DISK EDTASM™

COLOR COMPUTER
DISK EDITOR ASSEMBLER WITH ZBUG

CUSTOM MANUFACTURED
IN USA BY RADIO SHACK
A DIVISION OF TANDY CORPORATION

TERMS AND CONDITIONS OF SALE AND LICENSE OF RADIO SHACK COMPUTER EQUIPMENT AND SOFTWARE PURCHASED FROM A RADIO SHACK COMPANY-OWNED COMPUTER CENTER, RETAIL STORE OR FROM A RADIO SHACK FRANCHISEE OR DEALER AT ITS AUTHORIZED LOCATION

LIMITED WARRANTY

I. CUSTOMER OBLIGATIONS

A. CUSTOMER assumes full responsibility that this Radio Shack computer hardware purchased (the "Equipment"), and any copies of Radio Shack software included with the Equipment or licensed separately (the "Software") meets the specifications, capacity, capabilities, versatility, and other requirements of CUSTOMER.

B. CUSTOMER assumes full responsibility for the condition and effectiveness of the operating environment in which the Equipment and Software are to function, and for its installation.

II. RADIO SHACK LIMITED WARRANTIES AND CONDITIONS OF SALE

A. For a period of ninety (90) calendar days from the date of the Radio Shack sales document received upon purchase of the Equipment, RADIO SHACK warrants to the original CUSTOMER that the Equipment and the medium upon which the Software is stored is free from manufacturing defects. THIS WARRANTY IS ONLY APPLICABLE TO PURCHASES OF RADIO SHACK EQUIPMENT BY THE ORIGINAL CUSTOMER FROM RADIO SHACK COMPANY-OWNED COMPUTER CENTERS, RETAIL STORES AND FROM RADIO SHACK FRANCHISEES AND DEALERS AT ITS AUTHORIZED LOCATION. The warranty is void if the Equipment's case or cabinet has been opened, or if the Equipment or Software has been subjected to improper or abnormal use. If a manufacturing defect is discovered during the stated warranty period, the defective Equipment must be returned to a Radio Shack Computer Center, a Radio Shack retail store, participating Radio Shack franchisee or Radio Shack dealer for repair, along with a copy of the sales document or lease agreement. The original CUSTOMER'S sole and exclusive remedy in the event of a defect is limited to the correction of the defect by repair, replacement, or refund of the purchase price, at RADIO SHACK'S election and sole expense. RADIO SHACK has no obligation to replace or repair expendable items.

B. RADIO SHACK makes no warranty as to the design, capability, capacity, or suitability for use of the Software, except as provided in this paragraph. Software is licensed on an "AS IS" basis, without warranty. The original CUSTOMER'S exclusive remedy, in the event of a Software manufacturing defect, is its repair or replacement within thirty (30) calendar days of the date of the Radio Shack sales document received upon license of the Software. The defective Software shall be returned to a Radio Shack Computer Center, a Radio Shack retail store, participating Radio Shack franchisee or Radio Shack dealer along with the sales document.

C. Except as provided herein no employee, agent, franchisee, dealer or other person is authorized to give any warranties of any nature on behalf of RADIO SHACK.

D. Except as provided herein, **RADIO SHACK MAKES NO WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

E. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation(s) may not apply to CUSTOMER.

III. LIMITATION OF LIABILITY

A. EXCEPT AS PROVIDED HEREIN, RADIO SHACK SHALL HAVE NO LIABILITY OR RESPONSIBILITY TO CUSTOMER OR ANY OTHER PERSON OR ENTITY WITH RESPECT TO ANY LIABILITY, LOSS OR DAMAGE CAUSED OR ALLEGED TO BE CAUSED DIRECTLY OR INDIRECTLY BY "EQUIPMENT" OR "SOFTWARE" SOLD, LEASED, LICENSED OR FURNISHED BY RADIO SHACK, INCLUDING, BUT NOT LIMITED TO, ANY INTERRUPTION OF SERVICE, LOSS OF BUSINESS OR ANTICIPATORY PROFITS OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR OPERATION OF THE "EQUIPMENT" OR "SOFTWARE". IN NO EVENT SHALL RADIO SHACK BE LIABLE FOR LOSS OF PROFITS, OR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF ANY BREACH OF THIS WARRANTY OR IN ANY MANNER ARISING OUT OF OR CONNECTED WITH THE SALE, LEASE, LICENSE, USE OR ANTICIPATED USE OF THE "EQUIPMENT" OR "SOFTWARE".

NOTWITHSTANDING THE ABOVE LIMITATIONS AND WARRANTIES, RADIO SHACK'S LIABILITY HEREUNDER FOR DAMAGES INCURRED BY CUSTOMER OR OTHERS SHALL NOT EXCEED THE AMOUNT PAID BY CUSTOMER FOR THE PARTICULAR "EQUIPMENT" OR "SOFTWARE" INVOLVED.

B. RADIO SHACK shall not be liable for any damages caused by delay in delivering or furnishing Equipment and/or Software.

C. No action arising out of any claimed breach of this Warranty or transactions under this Warranty may be brought more than two (2) years after the cause of action has accrued or more than four (4) years after the date of the Radio Shack sales document for the Equipment or Software, whichever first occurs.

D. Some states do not allow the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to CUSTOMER.

IV. RADIO SHACK SOFTWARE LICENSE

RADIO SHACK grants to CUSTOMER a non-exclusive, paid-up license to use the RADIO SHACK Software on **one** computer, subject to the following provisions:

A. Except as otherwise provided in this Software License, applicable copyright laws shall apply to the Software.

B. Title to the medium on which the Software is recorded (cassette and/or diskette) or stored (ROM) is transferred to CUSTOMER, but not title to the Software.

C. CUSTOMER may use Software on one host computer and access that Software through one or more terminals if the Software permits this function.

D. CUSTOMER shall not use, make, manufacture, or reproduce copies of Software except for use on **one** computer and as is specifically provided in this Software License. Customer is expressly prohibited from disassembling the Software.

E. CUSTOMER is permitted to make additional copies of the Software **only** for backup or archival purposes or if additional copies are required in the operation of **one** computer with the Software, but only to the extent the Software allows a backup copy to be made. However, for TRSDOS Software, CUSTOMER is permitted to make a limited number of additional copies for CUSTOMER'S own use.

F. CUSTOMER may resell or distribute unmodified copies of the Software provided CUSTOMER has purchased one copy of the Software for each one sold or distributed. The provisions of this Software License shall also be applicable to third parties receiving copies of the Software from CUSTOMER.

G. All copyright notices shall be retained on all copies of the Software.

V. APPLICABILITY OF WARRANTY

A. The terms and conditions of this Warranty are applicable as between RADIO SHACK and CUSTOMER to either a sale of the Equipment and/or Software License to CUSTOMER or to a transaction whereby RADIO SHACK sells or conveys such Equipment to a third party for lease to CUSTOMER.

B. The limitations of liability and Warranty provisions herein shall inure to the benefit of RADIO SHACK, the author, owner and/or licensor of the Software and any manufacturer of the Equipment sold by RADIO SHACK.

VI. STATE LAW RIGHTS

The warranties granted herein give the **original** CUSTOMER specific legal rights, and the **original** CUSTOMER may have other rights which vary from state to state.

DISK EDTASM™

COLOR COMPUTER
DISK EDITOR ASSEMBLER WITH ZBUG

CUSTOM MANUFACTURED
IN USA BY RADIO SHACK
A DIVISION OF TANDY CORPORATION

To Our Customers . . .

The heart of the Color Computer is a 6809E "processor." It controls all other parts of the Color Computer.

The processor understands only a code of 0s and 1s, not at all intelligible to the human mind. This code is called "6809 machine code."

When you run a BASIC program, a system called the "BASIC Interpreter" translates each statement, one at a time, into 6809 machine code. This is an easy way to program, but inefficient.

The Disk EDTASM lets you program using an intelligible representation of 6809 machine code, called "assembly language," that talks directly to the processor. You then assemble the entire program into 6809 machine code before running it.

Programming with the Disk EDTASM gives you these benefits:

- You have direct and complete control of the Color Computer. You can use its features — such as high resolution graphics — in ways that are impossible with BASIC.
- Your program runs faster. This is because it is already translated into 6809 machine code when you run it.

To Use the Disk EDTASM You Need . . .

A Color Computer Disk System that has at least 16K of RAM, preferably 32K. (A 16K System will leave you little room for programs.)

The Disk EDTASM Contains:

- EDTASM/BIN, a system for creating 6809 programs. EDTASM contains:

  An editor, for writing and editing 6809 assembly-language programs.

  An assembler, for assembling the programs into 6809 machine code.

  ZBUG, for examining and debugging 6809 machine-code programs.

  You must have 32K to run EDTASM. If you have 16K, run EDTASMOV (described next).

- EDTASMOV/BIN, a memory-efficient version of EDTASM consisting of overlays. EDTASMOV contains the editor and assembler, but not ZBUG.
- ZBUG/BIN, a stand-alone version of ZBUG, primarily for use with EDTASMOV.
- DOS/BIN, a disk operating system. DOS contains disk access routines that you can call from an assembly language program. (You cannot call BASIC's disk access routines with any program other than BASIC.)

  EDTASM/BIN, EDTASMOV/BIN, and ZBUG/BIN all use DOS routines and must be run with DOS.

The Disk EDTASM also contains:

- DOS/BAS. A BASIC program that loads DOS/BIN.
- ZBUG/BAS. A BASIC program that loads ZBUG/BIN.

How to Use this Manual

This manual is organized for both beginning and advanced assembly language programmers. *Sections I-IV* are tutorials; *Section V* is reference.

Beginning Programmers:

Read *Section I* first. It shows how the entire system works and explains enough about assembly language to get you started.

Then, read *Sections II, III,* and *IV* in any order you want. Use *Section V*, "Reference," as a summary.

This manual does not try to teach you 6809 mnemonics. To learn this, read:

> Radio Shack Catalog #62-2077
> by William Barden Jr.
>
> *6809 Assembly Language Programming*
> by Lance A. Leventhal

Nor does it teach you disk programming concepts. To learn these, read:

> *Color Computer Disk System Manual*
> (Radio Shack Catalog #26-3022)

Advanced Programmers:

First, read *Chapters 1* and *2* to get started and see how the entire system works. Then, read *Section V*, "Reference."

You can use the DOS program listing to obtain information on routines and addresses not explained in this manual. Please note the following:

> Radio Shack supports only these DOS routines: OPEN, CLOSE, READ, and WRITE. Additional DOS routines are listed in *Reference H*. However, Radio Shack does not promise to support them.
>
> Even more DOS routines and addresses can be found in the program listing. However, Radio Shack does not promise to support them nor even provide them in the future.

For technical information on the Color Computer Disk System and 6809, refer to *6809 Assembly Language Programming* and *Color Computer Disk System Manual*, listed above.

This manual uses these terms and notations:

(KEY)	To denote a key you must press.
Italics	To denote a value you must supply.
filespec	To denote a DOS file specification. A DOS filespec is in one of these formats: *filename*/ext:drive *filename*.ext:drive *filename* has one to eight characters. *extension* has one to three characters. *drive* is the drive number. If the drive number is omitted, DOS uses the first available drive.
$	To denote a hexadecimal (Base 16) number. For example, $0F represents hexadecimal 0F, which is equal to 15 in decimal (Base 10) notation.

Contents

Section I/ Getting Started

Section II/ Commands

Section III/ Assembly Language

Section IV/ ROM and DOS Routines

Section V/ Reference

Section VI/ Program Listing

Index

SECTION I

GETTING STARTED

SECTION I

GETTING STARTED

This section gets you started using the Disk EDTASM and explains some concepts you need to know.

Chapter 1/ Preparing Diskettes

Before using the Disk EDTASM, you need to format blank diskettes and back up the master Disk EDTASM diskette.

Formatting Blank Diskettes

1. Power up your disk system and insert a blank diskette in Drive 0. (See the *Color Computer Disk System Manual* for help.)
2. At the OK prompt, type:

   `DSKINIØ` **(ENTER)**

   BASIC formats the diskette. When finished, it again shows the OK prompt.

Making Backups of Disk EDTASM

Single-Drive Systems

1. Insert the master Disk EDTASM diskette, your "source" diskette, in Drive 0.
2. At the BASIC OK prompt, type:

   `BACKUP Ø TO Ø` **(ENTER)**

3. BASIC then prompts you to insert the "destination" diskette. Remove the source diskette and insert a formatted diskette. Press **(ENTER)**
4. BASIC prompts you to alternatively insert the source, then destination diskettes. When the backup is finished, the OK prompt appears.

The destination diskette is now a duplicate of the master Disk EDTASM diskette.

Multi-Drive Systems

1. Insert the master Disk EDTASM diskette in Drive 0.
2. Insert a formatted diskette in Drive 1.
3. At BASIC's OK prompt, type:

   `BACKUP Ø TO 1` **(ENTER)**

   BASIC makes the backup. When the backup is finished, the OK prompt appears.

The diskette in Drive 1 is now a duplicate of the master Disk EDTASM diskette.

Chapter 2/
Running a Sample Program

This "sample session" gets you started writing programs and shows how to use the Disk EDTASM. The next chapters explain why the program works the way it does.

1. Load and Run DOS

Insert the Disk EDTASM diskette in Drive 0. At the OK prompt, type:

RUN "DOS" (ENTER)

DOS then loads and puts you in its "command mode." The screen shows the DOS command menu:

```
1. Exit to BASIC
2. Exec a Program
3. Start Clock Display
4. Disk Allocation Map
5. Copy Files
6. Directory
```

DOS consists of many disk input and output routines which EDTASM uses. You must load DOS before loading EDTASM.

2. Load and Run EDTASM

At the DOS Menu, press (2) to select "Execute a Program." The screen asks for the name of a program file.

If your system has 32K or more, use EDTASM. If it has only a 16K system, use EDTASMOV.

Loading EDTASM:

Type EDTASM. The screen shows:

```
EXECUTE A PROGRAM
PROGRAM NAME: [EDTASM ]/BIN
```

If you make a typing error, use the (←) to reposition the cursor at the beginning of the line, then correct the mistake. Replace any trailing characters with blank spaces.

Press (ENTER). EDTASM loads and shows its startup message.

Loading EDTASMOV:

Type EDTASMOV. The screen shows:

```
EXECUTE A PROGRAM
PROGRAM NAME:  [EDTASMOV]/BIN
```

If you make a mistake, use the (←) to reposition the cursor, then correct the mistake.

EDTASMOV loads and shows its startup message.

Always keep EDTASMOV in Drive 0. It contains overlays which it loads into memory as required. It always looks for these overlays in Drive 0.

3. Type the Source Program

Notice the asterisk (*) prompt. This means you are in the editor program of EDTASM or EDTASMOV. The editor lets you type and edit an assembly language "source" program.

At the * prompt, type:

I (ENTER)

This puts you in the editor's insert mode. The editor responds with line number 00100. Type:

START (→) LDA (→) #$F9 (ENTER)

The right arrow tabs to the next column. (ENTER) inserts the line in the editor's "edit buffer." The $ means that F9 is a hexadecimal (Base 16) number.

Your screen should show:

```
00100     START     LDA       #$F9
00110
```

meaning that you inserted line 100 and can now insert line 110.

If you make a mistake, press (BREAK). Then, at the * prompt, delete Line 100 by typing:

```
D100 (ENTER)
```

Now, insert Line 100 correctly in the same manner described above.

Insert the entire assembly language program listed below.

Note that line 150 uses brackets. Do not substitute parentheses for the brackets. To produce the left bracket, press (SHIFT) and (↓) at the same time. To produce the right bracket, press (SHIFT) and (→) at the same time.

```
00100     START     LDA       #$F9
00110               LDX       #$400
00120     SCREEN    STA       ,X+
00130               CMPX      #$600
00140               BNE       SCREEN
00150     WAIT      JSR       [$A000]
00160               BEQ       WAIT
00170               CLR       $71
00180               JMP       [$FFFE]
00190     DONE      EQU       *
00200               END
```

If you make a mistake, press (BREAK). Then, at the * prompt, delete the program by typing:

```
D#:*
```

Now, insert the program correctly.

When finished, press (BREAK). The program you have inserted is an assembly language "source" program, which we'll explain in the next chapter.

4. Assemble the Source Program in Memory

At the * prompt, type:

```
A/IM/WE (ENTER)
```

which loads the assembler program. The assembler then assembles your source program into 6809 machine code into the memory area just above the EDTASM or EDTASMOV program. To let you know what it has done, it prints this listing:

```
4B28 86     F9          00100 START
  LDA       #$F9
4B2A 8E     0400        00110
  LDX       #$400
4B2D A7     80          00120 SCREEN
  STA       ,X+
4B2F 8C     0600        00130
  CMPX      #$600
4B32 26     F9          00140
  BNE       SCREEN
4B34 AD     9F A000     00150 WAIT
  JSR       [$A000]
4B38 27     FA          00160
  BEQ       WAIT
4B3A 0F     71          00170
  CLR       $71
4B3C 6E     9F FFFE     00180
  JMP       [$FFFE]
            4B40        00190 DONE
  EQU       *
            0000        00200
  END

00000 TOTAL ERRORS

DONE        4B40
SCREEN      4B2D
START       4B28
WAIT        4B34
```

(If using EDTASMOV, the numbers will be different.)

If the assembler does not print this entire listing, but stops and shows an error message instead, you have an error in the source program. Repeat Steps 3 and 4.

The assembler listing is explained in *Figure 1* of *Chapter 7.*

5. Prepare the Program for DOS

Before saving the program, you need to prepare it so that you can load and run it from DOS.

First, you must give it an "origination address" for DOS to use in loading the program back into memory. (We recommend you use Address $1200, the first address available after the DOS system.) To do so, type:

```
I50 (ENTER)
```

and insert this line:

```
50              ORG         $1200
```

Next, you need to add two lines to your program to tell DOS how long the program is. Insert these lines:

```
60    BEGIN     JMP   START
70              FDB   DONE-BEGIN
```

When finished, press (BREAK). To see the entire program, type:

```
P#:* (ENTER)
```

It should look like this:

```
00050             ORG    $1200
00060   BEGIN     JMP    START
00070             FDB    DONE-BEGIN
00100   START     LDA    #$F9
00110             LDX    #$400
00120   SCREEN    STA    ,X+
00130             CMPX   #$600
00140             BNE    SCREEN
00150   WAIT      JSR    [$A000]
00160             BEQ    WAIT
00170             CLR    $71
00180             JMP    [$FFFE]
00190   DONE      EQU    *
00200             END
```

If you make a mistake, delete the line with the error and insert it again.

6. Save the Source Program on Disk

To save the source program, type (at the * prompt):

```
WD SAMPLE (ENTER)
```

This saves the source program on disk as SAMPLE/ASM.

7. Save the Assembled Program on Disk

At the * prompt, type:

```
AD SAMPLE /SR (ENTER)
```

Be sure you have a blank space between SAMPLE and /SR. This causes the assembler to again assemble the source program into 6809 code. This time, the Assembler saves the assembled program on disk as SAMPLE/BIN.

(You must use the /SR "switch" to assemble any program that you want to load and run from DOS.)

8. Run the Assembled Program from DOS

To run the assembled program, you need to be in the DOS command mode. At the * prompt, type:

```
K (ENTER)
```

which causes the Editor to return you to the DOS command menu. Press (2) to execute a program. Then type SAMPLE, the name of the assembled program. (The assembler assumes you mean SAMPLE/BIN.) The screen shows:

```
EXECUTE A PROGRAM
PROGRAM NAME:  [SAMPLE ]/BIN
```

Press (ENTER). The SAMPLE program executes, filling your entire screen with a graphics checkerboard.

Press any key to exit the program. The program returns to BASIC startup message.

9. Debug the Program (if necessary)

ZBUG lets you to look at memory. How you load ZBUG depends on whether you are using EDTASM or EDTASMOV.

EDTASM Users:

You can load ZBUG from EDTASM. Load DOS and EDTASM again (Steps 1 and 2). Then, at the * prompt, type:

```
Z (ENTER)
```

EDTASM loads its ZBUG program and displays ZBUG's # prompt. You can now examine any memory address. Type:

```
4000/
```

and ZBUG shows you what is in memory at this address. Press ↓ a few times to look at more memory addresses. When finished, press BREAK.

In *Chapter 8*, we'll show you how to use ZBUG to examine and test your program. To return to EDTASM's editor, type:

```
E ENTER
```

EDTASMOV Users:

You must use the Stand-Alone ZBUG. Load DOS again (Step 1). At the DOS Menu, press 2, "Execute a Program," and run the ZBUG program. After typing ZBUG, the screen shows:

```
EXECUTE A PROGRAM
PROGRAM NAME:  [ZBUG    ]/BIN
```

DOS loads the stand-alone ZBUG and displays ZBUG's # prompt. You can now examine any memory address. Type:

```
3800/
```

and ZBUG shows you what is in memory at this address. Press ↓ a few times to look at more memory addresses. When finished, press BREAK.

In *Chapter 8*, we'll show you how to use ZBUG to examine and test your program. To return to DOS, type:

```
K ENTER
```

Chapter 3/ Overview

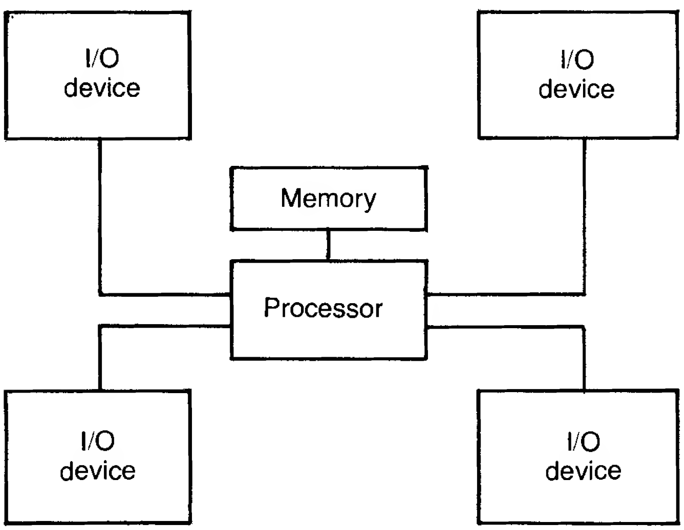
This chapter is for beginning assembly language programmers. It explains some concepts you need. If you're not a beginner, use this chapter as a refresher or skip it.

The Color Computer Hardware

The Color Computer consists of:

- The 6809E Processor
- Memory
- Input/Output Devices

This shows how they relate to each other:



The Processor

The processor processes all data going to each memory address and device. It contains:

- Registers — for temporarily storing 1- or 2-byte values.
- Buses — for transferring data to or from the processor.

All instructions to the processor must be in 6809 machine code: a code of 0s and 1s containing "opcodes" and data. "Opcodes" are instructions that tell the processor to manipulate data in some way.

For example, the machine-code instruction "10000110 11111001" contains:

- The opcode "10000110" (decimal 134 or hexadecimal 86)
- The data "11111001" (decimal 249 or hexadecimal F9)

This instruction tells the processor to load Register A with 11111001.

Memory

Memory is a storage area for programs and data. There are two kinds of memory:

- Random access memory (RAM) — for temporary storage of programs or data. When you load a program from disk, you load it into RAM. Many opcodes store data in RAM temporarily.
- Read only memory (ROM) — for permanent storage of programs. BASIC, as well as any program pack you use, is stored in ROM. The Color Computer contains several "ROM routines" that you can use to access the keyboard, screen, or tape recorder.

When writing an assembly language program, you must constantly be aware of what's happening in memory. For this reason, this manual provides a memory map. (See *Reference J.*)

Devices

All other parts of the hardware are called devices. A device expects the processor to input or output data to it in a certain format. To input or output data in this format, you can use these pre-programmed subroutines:

- Routines stored in ROM (ROM routines) — for inputting or outputting to the keyboard, screen, printer, or tape recorder.
- Routines stored in DOS (DOS routines) — for inputting or outputting to disk.

The Disk EDTASM Assembler

The Disk EDTASM looks for three fields in your instructions: label, command, and operand. For example, in this instruction:

```
BEGIN      JMP      START
```

BEGIN is the label. JMP is the command. START is the operand.

In the label field, it looks for:

- Symbols (symbolic names)

In the command field, it looks for:

- Mnemonics
- Pseudo Ops

In the operand field, it looks for:

- Symbols
- Operators
- Addressing-Mode Characters
- Data

Symbols

A symbol is similar to a variable. It can represent a value or a location. BEGIN (in the sample session) is a symbol that represents the location of the instruction JMP START. START is also a symbol that represents the location of LDA #$F9.

Mnemonics

A mnemonic is a symbolic representation of an opcode. It is a command to the processor. "LDA" is a mnemonic. Depending on which "addressing-mode character" you use, LDA represents one of these opcodes:

10000110
10010110
10110110
10100110

(Addressing-mode characters are discussed below.)

Mnemonics are specific to a particular processor. For example, Radio Shack's Model 4 uses the Z80 processor, which understands Z80 mnemonics, rather than the 6809 mnemonics.

Pseudo Ops

A pseudo op is a command to the assembler. END (in the sample session) is a pseudo op. It tells the assembler to quit assembling the program.

Data

Data is numbers or characters. Many of the mnemonics and pseudo ops call for data. Unless you use an operator (described next), the assembler interprets your data as a decimal (Base 10) number.

Operators

An operator tells the assembler to perform a certain operation on the data. In the value $1200, the $ sign is an operator. It tells the assembler that 1200 is a hexadecimal (Base 16) number, rather than a decimal (Base 10) number.

The more commonly used operators are arithmetic and relational. Addition (+) and equation (=) are examples of these operators.

Addressing-Mode Characters

An addressing mode character tells the assembler how it should interpret the mnemonic. The assembler then assembles the mnemonic into the appropriate opcode.

The sample session uses the # character with the LDA mnemonic to denote the "immediate" addressing mode. This causes the assembler to assemble LDA into the opcode 10000110.

The immediate mode means that the number following the mnemonic (in this case, $F9) is data rather than an address where the data is stored.

Pseudo ops, symbols, operators, and addressing-mode characters vary from one assembler to another. *Section III* explains them in detail.

Sample Program

This is how each line in the sample program works:

```
50                    ORG  $1200
```

ORG is a pseudo op for "originate." It tells the assembler to begin loading the program at Location $1200 (Hexadecimal 1200). This means that when you load and run the program from DOS, the program starts at Memory Address $1200.

```
60       BEGIN        JMP  START
```

BEGIN is a symbol. It equals the location where the JMP START instruction is stored.

JMP is a mnemonic for "jump to an address." It causes the processor to jump to the location of the program labeled by the symbol START, which is the LDA #$F9 instruction. You must use JMP or LBRA as the first instruction in a DOS program.

```
70                 FDB  DONE-BEGIN
```

FDB is a pseudo op for "store a 2-byte value in memory." It stores the value of DONE-BEGIN (the length of the program) in the next two bytes of memory. You must store this value at the beginning of the program to tell DOS how much of the program to load.

```
00100    START        LDA  #$F9
```

START is a symbol. It equals the location where LDA #$F9 is stored.

LDA is a mnemonic for "load Register A." It loads Register A with $F9, which is the hexadecimal ASCII code for a graphics character. The ASCII characters are listed in *Reference K*.

```
00110                  LDX  #$400
```

LDX is a mnemonic for "load Register X." It loads Register X with $400, the first address of video memory. *Reference J* shows where video memory begins and ends.

```
00120    SCREEN       STA  ,X+
```

SCREEN is a symbol. It equals the location where STA ,X+ is stored.

STA is a mnemonic for "store Register A." It stores the contents of Register A ($F9) in the address contained in Register X ($400). This puts the $F9 graphics character at the upper left corner of your screen.

The "," and "+" are addressing-mode characters. The , causes the processor to store $F9 in the address contained in Register X. The + causes the processor to then increment the contents of Register X to $401.

```
00130                 CMPX #$600
```

CMPX is a mnemonic for "compare Register X." It compares the contents of Register X with $600. If Register X contains $600, the processor sets the "Z" bit in the Register CC to 1.

```
00140                 BNE  SCREEN
```

BNE is a mnemonic for "branch if not equal." It tells the processor return to SCREEN (the STA,X+ instruction) until the Z bit is set.

The BNE SCREEN instruction creates a loop. The program branches back to SCREEN, filling all video memory addresses with $F9, until it fills Address $600. At that time, Register X contains $600, Bit Z is set, and program control continues to the next instruction.

```
00150    WAIT     JSR  [$A000]
```

JSR is a mnemonic for "jump to a subroutine." $A000 is a memory address that stores the address of a ROM routine called POLCAT. (See *Reference F.*)

POLCAT scans the keyboard to see if you press a key. When you do, it clears the Z bit.

The "[ ]" are addressing-mode characters. They tell the processor to use an address contained in an address, rather than the address itself. Always use the "[ ]" signs when calling ROM routines.

```
00160                 BEQ  WAIT
```

BEQ is a mnemonic for "branch if equal." It branches to the JSR [$A000] instruction until the Z bit is clear. This causes the program to loop until you press a key, at which time POLCAT clears the Z bit.

```
00170                 CLR  $71
00180                 JMP  [$FFFE]
```

CLR is a mnemonic for "clear," and JMP is a mnemonic for "jump to memory address." These two instructions end the program and return to BASIC's startup message.

(CLR inserts a zero in Address $71; this signals that the system is at its original "uninitialized" condition. JMP goes to the address contained in Address $FFFE; this is where BASIC initialization begins.)

```
00180    DONE     EQU  *
```

EQU is a pseudo op. It equates the symbol DONE with an asterisk (*), which represents the last line in the program.

```
00190                END
```

END is a pseudo op. It tells the assembler to quit assembling the program.

Section II

COMMANDS

Section II

COMMANDS

This section shows how to use the many Disk EDTASM commands. Knowing these commands will help you edit and test your program.

Chapter 4/ Using the DOS Menu (DOS Commands)

When you first enter DOS, a menu of six DOS commands appear on the screen. *Chapter 2* shows how to use the first two DOS commands. This chapter shows how to use the remaining commands:

- Start Clock Display
- Disk Allocation Map
- Copy Files
- Directory

To use the examples in this chapter, you need to have the SAMPLE disk files, which you created in *Chapter 2*, on the diskette in Drive 0.

Directory

The DOS "directory" command lets you select the directory entries you want to see, using three fields: filename, extension, and drive number.

To select the directory entries, press 6 at the DOS Menu. Then, press the ← to move the cursor left or → to move right.

Type this line to select all directory entries that have the filename SAMPLE.

```
[SAMPLE**] [***] :[0] <FILE SPEC
```

Use the SPACEBAR to erase characters. Press ENTER when finished. Then, press any key to return to the DOS menu, and press 6 to return to the directory.

Type this line to select all directory entries with the extension /BIN:

```
[********] [BIN] :[0] <FILE SPEC
```

Press ENTER when finished. Return to the main menu.

To see all directory entries on the disk in Drive 0, simply press ENTER without specifying a filename or extension:

```
[********] [***] :[0] <FILE SPEC
```

Disk Allocation Map

The "disk allocation map" command tells you how much free space you have on your diskettes. To see the map, press 4 at the DOS menu.

DOS shows a map of the diskettes that are in each drive. The map shows how each of the diskette's 68 granules is allocated:

- A period (.) means the granule is free.
- An X means all the sectors in the granule are currently allocated to a file.
- A number indicates how many sectors in the granule are currently allocated to a file.

Press any key to return to the DOS menu.

Copy Files

The "Copy Files" command makes a duplicate of a disk file. To use it, press 5 at the DOS menu. DOS then prompts you for the names of the files.

Single-Drive Copy

The first example copies SAMPLE/ASM to another file named COPY/ASM. Use the ← and → to position the cursor. Answer the prompts as shown:

```
Source File Name          [SAMPLE ]
       Extension          [ASM]
       Drive              [0]

Destination File Name     [COPY    ]
       Extension          [ASM]
       Drive              [0]

If Drives are the same are you
using different diskettes?
      ( Y  or  N )?   [N]
```

When finished, press (ENTER). DOS copies SAMPLE/ASM to a new file named COPY/ASM and then returns to the DOS menu. Check the directory (by pressing (6)) and you'll see that both SAMPLE/ASM and COPY/ASM are on your diskette.

The next example copies SAMPLE/ASM to another diskette. Answer the prompts as shown:

```
Source File Name          [SAMPLE ]
       Extension          [ASM]
       Drive              [0]

Destination File Name     [COPY    ]
       Extension          [ASM]
       Drive              [0]

If Drives are the same are you
using different diskettes?
( Y  or  N )?    [Y]
```

Press (ENTER). DOS then prompts you to insert the source diskette. Press (ENTER) again.

DOS then prompts you for a destination diskette. Insert the destination diskette and press (ENTER). After copying the file, DOS prompts you for a system diskette. If you press (ENTER) without inserting a system diskette, you will get a SYSTEM FAILURE error.

When finished, it returns to the DOS menu.

Multi-Drive Copy

This example copies SAMPLE/ASM in Drive 0 to SAMPLE/ASM in Drive 1. Answer the prompts as shown:

```
Source File Name          [SAMPLE ]
       Extension          [ASM]
       Drive              [0]

Destination File Name     [SAMPLE ]
       Extension          [ASM]
       Drive              [1]

If Drives are the same are you
using different diskettes?
( Y  or  N )?    [N]
```

Start Clock Display

The Color Computer has a clock that runs on 60-cycle interrupts. Since the clock skips a second or more when the computer accesses tape or disk, we recommend that you not use it while executing a program.

To use the clock, press (3), "Start Clock Display." Six digits appear at the upper right corner of your screen. The first two are hours, the next are minutes, and the next are seconds. This clock counts the time until you exit DOS.

Chapter 5/ Examining Memory ZBUG Commands — Part I

To use the Disk EDTASM, you must understand the Color Computer's memory. You need to know about memory to write the program, assemble it, debug it, and execute it.

In this chapter, we'll explore memory and see some of the many ways you can get the information you want. To do this, we'll use ZBUG.

If you are not "in" ZBUG, with the ZBUG # prompt displayed, you need to get in it now.

> **EDTASM:** Load and run DOS, then execute the EDTASM program. At the editor's * prompt, type
>
> Z (ENTER)
>
> **EDTASMOV:** Load and run DOS, then execute the ZBUG program.

You should now have a # prompt on your screen. This means you are in ZBUG and you may enter a ZBUG command. All ZBUG commands must be entered at this command level. You can return to the command level by pressing (BREAK) or (ENTER).

Examining a Memory Location

The 6809 can address 65,536 one-byte memory addresses, numbered 0-65535 ($0000-$FFFF). We'll examine Address $A000. At the # prompt, type:

B (ENTER)

to get into the "byte mode." Then type:

A000/

and ZBUG shows the contents of Address $A000. To see the contents of the next bytes, press (↓). Use (↑) to scroll to the preceding address.

Continue pressing (↓) or (↑). Notice that as you use the (↑) the screen continues to scroll down. The smaller addresses are on the lower part of the screen.

All the numbers you see are hexadecimal (Base 16). You see not only the 10 numeric digits, but also the 6 alpha characters needed for Base 16 (A-F). Unless you specify another base (which we do in Chapter 9), ZBUG assumes you want to see Base 16 numbers.

Notice that a zero precedes all the hexadecimal numbers that begin with an alphabetic character. This is done to avoid any confusion between hexadecimal numbers and registers.

Examination Modes

To help you interpret the contents of memory, ZBUG offers four ways of examining it:

- Byte Mode
- Word Mode
- ASCII Mode
- Mnemonic Mode

Byte Mode

Until now, you've been using the byte mode. Typing B (ENTER), at the # prompt got you into this mode.

The byte mode displays every byte of memory as a number, whether it is part of a machine-language program or data.

In this examination mode, the (↓) increments the address by one. The (↑) decrements the address by one.

Word Mode

Type (ENTER) to get back to the # prompt. To enter the word mode, type:

W (ENTER)

Look at the same memory address again. Press the (↓) key a few times. In this mode, the (↓) increments the address by two. The numbers contained in each address are the same, but you are seeing them two bytes or one word at a time.

Press the (↑) a few times. The (↑) always decrements the address by one, regardless of the examination mode.

Look at Address $A000 again by typing:

A000/

Note the contents of this address "word." This is the address where POLCAT, a ROM routine, is stored.

Examine the POLCAT routine. For example, if $A000 contains A1C1, type:

A1C1/

and you'll see the contents of the first two bytes in the POLCAT routine. We'll examine this routine later in this chapter using the "mnemonic mode."

ASCII Mode

Return to the command level. To enter the ASCII mode, type:

A (ENTER)

ZBUG now assumes the content of each memory address is an ASCII code. If the "code" is between $21 and $7F, ZBUG displays the character it represents. Otherwise, it displays meaningless characters or "garbage."

Here, the (↓) increments the address by one.

Mnemonic Mode

This is the default mode. Unless you ask for some other mode, you will be in the default mode.

Return to the # prompt. To enter the mnemonic mode from another mode, type:

M (ENTER)

Look at the addresses where the POLCAT routine is stored. For example, if you found that POLCAT is at address $A1C1, type:

A1C1/

Press the (↓) a few times. In the mnemonic mode, ZBUG assumes you're examining an assembly language program. The (↓) increments memory one to five bytes at a time by "disassembling" the numbers into the mnemonics they represent.

For example, assume the first two addresses in POLCAT contain $3454. $3454 is an opcode for the PSHS U,X,B mnemonic. Therefore, ZBUG disassembles $3454 into PSHS U,X,B.

Begin the disassembly at a different byte. Press (BREAK) and then examine the address of POLCAT plus one. For example, if POLCAT starts at address $A1C1, type:

A1C2/

You now see a different disassembly. The contents of memory have not changed. ZBUG has, however, interpreted them differently.

For example, assume $A1C2 contains a $54. This is the opcode for the LSRB mnemonic. Therefore, ZBUG disassembles $54 into LSRB.

To see the program correctly, you must be sure you are beginning at the correct byte. Sometimes, several bytes will contain the symbol "??". This means ZBUG can't figure out which instruction is in that byte and is possibly disassembling from the wrong point. The only way of knowing you're on the right byte is to know where the program starts.

Changing Memory

As you look at the contents of memory addresses, notice that the cursor is to the right. This allows you to change the contents of that address. After typing the new contents, press (ENTER) or (↓); the change will be made.

To show how to change memory, we'll open an address in video memory. Get into the byte mode and open Address $015A by typing:

(BREAK) B (ENTER)
015A/

Note that the cursor is to the right. To put a 1 in that address, type:

1 (ENTER)

If you want to change the contents of more than one address, type:

```
Ø15A/
```

Then type:

DD (↓)

This changes the contents to DD and lets you change the next address. (Press the (↑) to see that the change has been made.)

The size of the changes you make depends on the examination mode you are in. In the byte mode, you will change one byte only and can type one or two digits.

In the word mode, you will change one word at a time. Any 1-, 2-, 3-, or 4-digit number you type will be the new value of the word.

If you type a hexadecimal number that is also the name of a 6809 registers (A,B,D,CC,DP,X,Y,U,S,PC), ZBUG assumes it's a register and gives you an "EXPRESSION ERROR." To avoid this confusion, include a leading zero (0A,0B, etc.)

To change memory in the ASCII mode, use an apostrophe before the new letter. For example, here's how to write the letter C in memory at Address $015A. To get into the ASCII examination mode, type:

A (ENTER)

To open Address $015A,type:

```
Ø15A/
```

To change its contents to a C, type:

'C (↓)

Pressing the (↑) will assure you that the address contains the letter C.

If you are in mnemonic mode, you must change one to five bytes of memory depending on the length of the opcode. Changing memory is complex in mnemonic mode because you must type the opcodes rather than the mnemonic.

For example, get into the mnemonic mode and open Address $015A. Type:

M (ENTER)
Ø15A/

To change this instruction, type:

86 (ENTER)

Now Address $015A contains the opcode for the LDA mnemonic. Open location 015B:

```
Ø15B/
```

and insert $06, the operand:

Ø6 (ENTER)

Upon examining Address $015A again, you'll see it now contains an LDA #6 instruction.

Exploring the Computer's Memory

You are now invited to examine each section of memory using ZBUG commands to change examination modes. Use the Memory Map in *Reference J.*

Don't hesitate to try commands or change memory. You can restore anything you alter simply by removing the diskette and turning the computer off and then on again.

Chapter 6/ Editing the Program Editor Commands

The editor has many commands to help you edit your source program. *Chapter 2* shows how to enter a source program. This chapter shows how to edit it.

To use the edit commands you must return to the editor from ZBUG:

EDTASM: From EDTASM ZBUG, return to the editor by typing E (ENTER)

EDTASMOV: From Stand-Alone ZBUG, return to the DOS menu by typing K (ENTER). Then, execute the EDTASMOV program.

The screen now shows the editor's * prompt. While in the editor, you can return to the * prompt at any time by pressing (BREAK).

This chapter uses SAMPLE/ASM from *Chapter 2* as an example. To load SAMPLE/ASM into the editor, type:

L SAMPLE/ASM (ENTER)

Print Command
Prange

To print a line of the program on the screen, type:

P100 (ENTER)

To print more than one line, type:

P100:130 (ENTER)

You will often refer to the first line, last line, and current line (the last line you printed or inserted). To make this easier, you can refer to each with a single character:

- # first line
- * last line
- • current line (the last line you printed or inserted.)

To print the current line, type:

P. (ENTER)

To print the entire text of the sample program, type:

P#:* (ENTER)

This is the same as P050:200 (ENTER).

The colon separates the beginning and ending lines in a range of lines. Another way to specify a range of lines is with !. Type:

P#!5 (ENTER)

and five lines of your program, beginning with the first one, are printed on the screen.

To stop the listing while it is scrolling, quickly type:

(SHIFT) @

To continue, press any key.

Printer Commands
Hrange
Trange

If you have a printer, you can print your program with the H and T commands. The H command prints the editor-supplied line numbers. The T command does not.

To print every line of the edit buffer to the printer, type:

H#:* (ENTER)

You are prompted with:

PRINTER READY

Respond with (ENTER) when ready.

The next example prints six lines, beginning with line 100, but without the editor-supplied line numbers. Type:

T100!6 (ENTER)

Edit Command
Eline

You can edit lines in the same way you edit Extended

COLOR BASIC lines. For example, to edit line 100, type:

E1ØØ (ENTER)

The new line 100 is displayed below the old line 100 and is ready to be changed.

Press the (SPACEBAR) to position the cursor just after START. Type this insert subcommand:

IED (ENTER)

which inserts ED in the line.

The edit subcommands are listed in *Reference A.*

Delete Command

Drange

If you are using the sample program, be sure you have written it on disk before you experiment with this command. Type:

D11Ø:14Ø (ENTER)

Lines 110 through 140 are gone.

Insert Command

Istartline, increment

Type:

I152,2 (ENTER)

You may now insert lines (up to 127 characters long) beginning with line 152. Each line is incremented by two. (The editor does not allow you to accidently overwrite an existing line. When you get to line 160, it gives you an error message.)

Press (BREAK) to return to the command level. Then type:

I2ØØ (ENTER)

This lets you begin inserting lines at the end of the program. Each line is incremented by two, the last increment you used.

Type:

(BREAK) I (ENTER)

The editor begins inserting at the current line.

On startup, the editor sets the current line to 100 and the increment to 10. You may use any line numbers between 0 and 63999.

Renumber Command

N*startline,increment*

Another command that helps with inserting lines between the lines is N (for renumber). From the command level, type:

N1ØØ,5Ø (ENTER)

The first line is now Line 100 and each line is incremented by 50. This allows much more room for inserting between lines.

Type:

N (ENTER)

The current line is now the first line number.

Renumber now so you will be ready for the next instruction. Type:

N1ØØ,1Ø (ENTER)

Replace Command

R*startline,increment*

The replace command is a variation of the insert command. Type:

R1ØØ,3 (ENTER)

You may now replace line 100 with a new line and begin inserting lines using an increment of three.

Copy Command

C*startline,range,increment*

The copy command saves typing by duplicating any part of your program to another location in the program.

To copy lines, type:

C5ØØ,1ØØ:15Ø,1Ø (ENTER)

This copies lines 100 to 150 to a new location beginning at Line 500, with an increment of 10. An attempt to copy lines over each other will fail.

ZBUG Command

The EDTASM system contains a copy of the stand-alone ZBUG program. This allows you to enter ZBUG while your program is still in memory.

> **EDTASMOV Users:** You need to use the Stand-Alone ZBUG program, as shown in *Chapter 2.*

To enter ZBUG, type:

```
Z (ENTER)
```

The # prompt tells you that you are now in ZBUG.

To re-enter the editor from ZBUG, type the ZBUG command:

```
E (ENTER)
```

If you print your program, you'll see that entering and exiting ZBUG did not change it.

BASIC Command

To enter BASIC from the editor, type:

```
Q (ENTER)
```

If you want to enter DOS from the editor, type:

```
K (ENTER)
```

Entering DOS or BASIC empties your edit buffer. Re-entering the editor empties your BASIC buffer.

Write Command

WD *filespec*

This command is the same one you used in *Chapter 2* to write the source program to disk. It saves the program in a disk file named *filespec*. *Filespec* can be in one of these forms:

filename/ext:drive
filename.ext:drive

The *filename* can be one to eight characters. It is required.

The *extension* can be one to three characters. It is optional. If the extension is omitted, the editor assigns the file the extension /ASM.

The *drive* can be a number from 0 to 4. It is also optional. If the drive number is omitted, the editor uses the first available drive.

Examples:

```
WD TEST (ENTER)
```

saves source file currently in memory as TEST/ASM.

```
WD TEST/PR1
```

saves the source file currently in memory as TEST/PR1.

Load Command

LD *filespec*
LDA *filespec*

This command loads a source *filespec* from disk into the edit buffer. If the source *filespec* you specify does not have an extension, the editor uses /ASM.

If you don't specify the A option, the editor empties the edit buffer before loading the file.

If you specify the A option, the editor appends the file to the current contents of the edit buffer.

Appending files can be useful for chaining long programs. When the second file is loaded, simply renumber the file with the renumber command.

Examples:

```
LD SAMPLE:1
```

empties the edit buffer, then loads a file named SAMPLE/ASM from Drive 1.

```
LDA SAMPLE/PRO
```

loads a file named SAMPLE/PRO from the first available drive, then appends to the current contents of the edit buffer.

The editor has several other commands. These are listed in *Reference A*.

Hints on Writing Your Program

- Copy short programs from any legal source available to you. Then modify them one step at a time to learn how different commands and addressing modes work. Try to make the program relocatable by using indexed, relative, and indirect addressing (described in *Section III*).
- Try to write a long program as a series of short routines that use the same symbols. They will be easier to understand and debug. They can later be combined into longer routines.

  Note: You can use the editor to edit your BASIC programs, as well as assembly language programs. You might find this very useful since the EDTASM editor is much more powerful than the BASIC editor. You need to first save the BASIC program in ASCII format:

  SAVE *filespec*, A

  Then, load the program into the editor.

Chapter 7/ Assembling the Program (Assembler Commands)

To load the assembler program and assemble the source program into 6809 machine code, EDTASM (or EDTASMOV) has an "assembly command." Depending on how you enter the command, the assembler:

- Shows an "assembly listing" giving information on how the assembler is assembling the program.
- Stores the assembled program in memory.
- Stores the assembled program on disk.
- Stores the assembled program on tape.

This chapter shows the different ways you can control the assembly listing, the in-memory assembly, and the disk assembly. Knowing this will help you understand and debug a program.

The Assembly Command

The command to assemble your source program into 6809 machine code is:

Assembling in memory:

A /IM */switch2/switch3/* . . .

The /IM (in memory) switch is required.

Assembling to disk:

A *filespec /switch1/switch2/* . . .

The assembled program is stored on disk as *filespec*. If *filespec* does not include an *extension*, the assembler uses /BIN.

Assembling to tape:

A *filename /switch1/switch2/* . . .

The assembled program is stored on tape as *filename*.

