84  NO, CLEAR MY TRACE FLAG (PSEUDO TRACE NOW) (BE41)
  9A87  FORCE APPLESOFT TO TRACE FOR MY BENEFIT ONLY
  9A8B  RESTORE A REG AND FALL THRU TO EXIT BI

9A8D *********** SAVE ACTUAL IN/OUT VECTORS *************************

  9A8D  ---
  9A8E  COPY KSWL/H TO VECIN
  9A98  AND CSWL/H TO VECOUT
  9A9A  IN BI GLOBAL PAGE (BE31)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9AA3
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

9AA3 *********** SET CSWL/KSWL INTERCEPTS ***************************

  9AA3  ---
  9AA4  COPY VDOSIO VECTORS (BE34)
  9AA7  TO CSWL
  9AB1  AND KSWL
  9AB9  EXIT TO CALLER

9ABA *********** INPUT INTERCEPT: MODE = Ø ***************************
                  (IMMEDIATE MODE)

  9ABA  IS EXEC FILE ACTIVE? (BE43)
  9ABD  NO >>9AC5
  9ABF  YES, SAVE REGISTERS <9F62>
  9AC2  AND GO READ EXEC FILE FOR INPUT COMMANDS >>9BAF

  9AC5  NO EXEC FILE, RESTORE REAL CSWL/KSWL <9AØØ>
  9AC8  NO, READ A KEY FROM KEYBOARD <FD1Ø>
  9ACB  RETURN?
  9ACD  NO, EXIT >>9AEB
  9ACF  YES, SAVE REGISTERS <9F62>
  9AD2  STORE IT IN LINE BUFFER (Ø2ØØ)
          --> THIS ENTRY CALLED BY EXEC TO PROCESS
              A COMMAND STRING STORED AT $2ØØ
  9AD5  GO PROCESS THE COMMAND STRING <A677>
  9AD8  CHECK COMMAND NUMBER RETURNED FROM PARSE (BE53)
  9ADB  EXIT BI RIGHT NOW? >>9AE8
  9ADD  NO, COMMAND RETURNED WITH ERROR CODE? >>9AFØ
  9ADF  NO, RESTORE Y REG (BE4Ø)
  9AE2  RETURN A BACKSPACE TO CALLER OF KEYBOARD
  9AE4  AND A LINE INDEX OF ZERO
  9AE6  EXIT THE BI >>9AEB

  9AE8  RESTORE CALLER'S REGISTERS <9F6C>
  9AEB  AND EXIT BI BY INSTALLING INTERCEPTS >>9A8D

9AEE *********** ERROR HANDLER ****************************************

  9AEE  ERROR=3, "NO DEVICE CONNECTED"
  9AFØ  MAIN ENTRY: STORE ERROR CODE (BEØF)
  9AF3  AND IN APPLESOFT ONERR
  9AF5  CHECK BI STATE (BE42)
  9AF8  MEMORIZE WHETHER IT'S IMMEDIATE MODE
  9AFD  SET A HIGH FILE LEVEL FOR NON-EXEC FILES (BF94)
  9BØ2  NO ACTIVE READ/WRITE FILES OR PREFIX READ (BE44)
  9BØB  CLOSE ALL OPEN FILES AT OR ABOVE (BEDE)
  9BØE  FILE LEVEL = $ØF
  9B1Ø  MLI: CLOSE (ALL) <BE7Ø>
  9B13  ERROR? >>9B27
  9B15  WRITE ANY DATA I HAVE BUFFERED <AØØØ>
  9B18  ERROR? >>9B27
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9B1A
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  9B1A   PUT FILE LEVEL BACK TO ZERO
  9B22   NOW FLUSH ALL OPEN FILES
  9B24   MLI: FLUSH (ALL) <BE7Ø>
  9B27   ---
  9B28   ASSUME MODE WILL BE 4 (DEFERRED)
  9B2A   MEMORIZE WHETHER BASIC ONERR ACTIVE
  9B2C   DEFERRED MODE CURRENTLY? >>9B3Ø
  9B2E   NO, STILL IMMEDIATE MODE (MODE=Ø)
  9B3Ø   ---
  9B31   SET MODE AS DEFINED ABOVE <9F76>
  9B34   RESTORE BI'S CSWL/KSWL INTERCEPTS <9AA3>
  9B37   GET ERROR CODE (BEØF)
  9B3B   BASIC ONERR ACTIVE? THEN GO HANDLE IT >>9B4D
  9B3E   NO, JUST PRINT ERROR MESSAGE <BEØC>
  9B41   CLOSE EXEC FILE IF ONE IS OPEN <B2FB>
  9B45   DEFERRED MODE? >>9B53
  9B47   IMMED. MODE, PRINT RETURN AND... <9FAB>
  9B4A   WARMSTART APPLESOFT  >>D43F

  9B4D   RESTORE STACK FOR BASIC
  9B52   PASS ERROR CODE TO BASIC
  9B53   ---
  9B55   JUMP INTO APPLESOFT ERROR HANDLER >>D865

9B58 *********** RETURN TO IMMED. MODE ******************************

  9B58   CLEAR APPLESOFT ERRNUM
  9B5C   WILL LOOK FOR "#" FROM APPLESOFT
  9B61   SET NORMAL VIDEO IN APPLESOFT <F273>
  9B64   RESTORE TRUE CSWL/KSWL <9AØØ>
  9B67   TRY TO WRITE BUFFERED DATA <9FF4>
  9B6A   RESET MODE/SET UP BI'S INTERCEPTS <9A17>
  9B6D   RESTORE REGISTERS <9F6C>
  9B7Ø   GO TO PROCESS IMMED. INPUT REQUEST >>9ABA

9B73 *********** INPUT INTERCEPT: MODE=4 OR 8 ***********************

  9B73   SAVE REGISTERS <9F62>
  9B76   PREFIX INPUT ACTIVE? (BE46)
  9B79   NO >>9B7E
  9B7B   YES, GO DO SPECIAL HANDLING >>9D67
  9B7E   ELSE, IS READ FILE ACTIVE? (BE44)
  9B81   NO >>9B86
  9B83   YES, GO DO SPECIAL HANDLING FOR THAT >>9C16
  9B86   ELSE, IS EXEC FILE ACTIVE? (BE43)
  9B89   NO >>9BAF
  9B8B   YES, GET PROMPT CHARACTER
  9B8D   IT BETTER NOT BE A "]"
  9B8F   IT IS, RETURN TO IMMEDIATE MODE >>9B58
  9B91   ELSE, SET TRUE CSWL/KSWL <9AØØ>
  9B94   AND PASS CALLER'S AREG TO REMOVE CURSOR (BE3E)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9B97
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  9B97   RESTORE Y-REGISTER (BE4Ø)
  9B9A   REMOVE CURSOR AND GET A KEYPRESS <FD1Ø>
  9B9D   BACKSPACE?
  9B9F   NO, EXIT BI >>9BAC
  9BA1   YES, CHECK PROMPT
  9BA3   IF ITS A ">"...
  9BA5   THEN EXIT WITH THE BACKSPACE >>9BAA
  9BA8   ELSE, IF AT START OF LINE, REPROMPT >>9B94
  9BAA   MIDDLE OF LINE, RETURN A BACKSPACE
  9BAC   EXIT BI TO CALLER >>9A8D

9BAF *********** READ EXEC FILE *************************************

  9BAF   REMOVE CURSOR FROM SCREEN
  9BB1   CHECK PROMPT CHARACTER
  9BB3   IF ITS A ">"...
  9BB5   DO THINGS DIFFERENTLY >>9BF2
  9BB7   CHECK KEYBOARD (CØØØ)
  9BBA   NO KEY READY? >>9BCD
  9BBC   GOT A KEY, IS IT CONTROL-C?
  9BBE   NO, IGNORE IT  >>9BCD
  9BCØ   YES, CLOSE EXEC FILE <B2FB>
  9BC3   IMMEDIATE MODE? (BE42)
  9BC6   NO >>9CØ1
  9BC8   YES, CLEAR KEYBOARD STROBE (CØ1Ø)
  9BCB   AND GO START NEW LINE >>9CØ1
  9BCD   SET UP FOR EXEC LINE READ <9D8A>
  9BDØ   READ A LINE TO $2ØØ <9C6C>
  9BD3   ERROR? >>9BFA
  9BD5   SAVE REGISTERS <9F62>
  9BD8   HOP INTO LOOP >>9BDE
  9BDA   ---
  9BDB   BACKSCANNING $2ØØ BUFFER (Ø2ØØ)
  9BDE   FORCING THE MSB ON
  9BE6   RESTORE TRUE CSWL/KSWL <9AØØ>
  9BE9   GO PROCESS COMMAND LINE <9AD5>
  9BEC   CHECK COMMAND NUMBER (BE53)
  9BEF   IMMEDIATE EXIT? IF NOT, GET NEXT LINE >>9BCD
  9BF1   RETURN

            ******** HANDLE EXEC PROMPT > ***********

  9BF2   GET SET TO READ EXEC LINE <9D8A>
  9BF5   READ SINGLE CHARACTER PER CALL <9C48>
  9BF8   NO ERRORS, EXIT TO CALLER NOW >>9BF1

            ******** EXEC ERROR RECOVERY ************
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9BFA
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  9BFA  CLOSE EXEC FILE <B245>
  9BFD  WAS ERROR "END OF DATA"?
  9BFF  NO, REAL ERROR THEN >>9C13
  9C01  ELSE, OK -- JUST STOP EXECING
  9C03  GET CURSOR HORIZONTAL POSITION
  9C05  IF IN MID LINE, PASS SCREEN CHAR BACK >>9C0E
  9C07  ELSE, CHANGE PROMPT TO "]"
  9C0B  AND RETURN WITH A BACKSPACE
  9C0D  RETURN
  9C0E  GET SCREEN CHARACTER UNDER CURSOR
  9C10  AND EXIT THRU KSWL TO GET REAL KEYPRESS >>0038
  9C13  REAL ERROR, GO TO BI'S MAIN ERROR HANDLER >>9AF0

9C16 *********** INPUT FILE ACTIVE ***********************************

  9C16  GET PROMPT
  9C18  IF ITS A "]"...
  9C1C  THEN RESET TO IMMEDIATE MODE >>9B58
  9C1F  ELSE, REMOVE CURSOR FROM SCREEN (BE3E)
  9C24  CHECK KEYBOARD (C000)
  9C27  NO KEYPRESS? >>9C31
  9C29  GOT A KEY, IS IT CONTROL-C?
  9C2B  NO, IGNORE IT >>9C31
  9C2D  CLEAR STROBE AND EXIT TO CALLER (C010)
  9C30  RETURN

  9C31  GET PROMPT AGAIN
  9C33  IS THIS A DIRECTORY FILE? (BE47)
  9C36  YES >>9C95
  9C38  NO, IS PROMPT = ">"?
  9C3A  YES, READ A SINGLE BYTE AT A TIME >>9C42
  9C3C  ELSE, READ ENTIRE LINE <9C67>
  9C3F  ERROR? >>9C13
  9C41  RETURN

  9C42  READ SINGLE BYTE FROM INPUT FILE <9C48>
  9C45  ERROR? >>9C13
  9C47  RETURN

9C48 *********** READ NEXT BYTE OF FILE ******************************

  9C48  SAVE CURRENT READ/WRITE COUNT (BED9)
  9C4B  IN L KEYWORD VALUE (BE5F)
  9C50  SET UP TO READ ONE BYTE (BED9)
  9C55  MLI: READ <BE70>
  9C58  ERROR? >>9C66
  9C5A  PUT COUNT BACK TO MAXIMUM AGAIN (BE5F)
  9C60  GET FIRST CHARACTER ON $200 LINE (BED7)
  9C63  AND RETURN THAT TO CALLER (0200)
  9C66  RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9C66
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

9C67 *********** READ NEXT LINE OF FILE ******************************

  9C67  REMOVE CURSOR FROM SCREEN (BE3E)
  9C6C  ---
  9C6E  MLI: READ <BE70>
  9C71  ERROR? >>9C66
  9C73  GET LENGTH ACTUALLY TRANSMITTED (BEDB)
  9C76  NOTHING? >>9C8E
  9C79  GOT SOMETHING, FIND END OF DATA (BED7)
  9C7D  FETCH LAST BYTE OF LINE (01FF)
  9C82  IS IT A RETURN CHARACTER?
  9C84  NO, LEAVE LINE ALONE >>9C8E
  9C86  YES, WAS L KEYWORD GIVEN? (BE57)
  9C8B  YES, LEAVE IT BE >>9C8E
  9C8D  ELSE, CHOP OFF THE RETURN ITSELF
  9C8E  AND EXIT WITH A RETURN
  9C90  RESTORING Y REG AS YOU GO (BE40)
  9C94  RETURN

9C95 *********** READING DIR FILE ************************************

  9C95  ">" PROMPT?
  9C97  YES, EXIT RIGHT NOW >>9C8E
  9C99  ELSE, REMOVE CURSOR FROM SCREEN (BE3E)
  9C9E  SET 80 COLUMNS
  9CA5  MLI: GET MARK <BE70>
  9CA8  ERROR? >>9D1F
  9CAA  ARE WE AT BEGINNING OF THIS FILE? (BEC8)
  9CB0  NO, CONTINUE >>9CDF
  9CB2  YES, CAT FLAG = 2
  9CB7  READ DIRECTORY HEADER <B15D>
  9CBA  ERROR? >>9D1F
  9CBC  REF NUM TIMES 32 (BED6)
  9CC7  SET THE L VALUE OF THIS DIR FILE IN (BCFF)
  9CCA  THE OPEN FILE LIST TO THE ENTRY LENGTH (BCB8)
  9CCD  AND THE NUMBER OF ENTRIES PER BLOCK (BD00)

            ******** FORMAT DIRECTORY NAME **********

  9CD0  GO FORMAT NAME OF DIRECTORY <B0B8>
  9CD3  STORE THE LENGTH OF LINE AT $200
  9CD8  PUT A RETURN CHAR AT END OF LINE
  9CDD  AND EXIT TO CALLER
  9CDE  RETURN

  9CDF  GET CAT FLAG (BE4F)
  9CE2  IF ZERO, GO PROCESS INDIVIDUAL ENTRIES >>9D22
  9CE4  IF MINUS, GO DO SUMMARY LINE OR EXIT >>9CF9
  9CE6  POSITIVE, ASSUME NULL LINE WANTED
  9CE8  DROP CAT FLAG BY ONE (BE4F)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9CEB
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

 9CEB   IF ZERO, JUST GO PRINT A BLANK LINE >>9CD3

          ******** FORMAT TITLE LINE **************

 9CED   ELSE, BLANK OUT $2ØØ AND <A66C>
 9CF2   UNPACK "NAME TYPE BLOCKS ETC... <9FBØ>

 9CF5   LINE LENGTH IS 8Ø
 9CF7   GO RETURN IT TO CALLER >>9CD3

          ******** FORMAT SUMMARY LINE ************

 9CF9   DO SUMMARY LINE?
 9CFB   NO, JUST EXIT (ALL DONE) >>9D1C
 9CFD   YES, DROP CAT FLAG SO EXIT NEXT TIME (BE4F)
 9DØ2   CLEAR READ/WRITE COUNT (BED9)
 9DØA   MLI: READ <BE7Ø>
 9DØD   FORMAT BLOCKS FREE AND INUSE SUMMARY LINE <BØE7>
 9D11   GET REF NUM  (BED6)
 9D14   AND COPY TO GET/SET LIST (BEC7)
 9D18   NO ERRORS, EXIT >>9CF5
 9D1A   ERROR, JUMP TO BI ERROR EXIT >>9D1F
 9D1C   "END OF DATA" ERROR
 9D1F   GO TO BI ERROR EXIT >>9AFØ

          ******** FORMAT FILE/DIR ENTRIES ********

 9D22   SET DIR ENTRY NUM COUNTER TO -1
 9D27   GET REF NUM (BED6)
 9D2A   *32
 9D2F   USE AS INDEX TO GET ENTRY LENGTH (BCFF)
 9D35   AND ENTRIES PER BLOCK FROM OPEN FILE LIST (BDØØ)
 9D3B   POSITION ON EVEN BLOCK BOUNDARY (BEC9)
 9D41   AND GET SECTOR OFFSET (BEC8)
 9D45   SKIP FILE/DIR ENTRIES UNTIL POSITIONED TO (BCBB)
 9D48   CURRENT POSITION IN THIS BLOCK (BCB7)
 9D5Ø   READ NEXT DIR ENTRY FROM FILE <B1D1>
 9D53   NO ERROR? >>9D61
 9D55   ERROR, IF RANGE ERROR...
 9D57   NO, TRUE ERROR >>9D1F
 9D59   RANGE ERROR, READY FOR SUMMARY LINE NEXT (BE4F)
 9D5E   RETURN A BLANK LINE THIS TIME >>9CD3

 9D61   FORMAT FILE/DIR ENTRY INTO $2Ø1 <A4C4>
 9D64   AND RETURN IT TO CALLER >>9CF5
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9D67
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

9D67 *********** PREFIX INPUT ACTIVE **********************************

 9D67   PROMPT = "]"?
 9D69   NO, ALL IS WELL >>9D6E
 9D6B   YES, RETURN TO IMMEDIATE MODE NOW >>9B58
 9D6E   REMOVE CURSOR FROM SCREEN (BE3E)
 9D75   PREFIX NO LONGER ACTIVE AFTER THIS (BE46)
 9D7B   COPY PATHNAME BUFFER (PREFIX) (BCBC)
 9D7E   TO $2ØØ (Ø1FF)
 9D84   RETURN WITH IT TO BASIC (BCBC)
 9D89   RETURN

9D8A *********** SETUP TO READ LINE FROM EXEC ************************

 9D8A   SET READ REF NUM FOR EXEC FILE (BCA3)
 9D9Ø   READ TO $2ØØ
 9D95   FOR $EF BYTES OF LENGTH
 9D9A   (OR UNTIL A RETURN CHAR)
 9DA2   RETURN

9DA3 *********** OUTPUT INTERCEPT: MODE = C **************************
          (LOOK FOR CONTROL-D)

 9DA3   SAVE REGISTERS <9F62>
 9DA6   PRINTING A CONTROL-D?
 9DA8   NO >>9DC1
 9DAA   YES, WRITE OUT ANY BUFFERED DATA <9FF4>
 9DAD   NOTHING IN COMMAND LINE (BE4B)
 9DBØ   READ FILE INACTIVE (BE44)
 9DB3   WRITE FILE INACTIVE (BE45)
 9DB6   PREFIX READ INACTIVE (BE46)
 9DBB   SET MODE = 8 FROM NOW ON <9F76>
 9DBE   RESTORE REGS AND EXIT >>9F6C

 9DC1   GOT A CONTROL-D...
 9DC3   SET MODE = 4 FROM NOW ON <9F76>
 9DC6   RESTORE REGISTERS <9F6C>
 9DC9   OUTPUT CHARACTER AND EXIT >>B7F1

9DCC *********** OUTPUT INTERCEPT: MODE = 8 **************************
          (ASSEMBLE COMMAND LINE)

 9DCC   SAVE REGISTERS <9F62>
 9DD2   SAVE CHAR IN COMMAND LINE (Ø2ØØ)
 9DD5   WAS IT A RETURN?
 9DD7   YES, READY TO ROLL >>9DE7
 9DD9   NO, BUMP CHARACTER COUNTER (BE4B)
 9DDC   AND EXIT TO CALLER >>9DE3
 9DDE   OOPS! LINE TOO LONG
 9DEØ   "SYNTAX ERROR" >>9AFØ
 9DE3   ELSE, RESTORE X REG AND EXIT (BE3F)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9DE6
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  9DE6  RETURN

  9DE7  ---
  9DE9  NULL LINE? >>9DF6
  9DEB  NO, PUT BACK TRUE CSWL/KSWL <9A00>
  9DEE  SYNTAX SCAN CMD LINE <A677>
  9DF1  ERROR? >>9DE0
  9DF3  NO, PUT BACK BI'S INTERCEPTS <9A8D>
  9DF6  ---
  9DF8  MODE = 4 NOW <9F76>
  9DFB  RESTORE REGS AND EXIT >>9F6C

9DFE *********** WRITE BUFFERED CHARACTER ***************************

  9DFE  SAVE Y REG (BE40)
  9E01  CHECK PROMPT
  9E03  CHECK TO SEE IF WE ARE IN "IF", >>9E11
  9E06  "PRINT", "LIST", OR "CALL" STATEMENTS >>9E11
  9E09  OF AN APPLESOFT PROGRAM >>9E11
  9E0B  IF NOT, EXIT TO CALLER... (BE40)
  9E0E  WITH CHARACTER ECHOED TO SCREEN >>9A74

  9E11  GET INDEX TO TEMPORARILY BUFFERED CHARS (BE4A)
  9E16  STORE INTO BUFFER JUST ABOVE HIMEM
  9E1B  BUMP INDEX (BE4A)
  9E1E  OK >>9E2B
  9E20  BUFFER FULL, SAVE REGISTERS <9F62>
  9E23  WRITE BUFFER OUT TO DISK <9FEE>
  9E26  ERROR? >>9DE0
  9E28  RESTORE REGISTERS <9F6C>
  9E2B  AND EXIT ANYWAY

9E2C *********** OUTPUT INTERCEPT: MODE = 4 **************************
          (INITIAL ENTRY FOR A RUNNING PROGRAM)
          (FLUSH OUT NON COMMAND LINES)

  9E2C  PRINTING A "#"? (9F61)
  9E2F  NO >>9E49
  9E31  YES, SAVE X REGISTER (BE3F)
  9E35  RETURN ADDR IS IN APPLESOFT... (0103)
  9E38  TRACE ROUTINE...
  9E3C  AT $D812? (0104)
  9E41  YES >>9EB6
  9E43  NO, RESTORE REGISTERS (9F61)
  9E49  IS WRITE FILE ACTIVE? (BE45)
  9E4C  NOPE >>9E6C
  9E4E  YES, PRINTING A "]"?
  9E50  NO >>9E56
  9E52  YES, SAME AS PROMPT CHARACTER?
  9E54  YES >>9E86
  9E56  NO, PRINTING A RETURN CHAR?
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9E58
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  9E58  NO >>9DFE
  9E5A  YES, GET PROMPT
  9E60  DOES IT INDICATE RECURSION? >>9DFE
  9E62  YES, WRITE BUFFER OUT <9FF4>
  9E65  OUTPUT FILE INACTIVE NOW (BE45)
  9E6A  EXIT WITH RETURN CHAR >>9E9F

  9E6C  ---
  9E6D  INPUT FILE ACTIVE? (BE44)
  9E73  NO >>9E7D
  9E75  YES, CHECK PROMPT
  9E77  OR IN $04
  9E79  CONTROL-D?
  9E7B  YES >>9EA2
  9E7D  ---
  9E7E  NO, HOW BOUT "]"?
  9E80  NO, EXIT WITH ECHO THEN >>9E9F
  9E82  YES, IS THIS THE PROMPT CHAR?
  9E84  NO, EXIT WITH ECHO >>9E9F
  9E86  YES, SAVE REGISTERS <9F62>
  9E89  CHECK OPEN FILE COUNT (BE4D)
  9E8C  NONE OPEN? >>9E9C
  9E8E  SOME OPEN, WRITE BUFFER OUT <9FF4>
  9E91  INDICATE WRITE FILE INACTIVE NOW (BE45)
  9E94  SET TRUE CSWL/KSWL <9A00>
  9E99  PRINT "FILE(S) STILL OPEN" <BE0C>
  9E9C  RESTORE REGS <9F6C>
  9E9F  AND ECHO EXIT >>9A74

  9EA2  ---
  9EA3  CHAR IS A RETURN?
  9EA5  NO >>9EAA
  9EA7  YES, SAME AS LAST CHAR OUTPUT? (BE4C)
  9EAA  (SAVE IT FOR THIS TEST NEXT TIME) (BE4C)
  9EAD  NOT SAME, NO PROBLEM THEN >>9EB1
  9EAF  SAME, MARK PROMPT FOR RECURSION
  9EB1  RETURN

9EB2 *********** APPLESOFT TRACE INTERCEPT ***************************
          (CONTROL PASSES HERE FOR EVERY STATEMENT)
          (EXECUTED WHILE PRODOS IS ACTIVE)

  9EB2  BUMP APPLESOFT LINE POINTER
  9EB6  ---
  9EBA  MARK PROMPT FOR RECURSION
  9EBC  JUST IN CASE WE DIE IN HERE
  9EBE  RESTORE APPLESOFT'S STACK
  9EC1  DOES BI KNOW WE ARE TRACING? (BE41)
  9EC4  YES, REAL LIVE TRACE THEN >>9F39
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9EC4
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 9EC6   ELSE, PICK UP NEXT TOKEN ON LINE
 9ECA   IS IT A TOKEN? >>9EF1
 9ECC   OR END OF LINE? >>9EEE
 9ECE   NEITHER, DECREMENT STRING SPACE CTR (BE49)
 9ED1   OK >>9EEC
 9ED3   COMPUTE SIZE OF FREESPACE IN PAGES
 9ED7   AT LEAST 3 PAGES AVAILABLE?
 9ED9   YES >>9EE5
 9EDB   NO, WRITE BUFFERED DATA <9FF4>
 9EDE   AND THEN GARBAGE COLLECT <A044>
 9EE3   COMPUTE FREE SPACE NOW
 9EE5   AND SAVE IN STRING SPACE CTR  (BE49)
 9EEA   GET NEXT TOKEN
 9EEC   ---
 9EEE   JUMP BACK INTO APPLESOFT TO EXECUTE IT >>D820
 9EF1   STORE TOKEN IN PROMPT
 9EF4   LOOK UP TOKEN IN BI'S TOKEN TABLE (B799)
 9EF7   ITS NOT ONE BI IS INTERESTED IN >>9EEE
 9EF9   IT IS INTERESTING, CHANGE BRANCH (9EFD)
 9EFC   AND JUMP TO ONE OF THE FOLLOWING: >>9EFE

 9EFE   IF OR PRINT: PROMPT = Ø
 9FØØ   CLEAR OUT LAST CHAR SAVEAREA (BE4C)
 9FØ3   GO TO MODE = C NEXT TIME THRU (B8Ø3)
 9FØ6   (BEGIN LOOKING FOR COMMANDS) (BE38)
 9FØF   NOW GO PROCESS THE IF OR PRINT >>9F2E

 9F11   LIST: PROMPT = 1
 9F13   (DON'T LOOK FOR COMMANDS NOW)
 9F15   GO DO IT >>9F2E

 9F17   CALL: PROMPT = 2
 9F19   (DON'T LOOK FOR COMMANDS NOW)
 9F1B   GO DO IT >>9F2E

 9F1D   LET: DECREMENT STRING CTR
 9F1E   AND GO BACK FOR NEXT TOKEN >>9ECE

 9F21   TRACE: TURN TRACE ON (BE41)
 9F24   THEN CONTINUE BELOW >>9F2A

 9F26   NOTRACE: DROP INTO BACKGROUND TRACE (BE41)
 9F29   CHANGE TOKEN TO "TRACE"
 9F2A   FORCE ON APPLESOFT TRACE
 9F2E   ---
 9F2F   GO BACK TO APPLESOFT TO PERFORM IT >>D820
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9F2F
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 9F32   RESUME: CLEAR ONERR CODE
 9F37   GO TO APPLESOFT TO PROCESS IT >>9EEC

          ******** REAL TRACE ACTIVE **************

 9F39   RESTORE TRUE CSWL/KSWL <9AØØ>
 9F3E   PRINT "#" <FDED>
 9F45   USE APPLESOFT TO PRINT CURRENT LINE NO. <ED24>
 9F4A   PRINT A BLANK SPACE <FDED>
 9F4D   PUT BI'S CSWL/KSWL INTERCEPTS BACK <9A8D>
 9F51   THEN GO BACK AND HANDLE AS USUAL >>9EC6

 9F54   LOOKING FOR A LOWER CASE "c"
 9F58   LOOKING FOR A "#"
 9F5A   STORE CHAR TO SEARCH FOR (9F61)
 9F5E   BRANCH BACK INTO APPLESOFT >>9EEC
 9F6Ø   BREAK IF Y IS ZERO!!!

