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INSIDE ATARI® DOS

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INSIDE ATARI® DOS

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Preface

This book contains the only complete and official listings for the disk File Manager System (FMS) commonly known as "Atari DOS 2.0S." You will note that we have clearly stated that the purchase of this book does *not* entitle you to make, sell, give, or otherwise distribute copies of either the original Atari DOS 2.0S or any modified version you may produce as a result of using this book.

By way of information, should you desire to produce and distribute a modified version of this product (e.g., to support a new disk drive), you *must* sign a contract and licensing agreement with the party who owns the rights to grant such licenses for non-exclusive uses. Currently, Optimized Systems Software is the only entity able to grant such licenses.

Some of you may find it strange that the publishers of **COMPUTE!** magazine are publishing this book. You might wonder why Atari, Inc., hasn't released this information before. Why can you only obtain distribution rights from Optimized Systems Software? For the answers to these and other questions we present the following Introduction, an historical perspective on the development of the systems software for the Atari Home Computers.

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Introduction

BEING A HISTORY OF TWO BIRTHS "COLEEN" AND "CANDY"

I don't know exactly when the concept of the Atari Computer was developed within the corporate mind of Atari, Inc., nor do I know all of the people responsible for nursing that concept into reality. The following history covers the relationship with Atari, Inc., during the evolution of the system software.

Sometime in early 1978, when the Atari 800 and 400 were still called "Coleen" and "Candy" and were still in the breadboard stages, Atari bought a copy of the source for Microsoft 8K BASIC. This version of BASIC was fundamentally the same product that was implemented by Commodore in the early PETs, was used by OSI, and was a close ancestor of Applesoft. Six months and many, many Atari man-hours later, that 8K BASIC was *almost* functioning properly on the Atari prototypes. But buying source for a program buys you just that: source. Generally, you also receive little documentation, sometimes obscure code, no guide to modification, and no real support. What to do? The products were due to be shown in early January, 1979, at the Consumer Electronics Show (CES) in Las Vegas, Nevada.

Enter Shepardson Microsystems, Inc. (SMI), my employer at that time. Though little known by the microcomputer public, SMI had already produced some very successful, private labeled microcomputer software. Among our better-known efforts were the original Apple DOS, Cromemco 16K Extended BASIC, and

Cromemco 32K Structured BASIC (just being completed at that time). Also, we had done some work for Atari on a custom game processor. (Which used a 12-bit ROM and 5-bit RAM configuration and was well received at Atari, but never produced.)

Coincidentally, about that same time SMI had *also* purchased source for Microsoft 6502 BASIC. After producing Apple's DOS, we had the bright idea of mating the Apple II peripheral bus with the KIM/SYM/AIM system bus (and it still seems like a good idea to us, but ...). The idea was to provide a disk system (Apple's) to the Single Board Computer market. Needing a BASIC to sell with the system, we plunked down a few grand and purchased Microsoft's. Though it looked to us like it would be difficult to modify, we were intending to resell it with a minimum of changes, so it seemed appropriate.

A New BASIC?

Re-enter Atari, some time in the late summer of 1978, asking if SMI could help them. With Microsoft BASIC? Well ... we really didn't want to, but ... Could we propose a new BASIC? We talked. And had meetings, and a study contract, and more meetings, and finally we wrote a specification for a 10K, ROM-based BASIC. (I still have a copy of that spec, and it's amazing how little the final version deviated from that original.)

Of course, in the middle of all these discussions, Atari naturally divulged how their (truly superb) ROM-based Operating System would interface both with BASIC and with various devices. Somewhere in here, my memory of the sequence of events and discussions becomes a little unclear, but suffice it to say that we found ourselves making a bid on producing not only a BASIC for Atari, but also the File Manager (disk device driver) which would change Atari OS to Atari DOS.

Sometime in late September, 1978, the final proposal was made to Atari, and it was accepted by them shortly thereafter. In mid-October, 1978, we received the go-ahead. The project leader was Paul Laughton, author of Apple DOS. The bulk of the work ended up being done by Paul and Kathleen O'Brien. Though I was still involved in the finishing touches on Cromemco BASIC, I take credit for designing the floating point scheme used in Atari BASIC. Paul Krasno implemented the math library routines following guidelines supplied to us by Fred Ruckdeschel (author of the acclaimed text, *BASIC Scientific Subroutines*). And, of course, much credit must go to Mike Peters, our combination keypuncher/computer operator/junior programmer/troubleshooter.

Since we obviously couldn't have the Atari machines to work on (they hadn't been built yet), the first step was to bring up an emulator for Atari's CIO ("Central Input-Output," the true heart of Atari's OS) on our Apple II systems. With Paul Laughton leading the way (and doing a lion's share of the work), the pieces fell together quickly. "Little" things had to be overcome: the cross-assembler was modified to handle the syntax table pseudo-ops, the 256-byte Apple disk sectors had to be made to look like 128-byte Atari sectors, the BASIC interpreter seemed to function, but was waiting for the floating point routines. And there are funny things to tell of, also. Like our cross-assembler, running on an IMP-16P (a 1973 vintage, 16-bit, bit-sliced PMOS microprocessor) that used keypunched cards for input, a floppy disk (with no DOS) as temporary storage, and a paper tape punch as output.

Somehow, Kathleen and Paul guided the two programs unerringly toward completion. On December 28, 1978, Atari's purchasing department at last delivered a signed copy of the final purchase order. It called for delivery of both products by April 6, 1979. There was a clause which provided for a $1,000 per week incentive (if we finished early) and penalty (if we finished late). What is especially humorous about that December 28th date is that the first working versions of *both* BASIC and FMS had *already* been delivered to Atari over a week before! That is *fast* work.

Fortunately, then, Atari took their new Atari BASIC to CES. Unfortunately, there was a limit on the amount of incentive money collectible. Oh, well.

In the months that followed, SMI fixed bugs, proofread manuals, and worked on other projects (including the Atari Assembler/Editor, which was mostly Kathleen's effort). The nastiest bugs in BASIC were fixed by December, 1979, but it was too late: Atari had already ordered tens of thousands of BASIC ROMs. The FMS bugs were easier to get fixed, since DOS is distributed on disk.

In mid-1980, Paul Laughton once again tore into FMS. This time, he modified it to handle the ill-fated 815 double-density disk drive and added "burst I/O" (and there will be much more about both these subjects in the technical discussion that follows).

In late 1980, and early 1981, Bob Shepardson, owner of Shepardson Microsystems, Inc., decided that the pain and trouble of having employees wasn't justified by the amount of extra income (if any) that he derived. Though we still occasionally function in a loose, cooperative arrangement, the halcyon days of SMI seem to be over.

A New Beginning

I negotiated with Bob Shepardson for his rights to the Atari products (FMS, BASIC, and the Assembler/Editor) and their Apple II counterparts. Thankfully, Atari had purchased from SMI only a non-exclusive right to distribute these products. SMI had retained the rights to license other users on a similar non-exclusive basis (and, indeed, SMI sold a version for the Apple II during most of 1980).

So now it was frantic time again: this was February 25, 1981, and the West Coast Computer Faire was April 3rd. But our brand new company, Optimized Systems Software, arrived on time, bringing with it BASIC A+, OS/A+ and EASMD. All three were enhanced, disk-based versions of the original Atari programs (and, in fact, derived some of their enhancements from the previous OSS Apple II products).

The products have been well received by the Atari user community, in part due to the fact that they are truly compatible, yet enhanced, versions of standard Atari software.

Why This Book?

The decision to publish these listings was not an easy one to make; and it is, in its own way, an historic occasion. After all, have you ever seen anyone offering source or listings of CP/M, the most popular of all computer operating systems? Since Atari, to their credit, has honored the original agreement with SMI and not released either source or listings without permission, the responsibility for doing so seemed to rest with OSS.

But Atari has set a powerful precedent by publishing the listings of DUP (their portion of DOS 2.0S) and the OS ROMs. The clamor from Atari users for the source for FMS finally even reached us, so we have bowed to the inevitable, and honored the same commitment that Atari has made: to release as much information and aid as possible to the user community.

We hope that the users will appreciate these efforts and, in turn, respect our rights and Copyrights. As long as there is a mutual respect and benefit, you, the user, can expect continued support.

About This Book

With the release of this book, the dedicated Atari enthusiast can examine all the inner workings of Atari DOS and modify his (or her) system to his heart's delight. Rather than simply publish listings, we have chosen also to provide a complete guide to the workings of FMS.

Although the listing itself is relatively clear and commented, all

but the most expert would have trouble plowing through some of the tortuous logic necessary in such a program. The guide included here describes all aspects of the FMS, including the external view, the charts and tables, the various interfaces, and (in copious detail) the functions of the individual subroutines (including complete entry and exit parameters).

There is much of value here even for the person who never intends to modify Atari DOS. We feel that FMS is a fairly well-structured, relatively sophisticated, system level assembly language program. We hope that most users will gain by the insights presented here.

We would welcome any notes you would care to send pointing out errors either in the DOS or in this book.

Bill Wilkinson
Optimized Systems Software
Cupertino, California
February, 1982

Chapter One

ATARI DOS OVERVIEW

The standard Atari Disk Operating System, DOS 2.0S, consists of four separate elements, ranked as follows in order of their "visibility" to the average DOS user.

1. DUP – Disk Utility Package
2. CIO – Central Input/Output
3. FMS – File Management System
4. SIO – Serial Input/Output

It is helpful to understand the entire Input/Output (I/O) process. While this book is intended to give detailed information on the workings of FMS, this overview will attempt to at least show how the four elements of DOS are connected. To this end, we would first call your attention to Figure 1. This figure is, itself, an overview of the entire Atari I/O system, including indications as to how and where data and control flows between the various elements thereof. Figures 1-1 through 1-4 show "close-ups" of portions of this diagram as they relate to the four elements of DOS.

In these figures, the rectangular boxes represent system elements, and are appropriately labeled. The wide, lettered arrows represent the flow of data (via buffers, control blocks, or even registers) between the various elements. The narrow, numbered arrows show how and where control, and control information, is transferred.

1-1. Disk Utility Package

DUP (which shows as "DUP.SYS" in a disk directory listing) is the most obvious and visible element of Atari DOS. DUP's function is to provide the user with keyboard access to the various file management functions in FMS. It does so via the menu which is displayed when, for example, the user keys "DOS" from BASIC. Actually, the menu offers several options which are not directly a part of the FMS (e.g., copy and duplicate files). Refer to the Atari *Disk Operating System II*

Reference Manual (part number C016347) for more information.

DUP is *not* an integral part of FMS. DUP may be relatively easily replaced with a program of the user's choice. In fact, our own OS/A+ does exactly that: instead of a menu, the user is given a command-driven keyboard interface to the other elements of DOS.

DUP is not even a privileged portion of DOS (excepting, perhaps, for needing to know a little of the internals of FMS when it performs a Duplicate Disk function). Any user application program (and that includes Atari BASIC, BASIC A+, EASMD, and many, many more) interacts the same way DUP does. Figure 1-1 shows the "proper" flow of control in DOS. Note that DUP transfers control only to CIO, which, in turn, transfers control to FMS and thence to SIO. An application program which maintains this protocol should be able to perform correctly in any Atari system, regardless of the revision of the OS ROMs and/or FMS.

Of course, control is not the only thing which DUP must transfer. It must also tell CIO where its data is and what to do with it. Refer to Figure 1-2 for a diagram of the complete application/CIO interface (again, it is labeled in this way because DUP is just another application program as far as the rest of DOS is concerned). CIO always expects an Input/Output Control Block (IOCB) and usually (i.e., for all but the simplest operations) needs a buffer into or out of which it may perform its operations.

1-2. Central Input/Output

CIO is actually the heart of the entire Atari Computer. It is less than 800 bytes long and yet serves to handle virtually all the input and output which takes place in the computer. CIO is a part of the Atari "OS ROMs," the 10K byte package which also houses the floating point routines, the default character set, the interrupt handlers, and several device drivers.

The entire set of operations summarized in Figure 1-2 is covered in detail in the Atari OS Manual (C01655) and will be covered only briefly here. Readers of **COMPUTE!** will also find some helpful material on this subject in issues #18 through #21 (November, 1981, through February, 1982) in the "INSIGHT: ATARI" columns.

In order to allow easy control and data flow, CIO is written to expect and provide for eight Input/Output Control Blocks (IOCBs) which are used to pass the information needed to process the various kinds of I/O requests. An application places the necessary command and control information in an IOCB which it selects (data path A). If a buffer is required, the application must provide one (data path C)

and place its address into the IOCB. When ready to execute the I/O command, the application places the IOCB number (times 16) in the 6502's X-register (data path C) and executes a JSR call to CIO (control path 1). Note that a few command variations may pass data via the 6502's A-register, but we may consider that simply a special case location of the user's buffer.

When CIO receives control, it examines the information in the IOCB (and, for some operations, in the user buffer) to determine what actions it is to perform. Generally, this action requires the execution of a device handler routine.

A device handler (interchangeably known as a *device driver*) is a system routine that performs I/O operations for a specific device (or class of devices). Examples of device handlers include the "P:" driver (the printer) and the "E:" driver (the screen/keyboard editor). Figure 1-3 illustrates the interface between CIO and the various device handlers. Note that FMS is simply another device handler as far as CIO is concerned, having been given the name "D:".

All device drivers are required to contain a table of address pointers (known as the Device Vector Table) to various specific routines within themselves, including a device OPEN routine, GET CHARACTER routine, etc. The name of a device and the address of this table is placed in CIO's Device Handler Table. When an application program makes an I/O request to CIO for a specific device, CIO searches the Device Handler Table for the given name and corresponding Device Vector Table address. With the thus-located vector table, CIO can then call the appropriate device handler routine (via a JSR, along control path two of Figure 1-3).

1-3. File Management System

As stated above, FMS is actually simply another device driver as far as CIO is concerned. The control and data flows shown in Figure 1-3 are equally valid for all device drivers in the Atari system. Note that many of the drivers in the default ("as-shipped") system reside entirely within the so-called OS ROMs. Although it resides in RAM, what is somewhat unique about FMS is that the Atari system initialization code contains a segment of "boot" code which loads FMS into memory upon power-on.

FMS is the system device handler for all I/O operations that specify the device name "D" (including "D1:", "D2:", etc.). In order to perform its functions, FMS examines the data in the specified IOCB (data path F). It may also examine, read, or write data to or from the user-supplied buffer (data path I). Data path H is used to pass

the IOCB-designator (again, via the X-register) and single-byte transfer data (via the A-register).

FMS is called upon to perform a variety of tasks, including all disk I/O, file renaming, protecting, deleting, etc. Since the rest of this book consists of a listing of FMS along with detailed explanations of all sections thereof, we will not now dwell on the inner workings of FMS.

However, we do need to note that, in order to perform its work, FMS must transfer data to and from the disk. FMS accesses the disk drive via SIO, the fourth element of DOS.

1-4. Serial Input/Output

SIO is the name given to the component of DOS which drives and controls the Atari serial I/O bus and the various peripherals (disk, printer, modem, etc.) which are placed on that bus. Figure 1-4 illustrates the interface between FMS and SIO, but it could just as well serve to show (for example) how the printer driver talks to the various Atari printers.

The SIO is primarily driven by a request placed in SIO's Device Control Block (DCB) by the device handler (data path K) followed by a transfer of control (control path three) via a JSR. SIO uses the information in the DCB (data path M) to determine what it needs to do. If the DCB specifies a serial bus data transfer (as opposed to, for example, a status request), then the address of the data buffer must also be passed (via a field in the DCB). For example, the FMS buffer shown is accessed via data paths J (from FMS) and L (from SIO).

Although SIO only understands the single system DCB, the buffer specified may be located anywhere in memory. FMS takes advantage of this to implement "burst I/O" (discussed in section 12), which has SIO transferring data directly to or from the user's buffer (data path E).

Since the actual disk data transfer occurs in fact within the 810 disk drive and, since SIO communicates to the drive via data path N, one might reasonably argue that the disk drive constitutes a fifth component of DOS. However, because the disk drive functions are preprogrammed in ROM, and because SIO implements the only method of accessing the disk (as well as most other peripherals), then, for all practical purposes, even machine language software may treat SIO as the last link in the I/O chain on the Atari Computers.

Once again, we remind you to study Figure 1. In the following dissertation and dissection of FMS, we shall refer to this chart often.

Figure 1 (entire)
DOS Data And Control Flow

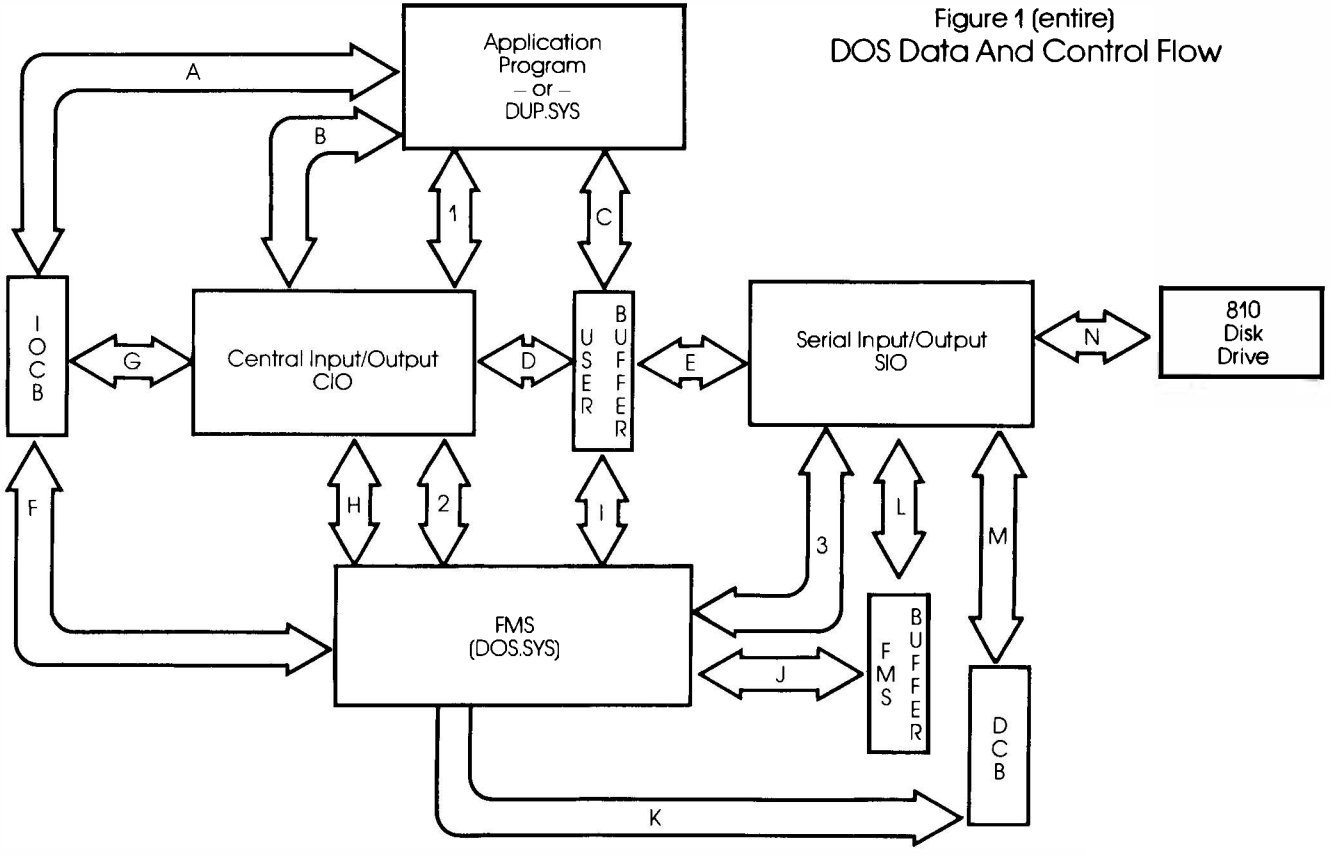


Figure 1-1
DOS Control Flow

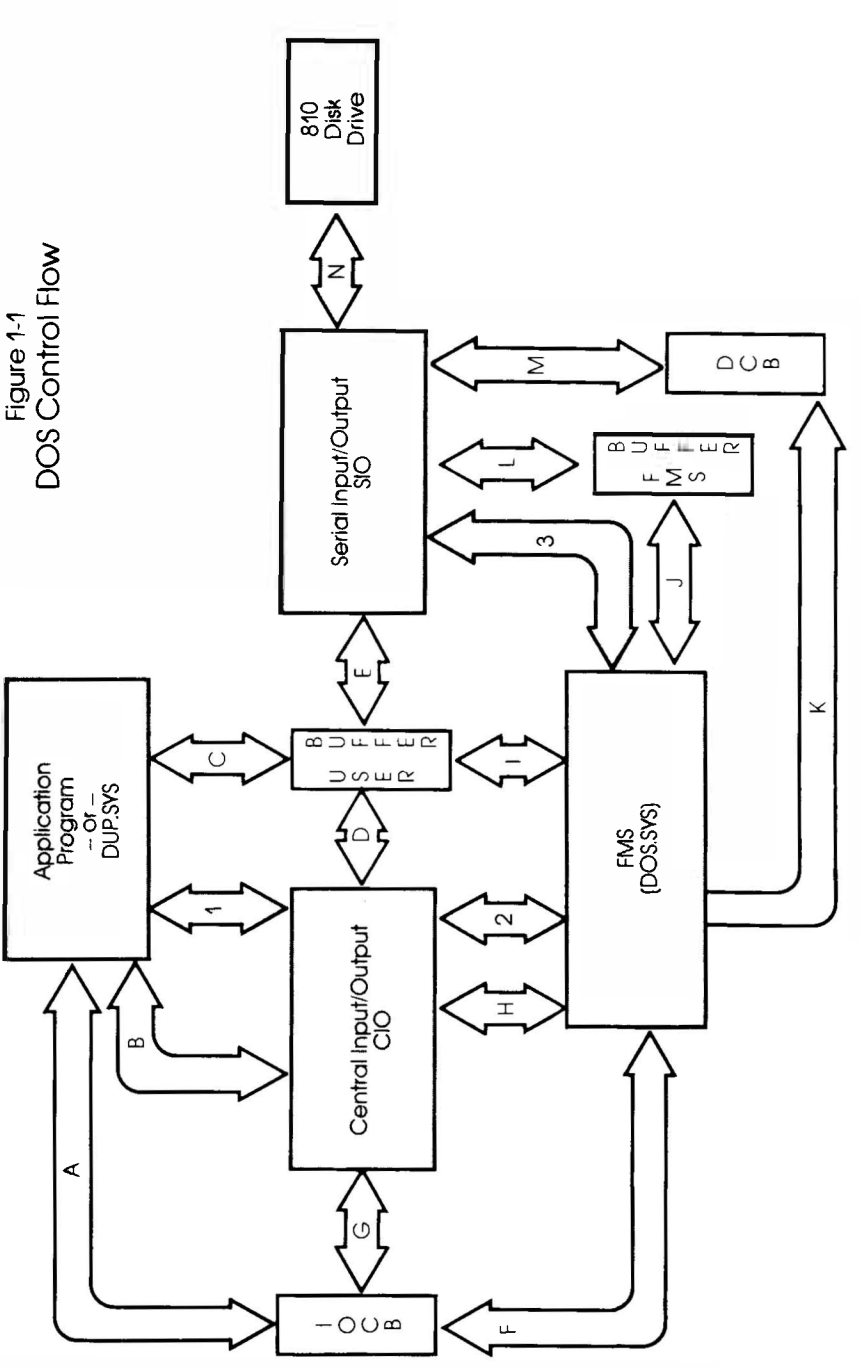


Figure 1-2
Application/CIO Interface

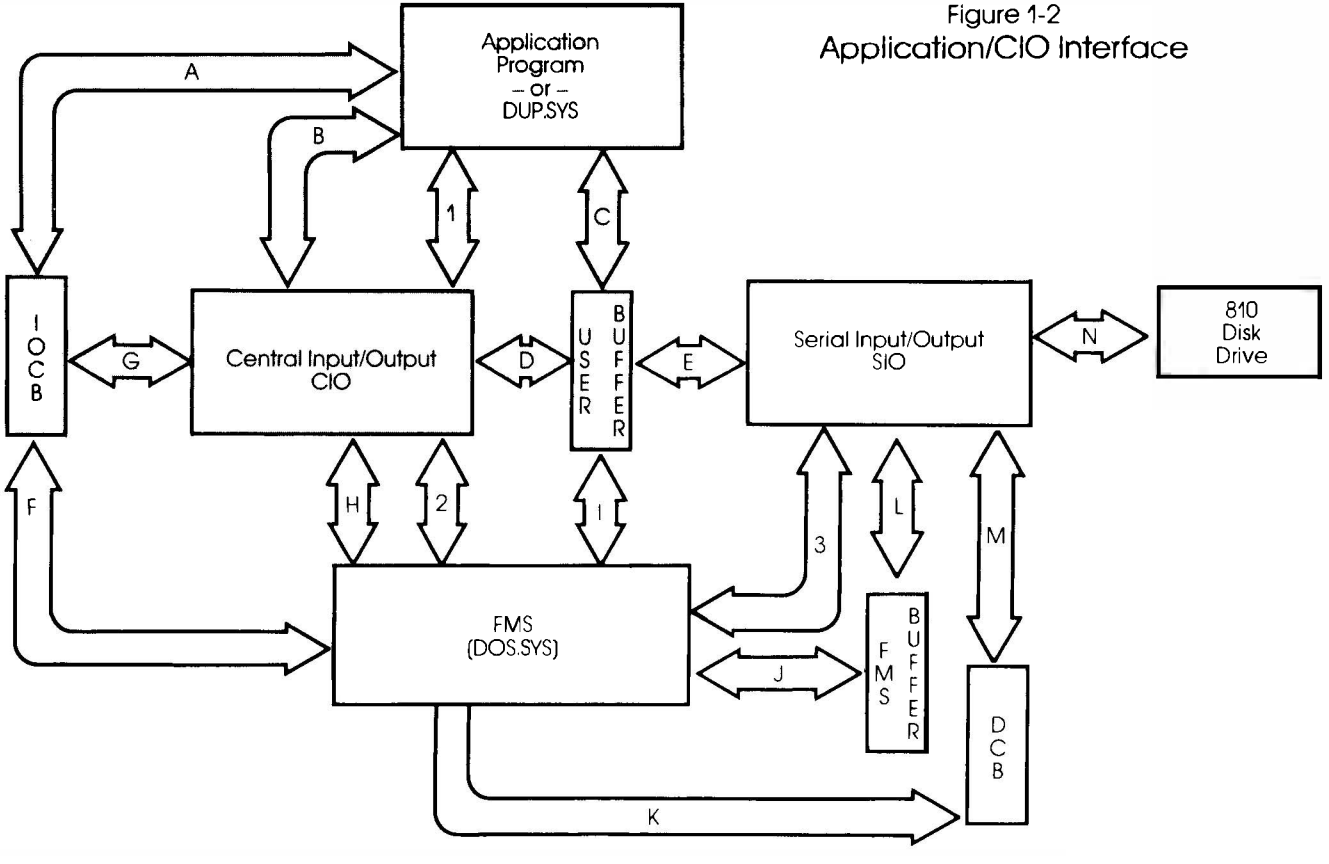


Figure 1-3
CIO-Device Handler Interface

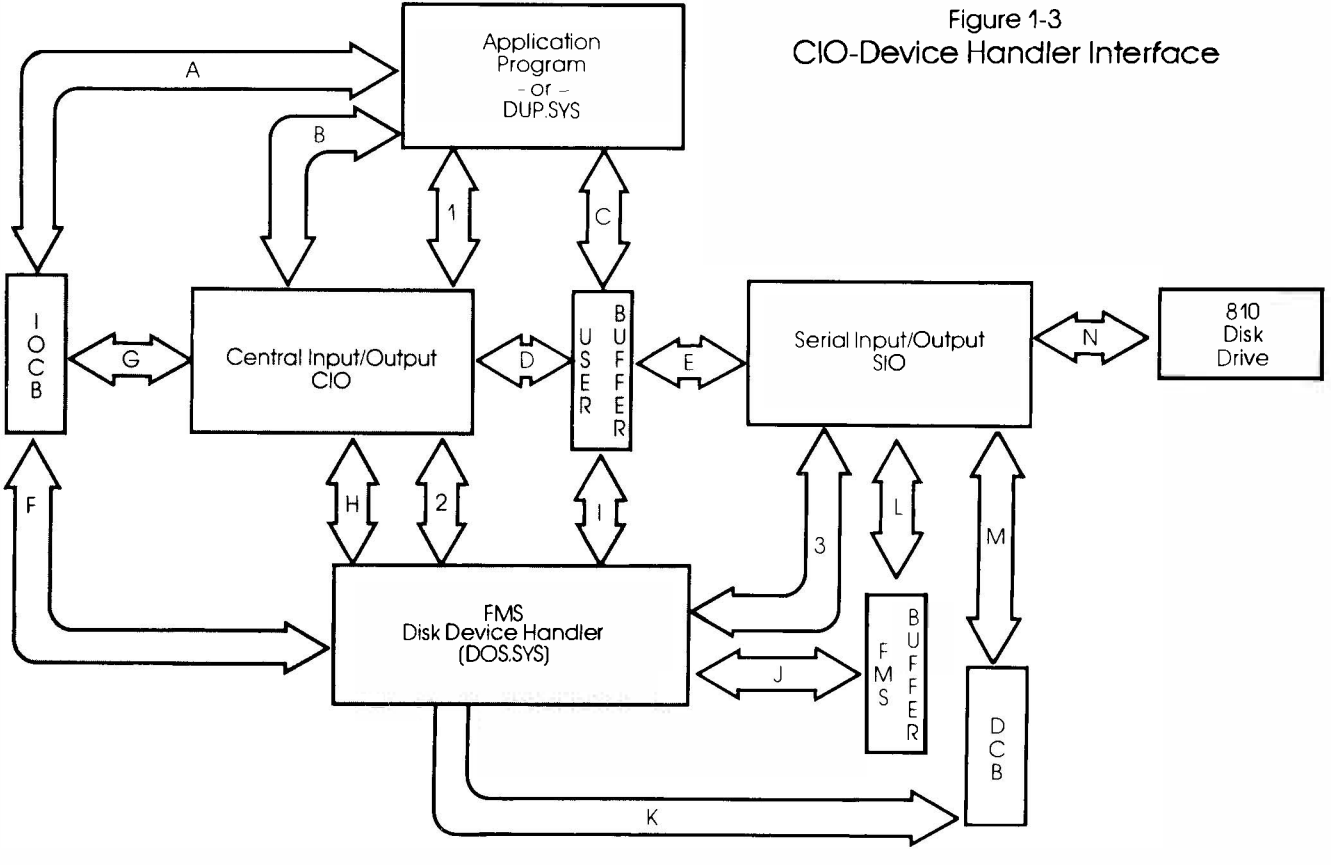
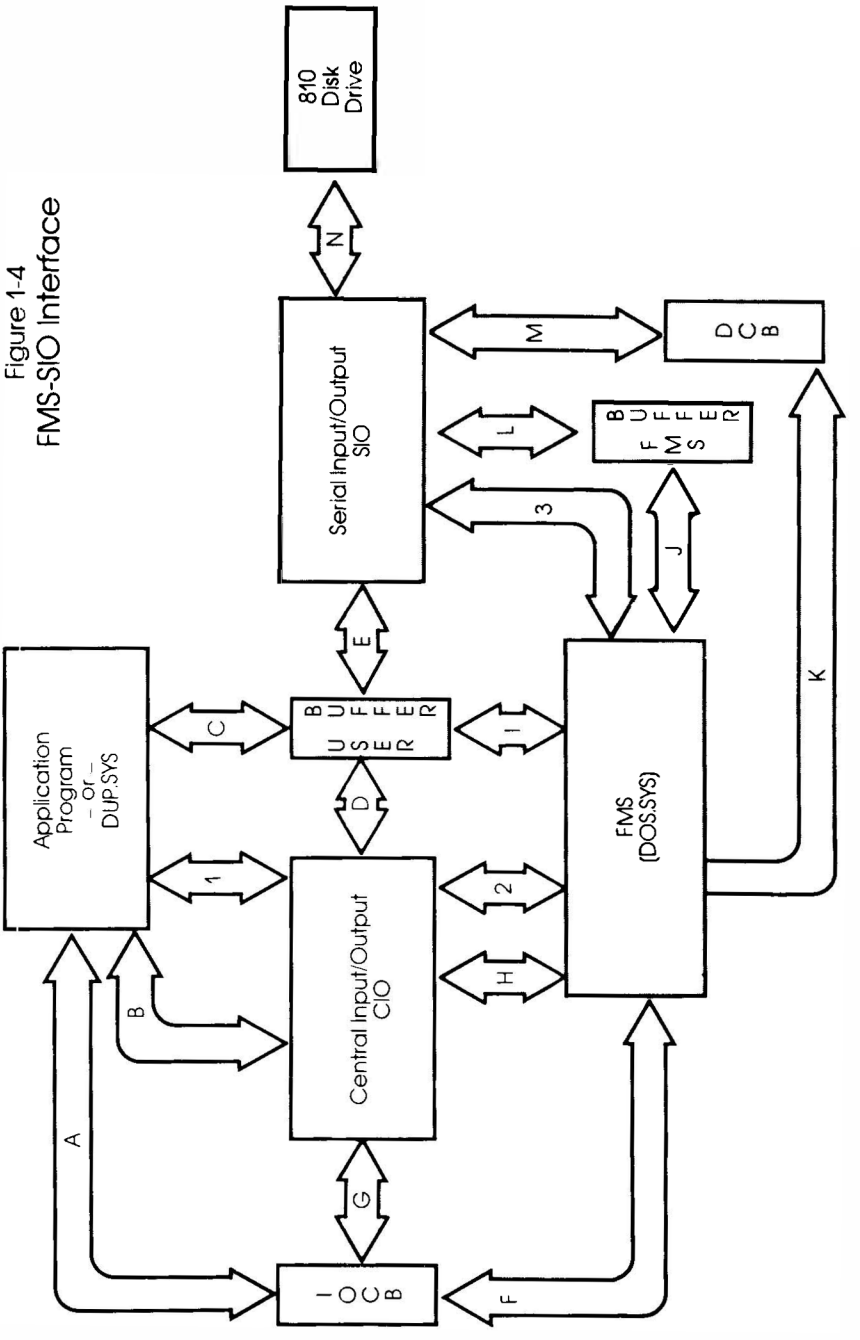


Figure 1-4
FMS-SIO Interface



Chapter Two

DISK ORGANIZATION

The purpose of FMS is to organize the 720 data sectors available on an 810 diskette into a system of named data files. FMS has three primary data structures that it uses to organize the disk: the Volume Table of Contents, the Directory, and Data Sectors. The Volume Table of Contents is a single disk sector which keeps track of which disk sectors are available for use in data files. The Directory consists of directory sectors. It is used to associate file names with the location of the files' sectors on the disk. Each Directory entry contains a file name, a pointer to the first data sector in the file, and some miscellaneous information. The Data sectors contain the actual data and some control information that link one data sector to the next data sector in the file. Figure 2-1 illustrates the relation between the Directory and the Data files.