The *switch* options are as follows:

/AO	Absolute origin
/IM	Assemble into memory
/LP	Assembler listing on the line printer
/MO	Manual origin
/NL	No listing
/NO	No object code in memory or disk
/NS	No symbol table in the listing
/SR	Single record
/SS	Short screen listing
/WE	Wait on assembly errors
/WS	With symbols

You may use any combination of the switch options. Be sure to include a blank space before the first switch. If you omit *filespec*, you must use the in-memory switch (/IM).

Examples:

```
A/IM/WE
```

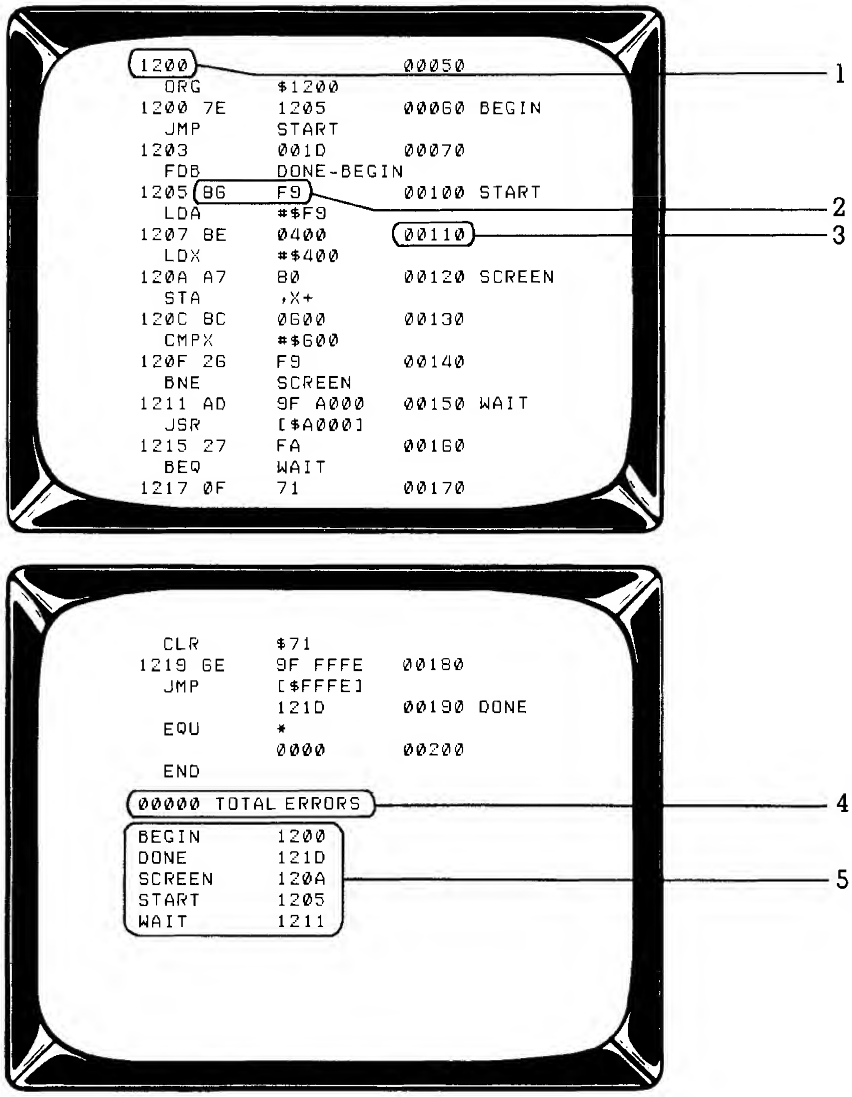
assembles the source program in memory (/IM) and stops at each error (/WE).

```
A TEST /LP
```

assembles the source program and saves it on disk as TEST/BIN. The listing is printed on the printer (/LP). Note that there must be a space between the *filespec* and the switch.

```
A TEST/PRO
```

assembles the source program and saves it on disk as TEST/PRO.



1. The location in memory where the assembled code will be stored. In this example, the assembled code for LDA#$F9 will be stored at hexadecimal location #1200.
2. The assembled code for the program line. $86F9 is the assembled code for LDA #$F9.
3. The program line.
4. The number of errors. If you have errors, you will want to assemble the program again with the /WE switch.
5. The symbols you used in your program and the memory locations they refer to.

Figure 1. Assembly Display Listing

Controlling the Assembly Listing

The assembler normally displays an assembly listing similar to the one in *Figure 1*. You can alter this listing with one of these switches:

/SS	Short screen listing
/NS	No symbol table in the listing
/NL	No listing
/LP	Listing printed on the printer

For example:

```
A SAMPLE /NS
```

assembles SAMPLE and shows a listing without the symbol table.

If you are printing the listing on the printer, you might want to set different parameters. You can do this with the editor's "set line printer parameters" command:

To use this command, type (at the * prompt):

S (ENTER)

The editor shows you the current values for:

- LINCNT — the number of lines printed on each page. ("line count")
- PAGLEN — the number of lines on a page. ("page length")
- PAGWID — the number of columns on a page. ("page width")
- FLDFLG — the "fold flag" (This flag should contain 1 if your printer does not "wrap around." Otherwise, the flag should contain 0.)

It then prompts you for different values. Check your printer manual for the appropriate parameters. If you want the value to remain the same, simply press (ENTER). For example:

```
LINCNT=58
PAGLEN=66
PAGWID=80
FLDFLG=0
```

sets the number of lines to 58, the page length to 66, and the page width to 80 columns. You can then assemble the program with the /LP switch:

```
A SAMPLE /LP
```

and the assembler prints the listing on the line printer using the parameters just set.

In-Memory Assembly The /IM Switch

The /IM switch causes the program to be assembled in memory, not on disk or tape. This is a good way to find errors in a program.

Where in memory? This depends on whether you use the /IM switch alone or accompany it with an ORG instruction, an /AO switch, or an /MO switch.

Using the /IM Switch Alone

This is the most efficient use of memory. The assembler stores your program at the first available address after the EDTASM (or EDTASMOV) program, the edit buffer, and the symbol table:

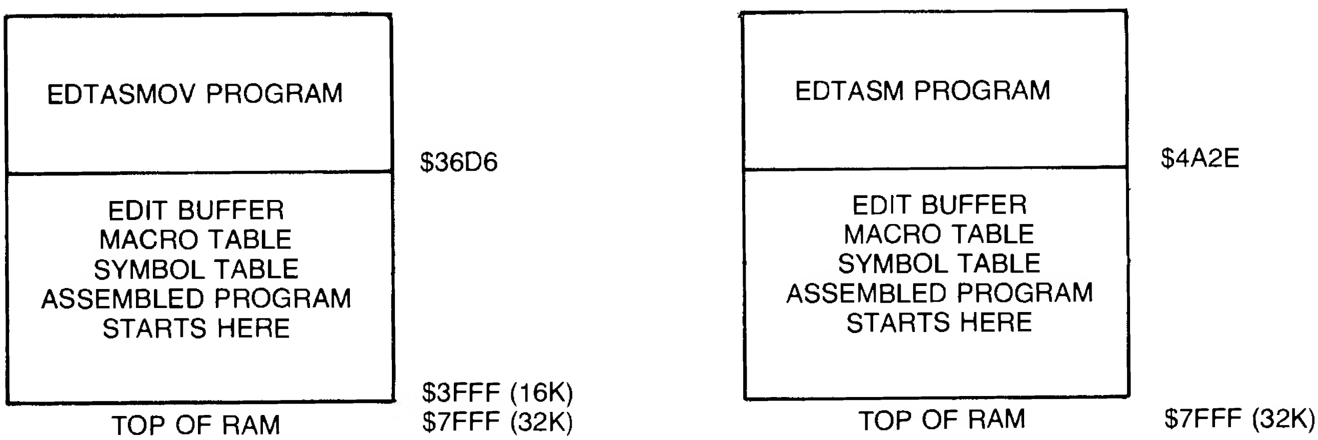


Figure 2. In-Memory Assembly

The EDTASM program ends at Address $4A2D. The EDTASMOV program ends at $36D5.

The edit buffer contains the source program. It begins at Address $4A2E or $36D6 and varies in size depending on your program's length.

The macro table references all the macro symbols in your program and their corresponding values. (Macros are described in Chapter 12.) Its size varies depending on how many macros your program contains.

The symbol table references all your program's symbols and their corresponding values. Its size varies depending on how many symbols your program contains.

Example:

Load the SAMPLE/ASM back into the edit buffer. At the * prompt, type:

```
L SAMPLE/ASM (ENTER)
```

Delete the ORG line. At the * prompt, type:

```
D50 (ENTER)
```

Then assemble the program in memory by typing:

```
A/IM (ENTER)
```

(If you want another look, type A/IM again. You can pause the display by pressing (SHIFT) (@) and continue by pressing any key.)

Since this sample program uses START to label the beginning of the program, you can find its originating address from the assembler listing. If you are using EDTASM, it should begin at Address $4B1E. If you are using EDTASMOV, it should begin at $37C6.

Using ORG with /IM for Origination Offset

If you have an ORG instruction in your program and do not use the AO switch, the assembler stores your program at:

the first available address + the value of ORG

Example:

Insert this line at the beginning of the sample program:

EDTASM Systems:

```
0050        ORG $6000
```

EDTASMOV Systems:

```
0050        ORG $3800
```

Then, at the * prompt, type:

```
A/IM (ENTER)
```

The START address is now the first available address + $6000 or $3800. This means that if you have less than 32K (with EDTASM) or less than 16K (with EDTASMOV), the program extends past the top of RAM and you will get a BAD MEMORY error.

Using IM with /AO for Absolute Origin

The AO switch causes the assembler to store your program "absolutely" at the address specified by ORG.

With the ORG instruction inserted, type (at the * prompt):

```
A/IM/AO (ENTER)
```

Your program now starts at address $6000 or $3800:

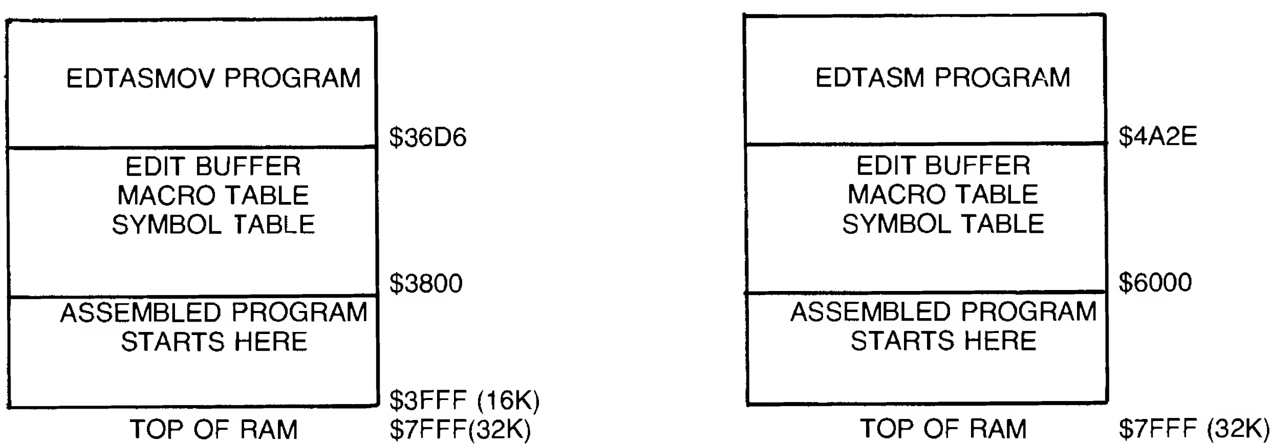


Figure 3. /AO In-Memory Assembly.

As you can see, the AO switch set the location of the assembled program only. It did not set the location of the edit buffer or the symbol table.

If your ORG instruction does not allow enough memory for your program, you will get a BAD MEMORY error. The assembler cannot store your program beyond the top of RAM.

Using /MO with /IM for Manual Origin

The /MO switch causes your program to be assembled at the address set by USRORG (plus the value set in your ORG instruction, if you use one). To set USRORG, use the editor's "origin" command.

Before setting USRORG, remove the ORG instruction from your program. Then, at the * prompt, type:

```
O (ENTER)
```

The editor shows you the current values for:

- FIRST — the first hexadecimal address available
- LAST — the last hexadecimal address available
- USRORG — the current hexadecimal value of USRORG. (On startup, USRORG is set to the top of RAM.)

It then prompts you for a new value for USRORG. If you want USRORG to remain the same, press (ENTER).

If you want to enter a new value, it must be between the FIRST address and LAST address. Otherwise, you will get a BAD MEMORY error.

EDTASM Systems: Set USRORG to $6050:

```
USRORG=6Ø5Ø (ENTER)
```

EDTASMOV Systems: Set USRORG to $3800:

```
USRORG=38ØØ (ENTER)
```

After setting USRORG, you can assemble the program at the USRORG address. Type:

```
A/IM/MO (ENTER)
```

Your assembled program now starts at Address $6050 or $3800:

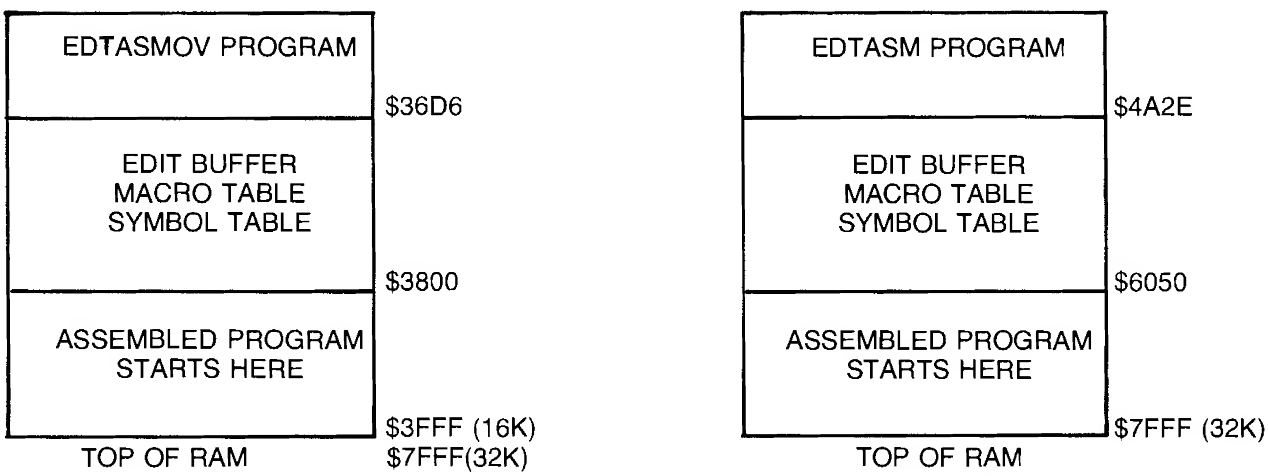


Figure 4. /MO In-Memory Assembly.

Disk Assembly

When you specify a filespec in the assembler command, the assembler saves the assembled program on disk. You can then load the program from one of these systems:

- DOS (to run as a stand-alone program)
- ZBUG (to debug with the stand-alone ZBUG program)
- BASIC (to call from a BASIC program)

The program originates at the address you specify in the ORG instruction.

What address you should use as the originating address depends upon which of the three systems you will be loading it into.

Assembling for DOS

Reference J shows the memory map that is in effect when DOS is loaded. As you can see, DOS consumes all the memory up to Address $1200. This means you must originate the program after $1200 or you will overwrite DOS.

In the sample program, reinsert the ORG $1200 instruction:

```
50      ORG  $1200
```

and assemble it to disk by typing:

```
A SAMPLE /SR (ENTER)
```

Note the /SR switch. You must use /SR when assembling to disk a program that you plan to load back into DOS. This puts the program in the format expected by DOS.

The assembler saves SAMPLE/BIN to disk with a starting address of $1200. You can now load and execute SAMPLE/BIN from the DOS menu.

Assembling for Stand-Alone ZBUG (EDTASMOV Users)

If you plan to use the stand-alone ZBUG for debugging your program, you need to save the program on disk so that you can load it into ZBUG.

Reference J also shows the memory map that is in effect when ZBUG is loaded. As you can see, you must use an originating address of at least $3800 or you will overwrite ZBUG. Change the ORG instruction to:

```
50      ORG  $3800
```

So that you can test this from ZBUG, without the program returning to BASIC, you need to change the ending of it. First, delete the CLR instruction in Line 170:

```
D170 (ENTER)
```

Then, change the JMP instruction in Line 180 to this:

```
180 SWI
```

After making the changes to the program, assemble it to disk by typing:

```
A SAMPLE/BUG /WS (ENTER)
```

The assembler saves SAMPLE/BUG on disk with a starting address of $3800. The /WS switch causes the assembler to save the symbol table also.

Hints On Assembly

- Use a symbol to label the beginning of your program.
- When doing an in-memory assembly on a program with an ORG instruction, you may want to use the /AO switch. Otherwise, the assembler will not use ORG as the program's originating address. It will use it to offset (add to) the loading address.
- The /WE switch is an excellent debugging tool. Use it to detect assembly errors before debugging the program.
- If you would like to examine the edit buffer and symbol table after an in-memory assembly, use ZBUG to examine the appropriate memory locations.

Chapter 8/ Debugging the Program (ZBUG Commands — Part II)

ZBUG has some powerful tools for a trial run of your assembled program. You can use them to look at each register, every flag, and every memory address during every step of running the program.

Before reading any further, you might want to review the ZBUG commands you learned in *Chapter 5*. We will be using these commands here.

Preparing the Program for ZBUG

In this chapter, we'll use the sample program from *Chapter 2* to show how to test a program. How you load the program into ZBUG depends on whether you are using EDTASM's ZBUG program or the stand-alone ZBUG program.

EDTASM ZBUG:

If you are using EDTASM, you can use EDTASM's ZBUG program.

1. Load SAMPLE/ASM into EDTASM (if it's not already loaded).
2. So that your program will be in the same area of memory as ours, change the ORG instruction to:

```
50        ORG       $5800
```

3. So that you can test the program properly from ZBUG (without the program returning to BASIC), you need to change the program's ending. First, delete the CLR instruction in Line 170:

```
D170 (ENTER)
```

Then, change the JMP instruction in Line 180 to this:

```
180       SWI
```

4. Assemble the program in memory using the /IM and /AO switches. At the * prompt, type:

```
A/IM/AO (ENTER)
```

5. Enter ZBUG. At the * prompt, type:

```
Z (ENTER)
```

When the # prompt appears, you're in ZBUG and can test the sample program.

Stand-Alone ZBUG:

If you are using EDTASMOV, you should use the Stand-Alone ZBUG.

1. Assemble SAMPLE/BUG to disk as instructed in the last chapter ("Assembling for Stand-Alone ZBUG").
2. Return to DOS and execute the stand-alone ZBUG program:

```
EXECUTE A PROGRAM
PROGRAM NAME [ZBUG    ]/BIN
```

ZBUG loads and displays its # prompt.

3. Load SAMPLE/BUG, along with its symbol table, into ZBUG. Type:

```
LDS SAMPLE/BUG (ENTER)
```

When the # prompt appears, you're ready to test the sample program with ZBUG.

Display Modes

In *Chapter 5*, we discussed four examination modes. ZBUG also has three display modes.

We'll examine each of these display modes from the mnemonic examination mode. If you're not in this mode, type M (ENTER) to get into it.

Numeric Mode

Type:

```
N (ENTER)
```

and examine the memory addresses that contain your program: $5800-$5817 for EDTASM's ZBUG or $3800-$3817 for Stand-Alone ZBUG.

In the numeric mode, you do not see any of the symbols in your program (BEGIN, START, SCREEN, WAIT, and DONE). All you see are numbers. For example, with EDTASM's ZBUG, Address $580F shows the instruction BNE 580A rather than BNE SCREEN.

Symbolic Mode

From the command level, type:

```
S (ENTER)
```

and examine your program again. ZBUG displays your entire program in terms of its symbols (BEGIN, START, SCREEN, WAIT, and DONE). Examine the memory address containing the BNE SCREEN instruction and type:

```
;
```

The semicolon causes ZBUG to display the operand (SCREEN) as a number (580A or 380A).

Half-Symbolic Mode

From the command level, type:

```
H (ENTER)
```

and examine the program. Now all the memory addresses (on the left) are shown as symbols, but the operands (on the right) are shown as numbers.

Using Symbols to Examine Memory

Since ZBUG understands symbols, you can use them in your commands. For example, with EDTASM's ZBUG, both these commands open the same memory address no matter which display mode you are in:

```
BEGIN/
5800/
```

Both of these commands get ZBUG to display your entire program:

```
T   BEGIN DONE
T   5800 5817
```

You can print this same listing on your printer by substituting TH for T.

Executing the Program

You can run your program from ZBUG using the G (Go) command followed by the program's start address:

EDTASM ZBUG: Type either of the following:

```
GBEGIN (ENTER)
G5800 (ENTER)
```

Stand-Alone ZBUG: Type either of the following:

```
GBEGIN (ENTER)
G3800 (ENTER)
```

The program executes, filling all of your screen with a pattern made up of F9 graphics characters. If you don't get this pattern, the program probably has a "bug." The rest of the chapter discusses program bugs.

After executing the program, ZBUG displays 8 BRK @ 5817, 8 BRK @ 3817, or 8 BRK @ DONE. This tells you the program stopped executing at the SWI instruction located at Address DONE. ZBUG interprets your closing SWI instruction as the eighth or final "breakpoint" (discussed below).

Setting Breakpoints

If your program doesn't work properly, you might find it easier to debug it if you break it up into small units and run each unit separately. From the command level, type X followed by the address where you want execution to break.

We'll set a breakpoint at the first address that contains the symbol SCREEN: $580A for EDTASM's ZBUG or 380A for Stand-Alone ZBUG.

EDTASM ZBUG: Type either of the following:

```
XSCREEN (ENTER)
X580A (ENTER)
```

Stand-Alone ZBUG: Type either of the following:

```
XSCREEN (ENTER)
X380A (ENTER)
```

Now type GBEGIN (ENTER) to execute the program. Each time execution breaks, type:

```
C (ENTER)
```

to continue. A graphics character appears on the screen each time ZBUG executes the SCREEN loop. (The characters appear to be in different positions because of scrolling.You will not see the first 32 characters because they scroll off the screen.)

Type:

```
D (ENTER)
```

to display all the breakpoints you have set. (You may set up to eight breakpoints numbered 0 through 7.)

Type:

```
C10 (ENTER)
```

and the tenth time ZBUG encounters that breakpoint, it halts execution.

Type:

```
Y (ENTER)
```

This is the command to "yank" (delete) all breakpoints. You can also delete a specific breakpoint. For example:

```
Y0 (ENTER)
```

This deletes the first breakpoint (Breakpoint 0).

You may not set a breakpoint in a ROM routine. If you set a breakpoint at the point where you are calling a ROM routine, the C command will not let you continue.

Examining Registers and Flags

Type:

```
R (ENTER)
```

What you see are the contents of every register during this stage of program execution. (See *Chapter 10* for definition of all the 6809 registers and flags.)

Look at Register CC (the Condition Code). Notice the letters to the right of it. These are the flags that are set in Register CC. The E, for example, means the E flag is set.

Type:

```
X/
```

and ZBUG displays only the contents of Register X. You can change this in the same way you change the contents of memory. Type:

```
0 (ENTER)
```

and the Register X now contains a zero.

Stepping Through the Program

Type:

```
BEGIN,        Note the comma!
```

LDA #$F9 is the next instruction to be executed. The first instruction, JMP START, has just been executed. To see the next instruction, type:

```
,       Simply a comma
```

Now, LDA #$F9 has been executed and LDX #$500 is the next. Type:

```
R (ENTER)
```

and you'll see this instruction has loaded Register A with $F9.

Use the comma and R command to continue single-stepping through the program examining the registers at will. If you manage to reach the JSR [$A000] instruction, ZBUG prints:

```
CAN'T CONTINUE
```

ZBUG cannot single-step through a ROM routine or through some of the DOS routines.

Transferring a Block of Memory

EDTASM ZBUG: Type:

```
U 5800 5000 6 (ENTER)
```

Stand-Alone ZBUG: Type:

```
U 3800 3850 6 (ENTER)
```

Now the first six bytes of your program have been copied to memory addresses beginning at 5000 or 3850.

Saving Memory to Disk

To save a block of memory from ZBUG, including the symbol table, type:

EDTASM ZBUG: `PS TEST/BUG 5800 5817 5800` (ENTER)

Stand-Alone ZBUG: `PS TEST/BUG 3800 3817 3800` (ENTER)

This saves your program on disk, beginning at Address 5800 (or 3800) and ending at Address 5817 (or 3817). The last address is where your program begins execution when you load it back into memory. In this case, this address is the same as the start address.

To load TEST/BUG and its symbol table back into ZBUG, type:

`LDS TEST/BUG` (ENTER)

Hints on Debugging

- Don't expect your first program to work the first time. Have patience. Most new programs have bugs. Debugging is a fact of life for all programmers, not just beginners.
- Be sure to make a copy of what you have in the edit buffer before executing the program. The edit buffer is not protected from machine language programs.

Chapter 9/ Using the ZBUG Calculator (ZBUG Commands — Part III)

ZBUG has a built-in calculator that performs arithmetic, relational, and logical operations. Also, it lets you use three different numbering systems, ASCII characters, and symbols.

This chapter contains many examples of how to use the calculator. Some of these examples use the same assembled program that we used in the last chapter.

> **Stand-Alone ZBUG:** Some of the memory addresses we use in the examples are too high for your system. Subtract $1000 from all the hexadecimal addresses and 4096 from all the decimal numbers.

Numbering System Modes

ZBUG recognizes numbers in three numbering systems: hexadecimal (Base 16), decimal (Base 10), and octal (Base 8).

Output Mode

The output mode determines which numbering system ZBUG uses to output (display) numbers. From the ZBUG command level, type:

```
O10 (ENTER)
```

Examine memory. The T at the end of each number stands for Base 10. Type:

```
O8 (ENTER)
```

Examine memory. The Q at the end of each number stands for Base 8. Type:

```
O16 (ENTER)
```

You're now back in Base 16, the default output mode.

Input Mode

You can change input modes in the same way you change output modes. For example, type:

```
I10 (ENTER)
```

Now, ZBUG interprets any number you input as a Base 10 number. For example, if you are in this mode and type:

```
T 49152 49162 (ENTER)
```

ZSBUG shows you memory addresses 49152 (Base 10) through 49162 (Base 10). Note that what is printed on the screen is determined by the output mode, not the input mode.

You can use these special characters to "override" your input mode:

BASE	BEFORE NUMBER	AFTER NUMBER
Base 10	&	T
Base 16	$	H
Base 8	@	Q

Table 1. Special Input Mode Characters

For example, while still in the I10 mode, type:

```
T 49152  $C010 (ENTER)
```

The "$" overrides the I10 mode. ZBUG, therefore, interprets C010 as a hexadecimal number. As another example, get into the I16 mode and type:

```
T 49152T  C010 (ENTER)
```

Here, the "T" overrides the I16 mode. ZBUG interprets 49152 as decimal.

Operations

ZBUG performs many kinds of operations for you. For example, type:

```
C000+25T/
```

and ZBUG goes to memory address C019 (Base 16), the sum of C000 (Base 16) and 25 (Base 10). If you simply want ZBUG to print the results of this calculation, type:

```
C000+25T=
```

On the following pages, we'll use the terms "operands," "operators," and "operation." An operation is any calculation you want ZBUG to solve. In this operation:

1 + 2 =

"1" and "2" are the operands. "+" is the operator.

Operands

You may use any of these as operands:.

1. ASCII characters
2. Symbols
3. Numbers (in either Base 8, 10, or 16) — Please note that ZBUG recognizes integers (whole numbers) only

Examples (Get into the 016 mode):

```
'A=
```

prints 41, the ASCII hexadecimal code for "A".

```
START=
```

prints the START address of the sample program. (It will print UNDEFINDED SYMBOL if you don't have the sample program assembled in memory.)

```
15Q=
```

prints the hexadecimal equivalent of octal 15.

If you want your results printed in a different numbering system, use a different output mode. For example, get into the O10 mode and try the above examples again.

Operators

You may use arithmetic, relational, or logical operators. (Get into the O16 mode for the following examples.)

Arithmetic Operators

Addition	+
Subtraction	–
Multiplication	*
Division	.DIV.
Modulus	.MOD.
Positive	+
Negative	–

Examples:

```
DONE-START=
```

prints the length of the sample program (not including the SWI at the end).

```
9.DIV.2=
```

prints 4. (ZBUG can divide integers only.)

```
9.MOD.2=
```

prints 1, the remainder of 9 divided by 2.

```
1-2=
```

prints OFFFF,65535T, or 177777Q, depending on which output mode you are in. ZBUG does not use negative numbers. Instead, it uses a "number circle" which operates on modulus 10000 (hexadecimal):

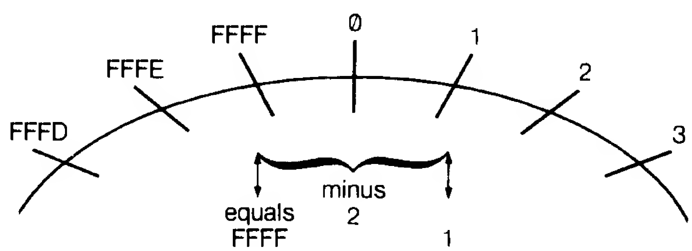


Figure 5. Number Circle Illustration of Memory.

To understand this number circle, you can use the clock as an analogy. A clock operates on modulus 12 in the same way the ZBUG operates on modulus 10000. Therefore, on a clock, 1:00 minus 2 equals 11:00:

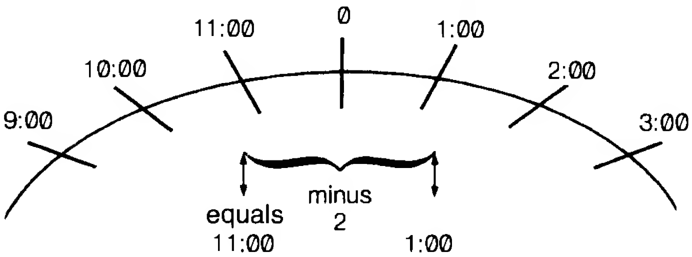


Figure 6. Number Circle Illustration of Clock.

Relational Operators

Equal to	.EQU.
Not Equal to	.NEQ.

These operators determine whether a relationship is true or false.

Examples:

```
5.EQU.5=
```

prints 0FFFF, since the relationship is true. (ZBUG prints 65535T in the O10 mode or 177777Q in the O8 mode.)

```
5.NEQ.5=
```

prints 0, since the relationship is false.

Logical Operators

Shift	<
LogicalAND	.AND.
InclusiveOR	.OR.
ExclusiveOR	.XOR.
Complement	.NOT.

Logical operators perform bit manipulation on binary numbers. To understand bit manipulation, see the 6809 assembly language book we referred to in the introduction.

Examples:

```
10<2=
```

shifts 10 two bits to the left to equal 40. The 6809 SL instruction also performs this operation.

```
10<-2=
```

shifts 10 two bits to the right to equal 4. The 6809 ASR instruction also performs this operation.

```
6.XOR.5=
```

prints 3, the exclusive or of 6 and 5. The 6809 EOR instruction also performs this operation.

Complex Operations

ZBUG calculates complex operations in this order:

```
+     .DIV.    .MOD.    <
          .AND.
       .OR.     .XOR
          +     -
      .EQU.    .NEQ.
```

You may use parentheses to change this order.

Examples:

```
4+4.DIV.2=
```

The division is performed first.

```
(4+4).DIV.2=
```

The addition is performed first.

```
4*4.DIV.4=
```

The multiplication is performed first.

SECTION III

ASSEMBLY LANGUAGE

SECTION III

ASSEMBLY LANGUAGE

This section gives details on the Disk EDTASM assembly language. It does not explain the 6809 mnemonics, however, since there are many books available on the 6809.

To learn about 6809 mnemonics, read one of the books listed in "About This Manual." If you need more technical information on the 6809, read:

MC6809-MC6809E
8-Bit Microprocessor Programming Manual
Motorola, Inc.

Chapter 10/ Writing the Program

Chapter 3 gives a general description of assembly language instructions. This chapter describes them in detail.

The 6809 Registers

The 6809 contains nine temporary storage areas that you may use in your program:

REGISTER	SIZE	DESCRIPTION
A	1 byte	Accumulator
B	1 byte	Accumulator
D	2 bytes	Accumulator (a combination of A and B)
DP	1 byte	Direct Page
CC	1 byte	Condition Code
PC	2 bytes	Program Counter
X	2 bytes	Index
Y	2 bytes	Index
U	2 bytes	Stack Pointer
S	2 bytes	Stack Pointer

Table 2. 6809 Registers

Registers A and **B** can manipulate data and perform arithmetic calculations. They each hold one byte of data. If you like, you can address them as D, a single 2-byte register.

Register DP is for direct addressing. It stores the most significant byte of an address. This lets the processor directly access an address with the single, least significant byte.

Registers X and **Y** can each hold two bytes of data. They are mainly for indexed addressing.

Register PC stores the address of the next instruction to be executed.

Registers U and **S** each hold a 2-byte address that points to an entire "stack" of memory. This address is the top of the stack + 1. For example, if Register U contains 0155, the stack begins with Address 154 and continues downwards.

The processor automatically points Register S to a stack of memory during subroutine calls and interrupts. Register U is solely for your own use. You can access either stack with the PSH and PUL mnemonics or with indexed addressing.

Register CC is for testing conditions and setting interrupts. It consists of eight "flags." Many mnemonics "set" or "clear" one or more of these flags. Others test to see if a certain flag is set or clear.

This is the meaning of each flag, if set:

C (Carry), Bit 0 — an 8-bit arithmetic operation caused a carry or borrow from the most significant bit.

V (Overflow), Bit 1 — an arithmetic operation caused a signed overflow.

Z (Zero), Bit 2 — the result of the previous operation is zero.

N (Negative), Bit 3 — the result of the previous operation is a negative number.

I (Interrupt Request Mask), Bit 4 — any requests for interrupts are disabled.

H (Half Carry), Bit 5 — an 8-bit addition operation caused a carry from Bit 3.

F (Fast Interrupt Request Mask), Bit 6 — any requests for fast interrupts are disabled.

E (Entire Flag), Bit 7 — all the registers were stacked during the last interrupt stacking operation. (If not set, only Registers PC and CC were stacked.)

Assembly Language Fields

You may use four fields in an assembly language instruction: label, command, operand, comment. In this instruction:

```
START    LDA    #$F9          GETS CHAR
```

START is the label. LDA is the command. #$F9+1 is the operand. GETS CHAR is the comment.

The comment is solely for your convenience. The assembler ignores it.

The Label

You can use a symbol in the label field to define a memory address or data. The above instruction uses START to define its memory address.

Once the address is defined, you can use START as an operand in other instructions. For example:

```
     BNE         START
```

branches to the memory address defined by START.

The assembler stores all the symbols, with the addresses or data they define, in a "symbol table," rather than as part of the "executable program." The symbol can be up to six characters.

The Command

The command can be either a pseudo op or a mnemonic.

Pseudo ops are commands to the assembler. The assembler does not translate them into opcodes and does not store them with the executable program. For example:

```
     NAME       EQU       $43
```

defines the symbol NAME as $43. The assembler stores this in its symbol table.

```
                ORG       $3000
```

tells the assembler to begin the executable program at Address $3000.

```
     SYMBOL     FCB       $6
```

stores 6 in the current memory address and labels this address SYMBOL. The assembler stores this information in its symbol table.

Mnemonics are commands to the processor. The assembler translates them into opcodes and stores them with the executable program. For example:

```
     CLRA
```

tells the processor to clear Register A. The assembler assembles this into opcode number $4F and stores it with the executable program.

The next chapter shows how to use pseudo ops. *Reference L* lists the 6809 mnemonics.

The Operand

The operand is either a memory address or data. For example:

```
     LDD                 #3000+COUNT
```

loads Register D with $3000 plus the value of COUNT. The operand, #$3000 + COUNT, specifies a data constant.

The assembler stores the operand with its opcode. Both are stored with the executable program.

Operators

The plus sign (+) in the above operand (#3000 + COUNT) is called an operator.

You can use any of the operators described in *Chapter 9*, "Using the ZBUG Calculator," as part of the operand.

Addressing Modes

The above example uses the # sign to tell the assembler and the processor that $3000 is data. When you omit the # sign, they interpret $3000 in a different "addressing mode."

Example:

```
     LDD                 $3000
```

tells the assembler and processor that $3000 is an address. The processor loads D with the data contained in Address $3000 and $3001.

Each of the 6809 mnemonics lets you use one to six addressing modes. These addressing modes tell you:

- If the processor requires an operand to execute the opcode
- How the assembler and processor will interpret the operand

1. Inherent Addressing

There is no operand, since the instruction doesn't require one. For example:

```
SWI
```

interrupts software. No operand is required.

```
CLRA
```

clears Register A. Again, no operand is required. Register A is part of the instruction.

2. Immediate Addressing

The operand is *data*. You must use the # sign to specify this mode. For example:

```
          ADDA      #$30
```

adds the value $30 to the contents of Register A.

```
DATA      EQU       $8004
          LDX       #DATA
```

loads the value $8004 into Register X.

```
          CMPX      #$1234
```

compares the contents of Register X with the value 1234.

3. Extended Addressing

The operand is an *address*. This is the default mode of all operands.

(Exception: If the first byte of the operand is identical to the direct page, which is 00 on startup, it is directly addressed. This is an automatic function of the assembler and the processor. You need not be concerned with it if you're a beginner.)

For example:

```
          JSR       #$1234
```

jumps to Address $1234.

```
SPOT      EQU       $1234
          STA       SPOT
```

stores the contents of Register A in Address $1234.

If the instruction calls for data, the operand contains the address where the data is stored.

```
          LDA       $1234
```

does not load Register A with $1234. The processor loads A with whatever data is in Address $1234. If $06 is stored in Address $1234, Register A is loaded with $06.

```
          ADDA      $1234
```

adds whatever data is stored in Address $1234 to the contents of Register A.

```
          LDD       $1234
```

loads D, a 2-byte register, with the data stored in memory addresses $1234 and $1235.

You can use the > sign, which is the sign for extended addressing, to force this mode. (See "Direct Addressing.")

Extended Indirect Addressing.

The operand is the *address* of an *address*. This is a variation of the extended addressing mode. The [ ] signs specify it. (Use (SHIFT) (↓) to produce the [sign and (SHIFT) (→) to produce the] sign.)

In understanding this mode, think of a treasure hunt game. The first instruction is "Look in the clock." The clock contains the second instruction, "Look in the refrigerator."

Examples:

```
          JSR       [$1234]
```

jumps to the address contained in Addresses $1234 and $1235. If $1234 contains $06 and $1235 contains $11, the effective address is $0611. The program jumps to $0611.

```
SPOT      EQU       $1234
          STA       [SPOT]
```

stores the contents of Register A in the address contained in Addresses $1234 and $1235.

```
          LDD       [$1234]
```

loads D with the data stored in the address that is stored in Addresses $1234 and $1235.

This is a good mode of addressing to use when calling ROM routines. For example, the entry address of the POLCAT routine is contained in Address $A000. Therefore, you can call it with these instructions:

```
POLCAT    EQU       $A000
          JSR       [POLCAT]
```

If a new version of ROM puts the entry point in a different address, your program still works without changes.

4. Indexed Addressing

The operand is an *index register* which points to an *address*. The *index register* can be any of the 2-byte registers, including PC. You can augment it with:

- A constant or register offset
- An auto-increment or auto-decrement of 1 or 2

The comma (,) indicates indexed addressing.

As an example, load X, a 2-byte register, with $1234:

```
        LDX         #$1234
```

You can now access Address $1234 through indexed addressing. This instruction:

```
        STA         ,X
```

stores the contents of A in Address $1234

```
        STA         3,X
```

stores the contents of A in Address $1237, which is $1234 + 3. (The number 3 is a constant offset.)

```
SYMBOL  EQU         $4
        STA         SYMBOL,X
```

stores the contents of A in Address $1238, which is $1234 + SYMBOL. (SYMBOL is a constant offset.)

```
        LDB         #$5
        STA         B,X
```

stores the contents of A in Address $1239 which is $1234 + the contents of B. (B is a register offset. You can use either of the accumulator registers as a register offset.)

```
        STA         ,X+
```

This instruction does two tasks: (1) stores A's contents in Address $1234 (the contents of X) and then (2) increments X's contents by one, so that X contains $1235.

```
        STA         ,X++
```

(1) stores A's contents in Address $1235 (the current contents of X) and then (2) increments X's contents by two to equal $1237.

```
        STA         ,--X
```

(1) decrements the current contents of X by two to equal $1235 ($1237 – 2) and then (2) stores A's contents in Address $1235.

As we said above, you can use PC as an index register. In this form of addressing, called program counter relative, the offset is interpreted differently. For example:

```
SYMBOL  FCB         Ø
        LDA         SYMBOL,PCR
```

While assembling the program, the assembler *subtracts* the contents of Register PC from the offset:

```
        LDA         SYMBOL-PC,PCR
```

While running the program, the processor *adds* the contents of Register PC to the offset. This causes A to be loaded with SYMBOL.

This seems to be the same as extended addressing. But, by using program counter relative adressing, you can relocate the program without having to reassemble it.

Indexed Indirect Addressing.

The operand is an *index register* which points to the *address* of an *address*. This is a variation of indexed addressing.

For example, assume that :

- Register X contains $1234
- Address $1234 contains $11
- Address $1235 contains $23
- Address $1123 contains $64

This instruction:

```
        LDA         [,X]
```

loads A with 64. (Register X points to the addresses of the address. This address is storing 6, the required data.)

```
        STA         [,X]
```

stores the contents of A in Address $1123. (Register X points to the addresses, $1234 and $1235, of the effective address, $1123.)

5. Relative Addressing

The assembler interprets the operand as a *relative address*. There is no sign to indicate this mode. The assembler automatically uses it for all branching instructions.

For example, if this instruction is located at Address $0580:

```
        BRA         $Ø585
```

The assembler converts $0585 to a relative branch of +3 (0585-0582).

This mode is invisible to you unless you get a BYTE OVERFLOW error, which we discuss below. Because the processor uses this mode, you can relocate your program in memory without changing any of the branching instructions.

The BYTE OVERFLOW error means that the relative branch is outside the range of –128 to +127. You must use a long branching instruction instead. For example:

```
LBRA        $0600
```

allows a relative branching range of –32768 to +32767.

6. *Direct Addressing*

In this mode, the operand is *half of an address*. The other half of the address is in Register DP:

ADDRESS	=	***DP REGISTER (most significant byte)***	***OPERAND (least significant byte)***

Figure 7. Direct Addressing

The assembler and the processor use this mode automatically whenever they approach an operand whose first byte is what they assume to be a "direct page" (the contents of Register DP). Until you change the direct page, the assembler and the processor assume it is 00.

For example, both of these instructions:

```
JSR         $0015
JSR         $15
```

cause a jump to Address $0015. In both cases, the assembler uses only 15 as the operand, not 00. When the processor executes them, it gets the 00 portion from Register DP and combines it with $15. (On startup, DP contains 0, as do all the other registers.)

Because of direct addressing, all operands beginning with 00, the direct page, consume less room in memory and run quicker. If most of your operands begin with $12, you might want to make $12 the direct page.

To do this, you first need to tell the assembler what you are doing, by putting a SETDP pseudo-operation in your program:

```
SETDP       $12
```

This tells the assembler to drop the $12 from all operands that begin with $12. That is, the assembler assembles the operand "1234" as simply "34".

Then, you must load Register DP with $12. Since you can use LD only with the accumulator registers, you have to load DP in a round-about manner:

```
LDB         #$12
TFR         B,DP
```

Now the direct page is $12, rather than 00. The processor executes all operands that begin with $12 (rather than 00) in an efficient, direct manner.

The assembler uses direct addressing on all operands whose first byte is the same as the direct page. You can denote direct addressing with the < sign if you want to document or be sure that direct addressing is being used.

For example, if the direct page is $12:

```
JSR         <$15
```

jumps to Address $1215. This instruction documents that the processor uses direct addressing.

Similarly, you might want to use the > sign to force extended addressing. For example:

```
JSR         >$1215
```

jumps to Address $1215. The assembler and processor use both bytes of the operand.

To learn more about 6809 addressing modes, read one of the books listed at the beginning of this manual.

Chapter 11/ Using Pseudo Ops

As discussed earlier, pseudo ops direct the assembler. You can use them to:

- Control where the program is assembled
- Define symbols
- Insert data into the program
- Change the assembly listing
- Do a "conditional" assembly
- Include another source file in your program

Pseudo ops are unique to the assembler you are using. Other 6809 assemblers may not recognize the Disk EDTASM pseudo ops.

The Disk EDTASM pseudo ops make it easier for you to program. This chapter shows how to use pseudo ops.

Controlling Where the Program is Assembled

The Disk EDTASM has two pseudo ops that control where the program is assembled:

- ORG, sets the first location
- END, ends the assembly

ORG

ORG *expression*

Tells the assembler to begin assembling the program at *expression*. Example:

```
        ORG                     $1800
```

tells the assembler to start assembling the program at Address $1800.

You can put more than one ORG command in a program. When the assembler arrives at the new ORG, it begins assembling at the new *expression*.

END

END *expression*

Tells the assembler to quit assembling the program. The *expression* option lets you store the program's start address. Use END as the last instruction in all your assembly language programs.

Example:

```
                ORG     $1800
DATA            FCC     'This is some data'
START           LDA     DATA
                 .
                 .
                END     START
```

The END pseudo op quits the assembly and stores the program's entry address (the value of START) on disk. When you load the program, the processor knows to start executing at START (the LDA instruction) rather than at DATA (the FCC instruction).

FCC is a pseudo op explained later in this chapter.

Defining Symbols

Symbols make it easy to write a program and also make the program easy to read and revise. The Disk EDTASM has two pseudo ops for defining symbols:

- EQU, for defining a constant value
- SET, for defining a variable value

EQU
symbol* EQU *expression

Equates *symbol* to *expression*. Examples:

```
CHAR        EQU         $F9
```

equates CHAR to $F9.

```
SCREEN      EQU         $500
            LDX         #SCREEN
```

equates SCREEN to $500. The next instruction loads X with $500.

EQU helps set the values of constants. You can use it anywhere in your program.

SET
symbol* SET *expression

Sets *symbol* equal to *expression*. You can use SET to reset the symbol elsewhere in the program. Example:

```
SYMBOL      SET         25
```

sets SYMBOL equal to 25. Later in the program, you can reset SYMBOL.

```
SYMBOL      SET         SYMBOL+COUNT
```

now SYMBOL equals 25 + COUNT.

Inserting Data into Your Program

The Disk EDTASM has four pseudo ops that make it simple for you to reserve memory and insert data in your program:

- RMB, for reserving areas of memory for data
- FCB, for inserting one byte of data in memory
- FDB, for inserting two bytes of data in memory
- FCC, for inserting a string of data in memory

Remember that the processor cannot "execute" a block of data in your program. If you use these pseudo ops:

- Use them at the end of your program (just before the END instruction), or
- Precede them with an instruction that jumps or branches to the next "executable" instruction.

RMB
symbol* RMB *expression

Reserves *expression* bytes of memory for data. Example:

```
BUFFER      RMB         256
```

reserves 256 bytes for data, starting at Address BUFFER.

```
DATA        RMB         6+SYMBOL
```

reserves 6 + SYMBOL bytes for data beginning at Address DATA.

FCB
symbol* FCB *expression

Stores a 1-byte *expression* in memory at the current address. The *symbol* is optional.

Examples:

```
DATA        FCB         $33
```

stores $33 in Address DATA.

```
FACTOR      FCB         NUM/2
            LDA         FACTOR
```

stores NUM/2 in Address FACTOR, then, loads NUM/2 into Register A.

FDB
symbol* FDB *expression

Stores a 2-byte *expression* in memory starting at the current address. The symbol is optional. Example:

```
DATA        FDB         $3322
```

stores $3322 in Address DATA and DATA + 1.