 9F61   "#" CHARACTER (ASOFT TRACE CHAR)

9F62 *********** SAVE CALLER'S REGISTERS ******************************

 9F62   SAVE A,X AND Y REGS (BE3E)
 9F6B   RETURN

9F6C *********** RESTORE CALLERS REGISTERS ****************************

 9F6C   RESTORE A,X AND Y REGS (BE3E)
 9F75   RETURN

9F76 *********** SET MODE AND CSWL/KSWL *******************************

 9F76   STORE "STATE" MODE FROM X REGISTER (BE42)
 9F7B   COPY PROPER CSWL/KSWL VALUES TO REDIRECT... (B7F7)
 9F7E   VECTOR DEPENDING ON CURRENT MODE (BE38)
 9F87   RETURN

9F88 *********** PRINTERR: PRINT ERROR MSG ****************************

 9F88   ---
 9F89   GET INDEX INTO PACKED MESSAGE TEXTS (BA13)
 9F8C   UNPACK MESSAGE INTO $2Ø1 <9FBØ>
 9F92   SAVE THE LENGTH (BCB6)
 9F95   SKIP A LINE <9FAB>
 9F9A   PRINT A BELL <9FAD>
 9F9D   ---
 9F9F   PRINT CONTENTS OF $2Ø1 MSG BUFFER (Ø2Ø1)
 9FAB   PRINT A RETURN CHARACTER
 9FAD   AND EXIT >>FDED
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9FAD
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------


9FB0 *********** UNPACK ERROR MESSAGE ********************************

  9FB0  NOTHING IN BUFFER AT FIRST
  9FB6  GET A NIBBLE FROM PACKED MSG  <9FD2>
  9FB9  NON-ZERO, COMMON CHARACTER >>9FC0
  9FBB  IF ZERO, GET NEXT NIBBLE <9FD2>
  9FBE  AND CONVERT TO UNCOMMON CHAR INDEX
  9FC0  ---
  9FC1  GET THE LETTER THIS NIBBLE REPRESENTS (BA28)
  9FC4  ZERO? THEN END OF MESSAGE >>9FD1
  9FC6  GET INDEX INTO OUTPUT BUFFER (BE4B)
  9FC9  AND STORE THE CHARACTER THERE (0201)
  9FCC  BUMP INDEX (BE4B)
  9FCF  AND CONTINUE >>9FB6
  9FD1  RETURN

9FD2 *********** UNPACK MESSAGE BYTE ********************************

  9FD2  GET NEXT MSG BYTE (BA48)
  9FD5  WORKING ON SECOND NIBBLE? >>9FE9
  9FD7  NO, TAB INDICATOR? >>9FDF
  9FD9  NO, ISOLATE HIGH NIBBLE
  9FDD  NEXT TIME GET LOW NIBBLE
  9FDE  RETURN

  9FDF  ---
  9FE0  GET TAB POSITION (BA48)
  9FE3  AND BUMP OUTPUT PTR ACCORDINGLY (BE4B)
  9FE7  THEN GO BACK FOR NEXT NIBBLE >>9FD2

  9FE9  BUMP BYTE PTR FOR NEXT TIME
  9FEA  ISOLATE LOW NIBBLE
  9FEC  NEXT TIME GET HIGH NIBBLE
  9FED  RETURN

9FEE *********** WRITE ONE BUFFERED BYTE ****************************

  9FEE  SET UP COUNT OF 0001
  9FF2  AND JUMP INTO ROUTINE BELOW >>A007

9FF4 *********** WRITE BUFFERED DATA/TEST ERROR *********************

  9FF4  WRITE BUFFERED DATA <A000>
  9FF7  OK? THEN EXIT >>A01C
  9FFA  ERROR, POP OUT OF THIS SUBROUTINE
  9FFD  AND GO TO ERROR HANDLER >>9AF0
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: 9FFD
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------


A000 *********** WRITE ALL BUFFERED DATA ****************************

  A000  ---
  A002  GET BUFFERED DATA COUNT (BE4A)
  A005  NONE BUFFERED? >>A01B
  A007  STORE BUFFERED DATA COUNT IN RW PARMS (BED9)
  A00F  MLI: WRITE  <BE70>
  A015  NOTHING BUFFERED NOW, COUNT=0 (BE4A)
  A019  ERROR? >>A01C
  A01B  NO, EXIT
  A01C  RETURN

A01D *********** SPECIAL GARBAGE COLLECT ****************************
          (PULL OUT STRING CONSTANTS ALSO)

  A01D  DO GARBAGE COLLECTION NORMALLY FIRST <A044>
  A020  ERROR? >>A043
  A024  START OF STRING AREA = PROGRAM START PTR (BC84)
  A02C  USE GENERAL PURPOSE BUFFER (ABOVE HIMEM)
  A02E  FOR A GARBAGE COLLECT WORKAREA (BC7D)
  A033  IT IS 3+1 PAGES IN LENGTH (BC7E)
  A038  END OF STRING AREA IS AT END OF FREEAREA (BC86)
  A040  GO COLLECT CONSTANT STRINGS NOW <A085>
  A043  THEN EXIT

A044 *********** "FRE" COMMAND **************************************
          (FAST APPLESOFT STRING GARBAGE COLLECTION)
                 ------------------------
                 |                      |
                 | GENERAL PURPOSE BUFFR |----
                 | (TOP OF OLD STRINGS)  |   |
       HIMEM --> ------------------------    |
                 | NEW STRINGS BUILDING  |<---
                 |         DOWN          |<---
                 -----------|------------    |
                 |          V            |   |
                 -//////////////////////-    |
                 |                      |    |
                 |     OLD STRINGS      |----
                 |                      |
                 |                      |
                 ------------------------
                 |                      |
                 |      FREE AREA       |
                 |                      |
          TOP PART OF OLD STRINGS IS SAVED IN THE
          GENERAL PURPOSE BUFFER OR IN THE FREE
          AREA (WHICHEVER IS LARGER) AND A NEW
          COPY OF THE STRINGS IS BUILT JUST BELOW
          HIMEM.
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A044
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

 A044   STRING AREA START IS ON PAGE BOUNDARY
 A04B   ASSUME 4 PAGE WORKAREA (BC7E)
 A050   IN GENERAL PURPOSE BUFFER ABOVE HIMEM (BC7D)
 A055   STRING START PTR IS START OF STRING AREA (BC84)
 A059   COMPUTE NUMBER OF FREE PAGES
 A05B   AT LEAST 7?
 A05D   IF NOT, USE G.P. WORKAREA INSTEAD >>A079
 A05F   DON'T USE ALL OF FREE AREA (LEAVE $300)
 A061   NEW WORKAREA SIZE IS FREE AREA SIZE-$300 (BC7E)
 A066   SET PTR TO WORKAREA AT FIRST FREE PAGE
 A06D   COMPUTE NUMBER OF STRING PAGES
 A071   USE SMALLER OF STRING PAGES OR WORKAREA SIZE (BC7E)
 A076   AS NEW WORKAREA SIZE (BC7E)
 A079   END OF STRING AREA IS HIMEM
 A085   RECORD WHETHER LAST PAGE IS PARTIAL
 A089   STRING START MSB IS HIMEM INITIALLY (BC86)
 A08E   ADJUST LORANGE AND HIRANGE MSB'S
 A090   FOR PARTIAL PAGES AT EITHER END, (BC7F)
 A093   SETTING THEM AT HIMEM FOR NOW.
 A09C   SET UP ARRAY END MSB +1 FOR COMPARES (BC82)
 A09F   $3E/$3F --> FIRST VARIABLE (LESS 7 BYTES)
 A0A1   (EACH VARIABLE IS 7 BYTES)
 A0AB   SET UP ARRAY START LSB FOR COMPARES
 A0B0   GET LORANGE VALUE (BC7F)
 A0B3   PRIOR TO STRING AREA? (BC84)
 A0B6   YES, THEN DONE! >>A0F6
 A0B8   ELSE, DROP LORANGE BY WORKAREA SIZE (BC7E)
 A0BB   AND SAVE THIS VALUE (BC7C)
 A0BE   NOW DROP IT ALSO BY THE DISTANCE BETWEEN
 A0C0   ...THE OLD LORANGE AND THE STRING START PTR (BC7F)
 A0CA   USE THE LOWER OF THE TWO VALUES (BC7C)
 A0CF   TO PRODUCE THE MAXIMUM SIZED RANGE (BC7C)
 A0D2   IS THIS BELOW THE BOTTOM OF THE STRINGS? (BC84)
 A0D5   NO  >>A0DC
 A0D7   YES, USE THE BOTTOM POINTER INSTEAD (BC84)
 A0DA   (ADJUSTING FOR PARTIAL PAGE)
 A0DC   STORE FINAL LORANGE VALUE (BC7F)
 A0DF   COPY SOME PAGES BELOW HIRANGE TO WORKAREA <A195>
 A0E2   (TO MAKE ROOM FOR NEW STRINGS)
 A0E4   COLLECT SIMPLE STRING VARS FOR THIS RANGE <A0F7>
 A0E7   ERROR? >>A0F4
 A0E9   THEN COLLECT STRING ARRAYS <A12D>
 A0EC   NEW HIRANGE = OLD LORANGE (BC7F)
 A0F2   CONTINUE LOOPING >>A09F

 A0F4   IF ERROR, "RAM TOO LARGE"
 A0F6   EXIT TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A0F6
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

A0F7 *********** COLLECT SIMPLE STRINGS *******************************

 A0F7   ---
 A0F8   ADD 7 BYTES TO $3E/$3F PTR FOR NEXT VAR
 A102   PTR AT ARRAYS NOW?
 A108   IF SO, WE ARE DONE >>A12B
 A10A   IS THIS A STRING VARIABLE?
 A111   NO >>A0F7
 A113   MAKE ABSOLUTELY SURE
 A117   GET MSB OF STRING POINTER
 A11B   IS IT WITHIN MY RANGE? (BC7F)
 A11E   NO >>A0F8
 A123   NO >>A0F7
 A125   YES, PULL IT OUT AND TACK IT TO HIMEM <A1B8>
 A128   ALL WENT WELL, GET NEXT VARIABLE >>A0F8
 A12A   IF ERROR, EXIT NOW

 A12B   NORMAL EXIT TO CALLER
 A12C   RETURN

A12D *********** COLLECT STRING ARRAYS ********************************

 A12D   FIND THE NEXT ARRAY <A15C>
 A130   NO MORE? >>A12B
 A132   GOT ONE, GET MSB OF ITS STRING PTR
 A136   WITHIN MY RANGE? (BC7F)
 A139   NO >>A146
 A13E   NO >>A146
 A140   YES, PULL IT OUT AND TACK IT TO HIMEM <A1B8>
 A143   AND CONTINUE WITH NEXT ARRAY ELEMENT >>A147
 A145   ERROR EXIT

 A146   ---
 A147   BUMP POINTER TO NEXT ARRAY MEMBER
 A151   POINTER NOW AT NEXT ARRAY? (BC81)
 A154   NO, DO THIS ELEMENT >>A132
 A158   NO >>A132
 A15A   YES, SET UP TO PROCESS THAT ONE THEN >>A12D

A15C *********** FIND NEXT STRING ARRAY *******************************

 A15C   ---
 A15D   $3E --> ARRAY VARIABLES (BC81)
 A164   AT END OF ARRAY VARS
 A166   NO, CONTINUE >>A16C
 A16A   YES, OUT (CARRY SET, NO MORE ARRAYS) >>A194
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A16A
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  A16C  POINT TO ARRAY FOLLOWING THIS (LSB AND...)
  A176  MSB TO X REGISTER
  A17D  CHECK TYPE OF VARIABLE
  A182  SKIP INTEGER AND REAL ARRAYS >>A15C
  A186  GET NUMBER OF DIMENSIONS
  A188  *2 TO SKIP SIZES
  A189  +5 TO SKIP FIXED STUFF AT BEGINNING
  A18D  POINT TO FIRST ARRAY MEMBER
  A191  READY TO ROLL, $3E POINTS TO IT
  A194  RETURN

A195 *********** COPY PAGES TO WORKAREA ******************************
          TO MAKE ROOM FOR NEW STRINGS BEING MOVED
          TO HIMEM, COPY SOME STRING PAGES FROM OLD
          STRING AREA TO THE WORKAREA TO PROTECT THEM.

  A195  $3A/$3B --> FIRST PAGE TO SAVE (BC7C)
  A19A  $3C/$3D --> WORKAREA (BC7D)
  A1A5  COPY N+1 PAGES (SIZE OF WORKAREA) (BC7E)
  A1A9  ---
  A1B7  EXIT WHEN FINISHED

A1B8 *********** PULL STRING OUT ************************************
          TACK STRING JUST UNDER HIMEM AT CURRENT
          STRING START POINTER.

  A1B8  IS STRING BELOW SAVED AREA? (BC7C)
  A1BB  YES, ITS STILL THERE THEN >>A1C4
  A1BD  ELSE, POINT TO SAVED STRING IN WORKAREA (BC7C)
  A1C4  $3A/$3B --> STRING
  A1CF  DROP STRING START PTR BY LEN OF THIS STRING
  A1D4  UPDATE STRING'S LSB IN VARIABLE PTR
  A1D8  FIX UP MSB OF STRING START PTR ALSO
  A1DD  AND OF VARIABLE PTR
  A1E1  IS THIS A NULL LENGTH STRING?
  A1E3  YES, NO MOVE TO DO >>A1EE
  A1E6  ---
  A1E7  ELSE, COPY STRING OUT
  A1EE  ---
  A1EF  OUT OF FREESPACE? (BC82)
  A1F4  RETURN TO CALLER WITH INDICATION

A1F5 *********** ALLOCATE BUFFER ************************************

  A1F5  NEED 4 PAGES
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A1F5
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

          ******** GENERAL PURPOSE ALLOCATE *******

  A1F7  STORE THAT (BB47)
  A1FA  GO GARBAGE COLLECT TO GET SPACE <A044>
  A1FD  ERROR? >>A24A
  A201  HOW MANY FREE PAGES ARE THERE?
  A203  ARE THERE ENOUGH? (BB47)
  A206  IF NOT, "RAM TOO LARGE" MSG
  A208  TOO FEW... >>A24A
  A20A  GOT ENOUGH, $3A-->TOP OF FREESPACE
  A211  AND $3C-->NEW TOP AFTER ALLOCATION
  A21B  COMPUTE LENGTH OF STRINGS FOR COPY
  A229  COPY STRINGS DOWN "N" PAGES IN MEMORY <A35B>
  A22F  SUBTRACT "N" FROM STRING ADDRESS MSB'S (BB47)
  A235  ADJUST ALL POINTERS IN SIMPLE & ARRAY VARS <A39F>
  A23A  OLD HIMEM BECOMES BUFF ADDR HIGH WATER MARK (BB49)
  A241  NEW HIMEM IS "N" PAGES LOWER
  A246  FIND PAGE JUST BEYOND A FILE BUFFER (BC88)
  A249  RETURN
  A24A  ---
  A24B  RETURN

A24C *********** FREE BUFFER ********************************************

  A24C  GARBAGE COLLECT STRINGS <A044>
  A24F  ERROR? >>A299
  A255  PUT HIMEM-$100 INTO $3A/3B
  A259  AND HIMEM+$400 INTO $3C/3D
  A25F  (COPY LSB'S)
  A266  BC92 = LENGTH OF STRINGS (BC92)
  A270  COPY STRINGS UP 4 PAGES <A37F>
  A275  PREPARE TO ADJUST THEM BY $400 (BC87)
  A27B  NEW HIMEM+$400
  A27D  ADJUST ALL STRING ADDRS UP BY $400 <A39F>
  A283  ARE WE FREEING BOTTOM-MOST BUFFER?
  A285  YES, DONE! >>A2B3
  A288  CHECK OPEN FILE COUNT (BE4D)
  A28B  NONE OPEN? (HOW CAN THAT BE?) >>A297
  A28D  WHICH FILE'S BUFFER IS NEXT TO HIMEM?
  A292  SEARCH UNTIL IT IS FOUND... >>A29A
  A297  ---
  A299  RETURN IF NO FILE IS USING THIS BUFFER
  A29A  ---
  A29B  GIVE THAT FILE THE BUFFER PASSED TO US (BEC9)
  A29E  (SURE HOPE THAT FILE WAS FLUSHED!) (BC93)
  A2A9  PASS FILE REF NUM TO MLI (BEC7)
  A2AE  MLI: SET NEW BUFFER <BE70>
  A2B1  ERROR? >>A299
  A2B3  ---
  A2B4  RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A2B4
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

A2B5 *********** GETBUFR: GET A BUFFER ******************************
          THIS ROUTINE IS CALLED THROUGH AN EXTERNAL
          ENTRY POINT IN THE GLOBAL PAGE.  IT ALLO-
          CATES A FIXED LOCATION BUFFER BETWEEN THE
          BI AND ITS BUFFERS.

  A2B5   ALLOCATE A BUFFER OF ANY SIZE (A=PAGES) <A1F7>
  A2B8   ERROR? >>A3ØØ
  A2BD   FIND FIRST PAGE OF BUFFER (BB4A)
  A2C4   GET FILE OPEN COUNT (BE4D)
  A2C7   NONE OPEN? >>A2EA
  A2C9   BUMP BUFFER PAGE PTR BY $4ØØ (BB49)
  A2CD   TO POINT TO PREVIOUSLY ALLOCATED
  A2CF   BUFFER. (BB49)
  A2D2   FIND OPEN FILE WITH THIS BUFFER (BC93)
  A2D7   GOT IT, (BEC9)
  A2DA   SET FILE BUFFER REAL LOW IN MEMORY <A352>
  A2DD   THEN SET IT TO NEW BUFFER LOCATION <A29B>
  A2EØ   BELOW ALL OTHERS (BEC9)
  A2E7   DO THIS FOR EACH OPEN FILE...
  A2E8   THEREBY INSERTING A BLANK BUFFER >>A2D2
  A2ED   IS EXEC FILE ACTIVE? (BE43)
  A2FØ   NO, DONE >>A2FF
  A2F2   YES,
  A2F4   MOVE EXEC BUFFER DOWN ALSO <A352>
  A2FD   AND BUMP UP ABOVE IT
  A2FF   EXIT TO CALLER
  A3ØØ   RETURN

A3Ø1 *********** FREEBUFR: FREE BUFFER ******************************
          THIS ROUTINE IS CALLED THROUGH AN EXTERNAL
          ENTRY POINT IN THE GLOBAL PAGE.  IT FREES
          A FIXED LOCATION BUFFER PREVIOUSLY ALLO-
          CATED BY GETBUFR.

  A3Ø1   GET COUNT OF OPEN FILES (BE4D)
  A3Ø5   INDEX THIS BY 4 PAGES PER FILE
  A3Ø6   ADD TO HIMEM MSB
  A3Ø8   SAVE THIS AS TOP OF BUFFERS (BB49)
  A3ØD   THEN SET UP BOTTOM AS HIMEM MSB (BB4A)
  A31Ø   GET OLD ORIGINAL HIMEM (BEFORE ANY BUFFERS) (BEFB)
  A313   SAME AS THIS ONE?
  A315   THEN NOTHING ELSE TO DO >>A35Ø
  A317   ASSUME NO BUFFERS BY REPLACING OLD HIMEM
  A319   ANY EXEC FILE OPEN? (BE43)
  A31C   NO, CONTINUE >>A323
  A31E   YES, MOVE EXEC BUFFER TO OLD HIMEM <A2F2>
  A321   AND GO MOVE HIMEM DOWN BY $4ØØ >>A341
  A323   ELSE, START WITH TOP BUFFER (BB49)
  A326   ANY OPEN FILES? (BE4D)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A329
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  A329   IF NOT, WE ARE DONE >>A34D
  A32B   SEARCH FOR OPEN FILE WITH THIS BUFFER (BC93)
  A32E   NOT IT? >>A34A
  A33Ø   GOT IT, GIVE IT NEW HOME AT HIMEM
  A332   AND SET BUFFER LOW <A352>
  A335   THEN TO NEW LOC <A29B>
  A339   DROP TOP BUFFER PTR BY $4ØØ (BB49)
  A341   AND DROP HIMEM BY $4ØØ
  A348   AND GO DO NEXT BUFFER >>A323
  A34A   ---
  A34B   (LOOP TO SEARCH FOR OPEN FILES) >>A32B
  A34D   WHEN FINISHED, GARBAGE COLLECT <AØ44>
  A35Ø   ---
  A351   THEN EXIT NORMALLY TO CALLER

            ******** SET BUFFER BELOW ALL OTHERS ***

  A352   ---
  A353   USE BOTTOM BUFFER PTR (BB4A)
  A356   SET FILE BUFFER <A29B>
  A35A   AND EXIT

A35B *********** COPY BLOCK DOWN IN MEMORY ***************************

  A35B   COPY ALL FULL PAGES DOWN TO THEIR NEW HOME
  A362   COPYING $3A-->$3C
  A369   BUMP BOTH MSB'S
  A36D   DROP PAGE COUNTER (BC93)
  A37Ø   AND CONTINUE >>A362
  A372   NO SHORT LAST PAGE? (BC92)
  A375   THEN EXIT NOW >>A37E
  A377   ELSE, COPY PARTIAL PAGE
  A37E   THEN EXIT

A37F *********** COPY BLOCK UP IN MEMORY *****************************

  A37F   PARTIAL PAGE? (BC92)
  A382   NO, JUST COPY FULL PAGES NOW >>A38B
  A384   YES, COPY SHORT PAGE FIRST <A396>
  A387   DROP BOTH MSB'S
  A38B   PAGE COUNT GONE TO ZERO? (BC93)
  A38E   YES, DONE >>A39E
  A39Ø   ELSE, DROP PAGE COUNT (BC93)
  A393   AND GO COPY A FULL PAGE UP >>A384

  A396   ---
  A397   COPY REMAINDER OF PAGE UP (BACKWARDS)
  A39E   RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A39E
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

A39F *********** ADJUST ALL STRING ADDRS *****************************
           (BC87 HAS ADDITIVE ADJUSTMENT FACTOR)