Disk Directory

The Directory starts at disk sector $169 and continues for eight contiguous sectors, ending with sector $170. These sectors were chosen for the directory because they are in the center of the disk and therefore have the minimum average seek time from any place else on the disk. Each directory sector has space for eight file entries. Thus, it is possible to have up to 64 files on one disk.

A Directory entry is 16 bytes in size, as illustrated by Figure 2-2. The directory entry flag field gives specific status information about the current entry. The directory count field is used to store the number of sectors currently used by the file. The last eleven bytes of the entry are the actual file name. The primary name is left justified in the primary name field. The name extension is left justified in the extension field. Unused filename characters are blanks ($20). The Start Sector Number field points to the first sector of the data file.

Data Sectors

A Data Sector is used to contain the file's data bytes. Each 128 byte data sector is organized to hold 125 bytes of data and three bytes of

control information as shown in Figure 2-3. The data bytes start with the first byte (byte 0) in the sector and run contiguously up to, and including, byte 124. The control information starts at byte 125.

The sector byte count is contained in byte 125. This value is the actual number of data bytes in this particular sector. The value may range from zero (no data) to 125 (a full sector). Any data sector in a file may be a short sector (contain less than 125 data bytes).

The left six bits of byte 126 contain the file number of the file. This number corresponds to the location of the file's entry in the Directory. Directory entry zero in Directory sector $169 has the file number of zero. Entry one in Directory sector $169 has the file number one – and so forth. The file number value may range from zero to 63 ($3F). The file number is used to insure that the sectors of one file do not get mixed up with the sectors of another file.

The right two bits of byte 126 (and all eight bits of byte 127) are used to point to the next data sector in the file. The ten bit number contains the actual disk sector number of the next sector. Its value ranges from zero to 719 ($2CF). If the value is zero, then there are no more sectors in the file sector chain. The last sector in the file sector chain is the End-Of-File sector. The End-Of-File sector may or may not contain data, depending upon the value of the sector byte count field.

Volume Table Of Contents (VTOC)

The VTOC sector is used to keep track of which disk sectors are available for data file usage. The VTOC sector is located at sector $168. Figure 2-4 illustrates the organization of the VTOC sector. The most important part of the VTOC is the sector bit map.

The sector bit map is a contiguous string of 90 bytes, each of which contains eight bits. There are a total of 720 (90 x 8) bits in the bit map – one for each possible sector on an 810 diskette. The 90 bytes of bit map start at VTOC byte ten ($0A). The leftmost bit ($80 bit) of byte $0A represents sector zero. The bit just to the right of the leftmost bit ($40 bit) represents sector one. The rightmost bit (bit $01) of byte $63 represents sector 719.

The fact that FMS interprets the bit map as representing sectors zero through 719 is a bug. The Atari 810 disk drive will not accept commands for sector zero. It will accept commands for sector 720. In other words, the bit map is skewed by one. The problem cannot be fixed now because there are already tens of thousands of diskettes whose bit maps are to be interpreted as representing sectors zero through 719, and because some savvy applications writers have taken advantage

of this feature. (A bug which generates useful side effects is known in the programming profession as a *feature*.) Sector 720 can never be used by FMS and is therefore available for miscellaneous purposes.

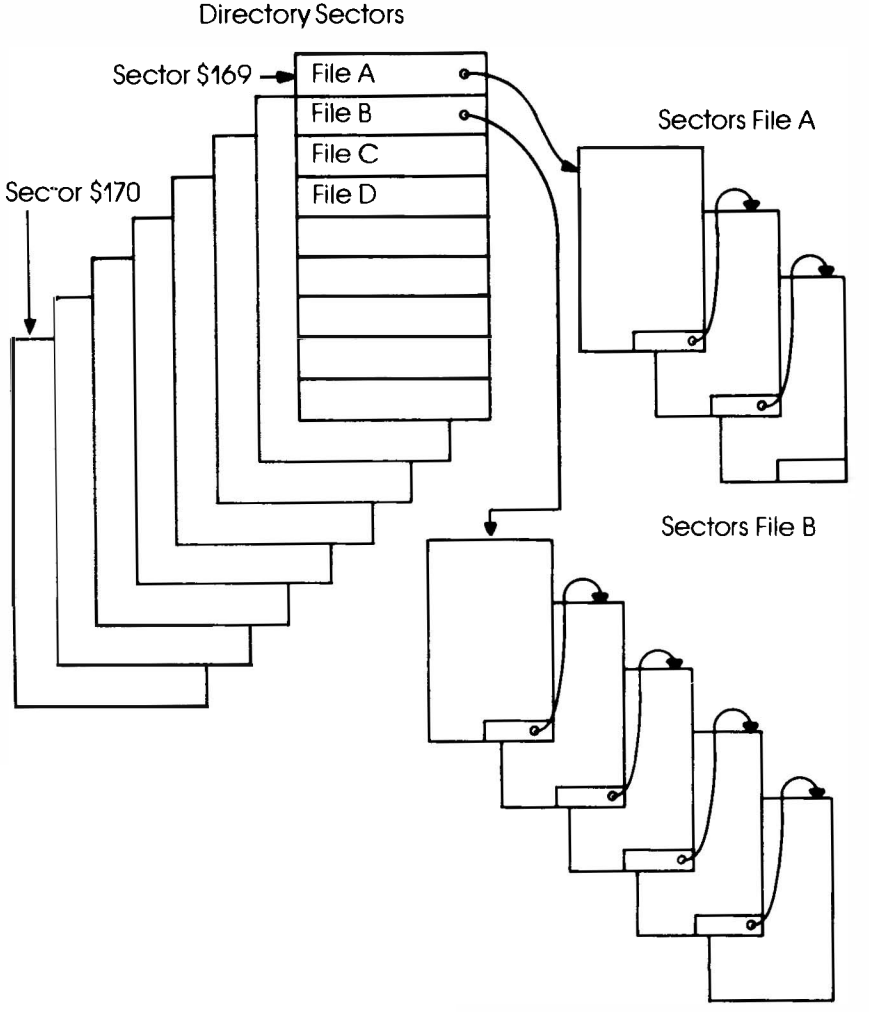


Figure 2-1

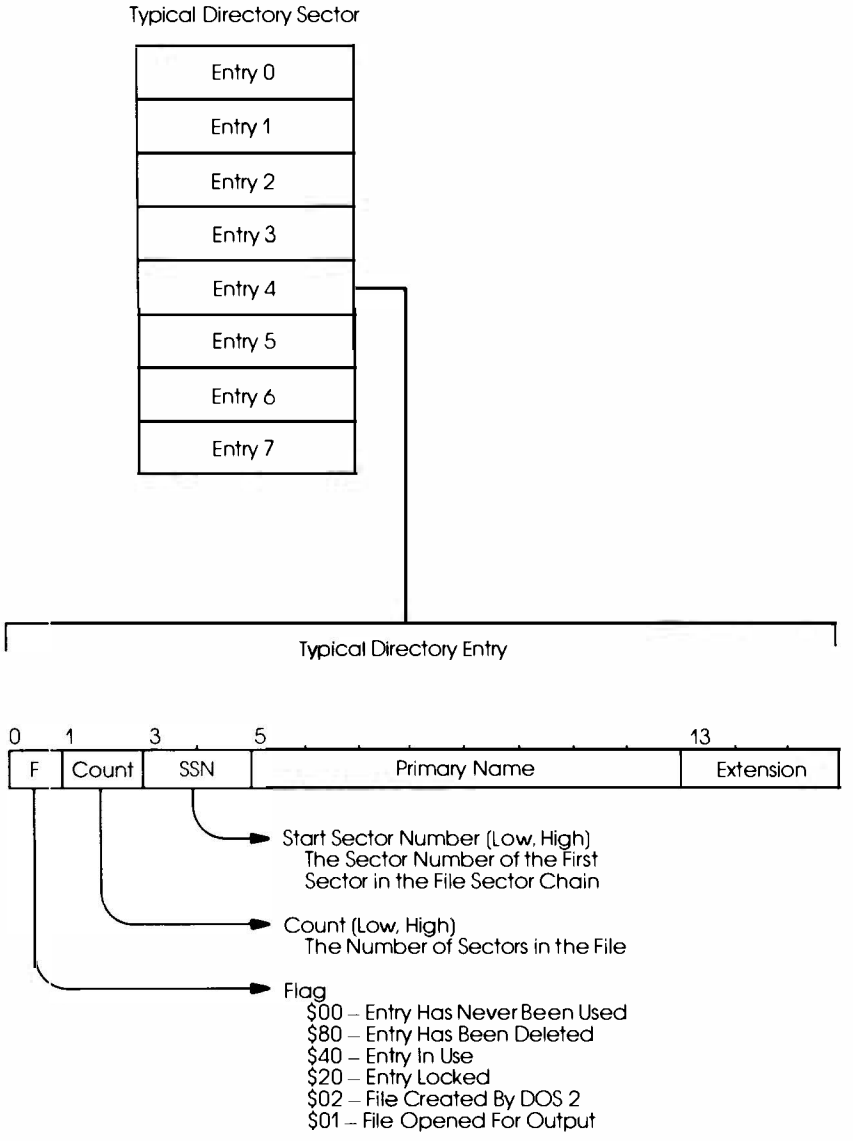

Typical Directory Sector
Entry 0
Entry 1
Entry 2
Entry 3
Entry 4
Entry 5
Entry 6
Entry 7
Typical Directory Entry
0
1
3
5
13
F
Count
SSN
Primary Name
Extension
Start Sector Number (Low, High)
The Sector Number of the First
Sector in the File Sector Chain
Count (Low, High)
The Number of Sectors in the File
Flag
$00 – Entry Has Never Been Used
$80 – Entry Has Been Deleted
$40 – Entry In Use
$20 – Entry Locked
$02 – File Created By DOS 2
$01 – File Opened For Output

Figure 2-2

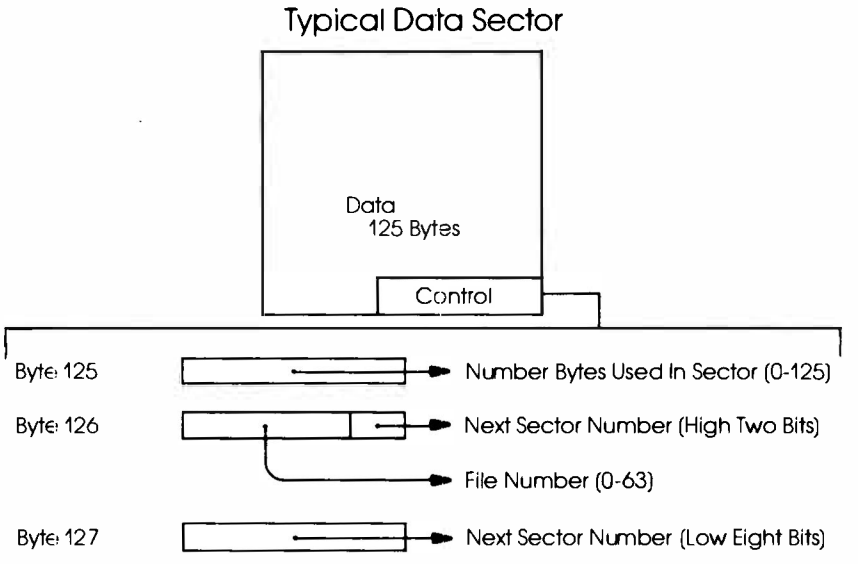


Figure 2-3

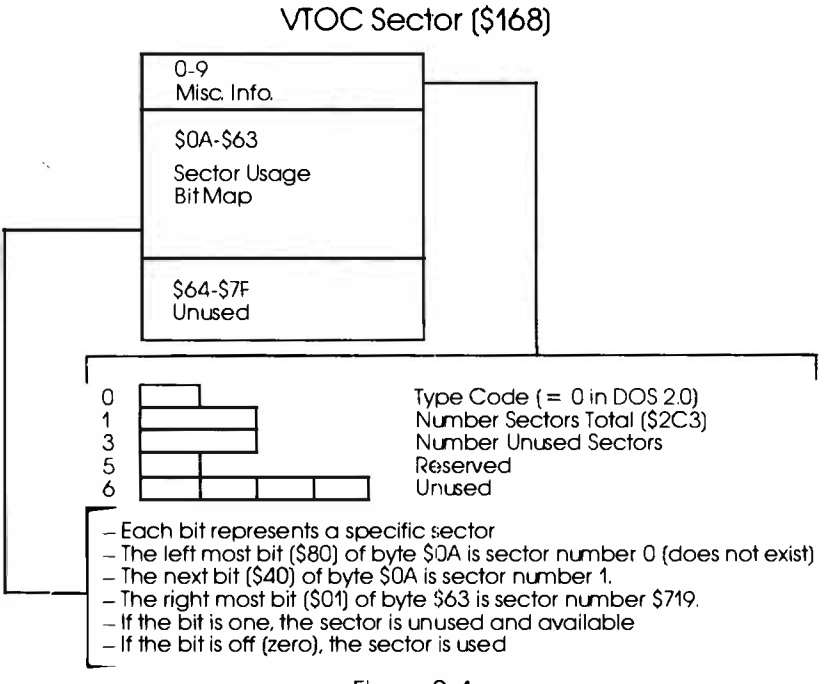


Figure 2-4

Chapter Three

FMS FILE CONTROL BLOCKS (FCB)

The FMS File Control Blocks are used to store information about files that are currently being processed. Each file that is being processed concurrently by FMS requires one FCB. Since the Atari system has eight IOCB's, FMS must be prepared to handle up to eight files concurrently, thus there are eight FCBs. The FCBs were designed to have a one-to-one correspondence with the IOCBs. When a file is to be processed with IOCB number three, FMS will use FCB number three for that file. When a file is to be processed with IOCB number five, FMS will use FCB number five for that file. Each FCB is the same size as an IOCB (16 bytes). The FCBs are located in a contiguous RAM area just like the IOCBs. When CIO calls FMS, the X register contains the displacement (IOCB number times 16) to the IOCB making the request. The FMS uses this displacement value to access both the IOCB information and the FCB information. Please refer to the listing at location $1381 for the following discussion about the FCBs.

FCBFNO

The file number of the file currently being processed. The value (zero to 63) is shifted left two bits. When a file has been opened for reading, this value will be used to check for a file number mismatch in the data sectors. When a file is opened for write, this value will be placed in the file number field of the data sectors.

FCBOTC

Open Type Code. This value is used as a flag to indicate which mode the file has been opened for:

Input is $04.

Output is $08.
Update is $0C.
Append is $01.
Directory read is $02.

FCBSLT

This is a flag used to indicate that the file being processed was created by DOS 1 rather than DOS 2. The Data Sector length byte has a different interpretation under DOS 1.

FCBFLG

This field is a working flag. If the value is $80, then the file is eligible to acquire new data sectors. Files that are opened for Output or Append are eligible to acquire new data sectors. If the value is $40, then the sector currently is in a memory buffer, has been modified, and needs to be written back to the disk.

FCBMNL

If the file is opened for Output or Append, this value will be either 125 or 253 depending upon the drive type. The 253 value is meant for the Atari 815 dual density drive. If the file is opened for Read or Update, then this value represents the number of data bytes that are in the data sector currently in a buffer. This value is obtained from the Data Sector data length field (byte 125 of the data sector.)

FCBDLN

This value points to the next data byte to be operated on in a data sector. If the file is opened for Output or Append, this value points to the next available (unused) data byte in the current data sector. If the file is opened for Update, then this value points to the next data sector byte to be either read or modified. If the file is opened for Input, then this value points to the next byte to be read.

FCBBUF

This value is an index into the sector buffer table. The sector buffer table is a list of buffer addresses. When a file is being processed, a sector buffer is required to hold data sectors. This field tells FMS which FMS buffer has been allocated to the file.

FCBCSN

The sector number of the sector currently in the buffer is stored in this field.

FCBLSN

The sector number of the next sector in the file chain is stored in this field.

FCBSSN

If the file has been Opened for Append, then this field contains the sector number of the start of the sectors to be appended to the file when the append file is closed.

Chapter Four

FMS INITIALIZATION

DUP gets control whenever the system is booted or the RESET key is pressed. DUP will call the FMS initialization routine, DINIT at $7E0.

DINIT

Functions:

1) Determine how many (and what type of) disk drives will be used.
2) Set up a drive table and allocate a drive buffer for each drive.
3) Allocate sector buffers and build the sector buffer table.
4) Clear the FCBs to zero.
5) Set MEMLO.
6) Enter the D: device into the Device Handler Table.
7) Exit to caller via RTS.

Drive Determination

The DRVBYT byte at $70A is used to tell FMS how many disk drives will be used and what the drive number of the drives will be. The

rightmost bit (bit $01) indicates drive 1. The next left bit ($02) indicated drive 2 – and so forth. If the bit is one, then the drive is to be used. If the drive is zero then the drive is not to be used. The code will allocate up the eight drives, even though the 810 hardware only has switches for drives 1,2,3 and 4.

If DRVBYT indicates that a drive is to be used, then FMS issues a status command to that drive to determine if it is active and what type (810 or 815) of drive it is.

Drive Allocations

The drive determination process sets up two tables (Figure 4-1). The first table is the DRVTBL. This table is indexed into by the drive number (minus one). If the value in the table is zero then the drive is not to be used. If the value is one, then the drive is an active 810 and requires one drive buffer. If the value is two, then the drive is an 815 and requires two 128 byte buffers.

The second table is the drive buffer table. The drive buffer table contains the address of the drive buffer to be used for each drive. This Drive Buffer will be used to hold the VTOC sector on the diskette in the drive. The table is separated into two sections: DBUFAL contains the least significant address byte and DBUFAH which contains the most significant address byte. The drive buffer table is also accessed by the drive number (minus one).

When a file is being processed, the Drive number is obtained from the IOCB Device Number field, ICDNO. The obtained value is decremented by one and is then used as an index into the Drive Tables. The Drive Type is copied from the DRVTBL entry to DRVTYP ($12FE) for easy access by FMS. The Drive Buffer address is copied from the DBUFAL and DBUFAH table entries to the zero page drive buffer pointer, ZDRVA ($45).

Sector Buffer Allocations

The SABYTE at location $709 is used to inform FMS about the number of 128 areas to be allocated as sector buffers. One 128 buffer is required for each file which is to be processed concurrently on 810 drives. Two 128 byte buffers are required for each file which is to be processed concurrently on 815 drives.

The Sector Buffer Allocation table, SECTBL at $1319, is used to indicate if a buffer is available for allocation to a file (Figure 4-2). If a buffer is available, the entry is set to zero. If the buffer is not available, the entry is a minus value. The table is 16 bytes in size and therefore can be used to allocate up to sixteen 128 byte buffers. During the

initialization process, entries which are to be unused are set to a minus value.

The Sector Buffer Address Table is a table of addresses which point to the individual sector buffers. The table is divided into two parts: SABUFL contains the least significant address byte, SABUFH contains the most significant address byte.

When a file is being processed, an available buffer number is found in SECTBL by search for a zero valued entry. The located buffer is allocated to the file by entering a minus value ($80) into the table and placing the corresponding buffer number into the DCB buffer number field, FCBBUF. When the file processing is done, the buffer is deallocated by setting the SECTBL entry to zero.

Setting MEMLO

The Atari MEMLO location ($2E7) is set after the FMS buffers have been allocated. The address of the last sector buffer allocated is incremented by 128. This value is then placed into MEMLO.

Device Handler Table Entry

The Device Handler Table ($31A) is searched for a "D" entry or the first (from the top) empty entry. When an appropriate entry is found, FMS inserts (or reenters) "D" as a DEVICE NAME and sets the DEVICE vector entry to point to the FMS Device Vector table at DFMSDH ($7CB).

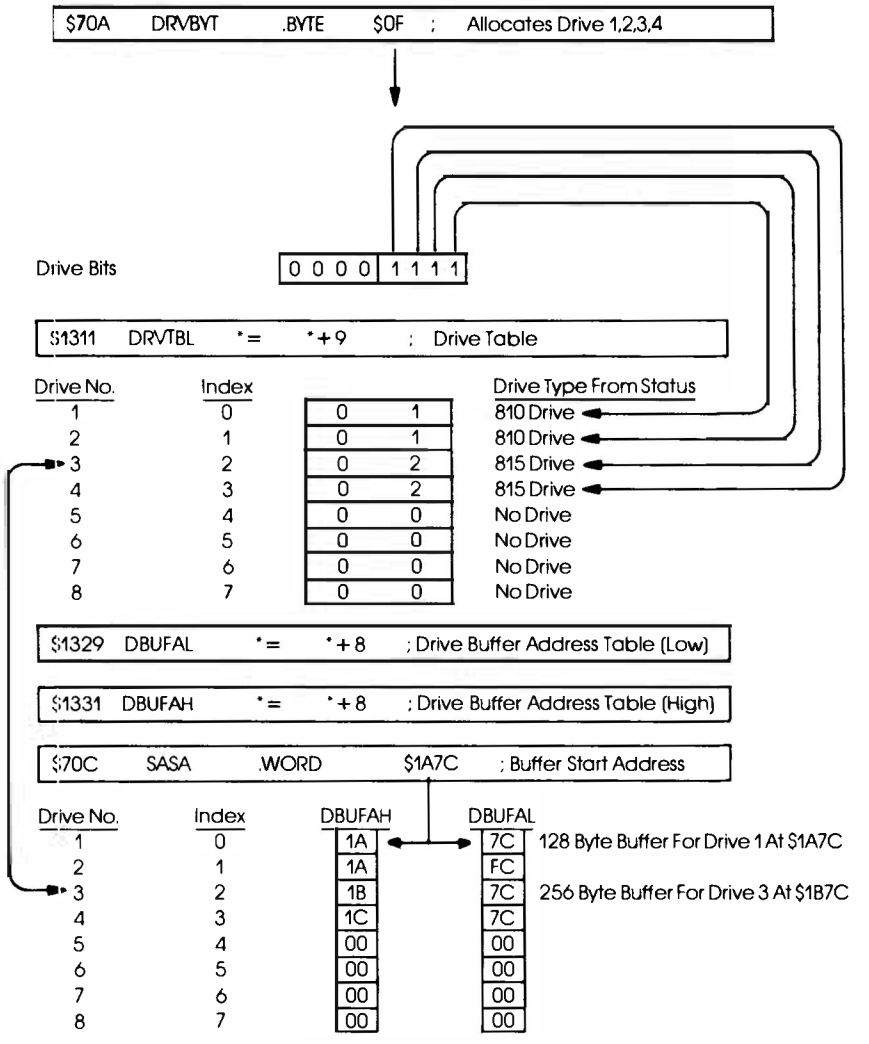


Figure 4-1
Drive Tables

```
$1319   SECTBL     *=    *+16        ; Sector Allocation Table
```

Buffer Number		
0	00	Buffer Is Available
1	00	
2	00	
3	00	
4	00	
5	00	
6	00	Buffer Is Available
7	FF	Buffer NOT Available
8	FE	
9	FD	
10	FC	
11	FB	
12	FA	
13	F9	
14	F8	
15	F7	
16	F6	Buffer NOT Available

```
$709    SABYTE    .BYTE   7          ; Number Of 128 Byte Sector Buffers

$1339   SABUFL    *=    *+16        ; Sector Buffer Address (Low) Table

$1349   SABUFH    *=    *+16        ; Sector Buffer Address (High) Table
```

(Last Drive Buffer Address + Drive Type (1 or 2) * 128)

Buffer Number	SABUFL	SABUFH	
0	1C	8C	
1	1D	0C	(Previous Entry + 128)
2	1D	8C	
3	1E	0C	
4	1E	8C	Sector Buffer 4 Address = $1E8C
5	1F	0C	
6	1F	8C	
7	20	0C	
8	00	00	
9	00	00	
10	00	00	
11	00	00	
12	00	00	
13	00	00	
14	00	00	
15	00	00	

Figure 4-2
Sector Allocation Tables

Chapter Five

FMS ENTRY

The Device Vector Table for FMS is located at DFMSDH ($7CB). The address of this table is placed in the Device Handler Table by the FMS Initialization routine. When CIO needs to call an FMS function (Figure 1, control path 2), it will locate the address of the function via the table at DFMSDH. This table is the standard Atari Device Handler Vector Table. The six entries are for:

Open
Close
Get Byte
Put Byte
Status
Device Dependent (XIO) Commands

Each of the six FMS entry points starts with a subroutine call to the FMS SETUP routine. SETUP ($1164) prepares FMS parameters to deal with the particular task to be performed.

SETUP

Address – $1164

Entry Registers – A = Possible 'Put Data' data byte.
X = IOCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB number times 16.
Y = Sector Buffer Index.

Functions:

1) Initialize ERRNO to $9F. This value will be used in the FMS exit routines to form a FMS error number in the event of error.

2) Save the X Register in CURFCB. This value will be used as an index to the proper IOCB and the proper FCB for the current operation.

3) Save the value of the stack register as it was upon entry to

FMS. This value will be used in the FMS exit routine.

4) Set up drive information values from the drive number contained in the zero page IOCB field ICDNOZ.

5) Allocate a sector buffer to the FCB if one is not already allocated.

Chapter Six

FMS EXIT

There are two types of FMS exits: the normal exit and the error exits. Both of these exit types end up calling the RETURN routine.

RETURN

Address – $12D3

Entry Registers – A = Return Code.
X = Don't Care.
Y = Don't Care.

Exit Registers – A = Possible 'Get Byte' data byte.
X = IOCB number times 16.
Y = Return Code.

Functions:

1) The X register is loaded with the current IOCB number times 16 from CURFCB.

2) The return code is placed in the IOCB status field (ICSTA).

3) The stack register is restored to point to the stack displacement at FMS entry from the value saved in ENTSTK.

4) The possible "Get Data" data byte is loaded into the A register.

5) The Y register is loaded with the return code.

6) The caller (CIO) is returned to via the RTS instruction.

GREAT And FGREAT

GREAT and FGREAT are the exit points used by FMS when the operation has terminated normally. FGREAT is located at $12EA and is used to free the sector buffer that has been allocated to the FCB. The FRESBUF routine is used to free the buffer. FGREAT exits directly to GREAT ($12F0). The GREAT exit point loads the normal return code ($01) into the A register and goes to RETURN.

Error Exits

The ERREOF exit is called when an end of file condition is found. ERREOF loads the end-of-file condition code ($88) in the A register and goes to RETURN.

The ERRIO exit is called if an error occurs during an I/O operation (Figure 1, control flow 3). The error code from the DCB (control path K) is loaded into the A register as the FMS return code and control is passed to RETURN.

All other errors exits are at the ERxxx labels starting at $12B5. The error code is developed by means of a series of 6502 INC instructions which increment the ERRNO (which was initialized to $9F at FMS entry). The final instruction at the end of the INC chain loads the final ERRNO value into the A register and control is passed directly to RETURN.

Chapter Seven

DEVICE DEPENDENT COMMANDS

A Device Dependent Command is any command which is not Open, Close, Get Byte, Put Byte, or Status. When the command value in the IOCB is greater than 15 ($0F), CIO will call the Device Handler Device Dependent Command routine. The Device Handler must determine if the command is a valid command for that device. The Device Dependent Commands that for FMS are:

Rename
Delete
Lock
Unlock
Point
Note
Format

The FMS Device Dependent Command routine starts at DFMDDC.

DFMDDC

Address – $BA7

Entry Registers – A = Don't Care.
X = IOCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Function:

1) Call SETUP

2) If the command is Format (254), then go to the Format routine, XFORMAT at $D18.

3) If the command is not Format, then check that the command

value is $20 through $26. If the command value is not in this range then exit via the ERDVDC (Command Error) routine.

4) If the command is valid, go to the command via the DCDCVT vector table.

XFORMAT

The XFORMAT routine executes the FORMAT Device Dependent Command.

Address – $D18

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) Issue the format I/O command to the drive. This will cause the drive to perform the physical formating of the disk. If the command returns with good status and there were no bad sectors reported, then continue with the logical format operations. In the event of physical format errors, exit via the ERDBAD error exit.

2) Clear the drive buffer to zero.

3) Set the sector count values into the DVDMSN (VTOC displacement one) and the DVDNSA (VTOC displacement three) fields.

4) Set all 90 sector bit map bits to one (available).

5) Deallocate the first four sectors for the boot sectors.

6) Deallocate the middle nine sectors for the VTOC and the Directory.

7) Write the VTOC to the Disk.

8) Clear the eight directory sectors to zero.

9) Exit via the FGREAT exit.

XDELETE

The XDELETE routine executes the DELETE Device Dependent Command.

Address – $C32

Entry Registers – A = Don't Care.

X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Parameters – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The filename is decoded via the FNDCODE routine.

2) The first filename is searched for via the SFDIR routine.

3) The file, if found, is deleted via the XDEL0 routine.

4) If the file just deleted was DOS.SYS then the boot record is re-written via the DELDOS routine.

5) The directory is searched for the next matching entry. If an entry is found then the process repeats at step three. If no further matching directory entries are found, then exit via FGREAT.

XDEL0

The XDEL0 routine is used to delete the file whose directory entry is indicated by the CDIRD (current Directory Displacement) byte ($1305).

Address – $C53

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The OPVTOC routine is called to insure that the disk is not write protected.

2) The TSTLOCK routine is called to insure that the file is not locked.

3) The file deleted bit is set in the directory entry flag and the directory sector is written back to the disk.

4) The VTOC sector bit map bits for the sectors in the file are set to one to make them eligible for reuse. This process is achieved by reading each sector in the file sector chain and calling the FRESECT routine to change the VTOC bit map.

5) The VTOC Write Required Bit is set so that the VTOC will be written back to the disk.

XRENAME

The XRENAME routine executes the RENAME Device Dependent Command.

Address – $BD9

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The filename is decoded via the FNDCODE routine.

2) The directory is searched for the first entry to be renamed. If no entry is found then the ERFNF (File not found) exit is taken.

3) The TSTLOCK routine is called to insure that the file is not locked.

4) If TSTDOS determines that the old filename is DOS.SYS then the boot record is rewritten via the DELDOS routine.

5) If new filename is DOS.SYS, then the boot record is rewritten via the SETDOS routine.

6) The filename in the directory is changed to the new filename.

7) The directory sector is rewritten.

8) The directory is searched for the next filename match. If a match is found, then the process repeats at step three. If no further match is found then, exit via FGREAT.

XLOCK And XUNLOCK

The XLOCK routine executes the LOCK Device Dependent Command. The XUNLOCK routine executes the UNLOCK Device Dependent Command.

Address – $C7C

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The XLOCK entry sets the LOCK bit value, DFDLOC ($20), into TEMP4. The XUNLOCK entry sets a zero value into TEMP4. Both routines then go to XLCOM.