FCC
symbol* FCC *delimiter string delimiter

Stores an ASCII string in memory, beginning at the current address. The *symbol* is optional. The *delimiter* can be any character.

Examples:

```
TABLE   FCC     /THIS IS A STRING/
```

stores the ASCII codes for THIS IS A STRING in memory locations, beginning with TABLE.

```
NAME      FCC      'Dylan'
          FCB      $ØD
          LDB      #NAME
INIT      LDA      NAME
          .
          .
          INCB
          CMPA     NAME
          BNE      INIT
```

The first instruction stores "Dylan" in the five memory addresses beginning with NAME. The next instructions process this data.

Changing the Assembly Listing

You can use three pseudo ops to change the listing the assembler prints for you:

- TITLE, inserts a title at the top of each listing page
- PAGE, ejects the listing to the next page
- OPT, turns on or off the switches that determine how the assembler lists "macros" (Macros are discussed in the next chapter.)

TITLE *string*

Tells the assembler to print the first 32 characters of the *string* at the top of each assembly listing page. Example:

```
TITLE     Budget Program
```

causes the assembler to print Budget Program as the title of each page in the assembly listing.

PAGE

Starts a new page if the assembly listing is being printed on the line printer. Example:

```
PAGE
```

tells the assembler to eject the listing to the next page.

OPT

OPT *switch, switch, . . .*

Causes the assembler to use the specified *switches* when printing its listing. You can specify these *switches* with OPT:

MC	List macro calls (default)
NOMC	Do not list macro calls
MD	List macro definitions (default)
NOMD	Do not list macro definitions
MEX	List macro expansions
NOMEX	Do not list macro expansions (default)
L	Turn on the listing (default)
NOL	Turn off the listing

Example:

```
OPT       MEX
```

Causes the assembler to list the macro expansions in its listing. (Macros are discussed in the next chapter.)

Conditional Assembly

You may want to execute a certain section of your program only if a certain condition is true. The Disk EDTASM lets you set up a "conditional" section of your program, using these two pseudo ops:

COND

COND *condition expression*

Assembles the following instructions only if the *expression* is true (non-zero). If not true (zero), the assembler goes to the instruction that immediately follows the ENDC instruction.

Only these operators are recognized in a condition expression: +,–,/,*. See ENDC below for an example.

ENDC

ENDC

Ends a conditional assembly, initiated by COND.

Examples:

```
COND SYMBOL
 .
 .
ENDC
```

assembles the lines between COND SYMBOL and ENDC only if SYMBOL is not equal to zero.

```
COND VALUE2-VALUE1
 .
 .
ENDC
```

assembles the lines between VALUE2-VALUE1 only if VALUE2-VALUE1 are not equal (which causes the result to be a non-zero value).

Including Other Source Files

To let you load another source file and include it in your program, the Disk EDTASM offers an INCLUDE pseudo op.

INCLUDE

INCLUDE *filespec*

Inserts *filespec*, a file of source assembly language instructions, at the point where INCLUDE appears in the program. The assembler assembles the entire included file before assembling the next instruction.

Example:

```
INCLUDE          ROUTINE/SRC
```

inserts and assembles ROUTINE/SRC, a source file, before assembling the next instruction.

```
INCLUDE          SUB1/SRC
INCLUDE          SUB2/SRC
```

inserts and assembles SUB1, then inserts and assembles SUB2, then proceeds with the next instruction.

Chapter 12/ Using Macros

A macro is like a subroutine. It lets you call an entire group of instructions with a single program line. This helps when you want to use the same group of instructions many times in the program.

This chapter first tells how to use a macro. It then gives guidelines on the format of a macro.

How to Use a Macro

To use a macro, you must first define it. For example, you could define the entire sample program (from *Chapter 2*) as a macro named GRAPH.

After defining the macro, you can use its name the same way you use a mnemonic. Whenever the assembler encounters the macro's name, it expands it into the defined instructions.

Defining a Macro

To define a macro, you need to:

- Use MACRO (a pseudo op) to begin the macro definition and assign it a name.
- Use source instructions to define the macro.
- Use ENDM (a pseudo op) to end the macro definition.

This is an example of the sample program converted into a macro definition:

```
00030 GRAPH     MACRO
00100           LDA     #$F9
00110           LDX     #$400
00120 \.A       STA     ,X+
00130           CMPX    #$600
00140           BNE     \.A
00150 \.B       JSR     [$A000]
00160           BEQ     \.B
00180           ENDM
```

Line 30 names the macro as GRAPH, lines 50-160 define the macro, and line 180 ends the macro definition.

Notice the names of the symbols within the macro definition: \.A and \.B. If you do not use this format for naming symbols, you'll get a MULTIPLY DEFINED SYMBOL error when you call the macro more than once. (More on this later.)

Insert the above program using SHIFT CLEAR to generate the backslash character (\). Save the program on disk as MACRO1 and then delete it.

```
WD MACRO1 (ENTER)
D#:* (ENTER)
```

Calling a Macro

To call a macro, simply use the macro name as if it were a mnemonic. For example, this sample program calls GRAPH and then ends:

```
00110           ORG      $1200
00120 BEGIN     JMP      START
00130           FDB      DONE-BEGIN
00140 START     *
00150           INCLUDE  MACRO1/ASM
00160           GRAPH
00170           CLR      $71
00180           JMP      [$FFFE]
00190 DONE      *
00200           END
```

Line 150 loads MACRO1, the file containing the definition of GRAPH, and includes it in the source program. Line 160 calls the GRAPH macro.

To see how the assembler expands the GRAPHIC macro, insert this line:

```
00135           OPT      MEX
```

and assemble the program. The assembler listing shows how the assembler expands GRAPH into its defined instructions.

Note that the assembler has replaced \.A with A0000 and \.B with B0000. The zeroes indicate that this is the first expansion of the symbols in GRAPH. (In this case, this is the only expansion.)

Passing Values to a Macro

A convenient way to use a macro is to pass values to it. You can use a macro many times in your program, passing different values to it each time.

This is a definition of the GRAPH macro, slightly modified so that you can pass two values to it. Insert this program, save it as MACRO2 and then delete it.

```
00030 GRAPH2  MACRO
00100         LDA     \0
00110         LDX     \1
00120 \.A     STA     ,X+
00130         CMPX    #$600
00140         BNE     \.A
00150 \.B     JSR     [$A000]
00160         BEQ     \.B
00190         ENDM
```

The \0 and \1 are dummy values. The assembler replaces these numbers with the values you specify when you call GRAPH.

The following program calls GRAPH2 three times. Each time it passes two different sets of values:

```
00100         ORG     $1200
00110 BEGIN   JMP     START
00120         FDB     DONE-BEGIN
00130 START   *
00140         OPT     MEX
00150         INCLUDE MACRO2/ASM
00160         GRAPH2  #$F9,#$400
00170         GRAPH2  #$F8,#$450
00180         GRAPH2  #$F7,#$500
00190         CLR     $71
00200         JMP     [$FFFE]
00210 DONE    *
00220         END
```

When the assembler expands the macro, it replaces the dummy values with the values passed by the macro call. For example, the second time GRAPH2 is called, the assembler replaces \0 with #$F8 and replaces \1 with #$450.

Assemble the above program. Note that each time the assembler expands GRAPH2, it replaces the \.A and \.B symbols with different symbol names: First A0000 and B0000, then A0001 and B0001, and finally A0002 and B0002.

If the assembler used the same symbol names in each expansion, it would be forced to assign different value to the symbols in each expansion. You would get a MULTIPLY DEFINED SYMBOL error.

Also, note the assembler has inserted an additional symbol, NARG, in the symbol table. NARG is always set to the number of values passed in the most recent macro call.

In the sample program, the symbol table shows that NARG is set to "2" at the end of the assembly. This shows that there were two values passed to GRAPH2 the last time it was called.

You might want to use NARG as a variable in your program. For example, you could conditionally assemble parts of a macro definition based on the current value of NARG.

To see the program run, assemble it to disk, press a key three times to see different graphics and then end the program.

Format of Macros

The remainder of this chapter gives details on the format to use in a macro definition and macro call.

Macro Definition

Beginning the Definition

Use this format for beginning the macro definition and assigning it a name:

symbol MACRO

symbol is the name of the macro. It is, of course, required.

Using Symbols in the Definition

Use this format to name any symbols you use within a macro definition:

\.*c*

c is an alpha character (A-Z). When the assembler expands the macro, it replaces \.*c* with:

cnnnn

nnnn is a 4-digit hexadecimal number that the assembler increments each time the assembler expands the macro.

For example, if you use the symbol \.M in the macro definition and you call the macro 10 times, the assembler replaces \.M with these symbol names:

```
1st  expansion          M0001
2nd  expansion          M0002
         .
10th expansion          M000A
```

You must use this symbol-name format when calling a macro more than once. Otherwise, you get MULTIPLY DEFINED SYMBOL errors.

Using Dummy Values in the Definition

Use this format for specifying dummy values within a macro definition:

n

n is an alphanumeric character (0-9,A-Z). The assembler replaces this dummy value with a corresponding value in the macro call line:

```
\0 is replaced with the 1st value
\1 is replaced with the 2nd value
      .
      .
\9 is replaced with the 10th value
\A is replaced with the 11th value
      .
      .
\Z is replaced with the 36th value
```

For example, this line in a macro definition:

```
LDA    \B
```

specifies \B as a dummy value. The assembler replaces \B with the 12th value in the macro call line. If the macro call line is:

```
ADD     NUM0,NUM1,NUM2,NUM3,NUM4,
NUM5,NUM6,NUM7,NUM8,NUM9,NUMA,NUMB
```

the assembler replaces \B with NUMB.

You do not need to assign macro call values to dummy values in consecutive order. For example:

```
          GRAPHX    #$F9,#$400,#$600
GRAPHX    MACRO
          LDX       \1
          LDY       \2
          LDA       \0
          LDB       \0
          ENDM
```

Here, the assembler replaces dummy value \1 with #$400, replaces dummy value \2 with #$600, and, in two lines, replaces dummy value \0 with #$F9. Note that you can pass a value to a macro more than once, as this example does with #$F9.

If there are more dummy values than values in a macro call, a byte overflow error results.

If there are more values than dummy values in a macro call, the extra values are ignored.

Be sure not to enclose dummy values in quotes. If you do this, the assembler treats them as ordinary characters.

Ending the Macro Definition

Use this format for ending the macro definition:

```
ENDM
```

You may not use a symbol to label this line. If you do so, you get a MISSING END STATEMENT error at the end of the assembly listing.

Macro Call

Use this format when passing values to a macro in a macro call line:

macro call   *string1, string2, ...*

macro call is the name of the macro.

string(s) is the value being passed to the macro. It can be 1 to 16 characters (any extra characters are ignored).

Each string, except the last, must be separated by a comma. The last string must be terminated by a comma, space, carriage return, or tab.

Each string may contain any characters except a carriage return. If a string contains a comma, space, tab, or left parenthesis, you must enclose it in parentheses. For example, in this macro call:

```
PRINT      (ABC,DEF)
```

the assembler interprets ABC,DEF as a single string. However, in this call:

```
PRINT      ABC,DEF
```

the assembler interprets ABC as one string and DEF as another.

Hints on Macros

- Remember to define a macro before calling it. If you call a macro without defining it, you get a BAD OPCODE error.

- We recommend storing all macro definitions in a file and then using INCLUDE to insert them into your main program.
- Do not use a mnemonic or pseudo op as a macro name. This causes the assembler to redefine the mnemonic or pseudo op according to the macro definition.
- If the macro definition has an error, you will not discover the error until you call the macro. The assembler waits until you call the macro before it assembles it.
- You cannot "nest" macro definitions. That is, one macro definition cannot call another.
- Using the same macro more than once uses a large amount of memory. Expand a large macro only once. When you want to use it again, call it as a subroutine.

SECTION IV

ROM AND DOS ROUTINES

SECTION IV

ROM AND DOS ROUTINES

In an assembly language program, the simplest way to use the I/O devices is with ROM and DOS routines. This section shows how.

Complete lists of the ROM routines and DOS routines are in the reference section.

Chapter 13/ Using the Keyboard and Video Display (ROM Routines)

The Color Computer uses its own machine-code routines to access the screen, keyboard, and tape. These routines are built into the computer's ROM. You can use the same routines in your own program.

Appendix F lists each ROM routine and the ROM address that points to it. This chapter uses two of these routines, POLCAT and CHROUT, as samples in showing the steps for using ROM routines.

Steps for Calling ROM Routines

We recommend these steps for calling a ROM routine:

1. Equate the routine's address to its name. This lets you refer to the routine by its name rather than its address, making your program easier to read and revise.
2. Set up any entry conditions required by the routine. This lets you pass data to the routine.
3. Preserve the contents of the registers. Since many routines change the contents of the registers, you might want to store the registers' contents temporarily before jumping to the routine.
4. Call the ROM routine, using the indirect addressing mode.
5. Use any exit conditions that the routine passes back to your program.
6. Restore the contents of the registers (if you temporarily preserved them in Step 3).

Sample 1 Keyboard Input with POLCAT

POLCAT "polls" the keyboard to see if you press a key. If you do not, POLCAT sets Bit Z.

If you do press a key, POLCAT:

(1) Clears Bit Z of Register CC and
(2) Loads Register A with the key's ASCII code.

This short program uses POLCAT to poll the keyboard. When you press a key, the program ends:

```
         ORG    $1200
BEGIN    JMP    START
         FDB    DONE-BEGIN
POLCAT   EQU    $A000
START    PSHS   DP,CC,X,Y,U
WAIT     JSR    [POLCAT]
         BEQ    WAIT
         PULS   DP,CC,X,Y,U
         CLR    $71
         JMP    [$FFFE]
DONE     *
         END
```

This is how we applied the above steps in writing this program:

1. Equate POLCAT to its Address

This equates POLCAT to $A000, the address that points to POLCAT's address:

```
POLCAT   EQU    $A000
```

2. Set Up Entry Conditions

POLCAT has no entry conditions.

3. Preserve the Registers' Contents

POLCAT's "Exit Conditions" state that POLCAT modifies all registers except B and X. Assume that you want to preserve the contents of Registers DP, CC, X, Y, and U. To do this, you can "push" these values into the "hardware stack":

```
PSHS    DP,CC,X,Y,U
```

(The hardware stack is an area of memory, pointed to by Register S, that the processor uses for subroutines. PSHS "preserves" the contents of certain registers by storing them in the hardware stack.)

4. Jump to POLCAT

This jumps to POLCAT using its indirect address:

```
WAIT    JSR    [POLCAT]
```

5. Use Exit Conditions

For now, assume you want to look only at the status of Bit Z to see if a key has been pressed:

```
BEQ    WAIT
```

The above instruction branches back to WAIT (the JSR [POLCAT] instruction) unless you press a key. (Pressing a key causes POLCAT to clear Bit Z.)

6. Restore the Register's Contents

This "pulls" (inserts) the contents of the hardware stack back into the registers:

```
PULS    DP,CC,X,Y,U
```

Now, the above registers are restored to the data they contained before executing the POLCAT routine.

Sample 2 Character Output with CHROUT

The CHROUT routine prints a character on either the screen or printer. On entry, it checks two places:

- Register A — to determine which character to print
- Address $6F — to determine whether to print it on the screen or the printer

This program uses CHROUT to print "This is a Message" on the screen. It then uses POLCAT to wait for you to press a key before returning to BASIC.

```
              ORG     $1200
****** Equates for Routines ******
POLCAT        EQU     $A000
CHROUT        EQU     $A002
DEVNUM        EQU     $6F
************ Variable ************
SCREEN        EQU     00
*** DOS Programming Convention ***
BEGIN         JMP     START
              FDB     DONE-BEGIN
******** Print the Message ********
START         LDB     #SCREEN
              STB     DEVNUM
              LDX     #MSG
PRINT         LDA     ,X+
              JSR     [CHROUT]
              CMPA    #$0D
              BNE     PRINT
********* Wait for a Key *********
INPUT         PSHS    DP,CC,X,Y,U
WAIT          JSR     [POLCAT]
              BEQ     WAIT
              PULS    DP,CC,X,Y,U
              CLR     $71
              JMP     [$FFFE]
************* Message *************
MSG           FCC     'THIS IS A MESSAGE'
              FCB     $0D
******** Memory for Stack ********
DONE          *
              END
```

Most of the steps we used in writing this program are obvious. What may not be obvious is the way we set up CHROUT's entry conditions, Address $6F and Register A.

These lines set Address $6F to 00 (the screen):

```
DEVNUM        EQU     $6F
SCREEN        EQU     00
START         LDB     #SCREEN
              STB     DEVNUM
```

Setting Register A involves two steps. First, point Register X to the message:

```
MSG         FCC    'THIS IS A MESSAGE'
            FCB    $0D
            LDX    #MSG
```

and then load Register A with each character in the message:

```
PRINT       LDA    ,X+
            JSR    [CHROUT]
            CMPA   #$0D
            BNE    PRINT
```

Sample 3
POLCAT and CHROUT

This combines POLCAT with CHROUT. It prints on the screen whatever key you press. When you press (↓) (hexadecimal 0A), the program returns to BASIC:

```
            ORG    $1200
****** Equates for Routines ******
POLCAT      EQU    $A000
CHROUT      EQU    $A002
DEVNUM      EQU    $6F
************ Variable ************
SCREEN      EQU    00
*** DOS Programming Convention ***
BEGIN       JMP    MAIN
            FDB    DONE-BEGIN
********** Main Program **********
MAIN        JSR    INPUT
            CMPA   #$0A
            BEQ    FINISH
            JSR    PRINT
            BRA    MAIN
FINISH      CLR    $71
            JMP    [$FFFE]
* Input a Character from Keyboard *
INPUT       PSHS   DP,CC,X,Y,U
WAIT        JSR    [POLCAT]
            BEQ    WAIT
            PULS   DP,CC,X,Y,U
            RTS
** Print a Character on Display **
PRINT       LDB    #SCREEN
            STB    DEVNUM
            JSR    [CHROUT]
            RTS
******** Memory for Stack ********
DONE        *
            END
```

Chapter 14/ Opening and Closing a Disk File DOS Routines — Part I

Because of the organization and timing of a disk, reading it and writing to it are complex. This is why you'll want to make use of DOS routines in your disk programs.

This chapter shows how to use DOS routines to open and close a disk file. The next chapter shows how to use them to read a disk and write to it. *Reference H* contains a complete list of all the DOS routines supported by Radio Shack.

Overview

All DOS routines, like ROM routines, have their own entry and exit conditions. However, most DOS routines have more involved entry conditions than do ROM routines. They require you to set up three areas in memory: two "buffers" and a "data control block."

Buffers

Buffers are areas in memory that DOS uses for storing data to be input or output to disk. DOS requires that you reserve two buffers:

- A logical buffer — This can be any length. Your program uses this to store data for DOS to input or output to disk.
- A physical buffer — This must be 256 bytes. DOS uses this to hold data temporarily so that it can input and output the data to a disk sector in 256-byte blocks.

For example, suppose you want to output 100 10-byte records to disk. You can send each record, one at a time, to the area you reserved as the logical buffer.

DOS then transfers the records from the logical buffer to the area you reserved as the physical buffer. As soon as there are 256 bytes in the physical buffer, DOS sends them out to a disk sector.

You need not be concerned that DOS' "physical" records are a different size from your program's "logical" records. DOS handles the "spanning" of logical records into physical records internally. Except for reserving memory for a physical buffer, you do not need to be concerned with physical records.

Data Control Block

A data control block is a 49-byte "block" of memory that DOS uses to control a disk file. You need to reserve this block of memory for each disk file you are using. If you have three disk files open at the same time, you need to reserve three 49-byte data control blocks.

Reference G shows how DOS uses each of the 49 bytes, numbered 0-48, in the data control block. As you can see, DOS divides the data control block into 21 data-control segments.

Before opening a file, you must load the proper data into four of the segments of the data control block (DCB):

DCB Segment	DCB Address	You must load with . . .
Filename (DCBFNM)	Bytes 0-7	The eight-character name of your file.
Extension (DCBEXT)	Bytes 8-10	The three character extension of your filename.
Drive Number (DCBDRV)	Byte 33	The drive containing the disk file.

Physical Buffer Address (DCBBUF)	Byte 36-37	The first address of the physical buffer you have reserved.

For example, if you want to open a file in Drive 1, you need to load "1" into the DCBDRV location, which is the 33rd byte of the data control block.

You need not be concerned with most of the remaining segments of the data control block, unless you want to use them as data in your program. They are handled internally by DOS. The exceptions to this are:

- Logical Buffer Address, Record Size, Variable Record Terminator, and Logical Record Number — You need to use these when you read and write to the file. They are discussed in the next chapter.
- *File Type* and *ASCII Flag* — If you want your file to be compatible with BASIC and other Radio Shack programs, you need to set these when you create the file. See the "Technical Information" chapter of your *Disk System Owners Manual and Programming Guide.*

Steps for Using DOS Routines

The steps for using DOS routines are:

1. Equate the routine's address (for ease in reading the program).
2. Reserve memory for a physical buffer, logical buffer, and the DCB.
3. Clear the DCB and the physical buffer. You need to make sure they do not have extraneous data.
4. Set up all other entry conditions. Besides setting up registers, you need to load certain segments of the DCB with data. Which segments you load depends on the DOS routine you are using.
5. Preserve the contents of the registers. DOS routines change the contents of many of the registers. To be safe, you should preserve all of them that you want to use later in your program. Be sure to preserve Registers U and DP. If DOS changes their contents, your program acts unpredictably.
6. Call the routine.
7. Restore the contents of the registers.
8. Use all exit conditions. Most DOS routines return an error code in Register A if the routine did not work properly. If there were no errors, Register A contains a zero.

Sample Session Opening and Closing a Disk File

The DOS routines for opening and closing a file are OPEN and CLOSE. Both routines check Register U for the address of DCB. They expect to find the four segments described above in this block.

OPEN also expects you to set a file mode in Register A. It creates or opens an existing file depending on the mode you set.

Both routines return a status code in Register A. *Reference I* tells the meaning of the status codes.

Figure 8 at the end of this chapter is a sample program which creates, opens, and closes a disk file named WORKFILE/TXT. After running this program, you can look at your directory to see that the program has created this file. This shows how we applied the above steps in this program.

1. Equate OPEN and CLOSE

This equates OPEN and CLOSE to $600 and $602, their indirect addresses:

```
OPEN      EQU      $600
CLOSE     EQU      $602
```

2. Reserve Memory for Buffers and DCB

The OPEN and CLOSE routines use only the physical buffer, not the logical buffer. This stores 256 bytes for the physical buffer and uses PBUF to label those bytes:

```
PBUF      RMB      256
```

This reserves memory for a 49-byte DCB and stores the filename, WORKFILE, and the extension, TXT, in the first 11 bytes:

```
DCB       EQU      *
          FCC      'WORKFILE'
          FCC      'TXT'
          RMB      38
```

3. Clear DCB

This clears all but the first 11 bytes of DCB:

```
RCLEAR   LDX    #DCB+11
CLEAR1   CLR    ,X+
         CMPX   #DCB+48
         BNE    CLEAR1
         LDX    #PBUF
```

and this clears the physical buffer:

```
CLEAR2   CLR    ,X+
         CMPX   #PBUF+255
         BNE    CLEAR2
         RTS
```

4. Set Up Entry Conditions

On entry, OPEN and CLOSE require you to: (1) Set Register U to a DCB containing a filename, extension, drive number, and physical buffer address, and (2) Set Register A to a file mode.

Setting Register U

This sets Register U to the address of the first byte of the DCB:

```
         LDU    #DCB
```

The following lines set the drive number segment to 0. They do this by storing DRVNUM (0) into DCBDRV (33) + the contents of Register U (DCB). This inserts 0 into the 33rd byte of DCB:

```
DCBDRV   EQU    33
DRVNUM   FCB    00
         LDA    DRVNUM
         STA    DCBDRV,U
```

The following lines set the physical buffer address to PBUF. They do this by storing the address of PBUF into the memory address pointed to by Register U plus DCBBUF. This stores PBUF in the 36th byte of DCB:

```
DCBBUF   EQU    36
         LDX    #PBUF
         STX    DCBBUF,U
```

(The filename and extension were set in Step 2.)

Setting Register A

This table shows how you should set each bit in Register A to select one or more file modes:

MODE	BIT	DECIMAL NUMBER (IF SET)
Read	Bit 0	1
Write	Bit 1	2
Create	Bit 2	4
Extend	Bit 3	8
Work File (delete the file, when closed)	Bit 4	16
FAT (rewrite to the FAT* only when closed)	Bit 5	32
Shared Buffer	Bit 6	64

* The disk directory's FAT (file allocation table) is described in the "Techncial Information" chapter of the *Disk System Manual.*

The sample program loads Register A with decimal 1+2+4+8+32:

```
         LDA    #1+2+4+8+32
```

This tells DOS to set the file mode to read (decimal 1), write (decimal 2), create (decimal 4), extend (decimal 8), and rewrite the FAT only when the file is closed (decimal 32).

5. Preserve Registers

This preserves the contents of Registers U and DP:

```
ROPEN    PSHS   U,DP
```

6. Jump to the DOS Routine

These lines jump to OPEN and CLOSE:

```
         JSR    [OPEN]
         JSR    [CLOSE]
```

7. Restore Registers

This restores the contents of Registers U and DP:

```
         PULS   U,DP
```

8. Use Exit Conditions

The sample program branches to an error handling subroutine after each DOS routine. The subroutine tests Register A to see if it contains a non-zero value. If so, it prints the status code on the screen and waits for you to press a key:

```
             JSR        ERROR
             TSTA
             BEQ        RETURN
             STA        $450
   WAIT      JSR        [POLCAT]
             BEQ        WAIT
             RETURN     RTS
```

Figure 8. Sample Program to Open and Close a File

```
             ORG        $1200
**Equates for DOS and ROM routines **
   OPEN      EQU        $600
   CLOSE     EQU        $602
   POLCAT    EQU        $A000
****** Equates for DCB offsets *******
   DCBDRV    EQU        33
   DCBBUF    EQU        36
*****DOS Programming Convention *****
   BEGIN     JMP        MAIN
             FDB        DONE-BEGIN
************Main Program ************
   MAIN      JSR        RCLEAR
             JSR        ROPEN
             JSR        RCLOSE
             CLR        $71
             JMP        [$FFFE]
******Routine to Clear the DCB ******
******** and Physical Buffer*********
   RCLEAR    LDX        #DCB+11
   CLEAR1    CLR        ,X+
             CMPX       #DCB+48
             BNE        CLEAR1
             LDX        #PBUF
   CLEAR2    CLR        ,X+
             CMPX       #PBUF+255
             BNE        CLEAR2
             RTS
*******Routine to Open a File *******
   ROPEN     PSHS       U,DP
             LDU        #DCB
             LDA        DRVNUM
             STA        DCBDRV,U
             LDX        #PBUF
             STX        DCBBUF,U
             LDA        #1+2+4+8+32
             JSR        [OPEN]
             PULS       U,DP
             JSR        ERROR
             RTS
***** Routine to Close the File******
   RCLOSE    PSHS       U,DP
             LDU        #DCB
             JSR        [CLOSE]
             PULS       U,DP
             JSR        ERROR
             RTS
*******Error Handling Routine *******
   ERROR     TSTA
             BEQ        RETURN
             STA        $450
   WAIT      JSR        [POLCAT]
             BEQ        WAIT
   RETURN    RTS
*** Memory for Buffers and Stacks****
   PBUF      RMB        256
********Memory for Variables ********
   DRVNUM    FCB        00
***********Memory for DCB ***********
   DCB       EQU        *
             FCC        'WORKFILE'
             FCC        'TXT'
             RMB        38
*************************************
   DONE      EQU        *
             END
```

Chapter 15/ Reading and Writing a Disk File DOS Routines — Part 2

DOS has a WRITE routine for writing to a file and a READ routine for reading it back into memory. The way you use these routines depends on which method you are using to access the file:

- Sequential Access
- Direct Access

This chapter describes how to use these two methods in their simplest forms. You can use any variation of them that you want.

When reading data from just one file, you need only specify the logical buffer address, not the terminator character. DOS reads the terminator character from the disk's directory into DCBTRM.

Figure 9 at the end of this chapter is a program that writes to a file using $0D (the ENTER character) as a terminator character. *Figure 10* reads the same file back into memory.

Sequential vs. Direct Access

Sequential Access

(For Files with Variable-Length Records)

Sequential access lets you read and write to files with variable-length records. Using this method, you insert a terminator character at the end of each record. This character tells DOS where each record ends.

Before writing data to the file, you must load DCB with the following:

DCB Segment	DCB Address	You must load with...
Logical Buffer Address (DCBLRB)	Bytes 39-40	The first address of the logical buffer you have reserved
Terminator Character (DCBTRM)	Byte 19	The character you select to end each record

Direct Access

(For Files with Fixed-Length Records)

Direct access works only with files containing fixed-length records. With this method, DOS uses the record size and record number to access the record.

Before reading data from the file or writing data to it, you must set this DCB segment:

DCB Segment	DCB Address	You must load with . .
Logical Buffer Address (DCBLRB)	Bytes 39-40	The address of the first byte of the logical buffer you have reserved

Unless you are using the record size already in the file's directory, you must also set:

Logical Record Size (DCBRSZ)	Bytes 17-18	The size of each record

If you want to write a record which is not sequentially the next one, you must also set:

Logical Record Number (DCBLRN)	Bytes 46-47	The number of the record you want to access

Setting the Read/Write Option

DOS requires that you set Register A with a "read/write option" before entering the READ or WRITE routines. The read/write option lets you specify:

- Whether you want direct or sequential access
- Whether you want DOS to point to the next record after reading or writing the record

To set the read/write option, load the first two bits of Register A with one of these four values:

Read/Write Option	Bits	Decimal Number
Direct Access Point to next record	00	0
Sequential Access Point to next record	01	1
Direct Access Do not point to next record	10	2
Sequential Access Do not point to next record	11	3

For example:

```
     LDA       #2
     JSR       [READ]
```

tells DOS to write the record sequentially (up to the terminator character). When finished, DOS points to the next sequential record.

Figure 9. Sample Program to Write to a File

```
          ORG       $1200
 **Equates for DOS and ROM routines **
OPEN      EQU       $600
CLOSE     EQU       $602
WRITE     EQU       $606
POLCAT    EQU       $A000
 ****** Equates for DCB offsets*******
DCBTRM    EQU       19
DCBDRV    EQU       33
DCBBUF    EQU       36
DCBLRB    EQU       39
 *****DOS Programming Convention *****
BEGIN     JMP       MAIN
          FDB       DONE-BEGIN
 ************Main Program ************
MAIN      JSR       CLEAR
          JSR       INTDCB
          JSR       SOPEN
          JSR       SPRINT
          JSR       SWRITE
          JSR       SCLOSE
          CLR       $71
          JMP       [$FFFE]
 ******Routine to Clear the DCB ******
 and the Physical and Logical Buffers
CLEAR     LDX       #PBUF
CLEAR1    CLR       ,X+
          CMPX      #PBUF+255
          BNE       CLEAR1
          LDX       #LBUF
CLEAR2    CLR       ,X+
          CMPX      #LBUF+24
          BNE       CLEAR2
          LDX       #DCB+11
CLEAR3    CLR       ,X+
          CMPX      #DCB+48
          BNE       CLEAR3
          RTS
 ********* Routine to Insert **********
 ********* Values in the DCB **********
INTDCB    LDU       #DCB
          LDA       DRVNUM
          STA       DCBDRV,U
          LDA       #$0D
          STA       DCBTRM,U
          LDX       #PBUF
          STX       DCBBUF,U
          LDX       #LBUF
          STX       DCBLRB,U
          RTS
 *******Routine to Open a File *******
SOPEN     LDU       #DCB
          PSHS      U,DP
          LDA       #1+2+4+8+32
          JSR       [OPEN]
          PULS      U,DP
          JSR       ERROR
          RTS
 ********Routine to Print Msg ********
```

```
SPRINT      LDY         #$500
            LDX         #MSG
CHAR        LDA         ,X+
            STA         ,Y+
            CMPA        #$3A
            BNE         CHAR
            LDX         #LBUF
            LDY         #$525
 ******* Routine to Input Data ********
 *********** from Keyboard ************
SINPUT      PSHS        U,DP,Y
WAIT1       JSR         [POLCAT]
            BEQ         WAIT1
            PULS        U,DP,Y
            STA         ,Y+
            STA         ,X+
            CMPA        #$0D
            BEQ         ENDINP
            CMPX        #LBUF+24
            BNE         SINPUT
ENDINP      RTS
 ******* Routine to Write Data ********
 ************** to File ***************
SWRITE      PSHS        U,DP
            LDU         #DCB
            LDA         #1
            JSR         [WRITE]
            PULS        U,DP
            JSR         ERROR
            RTS
 ******* Routine to Close File ********
SCLOSE      PSHS        U,DP
            LDU         #DCB
            JSR         [CLOSE]
            PULS        U,DP
            JSR         ERROR
            RTS
 *******Error Handling Routine *******
ERROR       TSTA
            BEQ         RETURN
            STA         $450
WAIT2       JSR         [POLCAT]
            BEQ         WAIT2
RETURN      RTS
 *** Memory for Buffers and Stacks ****
PBUF        RMB         256
LBUF        RMB         25
 ********Memory for Variables ********
DRVNUM      FCB         00
 ***********Memory for DCB ***********
DCB         EQU         *
            FCC         'WORKFILE'
            FCC         'TXT'
            RMB         38
```

```
 *********Memory for Message *********
MSG         FCC         'ENTER YOUR NAME:'
 ************************************
DONE        EQU         *
            END
```

Figure 10. Sample Program to Read to a File

Note: When running this program, a status code (generated by the Error subroutine) may appear on your screen. Press any key to continue program execution.

```
            ORG         $1200
 **Equates for DOS and ROM routines **
OPEN        EQU         $600
CLOSE       EQU         $602
READ        EQU         $604
POLCAT      EQU         $A000
CHROUT      EQU         $A002
 ****** Equates for DCB offsets *******
DEVNUM      EQU         $6F
SCREEN      EQU         0
DCBTRM      EQU         19
DCBDRV      EQU         33
DCBBUF      EQU         36
DCBLRB      EQU         39
 *****DOS Programming Convention *****
BEGIN       JMP         MAIN
            FDB         DONE-BEGIN
 ************Main Program ************
MAIN        JSR         CLEAR
            JSR         INTDCB
            JSR         SOPEN
            JSR         SREAD
            JSR         SCLOSE
            JSR         SPRINT
            CLR         $71
            JMP         [$FEEE]
 ******Routine to Clear the DCB ******
 and the Physical and Logical Buffers
CLEAR       LDX         #PBUF
CLEAR1      CLR         ,X+
            CMPX        #PBUF+255
            BNE         CLEAR1
            LDX         #LBUF
CLEAR2      CLR         ,X+
            CMPX        #LBUF+24
            BNE         CLEAR2
            LDX         #DCB+11
CLEAR3      CLR         ,X+
            CMPX        #DCB+48
            BNE         CLEAR3
            RTS
```

```
********* Routine to Insert **********
********* Values in the DCB **********
INTDCB     LDU        #DCB
           LDA        DRVNUM
           STA        DCBDRV,U
           LDA        #$ØD
           STA        DCBTRM,U
           LDX        #PBUF
           STX        DCBBUF,U
           LDX        #LBUF
           STX        DCBLRB,U
           RTS
*******Routine to Open a File *******
SOPEN      PSHS       U,DP
           LDU        #DCB
           LDA        #$2F
           JSR        [OPEN]
           PULS       U,DP
           JSR        ERROR
           RTS
*******Routine to Read a File *******
SREAD      PSHS       U,DP
           LDU        #DCB
           LDA        #3
           JSR        [READ]
           PULS       U,DP
           JSR        ERROR
           RTS
******* Routine to Print Data********
SPRINT     LDB        #SCREEN
           STB        DEVNUM
           LDX        #LBUF
PRINT      LDA        ,X+
           JSR        [CHROUT]
           CMPX       #LBUF+24
           BNE        PRINT
WAIT1      JSR        [POLCAT]
           BEQ        WAIT1
           RTS
******* Routine to Close File********
SCLOSE     PSHS       U,DP
           LDU        #DCB
           JSR        [CLOSE]
           PULS       U,DP
           JSR        ERROR
           RTS
*******Error Handling Routine *******
ERROR      TSTA
           BEQ        RETURN
           STA        $45Ø
WAIT2      JSR        [POLCAT]
           BEQ        WAIT2
RETURN     RTS
*** Memory for Buffers and Stacks ****
PBUF       RMB        256
LBUF       RMB        25
********Memory for Variables ********
DRVNUM     FCB        ØØ
***********Memory for DCB ***********
DCB        EQU        *
           FCC        'WORKFILE'
           FCC        'TXT'
           RMB        38
*************************************
DONE       EQU        *
           END
```

SECTION V/

REFERENCE

SECTION V/

REFERENCE

This section summarizes all the features of the Disk EDTASM.

Reference A/ Editor Commands

Definition of Terms

line
A *line* number in the program. Any *lines* between 0-63999 may be used. These symbols may be used:

- \# First line in the program
- * Last line in the program
- . Current line in the program

current line
The last line inserted, edited, or printed.

startline
The line where an operation will begin. In most commands *startline* is optional. If *startline* is omitted, the current line is used.

An asterisk (*) denotes a comment line when used as the first character in the line.

range
The line or lines to use in an operation. If the *range* includes more than one line, they must be specified with one of these symbols:

- : to separate the *startline* from the ending line
- , to separate the *startline* from the number of lines

increment
The *increment* to use between lines. In most commands, *increment* is optional. If the *increment* is omitted, the last specified *increment* is used. On startup, *increment* is set to 10.

filespec
A DOS disk file specification in the format:

filename/ext:drive

COMMANDS	PAGES DISCUSSED

Cstartline, range, increment
Copies range to a new location beginning with *startline* using the specified *increments*. *startline*, *range*, and *increment* must be included.

```
C500,100:150,10
```

D*range*
Deletes *range*. If *range* is omitted, *current line* is deleted.

```
D100        D100:150    D
```

E*line*
Enters a *line* for editing. If *line* is omitted, *current line* is used.

```
E100    E
```

These are the editing subcommands:

A	Cancels all changes and restarts the edit.
nCstring	Changes *n* characters to *string*. If *n* is omitted, changes the character at the current cursor position.
***n*D**	Deletes *n* characters. If *n* is omitted, deletes character at current cursor position.
E	Ends line editing and enters all changes without displaying the rest of the line.
H	Deletes rest of line and allows insert.
I *string*	Inserts *string* starting at the current cursor position. While in the mode, (←) deletes a character, and (SHIFT) (↑) (ESCAPE) ends the mode.
K	Deletes all characters from the current cursor position to the end of the line.
L	Lists current line and continues edit.
nScharacter	Searches for *n*th occurrence of *character*. If *n* is omitted, searches for the first occurrence.
X	Extends line.
(ENTER)	Ends line editing, enters all changes and displays the rest of the line.
(SHIFT) (↑)	Escapes from subcommand.
n (SPACEBAR)	Moves cursor n positions to the right. If *n* is omitted, moves one position.
n (←)	Moves cursor *n* positions to the left. If *n* is omitted, moves the cursor one position.

F*string*
Finds the string of characters. Search begins with the *current line* and ends each time *string* is found. If *string* is omitted, the last string defined is used.

```
FABC      F
```

H*range*
Prints *range* on the printer. If *range* is omitted, the *current line* is printed.

```
H100        H100:200    H
```

I*startline,increment*
Inserts lines up to 127 characters long beginning at *startline*, using the specified *increment*. *startline* and *increment* are optional.

```
I150,5      I200        I,10
```

K
Returns to DOS.

LCA *filename*
Loads *filename* from tape into the edit buffer. A is optional. If included, *filename* is appended to the edit buffer. If *filename* is omitted, the next tape file is loaded.

```
LC SAMPLE/EXT          LCA SAMPLE/EXT
```

LDA *filespec*
Loads the specified file from disk into the edit buffer. A is optional. If included, *filespec* is appended to the current contents of the edit buffer. If extension is omitted, /ASM is used.

```
LD SAMPLE/EXT          LDA SAMPLE/EXT
```

M*startline, range, increment*
Move command, works like copy except the original lines are deleted.

N*startline, increment*
Renumbers beginning at *startline*, using the specified *increment. startline* and *increment* are optional.

```
N100,50    N100      N
```

O
Shows the hexadecimal values of (1) the first available memory address, (2) the last available address, and (3) USRORG, the address where the assembler originates an /IM assembly with the /MO switch. Then, prompts you to change USRORG.

```
O
```

P*range*
Displays *range* on the screen.

```
P100:200   P100!5   P#   P+
P (Prints 15 lines to the screen)
```

Q
Returns to BASIC.

R *startline, increment*
Allows you to replace *startline* and then insert lines using *increment. startline* and *increment* are optional.

```
R100,10    R100      R
```

S
Shows the current printer parameters and lets you change them.

T*range*
Prints *range* to the printer, without line numbers.

```
T100       T100:500
```

V*filename*
Verifies *filename* (a tape file) to ensure that it is free of checksum errors. Works like BASIC's SKIPF command. If *filename* is omitted, this command verifies the next file found.

WC *filename*
Writes *filename* to tape. If *filename* is omitted, NONAME is used.

WD *filespec*
Writes *filespec* to disk. If the extension is omitted, ASM is used.

```
WD SAMPLE/EXT
```

Z
Jumps to ZBUG (EDTASM system only).

(↑)
Scrolls up in memory.

(↓)
Scrolls down in memory.

(SHIFT) (CLEAR)
Is used to create a backslash (\).

Reference B/ Assembler Commands and Switches

COMMANDS	PAGES DISCUSSED

AC filename switch . . .
Assembles the source program into machine code. If you specify the /IM switch, the assembly is in memory. If you specify *filename*, the assembly is saved on tape as *filename*. If you omit both *filename* and *switch*, the assembly is saved on tape as NONAME.

AD filespec switch . . .
Assembles the source program into machine code. Either the /IM switch or *filespec* is required: With /IM, the assembly is in memory; with *filespec*, the assembly is on disk. The D is optional.

There must be a space between *filespec* and *switch*.

The switches are:

/AO	Absolute origin.(Applies only If /IM is set.)
/IM	In-memory assembly.
/LP	Assembly listing on the printer.
/MO	Manual origin. (Applies only if /IM is set.)
/NL	No listing printed.
/NO	No object code generated.
/NS	No symbol table generated.
/SR	Single record.
/SS	Short screen.
/WE	Wait on assembly errors.
/WS	With symbols.

Examples:

```
AD SAMPLE
AD/IM/AO
AD SAMPLE /WE/SR
A SAMPLE/TST /WE
AC SAMPLE
AC
```

Reference C/ ZBUG Commands

Definition of Terms

expression
One or more numbers, symbols, or ASCII characters. If more than one is used, you may separate them with these operators:

Multiplication	*	Addition	+
Division	.DIV	Subtraction	–
Modulus	.MOD	Equals	.EQU
Shift	<	Not Equal	.NEG
Local And	.AND	Positive	+
Exclusive Or	.XOR	Negative	–
Logical Or	.OR	Complement	.NOT

address
A location in memory. This may be specified as an expression using numbers or symbols.

filename
A BASIC cassette file specification.

filespec
A DOS file specification. (The same as a BASIC specification.)

COMMANDS	PAGES DISCUSSED

C
Continues execution of the program after interruption at a breakpoint.

D
Displays all breakpoints that have been set.

E
Exits ZBUG and enters the editor. (This applies to the EDTASM ZBUG only, not to Stand-Alone ZBUG.)

G*address*
Executes the program beginning at *address*.

K
Returns to DOS. (Applies to Stand-Alone ZBUG only.)

LC *filename address*
Loads *filename* from tape. The optional *address* offsets the file's loading address. If *filename* is omitted, the next file is loaded.

LD *filespec address*
Loads *filespec* from disk. The optional *address* offsets the file's loading address.

LDS *filespec address1 address2*
Loads *filespec* from disk with its appended symbol table. The optional *address1* offsets the file's loading address. The optional *address2* offsets the symbol table's loading address. Note that *address2* does not offset the values of the symbols. The D is optional.

PC *filename start address end address execution address*
Saves memory from *start address* to *end address* to tape. You must also specify an *execution address*, the first address to be executed when the file is loaded. *Filename* is optional; if omitted, NONAME is used.

PD *filespec start address end address execution address*
Saves memory to disk from *start address* to *end address*. You must also specify an *execution address*, the first address to be executed when the file is loaded. (The D is optional.)

PDS *filespec start address end address execution address*
Saves memory to disk from *start address* to *end address*, with the current appended symbol table. You must also specify an *execution address*, the first address to be executed when the file is loaded. (The D is optional.)

Q
Returns to BASIC. (Applies to Stand-Alone ZBUG only.)

R
Displays the contents of all the registers.

T*address1 address2*
Displays the memory locations from *address1* to *address2*, inclusive.

TH*address1 address2*
Prints the memory locations from *address1* to *address2*, inclusive.

U*source address destination address count*
Transfers the contents of memory beginning at *source address* and continuing for *count* bytes to another location in memory beginning with *destination address*.

V*filename*
Verifies date on the specified file or, if no *filename* is specified, the next file on tape.

X*address*
Sets a breakpoint at *address*. If *address* is omitted, the current location is used. Each breakpoint is assigned a number from 0 to 7. The first breakpoint set is assigned as Breakpoint 0. A maximum of eight breakpoints may be set at one time.

Y*n*
Deletes the breakpoint referenced by the *n* number. If *n* is omitted, all breakpoints are deleted.

Examination Mode Commands

A	ASCII Mode
B	Byte Mode
M	Mnemonic Mode
W	Word Mode

(The default is M)

Display Mode Commands

H	Half Symbolic
N	Numeric
S	Symbolic

(The default is S)

Numbering System Mode Commands

***O**base*	Output
***I**base*	Input

(Base can be 8, 10, or 16. The default is 16)

Special Symbols

address/
register/

Opens *address* of *register* and displays its contents.
If *address* or *register* is omitted, the last address opened will be reopened. After the contents have been displayed, you may type:

new value	To change the contents.
(ENTER)	To close and enter any change.
(BREAK)	To close and delete any change.
(↓)	To open next *address* and enter any change.
(↑)	To open preceding *address*.
address (→)	To branch to the *address* pointed to by the instruction beginning at *address*. If *address* is omitted, the current *address* is used.
;	To force numeric display mode.
=	To force numeric and byte modes.
:	To force flags.*
"	To force ASCII mode.

address,
Executes *address*, if *address* is omitted, the next instruction is executed.

expression =
Calculates expression and displays the results.

* The colon does not actually have anything to do with the CC (status flag) register. It simply interprets the contents of the given address AS IF it contained flag bits.

Reference D/ EDTASM Error Messages

These are error messages you can get while in EDTASM or EDTASMOV:

BAD BREAKPOINT (*ZBUG*)
You are attempting to set a breakpoint (1) greater than 7, (2) in ROM, (3) at a SWI command, (4) at an address where one is already set.

BAD COMMAND (*Editor*)
An illegal command letter was used on the command line.

BAD COMMAND (*ZBUG*)
You are not using a ZBUG command.

BAD FILE DESCRIPTOR (*Disk,ZBug*)
The filespec is not in the proper DOS format. See "About This Manual" at the beginning of this manual for the proper file specification format.

BAD LABEL (*Assembler*)
The symbol you are using is (1) not a legal symbol, (2) not terminated with either a space, a tab, or a carriage return, (3) has been used with ORG or END, which do not allow labels, or (4) longer than six characters.

BAD MEMORY (*Assembler*)
You are attempting to do an in-memory assembly that would (1) overwrite system memory (an address lower than $1200) (2) overwrite the edit buffer of the symbol table, (3) go into the protected area set by USROG, or (4) go over the top of RAM.

If using the /AO switch, check to see that you've included an ORG instruction. When using /MO, check the addresses you set for BEGTEMP and USRORG. This could also be caused by the data not being stored correctly because of some code generated by an in-memory assembly. See *Chapter 7* for more information.