  A39F  USE LOMEM PAGE AS MSB FOR $3E/3F
  A3A3  GET LOMEM LSB
  A3A5  AND END OF SIMPLE VARS PAGE
  A3A8  JUMP INTO THE LOOP >>A3AF
  A3AA  ---
  A3AB  SKIP ONE SIMPLE VARIABLE
  A3AF  ---
  A3B1  OVERFLOW?  >>A3B5
  A3B3  YES, BUMP MSB
  A3B5  FINISHED WITH SIMPLE VARS?
  A3B9  (CHECK BOTH MSB AND LSB OF PTR)
  A3BB  ---
  A3BC  YES... >>A3D2
  A3BE  NO,
  A3CØ  LOOK AT A SIMPLE VARIABLE
  A3C5  SKIP INTEGER AND REAL VARS >>A3AA
  A3C7  (DOUBLE CHECK MSB)
  A3CB  ITS A STRING, POINT TO ITS LEN/ADDR
  A3CC  ADJUST IT IF NECESSARY <A3F9>
  A3CF  THEN SKIP OVER IT >>A3AA

  A3D2  COPY ARRAYS STARTING LSB
  A3D4  (MSB IS IN X REGISTER NOW) (BC81)
  A3D7  ---
  A3D8  FIND A STRING ARRAY <A15C>
  A3DB  NO MORE? THEN DONE... >>A4ØC
  A3DD  ---
  A3EØ  ADJUST ITS ADDRESS IF NEED BE <A3F9>
  A3E6  SKIP TO NEXT STRING ELEMENT OF ARRAY
  A3EE  AT END OF THIS ARRAY YET? (BC81)
  A3F1  NO... >>A3DD
  A3F3  (CHECK MSB ALSO)
  A3F7  YES..., GO GET NEXT ARRAY >>A3D7

A3F9 *********** ADJUST A STRING ADDRESS *****************************

  A3F9  GET STRING LENGTH
  A3FB  IGNORE NULL STRINGS >>A4ØC
  A3FD  POINT TO MSB OF ADDRESS
  A3FF  IS STRING STORED OUTSIDE OF PROGRAM?
  A4Ø3  NO, LEAVE IT ALONE >>A4ØC
  A4Ø5  STORE ABOVE LOMEM, ADD FACTOR TO MSB
  A4ØC  THEN EXIT
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A4ØC
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

A4ØD *********** COMPRESS ALL ASOFT VARS *****************************
           THIS ROUTINE SQUASHES ALL APPLESOFT VARS
           UP AGAINST THE BOTTOM OF THE STRINGS
           HIMEM --> ------------------------
                     |                      |
                     |      STRINGS         |
                     |                      |
                     ------------------------
                     |                      |
                     |      ARRAY VARS      |
                     |                      |
                     ------------------------
                     |                      |
                     |      SIMPLE VARS     |
                     |                      |
                     ------------------------

  A4ØD  GARBAGE COLLECT FIRST <AØ1D>
  A41Ø  ERROR? >>A471
  A412  COMPUTE LENGTH OF SIMPLE AND ARRAY VARS
  A417  AND SAVE IT (BC89)
  A427  NEXT, COMPUTE LENGTH OF SIMPLE VARS ONLY
  A42B  AND SAVE IT (BC8B)
  A435  SUBTRACT VAR LENGTH FROM STRING START
  A437  TO FIND A PLACE TO PUT THE VARS UNDER (BC92)
  A43A  THE STRINGS (START ON AN EVEN PAGE BOUND)
  A44Ø  $3C/$3D --> PLACE TO PUT VARS
  A447  $3A/$3B --> START OF VARS (ROUNDED TO EVEN
  A449              PAGE ALIGNEMENT)
  A44F  COPY VARS UP AGAINST STRINGS <A37F>
  A454  STORE START OF VARS PTR (BC8E)
  A457  BUMPING PAGE NUMBER BY ONE
  A463  SUBTRACT THIS PTR FROM HIMEM TO COMPUTE (BC9Ø)
  A466  TOTAL LENGTH OF COMBINED VARS/STRINGS
  A468  AND SAVE THIS TOO (BC8D)
  A46B  ALSO, SAVE HIMEM MSB IN CASE THEY ARE MOVED
  A471  DONE, EXIT

A472 *********** REEXPAND COMPRESSED VARS ****************************
           THIS ROUTINE MOVES SIMPLE AND ARRAY VARS
           BACK DOWN TO LOMEM.
           HIMEM --> ------------------------
                     |                      |
                     |      STRINGS         |
                     |                      |
                     ------------------------
                     |                      |
                     |                      |
                     /      FREE SPACE      /
                     /                      /
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A472
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

                      |                       |
                      |                       |
                      -------------------------
                      |                       |
                      |      ARRAY VARS       |
                      |                       |
                      -------------------------
                      |                       |
                      |      SIMPLE VARS      |
                      |                       |
           LOMEM -->  -------------------------

  A472   SAVE LENGTH OF SIMPLE AND ARRAY VARS (BC89)
  A479   ADD THIS TO START OF COMPRESSED VARS PTR
  A47B   TO GIVE START OF STRINGS ($6D/$6E)
  A487   $3C/$3D --> LOMEM (WHERE TO PUT SIMPLE VARS)
  A48E   $6B/$6C --> WHERE TO PUT ARRAY VARS
  A499   $3A/$3B --> START OF COMPRESSED VARS (BC8E)
  A4A3   COPY SIMPLE/ARRAY VARS DOWN TO LOMEM <A35B>
  A4AA   COMPUTE START OF STRINGS BY ADDING VARS
  A4AC   LENGTH TO VARS ORIGIN
  A4B5   DID HIMEM MOVE SINCE VARS WERE COMPRESSED?
  A4BA   NO... >>A4C2
  A4BC   YES, ADJUST BY DIFFERENCE IN HIMEM'S (BC87)
  A4BF   GO ADJUST ALL STRING POINTERS <A39F>
  A4C2   THEN EXIT
  A4C3   RETURN

A4C4 *********** FORMAT CATALOG ENTRY LINE ***************************

  A4C4   PUT OUT A BLANK LINE <A66C>
  A4C7   DOUBLE QUOTE TO $200
  A4CC   GET LENGTH OF NAME (0259)
  A4D2   COPY NAME TO LINE (0259)
  A4DD   ZERO ACCUMULATOR FOR LATER (BCB1)
  A4E0   GET FILE TYPE (0269)
  A4E3   I KNOW OF ONLY 13
  A4E5   ---
  A4E7   LOOK UP FILE TYPE IN TABLE (B989)
  A4EA   FOUND IT? >>A4F7
  A4F0   FILE TYPE NOT IN MY TABLE
  A4F2   PRINT IT IN HEXADECIMAL <A612>
  A4F5   AND CONTINUE BELOW >>A53B
  A4F7   ELSE, FOR KNOWN TYPES
  A4FA   COPY NAME OF TYPE TO THE LINE (B997)
  A505   80 COLUMNS PER LINE? (BCB6)
  A508   YES... >>A553
  A50A   NO,
  A50C   BIN FILE?
  A50E   YES... >>A525
  A510   TXT FILE?
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A512
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  A512   NO... >>A53B
  A514   YES, R VALUE GIVEN AS SUBTYPE
  A51F   CONVERT R VALUE TO DECIMAL <A62F>
  A522   SKIP OVER BIN CODE >>A536
  A525   BIN FILE, USE AD VALUE AS SUBTYPE
  A52D   CONVERT IT TO TWO HEX DIGITS <A612>
  A536   ADD AN "=" SIGN
  A53B   COPY MSB OF END OF FILE MARK (0270)
  A549   CONVERT LOW TWO BYTES OF EOF <A62F>
  A550   DO CREATION DATE/TIME <A570>
  A553   ---
  A55B   CONVERT BLOCKS USED <A62F>
  A563   CHECK FOR WRITE ACCESS
  A565   UNLOCKED? >>A56C
  A567   NO, ADD A "*"
  A56C   FALL THRU TO DO LAST MODIFIED DATE/TIME
  A56E   AND THEN EXIT TO CALLER

A570 *********** FORMAT A DATE/TIME **********************************
           X = OFFSET FROM $259 TO FIELD
           Y = $201 OFFSET TO DATE/TIME VALUE

  A570   ISOLATE YEAR (025A)
  A574   AND STORE IT (BCB5)
  A57B   ISOLATE DAY
  A57D   AND STORE IT (BCB4)
  A581   ISOLATE MONTH
  A587   (MONTH = 0 IS NO GOOD) >>A5A3
  A58B   (MONTH > 12 IS ALSO BAD) >>A5A3
  A58D   STORE MONTH (BCB3)
  A591   MULTIPLY MONTH INDEX BY 3 (BCB3)
  A594   AND SAVE IT INSTEAD (BCB3)
  A59A   (DAY = 0 IS NO GOOD) >>A5A3
  A5A1   (YEAR MUST BE < 99) >>A5B5

  A5A3   OTHERWISE, BAD DATE!
  A5A5   BACK UP 6 CHARACTERS ON LINE
  A5AA   AND PRINT "<NO DATE>" (B9E5)
  A5B4   THEN EXIT RIGHT AWAY

  A5B5   DATE OK, GET HOUR  (025C)
  A5B9   AND MINUTES (025B)
  A5BE   MINUTES > 60?
  A5C0   NO.. >>A5C3
  A5C2    YES, USE ZERO MINUTES
  A5C3   CONVERT MINUTES (LEFT ZERO FILL) <A60A>
  A5C8   THEN PRINT A ":" (0201)
  A5CC   GET HOUR AGAIN
  A5CF   GREATER THAN 24 HOURS?
  A5D1   NOPE >>A5D4
  A5D3   YES, USE ZERO
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A5D4
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  A5D4   1Ø OR MORE HOURS (TWO DIGITS?)
  A5D7   IN ANY CASE, CONVERT HOURS <A62F>
  A5DB   IF TWO DIGITS... >>A5DE
  A5DD   IF ONE, ADJUST LINE PTR
  A5DE   ---
  A5E2   CONVERT YEAR (LEFT ZERO FILL) <A6ØA>
  A5E6   GET MONTH INDEX (*3) (BCB3)
  A5E9   POINT TO LAST CHARACTER
  A5EC   COPY MONTH NAME FROM TABLE (B9BD)
  A5EF   TO LINE (Ø2Ø1)
  A5F7   BACKWARDS... >>A5EC
  A5FB   PUT A "-" IN (Ø2Ø1)
  A5FE   TWO PLACES (Ø2Ø5)
  A6Ø7   EXIT BY CONVERTING DAY >>A62F

A6ØA *********** CONVERT 2 DIGIT NUMBER ******************************
           (FORCE LEFT ZERO FILL)

  A6ØA   ---
  A6ØB   ADD 1ØØ TO FORCE SIGNIFICANCE IN TENS
  A6ØD   CONVERT IT <A62F>
  A61Ø   IGNORE 1ØØ'S PLACE
  A611   RETURN

A612 *********** CONVERT TO HEX **************************************

  A612   ---
  A613   ISOLATE LOW NIBBLE
  A615   AND GO CONVERT IT FIRST <A61D>
  A619   NOW ISOLATE HIGH NIBBLE
  A61C   AND FALL THRU TO CONVERT IT ALSO

  A61D   CONVERT NIBBLE TO NUMERIC ASCII
  A61F   >9?
  A621   NO >>A625
  A623   YES, CONVERT $BA-$BF TO $C1-$C6
  A625   AND STORE THE RESULT (Ø2Ø1)
  A628   BUMP LINE INDEX BACK
  A629   PRECEED WITH A $ SIGN
  A62E   RETURN

A62F *********** CONVERT TO DECIMAL **********************************

  A62F   A,X = NUMBER     Y=INDEX TO LAST FIELD DIGIT (BCBØ)
  A632   STORE NUMBER IN ACCUMULATOR (BCAF)
  A635   DIVIDE BY 1Ø <A64D>
  A638   GET DIGIT AND CONVERT IT (BCB2)
  A63D   STORE IN LINE (Ø2Ø1)
  A64Ø   AND DROP LINE INDEX BY ONE
  A641   IS QUOTIENT NOW ZERO? (BCAF)
  A64A   NO, CONTINUE UNTIL IT IS >>A635
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: A64C
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  A64C   ELSE, EXIT

           ******** DIVIDE ACCUMULATOR BY 1Ø *******

  A64D   24 BIT SHIFT (3 BYTES)
  A651   CLEAR SUM (BCB2)
  A654   GO ROL ACCUMULATOR LEFT ONE BIT <AAD7>
  A657   ALSO ROL 4TH BYTE OF ACCUM (BCB2)
  A65B   IF MSB > 1Ø... (BCB2)
  A665   THEN ADD ONE TO ACCUMULATIVE SUM (BCAF)
  A668   ---
  A669   SHIFT 24 TIMES >>A654
  A66B   RETURN
  A66C   ---
  A676   RETURN

A677 *********** SYNTAX: PARSE COMMAND LINE *************************
            (ALSO EXTERNAL ENTRY FOR COMMAND STRINGS)

  A677   INIT COMMAND NUMBER TO -1
  A67E   A BLANK ENDS EACH STRING (BCA9)
  A683   AT MOST 8 CHARACTERS IN A COMMAND   (BCAA)
  A686   PARSE COMMAND ITSELF <AA1B>
  A689   GET FIRST LETTER (BCBD)
  A68C   MUST BE ALPHABETIC
  A68E   IT IS... >>A697
  A69Ø   IT'S NOT, IS IT A "-"?
  A692   YES, OK THEN... >>A697
  A694   ELSE, ITS BAD - SYNTAX ERROR >>A839
  A697   SCAN FOR COMMAND IN TABLES <AAE1>
  A69A   BAD COMMAND? >>A694
  A69C   NO, IMMEDIATE COMMAND MODE? (BE42)
  A69F   NO, DEFERRED... >>A6AC
  A6A1   IMMEDIATE, EXEC ACTIVE? (BE43)
  A6A4   YES, NEVER MIND >>A6AC
  A6A6   ERASE TO END OF LINE <FC9C>
  A6A9   AND GO TO A NEW LINE ON SCREEN <9FAB>
  A6AC   ASSUME NO PARMS AT ALL
  A6B4   NO PATH NAME YET (BCBD)
  A6B7   NO SECONDARY PATH NAME EITHER (Ø28Ø)
  A6BD   CURRENT SLOT = DEFAULT SLOT (BE61)
  A6C3   CURRENT DRIVE = DEFAULT DRIVE (BE62)
  A6C8   BUFFER ALLOCATION = HIMEM (BC88)
  A6CB   GET LENGTH OF COMMAND NAME (BE52)
  A6DØ   ALLOW 2 MORE CHARACTERS FOR NOW (BCAA)
  A6D3   ARE ANY PARAMETERS PERMITTED? (BE54)
  A6D6   NO...MUST BE MON OR NOMON >>A736
  A6D8   YES, IN# OR PR#?
  A6D9   YES... >>A739
  A6DB   ELSE, REPARSE THE COMMAND <AA1B>
  A6EØ   FOR THIS COMMAND... (BE54)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A6E3
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  A6E3   DOES THE PREFIX NEED FETCHING? >>A6EA
  A6E5   YES,
  A6E7   MLI: GET PREFIX FROM DEFAULT DRIVE <BE70>
  A6EA   ---
  A6EC   END OF LINE? >>A736
  A6EE   NO, COMMA?
  A6F0   NO >>A6F5
  A6F2   YES, NO FILENAME, LOOK FOR KEYWORDS >>A787
  A6F5   "/"?
  A6F7   YES >>A6FD
  A6F9   NO, ALPHABETIC?
  A6FB   NO...FILE NAMES MUST BEGIN THAT WAY >>A72F
  A6FD   ---
  A6FE   DON'T FLUSH ANY BLANKS OUT OF PATHNAME
  A703   ALLOW 64 CHARACTERS NEXT PARSE
  A709   PARSE NEXT OPERAND ON LINE <AA1F>
  A70D   SAVE ITS LENGTH  (BCBC)
  A712   FOUND A PATHNAME#1 (BE56)
  A715   COPY PARM KEYWORD TO $280 (BCBC)
  A718   (ASSUMING PATHNAME1=PATHNAME2) (0280)
  A71F   CHECK NEXT CHAR (OTHER THAN A BLANK) <AA3A>
  A722   NOT COMMA OR RETURN, BAD! >>A72C
  A724   RETURN? >>A798
  A726   NO, PATHNAME EXPECTED NOW? (BE54)
  A72A   YES, ALL IS WELL >>A762
  A72C   NO, "SYNTAX ERROR" >>A839
  A72F   NON ALPHA FILE NAME, CHECK COMMAND NUMBER (BE53)
  A732   IS IT "RUN"
  A734   NO, ERROR >>A72C
  A736   YES, ITS OK THEN (MIGHT BE "RUN 100") >>A798
  A739   IN#S/PR#S, REPARSE COMMAND <AA1B>
  A73C   RETURN FOUND - ERROR >>A72C
  A73E   "A"?  (ADDRESS KEYWORD)
  A740   IF SO, GO PARSE THAT KEYWORD ONLY >>A78C
  A742   ELSE, ZERO ACCUMULATOR <AB37>
  A745   CONVERTING ONE BYTE'S WORTH (BCAD)
  A74A   PUT IT IN PR#/IN# SLOT VALUE AREA (BCAE)
  A74F   FOUND SLOT FOR PR#/IN# (BE56)
  A752   CONVERT SLOT # <A960>
  A755   ERROR? >>A761
  A757   GET CONVERTED VALUE (BE6B)
  A75A   >8?
  A75C   NO, ITS OK >>A791
  A75E   YES, "RANGE ERROR"
  A761   RETURN
  A762   SECOND PATHNAME EXPECTED?
  A763   NO >>A787
  A765   YES, FLUSH TO NON-BLANK <AA3A>
  A768   NOTHING ELSE ON LINE???? >>A72C
  A76B   DON'T FLUSH ANY BLANKS OUT OF PATHNAME
  A772   COPY SECOND PATHNAME TO $281 <AA00>
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A777
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  A777   SAVE IT'S LENGTH (LESS 1) (0280)
  A77C   FOUND PATHNAME1 AND PATHNAME2 (BE56)
  A780   GET LAST CHARACTER AGAIN <AA3A>
  A783   IF NOT COMMA OR RETURN, "SYNTAX ERROR" >>A72C
  A785   RETURN? >>A798
  A787   NO, COMMA, FLUSH TO NON-BLANK <AA3A>
  A78A   SYNTAX ERROR IF TWO COMMAS IN A ROW >>A72C
  A78C   LOOKUP KEYWORD CHAR AND PARSE ITS VALUE <A8E8>
  A78F   EXIT NOW? >>A761
  A791   NO, FLUSH TO NON-BLANK <AA3A>
  A794   SYNTAX ERROR IF COMMA OR RETURN NOT FOUND  >>A72C
  A796   COMMA? YES, GO GET NEXT KEYWORD >>A787

  A798   GET PARSED SLOT (BE61)
  A79B   MUST BE NON-ZERO >>A75E
  A79D   AND LESS THAN 8
  A79F   OR ELSE - "RANGE ERROR" >>A75E
  A7A1   CHECK DRIVE TOO (BE62)
  A7A6   MUST BE EITHER 1 OR 2
  A7AD   IS THIS A DEFERRED COMMAND?
  A7B0   NO... >>A7BB
  A7B2   YES, IS A PROGRAM RUNNING? (BE42)
  A7B5   YES >>A7BB
  A7B7   NO, "NOT DIRECT COMMAND"
  A7BA   RETURN
  A7BB   EXPECTING NO PATHNAMES? >>A7FD
  A7BD   NO... (BE55)
  A7C0   ARE S AND D VALID FOR THIS CMD?
  A7C2   NO >>A7FD
  A7C4   YES, HAVE WE GOT PATHNAME1? (BE56)
  A7C8   YES >>A7D3
  A7CD   IS PATHNAME REQUIRED?
  A7CF   YES, "SYNTAX ERROR" >>A839
  A7D1   NO, OPTIONAL - NO PREFIX FETCH THEN >>A7FD
  A7D6   DOES PATHNAME1 START WITH A "/"?
  A7D8   YES, FULLY QUALIFIED >>A7DF
  A7DA   NO, IS THERE A PREFIX ACTIVE? (BF9A)
  A7DD   NO >>A7F8
  A7DF   YES, (BE57)
  A7E2   SLOT/DRIVE GIVEN WITH THIS COMMAND?
  A7E4   NO, FORGET IT >>A7FD
  A7E6   YES, DO WE HAVE PATHNAME ALSO? >>A7F8
  A7E8   NO,
  A7EA   NULL OUT PATHNAME1 (BCBC)
  A7F2   MARK THAT WE WILL HAVE ONE SOON (BE56)
  A7F8   ADD PREFIX TO FILENAMES <A83D>
  A7FB   ERROR? >>A83B
  A7FD   GET COMMAND NUMBER (BE53)
  A800   *2 AS INDEX INTO TABLE
  A802   GET ADDRESS OF COMMAND HANDLING ROUTINE (B8E9)
  A80B   AND STORE IT FOR INDIRECT JMP (BCAC)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A81Ø
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  A81Ø  EXTERNAL COMMAND? IF SO GO NOW! >>A836
  A812  MY OWN COMMAND, "PREFIX"?
  A814  YES, GO NOW >>A836
  A819  S OR D VALID KEYWORDS FOR THIS CMD?
  A81B  NO, GO NOW >>A836
  A82Ø  PATHNAME1 GIVEN WITH THIS COMMAND?
  A821  NO, GO NOW >>A836
  A823  YES, GET FILE INFO FOR PATHNAME1 <B7DØ>
  A826  NO ERRORS I HOPE >>A836
  A828  ERROR WAS PATH NOT FOUND?
  A82A  NO, REAL ERROR - SAY SO >>A83B
  A82F  CAN WE CREATE PATHNAME1?
  A831  YES, OK THEN >>A836
  A833  ELSE, "PATH NOT FOUND"
  A835  RETURN
  A836  GO TO COMMAND HANDLING ROUTINE >>BCAB

A839 *********** SYNTAX ERROR *****************************************

  A839  LOAD BI CODE FOR "SYNTAX ERROR"
  A83B  AND RETURN WITH ERROR CONDITION
  A83C  RETURN

A83D *********** ADD PREFIX TO PATHNAMES *****************************

  A83D  GET SLOT NUMBER (BE61)
  A844  PUT SLOT IN HIGH 3 BITS
  A846  ADD DRIVE TO TOP BIT AND SHIFT SLOT DOWN (BE62)
  A84E  ...TO FORM THE UNIT NUMBER (BEC7)
  A853  READ THE PATHNAME PREFIX TO $2Ø1 (BEC8)
  A85D  MLI: ONLINE <BE7Ø>
  A86Ø  ERROR? >>A83B
  A865  DEFAULT DRIVE = PARSED DRIVE (BE3D)
  A86B  DEFAULT SLOT = PARSED SLOT (BE3C)
  A871  PATHNAME1 STARTS WITH "/"?
  A873  THEN ITS ALREADY GOT A PREFIX >>A8E6
  A878  ELSE, GET LENGTH OF PATHNAME
  A87A  BUMP IT BY 2 (TO ALLOW FOR /'S)
  A882  WITH PREFIX WILL IT EXCEED 64 CHARS?
  A887  YES, "SYNTAX ERROR"  >>A8E7
  A889  NO, UPDATE LENGTH TO INCLUDE PREFIX (BCBC)
  A88F  ---
  A893  AND COPY PATHNAME1 FORWARD TO MAKE ROOM (BCBD)
  A89C  PUT A "/" AT THE BEGINNING
  A8A1  AND AT THE END (BCBD)
  A8A4  COPY PREFIX JUST READ TO START OF PATHNAME1 (Ø2ØØ)
  A8AA  GET COMMAND NUMBER (BE53)
  A8AD  "OPEN"?
  A8AF  YES, DONE NOW! >>A8E6
  A8B1  "APPEND"?
  A8B3  YES, DONE NOW! >>A8E6
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A8B5
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  A8B5  "EXEC"?
  A8B7  YES, DONE NOW! >>A8E6
  A8B9  ELSE, GET LENGTH OF PATHNAME2 (Ø28Ø)
  A8BE  COMBINE THIS WITH PREFIX LENGTH (Ø2Ø1)
  A8C1  MORE THAN 64 CHARS?
  A8C6  IF SO, "SYNTAX ERROR" >>A8E7
  A8C8  UPDATE LENGTH (Ø28Ø)
  A8CB  ---
  A8CF  COPY PATHNAME2 FORWARD TO MAKE ROOM (Ø281)
  A8D8  PUT A "/" IN FIRST
  A8DD  THEN THE PREFIX AND ANOTHER SLASH (Ø281)
  A8E6  ---
  A8E7  DONE!