2) The filename is decoded via the FNDCODE routine.

3) The directory is searched for the first file entry match. If no match is found, the ERFNF (file not found) exit is taken.

4) The files directory flag is modified to either LOCKED or UNLOCKED by means of the value previously set into TEMP4.

5) The Directory sector is written back to the disk.

6) The CSFDIR routine is called to find the next filename match. If a match is found, then the process repeats at step four. If no match is found, then exit via FGREAT.

XPOINT

The XPOINT routine executes the POINT Device Dependent Command.

Address – $CBA

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) If the FCBFLG indicates that the file can acquire sectors (Opened for Output or Append), then exit via the ERRPOT (point error) exit.

2) If the current sector is not the same as the sector POINTed to by the IOCB AUX3 and AUX4 fields, then write the current sector back to the disk (if it has been changed).

3) Read the POINTed to sector into the sector buffer.

4) Set the FCB next byte pointer, FCBDLN, to the value indicated by the user Point data in the IOCB AUX5 field.

5) Exit to FGREAT.

XNOTE

The XNOTE routine executes the NOTE Device Dependent Command.

Address – $D03

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The current sector number and data displacement into the sector is moved to the appropriate IOCB fields, ICAUX3, ICAUX4, ICAUX5.

2) Exit via GREAT.

Chapter Eight

FMS OPEN ROUTINES

The FMS Open routine, DFMOPN, is called directly by CIO via the FMS Device Vector Table, DFMSDH at $7CB.

DFMOPN

The DFMOPN routine is the FMS file open routine.

Address – $8AB

Entry Registers – A = Don't Care.
X = IOCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) Initialize for this operation by calling SETUP.

2) Decode the filename via FNDCODE.

3) Examine the open code in ICAUX1 for the open-for-directory-read command. If this is a directory read command, go to LISTDIR.

4) If not a directory read, then search the directory for the first match on the file name and save the resulting search condition on the stack.

5) Determine the exact type of Open operation to be performed by examining the IOCB ACUX1 field. If INPUT, go to DFOIN. If Output, go to DFOUT. If Update, go to DFOUPD. If Append, go to DFOAPN. If none of the above, exit via the ERDVDC (device command error) exit.

DFOIN

DFOIN ($8D8) is entered when opening a file for Input. The routine pops the stack to determine if the directory search for the file name was successful. If the file name was found in the directory, then go to DFOUI. If the search was not successful, then exit to ERFNF (file not found).

DFOUPD

DFOUPD ($8DD) is entered when opening a file for Update (Input and Output). The routine pops the stack to determine if the file name was found in the directory. If the file was not found, then exit to ERFNF (file not found). If the file was found, insure that the file is not Locked by calling TSTLOCK. If the file is unlocked, then continue at DFOUI.

DFOUI

DFOUI ($8E3) is entered to finish opening a file for Input or Update. The read setup routine, DFRDSU, is called. FMS then exits via the GREAT exit.

DFDRDSU

DFDRDSU ($9AE) is entered to set up a data file for reading. It begins by calling SETFCB to set some standard file information into the FCB. It continues by setting up the FCB with various other parameters to read the first data sector in the file. This sector is read via the RDNS0 routine. When the sector has been read into the sector buffer, the code returns to the caller.

DFOAPN

DFOAPN ($BEC) is entered to open a file for Append.

1) Pop the stack to determine if the file has been found in the directory. If the file was not found exit via ERFNF.
2) If the file was created by DOS 1, then exit via ERAPO.
3) Insure the file is not locked by calling TSTLOCK.
4) Insure the diskette is not write protected by calling OPVTOC.
5) Allocate a new sector for the start of the Append chain by calling GETSECTOR.
6) Save the sector number of the sector obtained in FCBSSN so that it will be available when the file is closed.

7) Continue opening the file as if it were being opened for Output at DHFOX2.

DFOOUT

The DFOOUT ($911) routine is entered when opening a file for Output.

1) Pop the stack to determine if the file was found in the directory.

2) If the file was found, then delete it via the XDEL0 ($C53) routine.

3) If the file was not found, then make a new entry in the directory via the code at DFOX1 ($91D).

4) Allocate a data sector for the file via the GETSECTOR routine.

5) Put the necessary information about the file into the directory and write the directory sector back to the disk.

6) Continue at DHFOX2.

DHFOX2

DHFOX2 ($97C) is entered to finish the Open process for files that are being opened for Output or Append.

1) Finish initializing the FCB via SETFCB.

2) If the TSTDOS routine determines that the file name being opened is DOS.SYS, then write out DOS via the WRTDOS routine.

3) Exit via GREAT.

SETFCB

The SETFCB ($995) routine is used in the various Open file routines to place certain common data into the FCB.

Chapter Nine

FMS CLOSE ROUTINES

The FMS close routine is called directly by CIO via the FMS Device Vector Table, DFMSDH at $7CB.

DFMCLS

Address – $B15

Entry Registers – A = Don't Care.
X = IOCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) Initialize via call to SETUP.

2) If the file was not opened for some form of output (Output, Update or Append) then clear the FCB open flag, FCBOTC and exit via FGREAT.

3) If the FCBFLG indicates that the file has not acquired sectors, then continue at CLUPDT to close the Update file.

4) Write the last data sector via WRTLSEC.

5) Read the file's directory sector into the directory buffer via the RRDIR routine.

6) Get the sector count from the directory.

7) If the file was opened for Output (i.e. it is not open for Append), then continue at CLOUT.

8) Read all the data sector of the file until the end-of-file sector is found.

9) Place the sector address of the start of the Append chain into the link sector field of the (old) end-of-file sector.

10) Continue at CLOUT.

CLOUT

The CLOUT ($B50) routine is entered to finish closing a file that had been opened for Output or Append.

1) The sector count field of the directory is updated.
2) The open for output flag is turned off.
3) The file in use flag is set.
4) The directory sector is written back to the disk by the DRTDIR routine.
5) The VTOC sector is written back to the disk by the WRTVTOC routine.
6) The FCB open code flag, FCBOTC, is cleared to zero.
7) Exit via FGREAT.

CLUPDT

The CLUPDT ($B75) is called to finish the closing of a file that had been opened for Update.

1) If the current sector in the sector buffer has been modified then write it back to the disk via the WRCSIO routine.
2) Clear the FCB open flag, FCBOTC, to zero.
3) Exit via FGREAT.

Chapter Ten

GET BYTE ROUTINE

The FMS GET BYTE routine, DFMGET, is called directly by CIO via the FMS Device Vector Table, DFMSDH at $7CB. The GET BYTE routine's function is to get and return the next sequential data byte to CIO.

DFMGET

Address – $ABF

Entry Registers – A = Don't Care.
Y = IOCB number times 16.
X = Don't Care.

Exit Registers – A = Unknown.
Y = Unknown.
X = Unknown.

Functions:

1) Initialize via the SETUP routine.

2) If the FCB is opened for Directory read, then go to GDCHAR.

3) If the current sector is empty, attempt burst I/O (see Burst I/O section), then continue with number four.

4) Read the next sector via the RDNXTS routine. If the read sector operation did not return an end-of-file condition, then continue at step three, else exit via ERREOF (end-of-file error).

5) Get the data byte from the sector and place it in SVDBYT for the exit routines.

6) If the next byte in the file is the end-of-file byte, exit via RETURN with the impending end-of-file condition code ($03), else exit via GREAT.

Chapter Eleven

PUT BYTE ROUTINE

The FMS PUT BYTE routine, DFMPUT, is called directly by CIO via the FMS Device Vector Table, DFMSDH at $7CB. The PUT BYTE routine's function is to place the single data byte transmitted by CIO into the data sector.

DFMPUT

Address – $99C

Entry Registers – A = The "put data" data byte.
X = The IOCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The data byte in the A register is saved in SVDBYT.

2) SETUP is called to initialize for this operation.

3) If the caller was not CIO, then prevent a burst I/O operation from occurring.

4) If the file was not opened for output, then exit via ERDVDC (device command error).

5) If the current data sector is full, write the sector via WRTNXS, then attempt burst I/O (see BURST I/O section). If a burst I/O operation did take place, then get the next byte after the area just written by burst I/O and place it into the SVDBYT cell.

6) Increment the sector data byte count.

7) Move the data byte from SVDBYT to the next available data byte in the sector.

8) Set the sector modified flag in the FCB.

9) Exit via GREAT.

Chapter Twelve

BURST I/O

The CIO is designed to fill or empty a large user buffer with data bytes sent to or received from a device handler, a byte at a time. To fill a thousand-byte buffer, CIO would have to call FMS one thousand times in rapid succession. While the process is simple and easy to implement by both CIO and the Device Handlers, it can be very slow. This is particularly true in the case of FMS which has a great deal of overhead code to go through each time it is called. FMS circumvents most of the CIO/FMS calls for large data transfers via the BURST I/O routines.

Burst I/O operates by reading or writing data sectors directly into the user buffer (Figure 1, data path I). There are a number of tests that must be passed before a burst I/O operation can take place. If any of the tests fail, then the CIO/FMS data transfer reverts to the normal mode of operation.

When the PUT BYTE routine is called, it will call the WTBUR ($A1F) routine when it is ready to start filling a new data sector. WTBUR will not allow a burst I/O operation to happen if the file has been opened for Update. If the file has not been opened for Update, then WTBUR goes to the common read/write burst I/O test routine, TBURST at $A28. If the file has been opened for Update, then exit Burst I/O indicating that a Burst I/O did not happen. When WTBUR calls TBURST, it has the A register set to non-zero to indicate that it is write.

When the GET BYTE routine is called, it will call the RTBUR ($A26) routine when it is ready to read a new data sector. RTBUR indicates that it is read by setting the A register to zero and then enters TBURST.

TBURST

1) Save the A register in BURTYP. This value will indicate if the burst operation is a read or a write.

2) If the I/O command in the IOCB is for text I/O (a transfer that is to end when the Atari end-of-line ($9B) character is transferred), then TBURST will exit indicating (carry set) that a burst I/O operation did not occur.

3) If the user buffer length in the IOCB is not at least a full sector in size, then exit without doing a burst I/O.

4) If all the above tests pass, then perform a burst I/O operation. The first step in the burst I/O operation is to change the zero page sector buffer pointer, ZXBA ($47) from the FMS sector buffer address to the user buffer address.

5) If the operation is read, then read the next sector via RDNXTS. If the read sector operation produced an end-of-file, then go to BUREOF, else go to BBINC.

6) If the operation is write, then the area in the user buffer, where the three bytes of data sector control information is to be placed, will be saved. The data will be written via the WRTNXS routine. The saved user data will then be copied back into the user buffer. The code then continues at BBINC.

BBINC

The BBINC routine is entered after a single burst I/O sector has been read or written. BBINC updates data counters in the FCB and in the IOCB and tests for the end of the Burst I/O.

1) The zero page sector buffer pointer is incremented by the length of data in a sector (125 or 253).

2) The user buffer length is decremented by the length of data in a sector.

3) The TBLEN routine is called to determine if there is enough room left in the user buffer to read or write another full sector (128 or 256 bytes). If another sector can be read or written, then the process repeats at NXTBUR ($A3E).

4) If there is not enough room in the user buffer to perform another full sector read or write, then BUREOF is entered.

BUREOF

1) The final address in the zero page sector pointer, ZSBA ($47), is moved to the IOCB buffer address field.

2) The value in the zero page sector buffer pointer is restored by the SSBA routine.

3) The caller is returned to with the carry cleared to indicate that a burst I/O operation has happened.

Chapter Thirteen

READING THE DIRECTORY AS A FILE

A formatted subset of the data in the Directory can be read as if the Directory were a disk file. This is accomplished by using the open directory code ($02) in the IOCB ICAUX1 byte. When FMS recognizes this code in the Open routine (at $8B1), it will go directly to the LISTDIR routine. The LISTDIR routine prepares the FCB for reading the directory as a file. The GET BYTE routine will recognize the read directory condition from information stored in the FCBOTC field (see $AC2) and go directly to the directory read character I/O routine GDCHAR.

LISTDIR

Address – $DAD

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = Unknown.
Y = Unknown.

Functions:

1) The TEMP4 byte is used to count the characters that have been transmitted by GDBYTE from the formatted line buffer. LISTDIR sets this value to zero to indicate the start of a new formatted line.

2) The SFDIR routine is called to start a wild card search for the file name in the directory.

3) If a match is found then FDENT is called to format the entry and prepare for the GDBYTE calls. Exit via GREAT.

4) If a match is not found, then LDCNT is called to prepare to send the xxx FREE SECTORS line.

GDCHAR

GDCHAR ($DB9) is entered from GET BYTE to get a single data byte from a formatted directory line.

1) The TEMP4 flag is tested. If the value is negative, then all formatted information has been transmitted. Exit is via the ERREOF (end-of-file error) exit.

2) The value in TEMP4 is used as an index into the formatted line buffer to get the next character. The character is placed into SVDBYT for loading into the A register by the RETURN routine.

3) The character retrieved from the buffer is examined for the EOL ($9B) character.

4) If the character is not an EOL, then exit is via GREAT.

5) If the character was an EOL, then the line length is examined to see if the line was a directory entry line (i.e., if the length was 17) or the final xxx FREE SECTORS.

6) If the line was the final line, then TEMP4 is set to a negative value ($80) to indicate that all formatted lines have been sent. Exit is via GREAT.

7) If the line was not the final line, then CSFDIR is called to find the next matching file name.

8) If a file name match is found, then FDENT is called to format the found entry into the formatted line buffer. Exit is via GREAT.

9) If a file name match is not found, then go to LDCNT to format the final line.

LDCNT

LDCNT ($DE9) formats the final line of a directory read.

1) Read the VTOC.

2) Get the free sector count from the VTOC and convert it to ATASCII via the CVDX routine.

3) Move the FREE SECTORS message to the formatted line buffer.

4) EXIT is via FGREAT.

FDENT

The FDENT ($E21) routine formats the current directory entry into the formatted line buffer for subsequent reading by GDBYTE.

1) The directory flag is checked for the file locked condition. If

the file is locked, then the "*" is placed in the formatted line.

2) The file name is moved from the directory entry to the formatted line.

3) The file sector count is converted to ATASCII and placed in the formatted line.

4) The EOL character is placed in the formatted line.

5) Exit is via the RTS instruction.

Chapter Fourteen

SECTOR I/O ROUTINES

The FMS performs sector I/O by calling the SIO routine in the OS ROM (Figure 1, control path 3). All sector I/O calls in the FMS occur from the BSIO routine. There are several other routines that are designed to set up information for BSIO. These routines deal with reading and writing sectors of a particular type such as data sectors, directory sectors, and the VTOC sector.

BSIO

Address – $76C

Entry Registers – A = Sector number most significant byte.
Y = Sector number least significant byte.
X = If 1, then 128 byte I/O (810 drive).
If 2, then 256 byte I/O (815 drive).

Exit Registers – A = Status byte from DCB.
Y = Unknown.
X = IOCB and FCB number times 16.

Functions:

1) The sector number is stored in the DCB from the A,Y register pair. The DCB is the interface control block for SIO calls.

2) If the carry is clear, then the DCB is set up for read data. If the carry is set, then the DCB is set up for write data.

3) The serial bus ID for the disk, and the disk timeout values are placed into the DCB.

4) The error retry counter, RETRY, is set for four retries.

5) The I/O data length is set to 128 or 256 depending upon the data in the X register.

6) The serial I/O routine ($E459) is called to execute the I/O.

7) If the I/O operation was good, then the X register is loaded with the IOCB (and FCB) number times 16 from the CRFCB cell and the status byte from the DCB is loaded into the A register. Return is via the RTS instruction.

8) If the I/O operation was bad, then the retry counter is decremented. If the retry value is positive, then the I/O is retried. If the value is negative, then the routine is exited in the manner described in step seven.

DSIO

The DSIO routine is called to perform data sector I/O operations.

Address – $11F7

Entry Registers – A = Sector number most significant byte.
Y = Sector number least significant byte.
X = IOCB and FCB number times 16.

Exit Registers – A = I/O condition code.
Y = Unknown.
X = IOCB and FCB number times 16.

Functions:

1) The sector buffer address is obtained from the zero page sector buffer pointer ZSBA ($47) and placed in the DCB buffer address field, DCBBUF.

2) The drive type byte is loaded into the X register from DRVTYP. If the drive is an 810, then the value will be one. If the drive is an 815, then the value will be two.

3) BSIO is called.

4) The DSIO caller is returned to via the RTS instruction.

RDDIR And WRTDIR

The RDDIR and the WRTDIR routines are used to perform Directory sector I/O operations. The RDDIR entry ($106E) sets the carry to indicate read. The WRTDIR entry ($1071) clears the carry to indicate write. Both of the routines continue at DIRIO.

DIRIO

1) Save the read/write flag (carry sense) on the stack.

2) Set the address of the directory buffer into the DCB buffer field, DCBBUF.

3) The CDIRS cell contains the number of the directory sector to be read or written. This value ranges from zero to seven. The DIRIO routine creates the actual sector number to read or write by adding $169 to the CDIRS value. The resulting sector number is placed in the A,Y register combination.

4) Continue at DSYSIO.

RDVTOC And WRTVTOC

The RDVTOC and WRTVTOC routine are called to initiate I/O to and from the VTOC sector. The RDVTOC routine ($108B) first checks the write required byte in the VTOC sector buffer. If the value of this byte is not zero, then the VTOC is already in the buffer (and has been changed). If the VTOC is already in the buffer, then the read does not have to be done; therefore, the RDVTOC routine will return to the caller. If the write-required byte is zero, then RDVTOC will clear the carry to indicate that the operation is read. The WRTVTOC routine ($1095) sets the write required byte to zero, then sets the carry to indicate a write operation. Both RDVTOC and WRTVTOC continue at VTIO.

VTIO

1) The read/write flag is pushed onto the stack.

2) The VTOC sector buffer address is moved from the zero page drive buffer address pointer ZDRVA ($45) to the DCB buffer pointer, DCBBUF.

3) The A,Y register combination is loaded with the VTOC sector number ($168).

4) Continue at DSYSIO.

DSYSIO

1) The read/write sense is popped from the stack.

2) The drive type value is loaded into the X register from DRVTYP.

3) BSIO is called.

4) If the I/O operation was good, then return to the caller via the RTS instruction.

5) If the I/O operation was bad, the exit via the ERRSYS exit (fatal system I/O error).

OPVTOC

The OPVTOC routine ($10BF) is used by various FMS routines to insure that the diskette is not write protected before executing functions that will write to the disk. This routine will read the VTOC via RDVTOC and then attempt to write the VTOC via WRTVTOC. If the diskette is write protected, the WRTVTOC will cause an I/O error exit (error number 144). If the diskette is not write protected, then the routine will return to the caller. When OPVTOC does return to the caller, the current disk VTOC is in the drive buffer.

Chapter Fifteen

FILE NAME DECODE ROUTINE

The FNDCODE routine is used to transform the user supplied file name into a form that is usable in FMS for wild card searching of the directory. The primary and extension parts of the user file name are padded with blanks and question marks as required. The following examples show the types of transform performed by FNDCODE:

User File Name	Transformed File Name
D:*.*	??????????
D1:GLOP.*	GLOP ???
D1:GLOP.BAS	GLOP BAS
D2:*.ASM	????????ASM
D:GL?P.S*	GL?P S??
D1:G*	G???????

FNDCODE

Address – $E9E

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Functions:

1) The user file name buffer is searched for the colon (:) delimiter. If the delimiter is not found within 256 characters then exit to ERRFN routine (file name error).

2) The FMS file name buffer, FNAME, is cleared to blanks.

3) The EXTSW byte is set to zero. When EXTSW is zero, the primary file name field is being processed. When EXTSW is

minus, then the extension file name field is being processed.

4) The next character in the user file name buffer is examined.

5) If the character is an *asterisk (*)*, then the field is padded with question mark characters to the end of the field.

6) If the character is a period and the extension field is being processed, then exit via the RTS instruction.

7) If the character is a period and the primary field is being processed, then switch to the extension field processing.

8) If the character is a question mark, then put it into the FNAME via FDSCHAR.

9) If the character is alphanumeric (A through Z, or 0 through 9), then put it into FNAME via FDSCHAR.

10) If the character is none of the above, then assume that end of the filename has been found and exit via the RTS instruction.

11) If a character was stored, then continue at step four.

FDSCHAR

1) If the character counter register, X, indicates that the primary field is full, then exit without storing the character.

2) If the character counter register, X, indicates that the extension field name is full, then exit without storing the character.

3) Store the character into FNAME indexed by the X register.

4) Increment the X register.

5) Return to caller via the RTS instruction.

Chapter Sixteen

DIRECTORY SEARCHING

The Directory search routine searches the directory entries for a file name that matches the name in FNAME. The routine has two entry points: SFDIR which is used to begin the search at the start of the directory, and CSFDIR, which is used to continue searching the directory at the entry just past the previously found matching entry.

The routines have five memory cells that they use for controlling the search operation: DHOLES, DHOLED, CDIRS, CDIRD and SFNUM. The CDIRS cell contains the current relative directory sector number (zero through seven). The CDIRD cell contains the displacement into the directory sector of the current entry. DHOLES gives the relative directory sector number (zero through seven) of the first hole or available entry in the directory. The DHOLED cell gives the displacement to the first available entry that is the hole. The SFNUM cell is used to contain the current file number of the entry being examined. The value in SFNUM will be from zero through 63.

If the value of DHOLES is $FF at the end of the search, then the directory is full.

The directory search routine will exit with the carry clear if a match was found. It will exit with the carry set if no matching entry was found.

SFDIR

The SFDIR routine ($F21) is called to start searching the directory at the start of the directory.

1) Initialize DHOLES, CDIRS, SFNUM to $FF.
2) Initialize CDIRD to $70.
3) Continue at CSFDIR.

CSFDIR

The CSFDIR routine ($F31) is called to continue searching the directory.

1) Increment the file number, SFNUM.

2) Increment CDIRD by the size of a directory entry (16).

3) If the CDIRD is now greater than, or equal to, 128 ($80) then increment CDIRS by one. If the value of CDIRD is now eight, then exit with the carry set to indicate that a match was not found. If CDIRD is less than eight, then read the next directory sector via RDDIR. Set CDIRD to zero.

4) If the directory entry flag field is zero then the end of the used portion of the directory has been reached. If a hole has not been found, then mark this entry as a hole. Exit with the carry set to indicate that the file was not found.

5) If the directory entry flag field indicates that the file is open for output, then skip this entry.

6) If the directory entry flag field indicates that the file has been deleted, and a hole has not been found, then mark this entry as a hole and continue searching the directory.

7) If the file is in use, then check the file name in the directory entry for a match with the name in FNAME. Wild card characters in FNAME (question marks) are assumed to match the corresponding characters in the directory entry file name.

8) If the names match, then exit with the carry clear to indicate that a match was found.

9) If a match was not found, then continue to search the directory.

Chapter Seventeen

WRITE NEXT SECTOR

The write next sector routine, WRTNXS, is used to write a data sector to disk.

Address – $F94

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Functions:

1) If the file has been opened for update, and the sector has not been modified, then do not write the sector. Read the next data sector and then return to caller.

2) If the file has been opened for update, and the sector has been modified, then write the current sector. Read the next data sector into the sector buffer and return to the caller.

3) If the file is not opened for update, then allocate a new sector to the file by calling GETSECTOR.

4) Move the sector byte count from the FCB FCBDLN field to the data sector byte count field.

5) Move the address of the newly acquired sector from the FCB FCBLSN field into the link field of the current data sector.

6) Write the current sector to the disk via WRCSIO.

7) If the I/O was bad, mark the FCB by placing a zero value into FCBOTC as closed and exit via RETURN with the I/O error number as the return code.

8) If the I/O was good, then increment the FCB sector counter field, FCBCNT.

9) Call MVLSN to move the sector number of the link sector number field of the FCB, FCBLSN, to the current sector number field of the FCB, FCBCSN.

10) Set the current data length field of the FCB, FCBDLN, to zero.

11) Set the maximum data length field of the FCB, FCBMLN, to 125 (if 810 drive) or 253 (if 815 drive).

12) Return to user via the RTS instruction.

Chapter Eighteen

READ NEXT SECTOR

The read next sector routine, RDNXTS, reads the next sector in the file sector chain into the sector buffer. If there are no more sectors in the chain, then the routine returns with the carry set to indicate end-of-file. If the routine returns with the carry clear, then the next sector has been read.

RDNXTS

Address – $100F

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Functions:

1) If the file has been opened for Update, then WRTNXS is

called to write the current sector if it has been modified.

2) If the FCB link sector number field, FBCLSN, is zero then there are no further sectors to read. Return to the caller with the carry set to indicate that the end-of-file has been reached.

3) Call MVLSN to move the FCB link sector number field, FCBLSN, the FCB current sector number field, FCBCSN.

4) Call RWCSIO with the carry set to read the next sector.

5) If the I/O operation was bad, exit via the ERRIO exit (I/O error).

6) Insure that the file number in the sector just read agrees with the file number in the FCB. If the file numbers are not the same, exit via the ERFNMM exit (file number mismatch). Note: if the routine was called by delete, return to delete indicating end-of-file.

7) Move the link sector number from the data sector to the FCB link sector field in the FCB, FCBLSN.

8) Move the sector data length information from the data sector to the FCB maximum data length field, FCBMLN.

9) Reset the FCB data length field, FDBDLN, to zero.

10) Return to the caller with the carry clear to indicate that a sector has been read.

Chapter Nineteen

GET AND FREE SECTOR ROUTINES

The get sector routine, GETSECTOR, is called when a new sector is needed. The routine searches the bit map in the VTOC for a free sector. The sector found is deallocated from the bit map and the sector number is returned to the caller. The free sector routine, FRESECT, is given a sector number to be freed. FRESECT locates the required bit map bit in the VTOC and turns it on (sets it to one). The sector is now eligible for reuse.

GETSECTOR

Address – $1106

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Functions:

1) The Y register is used as an index into the bit map bytes.

2) The bit bytes are examined sequentially from the first bit map byte to the last bit map byte until a non-zero byte is found. The displacement to this byte is saved in TEMP1.

3) If no bits are found in the bit map, then the ERRNSA exit (no sectors available) is taken.

4) The number-of-sectors-available-field, in the VTOC, is decremented by one.

5) The VTOC write required byte in the VTOC is set to a non-

zero value to indicate that the VTOC has been changed and must be written back to the disk.

6) The non-zero bit map byte that was found in the bit map search is retrieved. The bits in this byte are shifted left until a bit moves into the carry flag. The carry is then set clear and the bits shifted back to their original position. The byte with the newly allocated sector bit turned off is placed back into the bit map.

7) The number of bits shifted and the index to the bit map byte are used to develop the sector number represented by the bit.

8) The sector number is stored in the FCB link sector field, FCBLSN.

9) The user then returned to via the RTS instruction.

FRESECT

Address – $10C5

Entry Registers – A = Don't Care.
X = IOCB and FCB number times 16.
Y = Don't Care.

Exit Registers – A = Unknown.
X = IOCB and FCB number times 16.
Y = Unknown.

Functions:

1) The sector to be freed is in the FCB current sector field, FCBCSN. If the sector number is zero, then FRESECT exits back to the user via the RTS instruction.

2) The sector number is divided by eight to determine the bit map byte which represents the sector. The remainder from this division represents the bit within the byte.

3) The byte is retrieved from the bit map, the bit is turned on, and the byte placed back into the bit map.

4) The number of available sectors field in the VTOC is incremented by one.

5) The VTOC write required byte is set to non-zero to indicate that the VTOC has been changed and needs to be written back to the disk.

6) The caller is returned to via the RTS instruction.

Chapter Twenty

THE BOOT PROCESS

When the Atari computer is turned on, the routines in the OS ROM will (under certain conditions) read the first sector from the disk in drive one into memory. It will then examine certain specific locations in this record to decide how to boot the disk. In the following discussion, refer to Figure 20-1. The OS ROM code will load BRCNT consecutive sectors (starting with sector one) onto memory, starting at the address contained in BLDADR. When the OS ROM code has finished this task, it will make a JSR call to the code that is seven bytes into the start of the boot area. In the case of FMS, this is the JMP XBCONT instruction at $706. The XBCONT code will continue the boot load process.

The XBCONT code examines the DFSFLG to see if a DOS.SYS file exists. If the file exists, then the sector number of the first sector in DOS.SYS will be in DFLINK. The routine will then read all the sectors in the chain starting at DFLINK into the memory area pointed to by DFLADR. When the entire DOS.SYS file is read into memory, XBCONT returns to the OS ROM code.

The OS ROM code will eventually vector through the BINTADR so that the FMS can initialize itself. In the DOS 2.0S system, BINTADR points into the DUP.SYS code. DUP.SYS then receives control from the OS ROM rather than the FMS. One of the tasks that DUP.SYS performs during its initialization is to call the FMS initialization routine.

XBCONT

The XBCONT routine ($714) is entered by the OS ROM code during the boot process to allow the boot process to continue in the manner best suited for the code being booted.

Functions:

1) If the DFSFLG indicates that a DOS.SYS file does not exist, then the OS ROM is returned to with the carry set to indicate that the boot has failed.

2) The address contained in DFLADR is moved to the zero page address pointer, ZBUFP, and to the DCB buffer pointer field, DCBBUF.

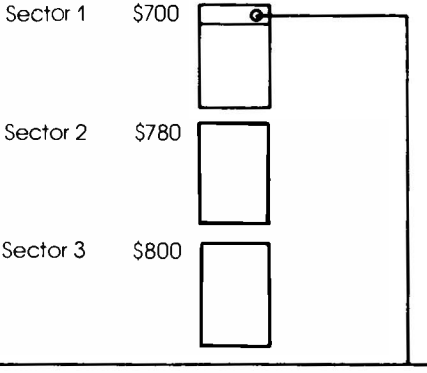
3) The sector number contained in DFLINK is loaded into the A,Y register pair, the carry is cleared to indicate read, and BSIO is called to read a DOS.SYS sector.

4) The next sector link is obtained from the link field of the data sector just read.

5) If the sector link value is zero, then the DOS.SYS end-of-file has been reached. The OS ROM will be returned to with the carry clear to indicate that the boot read was good.

6) If the sector link value is not zero, then the zero page buffer pointer and the DCB buffer pointer are incremented by the amount of data in the sector (125 for 810 drives, 253 for 815 drives).

7) The process continues by reading the next sector into memory.



$700	BFLAG	Flag (=0)
$701	BRCNT	Number of Consecutive Sectors to Read
$702	BLDADR	Address to Load Boot Sectors at
$704	BIWTARR	Initialization Address
$706	JMP XBCONT	Boot Continue Vector
$709	SABYTE	Number of Sector Buffers to Allocate
$70A	DRVBYT	Drive Bits
$70B		Unused
$70C	SASA	Buffer Start Address
$70E	DFSFLG	DOS Flag
$70F	DFLINK	Sector Pointer to DOS.SYS File
$711	BLDISP	Displacement in Sector to Sector Link
$712	DFLADR	Address of Start of DOS.SYS File

Figure 20-1
Boot Records

Chapter Twenty-One

MAINTAINING THE BOOT RECORD

The boot record (sector 1) contains information about the DOS.SYS file. When DOS.SYS is opened for output, FMS will write all of FMS out to the disk as part of the open process. It will also modify sector zero to indicate that a DOS.SYS file exists and to indicate where on the disk it is. If DOS.SYS is ever Deleted or Renamed (to something not DOS.SYS), then the boot record must be modified to indicate that a DOS.SYS file does not exist. If a file is ever renamed to DOS.SYS, then the boot record is modified to point to the new DOS.SYS file.

WRTDOS

The WRTDOS routine ($120A) is used to write a new DOS.SYS file to disk and to update the boot record to indicate that a DOS.SYS file exists.

Functions:

1) The sector number which is contained in the FCB sector number link field, FCBLSN, is used as the first sector of the DOS.SYS file. This sector number is placed in the boot record area in page seven along with the other necessary information.
2) Sectors one, two, and three are written from the memory area from $700 through $87F.
3) The FMS is written to the DOS.SYS via the WD0 routine.
4) Exit is via GREAT.

WD0

The WD0 routine ($1267) is used to write the FMS to the DOS.SYS file.

Functions:

1) The address contained in DFLADR is moved to the zero page

buffer pointer, ZBUFP.

2) The FMS is copied from its area in memory to the file sector buffer in 125 byte chunks.

3) The buffers are written to disk by the WRTNXS routine.

4) The process continues until the entire FMS area has been written.

5) The caller is returned to via the RTS instruction.

DELDOS

The DELDOS routine ($1219) is used to modify the boot record to indicate that DOS.SYS does not exist.

Functions:

1) The DFSFLG is set to zero to indicate that DOS.SYS does not exist.

2) The area from $700 to $87F is written to sectors one, two, and three.

3) The caller is returned to via the RTS instruction.