BAD MEMORY (*ZBUG*)
The data did not store correctly on a memory modification. This error will occur if you try to modify ROM addresses or try to store anything beyond MAXMEM.

BAD OPCODE (*Assembler*)
The op code is either not valid or is not terminated with a space, tab, or carriage return.

BAD OPERAND (*Assembler*)
There is some syntax error in the operand field. See *Section III* for the syntax of assembly language instructions.

BAD PARAMETERS (*Editor,ZBug*)
Usually this means your command line has a syntax error.

BAD PARAMETERS (*ZBUG*)
You have specified a filename that has more than eight characters.

BAD RADIX (*ZBUG*)
You have specified a numbering system other than 10, 8 or 16.

BUFFER EMPTY (*Editor*)
The specified command requires that there be some text in the Edit Buffer, and there isn't any.

BUFFER FULL (*Editor*)
There is not enough room in the edit buffer for another line of text.

BYTE OVERFLOW (*Assembler*)
There is a field overflow in an 8-bit data quantity in an immediate operand, an offset, a short branch, or an FCB pseudo op.

DIRECTORY FULL (*Disk*)
The directory does not have enough room for another entry. Use another diskette or delete a file (using the BASIC KILL command).

DISK FULL (*Disk*)
The diskette does not have enough room for another file. Use another diskette or delete a file (using the BASIC KILL command).

DISK WRITE PROTECTED (*Disk*)
You are attempting to write to a diskette that has the write-protect notch covered. Remove the write-protect label or use another diskette.

DOS ERROR (*Disk*)
This indicates an internal DOS error. It usually means either the DOS or the Editor/Assembler has been modified by the user program with harmful results.

DP ERROR (*Assembler*)
Direct Page error. The high order byte of an operand where direct addressing has been forced (,) does not match the value set by the most recent SETDP pseudo op.

DRIVE NOT READY (*Disk*)
The drive is not connected, powered up, working properly, or loaded properly.

END OF FILE (*Disk*)
Your program is attempting to access a record past the end of the file.

ENDC WITHOUT COND (*Assembler*)
The pseudo op ENDC was found without a matching COND having previously been encountered.

ENDM WITHOUT MACRO (*Assembler*)
The pseudo op ENDM was found without a matching MACRO having previously been encountered.

EXPRESSION ERROR (*Assembler and ZBUG*)
Either the syntax for the expression is incorrect (check *Chapter 9*) or the expression is dividing by zero.

FILE NOT FOUND (*Disk*)
The file is not on the disk's directory.

FM ERROR (*Editor, ZBUG and Disk*)
File Mode Error. The file you are attempting to load is not a TEXT file (if in the Editor) or a CODE file (if in ZBUG).

ILLEGAL NESTING (*Assembler*)
Illegal nesting conditions include the following:

1. Nested macro definitions.
2. Nested macro expansions.
3. Nested INCLUDE pseudo ops.
4. INCLUDE nested within a macro definition.

I/O ERROR (*Editor, ZBUG and Disk*)
Input/Output error. A checksum error was encountered while loading a file from a cassette tape. The tape may be bad, or the volume setting may be wrong. Try a higher volume.

MACRO FORWARD REFERENCE (*Assembler*)
A reference to the macro, which is defined on the current line, occurs previous to the macro definition.

MACRO TABLE FULL (*Assembler*)
The macro table is full, any additional entries will overwrite the symbol table. This happens when all memory allocated for the edit buffer, macro table, and symbol table has been used. Adjust USRORG using the Origin (O) command. (See the *Chapter 7*.)

MISSING END (*Assembler*)
Every assembly language program must have END as its last command.

MISSING INFORMATION (*Assembler*)
(1) There is a missing delimiter in an FCC pseudo op or (2) there is no label on a SET or EQU pseudo op.

MISSING OPERAND (*Assembler,ZBug*)
The command requires one or more operands.

MULTIPLY DEFINED SYMBOL (*Assembler*)
Your program has defined the same symbol with different values. If the error occurs in a macro expansion, use the /.1 notation to name the symbols. See *Chapter 12*.

NO ROOM BETWEEN LINES (*Editor*)
There is not enough room between lines to use the increment specified. Specify a smaller increment or renumber (N) the text using a larger increment. Remember that the last increment you used is kept until you specify a new one.

NO SUCH LINES (*Editor*)
The specified line or lines do not exist.

REGISTER ERROR (*Assembler*)
(1) No registers have been specified with a PSH/PUL instruction, (2) a register has been specified more than once in a PSH/PUL instruction, or (3) there is a register mismatch with an EXG/TFR instruction.

SEARCH FAILS (*Editor*)
The string specified in the Find (F) command could not be found in the edit buffer beginning with the line specified. If no line is specified the current line is used.

SYMBOL TABLE OVERFLOW (*Assembler*)
The symbol table is extending past USRORG into the protected area of user memory. Adjust USRORG using the O command. See *Chapter 7*.

SYNTAX ERROR (*Assembler*)
There is a syntax error in a macro dummy argument.

UNDEFINED SYMBOL (*Assembler,ZBug*)
Your program has not defined the symbol being used.

Reference E/ Assembler Pseudo Ops

Definition of Terms

symbol
Any *string* from one to six characters long, typed in the symbol field.

expression
Any *expression* typed in the operand field. See *Reference C*, "ZBUG commands," for a definition of valid expressions.

COMMANDS	PAGES DISCUSSED

COND *expression*
Assembles the instructions between COND and ENDC only if *expression* is true (a non-zero value).

```
         COND     SYMBOL
SYMBOL   FCB      10
VALUE    FCB       5
         COND     SYMBOL-VALUE
```

Valid operators for a conditional expression are +, −, /, *. If the expression equals zero, it is false; if non-zero, it is true.

END *expression*
Ends the assembly. The optional *expression* specifies the start address of the program.

ENDC
Ends a conditional assembly.

ENDM
Ends a macro definition.

symbol* EQU *expression
Equates *symbol* to an *expression*.

```
SYMBOL   EQU      $5000
```

symbol* FCB *expression, . . .
Stores a 1-byte *expression* beginning at the current address.

```
DATA2       FCB         $33+COUNT
```

symbol* FCC *delimiter string delimiter
Stores *string* in memory beginning with the current address. The *delimiter* can be any character.

```
TABLE       FCC         /THIS IS A STRING/
```

symbol* FDB *expression
Stores a 2-byte expression in memory begining at the current address.

```
DATA        FDB         $3322
```

INCLUDE *source filespec*
Includes *source filespec* in the current position of the source program.

```
INCLUDE     SAMPLE/ASM
```

***symbol* MACRO**
Defines the instructions between MACRO and ENDM as a macro named *symbol.*

```
DIVIDE      MACRO
```

OPT *switch, . . .*
Uses *switch* to control the listing of macros when assembling the program. The switches are:

MC	List macro calls (default)
NOMC	Do not list macro calls
MD	List macro definitions (default)
NOMD	Do not list macro definitions
MEX	List macro expansionns
NOMEX	Do not list macro expansions (default)
L	Turn on the listing (default)
NOL	Turn off the listing

ORG *expression*
Originates the program at *expression* address.

```
ORG         $3F00
```

PAGE
Ejects the assembly listing to the next page.

RMB *expression*
Reserves *expression* bytes of memory for data.

```
DATA        RMB         $06
```

symbol* SET *expression
Sets or resets *symbol* to *expression.*

```
SYMBOL      SET         $3500
```

SETDP *expression*
Sets the direct page to *expression.*

```
SETDP     $20
```

TITLE *string*
Prints *string* as the title of each page of the assembly listing. *String* can be up to 32 characters.

```
TITLE     Program 1
```

Reference F/ Rom Routines

This reference lists the indirect addresses where the Color Computer's ROM routines are stored. It also shows the entry and exit conditions for each routine.

The name of the routine is for documentation only. To jump to the routine, you must use its indirect address (the address contained in the brackets).

	COMMANDS	PAGES DISCUSSED

BLKIN = [$A006]

Reads a block from a cassette.

Entry Conditions:

Cassette must be on and in bit sync (see CSRDON).
CBUFAD contains the buffer address.

Exit Conditions:

BLKTYP, located at $7C, contains the block type:
0 = file header
1 = data
FF = end of file
BLKLEN, located at $7D, contains the number of data bytes in the block (0-255):
Bit Z in the Register CC, Register A, and CSRERR, located at Address $81, contains the error:
Z = 1, A = CSRERR = 0 (if no errors)
Z = 0, A = CSRERR = 1 (if a checksum error occurs)
Z = 0, A = CSRERR = 2 (if a memory error occurs)

BLKOUT = [$A008]

Writes a block to cassette.

Entry Conditions:

If this is the first block write after turning the motor on, the tape should be up to speed and a $55s should be written first.
CBUFAD, located at $7E, contains the buffer address.
BLKTYP, located at $7C, contains the block type.
BLKLEN, located at $7D, contains the number of bytes.

Exit Conditions:

Interrupts are masked.
X = CBUFAD + BLKLEN.
All registers are modified.

CHROUT = [A002]

Outputs a character to a device.

Entry Conditions:

Register A = character to be output
Address 6F (DEVNUM) = the device (–2 = printer; 0 = screen)

Exit Conditions:

Register CC is changed; all others are preserved.

CSRDON = [$A004]

Starts the cassette and gets into bit sync for reading.

Entry Conditions:

None

Exit Conditions:

FIRQ and IRO are masked.
Registers U and Y are preserved. All others are modified.

JOYIN = [$A00A]

Samples the four joystick pots and stores their values in POTVAL through POTVAL+3.

Left Joystick:

Up/Down	15A
Right/Left	15B

Right Joystick:

Up/Down	15C
Right/Left	15D

For Up/Down, the minimum value equals Up.
For Right/Left, the minimum value equals Left.

POLCAT = [A000]

Polls the keyboard for a character.

Entry Conditions:

None

Exit Conditions:

If no key is seen — Flag Z = 1, Register A = 0
If a key is seen — Flag Z = 0, Register A = key code
Registers B and X are preserved.
All other registers are modified.

Reference G/ DOS Disk Data Control Block (DCB)

DOS uses a 49-byte DCB to access a disk file. This reference shows the contents of each of the bytes (Bytes 0-48) in the DCB.

Bytes 0-31

The first 32 bytes of the DCB correspond to the disk file's 32-byte directory entry. When creating a file, DOS writes the DCB's first 32 bytes to the directory.

When opening an existing file, DOS searches each directory entry for the filename and extension you have set in the DCB. If it finds a match, it overwrites the first 32 bytes of the DCB with the 32-byte directory entry.

When you close the file, DOS overwrites the directory entry with the first 32 bytes of the DCB.

Filename (DCBFNM) **Bytes 0-7**
Contains the name of the file you want to access. You must set this value.

Extension (DCBFNM) **Bytes 8-10**
Contains the extension of the file you want to access. You must set this value.

File Type (DCBFTY) **Byte 11**
Contains the type of file you want to access. DOS ignores this, but BASIC uses it. You need to set this value when creating the file if you want the file compatible with BASIC.

ASCII Flag (DCBASC) **Byte 12**
Contains a flag if the file is in ASCII format. DOS ignores this, but BASIC uses it. You need to set this value when creating the file if you want the file compatible with BASIC.

First Cluster (DCBFCL) **Byte 13**
Contains the number of the first cluster in the file. (When you first create a file, this contains $FF.) DOS sets this value. Do not change it.

First Sector Bytes (DCBNLS) **Bytes 14-15**
Contains the number of bytes used in the first sector of the file. DOS ignores this. However, to be compatible with BASIC files, you should set this value before closing an output file.

File Mode (DCBCFS) **Byte 16**
Contains the mode you specified with Register A in the OPEN, WRITE, or READ routine. DOS sets this value.

Record Size (DCBRSZ) **Bytes 17-18**
Contains the size of each record. Use this with fixed-length records only. You set this value before reading from or writing to a direct access file.

Record Terminator (DCBTRM) **Byte 19**
Contains the character that DOS uses to terminate each record. You supply this value when reading from or writing to a sequential access file.

Undefined (DCBUSR) **Bytes 20-31**
Contains nothing at present. In future releases, DOS may use part of this.

Bytes 32 – 48

Bytes 32-48 are primarily set by DOS. However, you may use the contents of these bytes as data in your program.

The exceptions to this are the bytes for the drive number, physical buffer address, and logical buffer address. You must set the contents of these bytes before opening a file.

Operation Code (DCBOPC) **Byte 32**
Contains the last physical I/O operation performed on the file. See your Disk System Manual for details. DOS sets this value.

Drive Number (DCBDRV) **Byte 33**
Contains the drive number (0-3 or $FF). $FF tells DOS to use the first available drive and then insert the drive number in this segment. You must set this value before opening a file.

Track Number (DCBTRK) **Byte 34**
Contains the number of the last track DOS accessed while doing I/O for this file. DOS sets this value.

Sector Number (DCBSEC) **Byte 35**
Contains the number of the last sector DOS accessed while doing I/O for this file. DOS sets this value.

Physical Buffer Address (DCBBUF) **Bytes 36-37**
Contains the start address of a 256-byte physical buffer. The physical buffer is for storing data before or after disk I/O. You must set this value before opening a file.

Error Code (DCBOK) **Byte 38**
Contains the same value that the DOS routine returns in Register A: a zero if the last DOS routine was successful; the error number if there was an error. DOS sets this value.

Logical Buffer Address (DCBLRN) **Bytes 39-40**
Contains the start address of a logical buffer. The logical buffer is for storing a logical record before or after it goes through the physical buffer. You must set this value before opening a file, unless you have specified the "share" file mode. (See OPEN.)

Physical Record Number (DCBPRN). **Bytes 41-42**
Contains the number of the physical record currently in the physical buffer. DOS uses this to determine whether another physical read or write is required. This contains $FFFF when the file is opened. It also contains $FFFF after every read or write when the buffer is "shared." DOS sets this value.

Relative Byte Address (DCBRBA) **Bytes 43-45**
Contains an address which points to the record you want to read or write (zero when the file is first opened). With sequential access, this address always points to the next record. With direct access, this address is the product of DCBRSZ times DCBPRN. DOS sets and updates this value.

Logical Record Number (DCBLRN). **Bytes 46-47**
Contains the number of the next record to be accessed (zero when the file is first opened). Unless you set this value, DOS increments it after accessing each record.

Modified Data Tag (DCBMDT) **Byte 48**
Contains a tag ("1") if the contents of the physical buffer need to be written to disk. DOS sets this tag each time it writes to the logical buffer. The contents of the physical buffer are written to disk only when DOS must access a different sector (because the 256-byte buffer is full) or close the file. If the physical buffer is "shared," the physical buffer is written to disk after each logical write. DOS sets and updates this value.

Reference H/ DOS Routines

This reference lists all the DOS routines that Radio Shack will continue to provide in future releases. Please note that Radio Shack will support only the OPEN, CLOSE, READ, and WRITE routines. The other routines listed in this reference will be provided, but not necessarily supported.

Definition of Terms

root program
The portion of the program that is not an overlay. If you are not using overlays, this is the entire program.

overlay
A portion of the program that DOS loads into memory only when called. This can be your own overlay (called with DOUSR, GOUSR, or LOUSR) or a DOS overlay (called with DO, GO, or LOAD).

DOS programming convention
A convention, which any program using DOS routines must follow:

- The execution address must be the first instruction in the program.
- The first three bytes of the program must contain a JMP or LBR to any part of the root program. (JMP and LBR are both 3-byte instructions.) Example:

```
START     JMP     BEGIN
```

- The next two bytes must contain the length of the root program. If you are not using overlays, this is the entire program. Example:

```
          FDB     DONE-START
```

- If you are using overlays, this is the root program. Example:

```
          FDB     DONE-OVY1
```

DOS overlay conventions
A convention, which any of your own overlays must follow:

- The first two bytes must contain the size of the overlay. Example:

```
OVY1      FDB     OVY2-OVY1
```

- The next three bytes must contain a JMP or LBRA to any part of the overlay. Example:

```
          JSR     PROV1
```

- The last instruction should be an RTS, GO, or GOUSR.
- You must assign the overlay a number that is sequential. For example, assign your first overlay the overlay number of 1:

```
OVY       EQU     1
```

- The overlay must be written with relocatable (rather than absolute) addresses. When DOS loads the overlay, it sets Register X equal to the overlay's base address. Therefore, you can refer to all the local variables as an offset to Register X.

	COMMANDS	PAGES DISCUSSED

CLOSE =[$602]
Closes access to a disk file.

Entry Conditions:

Register U = the address of the DCB that was previously opened.
Program must follow DOS programming convention.

Exit Conditions

Register A = status code

Technical Function of CLOSE:

- Checks the drive specified by DCBDRV for a directory entry matching DCBFNM and DCBFEX. When the entry is found, checks to see if the file was previously open by seeing if DCBCFS contains a non-zero value.
- Checks DCBMDT for a modification tag. If found, writes the contents of the physical buffer to the disk.
- Sets DCBCFS to zero.
- Rewrites the directory entry with the first 32 bytes of the DCB. Any changes in the first 32 bytes of the DCB after OPEN and before CLOSE are recorded in the directory.
- Rewrites the diskette's FAT.

DO = [$60A]
Calls a DOS overlay.

Entry Conditions:

Register A = DOS overlay number

Exit Conditions:

Register A = status code

DOUSR = [$0610]
Calls one of your own overlays.

Entry Conditions:

Register A = overlay number (the number you have assigned to the overlay)

Exit Conditions:

Register A = status code

GO = [$60C]
Calls one DOS overlay from another DOS overlay.

Entry Conditions:

Register A = DOS overlay number

Exit Conditions:

Register A = status code

GOUSR = [$612]

Calls one overlay from another overlay. For example, OVY1 calls OVY2.
Entry Conditions:
Register A = overlay number (the number you have assigned to the overlay)
Exit Conditions:
Register A = "0" if no error; error code if error

LOAD = [$60E]

Loads a DOS overlay but does not execute it.
Entry Conditions:
Register A = DOS overlay number
Exit Conditions:
Register A = "0" if no error; error code if error

LODUSR = [$614]

Loads one of your overlays but does not execute it.
Entry Conditions:
Register A = overlay number (the number you have assigned to the overlay)
Exit Conditions:
Register A = "0" if no error; error code if error

OPEN = [$600]

Opens access to a disk file using the specified file mode.
Entry Conditions:
Register A = file mode
The file modes are:
Bit 0 set — allows reads
Bit 1 set — allows writes
Bit 2 set — allows file creation
Bit 3 set — allows extension past end of file
Bit 4 set — deletes the file when closed (work file)
Bit 5 set — rewrites the directory's file allocation table (FAT) only when the file is closed. (Otherwise, rewrites FAT after each READ; see the *Disk System Manual* for information on the FAT.)
Bit 6 set — shares the physical and logical buffer
Bit 7 set — undefined
Register U = the address where the DCB is stored.
The DCB must contain values for DCBFNM, DCBFEX, DCBDRV, and DCBBUF
Program must follow DOS programming conventions.
Exit Conditions:
Register A = 0 if no error; error code if error
Technical Function of OPEN:

- Checks the drive specified by DCBDRV for a directory entry matching DCBFNM and DCBFEX.
- If a match is found:
  - Uses the directory entry to overwrite the first 32 bytes of the DCB
  - Checks DCBCFS. It indicates a write, create, or extend, the file is opened and Status Code L is returned.
  - Inserts the file mode (contained in Register A) in DCBCFS.
  - Overwrites the directory entry with the first 32 bytes of the DCB.
- If a match is not found and the file mode is "create," creates a directory entry using the first 32 bytes of the DCB

- Sets DCBPRN to $FFFF
- Clears DCBLRN, DCBMDT, and DCBRBA.

READ = [$604]

Reads a record from a disk file.

Entry Conditions

Register A = read option

The read options are:

Bit 0 clear — direct access (read by record number; fixed length records)

Bit 0 set — sequential access (read by terminator character; variable length records)

Bit 1 clear — exit READ pointing to next record

Bit 1 set — exit READ leaving DCBLRN and DCBRBA the same (not pointing to next record)

The other bits can contain any value.

Register U = address pointing to the DCB

Program must follow DOS programming convention

Exit Conditions:

Register A = 0 if no error; error number if error logical buffer (pointed to by DCBLRB) contains the record

Technical Function of READ:

- Checks DCBCFS to see if the file was opened for "read."
- Checks DCBRBA for the record you want to access. (If Bit 0 in Register A is clear, READ calculates DCBRBA as the product of DCBLRN times DCBRSZ).
- Checks to see if the record is in the physical buffer (by comparing the high two bytes of DCBRBA with the contents of DCBPRN).
  If the record is not in the physical buffer, READ reads the record into the physical buffer then transfers it to the logical buffer.
- Checks to see if Register A's Bit 1 is set. If so, restore DCBLRN and DCBRBA to their original values.

RELSE = [$608]

Frees a physical buffer so that you can use it with another file.

Entry Conditions:

Register U = address where the DCB is stored of the file currently using the physical buffer.

Register A = 0 if no error; error code if error.

Technical Function of RELSE:

- Check DCBMDT. If the tag is set, the contents of the physical buffer are written to disk and DCBMDT is cleared.
- Sets DCBPRN to $FFFF.

WRITE = [$606]

Writes a logical record to disk.

Entry Conditions:

Register A = read/write option

The read/write options are:

Bit 0 clear — direct access (write by record number; fixed length records)

Bit 0 set — sequential access (write by terminator character; variable length records)

Bit 1 clear — exit READ pointing to next record
Bit 1 set — exit READ leaving DCBLRN and DCBRBA the same (not pointing to next record)
The other bits can contain any value.
Register U = address pointing to the DCB logical buffer (pointed to by DCBLRB) contains the record you want to write
Program must follow DOS programming conventions.

Exit Conditions:

Register A = 0 if no error; status code if error

Technical Function of WRITE:

- Checks DCBCFS to see if the file was opened for "write."
- Checks DCBRBA for the record you want to access. (If Bit 0 in Register A is off, WRITE calculates DCBRBA as the product of DCBLRN times DCBRSZ).
- Transfers the contents of the logical buffer to the physical buffer. If all 256 bytes of the physical buffer are full, writes the contents of the physical buffer to disk. If there is still more contents in the logical buffer, WRITE transfer these contents to the physical buffer and sets DCBMDT to 1.
- If the file mode is "share," writes the complete contents of the physical buffer to disk regardless of whether it completely fills the sector. Then, sets DCBPRN to $FFFF.

Reference I/ DOS Error Codes

Error Code	Hex Code	Character Displayed	Error
00	40	@	No errors
01	41	A	I/O error (drive not ready)
02	42	B	I/O error (write-protected diskette)
03	43	C	I/O error (write fault)
04	44	D	I/O error (seek error or record not found)
05	45	E	I/O error (CER error)
06	46	F	I/O error (lost data)
07	47	G	I/O error (undefined Bit 1)
08	48	H	I/O error (undefined Bit 0)
09	49	I	Register argument is invalid
0A	4A	J	File directory entry not found
0B	4B	K	Full directory
0C	4C	L	File was created by the OPEN function
0D	4D	M	File not closed after changes
0E	4E	N	Attempt to access an opened file
0F	4F	O	Attempt to read a read-protected file
10	50	P	RBA overflow (exceeds 3 bytes -16,777,216)
11	51	Q	Access beyond EOF or extension not allowed
12	52	R	FAT rewrite error
13	53	S	Attempt to close an unopened file
14	54	T	Can't access directly (record size is 0)
15	55	U	Attempt to write on write-protected diskette
16	56	V	Can't extend file (disk capacity exceeded)
17	57	W	Error while loading overlay
18	58	X	Insufficient print space allocated
19	59	Y	I/O error during BASIC line read
1A	5A	Z	Program's load address is too low
1B	5B	[	First byte of program file is not equal to zero
1C	5C	\	Not enough space for buffered keyboard
1D	5D	]	Not enough memory
1E	5E	^	Output file already exists
1F	5F	–	Wrong diskette

Reference J/ Memory Map

$0 - $69	Direct page RAM
$70-$FF	System direct page RAM
$100-$111	Interrupt vectors
$112-$119	System RAM
$11A	Keyboard alpha lock flag
$11B-$159	System RAM
$15A-$15D	Joystick pot values
$15E-$3FF	System RAM
$400-$5FF	Video memory
$600-$11FF	DOS
$1200-$3FFF	16K user memory
$1200-$7FFF	32K user memory
$8000-$9FFF	Extended BASIC
$A000-$BFFF	BASIC
$C000-$DFFF	Disk BASIC
$E000-$FEFF	ROM expansion
$FF00-$FFEE	Hardware address
$FFF0-$FFFF	Interrupt vectors

Reference K/ ASCII Codes

Video Control Codes

Dec	Hex	PRINT CHR$ *(code)*
8	08	Backspaces and erases current character.
13	0D	Line feed with carriage return.
32	20	Space

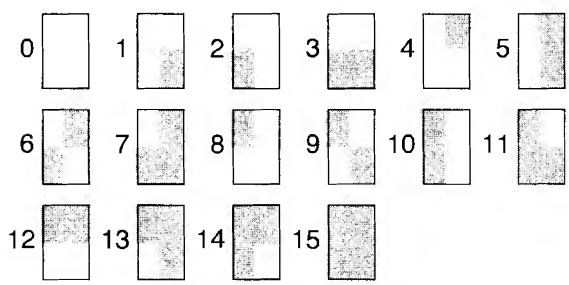
Color Codes

CODE	COLOR
0	Black
1	Green
2	Yellow
3	Blue
4	Red
5	Buff
6	Cyan
7	Magenta
8	Orange

Graphic Character Codes

Given the *color* (1-8) and the *pattern* (0-15), this formula will generate the correct code:

code = 128 + 16 * (*color* − 1) + *pattern*



For example, to print *pattern* 9 in blue (*code* 3), type:

```
C = 128 + 16 * (3-1) + 9
? CHR$ (C)
```

Alphanumeric Character Codes

CHARACTER	DECIMAL CODE	HEXADECIMAL CODE
SPACEBAR	32	20
!	33	21
"	34	22
#	35	23
$	36	24
%	37	25
&	38	26
'	39	27
(	40	28
)	41	29
*	42	2A
+	43	2B
,	44	2C
-	45	2D
.	46	2E
/	47	2F
0	48	30
1	49	31
2	50	32
3	51	33
4	52	34
5	53	35
6	54	36
7	55	37
8	56	38
9	57	39
:	58	3A
;	59	3B
<	60	3C
=	61	3D
>	62	3E
?	63	3F
@	64	40
A	65	41
B	66	42
C	67	43
D	68	44
E	69	45
F	70	46
G	71	47
H	72	48
I	73	49
J	74	4A
K	75	4B
L	76	4C
M	77	4D
N	78	4E
O	79	4F
P	80	50
Q	81	51
R	82	52
S	83	53

CHARACTER	DECIMAL CODE	HEXADECIMAL CODE
T	84	54
U	85	55
V	86	56
W	87	57
X	88	58
Y	89	59
Z	90	5A
(↑) *	94	5E
(↓) *	10	0A
(←) *	8	08
(→) *	9	09
(BREAK)	03	03
(CLEAR)	12	0C
(ENTER)	13	0D

*If shifted, the code for these characters are as follows: (CLEAR) is 92 (hex 5C); (↑) is 95 (hex 5F); (↓) is 91 (hex 5B); (←) is 21 (hex 15); and (→) is 93 (hex 5D).

These are the ASCII codes for lowercase letters. You can produce these characters by pressing (SHIFT)(0) simultaneously to get into an upper-lowercase mode. The lowercase letters will appear on your screen in reversed colors (green with a black background).

CHARACTER	DECIMAL CODE	HEXADECIMAL CODE
a	97	61
b	98	62
c	99	63
d	100	64
e	101	65
f	102	66
g	103	67
h	104	68
i	105	69
j	106	6A
k	107	6B
l	108	6C
m	109	6D
n	110	6E
o	111	6F
p	112	70
q	113	71
r	114	72
s	115	73
t	116	74
u	117	75
v	118	76
w	119	77
x	120	78
y	121	79
z	122	7A

Reference L/ 6809 Mnemonics

Definition of Terms

Source Forms:

This shows all the possible variations you can use with the instruction. *Table 4* gives the meaning of all the notations we use. The notations in italics represent values you can supply.

For example, the BEQ instruction has two source forms. BEQ *dd* allows you to use these instructions:

```
BEQ $08       BEQ $FF       BEQ $A0
```

Whereas LBEQ DDDD allows you these:

```
LBEQ $C000      LBEQ $FFFF
```

Operation:

This uses shorthand notation to show exactly what the instruction does, step by step. The meaning of all the codes are also in *Table 4.*

For example, the BEQ operation does this:

> *"If, (but only if), the zero flag is set, branch to the location indicated by the program counter plus the value of the 8-bit offset."*

Condition Codes:

This shows which of the flags in the CC register are affected by the instruction, if any. As you'll note, BEQ does not set or clear any of the flags.

Description:

This is an overall description, in English, of what the instruction does.

Addressing Mode:

This tells you which addressing modes you may use with the instruction. BEQ allows only the Relative addressing mode.

ABBREVIATION	MEANING
ACCA or A	Accumulator A.
ACCB or B	Accumulator B.
ACCA:ACCB or D	Accumulator D.
ACCX	Either accumulator A or accumulator B.
CCR or CC	Condition code register.
DPR or DP	Direct page register.
EA	Effective address.
IFF	If and only if.
IX or X	Index register X.
IY or Y	Index register Y.
LSN	Least significant nibble.
M	Memory location.
MI	Memory immediate.
MSN	Most significant nibble.
PC	Program counter.
R	A register before the operation.
R′	A register after the operation.
TEMP	A temporary storage location.
xxH	Most significant byte of any location.
xxL	Least significant byte of any location.
Sp or S	Hardware stack pointer.

ABBREVIATION	MEANING
Us or U	User stack pointer.
P	A memory location with immediate, direct, extended, and indexed addressing modes.
Q	A read-write-modify argument with direct, extended and indexed addressing modes.
( )	The data pointed to by the enclosed (16 bit address).
dd	8-bit branch offset.
DDDD	16-bit offset.
#	Immediate value follows.
$	Hexadecimal value follows.
[ ]	Indirection.
,	Indicates indexed addressing.
←	Is transferred to.
/	Boolean AND.
V	Boolean OR.
O	Boolean Exclusive OR (XOR).
—	Boolean NOT.
:	Concatination.
+	Arithmetic plus.
−	Arithmetic minus.
×	Arithmetic multiply.

Table 4. Notations and Codes

Add Accumulator B into Index Register X

ABX

Source Form: ABX
Operation: IX'←IX + ACCB
Condition Codes: Not affected.
Description: Add the 8-bit unsigned value in accumulator B into index register X.
Addressing Mode: Inherent.

Add with Carry into Register

ADC

Source Forms: ADCA *P*; ADCB *P*
Operation: R'←R + M + C
Condition Codes:
- H — Set if a half-carry is generated; cleared otherwise.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Set if an overflow is generated; cleared otherwise.
- C — Set if a carry is generated; cleared otherwise.

Description: Adds the contents of the C (carry) bit and the memory byte into an 8-bit accumulator.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Add Memory into Register

ADD (8-Bit)

Source Forms: ADDA *P*; ADDB *P*
Operation: R'←R + M
Condition Codes:
- H — Set if a half-carry is generated; cleared otherwise.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Set if an overflow is generated; cleared otherwise.
- C — Set if a carry is generated; cleared otherwise.

Description: Adds the memory byte into an 8-bit accumulator.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Add Memory into Register

ADD (16-Bit)

Source Form: ADDD *P*
Operation: R'←R + M:M + 1
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Set if an overflow is generated; cleared otherwise.
- C — Set if a carry is generated; cleared otherwise.

Description: Adds the 16-bit memory value into the 16-bit accumulator.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Logical AND Memory into Register

AND

Source Forms: ANDA *P*; ANDB *P*
Operation: R'←R ∧ M
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Always cleared.
- C — Not affected.

Description: Performs the logical AND operation between the contents of an accumulator and the contents of memory location M and the result is stored in the accumulator.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Logical AND Immediate Memory into Condition Code Register

AND

Source Form: ANDCC *#xx*
Operation: R'←R ∧ MI
Condition Codes: Affected according to the operation.
Description: Performs a logical AND between the condition code register and the immediate byte specified in the instruction and places the result in the condition code register.
Addressing Mode: Immediate.

Arithmetic Shift Left

ASL

Source Forms: ASL *Q*; ASLA; ASLB
Operation: C←[| | | | | | |]←0
b7 ← b0
Condition Codes:
- H — Undefined.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Loaded with the result of the exclusive OR of bits six and seven of the original operand.
- C — Loaded with bit seven of the original operand.

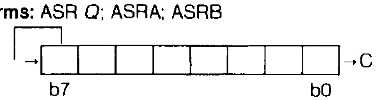
Description: Shifts all bits of the operand one place to the left. Bit zero is loaded with a zero. Bit seven is shifted into the C (carry) bit.
Addressing Modes: Inherent; Extended; Direct; Indexed.

ASR

Arithmetic Shift Right

Source Forms: ASR *Q*; ASRA; ASRB

Operation:



Condition Codes:
H — Undefined.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Not affected.
C — Loaded with bit zero of the original operand.

Description: Shifts all bits of the operand one place to the right. Bit seven is held constant. Bit zero is shifted into the C (carry) bit.

Addressing Modes: Inherent; Extended; Direct; Indexed.

BCC

Branch on Carry Clear

Source Forms: BCC *dd*; LBCC *DDDD*

Operation:
TEMP←MI
IFF C=0 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Tests the state of the C (carry) bit and causes a branch if it is clear.

Addressing Mode: Relative.

Comments: Equivalent to BHS dd; LBHS DDDD.

BCS

Branch on Carry Set

Source Forms: BCS *dd*; LBCS *DDDD*

Operation:
TEMP←MI
IFF C=1 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Tests the state of the C (carry) bit and causes a branch if it is set.

Addressing Mode: Relative.

Comments: Equivalent to BLO dd; LBLO DDDD.

BEQ

Branch on Equal

Source Forms: BEQ *dd*; LBEQ *DDDD*

Operation:
TEMP←MI
IFF Z=1 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Tests the state of the Z (zero) bit and causes a branch if it is set. When used after a subtract or compare operation, this instruction will branch if the compared values, signed or unsigned, were exactly the same.

Addressing Mode: Relative.

BGE

Branch on Greater than or Equal to Zero

Source Forms: BGE *dd*; LBGE *DDDD*

Operation:
TEMP←MI
IFF [N ⊕ V]=0 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Causes a branch if the N (negative) bit and the V (overflow) bit are either both set or both clear. That is, branch if the sign of a valid twos complement result is, or would be, positive. When used after a subtract or compare operation on twos complement values, this instruction will branch if the register was greater than or equal to the memory operand.

Addressing Mode: Relative.

BGT

Branch on Greater

Source Forms: BGT *dd*; LBGT *DDDD*

Operation:
TEMP←MI
IFF Z ∧ [N ⊕ V]=0 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Causes a branch if the N (negative) bit and V (overflow) bit are either both set or both clear and the Z (zero) bit is clear. In other words, branch if the sign of a valid twos complement result is, or would be, positive and not zero. When used after a subtract or compare operation on twos complement values, this instruction will branch if the register was greater than the memory operand.

Addressing Mode: Relative.

BHI

Branch if Higher

Source Forms: BHI *dd*; LBHI *DDDD*

Operation:
TEMP←MI
IFF [C v Z]=0 then PC'←PC+TEMP

Condition Codes: Not affected.

Description: Causes a branch if the previous operation caused neither a carry nor a zero result. When used after a subtract or compare operation on unsigned binary values, this instruction will branch if the register was higher than the memory operand.

Addressing Mode: Relative.

Comments: Generally not useful after INC/DEC, LD/TST, and TST/CLR/COM instructions.

Branch if Higher or Same

BHS

Source Forms: BHS *dd*; LBHS *DDDD*
Operation:
TEMP←MI
IFF C=0 then PC'←PC+MI
Condition Codes: Not affected.
Description: Tests the state of the C (carry) bit and causes a branch if it is clear. When used after a subtract or compare on unsigned binary values, this instruction will branch if the register was higher than or the same as the memory operand.
Addressing Mode: Relative.
Comments: This is a duplicate assembly-language mnemonic for the single machine instruction BCC. Generally not useful after INC/DEC, LD/ST, and TST/CLR/COM instructions.

Bit Test

BIT

Source Form: BIT *P*
Operation: TEMP←R ∧ M
Condition Codes:
H —Not affected.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Always cleared.
C —Not affected.
Description: Performs the logical AND of the contents of accumulator A or B and the contents of memory location M and modifies the condition codes accordingly. The contents of accumulator A or B and memory location M are not affected.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Branch on Less than or Equal to Zero

BLE

Source Forms: BLE *dd*; LBLE *DDDD*
Operation:
TEMP←MI
IFF Z v [N ⊕ V]=1 then PC'←PC+TEMP
Condition Codes: Not affected.
Description: Causes a branch if the exclusive OR of the N (negative) and V (overflow) bits is 1 or if the Z (zero) bit is set. That is, branch if the sign of a valid twos complement result is, or would be, negative. When used after a subtract or compare operation on twos complement values, this instruction will branch if the register was less than or equal to the memory operand.
Addressing Mode: Relative.

Branch on Lower

BLO

Source Forms: BLO *dd*; LBLO *DDDD*
Operation:
TEMP←MI
IFF C=1 then PC'←PC+TEMP
Condition Codes: Not affected.
Description: Tests the state of the C (carry) bit and causes a branch if it is set. When used after a subtract or compare on unsigned binary values, this instruction will branch if the register was lower than the memory operand.
Addressing Mode: Relative.
Comments: This is a duplicate assembly-language mnemonic for the single machine instruction BCS. Generally not useful after INC/DEC, LD/ST, and TST/CLR/COM instructions.

Branch on Lower or Same

BLS

Source Forms: BLS *dd*; LBLS *DDDD*
Operation:
TEMP←MI
IFF (C v Z)=1 then PC'←PC+TEMP
Condition Codes: Not affected.
Description: Causes a branch if the previous operation caused either a carry or a zero result. When used after a subtract or compare operation on unsigned binary values, this instruction will branch if the register was lower than or the same as the memory operand.
Addressing Mode: Relative.
Comments: Generally not useful after INC/DEC, LD/ST, and TST/CLR/COM instructions.

Branch on Less than Zero

BLT

Source Forms: BLT *dd*; LBLT *DDDD*
Operation:
TEMP←MI
IFF [N ⊕ V]=1 then PC'←PC+TEMP
Condition Codes: Not affected.
Description: Causes a branch if either, but not both, of the N (negative) or V (overflow) bits is set. That is, branch if the sign of a valid twos complement result is, or would be, negative. When used after a subtract or compare operation on twos complement binary values, this instruction will branch if the register was less than the memory operand.
Addressing Mode: Relative.

Branch on Minus

BMI

Source Forms: BMI *dd*; LBMI *DDDD*
Operation:
TEMP←MI
IFF N=1 then PC'←PC+TEMP
Condition Codes: Not affected.
Description: Tests the state of the N (negative) bit and causes a branch if set. That is, branch if the sign of the twos complement result is negative.
Addressing Mode: Relative.
Comments: When used after an operation on signed binary values, this instruction will branch if the result is minus. It is generally preferred to use the LBLT instruction after signed operations.

BNE

Branch Not Equal

Source Forms: BNE *dd*; LBNE *DDDD*
Operation:
TEMP←MI
IFF Z = 0 then PC'←PC + TEMP
Condition Codes: Not affected.
Description: Tests the state of the Z (zero) bit and causes a branch if it is clear. When used after a subtract or compare operation on any binary values, this instruction will branch if the register is, or would be, not equal to the memory operand.
Addressing Mode: Relative.

BPL

Branch on Plus

Source Forms: BPL *dd*; LBPL *DDDD*
Operation:
TEMP←MI
IFF N = 0 then PC'←PC + TEMP
Condition Codes: Not affected.
Description: Tests the state of the N (negative) bit and causes a branch if it is clear. That is, branch if the sign of the twos complement result is positive.
Addressing Mode: Relative.
Comments: When used after an operation on signed binary values, this instruction will branch if the result (possibly invalid) is positive. It is generally preferred to use the BGE instruction after signed operations.

BRA

Branch Always

Source Forms: BRA *dd*; LBRA *DDDD*
Operation:
TEMP←MI
PC'←PC + TEMP
Condition Codes: Not affected.
Description: Causes an unconditional branch.
Addressing Mode: Relative.

BRN

Branch Never

Source Forms: BRN *dd*; LBRN *DDDD*
Operation: TEMP←MI
Condition Codes: Not affected.
Description: Does not cause a branch. This instruction is essentially a no operation, but has a bit pattern logically related to branch always.
Addressing Mode: Relative.

BSR

Branch to Subroutine

Source Forms: BSR *dd*; LBSR *DDDD*
Operation:
TEMP←MI
SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
PC'←PC + TEMP
Condition Codes: Not affected.
Description: The program counter is pushed onto the stack. The program counter is then loaded with the sum of the program counter and the offset.
Addressing Mode: Relative.
Comments: A return from subroutine (RTS) instruction is used to reverse this process and must be the last instruction executed in a subroutine.

BVC

Branch on Overflow Clear

Source Forms: BVC *dd*; LBVC *DDDD*
Operation:
TEMP←MI
IFF V = 0 then PC'←PC + TEMP
Condition Codes: Not affected.
Description: Tests the state of the V (overflow) bit and causes a branch if it is clear. That is, branch if the twos complement result was valid. When used after an operation on twos complement binary values, this instruction will branch if there was no overflow.
Addressing Mode: Relative.

BVS

BVS Branch on Overflow set

Source Forms: BVS dd; LBVS DDDD
Operation: Temp←MI IFF V = 1 then PC'←PC + TEMP
Condition Codes: Not affected.
Description: Tests the state of V (overflow) bit and causes a branch if it is set. That is, branch if twos complement result was invalid. When used after an operation on twos complement binary values, this instruction will branch if there was an overflow.
Addressing Mode: Relative.

CLR

CLR Clear

Source Forms: CLR Q
Operation: TEMP← M M← 00 (base 16)
Condition codes:
H — Not affected.
N — Always cleared.
Z — Always set.
V — Always cleared.
C — Always cleared.
Description: Accumulator A or B or memory location M is loaded with 00000000. Note that the EA is read during this operation.
Addressing Modes: Inherent, Extended, Direct, Indexed.

Compare Memory from Register

CMP (8-Bit)

Source Forms: CMPA *P*; CMPB *P*
Operation: TEMP←R − M
Condition Codes:
H — Undefined.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Set if an overflow is generated; cleared otherwise.
C — Set if a borrow is generated; cleared otherwise.
Description: Compares the contents of memory location to the contents of the specified register and sets the appropriate condition codes. Neither memory location M nor the specified register is modified. The carry flag represents a borrow and is set to the inverse of the resulting binary carry.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Compare Memory from Register

CMP (16-Bit)

Source Forms: CMPD *P*; CMPX *P*; CMPY *P*; CMPU *P*; CMPS *P*
Operation: TEMP←R − M:M + 1
Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Set if an overflow is generated; cleared otherwise.
C — Set if a borrow is generated; cleared otherwise.
Description: Compares the 16-bit contents of the concatenated memory locations M:M + 1 to the contents of the specified register and sets the appropriate condition codes. Neither the memory locations nor the specified register is modified unless autoincrement or autodecrement are used. The carry flag represents a borrow and is set to the inverse of the resulting binary carry.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Complement

COM

Source Forms: COM *Q*; COMA; COMB
Operation: M'←O + $\overline{M}$
Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Always cleared.
C — Always set.
Description: Replaces the contents of memory location M or accumulator A or B with its logical complement. When operating on unsigned values, only BEQ and BNE branches can be expected to behave properly following a COM instruction. When operating on twos complement values, all signed branches are available.
Addressing Modes: Inherent; Extended; Direct; Indexed.

Clear CC bits and Wait for Interrupt

CWAI

Source Form: CWAI #$*XX*

E	F	H	I	N	Z	V	C

Operation:
CCR←CCR ∧ MI (Possibly clear masks)
Set E (entire state saved)
SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
SP'←SP − 1, (SP)←CCR
Condition Codes: Affected according to the operation.
Description: This instruction ANDs an immediate byte with the condition code register which may clear the interrupt mask bits I and F, stacks the entire machine state on the hardware stack and then looks for an interrupt. When a non-masked interrupt occurs, no further machine state information need be saved before vectoring to the interrupt handling routine. This instruction replaced the MC6800 CLI WAI sequence, but does not place the buses in a high-impedance state. A $\overline{\text{FIRQ}}$ (fast interrupt request) may enter its interrupt handler with its entire machine state saved. The RTI (return from interrupt) instruction will automatically return the entire machine state after testing the E (entire) bit of the recovered condition code register.
Addressing Mode: Immediate.
Comments: The following immediate values will have the following results:
FF = enable neither
EF = enable $\overline{\text{IRQ}}$
BF = enable $\overline{\text{FIRQ}}$
AF = enable both

Decimal Addition Adjust

DAA

Source Form: DAA
Operation: ACCA'←ACCA + CF (MSN):CF(LSN)
where CF is a Correction Factor, as follows: the CF for each nibble (BCD) digit is determined separately, and is either 6 or 0.
Least Significant Nibble
CF(LSN) = 6 IFF 1) C = 1
or 2) LSN>9
Most Significant Nibble
CF(MSN) = 6 IFF 1) C = 1
or 2) MSN>9
or 3) MSN>8 *and* LSN>9
Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Undefined.
C — Set if a carry is generated or if the carry bit was set before the operation; cleared otherwise.
Description: The sequence of a single-byte add instruction on accumulator A (either ADDA or ADCA) and a following decimal addition adjust instruction results in a BCD addition with an appropriate carry bit. Both values to be added must be in proper BCD form (each nibble such that: 0≤nibble≤9). Multiple-precision addition must add the carry generated by this decimal addition adust into the next higher digit during the add operation (ADCA) immediately prior to the next decimal addition adjust.
Addressing Mode: Inherent.

DEC

Decrement

Source Forms: DEC *Q*; DECA; DECB
Operation: M′←M − 1
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Set if the original operand was 10000000; cleared otherwise.
- C — Not affected.

Description: Subtract one from the operand. The carry bit is not affected, thus allowing this instruction to be used as a loop counter in multiple-precision computations. When operating on unsigned values, only BEQ and BNE branches can be expected to behave consistently. When operating on twos complement values, all signed branches are available.
Addressing Modes: Inherent; Extended; Direct; Indexed.

EOR

Exclusive OR

Source Forms: EORA *P*; EORB *P*
Operation: R′←R ⊕ M
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Always cleared.
- C — Not affected.

Description: The contents of memory location M is exclusive ORed into an 8-bit register.
Addressing Modes: Immediate; Extended; Direct; Indexed.

EXG

Exchange Registers

Source Form: EXG *R1,R2*
Operation: R1↔R2
Condition Codes: Not affected (unless one of the registers is the condition code register).
Description: Exchanges data between two designated registers. Bits 3-0 of the postbyte define one register, while bits 7-4 define the other, as follows:

0000 = A:B	1000 = A
0001 = X	1001 = B
0010 = Y	1010 = CCR
0011 = US	1011 = DPR
0100 = SP	1100 = Undefined
0101 = PC	1101 = Undefined
0110 = Undefined	1110 = Undefined
0111 = Undefined	1111 = Undefined

Only like size registers may be exchanged. (8-bit with 8-bit or 16-bit with 16-bit.)
Addressing Mode: Immediate.

INC

Increment

Source Forms: INC *Q*; INCA; INCB
Operation: M′←M + 1
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Set if the original operand was 01111111; cleared otherwise.
- C — Not affected.

Description: Adds to the operand. The carry bit is not affected, thus allowing this instruction to be used as a loop counter in multiple-precision computations. When operating on unsigned values, only the BEQ and BNE branches can be expected to behave consistently. When operating on twos complement values, all signed branches are correctly available.
Addressing Modes: Inherent; Extended; Direct; Indexed.

JMP

Jump

Source Form: JMP *EA*
Operation: PC′←EA
Condition Codes: Not affected.
Description: Program control is transferred to the effective address.
Addressing Modes: Extended; Direct; Indexed.