A8E8 *********** KEYWORD LOOKUP **************************************

  A8E8  ZERO THE ACCUMULATOR <AB37>
  A8EB  NINE POSSIBLE KEYWORDS IN TABLE
  A8ED  COMPARE AGAINST EACH (B96B)
  A8FØ  FOUND IT? >>A927
  A8F5  NO, IS IT "T"? (FILE TYPE)
  A8F7  YES, OK THEN >>A8FC
  A8F9  ELSE, BAD KEYWORD >>A839
  A8FC  IT'S "T", IS IT PERMITTED ON THIS CMD?
  A9Ø1  NO, ERROR >>A923
  A9Ø6  ELSE, MARK WE HAVE "T" (BE56)
  A9ØB  START WITH TYPE INDEX OF Ø (BCAD)
  A91Ø  INDICATE WHERE T VALUE IS TO GO (BCAE)
  A913  AND GO PARSE ONE CHAR <AA3A>
  A916  NOTHING THERE??? >>A8F9
  A918  IS IT A $?
  A91A  YES, HE GAVE TYPE IN HEX >>A976
  A91C  IS IT ALPHABETIC?
  A91E  NO, CONVERT DECIMAL TYPE >>A96Ø
  A92Ø  ELSE, GO LOOKUP TYPE NAME IN TABLE >>A9B6

  A923  ---
  A924  "INVALID PARAMETER"
  A926  RETURN

  A927  GET BIT POSITION OF THIS KEYWORD (B975)
  A92A  IGNORE "V" >>A947
  A92C  IS THIS KEYWORD PERMITTED? (BE55)
  A92F  NO, NOT WITH THIS COMMAND ANYWAY >>A923
  A931  S OR D?
  A933  NO >>A941
  A935  YES, ALREADY FOUND IT ON THIS LINE? (BE57)
  A938  YES, DON'T CHANGE DRIVE DEFAULT >>A947
  A93A  ELSE, ASSUME DRIVE = 1
  A941  MARK WE HAVE SLOT/DRIVE (BE57)
  A947  GET SIZE-1 IN BYTES OF VALUE (B97F)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A954
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  A954  AND OFFSET TO VALUE IN STORAGE AREA (BCAE)
  A957  FLUSH TO NON-BLANK <AA3A>
  A95A  NOTHING ELSE THERE? >>A9BØ
  A95C  IS NEXT CHAR A "$"?
  A95E  YES, GO CONVERT HEX - ELSE, FALL THRU >>A976

A96Ø *********** CONVERT DECIMAL NUMBER ******************************

  A96Ø  SAVE LINE INDEX (BE4B)
  A963  CONVERT/ADD ONE DECIMAL DIGIT TO ACCUM <AA5C>
  A966  OK.. >>A96C
  A968  OVERFLOW? THEN "RANGE ERROR" >>A9B3
  A96A  BAD DIGIT? THEN "SYNTAX ERROR" >>A9BØ
  A96C  RESTORE LINE INDEX (BE4B)
  A96F  FLUSH TO NEXT NON-BLANK <AA3A>
  A972  AND GO BACK TO CONVERT NEXT DIGIT >>A96Ø
  A974  ALL DONE, END OF LINE OR COMMA >>A98F

A976 *********** CONVERT HEX NUMBER **********************************

  A976  FLUSH TO NEXT NON-BLANK (SKIP "$")  <AA3A>
  A979  NOTHING LEFT? >>A9BØ
  A97B  SAVE LINE INDEX (BE4B)
  A97E  CONVERT HEX DIGIT <AAAE>
  A981  OK.. >>A987
  A983  OVERFLOW? THEN "RANGE ERROR" >>A9B3
  A985  BAD DIGIT? THEN "SYNTAX ERROR" >>A9BØ
  A987  RESTORE LINE INDEX (BE4B)
  A98A  FLUSH TO NEXT NON-BLANK <AA3A>
  A98D  AND GO CONVERT NEXT DIGIT >>A97B

A98F *********** STORE KEYWORD VALUE *********************************

  A98F  HOW MANY BYTES TO CHECK?
  A994  ALL HAVE BEEN CHECKED? >>A99E
  A996  NO, INSURE MSB'S OF ACCUM ARE ZERO (BCAF)
  A999  IF NUMBER IS A SHORT INTEGER >>A9B3
  A9A1  COPY ACCUM TO PROPER PARM STORAGE CELL (BCAF)
  A9AB  RESTORE LINE INDEX (BE4B)
  A9AF  AND EXIT

  A9BØ  "SYNTAX ERROR" JUMP >>A839
  A9B3  "RANGE ERROR" JUMP >>A75E

A9B6 *********** STORE KEYWORD VALUE *********************************

  A9B6  ---
  A9B8  COPY 3 CHARACTER TYPE TO ACCUM (BCAF)
  A9BE  (COPIED ALL 3?) >>A9C7
  A9CØ  (GET NEXT CHAR IGNORING BLANKS) <AA3A>
  A9C5  MUST HAVE 3 CHARACTERS! >>A9BØ
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: A9C7
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  A9C7  SAVE LINE INDEX (BE4B)
  A9CA  INITIALIZE NAME INDEX TO ZERO
  A9CF  HAVE ALL 13 BEEN CHECKED?
  A9D1  YES, NO MATCH >>A9BØ
  A9D4  ELSE, INDEX*3 (BCAD)
  A9D8  COMPARE TYPE GIVEN (BCAF)
  A9DB  TO TYPES IN TABLE (B997)
  A9DE  (IGNORE MSB'S)
  A9DF  NO MATCH ALREADY... >>A9E9
  A9E3  ELSE,
  A9E5  CHECK ALL THREE CHARS >>A9D8
  A9E7  THEY ALL MATCH! WE FOUND IT >>A9EE
  A9E9  NOT THE RIGHT ONE,  (BCAD)
  A9EC  GO TRY THE NEXT ONE >>A9CA
  A9EE  REVERSE NAME INDEX
  A9F5  AND GET TYPE VALUE FROM TABLE (B989)
  A9F8  STORE IT IN TYPE VALUE STORAGE AREA (BE6A)
  A9FB  RESTORE LINE INDEX (BE4B)
  A9FF  AND EXIT

AAØØ *********** COPY PATHNAME2 ***************************************

  AAØØ  GET NEXT CHARACTER <AA4A>
  AAØ3  AND STORE IT INDEXED OFF $28Ø (Ø28Ø)
  AAØ7  COMMA?
  AAØ9  YES, DONE >>AA37
  AAØB  BLANK?
  AAØD  YES, DONE >>AA37
  AAØF  RETURN?
  AA11  YES, OUT NOW >>AA48
  AA13  PATHNAME TOO LONG? (BCAA)
  AA16  NO, CONTINUE COPYING >>AAØØ
  AA18  ELSE, SET NOT-EQUAL CONDITION
  AA1A  AND EXIT

AA1B *********** COPY COMMAND NAME INTO TXTBUF ************************

  AA1B  SET INDICIES
  AA1F  GET NEXT NON-BLANK <AA4A>
  AA22  COPY TO TXTBUF (BCBD)
  AA26  COMMA?
  AA28  YES, DONE >>AA37
  AA2A  BLANK?
  AA2C  YES, DONE >>AA37
  AA2E  RETURN?
  AA3Ø  YES, DONE >>AA48
  AA32  AT MAX LENGTH (8)? (BCAA)
  AA35  NO, CONTINUE >>AA1F
  AA37  ELSE, SET NOT-EQUAL CONDITION
  AA39  AND EXIT
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AA39
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------


AA3A *********** FLUSH TO NON-BLANK **********************************
          Z-FLAG SET IF COMMA OR RETURN FOUND
          C-FLAG SET IF COMMA

  AA3A  IGNORE BLANKS
  AA3F  GET NEXT NON-BLANK <AA4A>
  AA42  COMMA?
  AA44  YES, OUT >>AA49
  AA46  RETURN?
  AA48  EXIT INDICATING WHAT WE FOUND
  AA49  RETURN

AA4A *********** GET NEXT CHARACTER **********************************

  AA4A  GET NEXT CHAR IN INPUT LINE (Ø2ØØ)
  AA4D  FORCE OFF MSB
  AA4F  LOWER CASE?
  AA51  NO >>AA55
  AA53  YES, FORCE UPPER CASE
  AA55  BUMP LINE INDEX
  AA56  IS THIS A FLUSH CHARACTER (LIKE BLANK)? (BCA9)
  AA59  YES, GO GET NEXT ONE >>AA4A
  AA5B  ELSE, RETURN WITH IT

AA5C *********** CONVERT DIGIT AND ADD TO ACCUM **********************

  AA5C  NUMERIC?
  AA5E  NO >>AA64
  AA62  YES >>AA68
  AA64  NOT NUMERIC, EXIT WITH CARRY SET
  AA65  AND Z-FLAG RESET
  AA67  RETURN
  AA68  ISOLATE DECIMAL PORTION OF DIGIT
  AA6B  CURRENT VALUE OF ACCUM... (BCB1)
  AA6E  >1,7Ø3,936?
  AA7Ø  YES, OVERFLOW >>AA94
  AA74  PUSH ENTIRE ACCUM ONTO STACK (BCAF)
  AA7B  ACCUM*2 (ROL IT ONCE) <AAD7>
  AA7E  ACCUM*4 (AND AGAIN) <AAD7>
  AA84  ---
  AA85  ACCUM*4+ACCUM --> ACCUM*5 (BCAF)
  AA91  FINALLY, ACCUM*5*2 --> ACCUM*1Ø <AAD7>
  AA94  ---
  AA95  ACCUM OVERFLOW? >>AAAA
  AA97  NO, ADD NEW DIGIT TO ACCUM (BCAF)
  AA9A  AND STORE IT (BCAF)
  AA9D  NO CARRY? >>AAAD
  AAAØ  GOT CARRY, PROPAGATE IT THRU ACCUM (BCBØ)
  AAAA  OVERFLOW ERROR
  AAAD   NORMAL EXIT
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AAAD
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------


AAAE *********** CONVERT HEX DIGIT AND ADD ***************************

  AAAE  NUMERIC?
  AABØ  NO >>AABE
  AAB4  YES >>AAC4
  AAB6  NON-NUMERIC, HOW BOUT "A" THRU
  AABA  "F"
  AABC  YES! >>AAC2
  AABE  ---
  AABF  NO, GET OUT NOW
  AAC1  RETURN
  AAC2  "A" THRU "F", CONVERT TO $BA-$BF
  AAC4  ISOLATE DIGIT
  AAC8  SHIFT ACCUM 4 BITS LEFT TO MAKE ROOM <AAD7>
  AACB  (WATCH OUT FOR OVERFLOW) >>AAAA
  AADØ  OR IN NEW NIBBLE (BCAF)
  AAD3  AND REPLACE IN ACCUM LSB (BCAF)
  AAD6  DONE

AAD7 *********** SHIFT 3 BYTE ACCUM LEFT A BIT ***********************

  AAD7  SHIFT THE THREE BYTE WORK ACCUM (BCAF)
  AAEØ  RETURN

AAE1 *********** SCAN CMD TABLE FOR COMMAND **************************

  AAE1  START WITH LAST COMMAND IN TABLE
  AAE6  IS IT A "-" COMMAND? (BCBD)
  AAEB  NOPE >>AAF5
  AAED  YES, SPECIAL COMMAND NUMBER (BE53)
  AAFØ  ZERO LENGTH COMMAND STRING (BE52)
  AAF3  CONTINUE >>AB12
  AAF5  FIRST COMMANDS IN TABLE ARE 8 CHARS
  AAFA  GET INDEX TO NEXT NAME (B858)
  AAFD  SAME LENGTH AS LAST NAME? >>ABØ5
  AAFF  NO,
  ABØ2  NAMES ARE ONE BYTE SHORTER FROM NOW ON (BE52)
  ABØ5  ---
  ABØ6  COMPARE HIS NAME TO MY TABLE (BCBD)
  ABØC  NOT IT... >>AB25
  AB1Ø  COMPARE ENTIRE NAME >>ABØ6

  AB12  FOUND IT! GET COMMAND INDEX (BE53)
  AB15  *2 FOR MOST THINGS
  AB17  PICK UP PERMITTED PARMS BITS (B92A)
  AB23  EXIT HAPPILY
  AB24  RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AB24
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  AB25  NOT THE ONE, SKIP TO NEXT (BE52)
  AB2E  IF THERE ARE ANY MORE >>AAFA
  AB30  ELSE, NO SUCH COMMAND (BE53)
  AB34  XRETURN THRU $BE06 VECTOR >>BE06

AB37 *********** ZERO THREE BYTE ACCUM ******************************

  AB37  ZERO THE THREE BYTE WORK
  AB39  ...ACCUMULATOR (BCAF)
  AB42  RETURN

AB43 *********** "-" COMMAND ****************************************

  AB43  CHECK FILE TYPE (BEB8)
  AB46  APPLESOFT PROGRAM?
  AB48  YES, "RUN" IT >>ABB2
  AB4A  BINARY FILE?
  AB4C  YES, "BRUN" IT >>AB8D
  AB4E  TEXT FILE?
  AB50  NO >>AB55
  AB52  YES, "EXEC" IT >>B221
  AB55  SYS FILE?
  AB57  YES, GO RUN IT >>AB5D
  AB59  ELSE, "FILE TYPE MISMATCH"
  AB5C  RETURN

         ******** RUN "SYS" FILE *****************

  AB5D  CLOSE ALL OPEN FILES <B4F2>
  AB60  CLOSE EXEC <B2FB>
  AB65  LSB OF A$ IS 00 (BE58)
  AB68  FREE UP ALL OF BI'S MEMORY (BF6B)
  AB7B  A$2000 IS WHERE IT WILL LOAD (BE59)
  AB80  TYPE IS "SYS" (BE6A)
  AB8A  FORCE, T, PATHNAME1, AD PARMS (BE56)
  AB8D  GO DO A STANDARD BRUN >>AE16

AB90 *********** "CHAIN" COMMAND ************************************

  AB90  SQUASH VARIABLES UP AGAINST HIMEM <A40D>
  AB95  SAVE HIMEM  (BC7B)
  AB9C  SET NEW HIMEM BELOW COMBINED VARS
  AB9E  LOAD FILE (LEAVE OTHERS OPEN) <AC03>
  ABA4  RESTORE OLD HIMEM
  ABA6  ERROR? >>AC14
  ABA8  NO, CLEAR VARIABLES <D665>
  ABAB  REEXPAND VARIABLES DOWN AGAINST LOMEM <A472>
  ABB0  THEN GO "RUN" PROGRAM >>ABC7
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: ABB0
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

ABB2 *********** "RUN" COMMAND **************************************

  ABB2  NO INPUT FILE ACTIVE NOW
  ABB7  NO APPLESOFT ERROR NUMBER
  ABBC  GOT PATHNAME1?
  ABBD  NO, ERROR >>ABD5
  ABBF  YES, LOAD PROGRAM <ABFE>
  ABC2  ERROR? >>AC14
  ABC4  NO, CLEAR VARIABLES <D665>

  ABC7  CLEAR ERROR FLAG
  ABC9  POSITION TO LINE NUMBER IF GIVEN <AC97>
  ABCC  RESTORE MY INTERCEPTS <9A8D>
  ABCF  CLEAR COMMAND NUMBER ETC., MODE = 4 <ABD5>
  ABD2  JUMP INTO APPLESOFT TO RUN PROGRAM >>D7D2

ABD5 *********** CLEAR COMMAND NUMBER ETC. **************************

  ABD5  SET NORMAL (NON-INVERSE OR FLASH) <F273>
  ABDA  SEARCH CHARACTER FOR TRACE IS "#" (9F61)
  ABDF  NO COMMAND NUMBER NOW (BE53)
  ABE2  NO PROMPT
  ABE6  SET MODE=4 (DEFERRED) <9F76>
  ABE9  "SYNTAX ERROR" IF THINGS GO WRONG >>A839

ABEC *********** "LOAD" COMMAND *************************************

  ABEC  LOAD PROGRAM <ABFE>
  ABEF  ERROR? IF NOT, FALL THRU TO WARMSTART >>AC14

ABF1 *********** WARMDOS: WARMSTART BI ******************************

  ABF1  CLEAR APPLESOFT, RESET POINTERS <D665>
  ABF4  RESET MODE/SET INTERCEPTS <9A17>
  ABF9  CURSOR HORIZ. = 0 (START OF LINE)
  ABFB  GO WARMSTART APPLESOFT >>D43F

ABFE *********** LOAD A PROGRAM *************************************

  ABFE  CLOSE ALL OPEN FILES <B4F2>
  AC01  ERROR? >>AC14
  AC03  GO LOAD FILE  <AC15>
  AC06  ERROR? >>AC14
  AC08  SET LOMEM = ARRAYS = FREESTART
  AC0A  ALL TO END OF PROGRAM LOADED
  AC14  RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AC14
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

AC15 *********** READ A PROGRAM FROM A FILE *************************

  AC15   READ REQUESTED
  AC17   TYPE = BAS ASSUMED
  AC19   OPEN THE FILE <B194>
  AC1C   ERROR? >>AC14
  AC2Ø   MLI: GET EOF <BE7Ø>
  AC23   ERROR? >>AC14
  AC27   APPLESOFT PROGRAM START --> READ DATA (BED7)
  AC2A   ADD TO THAT THE EOF MARK TO ... (BEC8)
  AC2D   SET AD PARM --> END OF PROGRAM IMAGE (BE58)
  AC3B   OVERFLOW? >>AC3F
  AC3D   NO, WOULD PROGRAM EXCEED HIMEM?
  AC3F   IF SO...
  AC41   "PROGRAM TOO LARGE" >>AC14
  AC43   ELSE, PICK UP LENGTH AGAIN (BEC8)
  AC49   AND GO READ IT IN <AF98>
  AC4C   ERROR? >>AC14
  AC4E   CLOSE FILE <AF94>
  AC51   ERROR? >>AC14
  AC53   RELOCATE PROGRAM IF NECESSARY <AC61>
  AC5C   COPY AD PARM TO APPLESOFT PGM END PTR
  AC6Ø   RETURN

AC61 *********** RELOCATE APPLESOFT PROGRAM *************************

  AC61   ---
  AC62   WAS APPLESOFT PROGRAM SAVED FROM SAME
  AC64   MEMORY LOCATION? (BEB9)
  AC73   YES, NOTHING TO DO THEN >>ACBA
  AC79   ELSE, LOOP THROUGH PROGRAM
  AC7B   ADJUSTING ALL ADDRESSES TO
  AC7D   THE NEW LOAD LOCATION

AC97 *********** POSITION TO LINE NUMBER ****************************

  AC97   WAS A LINE NUMBER PARM GIVEN? (BE57)
  AC9D   NO, NEVER MIND >>ACBA
  AC9F   COPY L KEYWORD VALUE TO APPLESOFT'S LINE # (BE68)
  ACA9   THEN CALL APPLESOFT TO FIND THE LINE <D61A>
  ACAF   SUBTRACT ONE FROM THE ADDRESS
  ACB1   AND POINT APPLESOFT'S GETCHR SUBROUTINE
  ACB3   AT IT (SO NEXT CHAR READ WILL BE FIRST
  ACB5   CHARACTER ON THE LINE).
  ACBA   RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: ACBA
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

ACBB *********** "SAVE" COMMAND *************************************

  ACBB   DOES FILE EXIST ALREADY? >>ACDF
  ACBD   NO, TYPE = BAS
  ACBF   IN T KEYWORD VALUE (BE6A)
  ACC2   AND MLI LIST (BEB8)
  ACC7   ALLOW ALL ACCESSES (READ/WRITE/ETC.) (BEB7)
  ACCC   SAVE PROGRAM START ADDRESS IN (BEA5)
  ACCF   AUXID'S (BEB9)
  ACDA   GO CREATE A NEW FILE <AD46>
  ACDD   ERROR? >>AD28

  ACDF   WRITE ACCESS REQUESTED
  ACE1   BAS TYPE FILE
  ACE3   OPEN IT <B194>
  ACE6   ERROR? >>AD28
  ACEB   SUBTRACT APPLESOFT PTRS TO COMPUTE
  ACED   LENGTH OF PROGRAM.
  ACEE   STORE THIS IN EOF MARK LIST (BEC8)
  ACFB   MSB OF EOF MARK IS ØØ (<64K PGM) (BECA)
  ADØØ   POINT LIST TO PROGRAM AS DATA TO WRITE (BED7)
  ADØ8   WRITE A RANGE TO DISK FILE <AF9C>
  ADØB   ERROR? >>AD28
  ADØF   MLI: SET EOF (TO TRUNCATE OLD LONGER FILE) <BE7Ø>
  AD12   ERROR? >>AD28
  AD14   CLOSE THE FILE <AF94>
  AD17   ERROR? >>AD28
  AD1B   DOES PROGRAM START MATCH AUXID IN FILE INFO?
  AD2Ø   NO, CHANGE IT >>AD29
  AD28   ELSE, EXIT

  AD29   TO CHANGE IT, (BEB9)
  AD2F   EXIT THRU SET FILE INFO ROUTINE >>B7D9

AD32 *********** "CREATE" COMMAND ***********************************

  AD32   AUXID = Ø (A$ OR RECLN)
  AD3D   TYPE KEYWORD GIVEN?
  AD3F   YES >>AD46
  AD43   NO, ASSUME TYPE = DIR (BE6A)

  AD46   *** CREATE FILE ENTRY *** (BE43)
  AD49   EXEC FILE ACTIVE?
  AD4C   HOW MANY FILES ARE OPEN INCLUDING EXEC? (BE4D)
  AD4F   8 OR MORE?
  AD51   YES, ERROR >>AD6E
  AD56   ELSE, SET TYPE IN MLI LIST (BEA4)
  AD59   FULL ACCESS (READ/WRITE/ETC.)
  AD5B   KIND = STANDARD FILE
  AD5D   DIR FILE WANTED?
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AD5F
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  AD5F   NO >>AD63
  AD61   YES, KIND = DIR FILE
  AD63   SET ACCESS (BEA3)
  AD66   AND KIND (BEA7)
  AD6B   MLI: CREATE (DON'T COME BACK HERE)  >>BE70

  AD6E   "RAM TOO LARGE" ERROR
  AD70   RETURN

AD71 *********** "RENAME" COMMAND ************************************

  AD71   ---
  AD75   SECOND PATHNAME GIVEN?
  AD78   IF SO, GO MLI: RENAME >>AD7F
  AD7A   "SYNTAX ERROR" OTHERWISE >>A839

AD7D *********** "DELETE" COMMAND ************************************

  AD7D   SETUP MLI: DELETE CALL TYPE
  AD7F   EXIT THRU MLI CALL >>BE70

AD82 *********** "LOCK" COMMAND **************************************

  AD82   GET FILE INFO FOR PATHNAME1 <B7D0>
  AD85   GET ACCESS CODES (BEB7)
  AD88   TURN OFF ALL...
  AD8A   BUT READ
  AD8F   THEN GO SET UPDATED FILE INFO >>B7E7

AD92 *********** "UNLOCK" COMMAND ************************************

  AD92   GET FILE INFO FOR PATHNAME1 <B7D0>
  AD95   TURN ON ALL FILE ACCESSES
  AD9D   THEN GO SET UPDATED FILE INFO >>B7E7

ADA0 *********** "PREFIX" COMMAND ************************************

  ADA0   SLOT/DRIVE GIVEN ON COMMAND? (BE57)
  ADA6   IF SO, GOT OPERAND ALREADY >>ADAC
  ADA8   ELSE, (BE56)
  ADAB   CHECK FOR PATHNAME1
  ADAC   AND GO DO MLI: SET PREFIX ...
  ADAE   IF IT'S THERE >>AD7F
  ADB0   ELSE, IS BASIC PROGRAM RUNNING?
  ADB2   IF SO, SET PREFIX ACTIVE FLAG >>ADD1
  ADB4   NO, NEW LINE <9FAB>
  ADBC   END OF NAME YET? >>ADC9
  ADBE   NO, COPY NAME IN PATHNAME1 BUFFER (BCBD)
  ADC3   TO OUTPUT DEVICE <9FAD>
  ADC9   AND SKIP A BLANK LINE <9FAB>
  ADD0   DONE
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: ADD0
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  ADD1   SET PREFIX ACTIVE FLAG
  ADD3   SO BASIC CAN READ THE PREFIX (BE46)
  ADD7   RETURN

ADD8 *********** "BSAVE" COMMAND *************************************

  ADD8   PATHNAME1 FOUND? >>AE0E
  ADDA   NO, NEW FILE (BE57)
  ADDD   AD, L, AND E POSSIBLE
  ADDF   AD AND EITHER L OR E REQUIRED
  ADE1   OR ELSE ERROR >>AE12
  ADE6   PUT AD IN CREATE PARAMETER LIST (BEA5)
  ADE9   AND IN GET FILE INFO LIST (BEB9)
  ADF7   TYPE = BIN ASSUMED (BE6A)
  AE00   T KEYWORD GIVEN?
  AE02   IF SO, ERROR >>AE12
  AE04   GO CREATE THE FILE <AD46>
  AE07   ERROR? >>AE14
  AE09   GET FILE INFO <B7D0>
  AE0C   ERROR? >>AE14
  AE0E   WRITING...
  AE10   GO PROCESS LIKE A BLOAD OTHERWISE >>AE25

  AE12   "PATH NOT FOUND" ERROR
  AE14   ---
  AE15   RETURN

AE16 *********** "BRUN" COMMAND **************************************
           (DOES NOT SET MODE=4 SO DOS COMMANDS MAY
           NOT BE ISSUED AS WITH A BASIC PROGRAM)

  AE16   BLOAD IT FIRST <AE23>
  AE19   ERROR? >>AE14
  AE1B   THEN CALL IT <AE20>
  AE1E   THEN EXIT
  AE1F   RETURN
  AE20   INDIRECT JMP TO BINARY PROGRAM >>BED7