ATARI DOS 2.0S

```
FMS - 128/256 BYTE SECTOR (2.0S)
     --- Copyright and Author Notice ---

0000          1001          .PAGE "  --- Copyright and Author Notice ---"
              1002 ;
              1003 ;
              1004 ;COPYRIGHT (C) 1978,1979,1980,1982
              1005 ;OPTIMIZED SYSTEMS SOFTWARE,
              1006 ;CUPERTINO, CA.
              1007 ;
              1008 ;THIS PROGRAM MAY NOT BE REPRODUCED,
              1009 ;STORED IN A RETRIEVAL SYSTEM, OR
              1010 ;TRANSMITTED IN WHOLE OR IN PART,
              1011 ;IN ANY FORM, OR BY ANY MEANS, BE IT
              1012 ;ELECTRONIC,MECHANICAL, PHOTOCOPYING,
              1013 ;RECORDING, OR OTHERWISE WITHOUT THE
              1014 ;PRIOR WRITTEN PERMISSION OF
              1015 ;       OPTIMIZED SYSTEMS SOFTWARE, INC.
              1016 ;       10379 LANSDALE AVENUE
              1017 ;       CUPERTINO, CALIFORNIA 95014 (U.S.A.)
              1018 ;
              1019 ;       PHONE:  (408) 446-3099
              1020 ;
              1021 ;
              1022 ;***********************************
              1023 ;
              1024 ; PROGRAMMER PAUL LAUGHTON
              1025 ;   UPDATED:  19-AUG-80
              1026 ;
               1027 ;***********************************
              1028 ;

    System Equates

0000          1029          .PAGE "    System Equates"
              1030 ;***********************************
              1031 ;
              1032 ;
              1033 ;
0700          1034 FMSORG =     $700
0043          1035 FMSZPG =     $43
0340          1036 IOCBORG =    $340
0003          1037 LMASK  =     03          ;LINK MASK
0300          1038 DCBORG =     $300
E453          1039 DHADR  =     $E453
009B          1040 EOL    =     $9B
031A          1041 DEVTAB =     $31A
0020          1042 ZICB   =     $20
02E7          1043 LMADR  =     $2E7
1540          1044 DUPINIT =    $1540       ;INIT ADDR FOR DUP
0102          1045 STAK   =     $102        ;STACK LOC FOR PUT BYTE
00DF          1046 OSBTM  =     $DF         ;HI BYTE OF ADDR LESS THAN OS
                                             SPACE
0246          1047 DSKTIM =     $246        ;ADDR OF OS WORST CASE DISK
                                             TIME OUT
003F          1048 TIMOUT =     15          ;TIME OUT VALUEE OF 15 SECS.

     IOCB

0000          1049          .PAGE "      IOCB"
0000          1050          *=    IOCBORG
              1051 ;
              1052 ; IOCB - IO CONTROL BLOCK
              1053 ; THERE ARE 8 I/O CONTROL BLOCKS
              1054 ; 1 IOCB IS REQUIRED FOR EACH
              1055 ; CURRENTLY OPEN DEVICE OR FILE
              1056 ;
```

```
                1057 IOCB
0340            1058 ICHID  *=    *+1       ;DEVICE NUMBER
0341            1059 ICDNO  *=    *+1       ;DEVICE HANDLER
0342            1060 ICCOM  *=    *+1       ; I/O COMMAND
0343            1061 ICSTA  *=    *+1       ;I/O STATUS
0344            1062 ICBAL  *=    *+1
0345            1063 ICBAH  *=    *+1       ;BUFFER ADR (H,L)
0346            1064 ICPUT  *=    *+2       ;PUT CHAR DH ADDR
0348            1065 ICBLL  *=    *+1
0349            1066 ICBLH  *=    *+1       ;BUFFER LEN (H,L)
034A            1067 ICAUX1 *=    *+1       ;AUX 1
034B            1068 ICAUX2 *=    *+1       ;AUX 2
034C            1069 ICAUX3 *=    *+1       ;AUX 3
034D            1070 ICAUX4 *=    *+1       ;AUX 4
034E            1071 ICAUX5 *=    *+1       ;AUX 5
034F            1072 ICAUX6 *=    *+1       ;AUX 6
0010            1073 ICLEN  =     *-IOCB
                1074 ;
0350            1075        *=    *+ICLEN*7 ;SPACE FOR 7 MORE IOCB'S
                1076 ;
                1077 ; ICCOM VALUE EQUATES
                1078 ;
0001            1079 ICOIN  =     $01       ;OPEN INPUT
0002            1080 ICOOUT =     $02       ;OPEN OUTPUT
0003            1081 ICIO   =     $03       ;OPEN UN/OUT
0004            1082 ICGBR  =     $04       ;GET BINARY RECORD
0005            1083 ICGTR  =     $05       ; GET TEXT RECORD
0006            1084 ICGBC  =     $06       ;GET BINARY CHAR
0007            1085 ICGTC  =     $07       ;GET TEXT CHAR
0008            1086 ICPBR  =     $08       ;GET BINARY RECORD
0009            1087 ICPTR  =     $09       ;PUT TEXT RECORD
000A            1088 ICPBC  =     $0A       ;PUT BINARY CHAR
000B            1089 ICPTC  =     $0B       ;PUT TEXT CHAR
000C            1090 ICCLOSE =    $0C       ;CLOSE FILE
000D            1091 ICSTAT =     $0D       ;GET STATUS
000E            1092 ICDDC  =     $0E       ;DEVICE DEPENDENT
000E            1093 ICMAX  =     $0E       ;MAX VALUE
000F            1094 ICFREE =     $0F       ;IOCB FREE INDICATOR
                1095 ;
                1096 ; ICSTA VALUE EQUATES
                1097 ;
0001            1098 ICSOK  =     $01       ;STATUS GOOD, NO ERRORS
0002            1099 ICSTR  =     $02       ;TRUNCAIATED RECORD


     IOCB

0003            1100 ICSEOF =     $03       ;END OF FILE
0080            1101 ICSBRK =     $80       ;BREAK KEY ABORT
0081            1102 ICSDNR =     $81       ;DEVICE NOT READY
0082            1103 ICSNED =     $82       ;NON EXISTENT DEVICE
0083            1104 ICSDER =     $83       ;DATA ERROR
0084            1105 ICSIVC =     $84       ;INVALID COMMAND
0085            1106 ICSNOP =     $85       ;DEVICE/FILE NOT OPEN
0086            1107 ICSIVN =     $86       ;INVALID IOCB #
0087            1108 ICSWPC =     $87       ;WRITE PROTECT
                1109 ;
                1110 ; ZERO PAGE IOCB LABELS
                1111 ;
0021            1112 ICDNOZ =     ICDNO-IOCB+ZICB
0028            1113 ICBLLZ =     ICBLL-IOCB+ZICB ;BUF LEN
0029            1114 ICBLHZ =     ICBLH-IOCB+ZICB
0024            1115 ICBALZ =     ICBAL-IOCB+ZICB ;BUF ADDR
0025            1116 ICBAHZ =     ICBAH-IOCB+ZICB
0022            1117 ICCOMZ =     ICCOM-IOCB+ZICB
0026            1118 ICPUTZ =     ICPUT-IOCB+ZICB ;PUT RTN ADDR
```

```
      DCB

17A0          1119          .PAGE "      DCB"
17A0          1120          *=    DCBORG
              1121 ;
              1122 ; DCB - DATA CONTROL BLOCK
              1123 ; THE DCB IS AN IOCB LIKE CONTROL
              1124 ; BLOCK USED TO INTERFACE THE DISK
              1125 ; FILE MANAGEMENT SYSTEM TO THE
              1126 ; DISK HANDLER
              1127 ;
              1128 DCB
0300          1129 DCBSBI *=    *+1         ;SERIAL BUS ID
0301          1130 DCBDRV *=    *+1         ;DISK DRIVE #
0302          1131 DCBCMD *=    *+1         ;COMMAND
0303          1132 DCBSTA *=    *+1         ;I/O STATUS
0304          1133 DCBBUF *=    *+2         ;I/O BUFFER ADDR (H,L)
0306          1134 DCBTO  *=    *+2         ;TIME OUT CNT
0308          1135 DCBCNT *=    *+2         ;I/O BYTE COUNT
030A          1136 DCBSEC *=    *+2         ;I/O SECTOR NUMBER
              1137 ;
              1138 ; DCBCMD VALUE EQUATES
              1139 ;
0052          1140 DCBCRS =     'R          ;Read sector      ($52)
0050          1141 DCBCWS =     'P          ;Put sector       ($50)
0053          1142 DCBCST =     'S          ;Status request   ($53)
0021          1143 DCBCFD =     '!          ;FORMAT DISKETTE ($21)
              1144 ;
              1145 ;  *** SPECIAL NOTE:
              1146 ;          DCBCWS may be changed to 'W ($57)
              1147 ;          if desired to have disk perform
              1148 ;          a verifying read after each write.
              1149 ;          Disk write ('W) operations will take
              1150 ;          longer, but will be more reliable.
              1151 ;
              1152 ;
              1153 ; DCBSTA VALUE EQUATES
              1154 ;
0001          1155 DCBSOK =     $01         ;STATUS NORMAL
0081          1156 DCBDNR =     $81         ;DEVICE NOT READY
0082          1157 DCBCNR =     $82         ;CONTROLLER NOT READY
0083          1158 DCBDER =     $83         ;DATA ERROR
0084          1159 DCBIVC =     $84         ;INVALID COMMAND
0087          1160 DCBWPR =     $87         ; WRITE PROTECT


      ZERO PAGE

030C          1161          .PAGE "      ZERO PAGE"
030C          1162          *=    FMSZPG
              1163 ;
0043          1164 ZBUFP  *=    *+2         ;BUFFER PTR
0045          1165 ZDRVA  *=    *+2         ;ZERO PG DRIVE PTR
0047          1166 ZSBA   *=    *+2         ;ZERO PG SECTOR BUF PTR
0049          1167 ERRNO  *=    *+1         ;ERROR NUMBER
              1168 ;
              1169 ;
004A          15            .INCLUDE #E:
004A          20            .INCLUDE #D:ATFMS1.SRC


BOOT RECORD

004A          2000          .PAGE "BOOT RECORD"
004A          2001          *=    FMSORG
              2002 ;
              2003 ; THE FOLLOWING BYTES ARE STORED
              2004 ; ON DISK SECTOR 0 THEY COMPRISE
```

```
                2005 ; THE BOOT LOAD RECORD
                2006 ;
0700 00         2007 BFLG    .BYTE 0          ;BOOT FLAG UNUSED=0
0701 03         2008 BRCNT   .BYTE 3          ;NO CONSECTIVE BOOT RECORDS TO
                                               READ
0702 0007       2009 BLDADR .WORD FMSORG      ;BOOT LOAD ADDR
0704 4015       2010 BINTADR .WORD DUPINIT    ;INIT ADDR
0706 4C1407     2011 BCONT   JMP  XBCONT       ;BOOT READ CONT PT
                2012 ;
                2013 ; THE FOLLOWING BYTES ARE SET BY
                2014 ; THE CONSOLE PROCESSOR. THEY ARE
                2015 ; ACTED UPON DURING FMS INIT ONLY.
                2016 ; THEY ARE PART OF THE BOOT RECORD
                2017 ; THUS DEFINING THE DEFAULT
                2018 ;INITIALIZATION PARMS
                2019 ;
0709 03         2020 SABYTE .BYTE 3           ;MAX # CONCURRENT OPEN FILES
070A 01         2021 DRVBYT .BYTE 01          ;DRIVE BITS
070B 00         2022 SAFBFW .BYTE 0           ;STORAGE ALLOCATION DIR SW
070C 0115       2023 SASA    .WORD ENDFMS     ;STORAGE ALLOCATION START ADDR
                2024 ;
                2025 ; THE FOLLOWING CODE READS THE FMS
                2026 ; AND CONSOLE PROCESSOR (DOS) FROM
                2027 ; THE DOS.SYS FILE
                2028 ;
070E 00         2029 DFSFLG .BYTE 0           ;DOS FLAG
                2030 ;
                2031 ; 00 NO DOS FILE
                2032 ; 01 128 BYTE SECTOR DISK
                2033 ; 02 256 BYTE SECTOR DISK
                2034 ;
070F 00         2035 DFLINK .BYTE 0,0         ;DOS FILE START SECTOR NUMBER
0710 00
0711 7D         2036 BLDISP .BYTE 125         ;DISPL TO SECTOR LINK
0712 CB07       2037 DFLADR .WORD DFMSDH      ;ADDR START OF DOS.SYS FILE
                2038 ;
                2039 XBCONT
00714 AC0E07 2040         LDY  DFSFLG     ;GET DOS FLAG
0717 F036       2041         BEQ  BFAIL      ;BR IF NO DOS.SYS FILE
                2042 ;
0719 AD1207 2043         LDA  DFLADR     ;MOVE LOAD START ADDR
071C 8543   2044         STA  ZBUFP      ;TO ZERO PAGE PTR
071E 8D0403 2045         STA  DCBBUF     ; AND TO DCB
0721 AD1307 2046         LDA  DFLADR+1
0724 8544   2047         STA  ZBUFP+1
0726 8D0503 2048         STA  DCBBUF+1
                2049 ;

BOOT RECORD

                2050 ;
0729 AD1007 2051         LDA  DFLINK+1  ;GET 1ST SECTOR #
072C AC0F07 2052         LDY  DFLINK
072F 18     2053 XBC1    CLC
0730 AE0E07 2054         LDX  DFSFLG    ;LOAD DISK TYPE CODE
0733 206C07 2055         JSR  BSIO      ;GO READ BOOT SECTOR
0736 3017   2056         BMI  BFAIL
                2057 ;
0738 AC1107 2058         LDY  BLDISP    ;POINT TO LINK
073B B143   2059         LDA  (ZBUFP),Y ;GET LINK HI
073D 2903   2060         AND  #LMASK    ;MASK TO LINK BITS
073F 48     2061         PHA
0740 C8     2062         INY
0741 1143   2063         ORA  (ZBUFP),Y
0743 F00E   2064         BEQ  BGOOD
0745 B143   2065         LDA  (ZBUFP),Y ;GET LINK LOW
0747 A8     2066         TAY
```

```
0748 205707 2067         JSR  INCBA      ;GO INCREMENT BUF ADR
            2068 ;
074B 68     2069         PLA             ;RESTORE LINK HI
074C 4C2F07 2070         JMP  XBC1       ;GO READ NEXT SECTOR
            2071 ;
074F A9C0   2072 BFAIL   LDA  #$C0       ;SET FOR CARRY SET
0751 D001   2073         BNE  XBRTN      ;ANY P,Y = $80
            2074 ;
0753 68     2075 BGOOD   PLA             ;SET FOR CARRY CLEAR
            2076 ;
0754 0A     2077 XBRTN   ASL  A
0755 A8     2078         TAY
0756 60     2079         RTS
            2080 ;
0757 18     2081 INCBA   CLC
0758 A543   2082         LDA  ZBUFP      ;INC BUFFER PTR
075A 6D1107 2083         ADC  BLDISP     ;BY DATA LINK (125)
075D 8D0403 2084         STA  DCBBUF
0760 8543   2085         STA  ZBUFP
0762 A544   2086         LDA  ZBUFP+1
0764 6900   2087         ADC  #0
0766 8D0503 2088         STA  DCBBUF+1
0769 8544   2089         STA  ZBUFP+1
076B 60     2090         RTS
            2091 ;

SECTOR I/O

076C        2092         .PAGE "SECTOR I/O"
            2093 ;
            2094 ; BSIO - DO SECTOR I/O
            2095 ;
076C        2096 BSIO    =    *
            2097 ;
076C 8D0B03 2098         STA  DCBSEC+1  ; SET SECTOR HI
076F 8C0A03 2099         STY  DCBSEC    ;SECTOR LO
            2100 ;
0772 A952   2101 BSIOR   LDA  #DCBCRS   ;ASSUME READ SECTOR
0774 A040   2102         LDY  #$40      ;AND GET DATA
0776 9004   2103         BCC  DSIO1     ;BR IF READ
            2104 ;
0778 A950   2105         LDA  #DCBCWS   ;ELSE LOAD WRITE SECTOR
077A A080   2106         LDY  #$80      ;AND PUT DATA
            2107 ;
            2108 DSIO1
077C 8D0203 2109         STA  DCBCMD    ;SET COMMAND
077F 8C0303 2110         STY  DCBSTA    ;AND SIO CMD
            2111 ;
0782 A931   2112         LDA  #$31      ;DISK SERIAL BUS ID
0784 A00F   2113         LDY  #TIMOUT   ;TIMEOUT DEFAULT LOADED
            2114 ;
            2115 DSIO2
0786 8D0003 2116         STA  DCBSBI    ;SET ID
0789 8C0603 2117         STY  DCBTO     ;SET TIME OUT
            2118 ;
078C A903   2119         LDA  #3        ;SET RETRY COUNT
078E 8DFF12 2120         STA  RETRY
            2121 ;
0791 A900   2122         LDA  #0        ;ASSUME 128 BYTE
0793 A080   2123         LDY  #$80      ;SECTOR DISK
0795 CA     2124         DEX
0796 F004   2125         BEQ  DSIO3     ;SO BR
            2126 ;
0798 A901   2127         LDA  #1        ;ELSE IS 256
079A A000   2128         LDY  #0
            2129 ;
079C 8D0903 2130 DSIO3   STA  DCBCNT+1  ;SET I/O BYTE CNT
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079F 8C0803 2131         STY  DCBCNT
            2132 ;
            2133 DSIO4
07A2 2059E4 2134         JSR  $E459      ;CALL SERIAL I/O
07A5 101D   2135         BPL  DSIO5      ;IF GOOD I/O THEN RTS
            2136 ;
07A7 CEFF12 2137         DEC  RETRY      ;TST IF ANOTHER RETRY AVAIL
07AA 3018   2138         BMI  DSIO5      ;NO THEN RTS WITH ERROR
            2139 ;
07AC A240   2140         LDX  #$40       ;DO RETRY-RESET TYPE ACTION
07AE A952   2141         LDA  #DCBCRS    ;ASSUME READ-CK IF IS
07B0 CD0203 2142         CMP  DCBCMD     ;IF COMMAND GET SECTOR

SECTOR I/O

07B3 F009   2143         BEQ  STRTYP     ;YES THEN STORE GETSECTOR IN O
07B5 A921   2144         LDA  #DCBCFD    ;TEST IF FORMAT CMD
07B7 CD0203 2145         CMP  DCBCMD     ;IT ALSO RECIEVES DATA
07BA F002   2146         BEQ  STRTYP     ;YES THEN SET AS GET DATA
07BC A280   2147         LDX  #$80       ;ELSE STORE PUTSECTOR
07BE 8E0303 2148 STRTYP  STX  DCBSTA
            2149 ;
07C1 4CA207 2150         JMP  DSIO4      ;RETRY THE I/O
            2151 ;
07C4 AE0113 2152 DSIO5   LDX  CURFCB     ;RELOAD CURRENT FCB
07C7 AD0303 2153         LDA  DCBSTA     ;AND I/O STATUS SET FLAGS
07CA 60     2154         RTS
            2155 ;

FILE MANGER ENTRY POINT

07CB        2156         .PAGE "FILE MANGER ENTRY POINT"
            2157 ;
            2158 ; DFMSDH - DISK FILE MANAGEMENT DISK
            2159 ; HANDLER ENTRY POINT
            2160 ;
            2161 DFMSDH
07CB AA08   2162         .WORD DFMOPN-1 ;OPEN FILE
07CD 140B   2163         .WORD DFMCLS-1 ;CLOSE FILE
07CF BE0A   2164         .WORD DFMGET-1 ;GET FILE
07D1 CB09   2165         .WORD DFMPUT-1 ;PUT BYTE
07D3 000B   2166         .WORD DFMSTA-1 ;STATUS
07D5 A60B   2167         .WORD DFMDDC-1 ;DEVICE DEPENDENT CMD
            2168 ;
            2169 ; INITIALIZATION CODE
            2170 ;
            2171 ; GIVE ROOM FOR BOOT EXPANSION !!!
            2172 ;
07D7        2173         *=   $7E0
07E0        2174 DINIT   =    *
            2175 ;
            2176 ; SET UP DRIVE INFO
            2177 ;
            2178 ; DRVTBL - 8 BYTES-ONE FOR EACH POSSIBLE DRIVE
            2179 ;
            2180 ; 0 = NO DRIVE
            2181 ; 1 = 128 BYTE SECTOR DRIVE
            2182 ; 2 = 256 BYTE SECTOR DRIVE
            2183 ;
            2184 ; DBUFA(L,H) 8 TWO BYTE ENTRYS THE
            2185 ; DRIVE (VTOC) BUFFER ADR FOR A DRIVE
            2186 ;
07E0 AD0C07 2187         LDA  SASA       ;MOVE START OF ALLOC
07E3 8543   2188         STA  ZBUFP      ;AREA TO ZBUFP
07E5 AD0D07 2189         LDA  SASA+1
07E8 8544   2190         STA  ZBUFP+1
            2191 ;
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07EA AD0A07 2192         LDA  DRVBYT     ;TEMP 1 IS DRIVE
07ED 8D0C13 2193         STA  TEMP1      ;EXCESS BITS FROM BOOT
            2194 ;
07F0 A207   2195         LDX  #7         ;TEMP 2 IS
            2196 ;
07F2 8E0D13 2197 DIA     STX  TEMP2      ;DR # MINUS 1
07F5 0E0C13 2198         ASL  TEMP1      ;SHIFT DR BIT TO CARRY
07F8 B00D   2199         BCS  DIHAVE     ;BR IF DR EXISTS
            2200 ;
07FA A900   2201         LDA  #0         DRVTBL,X ;SET NO DRIVE
07FC 9D1113 2202         STA  DRVTBL,X
07FF 9D2913 2203         STA  DBUFAL,X
0802 9D3113 2204         STA  DBUFAH,X
0805 F036   2205         BEQ  DIDDEC     ;GO DEC DRIVE #
            2206 ;

FILE MANGER ENTRY POINT

            2207 DIHAVE
0807 A005   2208         LDY  #DVDWRQ    ;SET WRITE READ OFF
0809 A900   2209         LDA  #0
080B 9143   2210         STA  (ZBUFP),Y ;IN THE DRIVE BUFFER
            2211 ;
080D E8     2212         INX             ;PUT DR # IN DCB
080E 8E0103 2213         STX  DCBDRV
0811 A953   2214         LDA  #DCBCST    ;GET DRIVE STATUS
0813 8D0203 2215         STA  DCBCMD
0816 2053E4 2216         JSR  DHADR
            2217 ;
0819 A002   2218         LDY  #2         ;ASSUME 256 BYTE DRIVE
081B ADEA02 2219         LDA  $2EA       ;GET STATUS BYTE
081E 2920   2220         AND  #$20
0820 D001   2221         BNE  DI256      ;BR IF 256
0822 88     2222         DEY
            2223 ;
0823 98     2224 DI256   TYA
0824 AE0D13 2225         LDX  TEMP2      ;SET DR TYPE INTO
0827 9D1113 2226         STA  DRVTBL,X ;TBL AT DRIVE DISPL
082A A543   2227         LDA  ZBUFP      ;MOVE CURRENT ALLOC
082C 9D2913 2228         STA  DBUFAL,X ;ADDR TO DBUFA
082F A544   2229         LDA  ZBUFP+1    ;AND INC ALLOC
0831 9D3113 2230         STA  DBUFAH,X ;BY 128 BYTES
0834 207008 2231         JSR  DINCBP     ;VIA DINCBP
            2232 ;
0837 88     2233         DEY             ;IF DR WAS A
0838 F003   2234         BEQ  DIDDEC     ;128 BYTES THEN DONE
            2235 ;
083A 207008 2236         JSR  DINCBP     ;ELSE INC PTR BY 128
            2237 ;
083D CA     2238 DIDDEC  DEX             ;DEC DRIVE
083E 10B2   2239         BPL  DIA        ;BR IF MORE TO TEST
            2240 ;
            2241 ; SET UP SECTOR ALLOCATION TABLE
            2242 ;
            2243 ; THE SECTOR ALLOCATION TABLE (SECTBL)
            2244 ; WAS 16 ONE BYTE ENTRIES ONE FOR
            2245 ; EACH POSSIBLE 128 BYTE BUFFER SABYTE
            2246 ; IN THE BOOT RECORD DETERMINES THE
            2247 ; NUMBER OF ENTRYS TO ALLOCATE
            2248 ; NON-ALLOCATED BYTE ARE MINUS
            2249 ;
            2250 ; SABUF(L,H) CONTAINS THE ADDR OF THE SECTOR BUFFER
            2251 ;
0840 AC0907 2252         LDY  SABYTE     ;GET AND SAVE COUNT
0843 A200   2253         LDX  #0
            2254 ;
0845 A900   2255 DINXTS LDA  #0         ;ASSUME ALLOCATE
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0847 88      2256         DEY              ;DEC COUNT OF ALLOCATED
0848 1001    2257         BPL  DISETS      ;IF PLUS STILL ALLOCATE
084A 98      2258         TYA              ;ELSE DE ALLOCATE

FILE MANGER ENTRY POINT

             2259 ;
084B 9D1913 2260 DISETS STA  SECTBL,X  ;SET ALLOCATE BYTE
084E 98      2261         TYA              ;IF NO ALLOCATED
084F 300D    2262         BMI  DISNI       ;THEN DON'T ALLOCATE BUF
             2263 ;
0851 A543    2264         LDA  ZBUFP       ;MOVE BUFFER ADDR
0853 9D3913 2265         STA  SABUFL,X  ;TO SECTOR BUF PTR
0856 A544    2266         LDA  ZBUFP+1
0858 9D4913 2267         STA  SABUFH,X
085B 207008 2268         JSR  DINCBP      ;INC SECTOR ADDR
             2269 ;
085E E8      2270 DISNI  INX              ;INC BUF #
085F E010    2271         CPX  #16         ;IF NOT ALL 16
0861 D0E2    2272         BNE  DINXTS      ;DO AGAIN
             2273 ;
             2274 ; SET LOW MEM
             2275 ;
0863 A543    2276         LDA  ZBUFP       ;MOVE FINAL ADDR
0865 8DE702 2277         STA  LMADR       ;TO LOW MEM PTR
0868 A544    2278         LDA  ZBUFP+1
086A 8DE802 2279         STA  LMADR+1
             2280 ;
086D 4C7E08 2281         JMP  CLRFCB      ;CONT INIT
             2282 ;
             2283 ; DINCBP - INC ZBUFP BY 128
             2284 ;
0870 18      2285 DINCBP CLC
0871 A543    2286         LDA  ZBUFP
0873 6980    2287         ADC  #128
0875 8543    2288         STA  ZBUFP
0877 A544    2289         LDA  ZBUFP+1
0879 6900    2290         ADC  #0
087B 8544    2291         STA  ZBUFP+1
087D 60      2292         RTS
             2293 ;
             2294 ; CLEAR FCBS TO ZERO
             2295 ;
087E         2296 CLRFCB =    *
087E A07F    2297         LDY  #$7F        ;128 OF FCB
0880 A900    2298         LDA  #0
0882 998113 2299 CFCBX  STA  FCB,Y       ;TO BE CLEARED
0885 88      2300         DEY
0886 D0FA    2301         BNE  CFCBX
             2302 ;

FILE MANGER ENTRY POINT

0888         2303         .PAGE
             2304 ;
0888 A000    2305         LDY  #0
088A B91A03 2306 ADI1   LDA  DEVTAB,Y  ;FIND AH
088D F00C    2307         BEQ  ADI2        ;UNUSED
088F C944    2308         CMP  #'D         ;OR DISK
0891 F008    2309         BEQ  ADI2        ;EMPTY
0893 C8      2310         INY
0894 C8      2311         INY
0895 C8      2312         INY
0896 C01E    2313         CPY  #30
0898 D0F0    2314         BNE  ADI1
089A 00      2315         BRK              ;ELSE BREAK
             2316 ;
```

```
089B A944    2317 ADI2   LDA  #'D        ;SET DISK
089D 991A03  2318        STA  DEVTAB,Y
08A0 A9CB    2319        LDA  #DFMSDH&255 ;SET FMS ADDR
08A2 991B03  2320        STA  DEVTAB+1,Y
08A5 A907    2321        LDA  #DFMSDH/256
08A7 991C03  2322        STA  DEVTAB+2,Y
             2323 ;
08AA 60      2324        RTS

OPEN

08AB         2325        .PAGE "OPEN"
             2326 ;
             2327 ; DFMOPN - FILE OPEN EXECUTION ENTRY PT
             2328 ;
             2329 DFMOPN
08AB 206411  2330        JSR  SETUP      ; DO FCB SET UP
08AE 209E0E  2331        JSR  FNDCODE    ;GO DECODE FILE NAME
08B1 BD4A03  2332        LDA  ICAUX1,X   ; GET AUX1 (OPEN TYPE CODES)
08B4 9D8213  2333        STA  FCBOTC,X   ;PUT INTO FCB
08B7 2902    2334        AND  #OPDIR     ; IS THIS LIST DIRECTORY
08B9 F003    2335        BEQ  OPN1       ;BR IF NOT
08BB 4CAD0D  2336        JMP  LISTDIR    ;GOTO DIR LIST CODE
             2337 ;
08BE 20210F  2338 OPN1   JSR  SFDIR      ;GO SEARCH FILE DIR
08C1 08      2339        PHP
             2340 ;
08C2 BD8213  2341        LDA  FCBOTC,X   ;GET OPEN TYPE CODE
08C5 C904    2342        CMP  #OPIN      ;INPUT
08C7 F00F    2343        BEQ  DFOIN
08C9 C908    2344        CMP  #OPOUT     ;OUTPUT
08CB F044    2345        BEQ  DFOOUT
08CD C90C    2346        CMP  #OPIN+OPOUT ;UPDATE
08CF F00C    2347        BEQ  DFOUPD
08D1 C909    2348        CMP  #OPOUT+OPAPND ;APPEND
08D3 F017    2349        BEQ  DFOAPN
08D5 4CBF12  2350        JMP  ERDVDC     ;ERROR
             2351 ;
             2352 ; DFOIN - OPEN FOR INPUT
             2353 ;
08D8         2354 DFOIN  =    *
08D8 28      2355        PLP             ;GET SEARCH FLAG
08D9 B00E    2356        BCS  OPNER1     ;ERROR IF NOT FOUND
08DB 9006    2357        BCC  DFOUI
             2358 ;
             2359 ; DFOUPD - OPEN FOR UPDATA
             2360 ;
08DD         2361 DFOUPD =    *
08DD 28      2362        PLP             ;GET SEARCH FLAG
08DE B009    2363        BCS  OPNER1     ;BR NOT FOUND
08E0 20AC0C  2364        JSR  TSTLOCK    ;TEST LOCK
             2365 ;
08E3         2366 DFOUI  =    *
08E3 20AE09  2367        JSR  DFRDSU     ;SET UP FOR READ
08E6 4CF012  2368        JMP  GREAT      ;DONE
             2369 ;
08E9 4CBB12  2370 OPNER1 JMP  ERFNF      ;FILE NOT FOUND

OPEN

08EC         2371        .PAGE
             2372 ;
             2373 ; DFOAPN - OPEN APPEND
             2374 ;
08EC         2375 DFOAPN =    *
08EC 28      2376        PLP             ;GET READ STATUS
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08ED B0FA    2377          BCS  OPNER1     ;BR NOT FOUND
08EF AC0513 2378          LDY  CDIRD      ;IF OLD.
08F2 B90114 2379          LDA  FILDIR+DFDFL1,Y ;FILE TYPE
08F5 2902    2380          AND  #DFDNLD    ;THEN
08F7 F015    2381          BEQ  APOER      ;ERROR
08F9 20AC0C 2382          JSR  TSTLOCK    ;TEST LOCKED
08FC 20BF10 2383          JSR  OPVTOC     ;READ VTOC
08FF 200611 2384          JSR  GETSECTOR ;GET A SECTOR
0902 9D8E13 2385          STA  FCBSSN+1,X ;MOVE START SECTOR #
0905 BD8B13 2386          LDA  FCBLSN,X   ;TO START SECTOR #
0908 9D8D13 2387          STA  FCBSSN,X
090B 4C7C09 2388          JMP  DHFOX2     ;CONTINUE AS OPEN
090E 4CB712 2389 APOER    JMP  ERAPO
             2390 ;
             2391 ; DFOOUT - OPEN FOR OUTPUT
             2392 ;
0911         2393 DFOOUT =     *
0911 28      2394          PLP             ;GET SEARCH FLAG
0912 B009    2395          BCS  DFOX1
             2396 ;
0914 20530C 2397          JSR  XDEL0      ;DELETE THE FILE OR FILES
0917 AC0513 2398          LDY  CDIRD
091A 4C4809 2399          JMP  OPN1A
             2400 ;
091D         2401 DFOX1  =     *
091D AD0213 2402          LDA  DHOLES     ;WAS THERE A HOLE
0920 3070    2403          BMI  OPNER2     ;BR IF NO HOLE
0922 8D0613 2404          STA  CDIRS      ;SAVE HOLE SECTOR AS CURRENT
                                           DIR SEC
0925 206E10 2405          JSR  RDDIR      ;GO READ CURRENT DIR SECTOR
0928 AD0313 2406          LDA  DHOLED     ;MOVE HOLE DISPL TO
092B 8D0513 2407          STA  CDIRD      ;CUR DIR DISPL
092E AD0413 2408          LDA  DHFNUM     ;MOVE HOLE FN
0931 8D0713 2409          STA  SFNUM      ;TO CURRENT
0934 20BF10 2410          JSR  OPVTOC
0937 AC0513 2411          LDY  CDIRD
093A A20A    2412          LDX  #10
093C A920    2413          LDA  #$20
093E 990614 2414 OPN1B    STA  FILDIR+DFDPFN,Y ;BLANK FILL FILE ENTRY
                                                 FOR FILE NAME
0941 C8      2415          INY
0942 CA      2416          DEX
0943 10F9    2417          BPL  OPN1B
0945 AE0113 2418          LDX  CURFCB
             2419 ;
0948         2420 OPN1A  =     *
0948 200611 2421          JSR  GETSECTOR ;GET A SECTOR

OPEN

094B AC0513 2422          LDY  CDIRD      ;GET DIR DISPL
094E 990514 2423          STA  FILDIR+DFDSSN+1,Y ;PUT SECTOR INTO DIR
                                                   REC
0951 BD8B13 2424          LDA  FCBLSN,X
0954 990414 2425          STA  FILDIR+DFDSSN,Y
             2426 ;
0957 A943    2427          LDA  #DFDINU+DFDOUT+DFDNLD ;SET DIR ENTRY IN
                                                      USE
0959 990114 2428          STA  FILDIR+DFDFL1,Y
095C A900    2429          LDA  #0         ; SET NOT LOCKED
095E 990314 2430          STA  FILDIR+DFDCNT+1,Y ;SET COUNT = 0
0961 990214 2431          STA  FILDIR+DFDCNT,Y
             2432 ;
0964 A200    2433          LDX  #0
0966 BD5913 2434 OPN2     LDA  FNAME,X    ;MOVE FILE NAME
0969 C93F    2435          CMP  #'?        ;IF WILD CARD
096B F003    2436          BEQ  OPN2A      ;CHANGE TO BLANK
```

```
096D 990614 2437         STA  FILDIR+DFDPFN,Y ;TO DIRECTORY
0970        2438 OPN2A   =    *
0970 C8     2439         INY
0971 E8     2440         INX
0972 E00B   2441         CPX  #11
0974 90F0   2442         BCC  OPN2
            2443 ;
0976 AE0113 2444         LDX  CURFCB      ;RESTORE X REG
0979 207110 2445         JSR  WRTDIR      ;GO WRITE DIRECTORY
097C        2446 DHFOX2  =    *
097C 209509 2447         JSR  SETFCB
097F 20E20F 2448         JSR  WRTN6       ;FIX UP AS IF WRITE
0982 A980   2449 OPN3    LDA  #FCBFAS     ;SET NEW FILE
0984 9D8513 2450         STA  FCBFLG,X
0987 209B12 2451         JSR  TSTDOS      ;IF NOT DOS
098A D003   2452         BNE  DHFOX3      ;BR
098C 4C0A12 2453         JMP  WRTDOS      ;ELSE DO IT
098F        2454 DHFOX3  =    *
098F 4CF012 2455         JMP  GREAT
            2456 ;
0992 20BD12 2457 OPNER2  JSR  ERDFULL     ;DIRECTORY FULL
            2458 ;
            2459 ;
0995        2460 SETFCB  =    *
0995 A900   2461         LDA  #0          ;CLEAR
0997 9D8513 2462         STA  FCBFLG,X    ;FLAG
099A AD0713 2463 OPNF1   LDA  SFNUM       ;MOVE FILE NUM TO FCB
099D 0A     2464         ASL  A
099E 0A     2465         ASL  A
099F 9D8113 2466         STA  FCBFNO,X
09A2 A900   2467         LDA  #0
09A4 9D8713 2468         STA  FCBDLN,X    ;DATA LENGTH
09A7 9D8F13 2469         STA  FCBCNT,X    ;SET CNT = 0
09AA 9D9013 2470         STA  FCBCNT+1,X
09AD 60     2471         RTS
09AE 209509 2472 DFRDSU  JSR  SETFCB      ;SET UP FCB
09B1 AC0513 2473         LDY  CDIRD       ;MOVE START SECTOR TO LINK

OPEN

09B4 B90114 2474         LDA  DFDFL1+FILDIR,Y ;SET NEW
09B7 2902   2475         AND  #DFDNLD     ;SECTOR
09B9 9D8413 2476         STA  FCBSLT,X    ;FLAG
09BC B90414 2477         LDA  FILDIR+DFDSSN,Y
09BF 9D8B13 2478         STA  FCBLSN,X
09C2 B90514 2479         LDA  FILDIR+DFDSSN+1,Y
09C5 9D8C13 2480         STA  FCBLSN+1,X
09C8 201710 2481         JSR  RDNSO       ;READ 1ST SECTOR
09CB 60     2482         RTS
09CC        25           .INCLUDE #E:
09CC        30           .INCLUDE #D:ATFMS2.SRC

PUT BYTE

09CC        3000         .PAGE "PUT BYTE"
            3001 ;
            3002 ; DFMPUT - PUT A FILE BYTE
            3003 ;
            3004 DFMPUT
09CC 8D0813 3005         STA  SVDBYT
09CF BD4103 3006         LDA  ICDNO,X
09D2 8521   3007         STA  ICDNO-IOCB+ZICB
09D4 206411 3008         JSR  SETUP
09D7 AC0013 3009         LDY  ENTSTK      ;CHK TO SEE IF ENTRY WASN'T
                                           FROM CIO
09DA B90201 3010         LDA  STAK,Y      ;IF HI BYTE RTS IS NOT IN OS
                                           ADDR
```

```
09DD C9DF    3011          CMP  #OSBTM     ;SPACE THEN A NON-CIO ENTRY
09DF B004    3012          BCS  FRMCIO     ;BR IF FROM CIO
09E1 A900    3013          LDA  #0         ;ELSE PREVENT FROM DOING BURST
                                            I/O
09E3 8522    3014          STA  ICCOMZ
09E5 BD8213  3015 FRMCIO   LDA  FCBOTC,X   ;IF NOT OPEN
09E8 2908    3016          AND  #OPOUT     ;OUTPUT
09EA F02D    3017          BEQ  PUTER      ;ERROR
09EC BC8713  3018          LDY  FCBDLN,X   ;GET DATA LENGTH
09EF 98      3019          TYA
09F0 DD8613  3020          CMP  FCBMLN,X   ;IF SECTOR NOT FULL
09F3 9011    3021          BCC  PUT1       ;THEN BR
09F5 20940F  3022          JSR  WRTNXS     ;ELSE WRITE FULL SECTOR
09F8 B022    3023          BCS  PEOF       ;BR IF EOF
09FA 201F0A  3024          JSR  WTBUR      ;TEST BURST
09FD A000    3025          LDY  #0
09FF B005    3026          BCS  PUT1       ;BR IF NOT BURST
0A01 B124    3027          LDA  (ICBALZ),Y ;PUT NEXT BYTE
0A03 8D0813  3028          STA  SVDBYT     ;AFTER BURST AREA
             3029 ;
0A06 FE8713  3030 PUT1     INC  FCBDLN,X   ;INC DATA LEN
0A09 AD0813  3031          LDA  SVDBYT     ;GET DATA BYTE
0A0C 9147    3032          STA  (ZSBA),Y   ;AND PUT IN SECTOR BUFFER
             3033 ;
0A0E A940    3034          LDA  #FCBFSM    ;INDICATE SECTOR MODIFIED
0A10 1D8513  3035          ORA  FCBFLG,X
0A13 9D8513  3036          STA  FCBFLG,X
             3037 ;
0A16 4CF012  3038          JMP  GREAT      ;DONE
             3039 ;
0A19 4CBF12  3040 PUTER    JMP  ERDVDC
0A1C 4CF412  3041 PEOF     JMP  ERREOF
```