JSR

Jump to Subroutine

Source Form: JSR *EA*
Operation:
SP′←SP − 1, (SP)←PCL
SP′←SP − 1, (SP)←PCH
PC′←EA
Condition Codes: Not affected.
Description: Program control is transferred to the effective address after storing the return address on the hardware stack. A RTS instruction should be the last executed instruction of the subroutine.
Addressing Modes: Extended; Direct; Indexed.

LD (8-Bit)

Load Register from Memory

Source Forms: LDA *P*; LDB *P*
Operation: R′←M
Condition Codes:
- H — Not affected.
- N — Set if the loaded data is negative; cleared otherwise.
- Z — Set if the loaded data is zero; cleared otherwise.
- V — Always cleared.
- C — Not affected.

Description: Loads the contents of memory location M into the designated register.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Load Register from Memory

LD (16-Bit)

Source Forms: LDD *P*; LDX *P*; LDY *P*; LDS *P*; LDU *P*
Operation: R'←M:M + 1
Condition Codes:
H — Not affected.
N — Set if the loaded data is negative; cleared otherwise.
Z — Set if the loaded data is zero; cleared otherwise.
V — Always cleared.
C — Not affected.
Description: Load the contents of the memory location M:M + 1 into the designated 16-bit register.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Load Effective Address

LEA

Source Forms: LEAX, LEAY, LEAS, LEAU
Operation: R'←EA
Condition Codes:
H — Not affected.
N — Not affected.
Z — LEAX, LEAY: Set if the result is zero; cleared otherwise. LEAS, LEAU: Not affected.
V — Not affected.
C — Not affected.
Description: Calculates the effective address from the index addressing mode and places the address in an indexable register.

LEAX and LEAY affect the Z (zero) bit to allow use of these registers as counters and for MC6800 INX/DEX compatibility.

LEAU and LEAS do not affect the Z bit to allow cleaning up the stack while returning the Z bit as a parameter to a calling routine, and also for MC6800 INS/DES compatibility.
Addressing Mode: Indexed.
Comments: Due to the order in which effective addresses are calculated internally, the LEAX, X+ + and LEAX,X+ do not add 2 and 1 (respectively) to the X register; but instead leave the X register unchanged. This also applies to the Y, U, and S registers. For the expected results, use the faster instruction LEAX 2, X and LEAX 1, X.

Some examples of LEA instruction uses are given in the following table.

Instruction		Operation	Comment
LEAX	10, X	X+10→X	Adds 5-bit constant 10 to X.
LEAX	500, X	X+500→X	Adds 16-bit constant 500 to X.
LEAY	A, Y	Y+A→Y	Adds 8-bit accumulator to Y.
LEAY	D, Y	Y+D→Y	Adds 16-bit D accumulator to Y.
LEAU	−10, U	U−10→U	Subtracts 10 from U.
LEAS	−10, S	S−10→S	Used to reserve area on stack.
LEAS	10, S	S+10→S	Used to 'clean up' stack.
LEAX	5, S	S+5→X	Transfers as well as adds.

Logical Shift Left

LSL

Source Forms: LSL *Q*; LSLA; LSLB
Operation: C← [| | | | | | |] ←0
b7 b0
Condition Codes:
H — Undefined.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Loaded with the result of the exclusive OR of bits six and seven of the original operand.
C — Loaded with bit seven of the original operand.
Description: Shifts all bits of accumulator A or B or memory location M one place to the left. Bit zero is loaded with a zero. Bit seven of accumulator A or B or memory location M is shifted into the C (carry) bit.
Addressing Modes: Inherent; Extended; Direct; Indexed.
Comments: This is a duplicate assembly-language mnemonic for the single machine instruction ASL.

Logical Shift Right

LSR

Source Forms: LSR *Q*; LSRA; LSRB
Operation: 0→ [| | | | | | |] →C
b7 b0
Condition Codes:
H — Not affected.
N — Always cleared.
Z — Set if the result is zero; cleared otherwise.
V — Not affected.
C — Loaded with bit zero of the original operand.
Description: Performs a logical shift right on the operand. Shifts a zero into bit seven and bit zero into the C (carry) bit.
Addressing Modes: Inherent; Extended; Direct; Indexed.

Multiply

MUL

Source Form: MUL
Operation: ACCA':ACCB'←ACCA × ACCB
Condition Codes:
H — Not affected.
N — Not affected.
Z — Set if the result is zero; cleared otherwise.
V — Not affected.
C — Set if ACCB bit 7 of result is set; cleared otherwise.
Description: Multiply the unsigned binary numbers in the accumulators and place the result in both accumulators (ACCA contains the most-significant byte of the result). Unsigned multiply allows multiple-precision operations.
Addressing Mode: Inherent.
Comments: The C (carry) bit allows rounding the most-significant byte through the sequence: MUL, ADCA #0.

NEG

Negate

Source Forms: NEG *Q*; NEGA; NEGB
Operation: M'←0 − M
Condition Codes:
H — Undefined.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Set if the original operand was 10000000.
C — Set if a borrow is generated; cleared otherwise.
Description: Replaces the operand with its twos complement. The C (carry) bit represents a borrow and is set to the inverse of the resulting binary carry. Note that 80_{16} is replaced by itself and only in this case is the V (overflow) bit set. The value 00_{16} is also replaced by itself, and only in this case is the C (carry) bit cleared.
Addressing Modes: Inherent; Extended; Direct.

NOP

No Operation

Source Form: NOP
Operation: Not affected.
Condition Codes: This instruction causes only the program counter to be incremented. No other registers or memory locations are affected.
Addressing Mode: Inherent.

OR

Inclusive OR Memory into Register

Source Forms: ORA *P*; ORB *P*
Operation: R'←R v M
Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Always cleared.
C — Not affected.
Description: Performs an inclusive OR operation between the contents of accumulator A or B and the contents of memory location M and the result is stored in accumulator A or B.
Addressing Modes: Immediate; Extended; Direct; Indexed.

OR

Inclusive OR Memory Immediate into Condition Code Register

Source Form: ORCC *#XX*
Operation: R'←R v MI
Condition Codes: Affected according to the operation.
Description: Performs an inclusive OR operation between the contents of the condition code registers and the immediate value, and the result is placed in the condition code register. This instruction may be used to set interrupt masks (disable interrupts) or any other bit(s).
Addressing Mode: Immediate.

PSHS

Push Registers on the Hardware Stack

Source Form:
PSHS *register list*
PSHS *#LABEL*
Postbyte:

b7	b6	b5	b4	b3	b2	b1	b0
PC	U	Y	X	DP	B	A	CC

push order →

Operation:
IFF b7 of postbyte set, then: SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
IFF b6 of postbyte set, then: SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
IFF b5 of postbyte set, then: SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
IFF b4 of postbyte set, then: SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
IFF b3 of postbyte set, then: SP'←SP − 1, (SP)←DPR
IFF b2 of postbyte set, then: SP'←SP − 1, (SP)←ACCB
IFF b1 of postbyte set, then: SP'←SP − 1, (SP)←ACCA
IFF b0 of postbyte set, then: SP'←SP − 1, (SP)←CCR
Condition Codes: Not affected.
Description: All, some, or none of the processor registers are pushed onto the hardware stack (with the exception of the hardware stack pointer itself).
Addressing Mode: Immediate.
Comments: A single register may be placed on the stack with the condition codes set by doing an autodecrement store onto the stack (example: STX, − −S).

PSHU

Push Registers on the User Stack

Source Form:
PSHU *register list*
PSHU *#LABEL*
Postbyte:

b7	b6	b5	b4	b3	b2	b1	b0
PC	U	Y	X	DP	B	A	CC

push order →

Operation:
IFF b7 of postbyte set, then: US'←US − 1, (US)←PCL
US'←US − 1, (US)←PCH
IFF b6 of postbyte set, then: US'←US − 1, (US)←SPL
US'←US − 1, (US)←SPH
IFF b5 of postbyte set, then: US'←US − 1, (US)←IYL
US'←US − 1, (US)←IYH
IFF b4 of postbyte set, then: US'←US − 1, (US)←IXL
US'←US − 1, (US)←IXH
IFF b3 of postbyte set, then: US'←US − 1, (US)←DPR
IFF b2 of postbyte set, then: US'←US − 1, (US)←ACCB
IFF b1 of postbyte set, then: US'←US − 1, (US)←ACCA
IFF b0 of postbyte set, then: US'←US − 1, (US)←CCR
Condition Codes: Not affected.
Description: All, some, or none of the processor registers are pushed onto the user stack (with the exception of the user stack pointer itself).
Addressing Mode: Immediate.
Comments: A single register may be placed on the stack with the condition codes set by doing an autodecrement store onto the stack (example: STX, − −U).

PULS

Pull Registers from the Hardware Stack

Source Form:
PULS *register list*
PULS *#LABEL*
Postbyte:

b7	b6	b5	b4	b3	b2	b1	b0
PC	U	Y	X	DP	B	A	CC

← pull order

Operation:
IFF b0 of postbyte set, then: CCR' ←(SP), SP'←SP+1
IFF b1 of postbyte set, then: ACCA'←(SP), SP'←SP+1
IFF b2 of postbyte set, then: ACCB'←(SP), SP'←SP+1
IFF b3 of postbyte set, then: DPR' ←(SP), SP'←SP+1
IFF b4 of postbyte set, then: IXH' ←(SP), SP'←SP+1
IXL' ←(SP), SP'←SP+1
IFF b5 of postbyte set, then: IYH' ←(SP), SP'←SP+1
IYL' ←(SP), SP'←SP+1
IFF b6 of postbyte set, then: USH' ←(SP), SP'←SP+1
USL' ←(SP), SP'←SP+1
IFF b7 of postbyte set, then: PCH' ←(SP), SP'←SP+1
PCL' ←(SP), SP'←SP+1

Condition Codes: May be pulled from stack; not affected otherwise.
Description: All, some, or none of the processor registers are pulled from the hardware stack (with the exception of the hardware stack pointer itself).
Addressing Mode: Immediate.
Comments: A single register may be pulled from the stack with condition codes set by doing an autoincrement load from the stack (example; LDX,S++).

PULU

Pull Registers from the User Stack

Source Form:
PULU *register list*
PULU *#LABEL*
Postbyte:

b7	b6	b5	b4	b3	b2	b1	b0
PC	U	Y	X	DP	B	A	CC

← pull order

Operation:
IFF b0 of postbyte set, then: CCR' ←(US), US'←US+1
IFF b1 of postbyte set, then: ACCA'←(US), US'←US+1
IFF b2 of postbyte set, then: ACCB'←(US), US'←US+1
IFF b3 of postbyte set, then: DPR' ←(US), US'←US+1
IFF b4 of postbyte set, then: IXH' ←(US), US'←US+1
IXL' ←(US), US'←US+1
IFF b5 of postbyte set, then: IYH' ←(US), US'←US+1
IYL' ←(US), US'←US+1
IFF b6 of postbyte set, then: SPH' ←(US), US'←US+1
SPL' ←(US), US'←US+1
IFF b7 of postbyte set, then: PCH ←(US), US'←US+1
PCL' ←(US), US'←US+1

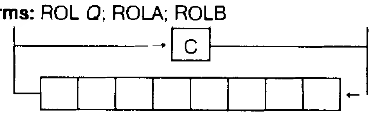
Condition Codes: May be pulled from stack; not affected otherwise.
Description: All, some, or none of the processor registers are pulled from the user stack (with the exception of the user stack pointer itself).
Addressing Mode: Immediate.
Comments: A single register may be pulled from the stack with condition codes set by doing an autoincrement load from the stack (example: LDX,U++).

ROL

Rotate Left

Source Forms: ROL *Q*; ROLA; ROLB

Operation:



b7 ← b0

Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Loaded with the result of the exclusive OR of bits six and seven of the original operand.
C — Loaded with bit seven of the original operand.

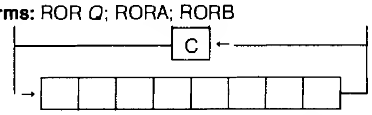
Description: Rotates all bits of the operand one place left through the C (carry) bit. This is a 9-bit rotation.
Addressing Mode: Inherent; Extended; Direct; Indexed.

ROR

Rotate Right

Source Forms: ROR *Q*; RORA; RORB

Operation:



b7 → b0

Condition Codes:
H — Not affected.
N — Set if the result is negative; cleared otherwise.
Z — Set if the result is zero; cleared otherwise.
V — Not affected.
C — Loaded with bit zero of the previous operand.

Description: Rotates all bits of the operand one place right through the C (carry) bit. This is a 9-bit rotation.
Addressing Modes: Inherent; Extended; Direct; Indexed.

RTI

Return from Interrupt

Source Form: RTI
Operation: CCR'←(SP), SP'←SP+1, then
IFF CCR bit E is set, then: ACCA'←(SP), SP'←SP+1
ACCB'←(SP), SP'←SP+1
DPR' ←(SP), SP'←SP+1
IXH' ←(SP), SP'←SP+1
IXL' ←(SP), SP'←SP+1
IYH' ←(SP), SP'←SP+1
IYL' ←(SP), SP'←SP+1
USH' ←(SP), SP'←SP+1
USL' ←(SP), SP'←SP+1
PCH' ←(SP), SP'←SP+1
PCL' ←(SP), SP'←SP+1
IFF CCR bit E is clear, then: PCH' ←(SP), SP'←SP+1
PCL' ←(SP), SP'←SP+1
Condition Codes: Recovered from the stack.
Description: The saved machine state is recovered from the hardware stack and control is returned to the interrupted program. If the recovered E (entire) bit is clear, it indicates that only a subset of the machine state was saved (return address and condition codes) and only that subset is recovered.
Addressing Mode: Inherent.

RTS

Return from Subroutine

Source Form: RTS
Operation:
PCH'←(SP), SP'←SP+1
PCL'←(SP), SP'←SP+1
Condition Codes: Not affected.
Description: Program control is returned from the subroutine to the calling program. The return address is pulled from the stack.
Addressing Mode: Inherent.

SBC

Subtract with Borrow

Source Forms: SBCA *P*; SBCB *P*
Operation: R'←R−M−C
Condition Codes:
H —Undefined.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Set if an overflow is generated; cleared otherwise.
C —Set if a borrow is generated; cleared otherwise.
Description: Subtracts the contents of memory location M and the borrow (in the C (carry) bit) from the contents of the designated 8-bit register, and places the result in that register. The C bit represents a borrow and is set to the inverse of the resulting binary carry.
Addressing Modes: Immediate; Extended; Direct; Indexed.

SEX

Sign Extended

Source Form: SEX
Operation:
If bit seven of ACCB is set then ACCA'←FF_{16}
else ACCA'←00_{16}
Condition Codes:
H — Not affected.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero, cleared otherwise.
V —Not affected.
C —Not affected.
Description: This instruction transforms a twos complement 8-bit value in accumulator B into a twos complement 16-bit value in the D accumulator.
Addressing Mode: Inherent.

ST (8-Bit)

Store Register into Memory

Source Forms: STA *P*; STB *P*
Operation: M'←R
Condition Codes:
H —Not affected.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Always cleared.
C —Not affected.
Description: Writes the contents of an 8-bit register into a memory location.
Addressing Modes: Extended; Direct; Indexed.

ST (16-Bit)

Store Register into Memory

Source Forms: STD *P*; STX *P*; STY *P*; STS *P*; STU *P*
Operation: M':M+1'←R
Condition Codes:
H —Not affected.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Always cleared.
C —Not affected.
Description: Writes the contents of a 16-bit register into two consecutive memory locations.
Addressing Modes: Extended; Direct; Indexed.

SUB (8-Bit)

Subtract Memory from Register

Source Forms: SUBA *P*; SUBB *P*
Operation: R'←R−M
Condition Codes:
H —Undefined.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Set if the overflow is generated; cleared otherwise.
C —Set if a borrow is generated; cleared otherwise.
Description: Subtracts the value in memory location M from the contents of a designated 8-bit register. The C (carry) bit represents a borrow and is set to the inverse of the resulting binary carry.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Subtract Memory from Register

SUB (16-Bit)

Source Forms: SUBD *P*
Operation: R'←R − M:M + 1
Condition Codes:
H —Not affected.
N —Set if the result is negative; cleared otherwise.
Z —Set if the result is zero; cleared otherwise.
V —Set if the overflow is generated; cleared otherwise.
C —Set if a borrow is generated; cleared otherwise.
Description: Subtracts the value in memory location M:M + 1 from the contents of a designated 16-bit register. The C (carry) bit represents a borrow and is set to the inverse of the resulting binary carry.
Addressing Modes: Immediate; Extended; Direct; Indexed.

Software Interrupt

SWI

Source Form: SWI
Operation:
Set E (entire state will be saved)
SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
SP'←SP − 1, (SP)←CCR
Set I, F (mask interrupts)
PC'←(FFFA):(FFFB)
Condition Codes: Not affected.
Description: All of the processor registers are pushed onto the hardware stack (with the exception of the hardware stack pointer itself), and control is transferred through the software interrupt vector. Both the normal and fast interrupts are masked (disabled).
Addressing Mode: Inherent.

Software Interrupt 2

SWI2

Source Form: SWI2
Operation:
Set E (entire state saved)
SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
SP'←SP − 1, (SP)←CCR
PC'←(FFF4):(FFF5)
Condition Codes: Not affected.
Description: All of the processor registers are pushed onto the hardware stack (with the exception of the hardware stack pointer itself), and control is transferred through the software interrupt 2 vector. This interrupt is available to the end user and must not be used in packaged software. This interrupt does not mask (disable) the normal and fast interrupts.
Addressing Mode: Inherent.

Software Interrupt 3

SWI3

Source Form: SWI3
Operation:
Set E (entire state will be saved)
SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
SP'←SP − 1, (SP)←CCR
PC'←(FFF2):(FFF3)
Condition Codes: Not affected.
Description: All of the processor registers are pushed onto the hardware stack (with the exception of the hardware stack pointer itself), and control is transferred through the software interrupt 3 vector. This interrupt does not mask (disable) the normal and fast interrupts.
Addressing Mode: Inherent.

SYNC

Synchronize to External Event

Source Form: SYNC
Operation: Stop processing instructions.
Condition Codes: Not affected.
Description: When a SYNC instruction is executed, the processor enters a synchronizing state, stops processing instructions, and waits for an interrupt. When an interrupt occurs, the synchronizing state is cleared and processing continues. If the interrupt is enabled, and it last three cycles or more, the processor will perform the interrupt routine. If the interrupt is masked or is shorter than three cycles, the processor simply continues to the next instruction. While in the synchronizing state, the address and data buses are in the high-impedance state.

This instruction provides software synchronization with a hardware process. Consider the following example for high-speed acquisition of data:

```
FAST  SYNC              WAIT FOR DATA
      Interrupt!
      LDA     DISC      DATA FROM DISC AND
                          CLEAR INTERRUPT
      STA     ,X+       PUT IN BUFFER
      DECB              COUNT IT, DONE?
      BNE     FAST      GO AGAIN IF NOT.
```

The synchronizing state is cleared by any interrupt. Of course, enabled interrupts at this point may destroy the data transfer and, as such, should represent only emergency conditions.

The same connection used for interrupt-driven I/O service may also be used for high-speed data transfers by setting the interrupt mask and using the SYNC instruction as the above example demonstrates.

Addressing Mode: Inherent.

TFR

Transfer Register to Register

Source Form: TFR *R1*, *R2*
Operation: R1→R2
Condition Code: Not affected unless R2 is the condition code register.
Description: Transfers data between two designated registers. Bits 7-4 of the postbyte define the source register, while bits 3-0 define the destination register, as follows:

0000 = A:B	1000 = A	0010 = Y	1010 = CCR
0001 = X	1001 = B	0011 = US	1011 = DPR
		0100 = SP	1100 = Undefined
		0101 = PC	1101 = Undefined
		0110 = Undefined	1110 = Undefined
		0111 = Undefined	1111 = Undefined

Only like size registers may be transferred. (8-bit to 8-bit, or 16-bit to 16-bit.)

Addressing Mode: Immediate.

TST

Test

Source Forms: TST *Q*; TSTA; TSTB
Operation: TEMP←M − 0
Condition Codes:
- H — Not affected.
- N — Set if the result is negative; cleared otherwise.
- Z — Set if the result is zero; cleared otherwise.
- V — Always cleared.
- C — Not affected.

Description: Set the N (negative) and Z (zero) bits according to the contents of memory location M, and clear the V (overflow) bit. The TST instruction provides only minimum information when testing unsigned values; since no unsigned value is less than zero, BLO and BLS have no utility. While BHI could be used after TST, it provides exactly the same control as BNE, which is preferred. The signed branches are available.

Addressing Modes: Inherent; Extended; Direct; Indexed.
Comments: The MC6800 processor clears the C (carry) bit.

$\overline{\text{FIRQ}}$

Fast Interrupt Request (Hardware Interrupt)

Operation:

IFF F bit clear, then: SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
Clear E (subset state is saved)
SP'←SP − 1, (SP)←CCR
Set F, I (mask further interrupts)
PC'←(FFF6):(FFF7)

Condition Codes: Not affected.
Description: A $\overline{\text{FIRQ}}$ (fast interrupt request) with the F (fast interrupt request mask) bit clear causes this interrupt sequence to occur at the end of the current instruction. The program counter and condition code register are pushed onto the hardware stack. Program control is transferred through the fast interrupt request vector. An RTI (return from interrupt) instruction returns the processor to the original task. It is possible to enter the fast interrupt request routine with the entire machine state saved if the fast interrupt request occurs after a clear and wait for interrupt instruction. A normal interrupt request has lower priority than the fast interrupt request and is prevented from interrupting the fast interrupt request routine by automatic setting of the I (interrupt request mask) bit. This mask bit could then be reset during the interrupt routine if priority was not desired. The fast interrupt request allows operations on memory, TST, INC, DEC, etc. instructions without the overhead of saving the entire machine state on the stack.

Addressing Mode: Inherent.

Interrupt Request (Hardware Interrupt)

Operation:

IFF I bit clear, then: SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
Set E (entire state saved)
SP'←SP − 1, (SP)←CCR
Set I (mask further $\overline{IRQ}$ interrupts)
PC'←(FFF8):(FFF9)

Condition Codes: Not affected.

Description: If the I (interrupt request mask) bit is clear, a low level on the $\overline{IRQ}$ input causes this interrupt sequence to occur at the end of the current instruction. Control is returned to the interrupted program using a RTI (return from interrupt) instruction. A $\overline{FIRQ}$ (fast interrupt request) may interrupt a normal $\overline{IRQ}$ (interupt request) routine and be recognized anytime after the interrupt vector is taken.

Addressing Mode: Inherent.

IRQ

Non-Maskable Interrupt (Hardware Interrupt)

Operation:

SP'←SP − 1, (SP)←PCL
SP'←SP − 1, (SP)←PCH
SP'←SP − 1, (SP)←USL
SP'←SP − 1, (SP)←USH
SP'←SP − 1, (SP)←IYL
SP'←SP − 1, (SP)←IYH
SP'←SP − 1, (SP)←IXL
SP'←SP − 1, (SP)←IXH
SP'←SP − 1, (SP)←DPR
SP'←SP − 1, (SP)←ACCB
SP'←SP − 1, (SP)←ACCA
Set E (entire state save)
SP'←SP − 1, (SP)←CCR
Set I, F (mask interrupts)
PC'←(FFFC):(FFFD)

Condition Codes: Not affected.

Description: A negative edge on the $\overline{NMI}$ (non-maskable interrupt) input causes all of the processor's registers (except the hardware stack pointer) to be pushed onto the hardware stack, starting at the end of the current instruction. Program control is transferred through the $\overline{NMI}$ vector. Successive negative edges on the $\overline{NMI}$ input will cause successive $\overline{NMI}$ operations. Non-maskable interrupt operation can be internally blocked by a $\overline{RESET}$ operation and any non-maskable interrupt that occurs will be latched. If this happens, the non-maskable interrupt operation will occur after the first load into the stack pointer (LDS; TFR r,s; EXG r,s; etc.) after $\overline{RESET}$.

Addressing Mode: Inherent.

NMI

Restart (Hardware Interrupt)

Operation:

CCR'←X1X1XXXX
DPR'←00_{16}
PC'←(FFFE):(FFFF)

Condition Codes: Not affected.

Description: The processor is initialized (required after power-on) to start program execution. The starting address is fetched from the restart vector.

Addressing Mode: Extended; Indirect.

RESTART

Reference M/ Sample Programs

Example 1

```
10 '        This is an example of a BASIC program that calls
20 '        an assembly language program to paint the screen
30 '        yellow.
40 '
60 '        After entering the BASIC program save it on disk.
70 '
80 '        Run DOS and enter the assembly language program.
90 '        Use the WD and AD assembler commands to write the
100 '       source program to disk and to assemble it.
110 '
120 '       After returning to BASIC, load the assembled
130 '       program into memory with the LOADM command. You
140 '       must load the assembled program before the BASIC
150 '       program.
160 '
170 '       This program demonstrates how much faster
180 '       an assembly program can perform a function than a
190 '       BASIC statement.  After you run the program once,
200 '       delete lines 1030, 1040, 1050, and 1120.  Insert
210 '       this statement
220 '            1120 PAINT (1,1),2
230 '       and see how much longer it takes BASIC to paint
240 '       the entire screen yellow.
250 '
1000 'Specify the highest address BASIC can use.  This
1010 '      prevents BASIC from using the memory that contains
1020 '      your assembly language subroutine.
1030 CLEAR 200,16127
1040 PCLEAR 6          'reserve 6 pages of graphics memory
1050 DEF USR0=16128 'define the subroutine starting address
1060 ' The disk drive uses pages 0 and 1 of video memory.
1070 ' You must start at page 2, hex 1200.
1080 PMODE 3,2         'select mode 3, starting at page 2
1090 PCLS              'clear the screen
1100 SCREEN 1,0        'select graphics screen, color set 0
1110 COLOR 3,1         'set foreground color to blue
1120 A=USR(0)          'call the assembly language subroutine
1130 'draw a frame
```

```
1140 LINE (0,0)-(255,191),PSET,B
1150 LINE (12,12)-(242,178),PSET,B
1160 PAINT (2,2),4,3             'fill in the frame with red
1170 FOR X=50 TO 90 STEP 20      'draw top circles
1180 Y=30:ST=.5:EN=0             '    of big cloud
1190 GOSUB 5000
1200 Y=50:ST=0:EN=.5             'draw bottom circles
1210 GOSUB 5000:NEXT X           '    of big cloud
1220 FOR X=160 TO 180 STEP 20
1230 Y=30:ST=.5:EN=0             'draw top circles
1240 GOSUB 5000                       of little cloud
1250 Y=50:ST=0:EN=.5             'draw bottom circles
1260 GOSUB 5000:NEXT X                of little cloud
1270 Y=40:ST=.25:EN=.75          'draw left sides of clouds
1280 GOSUB 5020
1290 X=150:GOSUB 5020
1300 X=100:ST=.75:EN=.25         'draw right sides of clouds
1310 GOSUB 5020
1320 X=190:GOSUB 5020
1330 PAINT (52,30),3,3           'fill the clouds in with blue
1340 PAINT (162,30),3,3
1350 R=60:H=1:GOSUB 5040         'draw the umbrella
1360 R=37:H=1.7:GOSUB 5040       'draw the spokes of the
1370 R=15:H=4.7:GOSUB 5040       '    umbrella
1380 ST=.5:EN=0                  'draw the scalloped edges
1390 FOR X=78 TO 184 STEP 23     '    on the umbrella
1400 Y=124:GOSUB 5000
1410 NEXT X
1420 'draw umbrella handle
1430 DRAW "BM121,120;D40;R2;D2;R2;D2;R8;U2;R2;U2;R2;U3;
     L2;D2;L2;D2;L2;D2;L3;U2;L2;U2;L2;U40"
1440 PAINT (122,122),3,3         'paint umbrella handle
1450 PAINT (124,161),3
1460 PAINT (126,163),3
1470 C=8                         'set highest color number
1480 FOR X=68 TO 180 STEP 24     'paint umbrella panels
1490 PAINT (X,120),C,3
1500 C=C-1:NEXT X
1510 'play the song "Raindrops Keep Falling On My Head"
1520 GOSUB 6000:PLAY L$
1530 GOSUB 9000:PLAY L$
1540 PLAY M$:PLAY E$:PLAY N$
1550 PLAY G$:PLAY E$:PLAY O$
1560 PLAY P$:PLAY Q$:PLAY E$
1570 PLAY R$:PLAY S$:PLAY R$
1580 PLAY T$:PLAY P$:PLAY E$
1590 PLAY U$:GOSUB 9000
1600 PLAY V$:PLAY E$:PLAY E$
1610 PLAY W$:PLAY X$
1620 'Keep the image on the screen until a key is pressed.
1630 Z$=INKEY$
1640 IF Z$="" THEN 1630
1650 END
```

```
5000 CIRCLE (X,Y),13,3,.45,ST,EN
5010 RETURN
5020 CIRCLE (X,Y),16,3,.75,ST,EN
5030 RETURN
5040 CIRCLE (124,124),R,3,H,.5,0
5050 RETURN
5060 '
5070 'These lines define the notes of the song.
6000 A$="03;L4A;L8.;A;L16A;L8.;B-;L16A;L8.G;L16F;L4,;A"
6010 B$="P8;P4;P8;P16"
6020 C$="03;L16;C;04;L4C;L8.;C;L16C;L8.;D;L16C;L8.;C"
6030 D$="03;L16A;L4A;B-;G;F;04;E;P4"
6040 E$="P4"
6050 F$="04;L8.;D;L16C;03;L8.;A;L16E;04;L4.E"
6060 G$="P8"
6070 H$="04;L4.;D"
6080 I$="04;L4C;L8.;C;03;L16A;L8.;B-"
6090 J$="04;L16C;03;L8.;B-;L16A"
6100 K$="04;L4.;C;P4"
6110 L$="03;L4F;F;G"
6120 M$="03;L2;A"
6130 N$="04;L8.;C;03;L2G"
6140 O$="03;L8.;A;L4B-;L4A;L4G"
6150 P$="03;L8.;F;L4A;L4.;G"
6160 Q$="03;L4A;L8.;B-;04;L4D;L4C"
6170 R$="P8;P16"
6180 S$="03;L16A;04;L8D;L4C;L2C"
6190 T$="03;L16A;04;L8E;L4D;L2C"
6200 U$="P2;P1"
6210 V$="03;L4F;F;G;L2.;A"
6220 W$="03;L8.;F;L16F;04;L8.;D;L16C;03;L4F"
6230 X$="03;L8A;G;L4F;L2.;F"
9000 PLAY A$:PLAY B$:PLAY C$
9010 PLAY D$:PLAY E$:PLAY F$
9020 PLAY G$:PLAY H$:PLAY G$
9030 PLAY I$:PLAY J$
9040 PLAY I$:PLAY K$
9050 RETURN
```

```
00100 * Use EDTASM or EDTASMOV to enter this program.  Save
00110 *         the program on disk with WD command and
00120 *         assemble the program with AD command.  Do not
00130 *         use the SR switch because this program is
00140 *         called from BASIC, not executed from DOS.
00150 *
00160 * Use the LOADM command to load the assembled code
00170 *         into memory before you load the BASIC program.
00180 *         The ORG statement tells BASIC where in memory
00190 *         to load the program.
00200 *
00210         ORG   $3F00
00220 *
```

```
00230 * Put the hex code for a yellow point (55H) in
00240 *        register A and the address of the first byte
00250 *        of video memory (1200) in register X.
00260 *        The first byte of video memory is 1200 hex
00270 *        because the disk drive uses memory up to that
00280 *        address.
00290 *
00300 START    LDA    #$55
00310          LDX    #$1200
00320 *
00330 * Store the yellow dot at the current video memory
00340 *        address and increment X to the next video
00350 *        memory address.
00360 *
00370 SCREEN   STA    ,X+
00380          CMPX   #$2FFF      Is it the end of video memory?
00390          BNE    SCREEN      If no, continue to store dots
00400          RTS                If yes, exit subprogram and
00410 *                           and return to BASIC
00420 DONE     EQU    *
00430          END    START
```

Example 2

```
20 ' After entering the BASIC program save it on disk.
30 '
40 ' Run DOS and enter the assembly language program.  Use
50 '      the WD and AD assembler commands to write the
60 '      source program to disk and to assemble it.
70 '
80 ' After returning to BASIC, load the assembled
90 '      program into memory with the LOADM command. You
100 '      must load the assembled program before the BASIC
110 '      program.
120 '
130 ' Specify the highest address BASIC can use.  This
140 '      prevents BASIC from using the memory that contains
150 '      your assembly language subroutine.
160 CLEAR 200, 16127
170 DEF USR0=16128                'define address of subroutine
180 CLS                           'clear the screen
190 ' Print a prompting message and wait for a response.
200 INPUT "Press [ENTER] when ready"; A$
210 A=USR(0)                      'call subroutine
220 'Print another prompting message and wait for a response
230 INPUT "Want to do it again"; A$
240 'If operator types yes, start over.  Otherwise end.
250 IF A$="YES" THEN 20 ELSE END
```

```
00100 * Use EDTASM or EDTASMOV to enter this program.  Save
00110 *         the program on disk with WD command and
00120 *         assemble the program with AD command.  Do not
00130 *         use the SR switch because this program is
00140 *         called from BASIC, not executed from DOS.
00150 *
00160 * Use the LOADM command to load the assembled code
00170 *         into memory before you load the BASIC program.
00180 *         The ORG statement tells BASIC where in memory
00190 *         to load the program.
00200 *
00210         ORG     $3F00
00220 *
00230 * Put the hex code for a red checkerboard in
00240 *         register A and the address of the first byte
00250 *         of video memory (400) in register X.
00260 *
00270 START   LDA     #$0F9
00310         LDX     #$400
00320 *
00330 * Store the red checkerboard at the current video
00340 *         memory address and increment X to the next
00350 *         video memory address.
00360 *
00370 SCREEN  STA     ,X+
00380         CMPX    #$600       Is it the end of video memory?
00390         BNE     SCREEN      If no, continue to store red
00400 *                           checkerboards
00410         RTS                 If yes, exit subprogram and
00420 *                           and return to BASIC
00430 DONE    EQU     *
00440         END     START
```