AE23 *********** "BLOAD" COMMAND *************************************

  AE23   READING...
  AE25   TYPE = BIN
  AE27   OPEN THE FILE <B194>
  AE2A   ERROR? >>AE14
  AE2C   ASSUME USER SPECIFIED AD KEYWORD (BE58)
  AE35   IF SO, USE HIS ADDRESS >>AE47
  AE37   ELSE, USE AD IN FILE INFO AUXID (BEB9)
  AE40   WAS T KEYWORD GIVEN?
  AE42   YES, INVALID PARM (ONLY BIN IS LEGAL) >>AE78
  AE47   POINT READ/WRITE PARMS TO DATA (BED7)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AE4D
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  AE4D  PICK UP LENGTH FROM L KEYWORD VALUE (BE5F)
  AE53  WAS L OR E GIVEN?
  AE55  NEITHER >>AE7C
  AE57  BOTH?
  AE59  YES...NAUGHTY! >>AE78
  AE5B  E GIVEN?
  AE5D  NO, MUST BE L >>AE92
  AE5F  YES... (BE5D)
  AE63  COMPUTE L = (E - AD) (BE58)
  AE6F  PLUS ONE FOR INCLUSIVE RANGE >>AE72
  AE72  MAKE SURE NO BORROW OCCURED >>AE92

  AE74  OR ELSE, "RANGE ERROR"
  AE77  RETURN

  AE78  "INVALID PARM" ERROR
  AE7B  RETURN

  AE7C  ---
  AE7E  MLI: GET EOF <BE7Ø>
  AE81  ERROR? >>AE9Ø
  AE83  GET L (EOF MARK) (BEC8)
  AE89  BETTER NOT EXCEED 64K (BECA)
  AE8C  NO.. >>AE92

  AE8E  YES, "PROGRAM TOO LARGE"
  AE9Ø  ---
  AE91  RETURN

  AE92  STORE LENGTH TO READ OR WRITE (BED9)
  AE9B  B KEYWORD GIVEN?
  AE9D  NO >>AEC4
  AEA1  YES, COPY B VALUE TO SET MARK LIST (BE5A)
  AEAA  ---
  AEAC  MLI: SET MARK <BE7Ø>
  AEB2  NO ERROR? >>AEC4
  AEB4  ERROR, RANGE ERROR?
  AEB6  NO >>AE9Ø
  AEB8  BSAVING (NOT BLOAD/BRUNING)?
  AEBA  NO >>AE9Ø
  AEBE  MLI: FORCE EOF FORWARD TO MARK <BE7Ø>
  AEC1  AND TRY SET MARK AGAIN >>AEAA
  AEC3  RETURN
  AEC4  GET COMMAND NUMBER (BE53)
  AEC7  ASSUME READ
  AEC9  BSAVE?
  AECB  NO, READ IS CORRECT >>AECF
  AECD  WRITING
  AECF  MLI: READ OR WRITE <BE7Ø>
  AED2  ERROR? >>AE9Ø
  AED4  THEN EXIT THRU CLOSE >>AF94
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AED4
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

AED7 *********** "STORE" COMMAND *************************************

  AED7  PATHNAME1 EXISTS? >>AEEB
  AED9  NO, T = VAR BY DEFAULT
  AEE1  FULL ACCESS (READ/WRITE/ETC.)
  AEE6  CREATE THE FILE <AD46>
  AEE9  ERROR? >>AF39
  AEEB  COMPRESS APPLESOFT VARS AGAINST HIMEM <A4ØD>
  AEF4  OPEN "VAR" FILE FOR WRITE <B194>
  AEF7  ERROR? >>AF32
  AEF9  POINT TO INTERNAL 5 BYTE HEADER BUFFER <AF3A>
  AEFC  AND WRITE OUT LENGTHS OF VARS <AF9C>
  AEFF  ERROR? >>AF32
  AFØ1  STORE ADDRESS OF VARS (BC8E)
  AFØ4  IN READ/WRITE PARM LIST (BED7)
  AFØ7  AND FILE INFO AUXID (BEB9)
  AF13  GET LENGTH OF VARS (BC91)
  AF19  AND WRITE THEM OUT <AF9C>
  AF1C  ERROR? >>AF32
  AF2Ø  MLI: GET MARK <BE7Ø>
  AF25  MLI: SET NEW EOF (TRUNCATE IF NECESSARY) <BE7Ø>
  AF28  ERROR? >>AF32
  AF2A  SET FILE INFO WITH AD OF VARS <B7D9>
  AF2D  ERROR? >>AF32
  AF2F  CLOSE FILE <AF94>
  AF32  ---
  AF34  REEXPAND VARS BACK AGAIN <A472>
  AF39  RETURN

AF3A *********** SETUP TO READ/WRITE VAR HDR ************************
          APPLESOFT VARIABLES HEADER CONSISTS OF:
          2 BYTE LENGTH OF SIMPLE+ARRAY VARIABLES
          2 BYTE LENGTH OF SIMPLE VARIABLES ONLY
          1 BYTE MSB OF HIMEM FOR THESE VARIABLES

  AF3A  STORE ADDRESS OF 5 BYTE INFO
  AF3C  IN READ/WRITE PARM LIST (BED7)
  AF46  LENGTH = 5
  AF48  RETURN

AF49 *********** "RESTORE" COMMAND ***********************************

  AF49  TYPE = VAR
  AF4B  READING
  AF4D  OPEN THE FILE <B194>
  AF5Ø  ERROR? >>AF39
  AF52  SET UP TO READ THE HEADER <AF3A>
  AF55  READ 5 BYTE HEADER <AF98>
  AF58  ERROR? >>AF39
  AF5A  PICK UP WHERE TO READ IN COMPRESSED VARS (BEB9)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AF5D
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

 AF5D   FROM AUXID (BC8E)
 AF63   ADJUST MSB OF THIS BY THE DIFFERENCE
 AF66   BETWEEN HIMEM'S (NOW AND WHEN STORED) (BC8D)
 AF73   MAKE SURE VARS WON'T OVERLAY PROGRAM
 AF75   IF SO, ERROR >>AF90
 AF7F   COMPUTE LENGTH OF ALL VARS/STRINGS
 AF81   (HIMEM-START) (BC8F)
 AF85   GO READ COMBINED VARS INTO MEMORY <AF98>
 AF88   ERROR? >>AF39
 AF8A   CLOSE THE FILE <AF94>
 AF8D   EXIT BY REEXPANDING THE VARS DOWN >>AF32

 AF90   "PROGRAM TOO LARGE" ERROR
 AF93   RETURN

AF94 *********** CLOSE FILE ******************************************

 AF94   SET MLI CLOSE OPCODE
 AF96   AND GO TO MLI >>AFA4

AF98 *********** READ/WRITE A RANGE **********************************

 AF98   READ MLI OPCODE
 AF9A   JUMP IN >>AF9E
 AF9C   WRITE MLI OPCODE
 AF9E   STORE LENGTH (BEDA)
 AFA4   EXIT THRU MLI:READ OR WRITE >>BE70

AFA7 *********** "PR#" COMMAND ***************************************

 AFA7   USE CSWL AND OUTVEC
 AFAC   JUMP TO COMMON CODE >>AFB5

AFAE *********** "IN#" COMMAND ***************************************

 AFAE   USE KSWL
 AFB3   AND INVEC

 AFB5   OR IN SLOT GIVEN BY USER (BE6B)
 AFB8   *2 FOR USE AS INDEX INTO TABLE
 AFBD   WAS SLOT PARAMETER GIVEN?
 AFBF   NO... >>AFD2
 AFC1   YES, (BE57)
 AFC4   AD GIVEN? >>AFE7
 AFC6   NO, GET INVEC OR OUTVEC FOR THIS SLOT (BE10)
 AFC9   AND STORE ON AD KEYWORD VALUE (BE58)
 AFD2   VALIDITY CHECK I/O DRIVER <AFF9>
 AFD5   NO GOOD? >>AFE6
 AFD7   GET INDEX TO CSWL OR KSWL (BCA9)
 AFDD   AND REPLACE ONE OR THE OTHER WITH (0036)
 AFE0   HIS ADDRESS (BE59)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: AFE6
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

 AFE6   RETURN

 AFE7   VALIDITY CHECK AD KEYWORD VALUE <AFF9>
 AFEA   NO GOOD? >>AFF8
 AFEC   GOOD, COPY VALUE TO INVEC OR OUTVEC (BE59)
 AFF8   EXIT BUT DON'T REDIRECT I/O NOW

AFF9 *********** VALIDITY CHECK I/O DRIVER ***************************

 AFF9   $3A/3B --> NEW HANDLER (FROM AD PARM) (BE58)
 B005   IS DRIVER IN MAIN RAM (BELOW $C000)?
 B007   YES >>B01E
 B009   NO, RESET I/O CARD ROMS (CFFF)
 B00C   USE $3C TO COUNT ITERATIONS
 B00E   TEST ROM AT USER'S ADDRESS
 B014   FOR STABILITY
 B018   256 TIMES
 B01C   MUST BE OK
 B01D   RETURN
 B01E   MAIN RAM I/O DRIVER
 B020   MUST START WITH A "CLD" INSTRUCTION
 B022   OK... >>B01C

 B024   ELSE, "NO DEVICE CONNECTED"
 B027   RETURN

B028 *********** "BYE" COMMAND ***************************************

 B028   CLOSE ANY OPEN FILES <B4F2>
 B02B   CLOSE EXEC FILE, IF ANY <B2FB>
 B030   MLI CALL: <BF00>
 B033   QUIT
 B034   USE READ PARMLIST BECAUSE QUIT DOESN'T NEED PARMS.

B036 *********** "CAT" COMMAND ***************************************

 B036   39 CHARACTERS PER LINE
 B038   THEN PROCESS LIKE "CATALOG" >>B03C

B03A *********** "CATALOG" COMMAND ***********************************

 B03A   79 CHARACTERS PER LINE
 B03C   STORE LINE LENGTH (BCB6)
 B042   TEST FOR T AND
 B044   ....PATHNAME1 GIVEN
 B045   GOT T >>B04A
 B047   NO T, T=0 (ANY TYPE WILL DO) (BE6A)
 B04A   GOT PATHNAME1 >>B051
 B04C   NO PATHNAME1, GET FILE INFO FOR PREFIX <B7D0>
 B04F   ERROR? >>B0B7
 B051   OPEN/READ DIRECTORY HEADER <B14A>
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: BØ54
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  BØ54   ERROR? >>BØB7
  BØ56   SKIP TO A NEW LINE <9FAB>
  BØ59   FORMAT DIRECTORY'S NAME TO $2Ø1 <BØB8>
  BØ5C   PRINT $2Ø1 <9F9D>
  BØ5F   SKIP TO A NEW LINE <9FAB>
  BØ62   BLANK $2Ø1 BUFFER <A66C>
  BØ67   UNPACK HEADING MESSAGE LINE <9FBØ>
  BØ6A   PRINT IT (4Ø OR 8Ø COLUMNS) <9F9D>
  BØ6D   SKIP TO A NEW LINE <9FAB>
  BØ73   ANY FILES IN THIS DIRECTORY? (BCBA)
  BØ76   NO >>BØA3
  BØ78   YES, READ NEXT ENTRY <B1D1>
  BØ7B   ERROR?  >>BØB7
  BØ7D   GET TYPE REQUESTED FOR SEARCH (BE6A)
  BØ8Ø   ANY TYPE WILL DO? >>BØ87
  BØ82   NO, CHECK TYPE AGAINST THIS ENTRY (Ø269)
  BØ85   NOT IT, SKIP IT >>BØ8D
  BØ87   ELSE, FORMAT ENTRY TO $2Ø1 <A4C4>
  BØ8A   AND PRINT $2Ø1 <9F9D>
  BØ8D   CHECK KEYBOARD (CØØØ)
  BØ9Ø   FOR A CONTROL-C
  BØ92   IGNORE ANYTHING ELSE >>BØ9E

  BØ94   CONTROL-C, WHAT STATE ARE WE IN? (BE42)
  BØ97   DEFERRED >>BØA3
  BØ99   NO, IMMEDIATE, RESET KEYBOARD STROBE (CØ1Ø)
  BØ9C   AND EXIT RIGHT NOW >>BØA3

  BØ9E   ELSE, ANY FILES LEFT IN COUNT? (BCBA)
  BØA1   YES, CONTINUE >>BØ78
  BØA3   ELSE, CLOSE DIRECTORY <AF94>
  BØA6   ERROR? >>BØB7
  BØA8   SKIP TO A NEW LINE <9FAB>
  BØAB   FORMAT BLOCKS FREE AND IN USE TO $2Ø1 <BØE7>
  BØAE   ERROR? >>BØB7
  BØBØ   PRINT $2Ø1 <9F9D>
  BØB3   SKIP A LINE <9FAB>
  BØB7   DONE

BØB8 *********** FORMAT NAME OF DIRECTORY ****************************

  BØB8   BLANK $2Ø1 BUFFER <A66C>
  BØBB   FILE NAME IS AT +1 INTO DIR ENTRY
  BØBD   GET NAME LENGTH/TYPE (Ø25D)
  BØC2   VOLUME DIRECTORY HEADER?
  BØC4   NO >>BØCA
  BØC6   YES, START NAME WITH "/" (Ø2ØØ)
  BØCA   ---
  BØCB   ISOLATE NAME LENGTH FROM TYPE
  BØCD   AND SET UP LENGTH TO COPY (Ø2ØØ)
  BØD2   COPY DIRECTORY NAME TO (Ø259)
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: BØD7
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  BØD7   ...LINE (Ø2ØØ)
  BØE1   SET $2ØØ TO MAXIMUM LENGTH
  BØE6   RETURN

BØE7 *********** FORMAT BLOCKS FREE/INUSE ****************************

  BØE7   POINT MLI:ONLINE PARMLIST
  BØE9   TO TXTBUF (PATHNAME1) (BEC8)
  BØF1   COPY DEVICE NUMBER (UNIT) (BF3Ø)
  BØF9   MLI: ONLINE <BE7Ø>
  BØFC   ERROR? >>BØB7
  B1Ø1   ISOLATE NAME LENGTH FROM BUFFER
  B1Ø4   BUMP BY ONE TO INCLUDE "/"
  B1Ø5   AND STORE IT AS A PREFIX (BCBC)
  B1ØA   STORE "/" AS FIRST CHARACTER (BCBD)
  B1ØD   GET FILE INFO FOR PREFIX <B7DØ>
  B11Ø   ERROR? >>BØB7
  B112   BLANK $2Ø1 BUFFER <A66C>
  B117   UNPACK "BLOCKS FREE: BLOCKS USED.." <9FBØ>
  B11A   ZERO THE THREE BYTE ACCUM <AB37>
  B125   CONVERT AUXID (TOTAL BLOCKS) <A62F>
  B13Ø   CONVERT BLOCKS USED <A62F>
  B137   BLOCKS_FREE = TOTAL_BLOCKS (BEBC)
  B13E   ... - BLOCKS_USED (BEBD)
  B145   CONVERT BLOCKS FREE <A62F>
  B149   DONE!

B14A *********** OPEN/READ DIRECTORY HDR *****************************

  B14A   READ ONLY
  B14E   CHECK FILE KIND (BEBB)
  B151   VOLUME DIRECTORY?
  B153   NO >>B158
  B155   YES, TYPE = DIR (BEB8)
  B158   OPEN THE FILE <B1AØ>
  B15B   ERROR? IF NOT, FALL THRU >>B193

B15D *********** READ DIRECTORY HDR **********************************

  B15D   BUFFER IS $259
  B169   LENGTH IS $2B (ONE ENTRY) (BED9)
  B173   MLI: READ  <BE7Ø>
  B176   ERROR? >>B193
  B17A   COPY ENTRY LENGTH, ENTRIES PER BLOCK, (Ø27C)
  B17D   AND FILE COUNT FROM DIR HDR (BCB7)
  B183   STORE ENTRY LENGTH IN READ LENGTH NOW (BED9)
  B188   SET COUNTER TO FIRST ENTRY IN BLOCK (BCBB)
  B18D   MARK = Ø (START OF FILE) (BEC9)
  B193   RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B193
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

B194 *********** OPEN FILE ******************************************
          A REGISTER = ACCESS BITS
          X REGISTER = DEFAULT TYPE

  B194   ---
  B198   T KEYWORD GIVEN?
  B19A   NO >>B19F
  B19C   YES, USE KEYWORD VALUE INSTEAD (BE6A)
  B19F   ---
  B1AØ   EXISTING FILE OF THIS TYPE? (BEB8)
  B1A3   NO, ERROR >>B1C9
  B1A5   CHECK ACCESS REQUESTED (BEB7)
  B1A8   REQUESTED ACCESS NOT PERMITTED >>B1CD
  B1AA   SET SYSTEM BUFFER IN OPEN PARM LIST (BC88)
  B1B2   LEVEL = $ØF (BF94)
  B1B7   MLI: OPEN <BE7Ø>
  B1BA   ERROR? >>B1C8
  B1BF   SAVE REFNUM IN READ/WRITE PARMLIST (BED6)
  B1C2   AND CLOSE PARMLIST (BEDE)
  B1C5   AND GET/SET EOF/MARK LIST (BEC7)
  B1C8   AND EXIT

  B1C9   "FILE TYPE MISMATCH"
  B1CC   RETURN
  B1CD   "FILE LOCKED"
  B1DØ   RETURN

B1D1 *********** READ NEXT DIRECTORY ENTRY ***************************

  B1D1   FORCE MARK TO START OF THIS BLOCK (BEC9)
  B1D9   CHECK ENTRY NUMBER (BCBB)
  B1DE   LAST ENTRY IN THIS BLOCK? (BCB8)
  B1E1   NO >>B1ED
  B1E4   YES, ENTRY Ø NEXT TIME (BCBB)
  B1E7   BUMP MARK TO NEXT BLOCK  (BEC9)
  B1ED   ---
  B1EF   MARK POSITIONED TO PROPER ENTRY YET? >>B1F8
  B1F1   NO, BUMP POINTER TO NEXT ENTRY (BCB7)
  B1F4   AND CONTINUE IF STILL FIRST PAGE >>B1ED
  B1F6   JUST ENTERED SECOND PAGE >>B1EA
  B1F8   ADD 4 TO PTR TO ADJUST FOR BLOCK PREFIX
  B1FF   MLI: SET MARK <BE7Ø>
  B2Ø2   ERROR? >>B21D
  B2Ø6   MLI: READ <BE7Ø>
  B2Ø9   ERROR? >>B21D
  B2ØB   BUMP ENTRY COUNTER (BCBB)
  B211   IS THIS ENTRY VALID?
  B213   NO, SKIP OVER IT >>B1D1
  B215   DECREMENT FILE COUNT (BCB9)
  B21D   AND RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B21D
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

B21E *********** EXTERNAL COMMAND HANDLER ***************************

  B21E   INDIRECT JMP TO XTRNAD VECTOR >>BE5Ø

B221 *********** "EXEC" COMMAND ***************************************

  B221   IS THIS FILE OPEN ALREADY? <B41F>
  B224   NO >>B25Ø
  B226   YES, EXEC CLOSING? (BE4E)
  B229   NO >>B24C
  B22B   SAVE REFNUM (BEC7)
  B23Ø   RESET MARK TO ZERO (BEC8)
  B23B   MLI: SET MARK <BE7Ø>
  B23E   ERROR? >>B245
  B24Ø   GET REFNUM AGAIN (BEC7)
  B243   GO RESTART THIS EXEC FILE FROM ITS START >>B2C3

           ******** CLOSE EXEC FILE ****************

  B245   PRESERVE CALLER'S AREG
  B246   AND CLOSE THE FILE <B2FB>
  B24B   THEN RETURN WITH ERROR

  B24C   "FILE BUSY" ERROR
  B24F   RETURN

           ******** CONTINUE EXEC SETUP ************

  B25Ø   EXEC ACTIVE?  (BE43)
  B253   NO >>B25A
  B255   YES, CLOSE IT <B2FB>
  B258   ERROR? >>B263
  B25A   GET FILE TYPE (BEB8)
  B25D   SHOULD BE TXT
  B25F   IT IS >>B265

  B261   ELSE, "FILE TYPE MISMATCH"
  B263   RETURN WITH ERROR
  B264   RETURN

  B265   MOVE STRINGS TO MAKE ROOM FOR A BUFFER <A1F5>
  B268   NO ROOM? >>B263
  B26C   STORE NEW BUFFER ADDRESS IN PARM LIST (BEC8)
  B275   GET COUNT OF OPEN FILES (BE4D)
  B278   NO OTHERS CURRENTLY OPEN? >>B29E
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B278
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

        ******** MAKE EXEC TOPMOST BUFFER *******

 B27A   OTHERS ARE OPEN...
 B27C   OPENCOUNT*4 (4 PAGES PER BUFFER)
 B27E   ADD THIS TO MY BUFFER TO FIND TOP BUFFER (BC88)
 B282   SEARCH OPEN FILES TO FIND THE FILE WHICH (BC93)
 B285   IS USING THIS BUFFER... >>B28B
 B28A   IF IT IS NOT FOUND, BREAK!
 B28B   ---
 B28C   MOVE THAT FILE TO THE NEW BUFFER INSTEAD (BC93)
 B28F   GET THAT FILE'S REFNUM ALSO (BC9B)
 B297   MLI: SET BUFF <BE7Ø>
 B29A   NO ERRORS? >>B29D
 B29C   IF ERROR, BREAK!
 B29D   ---

        ******** OPEN NEW EXEC FILE *************

 B29E   SET NEW BUFFER ALLOCATION PAGE (BC88)
 B2A1   SET UP OPEN LIST FOR EXEC TOO (BECF)
 B2A6   LEVEL = Ø (BF94)
 B2AB   MLI: OPEN (EXEC FILE) <BE7Ø>
 B2AE   NO ERROR? >>B2B7

 B2BØ   ---
 B2B1   IF ERROR, FREE BUFFER FIRST <A24C>
 B2B6   THEN EXIT WITH ERROR

 B2B7   SAVE BUFFNO FOR EXEC  (BECF)
 B2BD   AND REFNUM TOO (BEDØ)

        ******** COMPLETE EXEC COMMAND **********

 B2C3   SAVE READ REFNUM (BED6)
 B2C6   AND GET/SET REFNUM (BEC7)
 B2C9   AND NEWLINE REFNUM (BED2)
 B2CF   SET "L" VALUE FROM AUXID (BE5F)
 B2D8   SAVE PATHNAME/AUXID IN OPEN FILE TABLE <B3EB>
 B2DD   IGNORE MSB FOR END OF LINE CHARS (BED3)
 B2E2   MLI: SET NEWLINE <BE7Ø>
 B2E8   WAS "F" OR "R" GIVEN ON COMMAND LINE?
 B2EA   NO >>B2F4
 B2EC   YES, POSITION TO SPECIFIED STARTING PT <B522>
 B2EF   NO ERRORS? >>B2F4
 B2F1   IF ERROR, GO CLOSE EXEC >>B245
 B2F4   MARK EXEC ACTIVE
 B2FA   AND RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B2FA
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

B2FB *********** CLOSE EXEC FILE *************************************

 B2FB   EXEC ACTIVE? (BE43)
 B2FE   NO, SKIP IT >>B3ØB
 B3ØØ   INDICATE EXEC FILE CLOSING (BE4E)
 B3Ø5   PICK UP REFNUM FOR EXEC (BC9B)
 B3Ø8   AND GO CLOSE IT <B4A5>
 B3ØB   RETURN

B3ØC *********** "VERIFY" COMMAND ************************************

 B3ØC   FILE NOT FOUND? >>B347
 B311   FILE FOUND, WAS A PATHNAME1 GIVEN?
 B313   YES >>B31D
 B315   NO,
 B317   PRINT "(C) APPLE COMPUTER..." <9F8C>
 B31A   AND A NEW LINE <9FAB>
 B31D   THEN EXIT
 B31E   RETURN

B31F *********** FLUSH ALL OPEN FILES ********************************

 B31F   REFNUM = Ø (ALL FILES)
 B321   JUMP INTO FLUSH >>B32F

B323 *********** "FLUSH" COMMAND *************************************

 B323   ---
 B326   WAS PATHNAME1 GIVEN?
 B328   NO, FLUSH ALL FILES >>B32F
 B32A   ELSE, LOOK UP NAME IN OPEN FILE LISTS <B41F>
 B32D   NOT AN OPEN FILE >>B337
 B32F   SAVE REFNUM IN PARM LIST (BEDE)
 B334   MLI: FLUSH <BE7Ø>
 B337   EXIT

B338 *********** "OPEN" COMMAND **************************************

 B338   ---
 B339   LOOK UP NAME IN OPEN FILE LIST <B41F>
 B33C   NOT CURRENTLY OPEN? >>B34B

 B33E   ---
 B33F   IT IS OPEN, "FILE BUSY" ERROR
 B342   RETURN
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B342
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  B343  "FILE TYPE MISMATCH" ERROR
  B346  RETURN