BURST I/O

```
0A1F         3042          .PAGE "BURST I/O"
             3043 ;
             3044 ; TEST BURST I/O AND DO IF POSSIBLE
             3045 ;
0A1F BD8513  3046 WTBUR    LDA  FCBFLG,X   ;IF NOT AQUIRING SECTORS
0A22 1026    3047          BPL  NOBURST    ;THEN UPDATE AND
0A24 3002    3048          BMI  TBURST     ;NO BURST
             3049 ;
0A26 A900    3050 RTBUR    LDA  #0         ;SET READ TYPE
             3051 ;
0A28 8D1013  3052 TBURST   STA  BURTYP     ;SET BURST TYPE
0A2B A522    3053          LDA  ICCOMZ     ;IF CMD
0A2D 2902    3054          AND  #2         ;IS TEXT MODE
0A2F F019    3055          BEQ  NOBURST    ;THEN NO BURST
             3056 ;
0A31 20AE0A  3057          JSR  TBLEN      ;IF USER BUFFER LESS
0A34 B014    3058          BCS  NOBURST    ;THEN SECTOR, NO BURST
             3059 ;
0A36 A524    3060          LDA  ICBALZ     ;MOVE USER BUFFER
0A38 8547    3061          STA  ZSBA       ;ADDR TO SECTPOR
0A3A A525    3062          LDA  ICBAHZ     ;BUFFER PTR
0A3C 8548    3063          STA  ZSBA+1
             3064 ;
0A3E AD1013  3065 NXTBUR   LDA  BURTYP     ;GET I/O TYPE
0A41 3009    3066          BMI  WRBUR      ;BR IF WRITE
             3067 ;
0A43 200F10  3068          JSR  RDNXTS     ;DO SECTOR READ
0A46 9033    3069          BCC  BBINC      ;BR IF EOF
0A48 B053    3070          BCS  BUREOF     ;BR RD EOF
             3071 ;
0A4A 38      3072 NOBURST SEC             ;INDICATE NO BURST
0A4B 60      3073          RTS
```

```
                3074 ;
0A4C ADF812     3075 WRBUR  LDA  DRVMDL     ;WRITE FULL SECTOR
0A4F 9D8713     3076        STA  FCBDLN,X   ;DATA COUNT
                3077 ;
0A52 A8         3078        TAY
0A53 B147       3079        LDA  (ZSBA),Y   ;SAVE DATA TO BE
0A55 8D0913     3080        STA  SVD1       ;TO BE CLOBBERED
0A58 C8         3081        INY
0A59 B147       3082        LDA  (ZSBA),Y   ;BY WRTNXT
0A5B 8D0A13     3083        STA  SVD2
0A5E C8         3084        INY
0A5F B147       3085        LDA  (ZSBA),Y
0A61 8D0B13     3086        STA  SVD3
                3087 ;
0A64 20940F     3088        JSR  WRTNXS     ;WRITE SECTOR
                3089 ;
0A67 ACF812     3090        LDY  DRVMDL     ;RESTORE CLOBBERED DATA
0A6A AD0913     3091        LDA  SVD1
0A6D 9147       3092        STA  (ZSBA),Y

BURST I/O

0A6F C8         3093        INY
0A70 AD0A13     3094        LDA  SVD2
0A73 9147       3095        STA  (ZSBA),Y
0A75 C8         3096        INY
0A76 AD0B13     3097        LDA  SVD3
0A79 9147       3098        STA  (ZSBA),Y
                3099 ;
                3100 ;
0A7B 18         3101 BBINC  CLC
0A7C A547       3102        LDA  ZSBA       ;INC SECTOR
0A7E 7D8613     3103        ADC  FCBMLN,X   ;BUFFER ADDR BY
0A81 8547       3104        STA  ZSBA       ;ACTUAL DATA LEN
0A83 A548       3105        LDA  ZSBA+1     ;GOT OT PUT
0A85 6900       3106        ADC  #0
0A87 8548       3107        STA  ZSBA+1
                3108 ;
0A89 38         3109        SEC
0A8A A528       3110        LDA  ICBLLZ     ;DEC USER
0A8C FD8613     3111        SBC  FCBMLN,X   ;BUFFER LEN BY
0A8F 8528       3112        STA  ICBLLZ     ;ACTUAL DATA LEN
0A91 A529       3113        LDA  ICBLHZ     ;GOT OR PUT
0A93 E900       3114        SBC  #0
0A95 EA         3115        NOP
0A96 8529       3116        STA  ICBLHZ
                3117 ;
0A98 20AE0A     3118        JSR  TBLEN      ;IF USER BUF LEN
0A9B 90A1       3119        BCC  NXTBUR     ;NOW >= SECTOR, DO AGAIN
                3120 ;
0A9D            3121 BUREOF =    *          ;END OF BURSTING
0A9D A547       3122        LDA  ZSBA       ;MOVE FINAL ADDR BACK
0A9F 8524       3123        STA  ICBALZ     ;TO USER BUF PTR
0AA1 A548       3124        LDA  ZSBA+1
0AA3 8525       3125        STA  ICBAHZ
                3126 ;
0AA5 BC8813     3127        LDY  FCBBUF,X   ;RESTORE ZSBA
0AA8 88         3128        DEY
0AA9 20D011     3129        JSR  SSBA
                3130 ;
0AAC 18         3131 BURST  CLC
0AAD 60         3132        RTS
                3133 ;
                3134 ; TEST USER BUF LEN FOR BURST
                3135 ;
0AAE            3136 TBLEN  = .  *
0AAE ADFE12     3137        LDA  DRVTYP     ;IF DRIVE NOT
```

```
ØAE1 C901    3138         CMP  #1         ;128 BYTE SECTOR TYPE
ØAE3 D004    3139         BNE  TBL256     ;THEN DO 256 BYTE TEST
             3140 ;
ØAE5 A528    3141         LDA  ICBLLZ
ØAE7 30F3    3142         BMI  BURST
             3143 ;
ØAE9 A529    3144 TBL256 LDA   ICBLHZ     ;IF BUF LEN HI >= 256


BURST I/O

ØAEB D0EF    3145         BNE  BURST      ;THEN CAN BURST
ØAED 38      3146         SEC
ØAEE 60      3147         RTS


GET BYTE

ØAEF         3148         .PAGE "GET BYTE"
             3149 ;
             3150 ;
             3151 ; DFMGET - GET A FILE BYTE
             3152 ;
ØAEF         3153 DFMGET =    *
ØAEF 206411 3154         JSR  SETUP      ;GO SET UP
ØAF2 BD8213 3155         LDA  FCBOTC,X   ;IF OPEN FOR
ØAF5 2902    3156         AND  #OPDIR     ;DIR CNT
ØAF7 F003    3157         BEQ  GET1
ØAF9 4CB90D 3158         JMP  GDCHAR     ;THEN GO TO DIR RTN
             3159 ;
ØAFC BD8713 3160 GET1    LDA  FCBDLN,X   ;GET DATA LEN
ØAFF DD8613 3161         CMP  FCBMLN,X   ;TEST EMPTY SECTOR
ØB02 900B    3162         BCC  GET2       ;BR IF NOT EMPTY
ØB04 20260A 3163         JSR  RTBUR      ;DO BURST IF POSSIBLE
ØB07 200F10 3164         JSR  RDNXTS     ;GET NEXT SECTOR
ØB0A 90F0    3165         BCC  GET1       ;BR IF NOT EOF
ØB0C         3166 GEOF    =    *
ØB0C 4CF412 3167         JMP  ERREOF     ;ELSE EOF ERROR
             3168 ;
ØB0F A8      3169 GET2    TAY
ØB10 B147    3170         LDA  (ZSBA),Y   ;GET DATA BYTE
ØB12 8D0813 3171         STA  SVDBYT     ;SAVE THE BYTE
ØB15 C8      3172         INY
ØB16 98      3173         TYA
ØB17 9D8713 3174         STA  FCBDLN,X   ;AND SET NEW VALUE
ØB1A         3175 EFLOOK =    *
ØB1A BC8B13 3176         LDY  FCBLSN,X   ;DO EOF LOOK AHEAD
ØB1D D00F    3177         BNE  GET3       ;IF LSN NOT ZERO
ØB1F BC8C13 3178         LDY  FCBLSN+1,X ;THEN
ØB22 D00A    3179         BNE  GET3       ;NOT EOF
ØB24 DD8613 3180         CMP  FCBMLN,X   ;IF LSN=0 THEN CHECK FOR
ØB27 9005    3181         BCC  GET3       ;LAST BYTE
ØB29 A903    3182         LDA  #$03       ;IF LAST BYTE THEN RTS
ØØAFB 4CD312 3183         JMP  RETURN
             3184 ;
ØB2E 4CF012 3185 GET3    JMP  GREAT


STATUS

ØB31         3186         .PAGE "STATUS"
             3187 ;
             3188 ; DFMSTA - GET A FILE STATUS
             3189 ;
             3190 DFMSTA
ØB31 206411 3191         JSR  SETUP      ; SETUP
ØB34 209E0E 3192         JSR  FNDCODE    ; DECODE FILE NAME
ØB37 20210F 3193         JSR  SFDIR      ;SEARCH FOR FILE
ØB3A B006    3194         BCS  SFNF       ;BR NOT FOUND
```

```
0B0C 20AC0C 3195         JSR  TSTLOCK    ;TEST LOCKED
0B0F 4CF012 3196         JMP  GREAT      ;FILE EXISTS AND UNLOCKED
            3197 ;
0B12 4CBB12 3198 SFNF    JMP  ERFNF
```

CLOSE

```
0B15        3199         .PAGE "CLOSE"
            3200 ;
            3201 ; DFMCLOSE - CLOSE A FILE
            3202 ;
            3203 DFMCLS
0B15 206411 3204         JSR  SETUP
0B18 BD8213 3205         LDA  FCBOTC,X   ;GET OPEN CODE
0B1B 2908   3206         AND  #OPOUT     ;IF NOT OUTPUT
0B1D F04E   3207         BEQ  CLDONE     ;THEN DONE
            3208 ;
0B1F 3E8513 3209         ROL  FCBFLG,X   ;IF NOT ACQUIRING SECTORS
0B22 9051   3210         BCC  CLUPDT     ;THEN IS UPDATE
            3211 ;
0B24 20AB0F 3212         JSR  WRTLSEC    ;WRITE LAST SECTOR
            3213 ;
0B27 20800B 3214         JSR  RRDIR      ;GO GET DIRECTORY
0B2A BD9013 3215         LDA  FCBCNT+1,X ;GET CNT OF SECTORS
0B2D 48     3216         PHA
0B2E BD8F13 3217         LDA  FCBCNT,X
0B31 48     3218         PHA
            3219 ;
0B32 BD8213 3220         LDA  FCBOTC,X   ;GET OPEN CODE
0B35 2901   3221         AND  #OPAPND    ;IF NOT APPEND
0B37 F017   3222         BEQ  CLOUT      ;BR
            3223 ;
0B39 20AE09 3224         JSR  DFRDSU     ;ELSE SET UP FOR READ
0B3C 200F10 3225 APP1    JSR  RDNXTS     ;READ TO EOF
0B3F 90FB   3226         BCC  APP1
            3227 ;
0B41 BD8D13 3228         LDA  FCBSSN,X   ;MOVE START SECTOR
0B44 9D8B13 3229         STA  FCBLSN,X   TO EOF LINK SECTOR
0B47 BD8E13 3230         LDA  FCBSSN+1,X
0B4A 9D8C13 3231         STA  FCBLSN+1,X
0B4D 20B30F 3232         JSR  WRTN2      ;THEN WRITE AS NOT EOF
            3233 ;
0B50 AC0513 3234 CLOUT   LDY  CDIRD      ;GET DIR DISPL
0B53 18     3235         CLC
0B54 68     3236         PLA
0B55 790214 3237         ADC  FILDIR+DFDCNT,Y
0B58 990214 3238         STA  FILDIR+DFDCNT,Y
0B5B 68     3239         PLA
0B5C 790314 3240         ADC  FILDIR+DFDCNT+1,Y
0B5F 990314 3241         STA  FILDIR+DFDCNT+1,Y
            3242 ;
0B62 A942   3243         LDA  #DFDINU+DFDNLD ;SET ENTRY TO IN USE
0B64 990114 3244         STA  FILDIR+DFDFL1,Y
0B67 207110 3245         JSR  WRTDIR     ;WRITE DIR
0B6A 209510 3246         JSR  WRTVTOC    ;WRITE VTOC
            3247 ;
0B6D A900   3248 CLDONE  LDA  #0         ;CLEAR OPEN CODE
0B6F 9D8213 3249         STA  FCBOTC,X
```

CLOSE

```
0B72 4CEA12 3250         JMP  FGREAT
            3251 ;
0B75        3252 CLUPDT  =    *
0B75 3E8513 3253         ROL  FCBFLG,X   ;IF SECTOR NOT MODIFIED
0B78 90F3   3254         BCC  CLDONE     ;THEN DONE
```

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0B7A 20F80F 3255         JSR  WRCSIO     ;ELSE WRITE IT
0B7D 4C6D0B 3256         JMP  CLDONE     ; THEN DONE
            3257 ;

CLOSE

0B80        3258         .PAGE
            3259 ;
            3260 ; RE-READ DIR RECORD
            3261 ;
0B80        3262 RRDIR   =    *
0B80 BD8113 3263         LDA  FCBFNO,X   ;GET FILE NUMBER
0B83 4A     3264         LSR  A
0B84 4A     3265         LSR  A
0B85 8D0713 3266         STA  SFNUM
            3267 ;
            3268 ;
0B88 209B0B 3269         JSR  FNSHFT     ;SET ACU=FILE NO/64
0B8B 8D0613 3270         STA  CDIRS      ;TO GET DIR SECTOR
0B8E 209B0B 3271         JSR  FNSHFT     ;SET ACU TO REM=16
0B91 209D0B 3272         JSR  FNSHF1
0B94 0A     3273         ASL  A
0B95 8D0513 3274         STA  CDIRD      ;TO GET DIR DISPL
            3275 ;
0B98 4C6E10 3276         JMP  RDDIR
0B9B A900   3277 FNSHFT  LDA  #0
0B9D A003   3278 FNSHF1  LDY  #3         ;SHIFT 3 BITS OF
0B9F 1E8113 3279 FNSHF2  ASL  FCBFNO,X   ;FILE NO INTO ACU
0BA2 2A     3280         ROL  A
0BA3 88     3281         DEY
0BA4 D0F9   3282         BNE  FNSHF2
0BA6 60     3283         RTS


DEVICE DEPENDENT COMMAND

0BA7        3284         .PAGE "DEVICE DEPENDENT COMMAND"
            3285 ;
            3286 ; DFMDDC - DEVICE DEPENDENT CMD EXECUTION
            3287 ;
            3288 DFMDDC
0BA7 2006411 3289        JSR  SETUP      ;SET UP FOR EXECUTION
0BAA BD4203 3290         LDA  ICCOM,X    ;GET COMMAND
0BAD C9FE   3291         CMP  #254       ;IS IT FORMAT
0BAF F025   3292         BEQ  XFV        ;BR IF
0BB1 C927   3293         CMP  #MAXDDC    ;TEST RANGE
0BB3 B01E   3294         BCS  DVDCER     ;BR OUT OF RANGE
0BB5 38     3295         SEC
0BB6 E920   3296         SBC  #$20       ;SUBTRACT BASE OF CMDS
0BB8 9019   3297         BCC  DVDCER     ;BR OUT OF RANGE
0BBA 0A     3298         ASL  A
0BBB A8     3299         TAY
0BBC B9C50B 3300         LDA  DVDCVT,Y
0BBF 48     3301         PHA             ;PUSH EXECUTION ADDR
0BC0 B9C60B 3302         LDA  DVDCVT+1,Y
0BC3 48     3303         PHA
0BC4 60     3304         RTS
            3305 ;
            3306 DVDCVT
0BC5 0BD8   3307         .DBYTE XRENAME-1 ;20-RENAME
0BC7 0C31   3308         .DBYTE XDELETE-1 ;21-DELETE
0BC9 0BD2   3309         .DBYTE DVDCER-1 ;INVALID CMD
0BCB 0C7B   3310         .DBYTE XLOCK-1 ;23-LOCK
0BCD 0C82   3311         .DBYTE XUNLOCK-1 ;24-UNLOCK
0BCF 0CB9   3312         .DBYTE XPOINT-1 ;25-POINT
0BD1 0D02   3313         .DBYTE XNOTE-1 ;26-NOTE
            3314 ;
0027        3315 MAXDDC =    $27         ;MAX DVDC+1
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```
                3316 ;
ØBD3 4CBF12     3317 DVDCER JMP  ERDVDC
ØBD6 4C18ØD     3318 XFV    JMP  XFORMAT    ;FORMAT VECTOR

RENAME

ØBD9            3319         .PAGE "RENAME"
                3320 ;
                3321 ;XRENAME - RENAME A FILE OR FILES
                3322 ;
                3323 XRENAME
ØBD9 2Ø9EØE     3324         JSR  FNDCODE    ;DECODE FILE NAME
ØBDC 8CØD13     3325         STY  TEMP2      ;SAVE FNAME INDEX
ØBDF 2Ø21ØF     3326         JSR  SFDIR      ;GO FINE FILE IN DIR
ØBE2 9ØØ3       3327         BCC  XRN1       ;BR IF FOUND
ØBE4 4CBB12     3328         JMP  ERFNF
                3329 ;
ØBE7 2ØACØC     3330 XRN1   JSR  TSTLOCK    ;TEST LOCK
ØBEA 2Ø9B12     3331         JSR  TSTDOS     ; IF NOT DOS
ØBED DØØ3       3332         BNE  XRN1A      ;THEN
ØBEF 2Ø1912     3333         JSR  DELDOS     ; DON'T CHANGE SO
                3334 XRN1A
ØBF2 ACØD13     3335         LDY  TEMP2      ;GET INDEX FOR END FN1
ØBF5 2ØB4ØE     3336         JSR  FNDCNX     ;GO DECODE NEXT FILE NAME
ØBF8 2Ø9B12     3337         JSR  TSTDOS     ;IF NOT DOS
ØBFB DØØF       3338         BNE  XRN1B      ;THEN
ØBFD ACØ513     3339         LDY  CDIRD
ØCØØ B9Ø514     3340         LDA  FILDIR+DFDSSN+1,Y
ØCØ3 48         3341         PHA
ØCØ4 B9Ø414     3342         LDA  FILDIR+DFDSSN,Y
ØCØ7 A8         3343         TAY             ;A,Y NEW DOS
ØCØ8 68         3344         PLA
ØCØ9 2Ø5312     3345         JSR  SETDSO     ;GO WRITE SECTOR ZERO
                3346 ;
                3347 XRN1B
ØCØC A2ØØ       3348         LDX  #Ø
ØCØE ACØ513     3349         LDY  CDIRD
                3350 ;
ØC11 BD5913     3351 XRN2   LDA  FNAME,X    ;MOVE FILE NAME
ØC14 C93F       3352         CMP  #'?        ;FROM FNAME TO DIR ENT
ØC16 FØØ3       3353         BEQ  XRN3       ;BUT DON'T CHANGE WILD CARD
ØC18 99Ø614     3354         STA  FILDIR+DFDPFN,Y ;CHARS INDICATED IN
                                                  FNAME
ØC1B C8         3355 XRN3   INY
ØC1C E8         3356         INX
ØC1D E ØØB      3357         CPX  #11
ØC1F 9ØF8       3358         BCC  XRN2
ØC21 AEØ113     3359         LDX  CURFCB     ;RESTORE X-REG
                3360 ;
ØC24 2Ø711Ø     3361         JSR  WRTDIR     ;GO WRITE CIR DIR RECORD
                3362 ;
ØC27 2Ø9EØE     3363         JSR  FNDCODE    ;GET OLD FILENAME AGAIN
ØC2A 2Ø31ØF     3364         JSR  CSFDIR     ;CONTINUE SEARCH OF DIR
ØC2D 9ØB8       3365         BCC  XRN1       ;BR IF FOUND ANOTHER
                3366 ;
ØC2F 4CEA12     3367         JMP  FGREAT     ;GO TO GOOD ENDING


DELETE

ØC32            3368         .PAGE "DELETE"
                3369 ;
                3370 ; XDELETE - DELETE ALL FILENAMES THAT MATCH
                3371 ;
                3372 XDELETE
ØC32 2Ø9EØE     3373         JSR  FNDCODE    ;GO DECODE FILENAME
ØC35 2Ø21ØF     3374         JSR  SFDIR      ;SEARCH DIR FOR FILENAME
```

```
0C38 B03F   3375         BCS  DFNF       ;BR NOT FOUND
0C3A        3376 XDELX   =    *
0C3A 20530C 3377         JSR  XDEL0
0C3D 209B12 3378         JSR  TSTDOS
0C40 D003   3379         BNE  XDELY
0C42 201912 3380         JSR  DELDOS
            3381 XDELY
            3382 ;
0C45 207110 3383 XDEL3   JSR  WRTDIR     ;WRITE DIR ENTRY
0C48 20310F 3384         JSR  CSFDIR     ;LOOK FOR NEXT MATCH
0C4B 90ED   3385         BCC  XDELX      ;BR IF FOUND
0C4D 209510 3386         JSR  WRTVTOC
0C50 4CEA12 3387         JMP  FGREAT
            3388 ;
0C53 20BF10 3389 XDEL0   JSR  OPVTOC
            3390 ;
0C56 AC0513 3391 XDEL1   LDY  CDIRD      ;GET DIR DISPL
0C59 20AC0C 3392         JSR  TSTLOCK    ;GO TEST LOCK
0C5C A980   3393         LDA  #DFDEDE    ;LOAD DELETED FLAG
0C5E 990114 3394         STA  FILDIR+DFDFL1,Y ;DELETE FILE
            3395 ;
0C61 20AE09 3396         JSR  DFRDSU
0C64 4C6C0C 3397         JMP  XDEL2A
            3398 ;
0C67 200F10 3399 XDEL2   JSR  RDNXTS     ;READ NEXT SECTOR
0C6A B006   3400         BCS  XDEL4
0C6C        3401 XDEL2A  =    *
0C6C 20C510 3402         JSR  FRESECT    ;FREE CURRENT SECTOR
0C6F 4C670C 3403         JMP  XDEL2
            3404 ;
0C72        3405 XDEL4   =    *
0C72 A005   3406         LDY  #DVDWRQ    ;TURN ON WRITE REQ'D
0C74 A9FF   3407         LDA  #$FF
0C76 9145   3408         STA  (ZDRVA),Y
0C78 60     3409         RTS
            3410 ;
0C79 4CBB12 3411 DFNF    JMP  ERFNF      ;FILE NOT FOUND

LOCK AND UNLOCK

0C7C        3412         .PAGE "LOCK AND UNLOCK"
            3413 ;
            3414 ; XLOCK - LOCK A FILE
            3415 ; XUNLOCK - UNLOCK A FILE
            3416 ;
            3417 XLOCK
0C7C A920   3418         LDA  #DFDLOC    ; SET LOCK
0C7E 8D0F13 3419         STA  TEMP4
0C81 D005   3420         BNE  XLCOM      ;GO TO COMMON
            3421 XUNLOCK
0C83 A900   3422         LDA  #0         ;SET UNLOCK
0C85 8D0F13 3423         STA  TEMP4
            3424 ;
0C88 209E0E 3425 XLCOM   JSR  FNDCODE    ; DECODE FILE NAME
0C8B 20210F 3426         JSR  SFDIR      ;FIND 1ST MATCH
0C8E 9003   3427         BCC  XLC1       ;BR MATCH FOUND
0C90 4CBB12 3428         JMP  ERFNF      ;BR NOT FOUND
            3429 ;
0C93 AC0513 3430 XLC1    LDY  CDIRD      ;GET CURRENT DISPL
0C96 B90114 3431         LDA  FILDIR+DFDFL1,Y ;GET LOCK BYTE
0C99 29DF   3432         AND  #$DF       ;TURN OFF LOCK
0C9B 0D0F13 3433         ORA  TEMP4      ;OR IN LOCK/UNLOCK
0C9E 990114 3434         STA  FILDIR+DFDFL1,Y ;SET NEW LOCK BYTE
0CA1 207110 3435         JSR  WRTDIR     ;GO WRITE
            3436 ;
0CA4 20310F 3437         JSR  CSFDIR     ;LOOK FOR NEXT MATCH
0CA7 90EA   3438         BCC  XLC1       ;BR FOUND
```

```
ØCA9 4CEA12 3439         JMP  FGREAT     ;ELSE DONE
            3440 ;
            3441 ; TSTLOCK - TEST FILE LOCKED
            3442 ;
            3443 TSTLOCK
ØCAC ACØ513 3444         LDY  CDIRD      ;GET DIR DISPL
ØCAF B90114 3445         LDA  FILDIR+DFDFL1,Y ;LOAD LOCK BYTE
ØCB2 2920   3446         AND  #DFDLOC    ;MASK LOCK BIT
ØCB4 D001   3447         BNE  TLF        ;BR IF LOCKED
ØCB6 60     3448         RTS
            3449 ;
ØCB7 4CC112 3450 TLF     JMP  ERFLOCK