SECTION VI

PROGRAM LISTING

SECTION VI

PROGRAM LISTING

This section provides a complete source listing of the DOS program.

```
PAGE  003  DOC      .SA:0

00630 00112
00640 00113
00650 00114
00660 00115
00670 00116
00680 00117
00690 00118
00700 00119
00710 00120
00720 00121
00730 00122
00740 00123
00750 00124
00760 00125                        *****************************************
00770 00126                        * I N S T R U C T I O N S   F O R   U S E
00780 00127                        *****************************************
00790 00128                        *
00800 00129                        *
00810 00130                        ***************************************************************************
00820 00131                        * ERROR NUMBERS AND THEIR MEANING
00830 00132                        * (THE EQUATES ARE USED SO THAT ERRORS CAN BE RESEARCHED USING XREF LIST)
00840 00133                        * DEFINITIONS START WITH BASIC LINE NUMBER 256 IN DOS
00850 00134                        ***************************************************************************
00860 00135          0000    A ERR0    EQU    0        256 NO ERRORS
00870 00136          0001    A ERR1    EQU    1        257 I/O ERROR - DRIVE NOT READY
00880 00137          0002    A ERR2    EQU    2        258 I/O ERROR - WRITE PROTECTED
00890 00138          0003    A ERR3    EQU    3        259 I/O ERROR - WRITE FAULT
00900 00139          0004    A ERR4    EQU    4        260 I/O ERROR - SEEK ERROR OR RECORD NOT FOUND
00910 00140          0005    A ERR5    EQU    5        261 I/O ERROR - CRC ERROR
00920 00141          0006    A ERR6    EQU    6        262 I/O ERROR - LOST DATA
00930 00142          0007    A ERR7    EQU    7        263 I/O ERROR - UNDEFINED BIT 1
00940 00143          0008    A ERR8    EQU    8        264 I/O ERROR - UNDEFINED BIT 0
00950 00144          0009    A ERR9    EQU    9        265 REGISTER ARGUMENT INVALID
00960 00145          000A    A ERR10   EQU    10       266 FILE'S DIRECTORY ENTRY NOT FOUND
00970 00146          000B    A ERR11   EQU    11       267 DIRECTORY IS FULL
00980 00147          000C    A ERR12   EQU    12       268 FILE WAS CREATED BY "OPEN" FUNCTION
00990 00148          000D    A ERR13   EQU    13       269 FILE NOT CLOSED AFTER CHANGES
01000 00149          000E    A ERR14   EQU    14       270 ATTEMPTING TO ACCESS AN UNOPENED FILE
01010 00150          000F    A ERR15   EQU    15       271 ATTEMPT TO READ - READ PROTECTED
01020 00151          0010    A ERR16   EQU    16       272 RBA OVERFLOW (EXCEEDS 3 BYTES - 16,777,216)
01030 00152          0011    A ERR17   EQU    17       273 ACCESS BEYOND EOF - EXTENSION NOT ALLOWED
01040 00153          0012    A ERR18   EQU    18       274 FAT REWRITE ERROR
01050 00154          0013    A ERR19   EQU    19       275 ATTEMPT TO CLOSE UNOPENED FILE
01060 00155          0014    A ERR20   EQU    20       276 CAN'T ACCESS RANDOMLY - REC SIZE IS ZERO!
01070 00156          0015    A ERR21   EQU    21       277 ATTEMPT TO WRITE - WRITE PROTECTED
01080 00157          0016    A ERR22   EQU    22       278 CAN'T EXTEND FILE - DISK CAPACITY EXCEEDED
01090 00158          0017    A ERR23   EQU    23       279 ERROR WHILE LOADING OVERLAY - FUNCTION NOT PERFORMED
01100 00159          0018    A ERR24   EQU    24       280 INSUFFICIENT PRINT SPACE ALLOCATED
01110 00160          0019    A ERR25   EQU    25       281 I/O ERROR DURING BASIC LINE READ
01120 00161          001A    A ERR26   EQU    26       282 PROGRAM'S LOAD ADDRESS IS TOO LOW
01130 00162          001B    A ERR27   EQU    27       283 FIRST BYTE OF PROGRAM FILE NOT EQUAL TO ZERO
01140 00163          001C    A ERR28   EQU    28       284 SPACE FOR BUFFERED KBD NOT BIG ENOUGH
01150 00164          001D    A ERR29   EQU    29       285 NOT ENOUGH MEMORY
01160 00165          001E    A ERR30   EQU    30       286 OUTPUT FILE ALREADY EXISTS
01170 00166          001F    A ERR31   EQU    31       287 WRONG DISKETTE
01180 00167                        *
01190 00168                        ***************************************************************************
01200 00169                        * DISK DATA CONTROL BLOCK (DCB) FORMAT
```

```
PAGE  004  DOC      .SA:0         DOS - INSTRUCTIONS

01210 00170                       ************************************************************************
01220 00171                       *
01230 00172                       * BYTES CONTENTS
01240 00173                       * ----- --------
01250 00174                       * THESE ITEMS ARE A COPY OF DISK DIRECTORY ENTRY
01260 00175                       * 0-7   FILENAME
01270 00176                       * 8-10  FILE EXTENSION
01280 00177                       * 11    FILE TYPE
01290 00178                       *       (0=BASIC PGM,1=BASIC DATA,2=MACHINE LANG. PGM,3=TEXT ED. SOURCE)
01300 00179                       * 12    ASCII FLAG (0=BINARY, FF = ASCII FILE)
01310 00180                       * 13    NUMBER OF FIRST CLUSTER IN FILE
01320 00181                       * 14-15 NUMBER OF BYTES IN USE IN LAST SECTOR OF FILE
01330 00182                       * THESE ITEMS WERE ADDED, USING LAST 16 BYTES OF DIRECTORY ENTRY
01340 00183                       * 16    CURRENT FILE STATUS
01350 00184                       *       BIT 0 ON ALLOWS READS
01360 00185                       *       BIT 1 ON ALLOWS WRITES
01370 00186                       *       BIT 2 ON ALLOWS FILE CREATE IF NON-EXISTANT
01380 00187                       *       BIT 3 ON ALLOWS FILE EXTENSION BEYOND EOF ON ACCESS ATTEMPTS
01390 00188                       *       BIT 4 ON MEANS WORK FILE - DELETE FILE WHEN CLOSED
01400 00189                       *       BIT 5 ON PREVENTS REWRITE OF FAT EVERY TIME A SECTOR IS ADDED TO
01410 00190                       *               THE FILE. (MINOR POWER FAILURE INCONSISTANCY COULD RESULT)
01420 00191                       *       BIT 6 ON MEANS I/O BUFFER IS SHARED. EACH LOGICAL I/O REQUIRES
01430 00192                       *               A PHYSICAL I/O
01440 00193                       *       BIT 7 RESERVED FOR FUTURE OPTION(LIKE RELEASE SPACE WHEN FILE SHORTENED)
01450 00194                       *       (ALL BITS OFF = FILE CLOSED)
01460 00195                       * 17-18 LOGICAL RECORD SIZE (AS OF LAST TIME FILE WAS CLOSED)
01470 00196                       *       ZERO MEANS VARIABLE LENGTH WITH RECORDS TERMINATED BY THE
01480 00197                       *            DELIMITER STORED BELOW.
01490 00198                       *       $FFFF MEANS VARIABLE LENGTH WITH FIRST TWO BYTES OF RECORD
01500 00199                       *            CONTAINING SIZE OF THE REST OF THE RECORD.
01510 00200                       *       ALL OTHER VALUES MEAN FIXED LENGTH OF SPECIFIED SIZE.
01520 00201                       * 19    VARIABLE LENGTH RECORD TERMINATOR
01530 00202                       * 20-31 AT PRESENT, UNUSED PART OF DIRECTORY ENTRY - USE WITH CAUTION.
01540 00203                       *
01550 00204                       * THESE ITEMS ARE USED FOR PHYSICAL I/O PARAMETERS
01560 00205                       * 32    LAST I/O OPCD
01570 00206                       * 33    LAST I/O DRIVE
01580 00207                       * 34    LAST I/O TRACK
01590 00208                       * 35    LAST I/O SECTOR
01600 00209                       * 36-37 LAST I/O BUFFER POINTER
01610 00210                       * 38    LAST I/O RESULT CODE
01620 00211                       *
01630 00212                       * THESE ITEMS ARE FOR LOGICAL USE
01640 00213                       * 39-40 LOGICAL RECORD BUFFER (CAN BE SAME AS DCBBUF IF DCBRSZ=256)
01650 00214                       * 41-42 LAST I/O PHYSICAL RECORD NUMBER (BEFORE XLATE INTO SECTOR WITHIN
01660 00215                       *       GRANULE).  THIS IS THE RECORD CURRENTLY IN THE BUFFER.
01670 00216                       * 43-45 CURRENT RELATIVE BYTE ADDRESS (RBA) OF FILE DATA POINTER
01680 00217                       * 46-47 CURRENT LOGICAL RECORD NUMBER
01690 00218                       * 48    MODIFIED DATA TAG - SET NON-ZERO WHEN BUFFER CONTENTS CHANGED
01700 00219                       *
01710 00220                       * EQUATES FOLLOW FOR MEANINGFUL SOURCE CODE WHEN ACCESSING DCB
01720 00221                       * IE: STD DCBLRN,U SAVE NEW LOGICAL RECORD NUMBER
01730 00222                       *     (BETTER THAN STD 46,U )
01740 00223             0000    A DCBFNM EQU    0        FILE NAME
01750 00224             0008    A DCBFEX EQU    8        FILE NAME EXTENSION
01760 00225             000B    A DCBFTY EQU    11       FILE TYPE
01770 00226             000C    A DCBASC EQU    12       ASCII CODE
01780 00227             000D    A DCBFCL EQU    13       FIRST CLUSTER NUMBER
```

```
PAGE  005  DOC      .SA:0          DOS - INSTRUCTIONS

01790 00228              000E    A DCBNLS EQU     14        NUMBER OF BYTES USED IN LAST SECTOR
01800 00229              0010    A DCBCFS EQU     16        CURRENT FILE STATUS
01810 00230              0011    A DCBRSZ EQU     17        RECORD SIZE
01820 00231              0013    A DCBTRM EQU     19        VAR LEN RECORD TERMINATOR
01830 00232              0014    A DCBMRB EQU     20        MAX RBA
01840 00233              0017    A DCBUSR EQU     23        USER AREA
01850 00234              0020    A DCBOPC EQU     32        OPERATION CODE
01860 00235              0021    A DCBDRV EQU     33        DRIVE
01870 00236              0022    A DCBTRK EQU     34        TRACK
01880 00237              0023    A DCBSEC EQU     35        SECTOR
01890 00238              0024    A DCBBUF EQU     36        I/O BUFFER ADDRESS
01900 00239              0026    A DCBOK  EQU     38        I/O RESULT CODE
01910 00240              0027    A DCBLRB EQU     39        LOGICAL RECORD BUFFER ADDRESS
01920 00241              0029    A DCBPRN EQU     41        PHYSICAL RECORD NUMBER IN BUFFER
01930 00242              002B    A DCBRBA EQU     43        CURRENT RELATIVE BYTE ADDRESS
01940 00243              002E    A DCBLRN EQU     46        CURRENT LOGICAL RECORD NUMBER
01950 00244              0030    A DCBMDT EQU     48        MODIFIED DATA TAG
01960 00245              0031    A DCBSZ  EQU     DCBMDT+1 SIZE OF DCB (CURRENTLY 50 BYTES)
01970 00246                        *
01980 00247                        ****************************************************
01990 00248                        * EQUATES TO SUPPORT ROUTINES IN ROM OPERATING SYSTEM
02000 00249                        ****************************************************
02010 00250              A000    A POLCAT EQU     $A000
02020 00251              0152    A ROLTAB EQU     $152      KBD ROLLOVER TABLE
02030 00252              A00A    A JOYIN  EQU     $A00A
02040 00253              A006    A BLKIN  EQU     $A006
02050 00254              A004    A CSRDON EQU     $A004
02060 00255              A00C    A WRTLDR EQU     $A00C
02070 00256              A008    A BLKOUT EQU     $A008
02080 00257              007C    A BLKTYP EQU     $7C
02090 00258              007D    A BLKLEN EQU     $7D
02100 00259              007E    A CBUFAD EQU     $7E
02110 00260              010C    A IRQ    EQU     $10C
02120 00261              015A    A POTS   EQU     $15A      JOYSTICK POT VALUES
02130 00262              011A    A ALPHLK EQU     $11A      KBD RTN'S ALPHA LOCK SWITCH
02140 00263                        *
02150 00264                        *****************************
02160 00265                        * EQUATES TO XREF USE OF PIA'S
02170 00266                        *****************************
02180 00267              FF21    A U4ACR  EQU     $FF21     CONTROL REG
02190 00268              FF20    A U4ADR  EQU     $FF20     DATA REG
02200 00269              FF20    A U4ADD  EQU     $FF20     DATA DIRECTION REG
02210 00270              FF23    A U4BCR  EQU     $FF23
02220 00271              FF22    A U4BDR  EQU     $FF22
02230 00272              FF22    A U4BDD  EQU     $FF22
02240 00273              FF01    A U8ACR  EQU     $FF01
02250 00274              FF00    A U8ADR  EQU     $FF00
02260 00275              FF00    A U8ADD  EQU     $FF00
02270 00276              FF03    A U8BCR  EQU     $FF03
02280 00277              FF02    A U8BDR  EQU     $FF02
02290 00278              FF02    A U8BDD  EQU     $FF02
02300 00279                        *
02310 00280                        * MISC ADDITIONAL EQUATES
02320 00281              0035    A ENABLE EQU     %00110101
02330 00282              0034    A DSABLE EQU     %00110100
02340 00283                        * COLOR VALUES
02350 00284              0000    A BUFF   EQU     %00000000
02360 00285              0055    A CYAN   EQU     %01010101
```

```
PAGE  006  DOC       .SA:0          DOS - INSTRUCTIONS

02370 00286              00AA     A MGNTA  EQU    %10101010
02380 00287              00FF     A ORANGE EQU    %11111111
02390 00288              0000     A GREEN  EQU    %00000000
02400 00289              0055     A YELLOW EQU    %01010101
02410 00290              00AA     A BLUE   EQU    %10101010
02420 00291              00FF     A RED    EQU    %11111111
02430 00292                         * CODES RETURNED BY POLCAT FOR FUNCTION KEYS
02440 00293              005E     A UP     EQU    $5E        UP ARROW
02450 00294              000A     A DOWN   EQU    $0A        DOWN ARROW
02460 00295              0009     A RIGHT  EQU    $09        RIGHT ARROW
02470 00296              0008     A LEFT   EQU    $08        LEFT ARROW
02480 00297              005F     A SUP    EQU    $5F        SHIFT UP ARROW
02490 00298              005B     A SDOWN  EQU    $5B        SHIFT DOWN ARROW
02500 00299              005D     A SRIGHT EQU    $5D        SHIFT RIGHT ARROW
02510 00300              0015     A SLEFT  EQU    $15        SHIFT LEFT ARROW
02520 00301              0003     A BREAK  EQU    $03        BREAK KEY
02530 00302              000C     A CLEAR  EQU    $0C        CLEAR KEY
02540 00303              005C     A SCLEAR EQU    $5C        SHIFTED CLEAR
02550 00304              000D     A ENTER  EQU    $0D        ENTER KEY
02560 00305              0040     A AT     EQU    $40        "@" KEY
02570 00306              0013     A SAT    EQU    $13        SHIFTED "@" KEY
02580 00307                         *
02590 00308                         ************************************************************
02600 00309                         * D O S   M A C R O   A N D   L O G I C A L   E Q U A T E S
02610 00310                         ************************************************************
02620 00311                         DOS    MACR              CALL A DOS FUNCTION
      00312                         2630  LDA #\1 OPTION
      00313                         2640  JSR [\0] INDIRECT FUNCTION ADDR
      00314                         2650  ENDM
02660 00315                         *
02670 00316                         * EQUATES USED WITH DOS MACRO
02680 00317                         *
02690 00318                         * THE FOLLOWING USED WITH "OPEN"
02700 00319              0600     A OPEN   EQU    $600       OPEN FUNCTION
02710 00320              0004     A CREATE EQU    4          ALLOWS FILE CREATION ON OPEN IF NOT FOUND
02720 00321              0008     A EXTEND EQU    8          ALLOWS EXTENSION OF FILE TO POINT OF ACCESS
02730 00322              0001     A INPUT  EQU    1          USED TO SIGNIFY THAT READS ARE ALLOWED
02740 00323              0001     A IN     EQU    1          SHORTER FORM OF ABOVE
02750 00324              0002     A OUT    EQU    2          ALLOWS WRITES
02760 00325              000E     A OUTPUT EQU    CREATE+EXTEND+OUT USUAL COMBINATION FOR OUTPUT FILES
02770 00326              0010     A WORK   EQU    16         CAUSES FILE TO BE KILLED WHEN CLOSED (WORK FILE)
02780 00327              0020     A FAST   EQU    32         MINIMIZES FAT REWRITES
02790 00328              0040     A SHARE  EQU    64         USED WHEN 2 OR MORE FILES SHARE THE SAME I/O BUFFER
02800 00329                         * EXAMPLES:
02810 00330                         *  DOS OPEN INPUT    TO READ AN EXISTING FILE
02820 00331                         *  DOS OPEN OUTPUT   TO CREATE & EXTEND AN OUTPUT FILE
02830 00332                         *  DOS OPEN IN+OUT   TO UPDATE AN EXISTING FILE (NO EXTENSIONS)
02840 00333                         *  DOS OPEN INPUT+OUTPUT+WORK TO CREATE, EXTEND, READ & WRITE AND KILL
02850 00334                         *                           WHEN CLOSED (A WORK FILE)
02860 00335                         * "SHARE" CAN BE ADDED TO ANY OF THE ABOVE EXAMPLES IF 2 OR MORE FILES
02870 00336                         * WILL BE USING THE SAME I/O BUFFER AT THE SAME TIME.  THIS OPTION CAUSES
02880 00337                         * A PHYSICAL I/O TO REFRESH THE BUFFER WITH EVERY LOGICAL I/O OPERATION.
02890 00338                         * WITHOUT THIS OPTION, SEVERAL LOGICAL READS OR WRITES TO OR FROM THE
02900 00339                         * SAME PHYSICAL SECTOR CAN BE DONE WITH A SINGLE PHYSICAL I/O. "SHARE"
02910 00340                         * INCREASES THE AMOUNT OF ACTUAL I/O ACTIVITY, BUT ALLOWS USE OF MANY
02920 00341                         * FILES AT THE SAME TIME WITH MUCH LESS MEMORY REQUIREMENTS FOR BUFFERS.
02930 00342                         *
02940 00343                         * USED WITH "CLOSE" FUNCTION
```

```
PAGE  007  DOC      .SA:0         DOS - INSTRUCTIONS

02950 00344              0602    A CLOSE  EQU     $602      CLOSE A FILE OPTIONS NOT USED
02960 00345              0000    A IT     EQU     0
02970 00346                        * EXAMPLE:
02980 00347                        *  DOS CLOSE,IT     TO CLOSE A FILE
02990 00348                        *
03000 00349                        * USED WITH "READ" AND "WRITE" FUNCTIONS
03010 00350              0604    A READ   EQU     $604      READ A RECORD
03020 00351              0606    A WRITE  EQU     $606      WRITE A RECORD
03030 00352              0001    A RBA    EQU     1         TO READ USING REL BYTE ADDR
03040 00353              0000    A RECORD EQU     0
03050 00354              0000    A REC    EQU     0
03060 00355              0002    A UPDATE EQU     2         TO PREVENT ADVANCING REC NBR OR RBA AFTER A READ
03070 00356              0008    A NOW    EQU     8         1 = ENSURE I/O BUFFER IS WRITTEN TO DISK AFTER LOGICAL WRITE
03080 00357                        * EXAMPLES:
03090 00358                        *  DOS READ,RECORD          TO RANDOMLY READ BY RECORD NUMBER
03100 00359                        *                        (FIXED LENGTH RECS ONLY)
03110 00360                        *                        (USE THIS FOR NORMAL SEQUENTIAL READ OF FIXED LENGTH)
03120 00361                        *  DOS READ,RBA          TO READ THE RECORD POINTED AT BY RBA
03130 00362                        *                        (REQUIRED IF USING VARIABLE LENGTH RECORDS)
03140 00363                        *  DOS READ,UPDATE       TO READ BY REC NBR WITHOUT ADVANCING REC NBR
03150 00364                        *  DOS READ,RBA+UPDATE TO READ THE RECORD POINTED AT BY RBA & NOT CHANGE RBA
03160 00365                        *  DOS WRITE,REC              WRITE VIA RECORD NUMBER (FIXED LENGTH ONLY)
03170 00366                        *  DOS WRITE,RBA          WRITE FIXED OR VARIABLE RECORD
03180 00367                        *  DOS WRITE,UPDATE       UNLIKELY OPTION - WRITES RECORD BUT DOES NOT CHANGE
03190 00368                        *                         RBA OR REC NUMBER. COULD BE REWRITTEN AGAIN.
03200 00369                        *  DOS WRITE,RBA+NOW     SAME AS: DOS WRITE,RBA FOLLOWED BY DOS RELSE,IT
03210 00370                        *
03220 00371              0608    A RELSE  EQU     $608      USE TO RELEASE I/O BUFFER WITHOUT CLOSING FILE
03230 00372                        * IF CONTENTS OF BUFFER HAVE BEEN CHANGED, IT IS REWRITTEN. THEN DCBPRN
03240 00373                        * IS SET TO $FFFF TO ENSURE A PHYSICAL I/O BEFORE THE NEXT LOGICAL I/O.
03250 00374                        * USE THIS FUNCTION WHEN USER IS CONTROLLING A SHARED BUFFER.
03260 00375                        * EXAMPLE:
03270 00376                        *  DOS RELSE,IT
03280 00377                        *
03290 00378                        * USED WITH OVERLAYABLE FUNCTIONS
03300 00379              060A    A DO     EQU     $60A      USE TO LOAD IF NECESSARY, THEN EXECUTE AN OVERLAY
03310 00380              060C    A GO     EQU     $60C      USE TO XFER CONTROL FROM ONE OVERLAY TO ANOTHER IN SAME AREA
03320 00381              060E    A LOAD   EQU     $60E      USE TO LOAD A SYSTEM OVERLAY - IT IS LOADED AT THE
03330 00382                        * EXAMPLE:
03340 00383                        *  DOS DO,MAP
03350 00384                        *
03360 00385                        * THE FOLLOWING USED WITH "LOAD" AND "DO" FUNCTIONS
03370 00386              0001    A INIT   EQU     1         INITIALIZATION OF DOS
03380 00387                        * EXAMPLE:
03390 00388                        *  DOS DO,INIT EXIT PROGRAM & RE-INITIALIZE DOS
03400 00389                        * NOTE: STACK AND OLYLOC SHOULD BE RESET BEFORE USING THIS OVERLAY
03410 00390                        *
03420 00391              000E    A MENU   EQU     14        DISPLAY DOS MAIN MENU
03430 00392                        * EXAMPLE:
03440 00393                        *  LDS #STACK
03450 00394                        *  LDD #OVRLAY WHERE OVERLAY AREA SHOULD START
03460 00395                        *  STD >OLYLOC
03470 00396                        *  DOS DO,MENU
03480 00397                        *
03490 00398              000A    A MAP    EQU     10        DISPLAY BASIC LINES
03500 00399                        * EXAMPLE:
03510 00400                        *  LDD #280 FIRST LINE NUMBER TO BE DISPLAYED
03520 00401                        *  LDY #283 LAST LINE TO BE DISPLAYED
```

```
PAGE  008  DOC      .SA:0          DOS - INSTRUCTIONS

                                  *  LDU <CURSOR STARTING DISPLAY ADDRESS
                                  *    (IF STARTING ADDR IS ZERO, SCREEN WILL BE CLEARED FIRST AND ROUTINE
                                  *     WILL EXIT WITH U->FIRST CHAR AFTER FIRST LEFT BRACKET ON SCREEN)
                                  *  PSHS D,Y,U (PARAMETERS ARE PASSED IN THE STACK)
                                  *  DOS DO,BASMSG
                                  *  PULS D,Y,U NORMALIZE STACK
                                  *  BNE ERROR BRANCH ON ANY FAILURE IF DESIRED
                                  *
                     0002       A RUNIP  EQU    2        KEYIN A NAME AND RUN PGM
                                  * EXAMPLE:
                                  *  DOS DO,RUNIP
                                  *
                     0005       A CPYFLE EQU    5        GET INFO FROM USER & COPY A FILE
                                  * EXAMPLE:
                                  *  DOS DO,CPYFLE (IF "GO" USED, DOS MENU FOLLOWS COPY FUNCTION)
                                  *
                     000B       A FIELDI EQU    11       INPUT A MAPPED FIELD
                                  * EXAMPLE:
                                  *  LDX DEST WHERE THE DATA GOES IN MEMORY
                                  *  LDU FLDADR POINT TO FIELD ON SCREEN
                                  *  DOS DO,FIELDI INPUTS THE FIELD
                                  *  B IS RETURNED CONTAINING LAST KEYSTROKE ENTERED
                                  *
                     000C       A EXEC   EQU    12       GIVEN USRDCB CONTENTS, LOAD ROOT & EXECUTE PROGRAM
                                  * EXAMPLE:
                                  *  (WHATEVER LOGIC TO PUT NAME IN DCB AT "USRDCB")
                                  *  DOS GO,EXEC JUMP TO LOAD & EXECUTE OVERLAY
                                  *
                     000D       A REALTM EQU    13       CLOCK DISPLAY OVERLAY (SEE SKEL FOR EXAMPLE OF USE)
                                  *
                     000F       A BUFPRT EQU    15       BUFFERED PRINT OVERLAY
                                  * EXAMPLE:
                                  *   LDU #SIZE (TOTAL MEMORY TO BE USED (ROUTINE + BUFFER)
                                  *             (ROUTINE IS ABOUT 220 BYTES)
                                  *   DOS DO,BUFPRT (SETS IT UP - OVERLAY & BUFFER PROTECTED FROM
                                  *                 BEING OVERLAYED).
                                  * FROM THIS POINT ON, CHARACTERS PRINTED BY CALLING "PRNT" WILL GO
                                  * THROUGH BUFFERED I/O.  TO WRAP UP AT EOJ, DO THIS:
                                  *   CLRA
                                  *   JSR [PRNT] REQUEST TO END BUFFERING.
                                  * THIS WILL CAUSE "PRNT" TO WAIT UNTIL THE BUFFER IS EMPTIED (PRINTER
                                  * HAS CAUGHT UP), AND THEN OVERLAY AND BUFFER AREA ARE RELEASED.
                                  *
                     0011       A COPY   EQU    17       COPY A FILE
                                  * GIVEN:
                                  *  U->SOURCE FILE DCB (NOT OPENED)
                                  *  Y->DEST FILE DCB (NOT OPENED)
                                  *  B (BIT 0) - OFF IF NO DISKETTE SWAPPING, ON FOR DISKETTE SWAPPING
                                  * RETURNED A=ERROR NUMBER
                                  *
                                  * SIMILAR FUNCTIONS FOR USING USER OVERLAYS
                     0610       A DOUSR  EQU    $610     LOAD IF NECESSARY & EXECUTE USER OVERLAY
                     0612       A GOUSR  EQU    $612     JUMP TO A DIFFERENT OVERLAY
                     0614       A LODUSR EQU    $614     LOAD USER OVERLAY
                                  * USER SHOULD PROVIDE EQUATES FOR HIS OVERLAYS HERE
                                  *
                     0616       A ERROR  EQU    $616     JSR HERE FOR DISPLAY OF ERR MSG
                                  *
```

```
PAGE  009  DOC      .SA:0          DOS - INSTRUCTIONS

04110 00460              0618    A TIME    EQU     $618      TURN ON/OFF TIME ROUTINE
04120 00461              0001    A ON      EQU     1
04130 00462              0000    A OFF     EQU     0
04140 00463                        * EXAMPLE:
04150 00464                        *  LDU #TMERTN LOAD ADDR OF ROUTINE
04160 00465                        *  DOS TIME,ON GO ACTIVATE THIS ROUTINE
04170 00466                        *
04180 00467              061A    A PRNT    EQU     $61A      PRINT A CHARACTER ON PRINTER
04190 00468                        * THIS IS CHANGED BY CALLING BUFFERED PRINTER OVERLAY TO POINT
04200 00469                        * AT BUFFERED IO ROUTINE
04210 00470                        *
04220 00471              061C    A KEYIN   EQU     $61C      POLL KEYBOARD FOR INPUT CHARACTER
04230 00472                        * THIS IS CHANGED BY CALLING BUFFERED KEYBOARD OVERLAY TO POINT
04240 00473                        * AT BUFFERED IO ROUTINE
04250 00474                        *
04260 00475              061E    A BASIC   EQU     $61E      JMP HERE TO RETURN TO BASIC
04270 00476                        *
04280 00477                        *****************************************************
04290 00478                        * O T H E R   U S E F U L   M A C R O S   F O L L O W
04300 00479                        *****************************************************
04310 00480                        ENABLI MACR               ENABLE INTERUPTS
      00481                        4320  ANDCC #%11101111
      00482                        4330  ENDM
04340 00483                        *
04350 00484                        DSABLI MACR               DISABLE INTERUPTS
      00485                        4360  ORCC #%01010000
      00486                        4370  ENDM
04380 00487                        *
04390 00488                        NEGD   MACR               NEGATE D
      00489                        4400  COMA
      00490                        4410  COMB
      00491                        4420  ADDD #1
      00492                        4430  ENDM
04440 00493                        *
04450 00494                        LSRD   MACR               LOGICAL SHIFT RIGHT D
      00495                        4460  LSRA
      00496                        4470  RORB
      00497                        4480  ENDM
04490 00498                        *
04500 00499                        LSLD   MACR               LOGICAL SHIFT LEFT D
      00500                        4510  LSLB
      00501                        4520  ROLA
      00502                        4530  ENDM
04540 00503                        *
04550 00504                        CLRD   MACR               CLEAR D
      00505                        4560  CLRA
      00506                        4570  CLRB
      00507                        4580  ENDM
04590 00508                        *
04600 00509                        INCD   MACR               ADD 1 TO D
      00510                        4610  ADDD #1
      00511                        4620  ENDM
04630 00512                        *
04640 00513                        *****************************************************************
04650 00514                        * S Y S T E M   R A M   -   D O S
04660 00515                        *****************************************************************
04670 00516                        * ADDITIONAL WS USING EXTENDED ADDRESSING
04680 00517A 015E                         ORG     $15E
```

```
PAGE  010  DOC      .SA:0          DOS - INSTRUCTIONS

04690 00518A 0600                      ORG     $600
04700 00519                          * AREA WHERE USER ACCESSABLE VECTORS & VARIABLES STORED
04710 00520A 0600       0020       A VECTOR RMB    2*16      2 BYTES PER VECTOR
04720 00521                          * OPEN   OPEN A DISK FILE
04730 00522                          * CLOSE  CLOSE A DISK FILE
04740 00523                          * READ   READ FROM A DISK FILE
04750 00524                          * WRITE  WRITE TO A DISK FILE
04760 00525                          * RELSE  RELEASE I/O BUFFER (ALLOW USE FOR ANOTHER FILE)
04770 00526                          * DO     LOAD & EXECUTE A SYSTEM OVERLAY
04780 00527                          * GO     LOAD ON TOP OF CURRENT OVERLAY & JUMP TO SYSTEM OVERLAY
04790 00528                          * LOAD   LOAD SYSTEM OVERLAY
04800 00529                          * DOUSR  LOAD & EXECUTE USER OVERLAY
04810 00530                          * GOUSR  LOAD ON TOP OF CURRENT OVERLAY & JUMP TO USER OVERLAY
04820 00531                          * LODUSR LOAD USER OVERLAY
04830 00532                          * ERROR  DISPLAY ERROR NUMBER IN "A"
04840 00533                          * TIME   TURN ON/OFF TIME INTERVAL ROUTINE
04850 00534                          * PRNT   PRINT A CHARACTER ON PRINTER
04860 00535                          * KEYIN  INPUT NEXT KEYSTROKE FROM KEYBOARD
04870 00536                          * BASIC  RETURN TO BASIC CONTROL
04880 00537A 0620       0002       A CLOCK  RMB    2         COUNT OF 60THS OF A SECOND
04890 00538A 0622       0001       A RETRYS RMB    1         NUMBER OF I/O RETRYS INITIALLY SET TO 5
04900 00539A 0623       0002       A RATE   RMB    2         TIME CONSTANT THAT CONTROLS PRINTER TRANSMISSION SPEED
04910 00540A 0625       0002       A OLYLOC RMB    2         ADDRESS WHERE CURRENT OVERLAY WAS LOADED
04920 00541A 0627       0002       A USRBSE RMB    2         BASE OF USER'S ROOT + 1.  POINTS TO ENTRY ZERO OF OVERLAY'S RBA'
04930 00542A 0629       0002       A HOOK1  RMB    2         JUST BEFORE CHECKING FOR AUTO EXECUTE
04940 00543A 062B       0002       A HOOK2  RMB    2         JUST BEFORE BRANCHING TO USER PROGRAM
04950 00544A 062D       0002       A HOOK3  RMB    2
04960 00545A 062F       0002       A HOOK4  RMB    2
04970 00546A 0631       0002       A HOOK5  RMB    2
04980 00547A 0633       0002       A RETURN RMB    2         CONTAINS TWO RTS CODES - ALL HOOKS RETURN THRU HERE
04990 00548A 0635       0031       A DOSDCB RMB    DCBSZ     DCB USED TO READ SYSTEM OVERLAYS
05000 00549A 0666       0031       A MSGDCB RMB    DCBSZ     DCB USED TO READ "MAPS" AND MESSAGES
05010 00550A 0697       0031       A USRDCB RMB    DCBSZ     DCB USED TO READ USER'S PROGRAM & OVERLAYS
05020 00551A 06C8       0100       A SYSBUF RMB    256       BUFFER FOR SYSTEM USE(DIRECTORY + FAT READS & WRITES)
05030 00552             0045       A FATSZ  EQU    69        FILE ALLOCATION TABLE (FAT) SIZE
05040 00553A 07C8       0045       A FAT0   RMB    FATSZ     SAVE AREA FOR DRIVE 0 FAT TABLE
05050 00554A 080D       0045       A FAT1   RMB    FATSZ     SAME FOR DRIVE 1
05060 00555A 0852       0045       A FAT2   RMB    FATSZ
05070 00556A 0897       0045       A FAT3   RMB    FATSZ
05080 00557             07C8       A FATS   EQU    FAT0
05090 00558A 08DC       0002       A MAXMEM RMB    2         ADDR OF HIGHEST USEABLE MEMORY
05100 00559A 08DE       0001       A DRIVES RMB    1         MAX NBR OF DRIVES TO SEARCH ON GLOBAL OPEN
05110 00560                            OPT     L
05120 00561A 08DF       0001       A ENDWSE RMB    1         END OF EXTENDED WS
05130 00562                            OPT     NOL
05140 00563                          *********************************************************************
05150 00564                          *   D  O  S     S  T  A  R  T  S    H  E  R  E
05160 00565                          *********************************************************************
05170 00566A 0989                      ORG     ORGIN     SEE 1ST MODULE FOR VALUE ASSIGNED
00010 00567                            OPT     L
00020 00568                            TTL     DOS - I/O ROUTINES
00030 00569                            OPT     NOL
00040 00570                          **********************************************************************
00050 00571                          *        O P E N   D I S K   F I L E
00060 00572                          *
00070 00573                          * GIVEN:
00080 00574                          * A=DESIRED FILE STATUS
00090 00575                          * U->DCB
```

```
PAGE  011  IO       .SA:0          DOS - I/O ROUTINES

00100 00576                        * DCBDRV,U = DRIVE TO BE CHECKED ($FF=CHECK ALL DRIVES)
00110 00577                        *
00120 00578                        * BEFORE CALLING "OPEN", DCB SHOULD CONTAIN: FILENAME, EXTENSION,
00130 00579                        * I/O BUFFER ADDRESS. NAME AND EXTENSION ONLY ARE COMPARED
00140 00580                        * TO DIRECTORY ENTRIES TO FIND MATCH.  TYPE AND ASCII FLAG ARE USED ONLY
00150 00581                        * WHEN CREATING FILE (OTHERWISE THEY ARE OVERLAYED BY EXISTING VALUES).
00160 00582                        * ALL I/O NEEDED TO OPEN FILE USES THE 256 BYTE AREA POINTED TO BY
00170 00583                        * LAST I/O ADDRESS AS A BUFFER.
00180 00584                        *
00190 00585                        * OPEN WORKS EXACTLY THE SAME FOR INPUT OR OUTPUT! ACTION IS CONTROLLED
00200 00586                        * BY FILE STATUS SUPPLIED IN "A" (SEE DCBCFS IN DCB DESCRIPTION).
00210 00587                        *
00220 00588                        * OPENING A NON-EXISTANT FILE - IF CREATION IS ALLOWED, FIRST 32 BYTES OF
00230 00589                        * DCB ARE PLACED IN DIRECTORY EXCEPT THAT DCBFCL IS SET TO $FF, DCBNLS
00240 00590                        * IS SET TO ZERO AND DCBCFS IS SET TO PROVIDED STATUS.
00250 00591                        *
00260 00592                        * OPENING AN EXISTING FILE - THE 32 BYTE DIRECTORY ENTRY OVERLAYS THE
00270 00593                        * FIRST 32 BYTES OF THE DCB EXCEPT FOR DCBCFS WHICH IS SET TO THE PROVIDED
00280 00594                        * VALUE.
00290 00595                        *
00300 00596                        * WHEN FILE IS OPENED, DCBPRN IS SET TO $FFFF (AN INVALID VALUE), DCBRBA
00310 00597                        * IS SET TO ZERO, AND DCBLRN IS SET TO ZERO. AT ANYTIME BEFORE OR AFTER
00320 00598                        * CALLING OPEN, DCBLRB CAN BE SET OR CHANGED.
00330 00599                        *
00340 00600                        * FILE TYPE AND ASCII FLAG CAN BE CHANGED AFTER OPEN TO CAUSE THEM TO BE
00350 00601                        * CHANGED WHEN FILE IS CLOSED.
00360 00602                        *
00370 00603                        *********************************************************************
00380 00604A 0989 E6   C8 21     A DOPEN  LDB    DCBDRV,U
00390 00605A 098C 34   16        A        PSHS   D,X
00400 00606A 098E C1   FF        A        CMPB   #$FF      REQUEST FOR SCAN OF ALL DRIVES
00410 00607A 0990 27   0A    099C         BEQ    DO0       IF YES
00420 00608A 0992 C1   04        A        CMPB   #4        VALID DRIVE REQUESTED?
00430 00609A 0994 25   07    099D         BCS    DO1       IF YES
00440 00610A 0996 86   09        A        LDA    #ERR9     PARAMETER ERROR
00450 00611A 0998 A7   E4        A DOERR  STA    ,S
00460 00612A 099A 35   96        A        PULS   D,X,PC    RETURN WITH ERROR CONDITION
00470 00613A 099C 5F               DO0    CLRB             START WITH DRIVE ZERO
00480 00614A 099D E7   C8 21     A DO1    STB    DCBDRV,U
00490 00615A 09A0 4F                      CLRA             SAY LOOK FOR MATCH
00500 00616A 09A1 17   02D2 0C76          LBSR   CHKDIR    CHECK DIRECTORY ON THIS DRIVE FOR MATCH
00510 00617A 09A4 27   50    09F6         BEQ    DO5       IF MATCH FOUND
00520 00618A 09A6 2B   08    09B0         BMI    DO3       IF NO I/O ERRORS - JUST DIDNT FIND IT
00530 00619                        * IT WAS SOME KIND OF I/O ERROR
00540 00620A 09A8 81   01        A        CMPA   #1        DRIVE NOT READY?
00550 00621A 09AA 26   EC    0998         BNE    DOERR     IF NO
00560 00622A 09AC 6D   61        A        TST    1,S       REQUEST FOR SPECIFIC DRIVE?
00570 00623A 09AE 2A   E8    0998         BPL    DOERR     IF YES, THEN THIS IS AN ERROR
00580 00624A 09B0 6D   61        A DO3    TST    1,S       REQUEST FOR SPECIFIC DRIVE?
00590 00625A 09B2 2A   09    09BD         BPL    DO4       IF YES, I DIDNT FIND HIS FILE
00600 00626A 09B4 E6   C8 21     A        LDB    DCBDRV,U  LAST DRIVE CHECKED
00610 00627A 09B7 5C                      INCB
00620 00628A 09B8 F1   08DE      A        CMPB   DRIVES    ANOTHER VALID DRIVE TO CHECK?
00630 00629A 09BB 25   E0    099D         BCS    DO1       IF YES
00640 00630                        * MATCH NOT FOUND - IS IT OK TO CREATE?
00650 00631A 09BD A6   E4        A DO4    LDA    ,S        (DESIRED STATUS)
00660 00632A 09BF 85   04        A        BITA   #CREATE   CREATE BIT ON?
00670 00633A 09C1 26   04    09C7         BNE    DO4A      IF YES
```

```
PAGE  012  IO       .SA:0          DOS - I/O ROUTINES

00634A 09C3 86    0A        A         LDA     #ERR10   FILE DIRECTORY ENTRY NOT FOUND
00635A 09C5 20    D1     0998         BRA     DOERR
00636A 09C7 6D    61        A DO4A    TST     1,S      ANY DRIVE SPECIFIED?
00637A 09C9 2A    03     09CE         BPL     DO4B     IF SPECIFIC
00638A 09CB 6F    C8 21     A         CLR     DCBDRV,U CREATE ON DRIVE ZERO
00639A 09CE 86    FF        A DO4B    LDA     #$FF     SAY LOOK FOR OPEN SLOT
00640A 09D0 17    02A3 0C76           LBSR    CHKDIR   SCAN THE DIRECTORY
00641A 09D3 27    06     09DB         BEQ     DO4C     IF SLOT FOUND
00642A 09D5 2A    C1     0998         BPL     DOERR    IF SOME KIND OF I/O ERROR
00643A 09D7 86    0B        A         LDA     #ERR11   DIRECTORY IS FULL
00644A 09D9 20    BD     0998 DOERRL  BRA     DOERR
00645A 09DB A6    E4        A DO4C    LDA     ,S       DESIRED STATUS
00646A 09DD A7    61        A         STA     1,S      SAVE IT
00647A 09DF 86    0C        A         LDA     #ERR12   SAY DIRECTORY WAS CREATED
00648A 09E1 A7    E4        A         STA     ,S
00649A 09E3 86    FF        A         LDA     #$FF
00650A 09E5 A7    4D        A         STA     DCBFCL,U SET NUMBER OF 1ST CLUSTER
00651A 09E7                           CLRD
00652A 09E9 ED    4E        A         STD     DCBNLS,U CLEAR BYTES IN LAST SECTOR
00653A 09EB ED    C8 14     A         STD     DCBMRB,U CLEAR MAX RBA
00654A 09EE A7    C8 16     A         STA     DCBMRB+2,U
00655A 09F1 17    0263 0C57           LBSR    DCBDIR   XFER DATA TO DIRECTORY
00656A 09F4 20    18     0A0E         BRA     DO6      GO CONTINUE PROCESSING
00657                         * DIRECTORY ENTRY FOUND
00658A 09F6 A6    E4        A DO5     LDA     ,S       DESIRED STATUS
00659A 09F8 A7    61        A         STA     1,S      SAVE IT
00660A 09FA 6F    E4        A         CLR     ,S
00661A 09FC A6    88 10     A         LDA     DCBCFS,X CHK PREVIOUS FILE STATUS
00662A 09FF 27    0D     0A0E         BEQ     DO6      IF IT WAS CLOSED
00663A 0A01 84    0E        A         ANDA    #CREATE+EXTEND+OUT IF LAST OPENED TO MODIFICATION?
00664A 0A03 27    09     0A0E         BEQ     DO6      IF NO
00665A 0A05 6D    88 10     A         TST     DCBCFS,X CHK PREVIOUS FILE STATUS
00666A 0A08 27    04     0A0E         BEQ     DO6      IF IT WAS CLOSED
00667A 0A0A 86    0D        A         LDA     #ERR13   SAY IT WASNT PREVIOUSLY CLOSED
00668A 0A0C A7    E4        A         STA     ,S
00669                         * XFER DIRECTORY ENTRY TO DCB
00670A 0A0E A6    61        A DO6     LDA     1,S      DESIRED STATUS
00671A 0A10 A7    88 10     A         STA     DCBCFS,X PUT IN DIRECTORY ENTRY
00672A 0A13 17    0249 0C5F           LBSR    DIRDCB   XFER DIRECTORY ENTRY TO DCB
00673A 0A16 A6    C8 10     A         LDA     DCBCFS,U
00674A 0A19 84    0E        A         ANDA    #CREATE+EXTEND+OUT WRITES ALLOWED?
00675A 0A1B 27    05     0A22         BEQ     DO6A     IF NO
00676A 0A1D 17    031F 0D3F           LBSR    SYSWRT   REWRITE DIRECTORY RECORD
00677A 0A20 26    B7     09D9         BNE     DOERRL   IF I/O ERROR
00678A 0A22 86    02        A DO6A    LDA     #2
00679A 0A24 A7    C8 23     A         STA     DCBSEC,U
00680A 0A27 17    02FD 0D27           LBSR    SYSRED   READ FAT RECORD
00681A 0A2A 26    AD     09D9         BNE     DOERRL
00682A 0A2C 17    021C 0C4B           LBSR    ADRFAT   POINT "X" AT FAT TABLE IN MEMORY
00683A 0A2F 34    40        A         PSHS    U
00684A 0A31 CE    06C8      A         LDU     #SYSBUF  POINT TO BUFFER
00685A 0A34 C6    45        A         LDB     #69      BYTES TO MOVE
00686A 0A36 17    022E 0C67           LBSR    XFRUX    MOVE THEM
00687A 0A39 35    40        A         PULS    U
00688                         * DO OPEN RESETTING
00689A 0A3B CC    FFFF      A         LDD     #$FFFF
00690A 0A3E ED    C8 29     A         STD     DCBPRN,U
00691A 0A41                           CLRD
```

```
PAGE  013  IO      .SA:0          DOS - I/O ROUTINES

01260 00692A 0A43 ED   C8 2B   A        STD    DCBRBA,U
01270 00693A 0A46 A7   C8 2D   A        STA    DCBRBA+2,U
01280 00694A 0A49 ED   C8 2E   A        STD    DCBLRN,U
01290 00695A 0A4C 6F   C8 30   A        CLR    DCBMDT,U
01300 00696A 0A4F 16   008C 0ADE        LBRA   DC5
01310 00697                      *
01320 00698                      ************************************************************************
01330 00699                      *  C L O S E   D I S K   F I L E
01340 00700                      *
01350 00701                      * GIVEN: U -> DCB  (CONTAINING FILE STATUS)
01360 00702                      *
01370 00703                      * FUNCTION:
01380 00704                      *  FIND DIRECTORY ENTRY AND VERIFY THAT FILE IS OPEN. THEN, IF FILE IS
01390 00705                      *  TO BE KEPT, UPDATE AND RE-WRITE DIRECTORY ENTRY AND REWRITE FAT TABLE.
01400 00706                      *  IF FILE IS TO BE PURGED, MARK DIRECTORY ENTRY AS RE-USEABLE AND RE-WRITE
01410 00707                      *  THEN MARK CLUSTERS AVAILABLE IN FAT TABLE AND REWRITE.
01420 00708                      *************************************************************************
01430 00709A 0A52 4F             DCLOSE CLRA          (RESULT CODE)
01440 00710A 0A53 34   16      A        PSHS   D,X
01450 00711A 0A55 4F                    CLRA          SAY LOOK FOR A MATCH
01460 00712A 0A56 17   021D 0C76        LBSR   CHKDIR   CHECK DIRECTORY FOR A MATCH
01470 00713A 0A59 27   07   0A62        BEQ    DC1      IF MATCH FOUND
01480 00714A 0A5B 2A   02   0A5F        BPL    DCERR    IF I/O ERR
01490 00715A 0A5D 86   0A      A        LDA    #ERR10   DIRECTORY ENTRY NOT FOUND
01500 00716A 0A5F 16   FF36 0998 DCERR  LBRA   DOERR
01510 00717A 0A62 A6   C8 10   A DC1    LDA    DCBCFS,U IS FILE OPEN?
01520 00718A 0A65 26   04   0A6B        BNE    DC2
01530 00719A 0A67 86   13      A        LDA    #ERR19   CLOSING UNOPENED FILE
01540 00720A 0A69 20   F4   0A5F        BRA    DCERR
01550 00721A 0A6B EC   C8 22   A DC2    LDD    DCBTRK,U
01560 00722A 0A6E 34   06      A        PSHS   D        SAVE LOC OF DIR ENT
01570 00723A 0A70 17   02D0 0D43        LBSR   REWRTE   REWRITE BUFFER IF IT HAD BEEN MODIFIED
01580 00724A 0A73 35   06      A        PULS   D
01590 00725A 0A75 26   E8   0A5F        BNE    DCERR    IF I/O ERROR OCCURRED IN THE PROCESS
01600 00726A 0A77 ED   C8 22   A        STD    DCBTRK,U RESTORE LOC OF DIR ENT
01610 00727A 0A7A A6   C8 10   A        LDA    DCBCFS,U
01620 00728A 0A7D 34   02      A        PSHS   A        SAVE FOR DIRECTORY RE-WRITE DECISION
01630 00729A 0A7F 6F   C8 10   A        CLR    DCBCFS,U CLEAR CUR FILE STATUS IN DCB
01640 00730A 0A82 84   10      A        ANDA   #WORK    WORK FILE TO BE DELETED?
01650 00731A 0A84 27   18   0A9E        BEQ    DC4      IF NO GO REWRITE DIRECTORY & FAT TABLE
01660 00732A 0A86 6F   C4      A        CLR    ,U       MARK DIRECTORY ENTRY AS RE-USEABLE
01670 00733A 0A88 34   10      A        PSHS   X        SAVE ADDR OF DIRECTORY ENTRY
01680 00734                      * MARK FAT TABLE ENTRIES AS AVAILABLE
01690 00735A 0A8A 17   01BE 0C4B        LBSR   ADRFAT   POINT "X" AT FAT TABLE IN MEM