  B347  "PATH NOT FOUND" ERROR
  B349  ---
  B34A  RETURN

  B34B  ---
  B34C  ASSUME "L" IS ZERO
  B353  WAS "L" KEYWORD GIVEN?
  B355  YES, USE HIS VALUE >>B35D
  B357  NO, SET "L" TO ZERO (BE6Ø)
  B36Ø  WAS "T" GIVEN?
  B364  YES, USE HIS TYPE >>B36B
  B366  ELSE, DEFAULT TO "TXT"
  B36B  DOES THE FILE ALREADY EXIST? >>B38E
  B36D  NO, "T" GIVEN? IF SO, ERROR >>B347
  B36F  FORCE TYPE = "TXT" (BEB8)
  B374  FULL ACCESS (BEB7)
  B37A  COPY "L" KEYWORD VALUE (BE5F)
  B37D  TO CREATE (BEA6)
  B38Ø  AND SET FILE INFO LISTS (BEBA)
  B389  GO CREATE THE FILE <AD46>
  B38C  ERROR? >>B349
  B38E  CHECK FILE TYPE (BEB8)
  B391  AGAINST HIS "T" VALUE (BE6A)
  B394  MISMATCH? >>B343
  B396  NO, TYPE = TXT?
  B398  NO >>B3AD
  B39A  YES, GET RECORD LENGTH FROM AUXID  (BEBA)
  B3A3  WAS "L" KEYWORD VALUE GIVEN?
  B3A5  YES, USE THAT INSTEAD >>B3AD
  B3A7  OTHERWISE, SAVE AUXID RECORD LEN (BE6Ø)
  B3AD  ALLOCATE A NEW FILE BUFFER <A1F5>
  B3BØ  ERROR? >>B349
  B3B2  GET BUFFER PAGE NO. (BC88)
  B3B5  AND STORE IN OPEN LIST (BECF)
  B3BA  LEVEL = 7 (BF94)
  B3BF  MLI: OPEN <BE7Ø>
  B3C2  NO ERRORS? >>B3CB

  B3C4  ---
  B3C5  ERROR, FREE BUFFER FIRST <A24C>
  B3CA  THEN EXIT WITH ERROR CODE

  B3CB  CHECK FILE TYPE AGAIN (BEB8)
  B3CE  "DIR" FILE?
  B3DØ  YES >>B3D3
  B3D2  NO
  B3D3  ---
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B3D6
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  B3D6  SET DIR FLAG ACCORDINGLY (BE47)
  B3D9  USING OPEN COUNT AS AN INDEX (BE4D)
  B3DF  STORE BUFFER LOCATION IN OPEN FILE LIST (BC94)
  B3E5  ALSO, THE REFNUM (BC9C)
  B3E8  AND BUMP OPEN FILE COUNT AND FALL THRU (BE4D)

B3EB *********** SAVE FILE NAME/RECLEN IN TABLE **********************

  B3EB  MAKE INDEX FROM REFNUM*32 BYTES
  B3F1  GET NAME LENGTH (Ø28Ø)
  B3F4  OR IN DIR FLAG (BE47)
  B3F7  AND STORE IN OPEN FILE NAME LIST (BCFE)
  B3FD  NAME > OR = TO 3Ø BYTES?
  B3FF  NO... >>B4Ø3
  B4Ø1  YES, USE 29
  B4Ø3  STORE THAT AS A LOOP COUNTER
  B4Ø8  COPY "L" KEYWORD VALUE TO NAME LIST TOO (BCFF)
  B411  ---
  B412  COPY FILE NAME TO NAME LIST (Ø28Ø)
  B41B  COPY ALL OF NAME, THEN FALL THRU TO EXIT >>B411

B41D *********** "MON" AND "NOMON" COMMANDS **************************

  B41D  IGNORE THESE COMMANDS AND
  B41E  RETURN TO CALLER

B41F *********** LOOKUP OPEN FILENAME ********************************
           (RETURNS REFNUM OF OPEN FILE)

  B41F  ---
  B422  WAS PATHNAME1 GIVEN?
  B424  YES >>B42A

  B426  NO, "SYNTAX ERROR"
  B429  EXIT WITH ERROR

  B42A  ANY FILES CURRENTLY OPEN? (BE4D)
  B42D  NO, CAN'T FIND IT THEN >>B448
  B42F  YES, CLEAR EXEC FILE CLOSING FLAG (BE4E)
  B432  STORE FILE COUNT AS LOOP COUNTER
  B434  GET NEXT REFNUM (BC9B)
  B437  COMPARE FILENAMES <B462>
  B43A  NOT THE ONE? >>B443
  B43C  ELSE, WE'VE GOT IT!
  B43E  PICK UP APPROPRIATE REFNUM (BC9B)
  B441  ---
  B442  AND RETURN WITH IT
  B443  ELSE, NOT IT, TRY NEXT ONE
  B446  AND CONTINUE LOOPING >>B432
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B446
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------


  B448  CAN'T FIND IT, IS EXEC ACTIVE? (BE43)
  B44B  NO, THEN WE MUST GIVE UP >>B45E
  B45Ø  IS HE LOOKING FOR EXEC FILE? <B462>
  B453  NO, GIVE UP >>B45E
  B457  YES, EXEC FILE CLOSING (BE4E)
  B45C  AND RETURN WITH EXEC'S REFNUM >>B43E

  B45E  "FILE NOT OPEN" ERROR
  B461  RETURN WITH ERROR CODE

B462 *********** COMPARE FILENAMES **********************************

  B462  REFNUM*32 FOR FILENAME INDEX
  B468  PICK UP DIR FLAG FROM THIS ENTRY (BCFE)
  B47Ø  SAME LENGTH AS HIS FILENAME? (Ø28Ø)
  B473  NO, CAN'T BE IT THEN >>B498
  B476  MAKE SURE LENGTH DOES NOT EXCEED 29
  B47A  IF IT DOES, ONLY LOOK AT FIRST 29
  B47C  USE $3A AS LOOP COUNTER
  B481  COPY "L" OF THIS FILE TO KEYWORD (BCA4)
  B48A  ---
  B48B  COMPARE NAMES (Ø28Ø)
  B491  NO MATCH? EXIT WITH Z FLAG CLEAR >>B498
  B498  MATCH, EXIT WITH Z FLAG SET

B499 *********** "CLOSE" COMMAND ************************************

  B499  ---
  B49C  PATHNAME1 GIVEN?
  B49E  NO, CLOSE ALL FILES >>B4F2
  B4AØ  YES, LOOK IT UP IN OPEN FILE TABLES <B41F>
  B4A3  NOT FOUND? >>B441
  B4A5  FOUND IT, STORE REFNUM IN CLOSE LIST (BEDE)
  B4AB  MARK BUFFER PAGE FREE (BC88)
  B4AE  EXEC CLOSING? (BE4E)
  B4B1  YES...NO NEED TO COMPRESS LISTS >>B4CF
  B4B3  GET OPEN COUNT (LAST OPENED FILE NO.) (BE4D)
  B4B7  SWAP BUFFERS (BC93)
  B4C5  AND REFNUMS WITH THE LAST OPENED FILE (BC9B)
  B4CF  ---
  B4D1  LEVEL = Ø (BF94)
  B4D6  MLI: CLOSE <BE7Ø>
  B4D9  ERROR? >>B5Ø2
  B4DB  RELEASE THE BUFFER <A24C>
  B4DE  EXEC FILE CLOSING? (BE4E)
  B4E1  NO >>B4EE
  B4E6  YES, EXEC NO LONGER ACTIVE (BE43)
  B4E9  AND NO LONGER CLOSING (BE4E)
  B4ED  RETURN TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B4ED
----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  B4EE  DROP OPEN FILE COUNT  (BE4D)
  B4F1  AND EXIT

B4F2 *********** CLOSE ALL OPEN FILES *******************************

  B4F2  ANY FILES OPEN? (BE4D)
  B4F5  NO >>B5Ø3
  B4F7  YES, EXEC NOT CLOSING (BE4E)
  B4FD  CLOSE LAST FILE OPENED <B4A5>
  B5ØØ  IF THAT WORKS, START ALL OVER AGAIN >>B4F2
  B5Ø2  EXIT WHEN ALL ARE CLOSED

  B5Ø3  ---
  B5Ø5  SET CLOSE REFNUM TO ZERO (ALL FILES) (BEDE)
  B5ØA  LEVEL = 7 (LEVEL Ø FILES ALREADY CLOSED) (BF94)
  B5ØF  EXIT THRU MLI: CLOSE >>BE7Ø

B512 *********** "POSITION" COMMAND *********************************

  B512  LOOKUP NAME OF FILE <B41F>
  B515  NOT OPEN? >>B57F
  B517  SET REFNUM IN READ/WRITE PARMLIST (BED6)
  B51A  AND SET NEWLINE LIST (BED2)
  B51D  DIR FILE? (BE47)
  B52Ø  YES, GET OUT RIGHT NOW! >>B58Ø

  B522  "F" OR "R" GIVEN? (BE57)
  B527  NO, INVALID PARM >>B57D
  B529  BOTH GIVEN?
  B52B  YES, INVALID PARM >>B57D
  B52D  JUST "R" GIVEN?
  B52F  NO, JUST "F" >>B53D
  B531  JUST "R", COPY "R" VALUE TO "F" (BE65)
  B534  ("R" AND "F" ARE ALIASES) (BE63)
  B53D  SET COUNT TO 239. (MAXIMUM LINE LEN)
  B54C  BUFFER IS AT $2ØØ (BED8)
  B54F  ---
  B551  NEW LINE CHAR IS EITHER $ØD OR $8D (BED3)
  B556  MLI: SET NEWLINE <BE7Ø>
  B559  ERROR? >>B57F

          ******** SKIP LINES BY READING THEM *****

  B55B  ---
  B55E  "F" = Ø? (BE64)
  B562  YES, DONE >>B58Ø
  B564  ELSE...
  B566  MLI: READ NEXT FIELD (LINE)  <BE7Ø>
  B569  ERROR? >>B57F
  B56E  DECREMENT "F" VALUE BY ONE
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B57B
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  B57B  AND GO CHECK IT AGAIN >>B55B

  B57D  "INVALID PARAMETER" ERROR
  B57F  ---
  B580  EXIT TO CALLER

B581 *********** COMPUTE NEW FILE POSITION ***************************
          (COMPUTES ABSOLUTE FILE POSITION MARK)

  B581  ACCUM = CURRENT RECORD LENGTH (BCA4)
  B595  MARK = 0 (BEC8)

          ******** MARK = "R" * RECLEN ************

  B59E  SHIFT "R" VALUE RIGHT (BE66)
  B5A6  IF LOW BIT OFF, NO ADD >>B5BF
  B5A9  ADD ONE INSTANCE OF RECLEN TO MARK (BCAF)
  B5B8  OVERFLOW? >>B5D2
  B5BD  ACCUM OVERFLOW? >>B5D2
  B5BF  SCALE ACCUM (MULTIPLIER) UP BY 2 (BCAF)
  B5C8  IF "R" NON ZERO... (BE65)
  B5CE  CONTINUE LOOPING >>B59E
  B5D1  ELSE, EXIT TO CALLER

  B5D2  "RANGE ERROR"
  B5D5  RETURN

B5D6 *********** "READ" COMMAND **************************************

  B5D6  LOOK UP FILE NAME <B41F>
  B5D9  NOT OPEN? >>B62B
  B5DB  ITS OPEN, STORE REFNUM IN READ/WRITE... (BED6)
  B5DE  GET/SET... (BEC7)
  B5E1  AND SET NEWLINE PARMLISTS (BED2)
  B5E4  DIR FILE? (BE47)
  B5E7  YES, SPECIAL HANDLING REQUIRED >>B62C
  B5E9  NO, PRE-POSITION FOR "B", "F", OR "R" <B666>
  B5EC  ERROR POSITIONING? >>B62B
  B5EE  ASSUME "L" = 239.
  B5F5  "L" GIVEN?
  B5F7  NO >>B60C
  B5F9  YES, USE HIS "L" VALUE (BE5F)
  B5FF  UNLESS ITS >256 >>B661
  B603  OR >239. >>B661
  B607  DOUBLE QOUTE IT SO COMMAS COME THRU (0200)
  B60A  READ INTO $201
  B60C  IF NO "L", READ TO $200 (BED7)
  B612  NL CHAR = $0D/$8D (OR NONE IF "L") (BED3)
  B621  MLI: SET NEWLINE <BE70>
  B624  ERROR? >>B62B
  B626  ---
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B628
------------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
------------------------------------------------------------------------

  B628  MARK INPUT "READ" FILE ACTIVE (BE44)
  B62B  AND RETURN

          ******** READ DIR FILE ******************

  B62C  SET READ/WRITE LIST REFNUM (BED6)
  B62F  AND GET/SET LIST REFNUM (BEC7)
  B634  READING TO $259 (BED7)
  B63E  INIT CAT FLAG TO FIRST LINE VALUE (BE4F)
  B644  "R" GIVEN?
  B647  NO, DONE >>B626
  B64B  YES, ZERO OUT MARK (BEC8)
  B656  MLI: REWIND FILE <BE70>
  B659  ERROR? >>B660
  B65D  MARK INPUT FILE ACTIVE  (BE44)
  B660  AND EXIT

B661 *********** "RANGE ERROR" ***************************************

  B661  "RANGE ERROR" CODE
  B665  EXIT TO CALLER

B666 *********** PRE-POSITION FOR I/O ********************************

  B666  ---
  B669  "B", "F", OR "R" GIVEN?
  B66B  NO, EXIT >>B6AF
  B66D  "R"?
  B66F  NO >>B67B
  B671  YES, COMPUTE ABSOLUTE POSITION <B581>
  B674  ERROR? >>B661
  B676  NO, SET MARK TO NEW POSITION <B6A8>
  B679  ERROR? >>B6B0
  B67B  "F" GIVEN? (BE57)
  B680  NO >>B687
  B682  SKIP LINES UNTIL "F" = 0 <B53D>
  B685  ERROR? >>B6B0
  B687  "B" GIVEN? (BE57)
  B68C  NO >>B6AF
  B690  MLI: GET MARK <BE70>
  B693  ERROR? >>B6B0
  B699  ADD "B" VALUE TO CURRENT MARK (BE5A)
  B69C  (3 BYTE ADD) (BEC8)
  B6A6  OVERFLOW? >>B661
  B6A8  ---
  B6AA  MLI: SET MARK <BE70>
  B6AD  ERROR? >>B6B0
  B6AF  ---
  B6B0  ---
  B6B2  EXIT TO CALLER
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: B6B2
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------


B6B3 *********** "WRITE" COMMAND ************************************

  B6B3  LOOKUP OPEN FILE NAME <B41F>
  B6B6  NOT AN OPEN FILE? >>B6C8
  B6B8  STORE READ/WRITE REFNUM (BED6)
  B6BB  AND GET/SET REFNUM (BEC7)
  B6BE  AND NEWLINE REFNUM IN PARM LISTS (BED2)
  B6C1  DIR FILE? (BE47)
  B6C4  NO, OK >>B6CA

  B6C6  YES, "FILE LOCKED" ERROR
  B6C8  ---
  B6C9  EXIT TO CALLER

  B6CA  DATA BUFFER AT $2ØØ
  B6D4  PRE-POSITION FOR "B", "F", AND "R" <B666>
  B6D7  NO ERRORS? >>B6ED
  B6D9  WAS ERROR A RANGE ERROR?
  B6DB  NO, REAL ERROR >>B6C8
  B6DD  YES, MY RANGE ERROR OR MLI'S?
  B6DF  MINE... >>B6C8
  B6E1  MLI'S...SET EOF FARTHER INTO FILE
  B6E3  MLI: SET EOF <BE7Ø>
  B6E6  ERROR? >>B6C8
  B6E8  AND THEN TRY AGAIN TO SET MARK <B676>
  B6EB  ERROR? THEN I GIVE UP >>B6C8
  B6ED  BUFFER IS AT HIMEM
  B6F9  INDICATE OUTPUT "WRITE" FILE ACTIVE (BE45)
  B6FD  RETURN TO CALLER

B6FE *********** "APPEND" COMMAND ***********************************

  B6FE  ---
  B6FF  LOOK UP NAME IN OPEN FILE LIST <B41F>
  B7Ø2  FOUND IT? >>B71Ø
  B7Ø5  NO, OPEN IT FIRST <B338>
  B7Ø8  ERROR? >>B71E
  B7ØA  NO, REFNUM NON-ZERO? (BEDØ)
  B7ØD  YES, OK >>B711
  B7ØF  ELSE, BREAK!!!
  B71Ø  ---
  B711  REFNUM TO READ/WRITE PARM LIST (BED6)
  B714  AND GET/SET LIST (BEC7)
  B717  DIR FILE? (BE47)
  B71A  NO >>B72Ø
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: B71A
--------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
--------------------------------------------------------------------------

  B71C  YES, "FILE LOCKED"
  B71E  ---
  B71F  EXIT TO CALLER

  B72Ø  PICK UP "L" VALUE (BE5F)
  B729  DID USER SPECIFY ONE?
  B72B  YES... >>B733
  B72D  NO, USE FILE'S CURRENT "L" VALUE (BEB9)
  B733  ---
  B738  COMPUTE REFNUM*32 FOR INDEX INTO
  B739  FILE NAME TABLE
  B73E  SAVE CURRENT "L" VALUE IN OPEN FILE (BCFF)
  B741  NAME TABLE AND IN CURRENT RECLEN (BCA4)
  B74D  MLI: GET EOF <BE7Ø>
  B75Ø  ERROR? >>B71E
  B752  IS "L" VALUE < 2? (NO SPECIFIC "L") (BCA5)
  B755  NO >>B75E
  B75C  YES >>B763
  B75E  NO, FORCE TO RECORD BOUNDARY <B766>
  B761  ERROR? >>B71E
  B763  ELSE, GO SET EOF=MARK/OUTPUT FILE ACTIVE >>B6E1

B766 *********** FORCE TO EVEN RECORD BOUNDARY **********************
             (FIND RECORD NUMBER OF THIS POSITION)

  B766  ---
  B768  COPY EOF TO ACCUM (BEC7)
  B771  CLEAR MSB'S (BCB2)
  B777  GET READY FOR A 24 BIT DIVIDE
  B779  DIVIDE EOF BY... <AAD7>
  B786  RECORD LENGTH (BCA4)
  B79B  ---
  B7A1  WAS THERE A REMAINDER? (BCB3)
  B7A5  NO, OK... >>B7CF
  B7AB  YES, CURRENT RECORD LEN LESS REMAINDER (BCB2)
  B7B8  PLUS OLD EOF MARK (BEC8)
  B7C2  GIVES NEW EOF ON AN EVEN RECORD BOUNDARY (BEC9)
  B7CD  "RANGE ERROR" POSSIBLE IF OVERFLOW OCCURS
  B7CF  RETURN TO CALLER

B7DØ *********** GET FILE INFO *************************************

  B7DØ  SET NUMBER OF PARMS (1Ø)
  B7D5  MLI CODE FOR GET FILE INFO
  B7D7  GO DO IT >>B7EE
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B7D7
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

B7D9 *********** SET FILE INFO ****************************************

  B7D9  MODIFIED TIME/DATE = Ø
  B7E7  SET NUMBER OF PARMS (7)
  B7EC  MLI CODE FOR SET FILE INFO
  B7EE  EXIT THRU MLI: GET/SET FILE INFO >>BE7Ø

B7F1 *********** BI I/O INDIRECTION VECTORS ***************************

  B7F1  DOSOUT VECTOR >>BE38
  B7F4  DOSIN VECTOR >>BE3A

B7F7 *********** STATE I/O VECTORS TABLE ******************************

  B7F7  IMMEDIATE MODE (STATE=Ø) CSWL/KSWL
  B7FB  DEFERRED MODE (STATE=4) CSWL/KSWL
  B7FF                (STATE=8) CSWL/KSWL
  B8Ø3                (STATE=C) CSWL

B8Ø5 *********** SYSCTBL **********************************************
           LSB'S OF MLI CALL PARAMETER LISTS IN THE
           BI GLOBAL PAGE ($BEXX)

  B8Ø5  CREATE: $AØ  DESTROY: $AC  RENAME: $AF
  B8Ø8  SFI:    $B4  GFI:     $B4  ONLINE: $C6
  B8ØB  SPFX:   $AC  GPFX:    $AC  OPEN:   $CB
  B8ØE  NEWLINE:$D1  READ:    $D5  WRITE:  $D5
  B811  CLOSE:  $DD  FLUSH:   $DD  SMARK:  $C6
  B814  GMARK:  $C6  SEOF:    $C6  GEOF:   $C6
  B817  SBUF:   $C6  GBUF:    $C6

B819 *********** APPLESOFT TOKENS *************************************
           TOKENS REQUIRING SPECIAL ATTENTION HAVE
           THEIR MSB OFF AND ARE AN OFFSET FROM A
           JMP IN THE TRACE HANDLER IN THE BI

  B819  FIRST IS $8Ø (END)
  B823   CALL
  B833   TRACE, NOTRACE, NORMAL
  B837   INVERSE, FLASH
  B83F   RESUME
  B843   LET, IF
  B853   PRINT, LIST

B859 *********** COMMAND NAME TABLES **********************************
           OFFSETS TO LAST CHARACTER OF EACH COMMAND
           NAME IN THE COMMAND NAME TABLE BELOW.
           COMMANDS ARE ARRANGED ACCORDING TO LENGTH
           WITH THREE BYTE NAMES FIRST.  IF THE MSB
           OF AN INDEX IS ON, THEN THIS IS THE LAST
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B859
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

           NAME OF THE GIVEN LENGTH (NEXT WILL BE
           ONE BYTE LONGER).

  B859  Ø1 IN#       Ø2 PR#       Ø3 CAT
  B85C  Ø4 FRE       Ø5 BYE       Ø6 RUN
  B85F  Ø7 BRUN      Ø8 EXEC      Ø9 LOAD
  B862  ØA LOCK      ØB OPEN      ØC READ
  B865  ØD SAVE      ØE BLOAD     ØF BSAVE
  B868  1Ø CHAIN     11 CLOSE     12 FLUSH
  B86B  13 NOMON     14 STORE     15 WRITE
  B86E  16 APPEND    17 CREATE    18 DELETE
  B871  19 PREFIX    1A RENAME    1B UNLOCK
  B874  1C VERIFY    1D CATALOG   1E RESTORE
  B877  1F POSITION

  B878  'BSAVERIFYBLOADELETEBYECATALOGOPE'
  B898  'NWRITEXECREATEFRESTORENAMEBRUNLO'
  B8B8  'CKCHAIN#FLUSHREADPOSITIONOMONPR#'
  B8D8  'PREFIXCLOSEAPPEND'

B8E9 *********** COMMAND HANDLER ADDRESS TABLE ************************
           ADDRESSES OF THE COMMAND HANDLER ROUTINES
           FOR EACH COMMAND IN THE ORDER GIVEN ABOVE.

  B8E9  (EXTERNAL)
  B8EB  IN#
  B8ED  PR#
  B8EF  CAT
  B8F1  FRE
  B8F3  BYE
  B8F5  RUN
  B8F7  BRUN
  B8F9  EXEC
  B8FB  LOAD
  B8FD  LOCK
  B8FF  OPEN
  B9Ø1  READ
  B9Ø3  SAVE
  B9Ø5  BLOAD
  B9Ø7  BSAVE
  B9Ø9  CHAIN
  B9ØB  CLOSE
  B9ØD  FLUSH
  B9ØF  NOMON
  B911  STORE
  B913  WRITE
  B915  APPEND
  B917  CREATE
  B919  DELETE
  B91B  PREFIX
  B91D  RENAME
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: B91F
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  B91F   UNLOCK
  B921   VERIFY
  B923   CATALOG
  B925   RESTORE
  B927   POSITION
  B929   "-" COMMAND

B92B *********** PERMITTED KEYWORDS FOR CMDS ************************
           TWO BYTES PER COMMAND IN THE ORDER ABOVE.
           EACH ENTRY HAS 16 BIT SETTINGS FOR THE
           PARAMETERS PERMITTED ON THAT COMMAND.
           8000 = FETCH PREFIX, PATHNAME OPTIONAL
           4000 = SLOT (FOR PR# OR IN#)
           2000 = DEFERRED COMMAND ONLY
           1000 = FILENAME IS OPTIONAL
           0800 = IF FILE NOT FOUND, CREATE IT
           0400 = "T" (FILE TYPE) PERMITTED
           0200 = PATHNAME2 (RENAME) PERMITTED
           0100 = PATHNAME1 EXPECTED
           0080 = "A" (ADDRESS) PERMITTED
           0040 = "B" (BYTE) PERMITTED
           0020 = "E" (END ADDRESS) PERMITTED
           0010 = "L" (LENGTH) PERMITTED
           0008 = "@" (LINE NO.) PERMITTED
           0004 = "S" AND/OR "D" (SLOT/DRIVE)
           0002 = "F" (FIELD) PERMITTED
           0001 = "R" (RECORD) PERMITTED
            ("V" IS IGNORED)

        C         P S D F N T P P A B E L @ S F R
        O         F L E N E | A A | | | | | / | |
        M         X O F O W | T T | | | | | D | |
        M         | T E P F | H H | | | | | | | |
        N         | | R T I | 2 1 | | | | | | | |
        D         | | | | L | | | | | | | | | | |

  B92B  IN#       . X . . . . . . X . . . . . . .
  B92D  PR#       . X . . . . . . X . . . . . . .
  B92F  CAT       X . . X . . . X . . . . . X . .
  B931  FRE       . . . . . . . . . . . . . . . .
  B933  BYE       . . . . . . . . . . . . . . . .
  B935  RUN       . . . X . . . X . . . . X X . .
  B937  BRUN      . . . . . . . X X X X X . X . .
  B939  EXEC      . . . . . . . X . . . . . X X X
  B93B  LOAD      . . . . . . . X . . . . . X . .
  B93D  LOCK      . . . . . . . X . . . . . X . .
  B93F  OPEN      . . X . X X . X . . . X . X . .
  B941  READ      . . X . . . . X . X . X . X X X
  B943  SAVE      . . . . X . . X . . . . . X . .
  B945  BLOAD     . . . . . X . X X X X X . X . .
  B947  BSAVE     . . . . X X . X X X X X . X . .
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84    NEXT OBJECT ADDR: B949
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  B949   CHAIN      . . . . . . . X . . . . X X . .
  B94B   CLOSE      . . . . . . . X . . . . . . . .
  B94D   FLUSH      . . . . . . . X . . . . . . . .
  B94F   NOMON      . . . . . . . . . . . . . . . .
  B951   STORE      . . . . X . . X . . . . . X . .
  B953   WRITE      . . X . . . . X . X . . . . X X
  B955   APPEND     . . X . X X . X . . . X . X . .
  B957   CREATE     . . . . X X . X . . . . . X . .
  B959   DELETE     . . . . . . . X . . . . . X . .
  B95B   PREFIX     X . . X . . . X . . . . . X . .
  B95D   RENAME     . . . . . . X X . . . . . X . .
  B95F   UNLOCK     . . . . . . . X . . . . . X . .
  B961   VERIFY     . . . X . . . X . . . . . X . .
  B963   CATALOG    X . . X . X . X . . . . . X . .
  B965   RESTORE    . . . . . . . X . . . . . X . .
  B967   POSITION   . . X . . . . X . . . . . . X X
  B969   "-"        . . . . . . . X . . . . . X . .