POINT

ØCBA        3451         .PAGE "POINT"
            3452 ;
            3453 ; XPOINT - POINT REQUEST
            3454 ;
            3455 XPOINT
ØCBA BD8513 3456         LDA  FCBFLG,X  ;IF ARQ SECTORS
ØCBD 3041   3457         BMI  PERR1     ;POINT INVALID
ØCBF BD4D03 3458         LDA  ICAUX4,X  ;IF REQUEST IS NOT
ØCC2 DD8A13 3459         CMP  FCBCSN+1,X ;SAME AS CURRENT
ØCC5 D008   3460         BNE  XP1       ;THEN BR
ØCC7 BD4C03 3461         LDA  ICAUX3,X
ØCCA DD8913 3462         CMP  FCBCSN,X
ØCCD F01E   3463         BEQ  XP2       ;ELSE NO NEED TO CHANGE
            3464 ;
ØCCF BD8513 3465 XP1     LDA  FCBFLG,X  ;IF NOT MODIFIED
ØCD2 F008   3466         BEQ  XP1A      ;BR
ØCD4 20F80F 3467         JSR  WRCSIO    ;ELSE WRITE IT
ØCD7 A900   3468         LDA  #0
ØCD9 9D8513 3469         STA  FCBFLG,X
ØCDC        3470 XP1A    =    *
ØCDC BD4D03 3471         LDA  ICAUX4,X
ØCDF 9D8C13 3472         STA  FCBLSN+1,X
ØCE2 BD4C03 3473         LDA  ICAUX3,X
ØCE5 9D8B13 3474         STA  FCBLSN,X
ØCE8 201710 3475         JSR  RDNSO     ;READ REQ SECTOR
ØCEB B00A   3476         BCS  XPERR
            3477 ;
ØCED BD4E03 3478 XP2     LDA  ICAUX5,X  ;TEST REQ DATA LEN
ØCF0 DD8613 3479         CMP  FCBMLN,X  ;LESS THEN MAX
ØCF3 9005   3480         BCC  XP3
ØCF5 F003   3481         BEQ  XP3
ØCF7        3482 XPERR   =    *
ØCF7 4CC312 3483         JMP  ERRPDL    ;IF NOT THEN ERROR
            3484 ;
ØCFA 9D8713 3485 XP3     STA  FCBDLN,X  ;SET NEW DATA LEN
ØCFD 4CF012 3486         JMP  GREAT
            3487 ;
ØD00 4CB912 3488 PERR1   JMP  ERRPOT


NOTE

ØD03        3489         .PAGE "NOTE"
            3490 ;
            3491 ; XNOTE - EXECUTE NOTE REQUEST
            3492 ;
            3493 XNOTE
ØD03 BD8713 3494         LDA  FCBDLN,X  ;DATA LENGHT VALUE
ØD06 9D4E03 3495         STA  ICAUX5,X  ;TO AUX 2
ØD09 BD8913 3496         LDA  FCBCSN,X  ;CUR SEC NO (LO)
ØD0C 9D4C03 3497         STA  ICAUX3,X  ;TO AUX 3
ØD0F BD8A13 3498         LDA  FCBCSN+1,X ;CUR SEC NO (HI)
```

```
ØD..2 9D4DØ3 3499         STA  ICAUX4,X  ;TO AUX 4
ØD..5 4CFØ12 35ØØ         JMP  GREAT

FORMAT

ØD18          3501         .PAGE "FORMAT"
              3502 ;
              3503 ; XFORMAT - FORMAT A DISKETTE
              3504 ;
              3505 XFORMAT
ØD18 A548     3506         LDA  ZSBA+1    ;MOVE VTOC BUF ADR
ØD1A 8DØ5Ø3 3507         STA  DCBBUF+1  ;TO DCB
ØD1D A547     3508         LDA  ZSBA
ØD1F 8DØ4Ø3 3509         STA  DCBBUF
ØD22 A921     3510         LDA  #DCBCFD   ;FORMAT
ØD24 8DØ2Ø3 3511         STA  DCBCMD    ;TO DCB
ØD27 A94Ø     3512         LDA  #$4Ø      ;TELL SIO RECIEVING DATA
ØD29 8DØ3Ø3 3513         STA  DCBSTA
ØD2C AEFE12 3514         LDX  DRVTYP    ;GET DR TYPE 128 OR 256
ØD2F A931     3515         LDA  #$31      ;BUS I.D.
ØD31 AC46Ø2 3516         LDY  DSKTIM    ;GET FORMAT TIME OUT VALUE
ØD34 2Ø86Ø7 3517         JSR  DSIO2     ;GOTO LOCAL DISK HANDLER THEN
                                         SIO
              3518 ;
ØD37 1Ø19     3519         BPL  XFØ       ;IF NO ERRORS CONT FORMATING
ØD39 C09Ø     3520         CPY  #$9Ø      ;ELSE CK FOR DEVICE DONE ERROR
ØD3B DØ12     3521         BNE  XFERR     ;NO, THEN ERROR EXIT
              3522 ;
ØD3D          3523 TSTFMT =    *          ;ELSE CK FOR BAD SECTOR INFO
ØD3D AØØØ     3524         LDY  #Ø        ;RETURNED BY CONTROLLER
ØD3F B147     3525         LDA  (ZSBA),Y
ØD41 C9FF     3526         CMP  #$FF
ØD43 DØØ7     3527         BNE  XFBAD     ;BAD SECTORS RET ERR MSG
ØD45 C8       3528         INY
ØD46 B147     3529         LDA  (ZSBA),Y
ØD48 C9FF     3530         CMP  #$FF
ØD4A FØØ3     3531         BEQ  XFERR     ;NOT BAD SEC ERR, REQ ERR EXIT
ØD4C 4CB512 3532 XFBAD    JMP  ERDBAD
              3533 ;
ØD4F 4CD312 3534 XFERR    JMP  RETURN    ;DO ERROR EXIT
              3535 ;
              3536 XFØ
ØD52 A9ØØ     3537         LDA  #Ø
ØD54 A8       3538         TAY
ØD55 9145     3539 XF1     STA  (ZDRVA),Y
ØD57 C8       3540         INY
ØD58 1ØFB     3541         BPL  XF1
              3542 ;
ØD5A AØØØ     3543         LDY  #Ø        ;SET
ØD5C A9Ø2     3544         LDA  #2        ;TYPE = 2
ØD5E 9145     3545         STA  (ZDRVA),Y
ØD6Ø C8       3546         INY
ØD61 A9C3     3547         LDA  #$C3      ;SET MSN AND
ØD63 9145     3548         STA  (ZDRVA),Y ;NSA=1Ø7=2C3
ØD65 C8       3549         INY
ØD66 C8       3550         INY
ØD67 9145     3551         STA  (ZDRVA),Y

FORMAT

ØD69 A9Ø2     3552         LDA  #$Ø2
ØD6B 88       3553         DEY
ØD6C 9145     3554         STA  (ZDRVA),Y
ØD6E C8       3555         INY
ØD6F C8       3556         INY
ØD7Ø 9145     3557         STA  (ZDRVA),Y
```

```
                3558 ;
ØD72 A00A       3559          LDY  #DVDSMP
ØD74 A9FF       3560          LDA  #$FF       ;SET SECTOR MAP TO
ØD76 9145       3561 XF2      STA  (ZDRVA),Y ;ALL ONES
ØD78 C8         3562          INY
ØD79 C064       3563          CPY  #DVDSMP+90
ØD7B D0F9       3564          BNE  XF2
                3565 ;
ØD7D A90F       3566          LDA  #$0F       ;DEALOCATE 1ST 4 SECTORS
ØD7F A00A       3567          LDY  #DVDSMP    ;FOR BOOT
ØD81 9145       3568          STA  (ZDRVA),Y
                3569 ;
ØD83 A037       3570          LDY  #DVDSMP+45 ;DEALLOCATE MIDDLE 9
ØD85 A900       3571          LDA  #0
ØD87 9145       3572          STA  (ZDRVA),Y ;FOR
ØD89 C8         3573          INY             ;VTOC AND FILE DIR
ØD8A A97F       3574          LDA  #$7F
ØD8C 9145       3575          STA  (ZDRVA),Y
                3576 ;
ØD8E 209510     3577          JSR  WRTVTOC    ;WRITE THE VTOC
                3578 ;
ØD91 A900       3579          LDA  #0         ;0 FILLE DIR SECTORS
ØD93 A8         3580          TAY
ØD94 990114     3581 XF3      STA  FILDIR,Y   ;USE FILE DIR BUFFER
ØD97 C8         3582          INY
ØD98 10FA       3583          BPL  XF3
                3584 ;
ØD9A A907       3585          LDA  #7         ;WRITE TO ALL 8 DIR SECTORS
ØD9C 8D0613     3586          STA  CDIRS
ØD9F 207110     3587 XF4      JSR  WRTDIR
ØDA2 CE0613     3588          DEC  CDIRS
ØDA5 10F8       3589          BPL  XF4
                3590 ;
ØDA7 201912     3591          JSR  DELDOS     ;SET NO DOS
                3592 ;
ØDAA 4CEA12     3593          JMP  FGREAT     ;DONE

LIST DIRECTORY

ØDAD            3594          .PAGE "LIST DIRECTORY"
                3595 ;
                3596 ; LISTDIR - LIST THE DIRECTORY
                3597 ; GDCHAR - GET NEXT DIR CHARACTER
                3598 ; THE DIRECTORY IS LISTED VIA OPEN
                3599 ; LIST DIRECTORY FUNCTION EACH DIR
                3600 ; ENTRY THAT MATCHES THE FILE SPEC
                3601 ; IS CONVERTED TO A PRINTABLE FORMAT
                3602 ; INTO A SECTOR BUFFER.  THE GET BYTE
                3603 ; ENTRY IS USED TO GET THE PRINTABLE
                3604 ; CHARACTERS ONE AT A TIME.  THE
                3605 ; LAST LINE PRINTED IS ALWAYS A
                3606 ; COUNT OF THE NUMBET OF SECTORS IN USE
                3607 ; AND THE NUMBER REMAINING AVAILABLE SECTORS
                3608 ;
                3609 LISTDIR
ØDAD A900       3610          LDA  #0
ØDAF 8D0F13     3611          STA  TEMP4
ØDB2 20210F     3612          JSR  SFDIR      ;SEARCH FOR A FILE NAME
ØDB5 902C       3613          BCC  LDENT1     ;BR IF FOUND
ØDB7 B030       3614          BCS  LDCNT      ;BR IF NOT FOUND
                3615 ;
                3616 GDCHAR
ØDB9 2C0F13     3617          BIT  TEMP4      ;TEST FLAG
ØDBC 3053       3618          BMI  LDDONE     ;BR IF ALL DONE
                3619 ;
ØDBE AC0F13     3620          LDY  TEMP4      ;GET COUNT OF CHARS SENT
ØDC1 B147       3621          LDA  (ZSBA),Y   ;GET NEXT CHAR
```

```
0DC3 8D0813 3622          STA  SVDBYT     ; IN SVDBYT
0DC6 EE0F13 3623          INC  TEMP4      ;INC COUNT
0DC9 C99B   3624          CMP  #EOL       ;TEST IF EOL DONE
0DCB D009   3625          BNE  GDCRTN     ;BR NOT EOL
0DCD C011   3626          CPY  #17        ;WAS THIS AN ENTRY
0DCF B008   3627          BCS  LDENT      ;BR IF IT WAS
0DD1 A980   3628          LDA  #$80       ;ELSE INDICATE END
0DD3 8D0F13 3629          STA  TEMP4      ;IN TEMP4
            3630 ;
0DD6 4CF012 3631 GDCRTN   JMP  GREAT      ;DONE
            3632 ;
0DD9 A900   3633 LDENT    LDA  #0         ;CLEAR CHAR COUNTER
0DDB 8D0F13 3634          STA  TEMP4
0DDE 20310F 3635          JSR  CSFDIR     ;SEARCH FOR NEXT MATCH
0DE1 B006   3636          BCS  LDCNT      ;BR NO MORE MATCHES
            3637 LDENT1
0DE3 20210E 3638          JSR  FDENT      ;FORMAT ENTRY
0DE6 4CF012 3639          JMP  GREAT      ;DONE
            3640 ;
0DE9 208B10 3641 LDCNT    JSR  RDVTOC     ;READ VTOC
0DEC A004   3642          LDY  #DVDNSA+1  ;GET # SECTOR AVR
0DEE B145   3643          LDA  (ZDRVA),Y
0DF0 48     3644          PHA


LIST DIRECTORY

0DF1 88     3645          DEY
0DF2 B145   3646          LDA  (ZDRVA),Y
0DF4 A8     3647          TAY
0DF5 68     3648          PLA
            3649 ;
0DF6 20570E 3650          JSR  CVDX       ;AND CONVERT
            3651 ;
0DF9 A003   3652          LDY  #3         ;SET EOL
0DFB A20C   3653          LDX  #FSCML-1   ;PUT IN CUTE
0DFD BD140E 3654 MVFSCM   LDA  FSCM,X     ; MSG
0E00 9147   3655          STA  (ZSBA),Y
0E02 C8     3656          INY
0E03 CA     3657          DEX
0E04 10F7   3658          BPL  MVFSCM
0E06 20670E 3659          JSR  CVDY
            3660 ;
0E09 A900   3661          LDA  #0         ; SET CHAR CNT
0E0B 8D0F13 3662          STA  TEMP4
0E0E 4CEA12 3663          JMP  FGREAT
            3664 ;
            3665 LDDONE
0E11 4CF412 3666          JMP  ERREOF     ;END OF FILE
            3667 ;
0E14 53     3668 FSCM     .BYTE "SROTCES EERF "
0E15 52
0E16 4F
0E17 54
0E18 43
0E19 45
0E1A 53
0E1B 20
0E1C 45
0E1D 45
0E1E 52
0E1F 46
0E20 20
0010D       3669 FSCML    =    *-FSCM
0E21        35           .INCLUDE #E:
0E21        40           .INCLUDE #D:ATFMS3.SRC
```

```
LIST DIRECTORY

0E21          4000          .PAGE
              4001 ;
              4002 ; FORMAT DIR ENTRY INTO A SECTOR BUFFER
              4003 ;
              4004 FDENT
0E21 A000     4005          LDY  #0          ;START AT DISPL ZERO
0E23 A920     4006          LDA  #$20        ;START WITH A BLANK
0E25 9147     4007          STA  (ZSBA),Y
0E27 AE0513   4008          LDX  CDIRD
0E2A BD0114   4009          LDA  FILDIR+DFDFL1,X
0E2D 2920     4010          AND  #DFDLOC     ;BUT IF FILE LOCKED
0E2F F004     4011          BEQ  LD1
0E31 A92A     4012          LDA  #'*         ;CHANGE TO AST
0E33 9147     4013          STA  (ZSBA),Y
0E35 C8       4014 LD1      INY
0E36 A920     4015          LDA  #$20        ;FOLLOWED BY A BLANK
0E38 9147     4016          STA  (ZSBA),Y
0E3A C8       4017          INY
              4018 ;
0E3B BD0614   4019 LD2      LDA  FILDIR+DFDPFN,X ;MOVE THE I2 CHAR
0E3E 9147     4020          STA  (ZSBA),Y    ;FILE NAME
0E40 E8       4021          INX
0E41 C8       4022          INY
0E42 C00D     4023          CPY  #13
0E44 90F5     4024          BCC  LD2
              4025 ;
0E46 A920     4026          LDA  #$20        ;FOLLOWED BY A BLANK
0E48 9147     4027          STA  (ZSBA),Y
0E4A C8       4028          INY
0E4B 8C0F13   4029          STY  TEMP4       ;SAVE INDEX = 15
              4030 ;
0E4E AE0513   4031          LDX  CDIRD
0E51 BC0214   4032          LDY  FILDIR+DFDCNT,X ;SET A,Y
0E54 BD0314   4033          LDA  FILDIR+DFDCNT+1,X ;=SECTOR COUNT
              4034 ;
              4035 CVDX
0E57 A264     4036          LDX  #100        ;CONVERT AND MOVE
0E59 20710E   4037          JSR  CVDIGIT     ;100S DIGIT
0E5C A20A     4038          LDX  #10
0E5E 20710E   4039          JSR  CVDIGIT     ;10S DIGIT
0E61 98       4040          TYA
0E62 208D0E   4041          JSR  STDIGIT     ;1S DIGIT
              4042 ;
0E65 A011     4043          LDY  #17         ;THEN PUT OUT
0E67 A99B     4044 CVDY     LDA  #EOL        ;AND EOL
0E69 9147     4045          STA  (ZSBA),Y
0E6B A000     4046          LDY  #0
0E6D 8C0F13   4047          STY  TEMP4       ;SET CHAR CNT = 0
0E70 60       4048          RTS
              4049 ;
0E71 8E0E13   4050 CVDIGIT  STX  TEMP3       ;SAVE DIGIT VALUE

LIST DIRECTORY

0E74 A2FF     4051          LDX  #$FF
              4052 ;
0E76 8D0D13   4053 CVD1     STA  TEMP2       ;SAVE CURR VALUE HI
0E79 8C0C13   4054          STY  TEMP1       ;AND LOW
0E7C E8       4055          INX              ; INC DIGIT COUNTER
0E7D 38       4056          SEC              ;SUBRTACT DIGIT VALUE
0E7E AD0C13   4057          LDA  TEMP1       ;FROM CUR VALUE
0E81 ED0E13   4058          SBC  TEMP3
0E84 A8       4059          TAY
0E85 AD0D13   4060          LDA  TEMP2
0E88 E900     4061          SBC  #0
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0E8A B0EA    4062         BCS  CVD1       ;IF NOT GONE MINUS, DO AGAIN
             4063 ;
0E8C 8A      4064         TXA             ;DIGIT TO ACU
0E8D 0930    4065 STDIGIT ORA #$30        ;PLUS ASCII ZERO
0E8F AC0F13  4066         LDY  TEMP4      ;GET OUTPUT INDEX
0E92 9147    4067         STA  (ZSBA),Y   ;AND SET DIGIT
0E94 EE0F13  4068         INC  TEMP4      ; INC OUTPUT INDEX
0E97 AD0D13  4069         LDA  TEMP2      ;LOAD VALUE HI
0E9A AC0C13  4070         LDY  TEMP1      ;AND VALUE LO
0E9D 60      4071         RTS


FILE NAME DECODE

0E9E         4072         .PAGE "FILE NAME DECODE"
             4073 ;
             4074 ; FNDCODE - DECODE A FILE NAME
             4075 ;
             4076 ; THE USER FILENAME IS POINTED TO BY
             4077 ;ZBUFP, IT IS ON THE FORM P.X WHERE P
             4078 ; IS THE PRIMARY FILE NAME (1 TO 8 CHARS)
             4079 ; AND X IS THE EXTENDED FILE NAME
             4080 ;(0 TO 4 CHARS).  THE PERIOD IS OPTIONAL
             4081 ; (IF NOT PRESENT, THEN NO EXTENSION).
             4082 ; THE DECODED FILENAME WILL BE 12 CHARS
             4083 ; IN LENGTH.  THE P FIELD WILL BE
             4084 ; LEFT JUSTIFIED IN THE 1ST 8 BYTES.
             4085 ; THE X FIELD WILL BE LEFT JUSTIFIED IN
             4086 ; THE LAST 4 BYTES.  BLANKS ARE USED
             4087 ; TO PAD THE FIELDS TO FULL SIZE.
             4088 ; IF THE USER SPECIFIED P OR X FILEDS
             4089 ; CONTAIN MORE THAN 8 OR 4 CHARS, THEN THE
             4090 ; EXTRA CHARS ARE IGNORED.  THE '*'
             4091 ; WILD CARD CHAR WILL CAUSE THE REST
             4092 ; OF THE FIELDS TO FILLED WITH THE
             4093 ; '?' WILD CARD CHAR.  ANY NON-ALPHANUMERIC
             4094 ; CHAR TERMINATES THE FILENAME.
             4095 ;
             4096 FNDCODE
0E9E BD4403  4097         LDA  ICBAL,X
0EA1 8543    4098         STA  ZBUFP
0EA3 BD4503  4099         LDA  ICBAH,X
0EA6 8544    4100         STA  ZBUFP+1
0EA8 A002    4101         LDY  #2         ;FIND THE 'D'
0EAA B143    4102 FD0A    LDA  (ZBUFP),Y
0EAC 88      4103         DEY
0EAD 3058    4104         BMI  FNDERR     ;BR IF 256 CHARS SEEN
0EAF C93A    4105         CMP  #':
0EB1 D0F7    4106         BNE  FD0A
             4107 FD0B
0EB3 C8      4108         INY
             4109 ;
             4110 FNDCNX
0EB4 A20B    4111         LDX  #11        ;CLEAR FILENAME TO BLANKS
0EB6 A920    4112         LDA  #$20
0EB8 9D5913  4113 FD0     STA  FNAME,X
0EBB CA      4114         DEX
0EBC 10FA    4115         BPL  FD0
             4116 ;
0EBE A200    4117         LDX  #0         ;SET FNAME CHAR CNT TO 0
0EC0 8E0C13  4118         STX  EXTSW      ;SET NOT IN EXTENSION
             4119 ;
             4120 ;
0EC3 C8      4121 FD1     INY             ;INC ZBUFP INDEX
0EC4 B143    4122         LDA  (ZBUFP),Y ;GET BUF CHAR
```

```
FILE NAME DECODE

                4123 ;
ØEC6 C92A       4124        CMP  #'*       ;TEST FOR WILD CARDS
ØEC8 DØØB       4125        BNE  FD3       ;BR NOT WILD CARD
                4126 ;
ØECA A93F       4127 FD2    LDA  #'?       ;LOAD ? WILD CARD
ØECC 200A0F     4128        JSR  FDSCHAR   ;GO STORE IT
ØECF 90F9       4129        BCC  FD2       ;BR IF PORX NOT FULL
ØED1 10F0       4130        BPL  FD1       ; BR IF AT START OF X
ØED3 302E       4131        BMI  FDEND     ;BR IF AT X END
                4132 ;
ØED5 C92E       4133 FD3    CMP  #'.       ;WAS CHAR FIELD SEPERATOR
ØED7 DØØC       4134        BNE  FD4       ;BR IF NOT
ØED9 2C0C13     4135        BIT  EXTSW     ;WAS THERE ALREADY 1 CHAR
ØEDC 3025       4136        BMI  FDEND     ;BR IF WAS END
ØEDE A208       4137        LDX  #8        ;ADV FNAME INDEX TO XFIELD
ØEE0 6E0C13     4138        ROR  EXTSW     ;SET EXTSW - MINUS
ØEE3 90DE       4139        BCC  FD1       ;CONT WITH NEXT CHAR
                4140 ;
ØEE5 C93F       4141 FD4    CMP  #'?       WAS IT WILD CARD
ØEE7 F014       4142        BEQ  FD6       ;BR IF WILD CARD
                4143 ;
ØEE9 C941       4144        CMP  #'A       ;IS CHAR ALPHA
ØEEB 9004       4145        BCC  FD5       ;BR NOT ALPHA
ØEED C95B       4146        CMP  #$5B      ;TEXT HI ALPHA
ØEEF 900C       4147        BCC  FD6       ;BR IF NOT APLHA
                4148 ;
ØEF1 E000       4149 FD5    CPX  #0        ;IF FIRST CHAR NOT
ØEF3 F012       4150        BEQ  FNDERR    ;ALPHA THEN ERROR
                4151 ;
ØEF5 C930       4152        CMP  #$30      ;IS CHAR NUMERIC
ØEF7 900A       4153        BCC  FDEND     ;BR NOT NUMERIC (END OF NAME)
ØEF9 C93A       4154        CMP  #$3A      ;TEST NUMERIC HI
ØEFB B006       4155        BCS  FDEND     ; BR NO NUMBER
                4156 ;
ØEFD 200A0F     4157 FD6    JSR  FDSCHAR   ;STORE THE CHAR
ØF00 4CC30E     4158        JMP  FD1       ;AND CONTINUE WITH NEXT
                4159 ;
ØF03 AE0113     4160 FDEND  LDX  CURFCB    ;RESTORE X REG
ØF06 60         4161        RTS
                4162 ;
ØF07 4CC512     4163 FNDERR JMP  ERRFN     ;INDICATE FILENAME ERROR

FMS - 128/256 BYTE SECTOR (2.0S)
FILE NAME DECODE

ØF0A            4164        .PAGE
                4165 ;
                4166 ; FDSCHAR - STORE FILENAME CHAR
                4167 ;
                4168 ; ON ENTRY
                4169 ; A = CHAR
                4170 ; X = NEXT FN POSITION
                4171 ;
                4172 ; ON EXIT
                4173 ; CARRY - SET IF FIELD FULL
                4174 ; MINUS - IF START OF EXECUTION
                4175 ; PLUS  - IF END OF EXECUTION
                4176 ;
                4177 FDSCHAR
ØF0A E008       4178        CPX  #8        ;AT EXECUTION
ØF0C 900D       4179        BCC  FDSC2     ;BR IF NOT
ØF0E F005       4180        BEQ  FDSC1     ;BR IF 1ST CHAR OF
                4181 ;
ØF10 E00C       4182        CPX  #12       ;AT END OF EXIT
ØF12 9007       4183        BCC  FDSC2     ;BR NOT AT END
```

```
0F14 60      4184         RTS
             4185 ;
0F15 2C0C13 4186 FDSC1    BIT  EXTSW      ;DO NOT STORE CHAR UNLESS
0F18 3001   4187          BMI  FDSC2      ;PERIOD WAS SEEN
0F1A 60     4188          RTS
             4189 ;
0F1B 9D5913 4190 FDSC2    STA  FNAME,X    ;SET CHAR INTO NAME
0F1E E8     4191          INX             ;INC TO NEXT CHAR
0F1F 18     4192          CLC
0F20 60     4193          RTS


DIRECTORY SEARCH

0F21         4194          .PAGE "DIRECTORY SEARCH"
             4195 ;
             4196 ; SFDIR - SEARCH FILE DIRECTORY
             4197 ; CSFDIR - FILE DIRECTORY SEARCH
             4198 ;
             4199 ; THE FILE DIRECTORY IS SEARCHED FOR THE
             4200 ; FILENAME IN FNAME.  THE SEARCH STARTS
             4201 ; AT THE CENTRAL SECTOR+1 AND WILL CONTINUE
             4202 ; FOR UP TO A TOTAL OF 8 SECTORS.  WHEN
             4203 ; TESTING FOR FNAME MATCH, '?' FNAME
             4204 ; CHARS WILL ALWAYS MATCH THE CORESPONDING
             4205 ; DIR FILENAME CHAR.  IF A MATCH IS FOUND
             4206 ; CDIRS CONTAINS THE RELATIVE DIRECTORY SECTOR
             4207 ; NUMBER (0-7) AND CDIRD (AND THE Y REG)
             4208 ; CONTAINS THE DISPLACEMENT OF THE ENTRY.
             4209 ; AFTER A MATCH HAS BEEN FOUND, THE DIRECTORY CAN
             4210 ; BE SEARCHED FOR ANOTHER MATCH VIA THE CSFDIR
             4211 ; ENTRY POINT.  IF A MATCH HAS NOT BEEN FOUND
             4212 ; THEN DHOLES AND DHOLED WILL POINT TO A
             4213 ; DIRECTORY HOLE THAT CAN BE USED.
             4214 ; IF DHOLED = FF THEN THE DIRECTORY IS FULL.
             4215 ; THE CARRY IS RETURNED CLEAR IF FILE FOUND,
             4216 ; SET IF FILE NOT FOUND.
             4217 ;
             4218 SFDIR
0F21 A9FF    4219          LDA  #$FF       ;INIT TO -1
0F23 8D0213 4220          STA  DHOLES     ;DIR HOLE SECTOR
0F26 8D0613 4221          STA  CDIRS      ;CUR DIR SECTOR
0F29 8D0713 4222          STA  SFNUM      ;FILE NUMBER
0F2C A970   4223          LDA  #$70       ;INIT TO -16 (-ENTRY LENGTH)
0F2E 8D0513 4224          STA  CDIRD      ;CUR DIR DISPL
             4225 ;
             4226 CSFDIR
0F31 EE0713 4227          INC  SFNUM
0F34 18     4228          CLC
0F35 AD0513 4229          LDA  CDIRD      ;CDIRD=CDIRD+ENTRY LEN
0F38 6910   4230          ADC  #DFDELN
0F3A 1011   4231          BPL  SFD2       ;IF RESULT <128 THEN BR
             4232 ; ELSE AT END OF DIR SECT
0F3C EE0613 4233          INC  CDIRS      ;INC TO NEXT DIR SECTOR
0F3F A908   4234          LDA  #8         ;TEST END OF DIR
0F41 CD0613 4235          CMP  CDIRS
0F44 9002   4236          BCC  SFD1       ;BR NOT END
0F46 F048   4237          BEQ  SDRTN
             4238 ;
0F48 206E10 4239 SFD1     JSR  RDDIR      ;READ THE NEXT DIR RECORD
0F4B A900   4240          LDA  #0         ;SET DIR DISPL = 0
             4241 ;
0F4D 8D0513 4242 SFD2     STA  CDIRD      ;SET NEW DIR DISPL
0F50 A8     4243          TAY             ;PUT DISPL IN Y AS INDEX
             4244 ;
```

```
DIRECTORY SEARCH

0F5. B90114 4245         LDA  FILDIR+DFDFL1,Y ;GET FLAG 1
0F54 F01D   4246         BEQ  SFDSH      ;BR IF UNUSED (END OF USED
                                          ENTRIES)
0F56 301B   4247         BMI  SFDSH      ;BR IF DELETED
0F58 2901   4248         AND  #DFDOUT    ;IF OPEN OUTPUT
0F5A D0D5   4249         BNE  CSFDIR     ;DON'T FIND IT
            4250 ;
            4251 ; ENTRY IN USE, TEST FOR MATCH
0F5C A200   4252         LDX  #0         ;TEST MATCH ON 12 CHARS
0F5E BD5913 4253 SFD3    LDA  FNAME,X    ;FILE NAME CHAR
0F61 C93F   4254         CMP  #'?        ;IS FNC WILD CARD
0F63 F005   4255         BEQ  SFD4       ;THEN IT MATCHES
0F65 D90614 4256         CMP  FILDIR+DFDPFN,Y ;ELSE IT MUST MATCH FOR
                                               REAC
0F68 D0C7   4257         BNE  CSFDIR     ;IF NOT MATCH THEN TRY NEXT
0F6A E8     4258 SFD4    INX             ;INC CHAR CNT
0F6B C8     4259         INY
0F6C E00B   4260         CPX  #11        ;TEST ALL
0F6E D0EE   4261         BNE  SFD3       ;AND CONTINUE CHECK
            4262 ;
0F70 18     4263         CLC             ;WE HAVE A MATCH
0F71 901D   4264         BCC  SDRTN
            4265 ;
            4266 SFDSH
0F73 AD0213 4267         LDA  DHOLES     ;IF DHOLES NOT MINUS
0F76 1012   4268         BPL  SFDSH1     ;THEN ALREADY HAVE A GOOD HOLE
            4269 ;
            4270 ; ELSE
            4271 ;
0F78 AD0613 4272         LDA  CDIRS      ;MOVE CURR DISPL SECTOR
0F7B 8D0213 4273         STA  DHOLES     ;AND CURRENT DIR DISPL
0F7E AD0513 4274         LDA  CDIRD      ;TO HOLE SECTOR AND DISPL
0F81 8D0313 4275         STA  DHOLED
0F84 AD0713 4276         LDA  SFNUM      ;SAVE HOLE
0F87 8D0413 4277         STA  DHFNUM     ;FILE NUMBER
            4278 ;
0F8A B90114 4279 SFDSH1  LDA  FILDIR+DFDFL1,Y ;IF HOLE WAS A DELETED
0F8D 30A2   4280         BMI  CSFDIR     ;ENTRY THEN CONTINUE
            4281 ;
            4282 ; ELSE WE ARE AT END OF
            4283 ;
0F8F 38     4284         SEC             ;USED ENTRIES THUS FILE NOT
                                          FOUND
0F90 AE0113 4285 SDRTN   LDX  CURFCB     ;RESTORE X REG
0F93 60     4286         RTS