01700 00736A 0A8D A6   4D      A        LDA    DCBFCL,U GET FIRST CLUSTER NUMBER
01710 00737A 0A8F 2B   0B   0A9C        BMI    DC3A     IF NO CLUSTERS IN USE
01720 00738A 0A91 E6   86      A DC3    LDB    A,X      GET NUMBER OF NEXT CLUSTER
01730 00739A 0A93 6F   86      A        CLR    A,X      CLEAR CLUSTER ENTRY
01740 00740A 0A95 6A   86      A        DEC    A,X      SET TO $FF
01750 00741A 0A97 1F   98      A        TFR    B,A
01760 00742A 0A99 4D                    TSTA
01770 00743A 0A9A 2A   F5   0A91        BPL    DC3      IF MORE TO GO
01780 00744A 0A9C 35   10      A DC3A   PULS   X        ADDR OF DIR ENTRY
01790 00745A 0A9E 17   01B6 0C57 DC4    LBSR   DCBDIR   XFER TO DIRECTORY
01800 00746A 0AA1 35   02      A        PULS   A        PRE-CLOSE CFS
01810 00747A 0AA3 84   0E      A        ANDA   #CREATE+EXTEND+OUT WRITES ALLOWED?
01820 00748A 0AA5 27   15   0ABC        BEQ    DC4B
01830 00749                      * SET DCBNLS TO REFLECT DCBMRB (MAX RBA)
```

```
PAGE  014  IO       .SA:0          DOS - I/O ROUTINES

01840 00750A 0AA7 4F                     CLRA
01850 00751A 0AA8 E6    88 16    A       LDB    DCBMRB+2,X
01860 00752A 0AAB 26    08   0AB5        BNE    DC4A
01870 00753A 0AAD EC    88 14    A       LDD    DCBMRB,X IS IT A NULL FILE
01880 00754A 0AB0 27    03   0AB5        BEQ    DC4A     IF YES
01890 00755A 0AB2 CC    0100     A       LDD    #$100
01900 00756A 0AB5 ED    0E       A DC4A  STD    DCBNLS,X
01910 00757A 0AB7 17    0285 0D3F        LBSR   SYSWRT   RE-WRITE DIRECTORY RECORD
01920 00758A 0ABA 26    A3   0A5F        BNE    DCERR    IF I/O ERROR
01930 00759A 0ABC 17    018C 0C4B DC4B   LBSR   ADRFAT
01940 00760A 0ABF 34    40       A       PSHS   U        SAVE DCB ADDR
01950 00761A 0AC1 CE    06C8     A       LDU    #SYSBUF  POINT TO SYSTEM'S BUFFER
01960 00762A 0AC4 C6    45       A       LDB    #69
01970 00763A 0AC6 17    01A6 0C6F        LBSR   XFRXU    XFER INTO BUFFER
01980 00764A 0AC9 30    41       A       LEAX   1,U
01990 00765A 0ACB C6    BA       A       LDB    #256-69-1
02000 00766A 0ACD 17    0197 0C67        LBSR   XFRUX    CLEAR REST OF BUFFER TO $FF
02010 00767A 0AD0 35    40       A       PULS   U        RESTORE DCB ADDR
02020 00768A 0AD2 86    02       A       LDA    #2
02030 00769A 0AD4 A7    C8 23    A       STA    DCBSEC,U
02040 00770A 0AD7 17    0265 0D3F        LBSR   SYSWRT   WRITE IT
02050 00771A 0ADA 27    02   0ADE        BEQ    DC5
02060 00772A 0ADC A7    E4       A       STA    ,S       IF I/O ERROR
02070 00773A 0ADE 6D    E4       A DC5   TST    ,S       SET COND CODES
02080 00774A 0AE0 35    96       A       PULS   D,X,PC
02090 00775                        *
02100 00776                        ***********************************************************************
02110 00777                        * R E A D   A   L O G I C A L   D I S K   R E C O R D
02120 00778                        *
02130 00779                        * GIVEN: U -> DCB (THAT HAS ALREADY BEEN OPENED!)
02140 00780                        *        A = FUNCTION DESIRED CODED AS FOLLOWS:
02150 00781                        * BIT 0 ON TO READ VIA RBA
02160 00782                        *       OFF TO READ VIA LRN
02170 00783                        * BIT 1 ON TO READ WITHOUT CHANGING POINTER
02180 00784                        *       OFF TO EXIT AFTER POINTING AT NEXT (PREVIOUS) RECORD
02190 00785                        * BIT 2 ON TO READ BACKWARDS
02200 00786                        *       OFF TO READ FORWARD
02210 00787                        * EXAMPLE: A=ZERO TO READ THE CURRENT LOGICAL RECORD AND THEN ADVANCE
02220 00788                        * THE LOGICAL RECORD NUMBER BY 1. A = 2 TO "READ FOR UPDATE" A LOGICAL
02230 00789                        * RECORD. A = 1+4 (5) TO READ STARTING WITH THE RBA'TH BYTE OF DATA
02240 00790                        * IN THE FILE, FOR DCBRSZ BYTES. THEN SET RBA TO POINT DCBRSZ BYTES
02250 00791                        * AHEAD OF THE FIRST BYTE READ.
02260 00792                        *
02270 00793                        * NOTE: LOGICAL RECORD SIZE, RECORD STORAGE ADDRESS AND I/O BUFFER
02280 00794                        * ADDRESS ARE USED.  IF LOGICAL RECORD SIZE IS 256, RECORD STORAGE
02290 00795                        * AND I/O BUFFER MAY BE THE SAME ADDRESS. IF DCBRSZ IS ZERO, READS WILL
02300 00796                        * TRANSFER BYTES FROM THE FILE TO [DCBREC] UNTIL A CHARACTER MATCHING
02310 00797                        * DCBTRM IS TRANSFERRED.
02320 00798                        ***********************************************************************
02330 00799A 0AE2 34    32       A DREAD PSHS   A,X,Y
02340 00800A 0AE4 CC    010F     A       LDD    #$0100+ERR15
02350 00801A 0AE7 17    0091 0B7B        LBSR   RDWR     DO SETUP COMMON TO READ AND WRITE
02360 00802                        *
02370 00803                        * LOOP TO XFER BYTES TO RECORD AREA
02380 00804                        * (X->BUFFER, Y->RECORD AREA)
02390 00805A 0AEA E6    C8 2D    A DR5   LDB    DCBRBA+2,U DISPLACEMENT IN CURRENT SECTOR
02400 00806A 0AED 4F                     CLRA
02410 00807A 0AEE A6    8B       A       LDA    D,X      GET A BYTE
```

```
PAGE  015  IO      .SA:0         DOS - I/O ROUTINES

00808A 0AF0 A7    A0       A         STA    ,Y+       STORE IN RECORD AREA
00809A 0AF2 6C    C8 2D    A         INC    DCBRBA+2,U ADVANCE POINTER IN BUFFER
00810A 0AF5 26    1E   0B15          BNE    DR5B      IF IN SAME SECTOR
00811A 0AF7 17    0249 0D43          LBSR   REWRTE    ENSURE PREVIOUSLY MODIFIED DATA GETS WRITTEN
00812A 0AFA 26    0E   0B0A          BNE    DR5AA     IF WRITE ERR
00813A 0AFC EC    C8 2B    A         LDD    DCBRBA,U
00814A 0AFF C3    0001     A         ADDD   #1        POINT TO NEXT SECTOR
00815A 0B02 ED    C8 2B    A         STD    DCBRBA,U
00816A 0B05 17    0291 0D99          LBSR   CALSEC    RECALCULATE TRACK & SECTOR
00817A 0B08 27    06   0B10          BEQ    DR5A      IF OK
00818A 0B0A 32    67       A DR5AA   LEAS   7,S       SCRAP STUFF IN STACK
00819A 0B0C A7    E4       A         STA    ,S
00820A 0B0E 35    B2       A         PULS   A,X,Y,PC
00821A 0B10 17    01D4 0CE7 DR5A     LBSR   DSKRED
00822A 0B13 26    F5   0B0A          BNE    DR5AA     IF I/O ERROR
00823A 0B15 EC    E4       A DR5B    LDD    ,S        GET COUNT DOWN VALUE
00824A 0B17 27    09   0B22          BEQ    DR5C      IF VARIABLE LENGTH STRING
00825A 0B19 83    0001     A         SUBD   #1
00826A 0B1C ED    E4       A         STD    ,S
00827A 0B1E 26    CA   0AEA          BNE    DR5       GO GET ANOTHER CHR
00828A 0B20 20    07   0B29          BRA    RDWRX     GO DO CLEAN-UP COMMON TO READ AND WRITE
00829A 0B22 A6    C8 13    A DR5C    LDA    DCBTRM,U STRING DELIMITER
00830A 0B25 A1    3F       A         CMPA   -1,Y      WAS LAST CHR STORED A DELIMITER?
00831A 0B27 26    C1   0AEA          BNE    DR5       IF NO, KEEP GOING
00832                        *
00833                        ***********************************
00834                        * CLEAN UP COMMON TO READ AND WRITE
00835                        ***********************************
00836                        * RECORD HAS BEEN READ - CLEAN UP
00837A 0B29 35    06       A RDWRX   PULS   D
00838A 0B2B A6    C8 10    A         LDA    DCBCFS,U FILE STATUS
00839A 0B2E 85    40       A         BITA   #SHARE    OPTION SET?
00840A 0B30 27    08   0B3A          BEQ    DR6A      IF NO
00841A 0B32 17    020E 0D43 DR6AA    LBSR   REWRTE    FREE UP BUFFER
00842A 0B35 CC    FFFF     A         LDD    #$FFFF    MARK INVALID SECTOR IN BUFFER
00843A 0B38 20    09   0B43          BRA    DR6B
00844A 0B3A A6    65       A DR6A    LDA    5,S       R/W OPTION
00845A 0B3C 85    08       A         BITA   #NOW      REWRITE NOW?
00846A 0B3E 26    F2   0B32          BNE    DR6AA     IF YES
00847A 0B40 EC    C8 2B    A         LDD    DCBRBA,U LAST SECTOR ACCESSED
00848A 0B43 ED    C8 29    A DR6B    STD    DCBPRN,U MARK WHICH SECTOR IS NOW IN BUFFER
00849                        * CHECK FOR NEW DCBMRB
00850A 0B46 EC    C8 2B    A         LDD    DCBRBA,U
00851A 0B49 10A3 C8 14     A         CMPD   DCBMRB,U
00852A 0B4D 25    16   0B65          BCS    DR6D      IF IN A LOWER SECTOR
00853A 0B4F 26    08   0B59          BNE    DR6C      IF A HIGHER SECTOR
00854A 0B51 A6    C8 2D    A         LDA    DCBRBA+2,U
00855A 0B54 A1    C8 16    A         CMPA   DCBMRB+2,U
00856A 0B57 25    0C   0B65          BCS    DR6D      IF A LOWER BYTE
00857A 0B59 EC    C8 2B    A DR6C    LDD    DCBRBA,U
00858A 0B5C ED    C8 14    A         STD    DCBMRB,U
00859A 0B5F A6    C8 2D    A         LDA    DCBRBA+2,U
00860A 0B62 A7    C8 16    A         STA    DCBMRB+2,U
00861A 0B65 A6    65       A DR6D    LDA    5,S       READ/WRITE OPTION
00862A 0B67 84    02       A         ANDA   #UPDATE   SHOULD RBA & LRN BE RESET TO STARTING VALUE?
00863A 0B69 35    32       A         PULS   A,X,Y
00864A 0B6B 27    0A   0B77          BEQ    DR6E      IF NO
00865                        * RESTORE ORIGINAL POINTERS
```

```
PAGE  016  IO       .SA:0          DOS - I/O ROUTINES

03000 00866A 0B6D A7    C8 2D    A        STA    DCBRBA+2,U
03010 00867A 0B70 AF    C8 2B    A        STX    DCBRBA,U
03020 00868A 0B73 10AF  C8 2E    A        STY    DCBLRN,U
03030 00869A 0B77 6F    E4       A DR6E   CLR    ,S
03040 00870A 0B79 35    B2       A        PULS   A,X,Y,PC
03050 00871                        *
03060 00872                        **********************************
03070 00873                        * SETUP FOR READ OR WRITE
03080 00874                        * GIVEN: A=1 FOR READ, 2 FOR WRITE
03090 00875                        *        B=ERR NBR FOR POSSIBLE USE
03100 00876                        **********************************
03110 00877A 0B7B 34    06       A RDWR   PSHS   D         SAVE IN CASE NEEDED
03120 00878                        * IS FILE OPEN?
03130 00879A 0B7D A6    C8 10    A        LDA    DCBCFS,U
03140 00880A 0B80 26    08    0B8A        BNE    RDWR1     IF YES
03150 00881A 0B82 86    0E       A        LDA    #ERR14    IF NOT OPEN
03160 00882A 0B84 32    64       A RDWRER LEAS   4,S       (DIDN'T NEED IT AND RET ADDR)
03170 00883A 0B86 A7    E4       A        STA    ,S
03180 00884A 0B88 35    B2       A        PULS   A,X,Y,PC
03190 00885                        * IS THIS TYPE OF OPERATION ALLOWED (READ OR WRITE)?
03200 00886A 0B8A A5    E4       A RDWR1  BITA   ,S        (1 FOR READ, 2 FOR WRITE
03210 00887A 0B8C 26    04    0B92        BNE    RDWR2     IF YES
03220 00888A 0B8E A6    61       A        LDA    1,S       (ERROR NUMBER PROVIDED)
03230 00889A 0B90 20    F2    0B84        BRA    RDWRER
03240 00890                        *
03250 00891                        * CHECK FOR STARTING RBA
03260 00892                        * IS I/O BY RBA OR LOGICAL RECORD?
03270 00893A 0B92 A6    64       A RDWR2  LDA    4,S       OPTION PROVIDED
03280 00894A 0B94 84    01       A        ANDA   #RBA
03290 00895A 0B96 26    0E    0BA6        BNE    RDWR4     IF READ VIA RBA, USE RBA'S CURRENT CONTENTS
03300 00896                        * READ BY RECORD NUMBER
03310 00897A 0B98 EC    C8 11    A        LDD    DCBRSZ,U FIXED OR VARIABLE LENGTH RECORDS?
03320 00898A 0B9B 26    04    0BA1        BNE    RDWR3     IF FIXED LENGTH
03330 00899A 0B9D 86    14       A        LDA    #ERR20    CANT CALCULATE - RSZ = ZERO
03340 00900A 0B9F 20    E3    0B84        BRA    RDWRER
03350 00901A 0BA1 17    01B3 0D57 RDWR3   LBSR   CALRBA    CALCULATE RECORD'S STARTING RBA
03360 00902A 0BA4 26    DE    0B84        BNE    RDWRER    IF OVERFLOW OCCURRED
03370 00903                        *
03380 00904                               OPT    L
03390 00905                        * MAKE SURE STARTING RECORD IS IN BUFFER
03400 00906A 0BA6 EC    C8 2B    A RDWR4  LDD    DCBRBA,U (RELATIVE RECORD NEEDED)
03410 00907A 0BA9 10A3  C8 29    A        CMPD   DCBPRN,U IS NEEDED RECORD IN BUFFER?
03420 00908A 0BAD 27    11    0BC0        BEQ    RDWR4A    IF YES
03430 00909A 0BAF 17    0191 0D43         LBSR   REWRTE    REWRITE BUFFER IF IT HAS BEEN MODIFIED
03440 00910A 0BB2 26    D0    0B84        BNE    RDWRER    IF I/O ERROR IN THE PROCESS
03450 00911A 0BB4 17    01E2 0D99         LBSR   CALSEC    CALCULATE TRACK & SECTOR
03460 00912A 0BB7 26    CB    0B84        BNE    RDWRER    IF TRYING TO GO BEYOND EOF
03470 00913A 0BB9 17    012B 0CE7         LBSR   DSKRED    READ THE SECTOR
03480 00914A 0BBC 26    C6    0B84        BNE    RDWRER    IF I/O ERR
03490 00915A 0BBE 20    05    0BC5        BRA    RDWR5
03500 00916A 0BC0 17    01DC 0D9F RDWR4A  LBSR   CSENT     CHECK FOR EOF
03510 00917A 0BC3 26    BF    0B84        BNE    RDWRER    IF TRYING TO GO PAST EOF
03520 00918                        *
03530 00919                        * CORRECT STARTING SECTOR IS IN BUFFER
03540 00920                        * GET SET TO XFER RECORD
03550 00921A 0BC5 35    26       A RDWR5  PULS   D,Y       (D=1/0, ERR NBR, Y = RETURN ADDR)
03560 00922                               OPT    NOL
03570 00923A 0BC7 AE    C8 2E    A        LDX    DCBLRN,U
```

```
00924A 0BCA 34   10      A         PSHS   X          SAVE IN CASE POINTERS DON'T ADVANCE
00925A 0BCC 30   01      A         LEAX   1,X        POINT TO NEXT RECORD
00926A 0BCE AF   C8 2E   A         STX    DCBLRN,U
00927A 0BD1 AE   C8 2B   A         LDX    DCBRBA,U
00928A 0BD4 A6   C8 2D   A         LDA    DCBRBA+2,U
00929A 0BD7 34   12      A         PSHS   A,X        SAVE INCASE POINTERS DON'T ADVANCE
00930A 0BD9 EC   C8 11   A         LDD    DCBRSZ,U GET RECORD LENGTH
00931A 0BDC 34   06      A         PSHS   D          SAVE AS COUNT DOWN VALUE FOR LOOP
00932A 0BDE 34   20      A         PSHS   Y          SAVE RET ADDR
00933A 0BE0 AE   C8 24   A         LDX    DCBBUF,U ADDR OF BUFFER
00934A 0BE3 10AE C8 27   A         LDY    DCBLRB,U ADDR OF LOGICAL RECORD BUFFER
00935A 0BE7 39                     RTS               RETURN TO READ OR WRITE LOOP
00936                      *
00937                      ************************************************************************
00938                      * W R I T E   A   L O G I C A L   D I S K   R E C O R D
00939                      *
00940                      * GIVEN: U -> DCB (THAT HAS ALREADY BEEN OPENED!)
00941                      *        A = FUNCTION DESIRED CODED AS FOLLOWS:
00942                      * BIT 0 ON TO WRITE VIA RBA
00943                      *       OFF TO WRITE VIA LRN
00944                      * BIT 1 ON TO WRITE WITHOUT CHANGING POINTER
00945                      *       OFF TO EXIT AFTER POINTING AT NEXT (PREVIOUS) RECORD
00946                      * BIT 2 ON TO WRITE BACKWARDS
00947                      *       OFF TO WRITE FORWARD
00948                      * BIT 3 ON TO RELEASE BUFFER AFTER WRITE
00949                      *       OFF TO WAIT UNTIL PHYSICAL I/O IS NECESSARY
00950                      * NOTE: FUNCTION IS NEARLY THE SAME AS DREAD - SEE NOTES UNDER DREAD.
00951                      *************************************************************************
00952A 0BE8 34   32      A DWRITE PSHS  A,X,Y
00953A 0BEA CC   0215    A         LDD    #$0200+ERR21
00954A 0BED 8D   8C   0B7B         BSR    RDWR       DO SETUP COMMON TO READ AND WRITE
00955                      *
00956                      * LOOP TO XFER BYTES FROM RECORD AREA
00957                      * (X->BUFFER, Y->RECORD AREA)
00958A 0BEF E6   C8 2D   A DW5     LDB    DCBRBA+2,U DISPLACEMENT IN CURRENT SECTOR
00959A 0BF2 4F                     CLRA
00960A 0BF3 AE   C8 24   A         LDX    DCBBUF,U ADDR OF BUFFER
00961A 0BF6 30   8B      A         LEAX   D,X        DETERMINE ADDR IN BUFFER
00962A 0BF8 A6   A0      A         LDA    ,Y+        GET BYTE FROM RECORD AREA
00963A 0BFA A7   84      A         STA    ,X         STORE IN BUFFER
00964A 0BFC 6C   C8 2D   A         INC    DCBRBA+2,U ADVANCE POINTER IN BUFFER
00965A 0BFF 26   23   0C24         BNE    DW5B       IF IN SAME SECTOR
00966A 0C01 17   00E6 0CEA         LBSR   DSKWRT     REWRITE SECTOR
00967A 0C04 26   0E   0C14         BNE    DW5AA      IF I/O ERROR
00968A 0C06 EC   C8 2B   A         LDD    DCBRBA,U
00969A 0C09 C3   0001    A         ADDD   #1         POINT TO NEXT SECTOR
00970A 0C0C ED   C8 2B   A         STD    DCBRBA,U
00971A 0C0F 17   0187 0D99         LBSR   CALSEC     RECALCULATE TRACK & SECTOR
00972A 0C12 27   06   0C1A         BEQ    DW5A       IF OK
00973A 0C14 32   67      A DW5AA   LEAS   7,S        SCRAP STUFF IN STACK
00974A 0C16 A7   E4      A         STA    ,S
00975A 0C18 35   B2      A         PULS   A,X,Y,PC
00976A 0C1A 17   00CA 0CE7 DW5A    LBSR   DSKRED
00977A 0C1D 26   F5   0C14         BNE    DW5AA      IF I/O ERROR
00978A 0C1F 86   01      A         LDA    #1
00979A 0C21 A7   C8 30   A         STA    DCBMDT,U MARK NEW REC AS MODIFIED
00980A 0C24 EC   E4      A DW5B    LDD    ,S         GET COUNT DOWN VALUE
00981A 0C26 27   09   0C31         BEQ    DW5C       IF VARIABLE LENGTH STRING
```

```
PAGE  018  IO       .SA:0          DOS - I/O ROUTINES

04160 00982A 0C28 83    0001     A         SUBD    #1
04170 00983A 0C2B ED    E4       A         STD     ,S
04180 00984A 0C2D 26    C0   0BEF          BNE     DW5      GO GET ANOTHER CHR
04190 00985A 0C2F 20    07   0C38          BRA     DW6
04200 00986A 0C31 A6    C8 13    A DW5C    LDA     DCBTRM,U STRING DELIMITER
04210 00987A 0C34 A1    3F       A         CMPA    -1,Y     WAS LAST CHR STORED A DELIMITER?
04220 00988A 0C36 26    B7   0BEF          BNE     DW5      IF NO, KEEP GOING
04230 00989                        *
04240 00990                        * RECORD HAS BEEN WRITTEN - CLEAN UP
04250 00991A 0C38 86    01       A DW6     LDA     #1
04260 00992A 0C3A A7    C8 30    A         STA     DCBMDT,U ENSURE THIS SECTOR GETS REWRITTEN (EVETUALLY)
04270 00993A 0C3D 7E    0B29     A         JMP     RDWRX    CLEAN UP SAME AS FOR READ
04280 00994                        *
04290 00995                        ************************************************
04300 00996                        * RELEASE THE I/O BUFFER
04310 00997                        * (USED WHEN USER WANTS TO CONTROL SHARED BUFFER)
04320 00998                        * GIVEN: U->DCB
04330 00999                        ************************************************
04340 01000A 0C40 17    0100 0D43 DRELSE LBSR   REWRTE   REWRITE BUFFER CONTENTS IF NECESSARY
04350 01001A 0C43 CC    FFFF     A         LDD     #$FFFF
04360 01002A 0C46 ED    C8 29    A         STD     DCBPRN,U FORCE READ NEXT TIME
04370 01003A 0C49 4F                       CLRA
04380 01004A 0C4A 39                       RTS
00010 01005                                OPT     L
00020 01006                                TTL     DOS - SUPPORTING SUBROUTINES
00030 01007                                OPT     NOL
00040 01008                        **********************************
00050 01009                        * POINT "X" AT FAT TABLE IN MEMORY
00060 01010                        * GIVEN: U-> DCB CONTAINING DCBDRV
00070 01011                        * RETURNED:X
00080 01012                        **********************************
00090 01013A 0C4B 8E    07C8     A ADRFAT LDX      #FATS    FAT TABLE STORE AREA
00100 01014A 0C4E A6    C8 21    A         LDA     DCBDRV,U DRIVE CONTAINING FILE
00110 01015A 0C51 C6    45       A         LDB     #69      NUMBER OF BYTES SAVED
00120 01016A 0C53 3D                       MUL
00130 01017A 0C54 30    8B       A         LEAX    D,X      POINT TO CORRECT AREA
00140 01018A 0C56 39                       RTS
00150 01019                        *
00160 01020                        *******************************************************
00170 01021                        * X F E R   B Y T E S   R O U T I N E S
00180 01022                        *******************************************************
00190 01023                        * XFER 32 BYTES FROM DCB (AT ,U) TO DIRECTORY (AT ,X)
00200 01024A 0C57 34    56       A DCBDIR PSHS     D,X,U
00210 01025A 0C59 C6    20       A         LDB     #32      BYTES TO XFER
00220 01026A 0C5B 8D    0A   0C67          BSR     XFRUX
00230 01027A 0C5D 35    D6       A         PULS    D,X,U,PC
00240 01028                        * XFER 32 BYTES FROM DIRECTORY AT ,X TO DCB AT ,U
00250 01029A 0C5F 34    56       A DIRDCB PSHS     D,X,U
00260 01030A 0C61 C6    20       A         LDB     #32
00270 01031A 0C63 8D    0A   0C6F          BSR     XFRXU
00280 01032A 0C65 35    D6       A         PULS    D,X,U,PC
00290 01033                        * TRANSFER B BYTES FROM ,U TO ,X
00300 01034A 0C67 A6    C0       A XFRUX   LDA     ,U+
00310 01035A 0C69 A7    80       A         STA     ,X+
00320 01036A 0C6B 5A                       DECB
00330 01037A 0C6C 26    F9   0C67          BNE     XFRUX
00340 01038A 0C6E 39                       RTS
00350 01039                        * TRANSFER B BYTES FROM ,X TO ,U
```

```
PAGE  019  RTN     .SA:0         DOS - SUPPORTING SUBROUTINES

00360 01040A 0C6F 1E    13       A XFRXU  EXG    X,U
00370 01041A 0C71 8D    F4    0C67        BSR    XFRUX
00380 01042A 0C73 1E    13       A        EXG    X,U
00390 01043A 0C75 39                      RTS
00400 01044                        *
00410 01045                        *************************************************
00420 01046                        * CHECK DIRECTORY ON THIS DRIVE
00430 01047                        * GIVEN: A=ZERO IF LOOKING FOR A MATCH
00440 01048                        *        A NOT ZERO IF LOOKING FOR AVAILABLE SLOT
00450 01049                        *        U -> DCB
00460 01050                        * RETURNED: A=ZERO IF REQUEST SUCCESSFUL
00470 01051                        *           A=FF IF NO MATCH FOUND
00480 01052                        *           A=1-8 IF I/O ERROR
00490 01053                        *           IF SUCCESSFUL,X-> DIRECTORY ENTRY IN BUFFER
00500 01054                        *************************************************
00510 01055A 0C76 34    06       A CHKDIR PSHS   D         SAVE OPTION
00520 01056A 0C78 CC    1103     A        LDD    #$1103
00530 01057A 0C7B A7    C8 22    A        STA    DCBTRK,U SET TO READ DIRECTORY TRACK
00540 01058A 0C7E E7    C8 23    A        STB    DCBSEC,U SET TO READ FIRST DIRECTORY ENTRIES
00550 01059                        * RETRY ONLY IF DRIVE IS READY!
00560 01060A 0C81 B6    0622     A CD1    LDA    >RETRYS
00570 01061A 0C84 34    02       A        PSHS   A
00580 01062A 0C86 86    02       A        LDA    #2        ** CHANGED IN VER 6 **
00590 01063A 0C88 B7    0622     A        STA    >RETRYS
00600 01064A 0C8B 17    0099 0D27         LBSR   SYSRED    DO PHYSICAL READ
00610 01065A 0C8E 35    04       A        PULS   B         GET ORIG NBR OF RETRYS
00620 01066A 0C90 27    12    0CA4        BEQ    CD2       IF I/O OK
00630 01067A 0C92 F7    0622     A        STB    >RETRYS
00640 01068A 0C95 81    01       A        CMPA   #ERR1     DRIVE NOT READY?
00650 01069A 0C97 26    04    0C9D        BNE    CD1A      IF I SHOULD TRY SOME MORE
00660 01070A 0C99 A7    E4       A CD1E   STA    ,S
00670 01071A 0C9B 35    86       A        PULS   D,PC
00680 01072A 0C9D 17    0087 0D27 CD1A    LBSR   SYSRED    GO TRY SOME MORE
00690 01073A 0CA0 26    F7    0C99        BNE    CD1E      IF STILL ERROR
00700 01074A 0CA2 20    03    0CA7        BRA    CD2A
00710 01075                        * CHECK THE DIRECTORY ENTRIES IN THIS RECORD
00720 01076A 0CA4 F7    0622     A CD2    STB    >RETRYS
00730 01077A 0CA7 86    08       A CD2A   LDA    #8        NUMBER OF DIRECTORY ENTRYS PER REC
00740 01078A 0CA9 A7    61       A        STA    1,S
00750 01079A 0CAB 8E    06C8     A        LDX    #SYSBUF   POINT AT SYSTEM BUFFER
00760 01080A 0CAE 6D    E4       A CD3    TST    ,S        OPTION?
00770 01081A 0CB0 27    0A    0CBC        BEQ    CD5       IF LOOKING FOR A MATCH
00780 01082A 0CB2 A6    84       A        LDA    ,X        LOOK AT 1ST BYTE
00790 01083A 0CB4 27    02    0CB8        BEQ    CD4       IF I FOUND RE-USABLE SPACE
00800 01084A 0CB6 2A    18    0CD0        BPL    CD7       IF NOT USEABLE
00810 01085A 0CB8 6F    E4       A CD4    CLR    ,S
00820 01086A 0CBA 35    86       A        PULS   D,PC      RETURN SUCCESSFULLY
00830 01087                        * COMPARE LOOP
00840 01088A 0CBC A6    84       A CD5    LDA    ,X        LOOK AT 1ST BYTE OF DIRECTORY ENTRY
00850 01089A 0CBE 27    10    0CD0        BEQ    CD7       IF DELETED ENTRY
00860 01090A 0CC0 2B    1F    0CE1        BMI    CD8       IF END OF DIRECTORY ENTRIES
00870 01091A 0CC2 5F                      CLRB             CHARACTER POSITION COUNTER
00880 01092A 0CC3 A6    85       A CD6    LDA    B,X       CHR IN DIRECTORY FILE NAME
00890 01093A 0CC5 A1    C5       A        CMPA   B,U       CHR IN DCB FILE NAME
00900 01094A 0CC7 26    07    0CD0        BNE    CD7       IF NOT A MATCH
00910 01095A 0CC9 5C                      INCB
00920 01096A 0CCA C1    0B       A        CMPB   #11       MORE CHARACTERS TO COMPARE?
00930 01097A 0CCC 25    F5    0CC3        BCS    CD6       IF YES
```

```
PAGE  020  RTN     .SA:0          DOS - SUPPORTING SUBROUTINES

00940 01098                       * MATCH FOUND
00950 01099A 0CCE 20   E8   0CB8         BRA    CD4
00960 01100                       *
00970 01101A 0CD0 30   88 20   A CD7     LEAX   32,X      POINT TO NEXT DIRECTORY ENTRY
00980 01102A 0CD3 6A   61      A         DEC    1,S       MORE ENTRIES TO LOOK AT IN THIS REC?
00990 01103A 0CD5 26   D7   0CAE         BNE    CD3       IF YES
01000 01104A 0CD7 6C   C8 23   A         INC    DCBSEC,U
01010 01105A 0CDA A6   C8 23   A         LDA    DCBSEC,U
01020 01106A 0CDD 81   0C      A         CMPA   #12       MORE DIRECTORY RECORDS TO READ?
01030 01107A 0CDF 25   A0   0C81         BCS    CD1       IF YES
01040 01108                       * DIRECTORY ENTRY NOT FOUND ON THIS DRIVE
01050 01109A 0CE1 86   FF      A CD8     LDA    #$FF
01060 01110A 0CE3 A7   E4      A         STA    ,S
01070 01111A 0CE5 35   86      A         PULS   D,PC
01080 01112                       *
01090 01113                       *****************************************
01100 01114                       * PHYSICAL DISK READ
01110 01115                       * GIVEN: U->DCB
01120 01116                       * FUNCTION: READ INTO DCBBUF
01130 01117                       *          (NOTE:DSKCON RETRYS ON ERROR 5 TIMES)
01140 01118                       * RETURNED:DCBOK = RESULT CODE (ALSO IN A)
01150 01119                       *****************************************
01160 01120A 0CE7 86   02      A DSKRED LDA    #2        READ SECTOR OP CODE
01170 01121A 0CE9      8C      A         FCB    $8C       SKIP OVER NEXT INSTR
01180 01122                       *
01190 01123                       ***************************
01200 01124                       * PHYSICAL DISK WRITE
01210 01125                       * ESSENTIALLY SAME AS ABOVE
01220 01126                       ***************************
01230 01127A 0CEA 86   03      A DSKWRT LDA    #3        WRITE OP CODE
01240 01128A 0CEC A7   C8 20   A DSKIO  STA    DCBOPC,U
01250 01129A 0CEF 6F   C8 30   A         CLR    DCBMDT,U
01260 01130                       * FALL THRU
01270 01131                       *
01280 01132                       ***********************************
01290 01133                       * CALL DSKCON
01300 01134                       * GIVEN:PARAMETERS IN DCB
01310 01135                       * FUNCTION: XFER PARAMS TO [C006]
01320 01136                       *          CALL DSKCON
01330 01137                       *          MOVE RESULT CODE TO DCB
01340 01138                       *          LEAVE RESULT CODE IN A
01350 01139                       ***********************************
01360 01140A 0CF2 34   14      A XFRIOP PSHS   B,X
01370 01141A 0CF4 BE   C006    A         LDX    >$C006
01380 01142A 0CF7 EC   C8 20   A         LDD    DCBOPC,U
01390 01143A 0CFA ED   81      A         STD    ,X++
01400 01144A 0CFC EC   C8 22   A         LDD    DCBTRK,U
01410 01145A 0CFF ED   81      A         STD    ,X++
01420 01146A 0D01 EC   C8 24   A         LDD    DCBBUF,U
01430 01147A 0D04 ED   81      A         STD    ,X++
01440 01148A 0D06 34   08      A XIOENT PSHS   DP
01450 01149A 0D08 4F                     CLRA
01460 01150A 0D09 1F   8B      A         TFR    A,DP
01470 01151A 0D0B 8D   10   0D1D         BSR    DOIO      DO I/O
01480 01152A 0D0D 35   08      A         PULS   DP
01490 01153A 0D0F 4F                     CLRA
01500 01154A 0D10 E6   84      A         LDB    ,X        GET RESULT CODE
01510 01155A 0D12 27   07   0D1B         BEQ    XIOX      IF NO ERROR, EXIT
```

```
PAGE  021  RTN     .SA:0          DOS - SUPPORTING SUBROUTINES

01520 01156                        * GENERATE ERROR NUMBER BASED ON WHICH BIT IS ON
01530 01157A 0D14 58               XIOA   LSLB              IS THIS BIT SET?
01540 01158A 0D15 25    03    0D1A        BCS    XIOB       IF YES
01550 01159A 0D17 4C                      INCA
01560 01160A 0D18 20    FA    0D14        BRA    XIOA
01570 01161A 0D1A 4C               XIOB   INCA
01580 01162A 0D1B 35    94       A XIOX   PULS   B,X,PC
01590 01163             0024     A ZZ     EQU    ERR1+ERR2+ERR3+ERR4+ERR5+ERR6+ERR7+ERR8
01600 01164                        * THE ABOVE LINE SIMPLY PUTS ERR1-8 ON THE XREF MAP
01610 01165A 0D1D 34    76       A DOIO   PSHS   D,X,Y,U
01620 01166A 0D1F B6    0622     A        LDA    >RETRYS
01630 01167A 0D22 BE    C004     A        LDX    >$C004
01640 01168A 0D25 6E    04       A        JMP    4,X
01650 01169                        *
01660 01170                        *******************************************
01670 01171                        * PHYSICAL DISK READ - SYSTEM FUNCTIONS
01680 01172                        * SAME AS DSKRED EXCEPT SYSTEM'S BUFFER USED
01690 01173                        *******************************************
01700 01174A 0D27 86    02       A SYSRED LDA    #2
01710 01175A 0D29 34    14       A SYSIO  PSHS   B,X
01720 01176A 0D2B E6    C8 21    A        LDB    DCBDRV,U
01730 01177A 0D2E BE    C006     A        LDX    >$C006
01740 01178A 0D31 ED    81       A        STD    ,X++
01750 01179A 0D33 EC    C8 22    A        LDD    DCBTRK,U
01760 01180A 0D36 ED    81       A        STD    ,X++      TRACK & SECTOR
01770 01181A 0D38 CC    06C8     A        LDD    #SYSBUF
01780 01182A 0D3B ED    81       A        STD    ,X++
01790 01183A 0D3D 20    C7    0D06        BRA    XIOENT    FINISH UP LIKE USER IO
01800 01184                        *
01810 01185                        ***************************************
01820 01186                        * PHYSICAL DISK WRITE - SYSTEM FUNCTIONS
01830 01187                        ***************************************
01840 01188A 0D3F 86    03       A SYSWRT LDA    #3
01850 01189A 0D41 20    E6    0D29        BRA    SYSIO
01860 01190                        *
01870 01191                        ***************************************************************************
01880 01192                        * IF DATA IN BUFFER HAS BEEN MODIFIED (DCBMDT NOT = 0) CHECK
01890 01193                        * TO SEE IF WRITES ARE ALLOWED. IF NO, DO NOT SET ERROR - JUST EXIT.
01900 01194                        * IF YES, REWRITE BLOCK IN BUFFER (EXIT WITH ERROR IN A IF WRITE NO GOOD.)
01910 01195                        *
01920 01196                        * GIVEN: U->DCB CONTAINING DCBPRN = PHYSICAL REC NUMBER THAT IS IN BUFFER.
01930 01197                        ***************************************************************************
01940 01198A 0D43 6D    C8 30    A REWRTE TST    DCBMDT,U DATA IN BUFFER MODIFIED?
01950 01199A 0D46 26    02    0D4A        BNE    RW1       IF YES
01960 01200A 0D48 4F               RWX    CLRA
01970 01201A 0D49 39               RWXX   RTS
01980 01202A 0D4A A6    C8 10    A RW1    LDA    DCBCFS,U
01990 01203A 0D4D 84    02       A        ANDA   #OUT      ARE WRITES ALLOWED?
02000 01204A 0D4F 27    F7    0D48        BEQ    RWX       IF NO, EXIT WITH NO ERROR
02010 01205A 0D51 8D    4C    0D9F        BSR    CSENT     RE-ESTABLISH TRK & SEC FROM PRN
02020 01206A 0D53 26    F4    0D49        BNE    RWXX      IF NG, EXIT WITH ERROR
02030 01207A 0D55 20    93    0CEA        BRA    DSKWRT    GO DO REWRITE & RETURN TO CALLER
02040 01208                        *
02050 01209                        *********************************************************
02060 01210                        * CALCULATE RELATIVE BYTE ADDRESS FROM LOGICAL RECORD NUMBER
02070 01211                        * (DCBRBA = DCBRSZ * DCBLRN)
02080 01212                        *********************************************************
02090 01213A 0D57 34    70       A CALRBA PSHS   X,Y,U
```

```
01214A 0D59 30   C8 2B    A        LEAX   DCBRBA,U
01215A 0D5C 31   C8 11    A        LEAY   DCBRSZ,U
01216A 0D5F 33   C8 2E    A        LEAU   DCBLRN,U
01217A 0D62 6F   84       A        CLR    ,X
01218A 0D64 6F   01       A        CLR    1,X
01219A 0D66 6F   02       A        CLR    2,X
01220A 0D68 A6   21       A        LDA    1,Y
01221A 0D6A E6   41       A        LDB    1,U
01222A 0D6C 3D                     MUL
01223A 0D6D ED   01       A        STD    1,X
01224A 0D6F A6   21       A        LDA    1,Y
01225A 0D71 E6   C4       A        LDB    ,U
01226A 0D73 3D                     MUL
01227A 0D74 E3   84       A        ADDD   ,X
01228A 0D76 25   1D    0D95        BCS    CRBAER    IF CARRY
01229A 0D78 ED   84       A        STD    ,X
01230A 0D7A A6   A4       A        LDA    ,Y
01231A 0D7C E6   41       A        LDB    1,U
01232A 0D7E 3D                     MUL
01233A 0D7F E3   84       A        ADDD   ,X
01234A 0D81 25   12    0D95        BCS    CRBAER
01235A 0D83 ED   84       A        STD    ,X
01236A 0D85 A6   A4       A        LDA    ,Y
01237A 0D87 E6   C4       A        LDB    ,U
01238A 0D89 3D                     MUL
01239A 0D8A EB   84       A        ADDB   ,X
01240A 0D8C 25   07    0D95        BCS    CRBAER
01241A 0D8E E7   84       A        STB    ,X
01242A 0D90 4D                     TSTA
01243A 0D91 26   02    0D95        BNE    CRBAER
01244A 0D93 35   F0       A        PULS   X,Y,U,PC
01245A 0D95 86   10       A CRBAER LDA    #ERR16
01246A 0D97 35   F0       A        PULS   X,Y,U,PC
01247                       *
01248                       ***********************************************************
01249                       * CALCULATE TRACK & SECTOR
01250                       *
01251                       * GIVEN: DCBPRN = RELATIVE RECORD NUMBER
01252                       * FUNCTION: FOLLOW CLUSTER CHAIN UNTIL PROPER CLUSTER FOUND
01253                       * RESULT: DCBTRK & DCBSEC IF RECORD IN RANGE
01254                       *  THEY POINT TO LAST SECTOR IF NOT IN RANGE.
01255                       *  A = ZERO IF SUCCESSFUL
01256                       *      NON ZERO IF NOT
01257                       ***********************************************************
01258A 0D99 EC   C8 2B    A CALSEC LDD    DCBRBA,U DESIRED REC NUMBER
01259A 0D9C ED   C8 29    A        STD    DCBPRN,U SAVE AS THE REC IN THE BUFFER
01260A 0D9F A6   4D       A CSENT  LDA    DCBFCL,U
01261A 0DA1 34   12       A        PSHS   A,X
01262A 0DA3 8E   07C8     A        LDX    #FATS
01263A 0DA6 A6   C8 21    A        LDA    DCBDRV,U
01264A 0DA9 C6   45       A        LDB    #FATSZ
01265A 0DAB 3D                     MUL
01266A 0DAC 30   8B       A        LEAX   D,X       POINT TO PROPER FAT TABLE
01267A 0DAE EC   C8 29    A        LDD    DCBPRN,U REC NUMBER DESIRED
01268A 0DB1 6D   E4       A        TST    ,S
01269A 0DB3 2B   15    0DCA        BMI    CS3       IF AT END OF CLUSTERS (NULL FILE)
01270A 0DB5 83   0009     A CS1    SUBD   #9
01271A 0DB8 25   1B    0DD5        BCS    CS4       IF IN THIS CLUSTER
```

```
PAGE  023  RTN     .SA:0          DOS - SUPPORTING SUBROUTINES

0DBA 34    06       A         PSHS   D
0DBC A6    62       A         LDA    2,S
0DBE A6    86       A         LDA    A,X       GET NEXT CLUSTER POINTER
0DC0 2B    06    0DC8         BMI    CS2       IF AT END OF CLUSTERS
0DC2 A7    62       A         STA    2,S
0DC4 35    06       A         PULS   D
0DC6 20    ED    0DB5         BRA    CS1
0DC8 35    06       A CS2     PULS   D
                        *
                        * REC IS BEYOND END OF CURRENT CLUSTERS
                        * AM I ALLOWED TO ADD ANOTHER CLUSTER?
0DCA A6    C8 10    A CS3     LDA    DCBCFS,U
0DCD 84    08       A         ANDA   #EXTEND   AM I ALLOWED?
0DCF 26    66    0E37         BNE    CS6       IF YES, GO TRY IT
0DD1 86    11       A CS3A    LDA    #ERR17    EXTENSION NOT ALLOWED
0DD3 20    46    0E1B         BRA    CSERR
                        *
                        * RECORD IS IN THIS CLUSTER
0DD5 CB    0A       A CS4     ADDB   #10       (RESULT IS 1-9)
                        * IS THE SECTOR NUMBER IN B IN USE IN THIS CLUSTER YET?
0DD7 A6    E4       A         LDA    ,S        (CLUSTER NUMBER)
0DD9 6D    86       A         TST    A,X       IS THIS CLUSTER THE LAST IN THE FILE?
0DDB 2A    44    0E21         BPL    CS5       IF NO
0DDD 34    06       A         PSHS   D         CLUSTER NUMBER/SECTOR NUMBER
                        * IS THIS RECORD BEYOND CURRENT LAST SECTOR USED?
0DDF E6    86       A         LDB    A,X
0DE1 C4    3F       A         ANDB   #63       CURRENT LAST SECTOR USED
0DE3 E1    61       A         CMPB   1,S       THIS ONE
0DE5 24    0B    0DF2         BCC    CS4A      IF THIS IS LESS OR EQUAL TO CURRENT END
0DE7 E6    C8 10    A         LDB    DCBCFS,U GET FILE STATUS
0DEA C4    08       A         ANDB   #EXTEND   FILE EXTENSIONS ALLOWED?
0DEC 26    18    0E06         BNE    CS4B      IF YES
0DEE 35    06       A CS4AE   PULS   D
0DF0 20    DF    0DD1         BRA    CS3A      EXTENSION NOT ALLOWED
0DF2 26    2B    0E1F CS4A    BNE    CS4C      IF NOT IN LAST SECTOR
0DF4 A6    C8 10    A         LDA    DCBCFS,U
0DF7 84    08       A         ANDA   #EXTEND   ALLOWED?
0DF9 26    24    0E1F         BNE    CS4C      IF ITS OK
                        * IS REC BEYOND LAST BYTE?
0DFB E6    C8 2D    A         LDB    DCBRBA+2,U
0DFE 4F                       CLRA
0DFF 10A3 4E        A         CMPD   DCBNLS,U
0E02 25    1B    0E1F         BCS    CS4C      IF OK
0E04 20    E8    0DEE         BRA    CS4AE     IF NG
                        * EXTEND LAST SECTOR IN THIS CLUSTER
0E06 E6    61       A CS4B    LDB    1,S       SECTOR NUMBER
0E08 CA    C0       A         ORB    #$C0
0E0A E7    86       A         STB    A,X       PUT IN FAT TABLE
                        * FAT HAS CHANGED - CAN I BYPASS UPDATE THIS TIME?
0E0C A6    C8 10    A         LDA    DCBCFS,U
0E0F 84    20       A         ANDA   #FAST
0E11 26    0C    0E1F         BNE    CS4C      IF YES
0E13 8D    69    0E7E         BSR    WRTFAT    RE-WRITE FAT TABLE TO REFLECT CHANGE
0E15 27    08    0E1F         BEQ    CS4C      IF I/O WAS OK
0E17 35    06       A         PULS   D
0E19 86    12       A         LDA    #ERR18    FAT RW ERR
0E1B A7    E4       A CSERR   STA    ,S
0E1D 35    92       A         PULS   A,X,PC
```

```
PAGE  024  RTN     .SA:0        DOS - SUPPORTING SUBROUTINES

01330A 0E1F 35   06       A CS4C   PULS   D          CONTINUE - IT IS NOW WITHIN RANGE OF FILE
01331                       * RECORD IS IN RANGE OF FILE - XLATE CLUSTER INTO TRACK & SECTOR
01332A 0E21 A6   E4       A CS5    LDA    ,S         CLUSTER NUMBER
01333A 0E23 44                     LSRA              IS THIS AN ODD CLUSTER?
01334A 0E24 24   02   0E28         BCC    CS5A       IF NO
01335A 0E26 CB   09       A        ADDB   #9         IF YES, USE SECTORS 10-18
01336A 0E28 E7   C8 23    A CS5A   STB    DCBSEC,U
01337A 0E2B 81   11       A        CMPA   #17        IS CLUSTER BELOW DIRECTORY?
01338A 0E2D 25   01   0E30         BCS    CS5B       IF YES
01339A 0E2F 4C                     INCA              IF NOT GO ONE TRACK FARTHER
01340A 0E30 A7   C8 22    A CS5B   STA    DCBTRK,U
01341A 0E33 6F   E4       A        CLR    ,S
01342A 0E35 35   92       A        PULS   A,X,PC
01343                       *
01344                       * TRY TO ADD ANOTHER CLUSTER TO THE FILE
01345                       * NEXT CLUSTER USED WILL BE THE CLOSEST ONE TO THE LAST ONE USED BY
01346                       * THIS FILE.  IF FIRST EVER FOR THIS FILE, IT WILL BE CLOSEST TO MIDDLE.
01347A 0E37 E6   E4       A CS6    LDB    ,S         LAST CLUSTER NUMBER USED
01348A 0E39 2A   02   0E3D         BPL    CS6A       IF NOT VERY FIRST ASSIGNED TO FILE
01349A 0E3B C6   22       A        LDB    #34        START SEARCH AT CLUSTER 34
01350A 0E3D 4F              CS6A   CLRA              STARTING DISPLACEMENT
01351A 0E3E 34   06       A        PSHS   D
01352                       * LOOP TO LOOK FOR AN AVAILABLE CLUSTER
01353A 0E40 A6   61       A CS7    LDA    1,S        LAST CLUSTER OF FILE
01354A 0E42 AB   E4       A        ADDA   ,S         ADD DISPLACEMENT
01355A 0E44 81   44       A        CMPA   #68        IN RANGE OF TABLE?
01356A 0E46 24   06   0E4E         BCC    CS7A       IF NO
01357A 0E48 E6   86       A        LDB    A,X        GET FAT TABLE BYTE
01358A 0E4A C1   FF       A        CMPB   #$FF       IS IT AVAILABLE
01359A 0E4C 27   1B   0E69         BEQ    CS8        IF YES
01360A 0E4E A6   61       A CS7A   LDA    1,S
01361A 0E50 A0   E4       A        SUBA   ,S         LOOK THE OTHER WAY
01362A 0E52 25   06   0E5A         BCS    CS7B       IF NOT IN RANGE OF THE TABLE
01363A 0E54 E6   86       A        LDB    A,X        GET FAT TABLE BYTE
01364A 0E56 C1   FF       A        CMPB   #$FF       AVAILABLE?
01365A 0E58 27   0F   0E69         BEQ    CS8        IF YES
01366A 0E5A A6   E4       A CS7B   LDA    ,S
01367A 0E5C 4C                     INCA
01368A 0E5D A7   E4       A        STA    ,S
01369A 0E5F 81   44       A        CMPA   #68        HAVE I TRIED ALL POSSIBILITIES?
01370A 0E61 25   DD   0E40         BCS    CS7        IF NOT YET
01371A 0E63 35   06       A        PULS   D          NORMALIZE STACK
01372A 0E65 86   16       A        LDA    #ERR22     DISK FULL
01373A 0E67 20   B2   0E1B         BRA    CSERR
01374A 0E69 E6   62       A CS8    LDB    2,S        ORIGINAL ENDING CLUSTER
01375A 0E6B 2A   04   0E71         BPL    CS8A
01376A 0E6D A7   4D       A        STA    DCBFCL,U THIS IS FIRST CLUSTER
01377A 0E6F 20   02   0E73         BRA    CS8B
01378A 0E71 A7   85       A CS8A   STA    B,X        ADD TO CHAIN
01379A 0E73 C6   C0       A CS8B   LDB    #$C0       SAY NONE OF THESE SECTORS USED
01380A 0E75 E7   86       A        STB    A,X
01381A 0E77 35   06       A        PULS   D
01382A 0E79 35   12       A        PULS   A,X        NORMALIZE STACK
01383A 0E7B 7E   0D9F     A        JMP    CSENT      GO TRY AGAIN FROM THE TOP!
01384                       *
01385                       ************************************************
01386                       * REWRITE FAT TABLE ON DIRECTORY TRACK
01387                       *
```

```
PAGE  025  RTN      .SA:0           DOS - SUPPORTING SUBROUTINES

                             * GIVEN: X-> CORRECT FAT TABLE IN MEMORY
                             *        U-> DCB CONTAINING CORRECT DRIVE NUMBER
                             ********************************************
A 0E7E 34    10       A WRTFAT PSHS    X
A 0E80 BE    C006     A        LDX     >$C006
A 0E83 86    03       A        LDA     #3         WRITE
A 0E85 A7    80       A        STA     ,X+
A 0E87 A6    C8 21    A        LDA     DCBDRV,U
A 0E8A A7    80       A        STA     ,X+
A 0E8C CC    1102     A        LDD     #$1102     TRACK 17, SECTOR 2
A 0E8F ED    81       A        STD     ,X++
A 0E91 EC    E4       A        LDD     ,S         ADDR OF FAT TABLE
A 0E93 ED    81       A        STD     ,X++
A 0E95 34    08       A        PSHS    DP
A 0E97 4F                      CLRA
A 0E98 1F    8B       A        TFR     A,DP
A 0E9A AD    9F C004 A         JSR     [$C004]    DO IO
A 0E9E 35    08       A        PULS    DP
A 0EA0 A6    84       A        LDA     ,X         RESULT
A 0EA2 35    90       A        PULS    X,PC
                               TTL     DOS - PAGING & OVERLAYS
                             *
                             ***************************************************************************
                             * ON DISK, THIS PROGRAM BEGINS HERE! EVERY THING THAT PRECEEDS THIS POINT
                             * IS RECORDED ON DISK AFTER THE END OF THE OVERLAYS.  WHEN DOS IS FIRST
                             * LOADED INTO MEMORY, THE ROUTINE CALLED "OVRLAY" SHIFTS THOSE ROUTINES
                             * DOWN TO THEIR PROPER PLACE.
                             ***************************************************************************
A 0EA4 7E    0ECF     A DOS    JMP     DOS1       JUMP OVER DISPLACEMENTS TO OVERLAYS
A 0EA7       0329     A        FDB     B1-DOS
A 0EA9       035C     A        FDB     B2-DOS
A 0EAB       037E     A        FDB     B3-DOS
A 0EAD       03AE     A        FDB     B4-DOS
A 0EAF       0440     A        FDB     B5-DOS
A 0EB1       0529     A        FDB     B6-DOS
A 0EB3       0607     A        FDB     B7-DOS
A 0EB5       0610     A        FDB     B8-DOS
A 0EB7       0619     A        FDB     B9-DOS
A 0EB9       0622     A        FDB     B10-DOS
A 0EBB       06EA     A        FDB     B11-DOS
A 0EBD       0762     A        FDB     B12-DOS
A 0EBF       07D9     A        FDB     B13-DOS
A 0EC1       088A     A        FDB     B14-DOS
A 0EC3       08B1     A        FDB     B15-DOS
A 0EC5       0984     A        FDB     B16-DOS
A 0EC7       0A49     A        FDB     B17-DOS
A 0EC9       0C08     A        FDB     B18-DOS
A 0ECB       0CA1     A        FDB     B19-DOS
A 0ECD       0D2A     A        FDB     B20-DOS
                             * MINIMUM INITIALIZATION FOLLOWS
A 0ECF                  DOS1   DOS     DO,INIT    GO INITIALIZE (MENU ETC)
A 0ED5 4D                      TSTA
A 0ED6 27    04    0EDC        BEQ     DOS2