B96B *********** KEYWORD NAME TABLE ********************************

  B96B   'ABELSDFRV@'

B975 *********** KEYWORD BIT POSITION TABLE ************************
           BIT POSITIONS IN PERMITTED PARMS TABLE
           FOR EACH KEYWORD IN THE ORDER GIVEN IN
           NAME TABLE.  "V" IS 00 (NOT USED)

  B975   ---

B97F *********** KEYWORD SIZE/OFFSET TABLE *************************
           LOW 2 BITS - SIZE-1 OF VALUE IN BYTES
           HIGH 6 BITS- OFFSET TO LAST BYTE OF VALUE
                        FROM $BE58

  B97F   A: 2 BYTES AT +1
  B980   B: 3 BYTES AT +4
  B981   E: 2 BYTES AT +6
  B982   L: 2 BYTES AT +8
  B983   S: 1 BYTE  AT +9
  B984   D: 1 BYTE  AT +A
  B985   F: 2 BYTES AT +C
  B986   R: 2 BYTES AT +E
  B987   V: 1 BYTE  AT +10   (IGNORED)
  B988   @: 2 BYTES AT +11

B989 *********** FILE TYPES TABLES *********************************
           FILE TYPE CODES, GIVEN IN INVERSE ORDER
           TO FILE TYPE NAMES WHICH FOLLOW.
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: B989
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  B989   $FF = "SYS"
  B98A   $FE = "REL"
  B98B   $FD = "VAR"
  B98C   $FC = "BAS"
  B98D   $FB = "IVR"
  B98E   $FA = "INT"
  B98F   $FØ = "CMD"
  B99Ø   $ØF = "DIR"
  B991   $Ø6 = "BIN"
  B992   $Ø4 = "TXT"
  B993   $EF = "PAS"
  B994   $1A = "AWP"
  B995   $1B = "ASP"
  B996   $19 = "ADB"

  B997   ---
  B997   'ADBASPAWPPASTXTBINDIRCMDINTIVRBASVARRELSYS'

B9C1 *********** MONTH TABLE ******************************************

  B9C1   'JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC'
  B9E5   '<NO DATE>'

B9EE *********** MLIERTBL ***********************************************
         MLI ERROR CODES WHICH HAVE BI EQUIVALENTS

  B9EE   ---

BAØ1 *********** BIERTBL ************************************************
         BI EQUIVALENTS TO MLI ERROR CODES ABOVE
         (IF MLI CODE NOT FOUND, MAPS TO LAST CODE
         IN THIS TABLE, $Ø8 "I/O ERRROR")

  BAØ1   ---

BA15 *********** INDEXS TO PACKED MESSAGES ****************************
         BY BI ERROR NUMBER

  BA15   ---

BA29 *********** COMMON LETTERS IN MESSAGES ***************************

  BA29   ---
  BA29   'ACDEFILMNORTU '
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: BA38
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

BA38 *********** LESS COMMON LETTERS **********************************

  BA38   ---
  BA39   'BGHKPSVWXY/().:'

BA48 *********** PACKED MESSAGES **************************************

  BA48    "COPYRIGHT APPLE COMPUTER"

  BA58   " NAME "
  BA5B   TAB($1Ø)
  BA5D   "TYPE  BLOCKS "
  BA66   TAB($1E)
  BA68   "MODIFIED"
  BA6C   TAB($2F)
  BA6E   "CREATED "
  BA72   TAB($4Ø)
  BA74   "ENDFILE SUBTYPE"

  BA7E   "BLOCKS FREE:"
  BA86   TAB($16)
  BA88   "BLOCKS USED:"
  BA91   TAB($2C)
  BA93   "TOTAL BLOCKS:"

  BA9C   "RANGE ERROR"                         ERROR=$2

  BAA3   "NO DEVICE CONNECTED"                 ERROR=$3

  BAAE   "WRITE PROTECTED"                     ERROR=$4

  BAB7   "END OF DATA"                         ERROR=$5

  BABD   "PATH NOT FOUND"                   ERROR=$6,$7
  BACØ

  BAC6   "I/O ERROR"                           ERROR=$8

  BACC   "DISK FULL"                           ERROR=$9

  BAD2   "FILE LOCKED"                         ERROR=$A

  BAD9   "INVALID PARAMETER"                   ERROR=$B

  BAE3   "RAM TOO LARGE"                       ERROR=$C

  BAFØ   "FILE TYPE MISMATCH"                  ERROR=$D
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: BAF8
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  BAFC   "PROGRAM TOO LARGE"             ERROR=$E

  BBØ7   "NOT DIRECT COMMAND"            ERROR=$F

  BB11   "SYNTAX ERROR"                  ERROR=$1Ø

  BB19   "DIRECTORY FULL"                ERROR=$11

  BB21   "FILE NOT OPEN"                 ERROR=$12

  BB29   "DUPLICATE FILE NAME"           ERROR=$13

  BB34   "FILE BUSY"                     ERROR=$14

  BB3B   "FILE(S) STILL OPEN"            ERROR=$15

BB47 *********** VARIABLES ********************************************

  BB47   NUMBER OF PAGES TO ALLOCATE/FREE
  BB48   NOT USED
  BB49   TOP OF BUFFERS FOR GARBAGE COLLECTION
  BB4A   BOTTOM OF BUFFERS

BB4B *********** $BB4B-$BC7A NOT USED *********************************

  BB4B   NOT USED

BC7B *********** VARIABLES ********************************************

  BC7B   SAVED HIMEM VALUE DURING CHAIN LOAD
           ******** GARBAGE COLLECT MARKED GC: ****
  BC7C   GC: HIRANGE - WORKSAREASIZE
  BC7D   GC: WORKAREA MSB
  BC7E   GC: NUMBER OF PAGES IN WORKAREA
  BC7F   GC: LORANGE (START OF STRINGS TO COPY)
  BC8Ø   GC: HIRANGE (END OF STRINGS TO COPY)
  BC81   ARRAYS START LSB
  BC82   ARRAYS ENDING MSB+1
  BC83   GC: START OF STRING AREA (ALSO PGM START)
  BC85   GC: END OF STRING AREA
  BC87   MSB ADJUST FACTOR FOR STRING POINTERS
  BC88   PAGE FOLLOWING BLOCK BUFFER
           ******** STORED VARIABLES FILE HEADER ***
  BC89   COMBINED LEN OF SIMPLE/ARRAY VARS
  BC8B   LEN OF SIMPLE VARS ONLY
  BC8D   HIMEM WHEN VARS WERE COMBINED
           ******************************************
  BC8E   POINTER TO COMBINED VARIABLES/STRINGS
  BC9Ø   LENGTH OF COMBINED VARIABLES/STRINGS
  BC92   LENGTH OF STRINGS ONLY
```

```
BASIC Interpreter (BI) -- V1.1.1 -- 18 JUN 84   NEXT OBJECT ADDR: BC92
-----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  BC94   OPEN FILES' BUFFER MSBS
  BC9B   OPEN EXEC FILE BUFFER MSB

  BC9C   OPEN FILES' REFERENCE NUMBERS
  BCA3   OPEN EXEC FILE REFNUM

  BCA4   CURRENT RECORD LENGTH
  BCA6   NOT USED
  BCA9   CHARACTER TO FLUSH WHEN PARSING (BLANK)
  BCAA   MAXIMUM LENGTH TO PARSE
  BCAB   ADDRESS OF COMMAND HANDLING ROUTINE
  BCAD   SIZE OF KEYWORD VALUE -1 IN BYTES
  BCAE   OFFSET INTO KEYWORD PARMS TO LAST BYTE
  BCAF   GENERAL PURPOSE 4 BYTE ACCUMULATOR
  BCB3   MONTH
  BCB4   DAY
  BCB5   YEAR
  BCB6   ERROR MSG LEN OR LINE LEN FOR CAT/CATALOG
  BCB7   ENTRY LENGTH IN DIRECTORY FILE
  BCB8   ENTRIES PER BLOCK IN DIRECTORY FILE
  BCB9   FILE COUNT FROM DIRECTORY FILE
  BCBB   DIRECTORY ENTRY NUMBER COUNTER

BCBC *********** PATHNAME 1 BUFFER ************************************

  BCBC   COMMAND OR PATH LENGTH
  BCBD   TXBUF (COMMAND OR PATHNAME STRING)
  BCFD   NOT USED

BCFE *********** OPEN FILE NAME TABLE *********************************
              (EACH ENTRY IS 32 BYTES LONG)
              (THERE ARE 8 ENTRIES)

  BCFE   FILE Ø: LENGTH OF NAME
  BCFF   FILE Ø: L VALUE LSB
  BDØØ   FILE Ø: L VALUE MSB
  BDØ1   FILE Ø: START OF NAME STRING
           (FILE NAME IS STORED BACKWARDS)
  BDFE   LAST 2 BYTES NOT USED
```

BASIC INTERPRETER GLOBAL PAGE

This page of memory is rigidly defined by the ProDOS BI. Fields given here will not move in later versions of ProDOS and may be referenced by external, user-written programs. Future additions to the global page may be made in areas which are marked "Not used".

```
ProDOS BI Global Page                  NEXT OBJECT ADDRESS: BEØØ
---------------------------------------------------------------
ADDR        LABEL        CONTENTS
---------------------------------------------------------------

BEØØ-BEØ2   BI.ENTRY     JMP to WARMDOS (BI warmstart vector).
BEØ3-BEØ5   DOSCMD       JMP to SYNTAX (BI command line parse and
                         execute).
BEØ6-BEØ8   EXTRNCMD     JMP to user-installed external command
                         parser.
BEØ9-BEØB   ERROUT       JMP to BI error handler.
BEØC-BEØE   PRINTERR     JMP to BI error message print routine.
                         Place error number in A-register.
BEØF        ERRCODE      ProDOS error code (also at $DE, Applesoft
                         ONERR code).
BE1Ø-BE1F   OUTVEC       Default output vector in monitor and for
                         each slot (1-7).
BE2Ø-BE2F   INVEC        Default input vector in monitor for each
                         slot (1-7).
BE3Ø-BE31   VECTOUT      Current output vector.
BE32-BE33   VECTIN       Current input vector.
BE34-BE35   VDOSIO       BI's output intercept address.
BE36-BE37                BI's input intercept address.
BE38-BE3B   VSYSIO       BI's internal redirection by STATE.
BE3C        DEFSLT       Default slot.
BE3D        DEFDRV       Default drive.
BE3E        PREGA        A-register savearea.
BE3F        PREGX        X-register savearea.
BE4Ø        PREGY        Y-register savearea.
BE41        DTRACE       Applesoft TRACE is enabled flag (MSB on).
BE42        STATE        Current intercept state. Ø = immediate
                         command mode. >Ø = deferred.
BE43        EXACTV       EXEC file active flag (MSB on).
BE44        IFILACTV     READ file active flag (MSB on).
BE45        OFILACTV     WRITE file active flag (MSB on).
BE46        PFXACTV      PREFIX read active flag (MSB on).
BE47        DIRFLG       File being READ is a DIR file (MSB on).
BE48        EDIRFLG      End of directory flag (no longer used).
BE49        STRINGS      String space count used to determine when
                         to garbage collect.
BE4A        TBUFPTR      Buffered WRITE data length.
BE4B        INPTR        Command line assembly length.
BE4C        CHRLAST      Previous output character (for recursion
                         check).
BE4D        OPENCNT      Number of files open (not counting EXEC).
BE4E        YXFILE       EXEC file being closed flag (MSB on).
BE4F        CATFLAG      Line type to format next in DIR file
                         READ.
BE5Ø-BE51   XTRNADDR     External command handler address.
BE52        XLEN         Length of command name (less one).
```

```
ProDOS BI Global Page                 NEXT OBJECT ADDRESS: BE53
-----------------------------------------------------------------
ADDR         LABEL        CONTENTS
-----------------------------------------------------------------

BE53         XCNUM          Number of command:
                       $ØØ = external   $ØA = OPEN       $14 = WRITE
                       $Ø1 = IN#        $ØB = READ       $15 = APPEND
                       $Ø2 = PR#        $ØC = SAVE       $16 = CREATE
                       $Ø3 = CAT        $ØD = BLOAD      $17 = DELETE
                       $Ø4 = FRE        $ØE = BSAVE      $18 = PREFIX
                       $Ø5 = RUN        $ØF = CHAIN      $19 = RENAME
                       $Ø6 = BRUN       $1Ø = CLOSE      $1A = UNLOCK
                       $Ø7 = EXEC       $11 = FLUSH      $1B = VERIFY
                       $Ø8 = LOAD       $12 = NOMON      $1C = CATALOG
                       $Ø9 = SAVE       $13 = STORE      $1D = RESTORE
                                                         $1E = POSITION

BE54-BE55    PBITS          Permitted command operands bits:
                       $8ØØØ  Prefix needed. Pathname optional.
                       $4ØØØ  Slot number only (PR# or IN#).
                       $2ØØØ  Deferred command.
                       $1ØØØ  File name optional.
                       $Ø8ØØ  If file does not exist, create it.
                       $Ø4ØØ  T: file type permitted.
                       $Ø2ØØ  Second file name required.
                       $Ø1ØØ  First file name required.
                       $ØØ8Ø  AD: address keyword permitted.
                       $ØØ4Ø  B: byte offset permitted.
                       $ØØ2Ø  E: ending address permitted.
                       $ØØ1Ø  L: length permitted.
                       $ØØØ8  @: line number permitted.
                       $ØØØ4  S or D: slot/drive permitted.
                       $ØØØ2  F: field permitted.
                       $ØØØ1  R: record permitted.
                       (V always permitted but ignored.)

BE56-BE57    FBITS        Operands found on command line. Same bit
                          assignments as above.
BE58-BE59    VADDR        A keyword value.
BE5A-BE5C    VBYTE        B keyword value.
BE5D-BE5E    VENDA        E keyword value.
BE5F-BE6Ø    VLNTH        L keyword value.
BE61         VSLOT        S keyword value.
BE62         VDRIV        D keyword value.
BE63-BE64    VFELD        F keyword value.
BE65-BE66    VRECD        R keyword value.
BE67         VVOLM        V keyword value (ignored).
BE68-BE69    VLINE        @ keyword value.
BE6A         VTYPE        T keyword value (in hex).
BE6B         VIOSLT       PR# or IN# slot number value.
```

```
ProDOS BI Global Page                 NEXT OBJECT ADDRESS: BE6C
-----------------------------------------------------------------
ADDR         LABEL        CONTENTS
-----------------------------------------------------------------

BE6C-BE6D    VPATH1       Primary pathname buffer (address of
                          length byte).
BE6E-BE6F    VPATH2       Secondary pathname buffer (address of
                          length byte).
BE7Ø-BE84    GOSYSTEM     Call the MLI using the parameter tables
                          which follow.
BE85         SYSCALL      MLI call number for this call.
BE86-BE87    SYSPARM      Address of MLI parameter list for this
                          call.
BE88-BE8A                 Return from MLI call.
BE8B-BE9E    BADCALL      MLI error return: translate error code to
                          BI error number.
BE9F         BISPARE1     Not used.
BEAØ-BEAB    SCREATE      CREATE parameter list.
BEAC-BEAE    SSGPRFX      GET_PREFIX, SET_PREFIX, DESTROY parameter
                          list.
BEAF-BEB3    SRENAME      RENAME parameter list.
BEB4-BEC5    SSGINFO      GET_FILE_INFO, SET_FILE_INFO parameter
                          list.
BEC6-BECA    SONLINE      ONLINE, SET_MARK, GET_MARK, SET_EOF,
                          GET_EOF, SET_BUF, GET_BUF, QUIT parameter
                          list.
BECB-BEDØ    SOPEN        OPEN parameter list.
BED1-BED4    SNEWLN       SET_NEWLINE parameter list.
BED5-BEDC    SREAD        READ, WRITE parameter list.
BEDD-BEDE    SCLOSE       CLOSE, FLUSH parameter list.
BEDF-BEF4    CCCSPARE     "COPYRIGHT APPLE, 1983"
BEF5-BEF7    GETBUFR      GETBUFR buffer allocation subroutine
                          vector.
BEF8-BEFA    FREEBUFR     FREEBUFR buffer free subroutine vector.
BEFB                      Original HIMEM MSB.
BEFC-BEFF                 Not used.
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C600
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

C600    MODULE STARTING ADDRESS

          *****************************************
          *                                       *
          *  BOOT ROM - APPLE DISK CONTROLLER     *
          *        FOR APPLE II, II+, AND IIe.    *
          *        THIS CODE RESIDES FROM $C600   *
          *        TO $C6FF, IT LOADS TRACK 0     *
          *        SECTOR 0 INTO RAM AT $800 AND  *
          *        JUMPS TO IT                    *
          *                                       *
          *****************************************

          ******** ZERO PAGE ADDRESSES ************

0026    SECTOR BUFFER POINTER
002B    SLOT NUMBER * 16 FOR INDEX
003C    WORKBYTE
003D    SECTOR WANTED
0040    TRACK FOUND
0041    TRACK WANTED

          ******** EXTERNAL ADDRESSES *************

0100    SYSTEM STACK
0300    AUXILIARY BUFFER
0356    TRANSLATE TABLE
0800    SECTORS TO LOAD
0801    ENTRY POINT
C080    PHASE0 OFF
C081    PHASE0 ON
C089    MOTOR ON
C08A    DRIVE SELECT
C08C    READ DATA REGISTER
C08E    SET READ MODE
FCA8    MONITOR WAIT ROUTINE
FF58    RTS

C600 *********** BUILD READ TRANSLATE TABLE **************************

  C600  SIGNATURE
  C602  INITIALIZE TABLE VALUE INDICATOR
  C606  STORE BIT PATTERN
  C609  SHIFT PATTERN LEFT ONE BIT
  C60A  ARE THERE ANY TWO ADJACENT BITS ON?
  C60C  NO, TRY ANOTHER PATTERN  >>C61E
  C60E  YES, TURN OFF RIGHTMOST OF EACH GROUP OF ZEROES
  C610  FLIP BITS, PAIR OF ZERO BITS NOW SINGLE ONE BIT
  C612  HIGH BIT ALWAYS ON/TURN OFF BIT WE MISSED BEFORE
  C614  --- >>C61E
  C616  SHIFT PATTERN RIGHT, MUST HAVE ONLY ONE BIT ON
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C617
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  C617  IF MORE THAN ONE BIT ON, TRY ANOTHER PATTERN  >>C614
  C619  FOUND ONE, GET TABLE VALUE
  C61A  AND STORE IT IN TABLE  (0356)
  C61D  INCREMENT TABLE VALUE INDICATOR
  C61E  GET NEXT BIT PATTERN, DONE YET
  C61F  NO, GO CHECK IT OUT  >>C606

C621 *********** DETERMINE SLOT, TURN DRIVE ON **********************

  C621  CALL A KNOWN RTS  <FF58>
  C624  GET STACK POINTER
  C625  GET HIGH BYTE OF WHERE WE ARE  (0100)
  C628  TIMES 16 TO GET SLOT
  C62C  SAVE SLOT
  C62E  PUT IN X REG FOR INDEX
  C62F  INSURE READ MODE  (C08E)
  C635  SELECT DRIVE 1  (C08A)
  C638  TURN THE MOTOR ON  (C089)

C63B *********** RECALIBRATE DISK ARM *******************************

  C63B  PREPAIR TO STEP THE ARM 80 PHASES
  C63D  TURN A PHASE OFF  (C080)
  C640  PUT COUNTER IN ACCUMULATOR
  C641  CREATE A PHASE NUMBER (0-3)
  C643  DOUBLE IT FOR PROPER INDEX
  C644  COMBINE WITH SLOT FOR FINAL INDEX
  C646  PUT INDEX IN X REGISTER
  C647  TURN A PHASE ON  (C081)
  C64A  DELAY ABOUT 20 MICROSECONDS
  C64F  DECREMENT COUNTER
  C650  LOOP UNTIL ALL 80 ARE DONE  >>C63D

C652 *********** INITIALIZATION *************************************

  C652  ---
  C654  SECTOR TO FIND -> $00
  C656  TRACK TO FIND -> $00
  C65A  MAIN BUFFER POINTER ($26) -> $0800
  C65C  CLEAR THE CARRY
  C65D  PUSH STATUS ON STACK

C65E *********** SEARCH FOR A VALID HEADER **************************

  C65E  CHECK DATA REGISTER  (C08C)
  C661  LOOP UNTIL DATA IS VALID  >>C65E
  C663  IS IT A $D5?
  C665  NO, TRY AGAIN  >>C65E
  C667  YES, CHECK REGISTER AGAIN  (C08C)
  C66A  LOOP UNTIL VALID  >>C667
  C66C  IS IT AN $AA
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C66E
----------------------------------------------------------------------
ADDR   DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 C66E  NO, SEE IF ITS A $D5  >>C663
 C67Ø  YES, DELAY FOR REGISTER TO CLEAR
 C671  CHECK REGISTER  (CØ8C)
 C674  LOOP UNTIL VALID  >>C671
 C676  IS IT A $96
 C678  YES, WE FOUND AN ADDRESS HEADER  >>C683
 C67A  NO, HAVE WE FOUND ONE PREVIOUSLY?
 C67B  IF NOT, START OVER  >>C65C
 C67D  WAS IT AN $AD?
 C67F  YES, WE FOUND A DATA HEADER  >>C6A6
 C681  NO, START OVER  >>C65C

C683 *********** DECODE ADDRESS FIELD ********************************

 C683  INITIALIZE COUNTER
 C685  SAVE VALUE DECODED, WILL BE TRACK ON LAST PASS
 C687  READ DATA REGISTER  (CØ8C)
 C68A  LOOP UNTIL DATA VALID  >>C687
 C68C  SHIFT BITS INTO POSITION X1X1X1X1
 C68D  SAVE FOR LATER
 C68F  READ REGISTER FOR NEXT BYTE  (CØ8C)
 C692  LOOP UNTIL VALID  >>C68F
 C694  COMBINE WITH PREVIOUS 1X1X1X1X AND X1X1X1X1
 C696  DECREMENT COUNTER, DONE YET?
 C697  NO, DO ANOTHER  >>C685
 C699  KEEP THE STACK CLEAN
 C69A  IS THIS SECTOR WE WANT?
 C69C  NO, START OVER  >>C65C
 C69E  GET TRACK FOUND
 C6AØ  IS IT TRACK WE WANT?
 C6A2  NO, START OVER  >>C65C
 C6A4  YES, INDICATE ADDRESS FOUND, GO LOOK FOR DATA FIELD  >>C65D

C6A6 *********** READ DATA FIELD *************************************

 C6A6  INITIALIZE OFFSET (AUXILIARY BUFFER)
 C6A8  ---
 C6AA  READ DATA REGISTER  (CØ8C)
 C6AD  LOOP UNTIL VALID  >>C6AA
 C6AF  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
 C6B4  DECREMENT OFFSET
 C6B5  STORE BYTE IN AUXILIARY BUFFER  (Ø3ØØ)
 C6B8  LOOP UNTIL BUFFER FULL  >>C6A8
 C6BA  INITIALIZE OFFSET (MAIN BUFFER)
 C6BC  READ DATA REGISTER  (CØ8C)
 C6BF  LOOP UNTIL VALID  >>C6BC
 C6C1  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
 C6C6  STORE BYTE IN MAIN BUFFER
 C6C8  INCREMENT OFFSET
 C6C9  LOOP UNTIL BUFFER FULL  >>C6BA
 C6CB  READ DATA REGISTER  (CØ8C)
```

```
Disk Controller Boot ROM -- Apple II/II+/IIe    NEXT OBJECT ADDR: C6CE
----------------------------------------------------------------------
ADDR   DESCRIPTION/CONTENTS
----------------------------------------------------------------------

 C6CE  LOOP UNTIL VALID  >>C6CB
 C6DØ  IS CHECKSUM OKAY?  (Ø2D6)
 C6D3  NO, START OVER  >>C65C

C6D5 *********** MERGE MAIN AND AUXILIARY BUFFERS********************

 C6D5  INITIALIZE OFFSET (MAIN BUFFER)
 C6D7  INITIALIZE OFFSET (AUXILIARY BUFFER)
 C6D9  DECREMENT OFFSET (AUX BUFFER)
 C6DA  IF LESS THAN ZERO RESET IT  >>C6D7
 C6DC  GET BYTE FROM MAIN BUFFER
 C6E1  ROLL IN TWO BITS FROM AUXILIARY BUFFER
 C6E6  SAVE COMPLETED DATA BYTE
 C6E8  INCREMENT OFFSET (MAIN BUFFER)
 C6E9  LOOP UNTIL WHOLE BUFFER IS DONE  >>C6D9

C6EB *********** DETERMINE IF THERE IS MORE TO DO********************

 C6EB  INCREMENT MAIN BUFFER POINTER
 C6ED  INCREMENT SECTOR NUMBER
 C6F1  IS THERE ANOTHER SECTOR TO LOAD?  (Ø8ØØ)
 C6F6  YES, GO DO IT  >>C6D3
 C6F8  NO, ENTER CODE WE JUST LOADED  >>Ø8Ø1

C6FB *********** UNUSED **********************************************

 C6FB  5 BYTES AT END OF PAGE ARE UNUSED
```

```
Disk Controller Boot ROM -- Apple IIc            NEXT OBJECT ADDR: C552
------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------

C552     MODULE STARTING ADDRESS

          ****************************************
          *                                      *
          *  BOOT ROM - APPLE //c CONTROLLER ROM *
          *       THIS CODE RESIDES FROM $C552   *
          *       TO $C6FF. IT LOADS TRACK Ø     *
          *       SECTOR Ø INTO RAM AT $8ØØ AND  *
          *       JUMPS TO IT.  IF BOOT FAILS IT *
          *       THEN TRIES TO BOOT SLOT 5,     *
          *       THE PROTOCOL CONVERTER.        *
          *                                      *
          *  THIS IS THE VERSION OF THE IIC ROM  *
          *    THAT SUPPORTS THE UNIDISK 3.5,    *
          *    26 JULY 85.                       *
          *                                      *
          ****************************************

          ******** ZERO PAGE ADDRESSES ************

ØØØ1     SLOT PAGE PUT HERE DURING AUTOBOOT
ØØØ3     RETRY COUNT (HIGH BYTE)
ØØ26     SECTOR BUFFER POINTER
ØØ2B     SLOT NUMBER * 16 FOR INDEX
ØØ3C     WORKBYTE
ØØ3D     SECTOR WANTED
ØØ4Ø     TRACK FOUND
ØØ41     TRACK WANTED
ØØ4F     DRIVE TO BOOT FROM

          ******** EXTERNAL ADDRESSES *************

Ø3ØØ     AUXILIARY BUFFER
Ø356     TRANSLATE TABLE
Ø7DB     SCREEN LOCATION
Ø8ØØ     SECTORS TO LOAD
Ø8Ø1     ENTRY POINT
CØ8Ø     PHASEØ OFF
CØ81     PHASEØ ON
CØ88     MOTOR OFF
CØ89     MOTOR ON
CØ8C     READ DATA REGISTER
CØ8E     SET READ MODE
CØEA     DRIVE SELECT
FCA8     MONITOR WAIT ROUTINE
```

```
Disk Controller Boot ROM -- Apple IIc                  NEXT OBJECT ADDR: C552
------------------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
------------------------------------------------------------------------------

C552 *********** SLOT5 CODE ******************************************

              THE FOLLOWING TWO ROUTINES ARE IN THE $C5ØØ
              AREA BUT ARE USED BY THE $C6ØØ LOGIC.