WRITE DATA SECTOR

0F94        4287         .PAGE "WRITE DATA SECTOR"
            4288 ;
            4289 ; WRTNXS - WRITE NEXT SECTOR
            4290 ;
            4291 WRTNXS
0F94 BD8513 4292         LDA  FCBFLG,X  ;IF ACQUIRING SECTORS
0F97 300F   4293         BMI  WRTN1     ;THEN NOT UPDATE
            4294 ;
0F99 0A     4295         ASL  A         ;IF SECTOR NOT MODIFIED
0F9A 1009   4296         BPL  WRU1      ;THEN DON'T IT
            4297 ;
0F9C 0A     4298         ASL  A
0F9D 9D8513 4299         STA  FCBFLG,X  ;TURN OFF FLAG BITS
0FA0 20F80F 4300         JSR  WRCSIO    ;WRITE CURRENT SECTOR
0FA3 3024   4301         BMI  WRNERR    ;BR IF BAD I/O
0FA5 4C0F10 4302 WRU1    JMP  RDNXTS    ;ELSE READ NEXT SECTOR
            4303 ;
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ØFA8 2ØØ611 4304 WRTN1  JSR  GETSECTOR ;GET A NEW SECTOR
             4305 ;
ØFAB BD8713 4306 WRTLSEC LDA FCBDLN,X  ;GET DATA LEN
ØFAE ACFB12 4307 WRTLS1 LDY  DRVLBT    ;INTO LAST BYTE
ØFB1 9147   4308        STA  (ZSBA),Y  ;OF SECTOR
             4309 ;
ØFB3 BD8C13 4310 WRTN2  LDA  FCBLSN+1,X ;MOVE LINK SECTOR
ØFB6 1D8113 4311        ORA  FCBFNO,X  ;PLUS FILE NUM
ØFB9 ACF812 4312        LDY  DRVMDL    ;TO BYTES 126,127
ØFBC 9147   4313        STA  (ZSBA),Y  ;OF SECTOR BUFF
ØFBE C8     4314        INY
ØFBF BD8B13 4315        LDA  FCBLSN,X
ØFC2 9147   4316        STA  (ZSBA),Y
             4317 ;
ØFC4 2ØF8ØF 4318        JSR  WRCSIO    ;WRITE SECTOR
ØFC7 1Ø11   4319        BPL  WRTN5     ;BR NOT ERROR
             4320 ;
ØFC9 ADØ3Ø3 4321 WRNERR LDA  DCBSTA    ;SAVE ERROR STATUS
ØFCC 8DØF13 4322        STA  TEMP4
ØFCF A9ØØ   4323        LDA  #Ø        ;CLOSE FILE
ØFD1 9D8213 4324        STA  FCBOTC,X
ØFD4 ADØF13 4325        LDA  TEMP4     ;RECOVER ERROR CODE
ØFD7 4CD312 4326        JMP  RETURN
             4327 ;
             4328 WRTN5
ØFDA FE8F13 4329        INC  FCBCNT,X  ;INC SECTOR CNT
ØFDD DØØ3   4330        BNE  WRTN6
ØFDF FE9Ø13 4331        INC  FCBCNT+1,X
             4332 WRTN6
ØFE2 2ØØ21Ø 4333        JSR  MVLSN     ;LINK TO CUR
ØFE5 A9ØØ   4334        LDA  #Ø
ØFE7 9D8B13 4335        STA  FCBLSN,X  ;LINK = Ø
ØFEA 9D8C13 4336        STA  FCBLSN+1,X
ØFED 9D8713 4337        STA  FCBDLN,X  ;DLN = Ø


WRITE DATA SECTOR

ØFFØ ADF812 4338        LDA  DRVMDL
ØFF3 9D8613 4339        STA  FCBMLN,X
             4340 WRNRTS
ØFF6 18     4341        CLC
ØFF7 6Ø     4342        RTS
             4343 ;
ØFF8 38     4344 WRCSIO SEC            ;WRITE CUR SECTOR
ØFF9 BD8A13 4345 RWCSIO LDA  FCBCSN+1,X
ØFFC BC8913 4346        LDY  FCBCSN,X
ØFFF 4CF711 4347        JMP  DSIO
             4348 ;
1ØØ2 BD8B13 4349 MVLSN  LDA  FCBLSN,X  ;MOVE LINK
1ØØ5 9D8913 4350        STA  FCBCSN,X
1ØØ8 BD8C13 4351        LDA  FCBLSN+1,X
1ØØB 9D8A13 4352        STA  FCBCSN+1,X
1ØØE 6Ø     4353        RTS
             4354 ;
1ØØF         45         .INCLUDE #E:
1ØØF         5Ø         .INCLUDE #D:ATFMS4.SRC


READ DATA SECTOR

1ØØF          5ØØØ          .PAGE "READ DATA SECTOR"
              5ØØ1 ;
              5ØØ2 ; RDNXTS - READ NEXT SECTOR
              5ØØ3 ;
              5ØØ4 RDNXTS
1ØØF BD8513   5ØØ5          LDA  FCBFLG,X  ;IF NOT UPD MODE
1Ø12 F3Ø3     5ØØ6          BEQ  RDNSO     ;BR
```

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1014 4C940F 5007         JMP  WRTNXS     ;ELSE WRITE FIRST
1017        5008 RDNSO   =    *
1017 BD8B13 5009         LDA  FCBLSN,X   ;IF LSN NOT
101A 1D8C13 5010         ORA  FCBLSN+1,X ;ZERO
101D D002   5011         BNE  RDNS1      ;BR
101F 38     5012         SEC             ;ELSE EOF
1020 60     5013         RTS
1021 200210 5014 RDNS1   JSR  MVLSN      ;MOVE LINK TO CURRENT
1024 18     5015         CLC             ;READ
1025 20F90F 5016         JSR  RWCSIO     ;CURRENT SECTOR
1028 3035   5017         BMI  RDIOER     ;BR IF OK READ
            5018 ;
            5019 ; ELSE GOTO I/O ERROR
            5020 ;
102A ACF812 5021         LDY  DRVMDL
102D B147   5022         LDA  (ZSBA),Y   ;TEST FOR SAME
102F 29FC   5023         AND  #$FC       ;FILE NO
1031 DD8113 5024         CMP  FCBFNO,X
1034 D02C   5025         BNE  RDFNMM     ;IF NOT THEN ERROR
            5026 ;
1036 B147   5027         LDA  (ZSBA),Y   ;MOVE LINK SECTOR
1038 2903   5028         AND  #$03
103A 9D8C13 5029         STA  FCBLSN+1,X
103D C8     5030         INY
103E B147   5031         LDA  (ZSBA),Y
1040 9D8B13 5032         STA  FCBLSN,X
            5033 ;
1043 C8     5034         INY             ;INC TO LEN BYTE
1044 B147   5035         LDA  (ZSBA),Y   ;GET LEN BYTE
1046 48     5036         PHA             ;SAVE IT
1047 BD8413 5037         LDA  FCBSLT,X   ;GET SECTOR LEN TYPE
104A D008   5038         BNE  RDNS3      ;BR IF NEW TYPE
            5039 ;
104C 68     5040         PLA             ;GET LEN
104D 3002   5041         BMI  RDNS2      ;BR IF OLD SHORT SECTOR
104F A97D   5042         LDA  #125       ;ELSE SET FULL SECTOR
1051 297F   5043 RDNS2   AND  #$7F       ;TURN OFF MSB
1053 48     5044         PHA             ;BALANCE STACK
            5045 ;
1054 68     5046 RDNS3   PLA
1055 9D8613 5047         STA  FCBMLN,X   ;SET MAX LEN
            5048 ;
1058 A900   5049         LDA  #0         ;SET CUR DATA LEN = 0
105A 9D8713 5050         STA  FCBDLN,X


READ DATA SECTOR

105D 18     5051         CLC
105E 60     5052         RTS
105F 20E512 5053 RDIOER  JSR  ERRIO      ;I/O ERROR
1062        5054 RDFNMM  =    *          ;FILE NUMBER MISMATCH
1062 BD4203 5055         LDA  ICCOM,X
1065 C921   5056         CMP  #$21       ;WAS THIS DELETE
1067 F003   5057         BEQ  RDDELE     ;BR IF DELETE
1069 20C712 5058         JSR  ERFNMM     ;BR NOT DELETE
106C 38     5059 RDDELE  SEC             ;INDICATE EOF TO DELETE
106D 60     5060         RTS
            5061 ;


READ/WRITE DIR

106E        5062         .PAGE "READ/WRITE DIR"
            5063 ;
            5064 ; RDDIR/WRDIR READ/WRITE DIRECTORY
            5065 ;
106E 18     5066 RDDIR   CLC             ;SET READ
```

```
106F 9001     5067          BCC  DIRIO
              5068 ;
1071 38       5069 WRTDIR SEC             ;SET WRITE
              5070 ;
1072 08       5071 DIRIO  PHP             ;SAVE READ WRITE
1073 A914     5072        LDA  #FILDIR/256 ;MOVE BUF ADDR
1075 8D0503   5073        STA  DCBBUF+1  ;TO DCB
1078 A901     5074        LDA  #FILDIR&255
107A 8D0403   5075        STA  DCBBUF
              5076 ;
107D 18       5077        CLC
107E AD0613   5078        LDA  CDIRS     ;CDIRS+
1081 6969     5079        ADC  #$69      ;((40*18)/2)+1
1083 A8       5080        TAY            ;INTO A,Y
1084 A901     5081        LDA  #1        ;IS DIR SECTOR NUMBER
1086 6900     5082        ADC  #0
              5083 ;
1088 4CAB10   5084        JMP  DSYSIO    ;GO DO SYSTEM I/O
              5085 ;

READ/WRITE VTOC

108B          5086          .PAGE "READ/WRITE VTOC"
              5087 ;
              5088 ; RDVTOC/WRCTOC - READ/WRITE VTOC
              5089 ;
              5090 RDVTOC
108B A005     5091        LDY  #DVDWRQ   ;IF WRITE REQD
108D B145     5092        LDA  (ZDRVA),Y
108F F001     5093        BEQ  RDVGO
1091 60       5094        RTS
1092 18       5095 RDVGO  CLC            ;SET READ
1093 9007     5096        BCC  VTIO
              5097 ;
              5098 WRTVTOC
1095 A005     5099 WRVTOC LDY  #DVDWRQ   ;TURN OFF
1097 A900     5100        LDA  #0        ;WRITE READ
1099 9145     5101        STA  (ZDRVA),Y
109B 38       5102        SEC
              5103 ;
              5104 ;
109C 08       5105 VTIO   PHP            ;SAVE R/W
109D A546     5106        LDA  ZDRVA+1   ;MOVE BUF ADDR
109F 8D0503   5107        STA  DCBBUF+1  ;TO DCB
10A2 A545     5108        LDA  ZDRVA
10A4 8D0403   5109        STA  DCBBUF
              5110 ;
10A7 A068     5111        LDY  #$68      ;READ SECTOR
10A9 A901     5112        LDA  #1        ;(40*18)/2
              5113 ;
              5114 DSYSIO
10AB 28       5115        PLP
              5116 DSYSIA
10AC AEFE12   5117        LDX  DRVTYP    ;LOAD DRIVE TYPE
10AF 206C07   5118        JSR  BSIO      ;GO DO I/O
10B2 3001     5119        BMI  DSIOER    ;BR IF ERROR
10B4 60       5120        RTS            ;RETURN
              5121 ;
              5122 ;
10B5 C983     5123 DSIOER CMP  #DCBDER   ;WAS IT DATA ERROR
10B7 F003     5124        BEQ  DEAD      ;BR IF WAS
10B9 4CE512   5125        JMP  ERRIO     ;ELSE USER PROBLEM
              5126 ;
10BC 4CC912   5127 DEAD   JMP  ERRSYS    ;FATAL ERROR
              5128 ;
              5129 ; OPEN VTOC
              5130 ;
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```
                5131 OPVTOC
10BF 208B10     5132        JSR  RDVTOC    ;READ IT
10C2 4C9510     5133        JMP  WRTVTOC   ;THEN WRITE IT
                5134 ;
                5135 ; INSURES NOT PROTECTED
                5136 ;

FREE SECTOR

10C5            5137        .PAGE "FREE SECTOR"
                5138 ;
                5139 ; FRESECT - FREE CURRENT SECTOR
                5140 ;
                5141 FRESECT
10C5 BD8913     5142        LDA  FCBCSN,X
10C8 1D8A13     5143        ORA  FCBCSN+1,X
10CB F038       5144        BEQ  FSRTS
10CD A900       5145        LDA  #0
10CF A003       5146        LDY  #3         ;DIVIDE SECTOR #
10D1 5E8A13     5147 FS1    LSR  FCBCSN+1,X ;BY 3 TO GET BYTE NO
10D4 7E8913     5148        ROR  FCBCSN,X   ;WITH REM IN ACU
10D7 6A         5149        ROR  A
10D8 88         5150        DEY
10D9 D0F6       5151        BNE  FS1
                5152 ;
10DB A005       5153        LDY  #5
10DD 6A         5154 FS2    ROR  A          ;TO FOR BYT BIT NO
10DE 88         5155        DEY
10DF D0FC       5156        BNE  FS2
                5157 ;
10E1 A8         5158        TAY             ;BIT NO (0-7) INTO Y
10E2 A900       5159        LDA  #0
10E4 38         5160        SEC             ;SHIFT IN A BIT
10E5 6A         5161 FS3    ROR  A          ;TO PROPER LOCATION
10E6 88         5162        DEY
10E7 10FC       5163        BPL  FS3
10E9 48         5164        PHA             ;SAVE MASK
10EA BD8913     5165        LDA  FCBCSN,X   ;GET BYTE NO
10ED 690A       5166        ADC  #DVDSMP    ;ADD OFFSET TO SMAP
10EF A8         5167        TAY             ;RESULT IS VTOC INDEX
                5168 ;
10F0 68         5169        PLA             ;GET BIT MASK
10F1 1145       5170        ORA  (ZDRVA),Y ;OF BIT TO BIT MAP
10F3 9145       5171        STA  (ZDRVA),Y ;AND SET RESULTS
                5172 ;
10F5 A003       5173        LDY  #DVDNSA    ;INC NO OF SECTORS AVAIL
10F7 B145       5174        LDA  (ZDRVA),Y
10F9 18         5175        CLC
10FA 6901       5176        ADC  #1
10FC 9145       5177        STA  (ZDRVA),Y
10FE C8         5178        INY
10FF B145       5179        LDA  (ZDRVA),Y
1101 6900       5180        ADC  #0
1103 9145       5181        STA  (ZDRVA),Y
                5182 ;
1105            5183 FSRTS  =    *
1105 60         5184        RTS
                5185 ;


GET SECTOR

11106           5186        .PAGE "GET SECTOR"
                5187 ;
                5188 ; GET SECTOR - GET A FREE SECTOR FOR
                5189 ; USE IN FCB AT X REG.  THE SECTOR
                5190 ;NUMBER IS PLACED IN FCBLSN
```

```
                5191 ;
                5192 ; THE SEARCH FOR A FREE SECTOR STARTS
                5193 ; AT THE DVDSMP BYTE.  SECTORS ARE
                5194 ; NUMBERED SEQUENTIALLY FROM ZERO TO
                5195 ; MAXSM WITH THE LEFT BIT OF THE DVDSMP
                5196 ; BEING WITH ZERO.
                5197 ;
                5198 GETSECTOR
1106 A009       5199         LDY  #DVDSMP-1 ;SET Y TO START MAP-1
                5200 ;
1108 C8         5201 GS1     INY            ;INC SMAP INDEX
1109 C064       5202         CPY  #90+DVDSMP ;AT END OF MAP?
110B B054       5203         BCS  GSERR     ;BR IF AT END
110D B145       5204         LDA  (ZDRVA),Y ;GET A MAP BYTE
110F F0F7       5205         BEQ  GS1       ;BR NO FREE SECTOR IN BYTE
                5206 ;
1111 8C0C13     5207         STY  TEMP1     ;SAVE MAP INDEX
1114 48         5208         PHA            ;DEC NO OF SECTORS AVAIL
1115 38         5209         SEC
1116 A003       5210         LDY  #DVDNSA
1118 B145       5211         LDA  (ZDRVA),Y
111A E901       5212         SBC  #1
111C 9145       5213         STA  (ZDRVA),Y
111E C8         5214         INY
111F B145       5215         LDA  (ZDRVA),Y
1121 E900       5216         SBC  #0
1123 9145       5217         STA  (ZDRVA),Y
                5218 ;
1125 C8         5219         INY            ;SET READ REQD
1126 A9FF       5220         LDA  #$FF
1128 9145       5221         STA  (ZDRVA),Y
                5222 ;
112A 68         5223         PLA
112B A0FF       5224         LDY  #$FF      ;SET BIT COUNTER =-1
                5225 ;
112D C8         5226 GS2     INY            ;SHIFT MAP BYTE
112E 0A         5227         ASL  A         ;UNTIL A FREE SECTOR
112F 90FC       5228         BCC  GS2       ;FOUND
1131 8C0D13     5229         STY  TEMP2     ;SAVE BIT NUMBER
1134 4A         5230 GS3     LSR  A         ;AND SHIFT BYTE
1135 88         5231         DEY            ;BACKS TO ITS ORIGINAL
1136 10FC       5232         BPL  GS3       ;POSITION AND PUT IT
1138 AC0C13     5233         LDY  TEMP1     ;BACK INTO THE MAP
113B 9145       5234         STA  (ZDRVA),Y
                5235 ;
                5236 ;

GET SECTOR

113D 38         5237         SEC            ;SECTOR MAP BYTE
113E AD0C13     5238         LDA  TEMP1     ;=DISPL-DVDSMP
1141 E90A       5239         SBC  #DVDSMP
                5240 ;
1143 A000       5241         LDY  #0
1145 8C0C13     5242         STY  TEMP1     ;CLEAR SECT NO HI
                5243 ;
1148 0A         5244 GS4     ASL  A         ;MULT REL SECTOR MAP
1149 2E0C13     5245         ROL  TEMP1
114C C8         5246         INY
114D C003       5247         CPY  #3
114F 90F7       5248         BCC  GS4
                5249 ;
1151 18         5250         CLC
1152 6D0D13     5251         ADC  TEMP2     ;ADD BIT NO TO
1155 9D8B13     5252         STA  FCBLSN,X  ;SECTOR #
1158 AD0C13     5253         LDA  TEMP1     ;AND PUT INTO
115B 6900       5254         ADC  #0        ;FCBLSN
```

```
115D 9D8C13 5255          STA  FCBLSN+1,X
            5256 ;
1160 60     5257          RTS
            5258 ;
1161 4CCB12 5259 GSERR    JMP  ERRNSA     ;NO SECTOR AVAIL
            5260 ;

SETUP ROUTINE

1164        5261          .PAGE "SETUP ROUTINE"
            5262 ;
            5263 ; SETUP - A ROUTINE USED FOR ALL COMMANDS
            5264 ; TO SET UP FMS CONTROLL CELLS
            5265 ; TO ACCESS A PARTICULAR FILE.
            5266 ;
            5267 SETUP
1164 A99F   5268          LDA  #$9F       ;INIT ERROR CODE
1166 8549   5269          STA  ERRNO      ;TO ZERO
1168 8E0113 5270          STX  CURFCB     ;SAVE FCB
            5271 ;
116B BA     5272          TSX
116C E8     5273          INX
116D E8     5274          INX
116E 8E0013 5275          STX  ENTSTK
            5276 ;
1171 AE0113 5277          LDX  CURFCB     ;GET CURRENT FCB
1174 A421   5278          LDY  ICDNOZ     ;MOVE DRIVE NO
1176 8C0103 5279          STY  DCBDRV     ;TO DCB
1179 88     5280          DEY             ;DEC FOR ACCESS TO TABLES
117A B92913 5281          LDA  DBUFAL,Y   ;MOVE WRITE BUFFER
117D 8545   5282          STA  ZDRVA      ;ADD TO ZERO PAGE PTR
117F B93113 5283          LDA  DBUFAH,Y
1182 8546   5284          STA  ZDRVA+1
            5285 ;
1184 B91113 5286          LDA  DRVTBL,Y   ;GET DRIVE TYPE
1187 F052   5287          BEQ  DERR1      ;BR IF NOT EXISTS
1189 8DFE12 5288          STA  DRVTYP     ;SAVE TYPE
            5289 ;
118C A8     5290          TAY             ;MOVE MAX DATA LEN
118D B9F812 5291          LDA  DRVMDL,Y   ;AND LAST SECTOR BYTE
1190 8DF812 5292          STA  DRVMDL     ;DISPL TO LAST OF
1193 B9FB12 5293          LDA  DRVLBT,Y   ;TABLES
1196 8DFB12 5294          STA  DRVLBT
            5295 ;
1199 BC8813 5296          LDY  FCBBUF,X   ;GET SECTOR BUF #
119C 88     5297          DEY             ;DEC TO ACCESS TBL
119D 1031   5298          BPL  SSBA       ;BR IF ONE IS ALLOCATED
            5299 ;
119F A000   5300          LDY  #0         ;IF NON ALLOCATED
11A1 B91913 5301 GSB1     LDA  SECTBL,Y   ;TRY TO FIND ONE
11A4 F008   5302          BEQ  GSB4       ;BR ONE FOUND
11A6 C8     5303 GSB2     INY             ;DEC TRY COUNT
11A7 C010   5304          CPY  #16
11A9 90F6   5305          BCC  GSB1       ;BR MORE TO TRY
            5306 ;
11AB 4CCD12 5307 GSB3     JMP  ERRNSB     ;NO SECTOR BUFFERS AVAIL
            5308 ;
11AE ADFE12 5309 GSB4     LDA  DRVTYP     ;FOUND ONE IF 256 BYTES
11B1 4A     5310          LSR  A          ;DRIVE NEEDED TO CONT
11B2 B010   5311          BCS  GSB5       ;BR NOT 256 BYTES

SETUP ROUTINE

11B4 C8     5312          INY             ;ELSE TRY NEXT CONTIG
11B5 C010   5313          CPY  #16        ;TEST END OF BUFFERS
11B7 B0F2   5314          BCS  GSB3       ;AND BR IF NO MORE
11B9 B91913 5315          LDA  SECTBL,Y   ;ELSE SEE IF ITS THREE
```

```
11BC D0E8   5316        BNE  GSB2       ;BR NOT FREE
11BE 88     5317        DEY
            5318 ;
11BF A980   5319        LDA  #$80       ;ALLOCATE SECOND OF 2
11C1 991A13 5320        STA  SECTBL+1,Y
            5321 ;
11C4 A980   5322 GSB5   LDA  #$80       ;ALLOCATE FIRST OR ONLY
11C6 991913 5323        STA  SECTBL,Y
11C9 98     5324        TYA
11CA 9D8813 5325        STA  FCBBUF,X   ;PUT BUF NO INTO FCB
11CD FE8813 5326        INC  FCBBUF,X   ;INC BUF NO SO NOT ZERO
            5327 ;
11D0 B93913 5328 SSBA   LDA  SABUFL,Y   ;MOVE BUFFER ADDR
11D3 8547   5329        STA  ZSBA       ;TO ZERO PAGE PTR
11D5 B94913 5330        LDA  SABUFH,Y
11D8 8548   5331        STA  ZSBA+1
            5332 ;
            5333 ;
11DA 60     5334        RTS
            5335 ;
11DB 4CCF12 5336 DERR1  JMP  ERRDNO     ;BAD DRIVE NO


SETUP ROUTINE

11DE        5337        .PAGE
            5338 ;
            5339 ; FREE SECTOR BUFFERS
            5340 ;
11DE        5341 FRESBUF =  *
11DE BC8813 5342        LDY  FCBBUF,X   ;GET BUF NO
11E1 F013   5343        BEQ  FSBR       ;BR IF NONE
11E3 88     5344        DEY             ;DEC FOR TBL ACCESS
11E4 A900   5345        LDA  #0         ;FREE
11E6 9D8813 5346        STA  FCBBUF,X   ;IN FCB
11E9 991913 5347        STA  SECTBL,Y   ;AND TABLE
11EC ADFE12 5348        LDA  DRVTYP     ;IF 128 BYTES
11EF 4A     5349        LSR  A          ;DRIVE
11F0 B004   5350        BCS  FSBR       ;FREE ONLY ONE
11F2 4A     5351        LSR  A          ;ELSE
11F3 991A13 5352        STA  SECTBL+1,Y ;FREE 2
11F6 60     5353 FSBR   RTS
            5354 ;


DATA SECTOR I/O

11F7        5355        .PAGE "DATA SECTOR I/O"
            5356 ;
            5357 ; DSIO - DATA SECTOR I/O
            5358 ;
            5359 DSIO
11F7 48     5360        PHA             ;SAVE ACU DATA
11F8 A547   5361        LDA  ZSBA       ;WRITE SECTOR BUF
11FA 8D0403 5362        STA  DCBBUF     ;ADR MOVED TO
11FD A548   5363        LDA  ZSBA+1     ;DCB
11FF 8D0503 5364        STA  DCBBUF+1
1202 68     5365        PLA             ;RESTORE ACU
            5366 ;
1203 AEFE12 5367        LDX  DRVTYP
1206 206C07 5368        JSR  BSIO       ;DO THE I/O
1209 60     5369        RTS
            5370 ;


WRITE DOS

120A        5371        .PAGE "WRITE DOS"
            5372 ;
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                5373 ; WRTDOS - WRITE DOS TO DISK
                5374 ;
                5375 WRTDOS
120A BC8913     5376         LDY  FCBCSN,X  ;MOVE START ADDR
120D BD8A13     5377         LDA  FCBCSN+1,X
1210 205312     5378         JSR  SETDSO    ;WRITE SECTOR 0
1213 206712     5379         JSR  WD0       ;WRITE DOS
1216 4CF012     5380         JMP  GREAT
                5381 ;
                5382 DELDOS
1219 A900       5383         LDA  #0        ;SET FILE NOT EXISTS
                5384 DD1
121B 8D0E07     5385         STA  DFSFLG
                5386 ;
                5387 WRTSCO
121E A907       5388         LDA  #FMSORG/256 ;MOVE FMS START
1220 8D0503     5389         STA  DCBBUF+1  ;ADDR TO DCB
1223 A900       5390         LDA  #FMSORG&255
1225 8D0403     5391         STA  DCBBUF
                5392 ;
1228 A900       5393         LDA  #0        ;CLEAR SECTOR NO TO ZERO
122A 8D0A03     5394         STA  DCBSEC
122D 8D0B03     5395         STA  DCBSEC+1
                5396 ;
1230 EE0A03     5397 WRNBS   INC  DCBSEC    ;INC SECTOR NO
1233 A201       5398         LDX  #1        ;GET DRIVE TYPE
1235 38         5399         SEC
1236 207207     5400         JSR  BSIOR     ;DO THE WRITE
                5401 ;
                5402 ;
1239 18         5403         CLC
123A AD0403     5404         LDA  DCBBUF    ;INC SECT ADDR
123D 6980       5405         ADC  #128
123F 8D0403     5406         STA  DCBBUF
1242 AD0503     5407         LDA  DCBBUF+1
1245 6900       5408         ADC  #0
1247 8D0503     5409         STA  DCBBUF+1
                5410 ;
124A AD0A03     5411         LDA  DCBSEC    ;TEST FOR WRITE
124D CD0107     5412         CMP  BRCNT     ;OF ALL BOOT SECTORS
1250 D0DE       5413         BNE  WRNBS     ;BR NOT ALL
                5414 ;
1252 60         5415         RTS
                5416 ;
1253 8C0F07     5417 SETDSO  STY  DFLINK    ;SET LINK START
1256 8D1007     5418         STA  DFLINK+1
1259 ADFE12     5419         LDA  DRVTYP
125C 8D0E07     5420         STA  DFSFLG
125F ACF812     5421         LDY  DRVMDL


WRITE DOS

1262 8C1107     5422         STY  BLDISP
1265 D0B4       5423         BNE  DD1       ;GO WRITE SECTOR 0
                5424 ;


WRITE DOS

1267            5425         .PAGE          "
1267 AD1207     5426 WD0     LDA  DFLADR    ;MOVE FILE START ADDR
126A 8543       5427         STA  ZBUFP     ;TO ZBUFP
126C AD1307     5428         LDA  DFLADR+1
126F 8544       5429         STA  ZBUFP+1
                5430 ;
1271 A000       5431 WD1     LDY  #0        ;MOVE 125
1273 B143       5432 WD2     LDA  (ZBUFP),Y ;BYTES OF DOS
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1275 9147   5433         STA  (ZSBA),Y  ;TO SECTOR BUFFER
1277 C8     5434         INY
1278 CCF812 5435         CPY  DRVMDL
127B 90F6   5436         BCC  WD2
127D 98     5437         TYA
127E 9D8713 5438         STA  FCBDLN,X  ;SET DATA LEN
            5439 ;
1281 205707 5440         JSR  INCBA     ;INC ZBUFP BY 125
1284 CD0D07 5441         CMP  SASA+1    ;IF NOT END OR
1287 900B   5442         BCC  WD3       ;PAST END OF DOS
1289 D00F   5443         BNE  WD4       ;THEN WRTNXS
128B A543   5444         LDA  ZBUFP     ;ELSE
128D CD0C07 5445         CMP  SASA      ; DONE
1290 9002   5446         BCC  WD3
1292 D006   5447         BNE  WD4
            5448 ;
1294 20940F 5449 WD3     JSR  WRTNXS    ;WRITE NEXT SECTOR
1297 4C7112 5450         JMP  WD1
            5451 ;
129A 60     5452 WD4     RTS            ;RETURN, CLOSE WILL WRITE
                                         FINAL SECTOR
            5453 ; AND RETURN
            5454 ;


TEST DOS FILE NAME

129B        5455         .PAGE "TEST DOS FILE NAME"
            5456 ;
            5457 ; TSTDOS - TEST FOR DOS SYS FILE NAME;
            5458 ;
            5459 TSTDOS
129B A00B   5460         LDY  #11       ;LOOK AT 12 CHARS
129D B95813 5461 TDF1    LDA  FNAME-1,Y ;TEST DECODE FILENAME CHAR
12A0 D9A812 5462         CMP  DFN-1,Y   ;WITH DOS FILENAME CHAR
12A3 D003   5463         BNE  TDFR      ;BR NOT MATCH
12A5 88     5464         DEY
12A6 D0F5   5465         BNE  TDF1      ;BR IF MORE, ELSE RTN EQ
12A8 60     5466 TDFR    RTS
            5467 ;
12A9 44     5468 DFN     .BYTE "DOS     SYS "
12AA 4F
12AB 53
12AC 20
12AD 20
12AE 20
12AF 20
12B0 20
12B1 53
12B2 59
12B3 53
12B4 20
            5469 ;
            5470 ; ERROR ROUTINES
            5471 ;
12B5 E649   5472 ERDBAD INC  ERRNO     ;BAD SECTOR AT FORMAT TIME
12B7 E649   5473 ERAPO  INC  ERRNO     ;ATTEMPT APPEND TO OLD TYPE
                                         FILE
12B9 E649   5474 ERRPOT INC  ERRNO     ;POINT INVALID
12BB E649   5475 ERFNF  INC  ERRNO     ;FILE NOT FOUND
12BD E649   5476 ERDFULL INC ERRNO     ;DIRECTORY FULL
12BF E649   5477 ERDVDC INC  ERRNO     ;DEVICE COMMAND INVALID
12C1 E649   5478 ERFLOCK INC ERRNO     ;FILE LOCKED
12C3 E649   5479 ERRPDL INC  ERRNO     ;POINT DATA LENGTH
12C5 E649   5480 ERRFN  INC  ERRNO     ;FILE NAME ERROR
12C7 E649   5481 ERFNMM INC  ERRNO     ;FILE NUMBER MISMATCH
12C9 E649   5482 ERRSYS INC  ERRNO     ;FATAL SYS DATA I/O ERROR
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12CB E649    5483 ERRNSA INC  ERRNO     ;NO SECTOR AVAIL
12CD E649    5484 ERRNSB INC  ERRNO     ;NO SECTOR BUFFERS AVAIL
12CF E649    5485 ERRDNO INC  ERRNO     ;DRIVE NO ERROR
             5486 ;
12D1 A549    5487        LDA  ERRNO     ;GET ERROR NUMBER
12D3 AE0113 5488 RETURN LDX  CURFCB    ;GET CUR FCB NO
12D6 9D4303 5489        STA  ICSTA,X   ;PUT IN FCB
12D9 AE0013 5490        LDX  ENTSTK    ;GET ENTRY STACK PTR
12DC 9A      5491        TXS            ;AND RESTORE
12DD AE0113 5492        LDX  CURFCB
12E0 A8      5493        TAY
12E1 AD0813 5494        LDA  SVDBYT    ;GET SAVED DATA BYTE


TEST DOS FILE NAME

12E4 60      5495        RTS
             5496 ;
12E5 AD0303 5497 ERRIO  LDA  DCBSTA    ;GET I/O ERROR CODE
12E8 30E9    5498        BMI  RETURN
             5499 ;
12EA AE0113 5500 FGREAT LDX  CURFCB
12ED 20DE11 5501        JSR  FRESBUF   ;FREE SECTOR BUFFER
12F0 A901    5502 GREAT  LDA  #01       ;SET ALL OK
12F2 D0DF    5503        BNE  RETURN
12F4 A988    5504 ERREOF LDA  #$88      ;SET EOF CODE
12F6 30DB    5505        BMI  RETURN
             5506 ;


MISC STORAGE

12F8         5507        .PAGE "MISC STORAGE"
             5508 ;
             5509 ; MISC NON ZERO PAGE STORAGE AREA
             5510 ;
12F8 00      5511 DRVMDL .BYTE 0        ;MAX DATA LEN
12F9 7D      5512        .BYTE 125      ;128 BYTE SECTOR
12FA FD      5513        .BYTE 253      ;256 BYTE SECTOR
             5514 ;
12FB 00      5515 DRVLBT .BYTE 0        ;DISPL TO LAST SECTOR BYTE
12FC 7F      5516        .BYTE 127      ;128 BYTE SECTOR
12FD FF      5517        .BYTE 255      ;256 BYTE SECTOR
12FE         5518 DRVTYP *=   *+1       ;DRIVE TYPE
12FF         5519 RETRY  *=   *+1       ;I/O RETRY COUNTER
1300         5520 ENTSTK *=   *+1       ;ENTRY STACK LEVEL
1301         5521 CURFCB *=   *+1       ;CURRENT FCB (IOCB ALSO)
1302         5522 DHOLES *=   *+1       ;DIR HOLE SECTOR
1303         5523 DHOLED *=   *+1       ;DIR HOLE DISPL
1304         5524 DHFNUM *=   *+1       DIR HOLE FILE NO
1305         5525 CDIRD  *=   *+1       ;CURRENT DIR DISPL
1306         5526 CDIRS  *=   *+1       ;CURRENT DIR SECTOR
1307         5527 SFNUM  *=   *+1       ;FILE NUMBER
1308         5528 SVDBYT *=   *+1       ;SAVED OUTPUT DATA BYTE
1309         5529 SVD1   *=   *+1       ;SAVE DATA BYTES
130A         5530 SVD2   *=   *+1       ;FOR WRITE BURST
130B         5531 SVD3   *=   *+1
             5532 EXTSW
130C         5533 TEMP1  *=   *+1       ;TEMP1
130D         5534 TEMP2  *=   *+1       ;TEMP2
130E         5535 TEMP3  *=   *+1       ;TEMP3
130F         5536 TEMP4  *=   *+1       ;TEMP4
1310         5537 BURTYP *=   *+1       ;BURST I/O TYPE
             5538 ;
1311         5539 DRVTBL *=   *+8       ;DRIVE TABLE
1319         5540 SECTBL *=   *+16      ;
1329         5541 DBUFAL *=   *+8       ;VTOC BUFFER
1331         5542 DBUFAH *=   *+8       ;PTR FOR DRIVE N
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1339          5543 SABUFL *=    *+16        ;SECTOR BUFFER
1349          5544 SABUFH *=    *+16        ;FOR SECTOR N
1359          5545 FNAME  *=    *+12        ;FILE NAME
1365          5546 AFNAME *=    *+12        ;AUXILLARY FILE NAME
              5547 ;
1371          5548 MDRV   *=    *+1         ;MAX DR NO
              5549 ;
1372          5550 Z      =     *           ;PUT ON SAME BOUNDRY AS
                                             PRODUCTION
1372          5551        *=    $1381       ;VERSION

FILE CONTROL BLOCKS

1381          5552          .PAGE "FILE CONTROL BLOCKS"
              5553 ;
              5554 ; FILE CONTROL BLOCK
              5555 ; ONE FILE CONTROL BLOCK IS USED FOR EACH
              5556 ; OPEN FILE.  THE RELATIVE FCB USED
              5557 ; RELATES DIRECTLY TO THE IOCB #
              5558 ; THAT OPENED THE FILE.  THUS THERE ARE
              5559 ; 8 FCBS.  THE FCB ARE (CONVIENTLY)
              5560 ; THE SAME SIZE AS IOCBS.  EACH FCB
              5561 ; CONTAINS ALL THE INFORMATION REQUIRED
              5562 ; TO CONTROL THE PROCESSING ON AN
              5563 ; OPEN FILE
              5564 ;
              5565 FCB
1381          5566 FCBFNO *=    *+1         ;FILE # LEFT JUSTIFIED
1382          5567 FCBOTC *=    *+1         ;OPEN TYPE CODE
1383          5568        *=    *+1         ;SPARE
1384          5569 FCBSLT *=    *+1         ;FLAG FOR NEW SECTOR LEN TYPE
1385          5570 FCBFLG *=    *+1         ;WORKING FLAG
1386          5571 FCBMLN *=    *+1         ;MAX SECTOR DATA LEN
1387          5572 FCBDLN *=    *+1         ;CUR SECTOR BUF DATA LEN
1388          5573 FCBBUF *=    *+1         ;SECTOR BUF NO
1389          5574 FCBCSN *=    *+2         ;CUR SECTOR #
138B          5575 FCBLSN *=    *+2         ;LINK/ALLOCATE SECTOR #
138D          5576 FCBSSN *=    *+2         ;CUR FILE RELATIVE SECTOR #
              5577 FCBCRS
138F          5578 FCBCNT *=    *+2         ;SECTOR COUNT
0010          5579 FCBLEN =     *-FCB       ;FCB LEN
              5580 ;
1391          5581        *=    FCBLEN*7+* ;ALLOCATE 7 MORE FCBS
              5582 ;
              5583 ; OPEN CODE BITS
              5584 ; USED IN IOCB AUX1
              5585 ; - AND FCBOTC
              5586 ;
0004          5587 OPIN   =     $04         ;INPUT
0008          5588 OPOUT  =     $08         ;OUTPUT
0002          5589 OPDIR  =     $02         ;LIST DIRECTORY
0001          5590 OPAPND =     $01         ;APPEND
              5591 ;
0080          5592 FCBFAS =     $80         ;FCBFLG - ACQ SECTORS
0040          5593 FCBFSM =     $40         ;FCBFLG - SECTOR MODIFIED

FILE DIRECTORY

1401          5594          .PAGE "FILE DIRECTORY"
              5595 ;
              5596 ; DISK FILE DIRECTORY
              5597 ; THE FILE DIRECTORY OCCUPIES 8
              5598 ;CONSECTUIVE SECTORS STARTING AT THE
              5599 ; CENTRAL SECTOR+1.  EACH FILE DIRECTORY
              5600 ; SECTOR CONTAINS 8 ENTRIES.  THERE
              5601 ; IS 1 ENTRY FOR EACH NAMED FILE.  THE
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                5602 ; THERE ARE A TOTAL OF 64 NAMED FILES
                5603 ; PER VOLUME
                5604 ;
                5605 ; THE FILE NUMBER IS USED THROUGH THE
                5606 ; THE SYSTEM IS THE RELATIVE (TO ONE)
                5607 ; FILE DIRECTORY ENTRY NUMBER.
                5608 ;
                5609 ; THE EQUATES BELOW ARE FOR A SINCE NAMED
                5610 ; FILE ENTRY
                5611 ;
0000            5612 DFDFL1 =    0          ;FLAG1 (1)
0001            5613 DFDCNT =    1          ;SECTOR COUNTER (LOW)
0003            5614 DFDSSN =    3          ;START SECTOR NO (2)
0005            5615 DFDPFN =    5          ;PRIMARY FILE NAME (8)
000D            5616 DFDXFN =    13         ;EXTENDED FILE NAME (4)
0010            5617 DFDELN =    16         ;ENTRY LENGTH
                5618 ;
                5619 ; DFDFL1 VALUE EQUATES
                5620 ;
0000            5621 DFDEUU =    0          ;ENTRY UNUSED
0080            5622 DFDEDE =    $80        ;ENTRY DELETED
0040            5623 DFDINU =    $40        ;ENTRY IN USE
0001            5624 DFDOUT =    $01        ;FILE OPEN FOR OUTPUT
0020            5625 DFDLOC =    $20        ;ENTRY LOCKED
0002            5626 DFDNLD =    $02        ;FILE HAS NEW TYPE SECTOR LEN
                                             BYTE
                5627 ;
1401            5628 FILDIR *=   *+256      ;RESUME FILE DIR SPACE
                5629 ;

VOLUME DIRECTORY

1501            5630         .PAGE "VOLUME DIRECTORY"
                5631 ;
                5632 ; DISK VOLUME DIRECTORY
                5633 ; THE VOLUME DIRECTORY OCCUPIES THE CENTRAL
                5634 ; VOLUME SECTOR.  THE VOLUME DIRECTORY
                5635 ; CONTAINS INFORMATION PERTAINING TO
                5636 ; THE ENTIRE DISKETTE VOLUME.
                5637 ;
                5638 ; THE LABELS BELOW, MAP THE VOLUME
                5639 ; DIRECTORY SECTOR.
                5640 ;
0000            5641 DVDTCD =    0          ;VOLUME DIRECTORY TYEP CODE )1)
                5642 ;
                5643 ; USED TO DELINATE MAJOR (1)
                5644 ; FMS SYSTEM FORMAT CHANGES
                5645 ;
0001            5646 DVDMSN =    1          ;MAX SECTOR NUMBER (1)
0003            5647 DVDNSA =    3          ;NO SECTORS AVAIL
                5648 ;
0005            5649 DVDWRQ =    5          ;WRITE REQUIRED
000A            5650 DVDSMP =    10         ;SECTOR MAP START
                5651 ;
                5652 ; EACH BIT REPRESENTS A SECTOR
                5653 ; IF THE BIT IS ON THEN THE SECTOR
                5654 ; IS FREE AND AVAILABLE.  IF THE
                5655 ; BIT IS OFF, THE SECTOR IS IN
                5656 ; USE OR BAD.  THE MOST SIGNIFICANT
                5657 ; BIT OF THE FIRST BYTE IS SECTOR ZERO.

END OF FMS

1501            5658         .PAGE "END OF FMS"
                5659 ;
1501            5660 ENDFMS =    *
1501            60           .END
```

```
END OF FMS

=0700 FMSORG      =0043 FMSZPG      =0340 IOCBORG     =0003 LMASK
=0300 DCBORG      =E453 DHADR       =009B EOL         =031A DEVTAB
=0020 ZICB        =02E7 LMADR       =1540 DUPINIT     =0102 STAK
=00DF OSBTM       =0246 DSKTIM      =000F TIMOUT       0340 IOCB
 0340 ICHID        0341 ICDNO        0342 ICCOM        0343 ICSTA
 0344 ICBAL        0345 ICBAH        0346 ICPUT        0348 ICBLL
 0349 ICBLH        034A ICAUX1       034B ICAUX2       034C ICAUX3
 034D ICAUX4       034E ICAUX5       034F ICAUX6       =0010 ICLEN
=0001 ICOIN       =0002 ICOOUT      =0003 ICIO        =0004 ICGBR
=0005 ICGTR       =0006 ICGBC       =0007 ICGTC       =0008 ICPBR
=0009 ICPTR       =000A ICPBC       =000B ICPTC       =000C ICCLOSE
=00OD ICSTAT      =000E ICDDC       =000E ICMAX       =000F ICFREE
=0001 ICSOK       =0002 ICSTR       =0003 ICSEOF      =0080 ICSBRK
=0081 ICSDNR      =0082 ICSNED      =0083 ICSDER      =0084 ICSIVC
=0085 ICSNOP      =0086 ICSIVN      =0087 ICSWPC      =0021 ICDNOZ
=0028 ICBLLZ      =0029 ICBLHZ      =0024 ICBALZ      =0025 ICBAHZ
=0022 ICCOMZ      =0026 ICPUTZ       0300 DCB          0300 DCBSBI
 0301 DCBDRV       0302 DCBCMD       0303 DCBSTA       0304 DCBBUF
 0306 DCBTO        0308 DCBCNT       030A DCBSEC       =0052 DCBCRS
=0050 DCBCWS      =0053 DCBCST      =0021 DCBCFD      =0001 DCBSOK
=0081 DCBDNR      =0082 DCBCNR      =0083 DCBDER      =0084 DCBIVC
=0087 DCBWPR       0043 ZBUFP        0045 ZDRVA        0047 ZSBA
 0049 ERRNO        0700 BFLG         0701 BRCNT        0702 BLDADR
 0704 BINTADR      0706 BCONT        0714 XBCONT       0709 SABYTE
 070A DRVBYT       070B SAFBFW       070C SASA         =1501 ENDFMS
 070E DFSFLG       070F DFLINK       0711 BLDISP       0712 DFLADR
 07CB DFMSDH       074F BFAIL        072F XBC1         =076C BSIO
 0753 BGOOD        0757 INCBA        0754 XBRTN        0772 BSIOR
 077C DSIO1        0786 DSIO2        12FF RETRY        079C DSIO3
 07A2 DSIO4        07C4 DSIO5        07BE STRTYP       1301 CURFCB
 08AB DFMOPN       0B15 DFMCLS      =0ABF DFMGET       09CC DFMPUT
 0B01 DFMSTA       0BA7 DFMDDC      =07E0 DINIT        130C TEMP1
 07F2 DIA          130D TEMP2        0807 DIHAVE       1311 DRVTBL
 1329 DBUFAL       1331 DBUFAH       083D DIDDEC      =0005 DVDWRQ
 0823 DI256        0870 DINCBP       0845 DINXTS       084B DISETS
 1319 SECTBL       085E DISNI        1339 SABUFL       1349 SABUFH
=087E CLRFCB       0882 CFCBX        1381 FCB          088A ADI1
 089B ADI2         1164 SETUP        0E9E FNDCODE      1382 FCBOTC
=0002 OPDIR        08BE OPN1         0DAD LISTDIR      0F21 SFDIR
=0004 OPIN        =08D8 DFOIN       =0008 OPOUT       =0911 DFOOUT
=08DD DFOUPD      =0001 OPAPND      =08EC DFOAPN       12BF ERDVDC
 08E9 OPNER1      =08E3 DFOUI       0CAC TSTLOCK      09AE DFRDSU
 12F0 GREAT        12BB ERFNF        1305 CDIRD        1401 FILDIR
=0000 DFDFL1      =0002 DFDNLD       090E APOER        10BF OPVTOC
 1106 GETSECTOR    138D FCBSSN       138B FCBLSN      =097C DHFOX2
 12B7 ERAPO       =091D DFOX1       0C53 XDEL0        =0948 OPN1A
 1302 DHOLES       0992 OPNER2       1306 CDIRS        106E RDDIR
 1303 DHOLED       1304 DHFNUM       1307 SFNUM        093E OPN1B
=0005 DFDPFN      =0003 DFDSSN      =0040 DFDINU      =0001 DFDOUT
=0001 DFDCNT       0966 OPN2         1359 FNAME        =0970 OPN2A
 1071 WRTDIR      =0995 SETFCB       0FE2 WRTN6        0982 OPN3
=0080 FCBFAS       1385 FCBFLG       129B TSTDOS      =098F DHFOX3
 120A WRTDOS       12BD ERDFULL      099A OPNF1        1381 FCBFNO
 1387 FCBDLN       138F FCBCNT       1384 FCBSLT      =1017 RDNSO
 1308 SVDBYT       1300 ENTSTK       09E5 FRMCIO       0A19 PUTER
 1386 FCBMLN       0A06 PUT1         0F94 WRTNXS       0A1C PEOF
 0A1F WTBUR       =0040 FCBFSM       12F4 ERREOF       0A4A NOBURST
 0A28 TBURST       0A26 RTBUR        1310 BURTYP      =0AAE TBLEN
 0A3E NXTBUR       0A4C WRBUR        100F RDNXTS       0A7B BBINC
=0A9D BUREOF       12F8 DRVMDL       1309 SVD1         130A SVD2
 130B SVD3         1388 FCBBUF       11D0 SSBA         0AAC BURST
 12FE DRVTYP       0AB9 TBL256       0ACC GET1         0DB9 GDCHAR
 0ADF GET2        =0ADC GEOF        =0AEA EFLOOK       0AFE GET3
 12D3 RETURN       0B12 SFNF         0B6D CLDONE      =0B75 CLUPDT
 0FAB WRTLSEC     =0B80 RRDIR       0B50 CLOUT        0B3C APP1
```

```
 ØFB3 WRTN2      1Ø95 WRTVTOC    12EA FGREAT     ØFF8 WRCSIO
 ØB9B FNSHFT     ØB9D FNSHF1     ØB9F FNSHF2     ØBD6 XFV
=ØØ27 MAXDDC     ØBD3 DVDCER     ØBC5 DVDCVT     ØBD9 XRENAME
 ØC32 XDELETE    ØC7C XLOCK      ØC83 XUNLOCK    ØCBA XPOINT
 ØD03 XNOTE      ØD18 XFORMAT    ØBE7 XRN1       ØBF2 XRN1A
 1219 DELDOS     ØEB4 FNDCNX     ØC0C XRN1B      1253 SETDSO
 ØC11 XRN2       ØC1B XRN3       ØF31 CSFDIR     ØC79 DFNF
=ØC3A XDELX      ØC45 XDELY      ØC45 XDEL3      ØC56 XDEL1
=ØØ8Ø DFDEDE    =ØC6C XDEL2A    ØC67 XDEL2     =ØC72 XDEL4
 1ØC5 FRESECT   =ØØ2Ø DFDLOC    130F TEMP4      ØC88 XLCOM
 ØC93 XLC1       ØCB7 TLF        12C1 ERFLOCK    ØD0Ø PERR1
 1389 FCBCSN     ØCCF XP1        ØCED XP2       =ØCDC XP1A
=ØCF7 XPERR      ØCFA XP3        12C3 ERRPDL     12B9 ERRPOT
 ØD52 XFØ        ØD4F XFERR     =ØD3D TSTFMT     ØD4C XFBAD
 12B5 ERDBAD     ØD55 XF1       =ØØØA DVDSMP     ØD76 XF2
 ØD94 XF3        ØD9F XF4        ØDE3 LDENT1     ØDE9 LDCNT
 ØE11 LDDONE     ØDD6 GDCRTN     ØDD9 LDENT      ØE21 FDENT
 1Ø8B RDVTOC    =ØØØ3 DVDNSA     ØE57 CVDX      =ØØØD FSCML
 ØDFD MVFSCM     ØE14 FSCM       ØE67 CVDY       ØE35 LD1
 ØE3B LD2        ØE71 CVDIGIT    ØE8D STDIGIT    130E TEMP3
 ØE76 CVD1       ØEAA FDØA       ØF07 FNDERR     ØEB3 FDØB
 ØEB8 FDØ        130C EXTSW      ØEC3 FD1        ØED5 FD3
 ØECA FD2        ØF0A FDSCHAR    ØF03 FDEND      ØEE5 FD4
 ØEFD FD6        ØEF1 FD5        12C5 ERRFN      ØF1B FDSC2
 ØF15 FDSC1     =ØØ1Ø DFDELN     ØF4D SFD2       ØF48 SFD1
 ØF9Ø SDRTN      ØF73 SFDSH      ØF5E SFD3       ØF6A SFD4
 ØF8A SFDSH1     ØFA8 WRTN1      ØFA5 WRU1       ØFC9 WRNERR
 ØFAE WRTLS1     12FB DRVLBT     ØFDA WRTN5      1ØØ2 MVLSN
 ØFF6 WRNRTS     ØFF9 RWCSIO     11F7 DSIO       1Ø21 RDNS1
 1Ø5F RDIOER    =1Ø62 RDFNMM     1Ø54 RDNS3      1Ø51 RDNS2
 12E5 ERRIO      1Ø6C RDDELE     12C7 ERFNMM     1Ø72 DIRIO
 1ØAB DSYSIO     1Ø92 RDVGO      1Ø9C VTIO       1Ø95 WRVTOC
 1ØAC DSYSIA     1ØB5 DSIOER     1ØBC DEAD       12C9 ERRSYS
=1105 FSRTS      1ØD1 FS1        1ØDD FS2        1ØE5 FS3
 1108 GS1        1161 GSERR      112D GS2        1134 GS3
 1148 GS4        12CB ERRNSA     11DB DERR1      11A1 GSB1
 11AE GSB4       11A6 GSB2       11AB GSB3       12CD ERRNSB
 11C4 GSB5       12CF ERRDNO    =11DE FRESBUF    11F6 FSBR
 1267 WDØ        121B DD1        121E WRTSCO     123Ø WRNBS
 1271 WD1        1273 WD2        1294 WD3        129A WD4
 129D TDF1       12A9 DFN        12A8 TDFR       1365 AFNAME
 1371 MDRV      =1372 Z         138F FCBCRS     =ØØ1Ø FCBLEN
=ØØØD DFDXFN    =ØØØØ DFDEUU    =ØØØØ DVDTCD    =ØØØ1 DVDMSN
```