C552 *********** BOOTFAIL ********************************************
              COME HERE IF BOOT FAILS.  PUT MESSAGE ON
              SCREEN AND GO TO SLEEP FOREVER.

  C552  17 CHARACTERS IN MESSAGE
  C557  PUT AT BOTTOM OF SCREEN (Ø7DB)
  C55D  THEN GO TO SLEEP >>C55D

  C55F  'Check Disk Drive'

C56F *********** SKIP OVER MISCELLANEOUS CODE ************************

  C56F  SLOT 5 LOGIC IN HERE

C58E *********** BUILD READ TRANSLATE TABLE **************************

  C58E  INITIALIZE BIT PATTERN
  C59Ø  INITIALIZE TABLE VALUE INDICATOR
  C592  STORE BIT PATTERN
  C595  SHIFT PATTERN LEFT ONE BIT
  C596  ARE THERE ANY TWO ADJACENT BITS ON?
  C598  NO, TRY ANOTHER PATTERN  >>C5AA
  C59A  YES, TURN OFF RIGHTMOST OF EACH GROUP OF ZEROES
  C59C  FLIP BITS, PAIR OF ZERO BITS NOW SINGLE BIT, ETC
  C59E  HIGH BIT ALWAYS ON/TURN OFF BIT WE MISSED BEFORE
  C5AØ  --- >>C5AA
  C5A2  SHIFT PATTERN RIGHT, MUST HAVE ONLY ONE BIT ON
  C5A3  IF MORE THAN ONE BIT ON, TRY ANOTHER PATTERN  >>C5AØ
  C5A5  FOUND ONE, GET TABLE VALUE
  C5A6  AND STORE IT IN TABLE  (Ø356)
  C5A9  INCREMENT TABLE VALUE INDICATOR
  C5AA  GET NEXT BIT PATTERN, DONE YET?
  C5AB  NO, GO CHECK IT OUT  >>C592
  C5AD  MAIN BUFFER POINTER ($26) -> $Ø8ØØ
  C5B1  INITIALIZE RETRY COUNT (LOW BYTE)
  C5B3  RETURN TO CALLER

C5B4 *********** SKIP OVER MISCELLANEOUS CODE ************************

  C5B4  SLOT 5 LOGIC IN HERE
```

```
Disk Controller Boot ROM -- Apple IIc           NEXT OBJECT ADDR: C5F5
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

C5F5 *********** JUMP TO BOOTFAIL ***********************************

  C5F5  BRANCH TO BOOTFAIL >>C552

  C5F8  REMAINING 8 BYTES NOT USED BY DISK II >>C576

C600 *********** INITIALIZATION *************************************

  C600  SIGNATURE
  C602  SET DRIVE -> 1
  C604  INITIALIZE RETRY COUNT (HIGH BYTE)

C608 *********** SELECT DRIVE AND TURN IT ON ************************

  C608  ---
  C60B  INITIALIZE SLOT (6)
  C60D  INITIALIZE DEVICE (1 OR 2)
  C60F  SAVE DRIVE NUMBER ON STACK
  C610  INSURE READ MODE  (C08E)
  C616  GET DRIVE NUMBER BACK
  C617  SELECT APPROPRIATE DRIVE   (C0EA)
  C61A  TURN MOTOR ON   (C089)

C61D *********** RECALIBRATE DISK ARM *******************************

  C61D  PREPAIR TO STEP THE ARM 80 PHASES
  C61F  TURN A PHASE OFF   (C080)
  C622  PUT COUNTER IN A REGISTER
  C623  CREATE A PHASE NUMBER (0-3)
  C625  DOUBLE IT FOR PROPER INDEX
  C626  COMBINE WITH SLOT FOR FINAL INDEX
  C628  PUT INDEX IN X REGISTER
  C629  TURN A PHASE ON   (C081)
  C62C  DELAY ABOUT 20 MICROSECONDS
  C631  DECREMENT COUNTER
  C632  LOOP UNTIL ALL 80 ARE DONE   >>C61F

C634 *********** INITIALIZATION *************************************

  C634  ---
  C636  SECTOR TO FIND -> $00
  C638  TRACK TO FIND -> $00
  C63A  BUILD THE TRANSLATE TABLE   <C58E>

C63D *********** COUNT RETRIES AND INDICATE ERROR IF BOOT FAILS*******

  C63D  INITIALIZE RETRY COUNT
  C63F  CLEAR THE CARRY
  C640  PUSH STATUS ON STACK
  C641  KEEP STACK CLEAN
  C642  GET SLOT
```

```
Disk Controller Boot ROM -- Apple IIc           NEXT OBJECT ADDR: C644
-----------------------------------------------------------------------
ADDR    DESCRIPTION/CONTENTS
-----------------------------------------------------------------------

  C644  DECREMEMT RETRY COUNT, TRY AGAIN?
  C646  YES, GO DO IT   >>C656
  C648  NO, TURN DRIVE OFF   (C088)
  C64B  AUTO BOOT FROM SLOT6?
  C64F  NO, FAIL NOW >>C5F5
  C651  MAYBE SLOT 5 WILL TALK TO US >>C500
  C654  TWO BYTES NOT USED >>0002
  C656  ---
  C657  DECREMENT RETRY COUNT (LOW BYTE)
  C658  IF NOT ZERO, TRY AGAIN   >>C65E
  C65A  IF SO, GO DECREMENT RETRY COUNT (HIGH BYTE)   >>C641
  C65C  SPACE FILLER TO POSITION CODE BELOW   >>C63D

C65E *********** SEARCH FOR A VALID HEADER **************************

  C65E  CHECK DATA REGISTER   (C08C)
  C661  LOOP UNTIL DATA IS VALID   >>C65E
  C663  IS IT A $D5?
  C665  NO, TRY AGAIN   >>C657
  C667  YES, CHECK REGISTER AGAIN    (C08C)
  C66A  LOOP UNTIL VALID   >>C667
  C66C  IS IT AN $AA
  C66E  NO, SEE IF ITS A $D5   >>C663
  C670  YES, DELAY FOR REGISTER TO CLEAR
  C671  CHECK REGISTER   (C08C)
  C674  LOOP UNTIL VALID   >>C671
  C676  IS IT A $96
  C678  YES, WE FOUND AN ADDRESS HEADER   >>C683
  C67A  NO, HAVE WE FOUND ONE PREVIOUSLY?
  C67B  IF NOT, START OVER   >>C63F
  C67D  WAS IT AN $AD?
  C67F  YES, WE FOUND A DATA HEADER   >>C6A6
  C681  NO, START OVER   >>C63F

C683 *********** DECODE ADDRESS FIELD *******************************

  C683  INITIALIZE COUNTER
  C685  SAVE VALUE DECODED, WILL BE TRACK ON LAST PASS
  C687  READ DATA REGISTER   (C08C)
  C68A  LOOP UNTIL DATA VALID   >>C687
  C68C  SHIFT BITS INTO POSITION X1X1X1X1
  C68D  SAVE FOR LATER
  C68F  READ REGISTER FOR NEXT BYTE   (C08C)
  C692  LOOP UNTIL VALID   >>C68F
  C694  COMBINE WITH PREVIOUS 1X1X1X1X AND X1X1X1X1
  C696  DECREMENT COUNTER, DONE YET?
  C697  NO, DO ANOTHER   >>C685
  C699  KEEP THE STACK CLEAN
  C69A  IS THIS SECTOR WE WANT?
  C69C  NO, START OVER   >>C63F
  C69E  GET TRACK FOUND
```

```
Disk Controller Boot ROM -- Apple IIc           NEXT OBJECT ADDR: C6AØ
----------------------------------------------------------------------
ADDR     DESCRIPTION/CONTENTS
----------------------------------------------------------------------

  C6AØ  IS IT TRACK WE WANT?
  C6A2  NO, START OVER  >>C63F
  C6A4  YES, INDICATE ADDRESS FOUND, GO LOOK FOR DATA FIELD  >>C642

C6A6 *********** READ DATA FIELD ************************************

  C6A6  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6A8  ---
  C6AA  READ DATA REGISTER  (CØ8C)
  C6AD  LOOP UNTIL VALID  >>C6AA
  C6AF  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
  C6B4  DECREMENT OFFSET
  C6B5  STORE BYTE IN AUXILIARY BUFFER  (Ø3ØØ)
  C6B8  LOOP UNTIL BUFFER FULL  >>C6A8
  C6BA  INITIALIZE OFFSET (MAIN BUFFER)
  C6BC  READ DATA REGISTER  (CØ8C)
  C6BF  LOOP UNTIL VALID  >>C6BC
  C6C1  EXCLUSIVE-OR WITH TRANSLATE TABLE  (Ø2D6)
  C6C6  STORE BYTE IN MAIN BUFFER
  C6C8  INCREMENT OFFSET
  C6C9  LOOP UNTIL BUFFER FULL  >>C6BA
  C6CB  READ DATA REGISTER  (CØ8C)
  C6CE  LOOP UNTIL VALID  >>C6CB
  C6DØ  IS CHECKSUM OKAY?  (Ø2D6)
  C6D3  NO, START OVER  >>C6A2

C6D5 *********** MERGE MAIN AND AUXILIARY BUFFERS********************

  C6D5  INITIALIZE OFFSET (MAIN BUFFER)
  C6D7  INITIALIZE OFFSET (AUXILIARY BUFFER)
  C6D9  DECREMENT OFFSET (AUX BUFFER)
  C6DA  IF LESS THAN ZERO RESET IT  >>C6D7
  C6DC  GET BYTE FROM MAIN BUFFER
  C6E1  ROLL IN TWO BITS FROM AUXILIARY BUFFER
  C6E6  SAVE COMPLETED DATA BYTE
  C6E8  INCREMENT OFFSET (MAIN BUFFER)
  C6E9  LOOP UNTIL WHOLE BUFFER IS DONE  >>C6D9

C6EB *********** DETERMINE IF THERE IS MORE TO DO********************

  C6EB  INCREMENT MAIN BUFFER POINTER
  C6ED  INCREMENT SECTOR NUMBER
  C6F1  IS THERE ANOTHER SECTOR TO LOAD?  (Ø8ØØ)
  C6F6  YES, GO DO IT  >>C6D3
  C6F8  NO, ENTER CODE WE JUST LOADED  >>Ø8Ø1

  C6FB  5 ZERO BYTES AT END OF PAGE
```

ERRATA TO BENEATH APPLE PRODOS (1st Printing, 1984)

You can identify which printing of Beneath Apple ProDOS you have by looking at the space between the title of the book and the author's names on the first page of the book (the title page). If this space is blank, you have the first printing. The second printing has "Second Printing, March 1985" in this space. If you have the second printing, skip to page 12Ø. If you have the first printing, all of the following errata apply.

Page 3-16:

In the first paragraph starting on the page, the sentence should read "The data is dealt with in larger pieces (512 **bytes** vs. 256 **bytes**)...", not **512K** vs. **256K**.

Page 6-63:

The code for "HOW MUCH MEMORY IS IN THIS MACHINE?" is incorrect. Replace it with:

```
        LDA    $BF98       GET MACHID FROM GLOBAL PAGE
        ASL    A           MOVE BITS TO TEST POSITION
        ASL    A
        BPL    SMLMEM      48K
        ASL    A
        BVS    MEM128      128K
        ...                OTHERWISE 64K
```

Page 6-64:

The code for "GIVEN A PAGE NUMBER, SEE IF IT IS FREE" is incorrect. Replace it with:

```
BITMAP  EQU    $BF58       SEE PAGE 8-6
        LDA    #PAGE       GET PAGE NUMBER (MSB OF ADDR)
        JSR    LOCATE      LOCATE ITS BIT IN BITMAP
        AND    BITMAP,Y    IS IT ALLOCATED?
        BNE    INUSE       YES, CAN'T TOUCH IT
        TXA                PUT BIT PATTERN IN ACCUM
        ORA    BITMAP,Y    MARK THIS PAGE AS IN USE
        STA    BITMAP,Y    UPDATE MAP
        ...                WE'VE GOT IT NOW
```

```
LOCATE   PHA                      SAVE PAGE NUMBER
         AND    #Ø7               ISOLATE BIT POSITION
         TAY                      THIS IS INDEX INTO MASK TABLE
         LDX    BITMASK,Y         PUT PROPER BIT PATTERN IN X
         PLA                      RESTORE PAGE NUMBER
         LSR    A                 DIVIDE PAGE BY 8
         LSR    A
         LSR    A
         TAY                      Y-REG IS OFFSET INTO BITMAP
         TXA                      PUT BIT PATTERN IN ACCUM
         RTS                      DONE

BITMASK  DFB    $8Ø,$4Ø,$2Ø,$1Ø  BIT MASK PATTERNS
         DFB    $Ø8,$Ø4,$Ø2,$Ø1
```

Page 7-9

The code on page 7-9 is incorrect and should be replaced with the following:

```
*        SQUISH OUT DEVICE NUMBER FROM DEVLST
         SKP 1
         LDX    $BF31           GET DEVCNT
DEVLP    LDA    $BF32,X         PICK UP LAST DEVICE NUM
         AND    #$7Ø            ISOLATE SLOT
         CMP    #$3Ø            SLOT = 3?
         BEQ    GOTSLT          YES, CONTINUE
         DEX
         BPL    DEVLP           CONTINUE SEARCH BACKWARDS
         BMI    NORAM           CAN'T FIND IT IN DEVLST
GOTSLT   LDA    $BF32+1,X       GET NEXT NUMBER
         STA    $BF32,X         AND MOVE THEM FORWARD
         INX
         CPX    $BF31           REACHED LAST ENTRY?
         BNE    GOTSLT          NO, LOOP
         DEC    $BF31           REDUCE DEVCNT BY 1
         LDA    #Ø              ZERO LAST ENTRY IN TABLE
         STA    $BF32,X
         CLC
         BCC    OKXIT           BRANCH ALWAYS TAKEN
         SKP    1
OLDVEC   DW     Ø               OLD VECTOR SAVEAREA
```

To reinstall the /RAM driver, execute this subroutine:

```
          SKP   1
*         SEE IF SLOT 3 HAS A DRIVER ALREADY
          SKP   1
HIMEM     EQU   $73         PTR TO BI'S GENERAL PURPOSE BUFFER
          SKP   1
INSTALL   LDX   $BF31       GET DEVCNT
INSLP     LDA   $BF32,X     GET A DEVNUM
          AND   #$70        ISOLATE SLOT
          CMP   #$30        SLOT 3?
          BEQ   INSOUT      YES, SKIP IT
          DEX
          BPL   INSLP       KEEP UP THE SEARCH
          SKP   1
*         RESTORE THE DEVNUM TO THE LST
          SKP   1
          LDX   $BF31       GET DEVCNT AGAIN
          CPX   #$0D        DEVICE TABLE FULL?
          BNE   INSLP2
ERROR     ...               YOUR ERROR ROUTINE

INSLP2    LDA   $BF32-1,X   MOVE ALL ENTRIES DOWN
          STA   $BF32,X     TO MAKE ROOM AT FRONT
          DEX               FOR A NEW ENTRY
          BNE   INSLP2
          LDA   #$B0
          STA   $BF32       SLOT 3, DRIVE 2 AT TOP OF LIST
          INC   $BF31       UPDATE DEVCNT
          SKP   1
```

Page 7-26:

Modifying the ProDOS Disk II Device Driver to allow 320 blocks instead of the normal 280. The fourth command line should read:

```
520D:40
```

Modifying FILER to format 40 tracks instead of 35. The fourth command line should read:

```
4244:40
```

[See Second printing errata for information about versions other than 1.0.1]

Page 8-6:

Under "Device Information", make the following changes:

BF10-BF11	DEVADR01	Slot 0 reserved.
...		
BF26-BF27	DEVADR32	/RAM device driver address (need extra 64K).

Page 8-7:

The wrong bit is indicated as the "expansion bit" in the MACHID byte. The first eight rows of that description should read:

```
00.. 0...   II
01.. 0...   II+
10.. 0...   IIe
11.. 0...   III emulation
00.. 1...   Future expansion
01.. 1...   Future expansion
10.. 1...   IIc
11.. 1...   Future expansion
```

Page B-8:

In the last paragraph, the sentence should read "A second way to use **an interpreted** language..." (not **a compiled** language).

Page D-1:

In the second paragraph, the sentence should read "Versions of the Disk Drive Controller Unit are now **used...**" (not **based**).

Reference Card, Panel 4

Under "SYSTEM GLOBAL PAGE FORMAT", replace the lines beginning BF05 and BF06 with the following two lines:

BF06	Jump to Date/Time Address (or RTS if no clock)

The description of BF1Ø-11 should be changed to:

```
BF1Ø-11  Slot Ø reserved
```

The description of BF26-27 should be changed to:

```
BF26-27  /RAM
```

Under the "MACHINE IDENTIFICATION BYTE", the second column of numbers should read:

```
Ø...
Ø...
Ø...
Ø...
1...
1...
1...
1...
```

Reference Card, Panel 9

The last entry for "MLI ERROR CODES" should be:

$5A Bad vol. bit map

(not **$58**).

ERRATA TO BENEATH APPLE PRODOS (2nd Printing, 1985)

Page 4-3Ø

The definitions of PARENT POINTER and PARENT ENTRY are incorrect. Replace them with:

$27-$28 PARENT_POINTER: The block number (within the volume directory or a subdirectory) which contains the file entry for this subdirectory.

$29 PARENT_ENTRY: The number of the file entry within the block number pointed to by the PARENT_POINTER. Given that "ENTRIES_PER_BLOCK" is $ØD, then the PARENT_ENTRY number ranges from $Ø1 to $ØD.

Page 7-26

Expand the 4Ø-track drive patch to show how to patch PRODOS versions 1.Ø.2 and 1.1.1 as well as 1.Ø.1.

This patch modifies the Disk II Driver, which is a part of the "PRODOS" file, so that it allows 32Ø blocks per volume instead of 28Ø blocks per volume.

```
UNLOCK PRODOS
BLOAD PRODOS,TSYS,A$2ØØØ
CALL -151
address*:4Ø
3DØG
BSAVE PRODOS,TSYS,A$2ØØØ
LOCK PRODOS
```

*"address" varies with the version of ProDOS, as follows:

ProDOS Version	address
1.Ø.1	52ØD
1.Ø.2	52CD
1.1.1	56E3

The following patch modifies the program FILER to format 4Ø tracks instead of 35. After this modification is made, only 4Ø-track drives may be formatted with FILER.

```
UNLOCK FILER
BLOAD FILER,TSYS,A$2ØØØ
CALL -151
addr**:4Ø
79F4:28
3DØG
BSAVE FILER,TSYS,A$2ØØØ
LOCK FILER
```

**"addr" depends on the release date of FILER. Here are the values of "addr" for two different release dates:

Release date	**addr**
1 JAN 84	4244
18 JUN 84	426A

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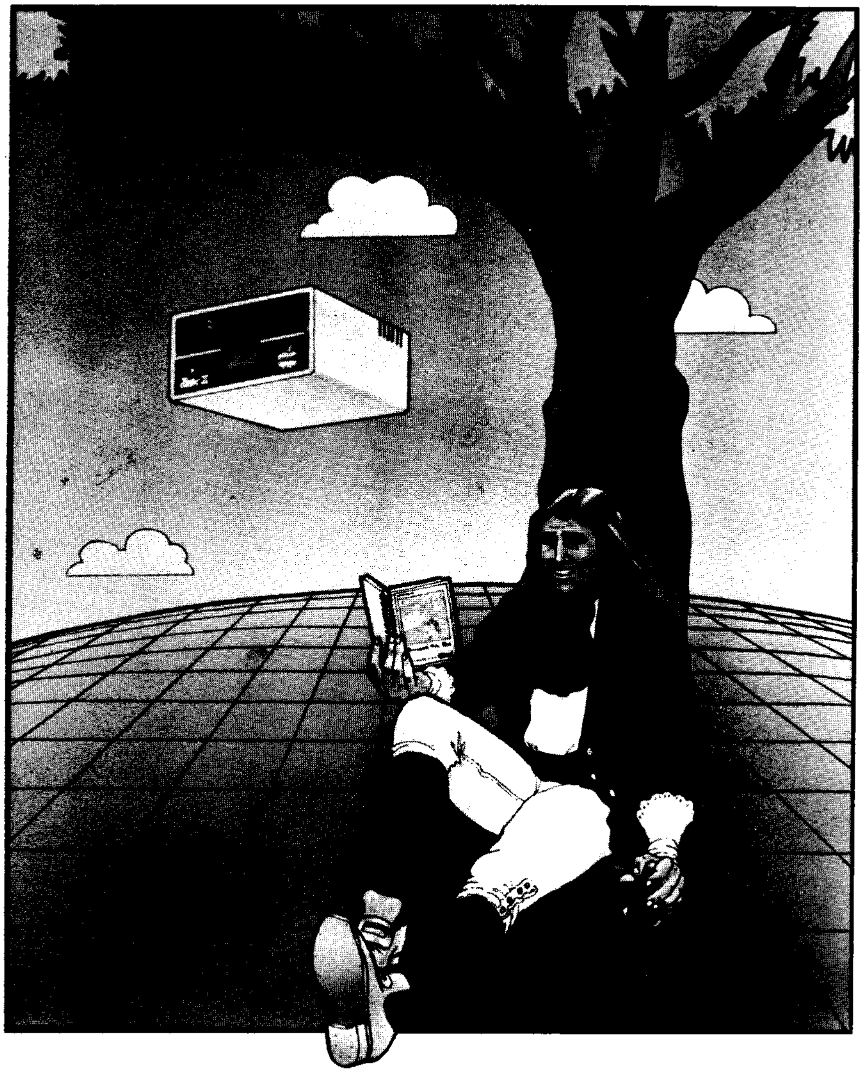
(1.1.1)

SUPPLEMENT TO

Beneath Apple ProDOS

For ProDOS Version 1.1.1



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