Appendix A

AN INTERMEDIATE USER'S GUIDE TO THIS BOOK

If you are familiar with machine language, commented source code, and hexadecimal numbers, you probably won't need to read this appendix. On the other hand, if you don't know or are new to machine language – perhaps some of the information here will help.

A knowledge of machine language is important to grasping the sense of the DOS since it is written in machine language. However, we will briefly cover some of the fundamentals, as they relate to the book, in the hope that this might be a starting point. One of the functions of this book is to reveal the inner workings of Atari DOS. A benefit of knowing how it works is that you are able to change it to suit yourself, to customize it.

First we'll examine the meaning of the various fields of information which are in the source code (page 59 on). Then, after a brief look at how to deal with hexadecimal numbers, we can make a modification to DOS step-by-step to show how it's done.

The book is divided into two sections: roughly the first half is a series of descriptions of the major subroutines of the disk operating system. The latter half is a *commented source code* of the DOS. In order to better understand what you can accomplish with all this information, we can set up a problem and solve it using the book.

What's "Commented Source Code"?

We'll change the DOS so that we could type in a disk command using lowercase letters. Unfortunately, the D: must be in uppercase, the program which makes this decision is in ROM and we can't get at it and change it. The rest of the command can be in lowercase, though, after we make our change to the DOS in RAM. After fixing it, any routine that uses the disk will accept lowercase as in D: open.

Before getting into the details of the modification there is some important preliminary information. What, for example, is "commented source code?"

Machine language differs in several respects from BASIC. When you write a program in BASIC, you never see how it looks to the computer. Instead you see something like this:

```
10 FOR I = 1 TO 100
20 NEXT I
```

This delay loop just creates a brief pause in a program. If you RUN the above, the computer handles the problem of translating the BASIC words into machine language. Anything the computer does must be translated into machine language (ML). Translating (or *interpreting*) a BASIC program takes place *during* the RUN of the program – that's why BASIC is so slow compared to ML.

By contrast, ML is translated *before* it is RUN. Programming ML is done in two stages: 1. writing the source code and then 2. assembling it into *object* code. The computer does most of the drudgery of this because most ML is written by using a program called an assembler which handles many of the details. Some assemblers are so complex that using them can seem almost like programming in BASIC.

Here is how you might program the above example delay loop when using an assembler:

```
1000          LDY #64     ; SET COUNTER TO 100
1001 LOOP     DEY
1002          BNE LOOP
```

Probably the most peculiar thing about this, to the beginner, is how 64 stands for 100 (it's hex, we'll get to it in a minute). The line numbers could be BASIC, but the instructions are 6502 mnemonics (memory aids). LDY means to load the Y register with 100 (decimal). The next line is named (labelled) "loop" because assemblers don't say GOTO 1001. Instead, they use convenient names. In any event, the Y register is decremented by DEY, it's lowered by one. So each time the program cycles through the LOOP address, it will lower the counter one. Finally, the instruction at 1002 says, Branch if Not Equal (to zero). In other words, GOTO LOOP if Y hasn't yet counted down to zero. When Y reaches zero, the program will continue on, following whatever instruction is in line 1003.

After the above program is written, though, it still cannot be RUN. There is the second step, the creation of object code (executable), the assembly process.

You tell the assembler to assemble this program. The result of

that is an additional two "fields" (zones). Above, we have five fields: line number, label, mnemonic (instruction), operand (the #64), and a comment field which is the equivalent of BASIC REM statements. There will soon be a total of seven fields.

After assembly, the two new fields are the addresses and the object code (expressed as hex bytes). By the way, BASIC always assigns its programs a starting address in memory, but, in ML, the programmer must make this known to the assembler. It's not the computer's decision. Assume the computer were told to assemble the above example at address $2000 (this would be 8192, in decimal). The dollar sign means that a number is a hex number. The labels, mnemonics, and operands would be translated into object code and put into the computer's memory. As you'll see in the second half of this book, a printout of completed assembly looks like this:

```
2000  A000  1000       LDY #64  ;SET COUNTER TO 100
2002  88    1001 LOOP  DEY
2003  D0FF  1002       BNE LOOP
```

Hex

Before concluding this brief overview of some fundamentals of machine language, we should explain how to read the numbers in the source code listings.

```
100 DIM H$(23),N$(9):OPEN#1,4,0,"K:"
130 GRAPHICS 0
140 PRINT "PLEASE CHOOSE:
150 PRINT "1 - Input HEX & get decimal back
    ."
160 PRINT "2 - Input DECIMAL to get hex bac
    k."
170 PRINT:PRINT "==>";:GET#1,K
180 IF K<49 OR K>50 THEN 170
190 PRINT CHR$(K):ON K-48 GOTO 300,400
300 H$="@ABCDEFGHI!!!!!!!JKLMNO"
310 PRINT "HEX";:INPUT N$:N=0
320 FOR I=1 TO LEN(N$)
330 N=N*16+ASC(H$(ASC(N$(I))-47))-64:NEXT I
350 PRINT "$";N$;"=";N:PRINT:PRINT:GOTO 140
400 H$="0123456789ABCDEF"
410 PRINT "DECIMAL";:INPUT N:M=4096
420 PRINT N;"=$";
```

```
430 FOR I=1 TO 4:J=INT(N/M)
440 PRINT H$(J+1,J+1);:N=N-M*J:M=M/16
450 NEXT I:PRINT:PRINT:GOTO 140
```

This program will turn a decimal number into hex or vice versa. Hexadecimal is a base 16 number system, where decimal is base ten. This means that you count from zero to fifteen before going to the next column. For example, you count up zero one two...until you reach nine in decimal. Then you go to the next column and have a one-zero (10) to show that there is one in the "ten's column" and zero in the "one's column."

In hex, what was a "ten's column" becomes a "sixteen's column." In other words, the symbol "10" means that there is one sixteen and zero "ones." So, the decimal number 17 would be written in hex, as $11 (one sixteen plus one one). The decimal number 15 would, in hex, be $0F. After nine, we run out of digits, so the first few letters of the alphabet are used: A = 10, B = 11, C = 12, D = 13, E = 14, and F = 15.

This explains how to "read" hex numbers if you don't want the program above to do it for you. The number $64 is decimal 100 because there are six 16's and four one's. 6 X 16 + 4 = 100.

Addresses can be larger than two digits, up to a maximum of four. You might see an address such as $11F7 in the listings. The third column is the 256's and the fourth column is the 4096's. So to find out what this address is in decimal, you can multiply 7 X 1, 15 X 16, 1 X 256, and 1 X 4096. And add them all together.

A quicker way is to find out the first two, (15 x 16 + 7 = 247) and then multiply the second two by 256. It comes out the same. The second two would be $11 (17 in decimal) so 17 x 256 + 247 = 4599. It might be easier to just use the BASIC program to make the translations until hex becomes more familiar.

Making A Modification

Now that you have the entire source listing of DOS 2.0S, you can customize it to fit your needs.

You may have felt restricted by the limitations on file names. A file name can consist of eleven characters: up to eight characters plus an optional three-character extension. The first character must be from A-Z; subsequent characters can be from A-Z or 0-9. That's it. No punctuation. No imbedded spaces. No lowercase.

By changing only two locations in the file name decode section of DOS, many more characters are permitted. We will modify DOS to

accept any ASCII characters in a file name except character graphics and inverse video. Additionally, the filename can start with a number (e.g. "D:3-D"). Unfortunately, there is no foolproof way to allow imbedded spaces such as "D:TIME OUT".

The following fragment of code checks to see that a character of the file name falls in the range of A-Z. If the character is less than (carry clear) 65 [ASC("A")] or greater than or equal to (carry set) 91 [ASC("Z") + 1], then the test fails. All we do is change the check for "A" to a check for "!" (its number in the code is one greater than "space"), and the check for "Z" + 1 to "z" + 1 (lowercase z).

Included in this range of 90 characters are the numbers (48-57) and all punctuation. Since we start with 33, "space" is excluded. It is possible to permit imbedded spaces, but the file would then be inaccessible in certain situations where a space is used as a delimiter. You can allow it at your discretion, or even permit the entire (almost) ATASCII character set to be used by changing the limits to 0 and 255.

```
CMP   #'A
BCC   FD5
CMP   #$5B
BCC   FD6
```

We change this to:

```
CMP   #'!
BCC   FD5
CMP   #$7B
BCC   FD6
```

The changes can be made in BASIC with POKE 3818,33:POKE 3822,123 or change hex locations $0EEA to $21 and $0EEE to $7B. The section of code we're modifying is located between source line numbers 4072 through 4193. Remember to rewrite the modified DOS to disk with WRITE DOS FILES (Menu selection "H") if you want your change to be permanent.

Other equally simple changes are also possible. You could change the wild-card character ("*") to any other character by changing location $0EC7 to the desired character. A more ambitious task would be to increase the maximum file name length.

This brings up a final point – software compatibility. For example, if you changed the wild card character to "@," you couldn't run any previous programs that assume "*" as the wild card character. Our change is less dangerous – if you allow lowercase file names, the unmodified DOS won't be able to access it, although it will look fine on the directory. This change has not been exhaustively tested for

conflicts, so we can't guarantee its usage. Nevertheless, it seems quite useful and shows that some customizing can be accomplished with a few simple changes.

When experimenting, always keep a backup copy of your valuable disks in case something should go awry.

```
100 REM CHANGE DOS PROGRAM
110 REM FOR DOS 2.0S ONLY
120 REM CHANGE LOW RANGE CHECK FROM
130 REM 65 TO 33.  THIS ALLOWS
140 REM ANY CHARACTER (EXCEPT
150 REM GRAPHICS AND INVERSE VIDEO)
160 REM TO START A FILENAME, INSTEAD
170 REM OF ONLY A THROUGH Z.
180 REM 0EE9 C941  CMP #'A
190 REM 0EE9 C921  CMP #'!
200 POKE 3818,33
210 REM CHANGE HIGH RANGE TO EXTEND
220 REM UP TO ASCII "z"
230 REM (LOWERCASE Z)
240 REM 0EED C95B  CMP #$5B
250 REM 0EED C97B  CMP #$7B
260 REM POKE 3822,123
270 REM NO NEED TO CHANGE NUMERIC
280 REM CHECK SINCE IT IS NO
290 REM LONGER EXECUTED, THANKS
300 REM TO THE ABOVE CODE.
```

Some Cautions

Care is necessary when making customizations. Only make the changes to a *copy* of your DOS – not the original "system master." (You shouldn't be able to do this anyway, since the disk is "write-protected," but better safe than sorry.) Remember that any files SAVEd with your custom DOS will probably not be compatible with the original, unchanged DOS. Alternation of the DOS can have unpredictable effects; we urge caution and cannot accept any liability for software or hardware damage incurred through the use of this book.

Things To Look Out For

These modifications could make a customized DOS incompatible with the original, unmodified DOS 2.0S:

1) File name changes (such as allowing lowercase, or increasing

the length)

2) Changes to DOS file structure (such as using a different "linking" system)

3) Removing error-checks. These built-in traps insure disk integrity and reliability. When you alter one, you could risk muddling one or more files. For example, if you allow an automatic "wild-card" feature, where an asterisk is assumed at the end of a file, it could cause havoc when performing a SCRATCH, RENAME, or UPDATE operation. Another example is removing some of the qualifications for "burst-I/O." Remember that a lot of thought went into each design consideration.

Keeping these suggestions in mind, here are some ideas for modifications. You may need to type in and re-assemble (with your insertions) the entire DOS when making certain modifications.

1) Adding a STATUS check before a disk access. Have you ever noticed how long the drive will grind away when no disk is inserted? You can query the disk for its status, and even add a "Drive not ready" error message if the drive door is not closed or a disk is not inserted. Check your DOS manual for details.

2) Adding Disk Utility commands. These would be additional functions performed by the FMS, keyed to the "special command." Some of the tasks performed by the Disk Utility Package could be a part of the DOS kernal, such as LOAD and SAVE binary files. You could even implement new commands such as "relative file" support, where you only give the DOS a "record number" to randomly access a file. The file could be divided into records of any length.

3) Allocate more sectors for the directory, thereby extending the maximum amount of directory entries.

4) Add a disk name and/or disk I.D. number (serial number?) to the disk (maybe on sector 720). It could even print out with the directory.

5) Given the extra "unused" bytes in the file name, add a byte for file type, such as program, data, object code, etc., and have it printed out with the directory, making it easy to identify files without having to use the extension. This would be hard to interface with software, however.

Remember that some of this is risky business. Keep backup disks for any disk you are "experimenting" with. That way, you should lose no important files.

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