A 0ED8 AD    9F 0616 A         JSR     [ERROR]
A 0EDC 7E    0FF6     A DOS2   JMP     OBASIC
A 0EDF CC    10A2     A DOS3   LDD     #OVRLAY
A 0EE2 FD    0625     A        STD     >OLYLOC
A 0EE5 39                      RTS
```

```
PAGE  026  ML       .SA:0          DOS - PAGING & OVERLAYS

00390 01446                         *
00400 01447                         ****************************************************
00410 01448                         * 8 BIT PRINTER DRIVER
00420 01449                         * GIVEN: A=CHR TO BE SENT TO PRINTER
00430 01450                         * RETURNED:A IN TACT
00440 01451                         *          CC = Z CONDITION IF SENT OK
00450 01452                         *          CC = NON-Z IF PRINTER NOT READY - TRY AGAIN
00460 01453                         ****************************************************
00470 01454                         * IS PRINTER READY?
00480 01455A 0EE6 34    16        A DPRNT  PSHS   D,X
00490 01456A 0EE8 B6    FF22      A        LDA    >U4BDR
00500 01457A 0EEB 44                       LSRA
00510 01458A 0EEC 24    04    0EF2         BCC    DP1       IF READY
00520 01459A 0EEE 86    01        A        LDA    #1        SET NON-Z CONDITION
00530 01460A 0EF0 35    96        A        PULS   D,X,PC
00540 01461A 0EF2 34    01        A DP1    PSHS   CC        SAVE INTERUPT STATUS
00550 01462A 0EF4                          DSABLI NO        INTERUPTS DURING HARD LOOP TIMING
00560 01463A 0EF6 A6    61        A        LDA    1,S       CHR TO SEND
00570 01464A 0EF8 5F                       CLRB
00580 01465A 0EF9 8D    1A    0F15         BSR    LPSND     SEND START BIT
00590 01466A 0EFB C6    08        A        LDB    #8        BITS TO SEND
00600 01467A 0EFD 34    04        A        PSHS   B         LOOP COUNTER
00610 01468A 0EFF 5F              DP2      CLRB
00620 01469A 0F00 44                       LSRA
00630 01470A 0F01 59                       ROLB
00640 01471A 0F02 59                       ROLB
00650 01472A 0F03 8D    10    0F15         BSR    LPSND     SEND THE BIT
00660 01473A 0F05 6A    E4        A        DEC    ,S
00670 01474A 0F07 26    F6    0EFF         BNE    DP2       GO BACK FOR NEXT BIT
00680 01475A 0F09 35    04        A        PULS   B
00690 01476                         * INITIATE STOP BIT (IT CONTINUES UNTIL PRINTER SAYS "READY")
00700 01477A 0F0B C6    02        A        LDB    #2
00710 01478A 0F0D F7    FF20      A        STB    >U4ADR
00720 01479A 0F10 35    01        A        PULS   CC        RESTORE INTERUPT STATUS
00730 01480A 0F12 4F                       CLRA             SET ZERO CONDITION CODES
00740 01481A 0F13 35    96        A        PULS   D,X,PC
00750 01482A 0F15 F7    FF20      A LPSND  STB    >U4ADR    LATCH BIT TO OUTPUT
00760 01483A 0F18 BE    0623      A        LDX    >RATE     TIME CONSTANT FOR TRANSMISSION
00770 01484A 0F1B 30    1F        A LPDLP  LEAX   -1,X
00780 01485A 0F1D 26    FC    0F1B         BNE    LPDLP
00790 01486A 0F1F 39                       RTS
00800 01487                         *
00810 01488                         ***********************************************
00820 01489                         * TURN ON OR OFF A TIME DRIVEN ROUTINE
00830 01490                         * GIVEN: U-> START OF ROUTINE THAT FOLLOWS SPECS
00840 01491                         ***********************************************
00850 01492A 0F20 34    46        A DTMEON PSHS   D,U
00860 01493A 0F22 4D                       TSTA             REQ FOR ON OR OFF?
00870 01494A 0F23 27    0C    0F31         BEQ    DTMEOF    IF OFF
00880 01495A 0F25 FC    010D      A        LDD    >IRQ+1
00890 01496A 0F28 ED    41        A        STD    1,U
00900 01497A 0F2A 33    43        A        LEAU   3,U
00910 01498A 0F2C FF    010D      A        STU    >IRQ+1
00920 01499A 0F2F 35    C6        A        PULS   D,U,PC
00930 01500                         *
00940 01501                         ********************************
00950 01502                         * TURN OFF A TIME DRIVEN ROUTINE
00960 01503                         * GIVEN: U -> START OF ROUTINE
```

```
PAGE  027  ML       .SA:0          DOS - PAGING & OVERLAYS

00970 01504                         *******************************
00980 01505A 0F31 33    43       A DTMEOF LEAU    3,U       ADDR STORED IN CHAIN
00990 01506A 0F33 34    50       A        PSHS    X,U
01000 01507A 0F35 CE    010D     A        LDU     #IRQ+1
01010 01508A 0F38 AE    C4       A DTO    LDX     ,U        LOOK AT ADDR OF NEXT ROUTINE
01020 01509A 0F3A 8C    0F58     A        CMPX    #STDTME   IS IT END OF CHAIN?
01030 01510A 0F3D 27    0A   0F49         BEQ     DTO2      IF YES, GET OUT
01040 01511A 0F3F AC    62       A        CMPX    2,S       IS IT THE ONE SOUGHT?
01050 01512A 0F41 27    0A   0F4D         BEQ     DTO3      IF YES
01060 01513A 0F43 1F    03       A        TFR     D,U
01070 01514A 0F45 33    5E       A        LEAU    -2,U
01080 01515A 0F47 20    EF   0F38         BRA     DTO
01090 01516A 0F49 35    50       A DTO2   PULS    X,U
01100 01517A 0F4B 35    C6       A        PULS    D,U,PC
01110 01518                        * X POINTING AT DESIRED ROUTINE
01120 01519                        * U POINTING AT WHERE THAT POINTER CAME FROM
01130 01520A 0F4D AE    1E       A DTO3   LDX     -2,X      GET ADDR THAT DESIRED ROUTINE POINTS TO
01140 01521A 0F4F AF    C4       A        STX     ,U        UNLINK HIS ROUTINE
01150 01522A 0F51 35    50       A        PULS    X,U
01160 01523A 0F53 35    C6       A        PULS    D,U,PC
01170 01524                        *
01180 01525                        ***********************************************************
01190 01526                        * STANDARD TIME ROUTINE - LINKED IN BY INITIAL START UP ROUTINE
01200 01527                        ***********************************************************
01210 01528A 0F55 7E    0000     A STMX   JMP     >0
01220 01529A 0F58 FC    0620     A STDTME LDD     >CLOCK
01230 01530A 0F5B                         INCD
01240 01531A 0F5E FD    0620     A        STD     >CLOCK
01250 01532A 0F61 4F                      CLRA
01260 01533A 0F62 1F    8B       A        TFR     A,DP      ENSURE ROM ROUTINE USES PAGE ZERO
01270 01534A 0F64 20    EF   0F55         BRA     STMX
01280 01535                        *
01290 01536                        *******************************************************
01300 01537                        * CALL A SYSTEM OVERLAY (OR USER OVERLAY)
01310 01538                        * GIVEN: OVERLAY NUMBER IN "A"
01320 01539                        * OVERLAY IS LOADED IF NOT PRESENT IN MEMORY
01330 01540                        * NOTE: X IS NOT PRESERVED - USED FOR OVERLAY BASE ADDRESS
01340 01541                        *******************************************************
01350 01542A 0F66 8A    80       A USROLY ORA     #$80
01360 01543A 0F68 BE    0625     A SYSOLY LDX     >OLYLOC   POINT AT CURRENT OVERLAY LOAD AREA
01370 01544A 0F6B A1    1F       A        CMPA    -1,X      IS THE DESIRED OVERLAY ALREADY THERE?
01380 01545A 0F6D 27    11   0F80         BEQ     SYSO3     IF YES
01390 01546A 0F6F 34    04       A        PSHS    B
01400 01547A 0F71 4D                      TSTA              SYSTEM OR USER?
01410 01548A 0F72 2B    04   0F78         BMI     SYSO1     IF USER
01420 01549A 0F74 8D    5C   0FD2         BSR     SYSLOD    LOAD THE OVERLAY
01430 01550A 0F76 20    06   0F7E         BRA     SYSO2
01440 01551A 0F78 8D    45   0FBF SYSO1   BSR     USRLOD    LOAD THE OVERLAY
01450 01552A 0F7A 27    02   0F7E         BEQ     SYSO2     IF OK
01460 01553A 0F7C 35    84       A        PULS    B,PC      IF LOAD ERROR
01470 01554A 0F7E 35    04       A SYSO2  PULS    B
01480 01555A 0F80 8E    0F9B     A SYSO3  LDX     #SYSO4    WHERE TO GO ON THE WAY BACK FROM THE OVERLAY
01490 01556A 0F83 34    10       A        PSHS    X
01500 01557A 0F85 BE    0625     A        LDX     >OLYLOC   OVERLAY LOAD AREA
01510 01558A 0F88 30    02       A        LEAX    2,X       ENTRY POINT WITHIN OVERLAY
01520 01559A 0F8A 34    10       A        PSHS    X
01530 01560A 0F8C 30    1E       A        LEAX    -2,X      PROVIDE USER WITH HIS BASE ADDRESS
01540 01561A 0F8E 34    14       A        PSHS    B,X
```

```
PAGE  028  ML      .SA:0         DOS - PAGING & OVERLAYS

01562A 0F90 EC    84      A         LDD    ,X        GET SIZE OF OVERLAY
01563A 0F92 30    8B      A         LEAX   D,X       POINT TO END OF OVERLAY
01564A 0F94 30    03      A         LEAX   3,X       POINT TO BASE OF NEXT OVERLAY AREA
01565A 0F96 BF    0625    A         STX    >OLYLOC
01566A 0F99 35    94      A         PULS   B,X,PC    BASE ADDR OF OVERLAY
01567                          *
01568                          * ON THE WAY BACK, ADJUST OLYLOC
01569A 0F9B 34    17      A SYS04   PSHS   CC,D,X
01570A 0F9D BE    0625    A         LDX    >OLYLOC
01571A 0FA0 30    1D      A         LEAX   -3,X
01572A 0FA2 EC    84      A         LDD    ,X        GET SIZE OF THIS OVERLAY
01573A 0FA4                         NEGD
01574A 0FA9 30    8B      A         LEAX   D,X       POINT AT BEGINNING OF OVERLAY I AM EXITING
01575A 0FAB BF    0625    A         STX    >OLYLOC   SAVE IT
01576A 0FAE 35    97      A         PULS   CC,D,X,PC
01577                          *
01578                          ***********************************************************
01579                          * RETURN FROM ONE OVERLAY & XFER CONTROL TO ANOTHER
01580                          * GIVEN: STACK NORMALIZED AS IF READY TO RTS FROM AN OVERLAY
01581                          *        A = DESIRED OVERLAY NUMBER
01582                          ***********************************************************
01583A 0FB0 8A    80      A DUSRGO  ORA    #$80
01584A 0FB2 34    06      A DGO     PSHS   D         SAVE D
01585A 0FB4 EC    64      A         LDD    4,S       (RET ADDR TO SYS04)
01586A 0FB6 ED    62      A         STD    2,S
01587A 0FB8 CC    0F68    A         LDD    #SYSOLY   CAUSE "RETURN" TO SYSOLY AFTER "UNDOING"
01588A 0FBB ED    64      A         STD    4,S
01589A 0FBD 35    86      A         PULS   D,PC      RETURNS TO SYS04
01590                          *
01591                          *****************************************
01592                          * LOAD A SYSTEM OVERLAY (OR USER OVERLAY)
01593                          * GIVEN: A = OVERLAY NUMBER
01594                          *****************************************
01595A 0FBF 8A    80      A USRLOD  ORA    #$80
01596A 0FC1 34    60      A         PSHS   Y,U
01597A 0FC3 10BE 0627     A         LDY    >USRBSE
01598A 0FC7 CE    0697    A         LDU    #USRDCB
01599A 0FCA 8D    7A   1046         BSR    PAGEIN    LOAD THE OVERLAY
01600A 0FCC 27    02   0FD0         BEQ    SLDX      IF LOADED OK
01601A 0FCE 86    17      A         LDA    #ERR23
01602A 0FD0 35    E0      A SLDX    PULS   Y,U,PC
01603A 0FD2 34    60      A SYSLOD  PSHS   Y,U
01604A 0FD4 108E 0EA5     A         LDY    #DOS+1    LOC OF OVERLAY'S RBA TABLE IN MEMORY
01605A 0FD8 CE    0635    A         LDU    #DOSDCB   POINT AT SYSTEM'S DCB
01606A 0FDB 8D    69   1046         BSR    PAGEIN    LOAD THE OVERLAY
01607A 0FDD 26    02   0FE1         BNE    ABORT     IF SYSTEM FAILURE
01608A 0FDF 35    E0      A         PULS   Y,U,PC
01609                          *
01610                          **********************************************
01611                          * FATAL ERROR OCCURRED IN DOS - CAN'T PROCEED
01612                          **********************************************
01613A 0FE1 8E    0400    A ABORT   LDX    #$400     VID
01614A 0FE4 CE    100D    A         LDU    #ABTMSG
01615A 0FE7 C6    10      A         LDB    #16
01616A 0FE9 17    FC7B 0C67         LBSR   XFRUX
01617A 0FEC CE    0400    A         LDU    #$400
01618A 0FEF C6    F0      A         LDB    #256-16
01619A 0FF1 17    FC73 0C67         LBSR   XFRUX
```

```
PAGE  029  ML       .SA:0          DOS - PAGING & OVERLAYS

02130 01620A 0FF4 8D    3F    1035        BSR    DERR     WAIT FOR A KEYSTROKE
02140 01621A 0FF6 4D                 OBASIC TSTA
02150 01622A 0FF7 27    0D    1006        BEQ    OBAS1
02160 01623A 0FF9 10CE 0400     A         LDS    #STACK
02170 01624A 0FFD BD    0EDF     A         JSR    DOS3     RESET STACK & OLYLOC
02180 01625A 1000                         DOS    DO,MENU
02190 01626A 1006 7F    0071     A OBAS1  CLR    >$71
02200 01627A 1009 6E    9F FFFE A         JMP    [$FFFE]
02210 01628A 100D       53       A ABTMSG FCC    /SYSTEM/
02220 01629A 1013       60       A         FCB    $60
02230 01630A 1014       46       A         FCC    /FAILURE/
02240 01631A 101B       6060     A         FDB    $6060
02250 01632                        *
02260 01633                        *************************
02270 01634                        * USER ABORT ROUTINE
02280 01635                        * GIVEN: ERROR NUMBER IN A
02290 01636                        *************************
02300 01637A 101D 1F    89       A DERROR TFR    A,B
02310 01638A 101F 86    01       A         LDA    #1       (ADD 256 TO IT)
02320 01639A 1021 34    06       A         PSHS   D        SAVE FOR LATER
02330 01640A 1023 CC    0032     A         LDD    #50      START OF INSTRUCTIONS
02340 01641A 1026 108E 0045     A         LDY    #69      END OF INSTRUCTIONS
02350 01642A 102A CE    0000     A         LDU    #0       CLEAR SCREEN FIRST
02360 01643A 102D 8D    0D    103C        BSR    DOMAP    GIVE INSTRUCTIONS
02370 01644A 102F 35    06       A         PULS   D
02380 01645A 1031 1F    02       A         TFR    D,Y
02390 01646A 1033 8D    07    103C        BSR    DOMAP    DISPLAY ERROR
02400 01647A 1035                  DERR   SYSTEM POLCAT   WAIT FOR ANY KEYSTROKE
02410 01648A 1039 27    FA    1035        BEQ    DERR
02420 01649A 103B 39                      RTS
02430 01650                        *
02440 01651                        ************************
02450 01652                        * DO MAP DISPLAY FUNCTION
02460 01653                        ************************
02470 01654A 103C 34    66       A DOMAP  PSHS   D,Y,U
02480 01655A 103E                         DOS    DO,MAP
02490 01656A 1044 35    E6       A         PULS   D,Y,U,PC
02500 01657                        *
02510 01658                        ***********************************************************************
02520 01659                        * L O A D   O V E R L A Y   R O U T I N E
02530 01660                        *
02540 01661                        * GIVEN: A=OVERLAY NUMBER
02550 01662                        *         U-> PROGRAM DCB
02560 01663                        *         Y-> TABLE CONTAINING RBA'S OF OVERLAYS
02570 01664                        *         THE FILE MUST HAVE PREVIOUSLY BEEN OPENED!
02580 01665                        ***********************************************************************
02590 01666A 1046 BE    0625     A PAGEIN LDX    >OLYLOC
02600 01667A 1049 A7    1F       A         STA    -1,X
02610 01668A 104B 1F    89       A         TFR    A,B
02620 01669A 104D C4    7F       A         ANDB   #$7F
02630 01670A 104F 58                      LSLB            2 BYTES PER VECTOR
02640 01671A 1050 4F                      CLRA
02650 01672A 1051 EC    AB       A         LDD    D,Y      GET RBA OF START OF OVERLAY
02660 01673A 1053 C3    0005     A         ADDD   #5       ADJUST TO RBA WITHIN DISK FILE
02670 01674A 1056 6F    C8 2B    A         CLR    DCBRBA,U
02680 01675A 1059 ED    C8 2C    A         STD    DCBRBA+1,U
02690 01676A 105C CC    0002     A         LDD    #2       LENGTH OF A SIZE FIELD
02700 01677A 105F ED    C8 11    A         STD    DCBRSZ,U SET TO READ 2 BYTES
```

```
PAGE  030  ML       .SA:0          DOS - PAGING & OVERLAYS

02710 01678A 1062 AF    C8 27    A        STX     DCBLRB,U
02720 01679A 1065 CC    FFFF     A        LDD     #$FFFF
02730 01680A 1068 ED    C8 29    A        STD     DCBPRN,U FORCE INITIAL PHYSICAL READ
02740 01681A 106B 8D    18   1085         BSR     PIRD
02750 01682A 106D 30    02       A        LEAX    2,X
02760 01683A 106F EC    D8 27    A        LDD     [DCBLRB,U] LENGTH OF ROUTINE (INCLUDING SIZE WORD)
02770 01684A 1072 AF    C8 27    A        STX     DCBLRB,U WHERE REST OF OVERLAY GOES
02780 01685A 1075 30    8B       A        LEAX    D,X      POINT TO END OF OVERLAY + 2
02790 01686A 1077 ED    1E       A        STD     -2,X     SAVE HIS SIZE AT END
02800 01687A 1079 6F    84       A        CLR     ,X       SAY NO VALID OVERLAYS FOLLOW
02810 01688A 107B 83    0002     A        SUBD    #2       SIZE OF THE REST
02820 01689A 107E ED    C8 11    A        STD     DCBRSZ,U SAVE AS RECORD SIZE
02830 01690A 1081 8D    02   1085         BSR     PIRD
02840 01691A 1083 4F                      CLRA
02850 01692A 1084 39                      RTS
02860 01693A 1085                  PIRD   DOS     READ,RBA
02870 01694A 108B 27    08   1095         BEQ     PIERX
02880 01695A 108D 32    62       A        LEAS    2,S      BYPASS RET ADDR
02890 01696A 108F BE    0625     A PIERR  LDX     >OLYLOC
02900 01697A 1092 6F    84       A        CLR     ,X       SAY THIS OVERLAY DOSN'T EXIST IN MEMORY
02910 01698A 1094 4D                      TSTA             SET COND CODES
02920 01699A 1095 39               PIERX  RTS
02930 01700                        *
02940 01701                        *****************************************************
02950 01702                        * MINIMUM LOGIC TO LOAD & PASS CONTROL TO USER PROGRAM
02960 01703                        * JUMP HERE FROM OVERLAY 12
02970 01704                        *****************************************************
02980 01705A 1096                  B12A   DOS     READ,RBA READ IN THE ROOT SEGMENT
02990 01706A 109C AE    C8 27    A        LDX     DCBLRB,U BASE OF PROGRAM
03000 01707A 109F 1F    15       A        TFR     X,PC     JUMP TO ROOT
03010 01708                        *
03020 01709A 10A1       00       A        FCB     0        PLACE WHERE NUMBER OF 1ST OVERLAY LOADED GOES
03030 01710                        *
03040 01711                        ***********************************************************************
03050 01712                        *          O V E R L A Y   S E C T I O N   F O L L O W S
03060 01713                        * ALL SECTIONS THAT FOLLOW ARE RELOCATABLE.
03070 01714                        * (THE FIRST OVERLAY IS LOADED AT THIS ADDRESS)
03080 01715                        ***********************************************************************
03090 01716                        *
03100 01717                        * THE FOLLOWING ROUTINE SIMPLY SHIFTS PART OF DOS DOWN TO $989.  IT
03110 01718                        * IS LOADED AFTER THE END OF THE REST OF THE PGM SO AS TO PREVENT
03120 01719                        * CONFLICTS WITH BASIC.
03130 01720                        * IT IS CLOBBERED WHEN FIRST OVERLAY IS LOADED!
03140 01721A 10A2 8E    1BD0     A OVRLAY LDX     #LASTPG
03150 01722A 10A5 CE    0989     A        LDU     #$989
03160 01723A 10A8 108E 051B      A        LDY     #DOS-ORGIN AMOUNT OF PGM TO XFER
03170 01724A 10AC A6    80       A OVLP   LDA     ,X+
03180 01725A 10AE A7    C0       A        STA     ,U+
03190 01726A 10B0 31    3F       A        LEAY    -1,Y
03200 01727A 10B2 26    F8   10AC         BNE     OVLP
03210 01728                        * INITIALIZE VECTORS AT $600
03220 01729A 10B4 CE    0600     A        LDU     #$600
03230 01730A 10B7 8E    1104     A        LDX     #VECINI
03240 01731A 10BA C6    C8       A        LDB     #ENDVEC-VECINI
03250 01732A 10BC BD    0C6F     A        JSR     XFRXU    MOVE IT TO $600
03260 01733                        * FROM THIS POINT ON, VECTORS AT $600 MAY BE USED
03270 01734A 10BF 10CE 0400      A        LDS     #STACK
03280 01735A 10C3 BE    010D     A        LDX     >IRQ+1   VECTOR TO DISK ROM TIME ROUTINE
```

```
03290 01736A 10C6 30   05     A        LEAX  5,X       BYPASS CHECK FOR WHICH INTERUPT IT IS
03300 01737A 10C8 BF   010D   A        STX   >IRQ+1    STORE REVISED ENTRY POINT
03310 01738A 10CB CE   0F55   A        LDU   #STMX
03320 01739A 10CE                      DOS   TIME,ON
03330 01740A 10D4 FC   A000   A        LDD   >POLCAT   ADDR OF ROM KBD SCAN ROUTINE
03340 01741A 10D7 FD   061C   A        STD   >KEYIN    SAVE IN KEYIN VECTOR
03350 01742                     * DETERMINE MEMORY SIZE
03360 01743A 10DA 8E   7FFF   A        LDX   #$7FFF    END OF 32K
03370 01744A 10DD A6   84     A        LDA   ,X
03380 01745A 10DF 43                   COMA
03390 01746A 10E0 A7   84     A        STA   ,X
03400 01747A 10E2 A1   84     A        CMPA  ,X
03410 01748A 10E4 27   03   10E9       BEQ   OVLP1     IF 32K MACHINE
03420 01749A 10E6 8E   3FFF   A        LDX   #$3FFF    FOR 16K
03430 01750A 10E9 BF   08DC   A OVLP1  STX   >MAXMEM
03440 01751A 10EC 86   04     A        LDA   #4        MAX NUMBER OF DRIVES
03450 01752A 10EE B7   08DE   A        STA   DRIVES
03460 01753A 10F1 CE   0635   A        LDU   #DOSDCB
03470 01754A 10F4 10CE 0400   A        LDS   #STACK
03480 01755A 10F8 BD   0EDF   A        JSR   DOS3
03490 01756A 10FB                      DOS   OPEN,INPUT READ ONLY
03500 01757A 1101 7E   0EA4   A        JMP   DOS
03510 01758                     *
03520 01759A 1104      0989   A VECINI FDB   DOPEN     POINTER TO OPEN FUNCTION
03530 01760A 1106      0A52   A        FDB   DCLOSE
03540 01761A 1108      0AE2   A        FDB   DREAD
03550 01762A 110A      0BE8   A        FDB   DWRITE
03560 01763A 110C      0C40   A        FDB   DRELSE    RELEASE I/O BUFFER
03570 01764A 110E      0F68   A        FDB   SYSOLY    CALL SYSTEM OVERLAY
03580 01765A 1110      0FB2   A        FDB   DGO       JUMP BETWEEN SYSTEM OVERLAYS
03590 01766A 1112      0FD2   A        FDB   SYSLOD    LOAD A SYSTEM OVERLAY
03600 01767A 1114      0F66   A        FDB   USROLY    CALL USER OVERLAY
03610 01768A 1116      0FB0   A        FDB   DUSRGO    JUMP BETWEEN USER OVERLAYS
03620 01769A 1118      0FBF   A        FDB   USRLOD    LOAD A USER OVERLAY
03630 01770A 111A      101D   A        FDB   DERROR    USER FATAL ERROR EXIT
03640 01771A 111C      0F20   A        FDB   DTMEON    TIME ROUTINE ON/OFF
03650 01772A 111E      0EE6   A        FDB   DPRNT     8 BIT PRINTER DRIVER
03660 01773A 1120      0000   A        FDB   0         SLOT FOR KEYIN
03670 01774A 1122      0FF6   A        FDB   OBASIC    RETURN TO BASIC
03680 01775A 1124      0000   A        FDB   0         INITIAL CLOCK VALUE
03690 01776A 1126      05     A        FCB   5         INITIAL RETRY COUNT
03700 01777A 1127      00AE   A        FDB   $AE       PRINTER TIME CONSTANT
03710 01778A 1129      10A2   A        FDB   OVRLAY    LOAD ADDRESS FOR NEXT OVERLAY
03720 01779A 112B      0000   A        FDB   0         BASE ADDR OF USER PGM + 1
03730 01780A 112D      0633   A        FDB   RETURN    HOOK1
03740 01781A 112F      0633   A        FDB   RETURN    HOOK2
03750 01782A 1131      0633   A        FDB   RETURN    HOOK3
03760 01783A 1133      0633   A        FDB   RETURN    HOOK4
03770 01784A 1135      0633   A        FDB   RETURN    HOOK5
03780 01785A 1137      3939   A        FDB   $3939     RETURN CODE FOR HOOKS
03790 01786                     * INIT COPY OF DOSDCB
03800 01787A 1139      44     A        FCC   /DOS      BIN/
03810 01788A 1144      00     A        FCB   0,0,0,0,0,0,0,0,0
03820 01789A 114D      00     A        FCB   0,0,0,0,0,0,0,0,0,0,0,0
03830 01790A 1159      00     A        FCB   0,$FF,0,0
03840 01791A 115D      06C8   A        FDB   SYSBUF
03850 01792A 115F      00     A        FCB   0
03860 01793A 1160      06C8   A        FDB   SYSBUF
```

```
PAGE  032  ML       .SA:0         DOS - PAGING & OVERLAYS

01794A 1162       00       A         FCB    0,0,0,0,0,0,0,0
01795                        * INIT COPY OF MSGDCB
01796A 116A       44       A         FCC    /DOS      BAS/
01797A 1175       00       A         FCB    0,0,0,0,0,0,0,0,0
01798A 117E       00       A         FCB    0,0,0,0,0,0,0,0,0,0,0,0
01799A 118A       00       A         FCB    0,$FF,0,0
01800A 118E       06C8     A         FDB    SYSBUF
01801A 1190       00       A         FCB    0
01802A 1191       0000     A         FDB    0         (SET WHEN USED)
01803A 1193       00       A         FCB    0,0,0,0,0,0,0,0
01804                        * INIT COPY OF USER PGM DCB
01805A 119B       20       A         FCC    /         BIN/
01806A 11A6       00       A         FCB    0,0,0,0,0,0,0,0,0
01807A 11AF       00       A         FCB    0,0,0,0,0,0,0,0,0,0,0,0
01808A 11BB       00       A         FCB    0,$FF,0,0
01809A 11BF       06C8     A         FDB    SYSBUF
01810A 11C1       00       A         FCB    0
01811A 11C2       0000     A         FDB    00
01812A 11C4       00       A         FCB    0,0,0,0,0,0,0,0
01813                        *
01814A 11CC       00       A ENDVEC FCB    0         END OF PRESET DATA
01815                        *
01816                        ***************************************************************************
01817                        * INITIAL START UP - CHECK FOR AUTO EXECUTE
01818                        *
01819                        ***************************************************************************
01820A 11CD       0033     A B1     FDB    B2-B1     SIZE OF OVERLAY
01821                        * CHECK FOR AUTO PROGRAM EXECUTION
01822A 11CF CC   0001     A        LDD    #$1
01823A 11D2 108E 0001     A        LDY    #$1
01824A 11D6 CE   0000     A        LDU    #$0
01825A 11D9 BD   103C     A        JSR    DOMAP     CLR SCREEN & IF AUTO EXISTS, DISPLAY IT
01826A 11DC 8E   0697     A        LDX    #USRDCB
01827A 11DF C6   08       A        LDB    #8        NAME LENGTH
01828A 11E1 A6   C4       A        LDA    ,U        GET 1ST CHR FROM SCREEN
01829A 11E3 81   60       A        CMPA   #$60      IS IT A BLANK?
01830A 11E5 27   13    11FA        BEQ    MENU0     IF YES, NO AUTO FUNCTION
01831A 11E7 A6   C0       A STRT1  LDA    ,U+
01832A 11E9 81   60       A        CMPA   #$60
01833A 11EB 25   02    11EF        BCS    STRT2
01834A 11ED 88   40       A        EORA   #$40
01835A 11EF A7   80       A STRT2  STA    ,X+
01836A 11F1 5A                     DECB
01837A 11F2 26   F3    11E7        BNE    STRT1
01838A 11F4                        DOS    GO,EXEC   GO LOAD & EXECUTE PROGRAM
01839A 11FA                  MENU0 DOS    GO,MENU   GO DISPLAY MENU & RE-INITIALIZE
01840                        *
01841                        ********************************************************
01842                        * MAIN MENU SELECTION 2 - EXECUTE A PROGRAM
01843                        ********************************************************
01844A 1200       0022     A B2     FDB    B3-B2     SIZE OF OVERLAY
01845A 1202 CC   0200     A        LDD    #512      STARTING LINE NUMBER
01846A 1205 108E 0225     A        LDY    #549      ENDING NUMBER
01847A 1209 CE   0000     A        LDU    #0
01848A 120C BD   103C     A        JSR    DOMAP     DISPLAY SCREEN FORMAT & GET ADDR OF INPUT FIELD
01849                        * NOTE U -> FIRST INPUT FIELD ON SCREEN
01850A 120F 8E   0697     A        LDX    #USRDCB   POINT AT DCB
01851A 1212 34   50       A        PSHS   X,U       ADDR OF VID AREA & DEST AREA
```

```
PAGE  033  OLY      .SA:0         DOS - PAGING & OVERLAYS

00370 01852A 1214                          DOS    DO,FIELDI INPUT A FIELD
00380 01853A 121A 35    50      A          PULS   X,U
00390 01854A 121C                          DOS    GO,EXEC  GO EXECUTE IT
00400 01855                       *
00410 01856                       ***********************************************
00420 01857                       * MAIN MENU SELECTION 3 - TURN ON CLOCK DISPLAY
00430 01858                       ***********************************************
00440 01859A 1222      0030     A B3       FDB    B4-B3     SIZE OF OVERLAY
00450 01860A 1224 FC   08DC     A          LDD    MAXMEM
00460 01861A 1227 83   00B6     A          SUBD   #B14-B13+5 ALLOW ROOM FOR CLOCK ROUTINE
00470 01862A 122A FD   08DC     A          STD    MAXMEM
00480 01863A 122D 10BE 0625     A          LDY    OLYLOC
00490 01864A 1231 34   20       A          PSHS   Y
00500 01865A 1233 FD   0625     A          STD    OLYLOC
00510 01866A 1236 CE   0418     A          LDU    #$400+32-8 DISPLAY AT TOP RIGHT CORNER
00520 01867A 1239 5F                       CLRB
00530 01868A 123A 108E 0007     A          LDY    #7
00540 01869A 123E                          DOS    DO,REALTM TURN ON DISPLAY
00550 01870A 1244 32   64       A          LEAS   4,S       NORMALIZE STACK
00560 01871A 1246 35   20       A          PULS   Y
00570 01872A 1248 10BF 0625     A          STY    OLYLOC
00580 01873A 124C                          DOS    GO,MENU
00590 01874                       *
00600 01875                       ***********************************************
00610 01876                       * MAIN MENU SELECTION 4 - DISPLAY FREE SPACE MAP
00620 01877                       ***********************************************
00630 01878A 1252      0092     A B4       FDB    B5-B4     SIZE
00640 01879A 1254 CC   0046     A          LDD    #70       START OF SCREEN FORMAT
00650 01880A 1257 108E 0063     A          LDY    #99       END OF FORMAT
00660 01881A 125B CE   0000     A          LDU    #0
00670 01882A 125E BD   103C     A          JSR    DOMAP     DISPLAY FORMAT
00680 01883A 1261 4F                       CLRA
00690 01884A 1262 34   02       A          PSHS   A         (DRIVE COUNTER)
00700 01885A 1264 CE   0400     A          LDU    #$400     VID BUFFER
00710 01886A 1267 8D   6C   12D5           BSR    FRES1     FIND STARTING DISPLAY POSN
00720 01887                       * LOOP ONCE PER DRIVE
00730 01888A 1269 1183 05FF     A FRE1     CMPU   #$5FF     MORE DISPLAY ROOM?
00740 01889A 126D 24   3D   12AC           BCC    FREX      IF NO
00750 01890A 126F 34   40       A          PSHS   U         SAVE NEXT DISPLAY ADDRESS
00760 01891A 1271 BE   C006     A          LDX    >$C006    POINT AT PARAMETERS
00770 01892A 1274 86   02       A          LDA    #2        (READ)
00780 01893A 1276 E6   62       A          LDB    2,S       (DRIVE)
00790 01894A 1278 ED   81       A          STD    ,X++
00800 01895A 127A CC   1102     A          LDD    #$1102    (TRK 17, SEC 2)
00810 01896A 127D ED   81       A          STD    ,X++
00820 01897A 127F CC   06C8     A          LDD    #SYSBUF
00830 01898A 1282 ED   81       A          STD    ,X++
00840 01899A 1284 86   02       A          LDA    #2        (ONLY 2 RETRYS)
00850 01900A 1286 B7   0622     A          STA    >RETRYS
00860 01901A 1289 BD   0D1D     A          JSR    DOIO
00870 01902A 128C 86   05       A          LDA    #5        (RESTORE TO 5)
00880 01903A 128E B7   0622     A          STA    >RETRYS
00890 01904A 1291 35   40       A          PULS   U         (DISPLAY LOC)
00900 01905A 1293 108E 06C8     A          LDY    #SYSBUF
00910 01906A 1297 C6   44       A          LDB    #68       LOOP COUNT
00920 01907A 1299 A6   84       A          LDA    ,X        RESULT
00930 01908A 129B 27   1B   12B8           BEQ    FRES      IF OK
00940 01909A 129D 86   58       A FRE3     LDA    #$58      (X)
```

```
PAGE  034  OLY      .SA:0         DOS - PAGING & OVERLAYS

00950 01910A 129F 8D    32    12D3         BSR    FRESET
00960 01911A 12A1 5A                       DECB
00970 01912A 12A2 26    F9    129D         BNE    FRE3
00980 01913A 12A4 6C    E4       A FRE4    INC    ,S        DRIVE COUNT
00990 01914A 12A6 A6    E4       A         LDA    ,S
01000 01915A 12A8 81    04       A         CMPA   #4        MORE DRIVES TO GO?
01010 01916A 12AA 25    BD    1269         BCS    FRE1      IF YES
01020 01917A 12AC BD    1035     A FREX    JSR    DERR      WAIT FOR A KEYSTROKE
01030 01918A 12AF 35    02       A         PULS   A
01040 01919A 12B1                          DOS    GO,MENU
01050 01920A 12B7 39                       RTS
01060 01921                        * DISPLAY FOR THIS DRIVE
01070 01922A 12B8 A6    A0       A FRE5    LDA    ,Y+
01080 01923A 12BA 2B    04    12C0         BMI    FRE6      IF PART OR ALL AVAILABLE
01090 01924A 12BC 86    58       A         LDA    #$58      (X)
01100 01925A 12BE 20    0C    12CC         BRA    FRE8
01110 01926A 12C0 81    FF       A FRE6    CMPA   #$FF      ALL AVAILABLE?
01120 01927A 12C2 26    04    12CB         BNE    FRE7      IF PART USED
01130 01928A 12C4 86    6E       A         LDA    #$6E      (PERIOD)
01140 01929A 12C6 20    04    12CC         BRA    FRE8
01150 01930A 12C8 84    0F       A FRE7    ANDA   #$F
01160 01931A 12CA 8A    70       A         ORA    #$70
01170 01932A 12CC 8D    05    12D3 FRE8    BSR    FRESET
01180 01933A 12CE 5A                       DECB
01190 01934A 12CF 26    E7    12B8         BNE    FRE5
01200 01935A 12D1 20    D1    12A4         BRA    FRE4      GO BACK FOR NEXT DRIVE
01210 01936                        *
01220 01937                        * STORE CHR ON SCREEN & FIND NEXT DISPLAY POSN
01230 01938A 12D3 A7    5F       A FRESET STA     -1,U
01240 01939A 12D5 A6    C0       A FRES1  LDA     ,U+
01250 01940A 12D7 81    6E       A         CMPA   #$6E      PERIOD?
01260 01941A 12D9 27    08    12E3         BEQ    FRESX
01270 01942A 12DB 1183 0600      A         CMPU   #$600     END OF SCREEN?
01280 01943A 12DF 26    F4    12D5         BNE    FRES1     IF NO
01290 01944A 12E1 33    5F       A         LEAU   -1,U
01300 01945A 12E3 39               FRESX   RTS
01310 01946                        *
01320 01947                        ************************************
01330 01948                        * MAIN MENU SELECTION 5 - COPY FILES
01340 01949                        ************************************
01350 01950A 12E4       00E9     A B5      FDB    B6-B5     SIZE OF OVERLAY
01360 01951A 12E6 34    10       A         PSHS   X
01370 01952A 12E8 20    62    134C         BRA    B5A
01380 01953A 12EA       0031     A B5DCB1 RMB     DCBSZ
01390 01954A 131B       0031     A B5DCB2 RMB     DCBSZ
01400 01955A 134C CC    0226     A B5A     LDD    #550      START OF FORMAT
01410 01956A 134F 108E 0257      A         LDY    #599      END OF FORMAT
01420 01957A 1353 CE    0000     A         LDU    #0        CLEAR SCREEN FIRST
01430 01958A 1356 BD    103C     A         JSR    DOMAP     DISPLAY SCREEN
01440 01959A 1359 C6    07       A         LDB    #7
01450 01960A 135B                          DOS    DO,INPTS
01460 01961A 1361 C1    03       A         CMPB   #BREAK
01470 01962A 1363 27    5F    13C4         BEQ    B5X
01480 01963                        *
01490 01964                        * ENTER PUSHED SET UP DCBS
01500 01965A 1365 8E    0400     A B5J     LDX    #$400
01510 01966A 1368 EE    E4       A         LDU    ,S        BASE ADDR
01520 01967A 136A 33    46       A         LEAU   B5DCB1-B5,U POINT AT SOURCE DCB
```

```
PAGE  035  OLY     .SA:0          DOS - PAGING & OVERLAYS

01968A 136C BD   07   1375          BSR     B5K       SET UP SOURCE DCB
01969A 136E 33   C8 31   A          LEAU    DCBSZ,U   POINT AT DEST DCB
01970A 1371 BD   02   1375          BSR     B5K
01971A 1373 20   2F   13A4          BRA     B5L
01972                        * SETUP A DCB
01973A 1375 BD   18   138F B5K      BSR     B5TAB
01974A 1377 C6   08      A          LDB     #8
01975A 1379 31   C4      A          LEAY    ,U
01976A 137B BD   19   1396          BSR     B5MOV
01977A 137D 8D   10   138F          BSR     B5TAB
01978A 137F 31   48      A          LEAY    DCBFEX,U
01979A 1381 C6   03      A          LDB     #3
01980A 1383 8D   11   1396          BSR     B5MOV     MOVE EXTENTION
01981A 1385 8D   08   138F          BSR     B5TAB
01982A 1387 A6   84      A          LDA     ,X
01983A 1389 80   70      A          SUBA    #$70      (ZERO)
01984A 138B A7   C8 21   A          STA     DCBDRV,U
01985A 138E 39                      RTS
01986A 138F A6   80      A B5TAB    LDA     ,X+
01987A 1391 81   5B      A          CMPA    #$5B
01988A 1393 26   FA   138F          BNE     B5TAB
01989A 1395 39                      RTS
01990A 1396 A6   80      A B5MOV    LDA     ,X+
01991A 1398 81   60      A          CMPA    #$60
01992A 139A 25   02   139E          BCS     B5MOV1
01993A 139C 80   40      A          SUBA    #$40
01994A 139E A7   A0      A B5MOV1   STA     ,Y+
01995A 13A0 5A                      DECB
01996A 13A1 26   F3   1396          BNE     B5MOV
01997A 13A3 39                      RTS
01998                        *
01999A 13A4 8D   E9   138F B5L      BSR     B5TAB     TO Y/N
02000A 13A6 E6   84      A          LDB     ,X
02001A 13A8 C1   59      A          CMPB    #$59      Y
02002A 13AA 27   04   13B0          BEQ     B5M
02003A 13AC C1   4E      A          CMPB    #$4E      N
02004A 13AE 26   14   13C4          BNE     B5X
02005A 13B0 AE   E4      A B5M      LDX     ,S        BASE
02006A 13B2 33   06      A          LEAU    B5DCB1-B5,X
02007A 13B4 31   88 37   A          LEAY    B5DCB2-B5,X
02008A 13B7                         DOS     DO,COPY
02009A 13BD 4D                      TSTA
02010A 13BE 27   04   13C4          BEQ     B5X
02011A 13C0 AD   9F 0616 A          JSR     [ERROR]
02012                        *
02013A 13C4 35   10      A B5X      PULS    X
02014A 13C6                         DOS     GO,MENU
02015A 13CC 39                      RTS
02016                        *
02017                        *********************************
02018                        * DISPLAY SELECTED DIRECTORY LIST
02019                        *********************************
02020A 13CD      00DE    A B6       FDB     B7-B6
02021A 13CF 30   89 000A A          LEAX    B6ARG-B6,X
02022A 13D3 34   10      A          PSHS    X
02023A 13D5 20   2D   1404          BRA     B6A
02024A 13D7      00      A B6ARG    FCB     0,0
02025A 13D9      20      A          FCC     /             /
```

```
PAGE  036  OLY      .SA:0          DOS - PAGING & OVERLAYS

02110 02026A 13E4      20       A        FCC     /
02120 02027A 1404 CC   0258     A B6A    LDD     #600
02130 02028A 1407 108E 0289     A        LDY     #649
02140 02029A 140B CE   0000     A        LDU     #0
02150 02030A 140E BD   103C     A        JSR     DOMAP     DISPLAY INPUT SCREEN
02160 02031                       * GET USER INPUTS
02170 02032A 1411 C6   03       A        LDB     #3        NUMBER OF FIELDS
02180 02033A 1413                        DOS     DO,INPTS  GET INPUTS
02190 02034                       * SETUP ARGUMENTS
02200 02035A 1419 EE   E4       A        LDU     ,S
02210 02036A 141B 33   42       A        LEAU    2,U       POINT TO NAME
02220 02037A 141D 8E   0400     A        LDX     #$400
02230 02038A 1420 8D   74   1496         BSR     B6TAB
02240 02039A 1422 C6   08       A        LDB     #8
02250 02040A 1424 8D   77   149D         BSR     B6MOV
02260 02041A 1426 8D   6E   1496         BSR     B6TAB
02270 02042A 1428 C6   03       A        LDB     #3
02280 02043A 142A 8D   71   149D         BSR     B6MOV
02290 02044A 142C 8D   68   1496         BSR     B6TAB
02300 02045A 142E A6   80       A        LDA     ,X+
02310 02046A 1430 84   03       A        ANDA    #3
02320 02047A 1432 EE   E4       A        LDU     ,S
02330 02048A 1434 A7   C4       A        STA     ,U
02340 02049A 1436 6F   41       A        CLR     1,U
02350 02050                       * PREPARE LISTING
02360 02051A 1438 A6   80       A B6D    LDA     ,X+
02370 02052A 143A 81   6E       A        CMPA    #$6E      .
02380 02053A 143C 27   15   1453         BEQ     B6E
02390 02054A 143E 91   6F       A        CMPA    $6F       /
02400 02055A 1440 27   11   1453         BEQ     B6E
02410 02056A 1442 8C   0600     A        CMPX    #$600
02420 02057A 1445 25   F1   1438         BCS     B6D
02430 02058A 1447 BD   1035     A B6D1   JSR     DERR      WAIT FOR A KEYSTROKE
02440 02059A 144A 35   40       A        PULS    U
02450 02060A 144C                        DOS     GO,MENU
02460 02061A 1452 39                     RTS
02470 02062A 1453 EE   E4       A B6E    LDU     ,S
02480 02063A 1455 34   50       A        PSHS    X,U
02490 02064A 1457                        DOS     DO,SCNDIR
02500 02065A 145D 35   50       A        PULS    X,U
02510 02066A 145F A6   41       A        LDA     1,U       ENTRY FOUND?
02520 02067A 1461 2B   E4   1447         BMI     B6D1      IF NO
02530 02068A 1463 33   4D       A        LEAU    13,U      POINT AT NAME FOUND
02540 02069A 1465 30   1F       A        LEAX    -1,X
02550 02070A 1467 C6   08       A        LDB     #8        MAX NAME LENGTH
02560 02071                       * DISPLAY NAME
02570 02072A 1469 A6   84       A B6F    LDA     ,X
02580 02073A 146B 81   6E       A        CMPA    #$6E      .
02590 02074A 146D 26   09   1478         BNE     B6G
02600 02075A 146F A6   C0       A        LDA     ,U+
02610 02076A 1471 8A   40       A        ORA     #$40
02620 02077A 1473 A7   80       A        STA     ,X+
02630 02078A 1475 5A                     DECB
02640 02079A 1476 26   F1   1469         BNE     B6F
02650 02080                       * DISPLAY EXTENT
02660 02081A 1478 EE   E4       A B6G    LDU     ,S
02670 02082A 147A 33   C8 15    A        LEAU    21,U      POINT AT EXT
02680 02083A 147D A6   80       A        LDA     ,X+
```

```
PAGE  037  OLY      .SA:0          DOS - PAGING & OVERLAYS

02084A 147F 81     6F      A          CMPA    #$6F      /
02085A 1481 26     B5    1438         BNE     B6D       GO GET NEXT ONE
02086A 1483 C6     03      A          LDB     #3
02087A 1485 A6     84      A B6H      LDA     ,X
02088A 1487 81     6E      A          CMPA    #$6E      .
02089A 1489 26     AD    1438         BNE     B6D
02090A 148B A6     C0      A          LDA     ,U+
02091A 148D 8A     40      A          ORA     #$40
02092A 148F A7     80      A          STA     ,X+
02093A 1491 5A                        DECB
02094A 1492 26     F1    1485         BNE     B6H
02095A 1494 20     A2    1438         BRA     B6D
02096A 1496 A6     80      A B6TAB    LDA     ,X+
02097A 1498 81     5B      A          CMPA    #$5B
02098A 149A 26     FA    1496         BNE     B6TAB
02099A 149C 39                        RTS
02100A 149D A6     80      A B6MOV    LDA     ,X+
02101A 149F 81     60      A          CMPA    #$60
02102A 14A1 25     02    14A5         BCS     B6MOV1
02103A 14A3 80     40      A          SUBA    #$40
02104A 14A5 A7     C0      A B6MOV1   STA     ,U+
02105A 14A7 5A                        DECB
02106A 14A8 26     F3    149D         BNE     B6MOV
02107A 14AA 39                        RTS
02108                        *
02109                        ***********************************
02110                        * FILL FOR ROUTINES NOT YET WRITTEN
02111                        ***********************************
02112                        * (OTHER MAIN MENU FUNCTIONS)
02113A 14AB        0009    A B7       FDB     B8-B7     SIZE OF OVERLAY
02114A 14AD                           DOS     GO,MENU
02115A 14B3 39                        RTS
02116                        *
02117A 14B4        0009    A B8       FDB     B9-B8     SIZE OF OVERLAY
02118A 14B6                           DOS     GO,MENU
02119A 14BC 39                        RTS
02120                        *
02121A 14BD        0009    A B9       FDB     B10-B9    SIZE OF OVERLAY
02122A 14BF                           DOS     GO,MENU
02123A 14C5 39                        RTS
02124                        *
02125                        ***************************************************************************
02126                        * GET SCREEN LINES OUT OF BASIC FILE & DISPLAY
02127                        *
02128                        * GIVEN IN THE STACK(PUSHED BEFORE CALLING:
02129                        *  (,S = RET ADDR TO UNDO)
02130                        *  (2,S = RET ADDR TO CALLER)
02131                        *   4,S STARTING LINE NUMBER DESIRED
02132                        *   6,S ENDING LINE NUMBER DESIRED
02133                        *   8,S INITIAL DISPLAY LOC
02134                        ***************************************************************************
02135A 14C6        00C8    A B10      FDB     B11-B10   OVERLAY SIZE
02136              14C6    A MAPBSE   EQU     B10       (ONLY THIS LINE & ONE ABOVE MUST CHG TO USE DIF OVRLAY NBR)
02137A 14C8 20     03    14CD         BRA     MAP1      BYPASS LOCALS
02138A 14CA        00      A MAPOSW   FCB     0         FILE OPEN SW - 0 WHEN OVERLAY 1ST LOADED, 1 FROM THEN ON
02139A 14CB        0000    A MAPLN    FDB     0         LAST LINE NUMBER READ
02140                        *
02141A 14CD CE     0666    A MAP1     LDU     #MSGDCB   POINT AT DCB
```

```
PAGE  038  OLY      .SA:0          DOS - PAGING & OVERLAYS

03270 02142A 14D0 10BE 0625     A        LDY     >OLYLOC  (POINTS BEYOND THIS OVERLAY (WHERE NEXT OVRLAY WOULD GO)
03280 02143A 14D4 10AF C8 27    A        STY     DCBLRB,U USE AS LOGICAL RECORD BUFFER
03290 02144A 14D8 6D   04       A        TST     MAPOSW-MAPBSE,X FILE OPENED?
03300 02145A 14DA 26   16    14F2        BNE     MAP3     IF YES
03310 02146                        * IF FIRST TIME CALLED, OPEN DISK FILE
03320 02147A 14DC                        DOS     OPEN,INPUT OPEN DISK FILE
03330 02148A 14E2 86   01       A        LDA     #1
03340 02149A 14E4 A7   04       A        STA     MAPOSW-MAPBSE,X SAY FILE IS OPEN
03350 02150                        * RESET TO BEGINNING OF FILE
03360 02151A 14E6                  MAP2  CLRD
03370 02152A 14E8 ED   05       A        STD     MAPLN-MAPBSE,X RESET LAST LINE READ
03380 02153A 14EA ED   C8 2B    A        STD     DCBRBA,U
03390 02154A 14ED 86   03       A        LDA     #3       (START READING AT RBA 00 00 03)
03400 02155A 14EF A7   C8 2D    A        STA     DCBRBA+2,U
03410 02156                        * CHECK TO SEE IF FILE NEEDS TO BE RESET
03420 02157                        * (REQUEST MUST BE > LAST LINE READ)
03430 02158A 14F2 CC   FFFF     A MAP3   LDD     #$FFFF
03440 02159A 14F5 ED   C8 29    A        STD     DCBPRN,U TO FORCE RE-READ INTO BUFFER
03450 02160A 14F8 EC   05       A        LDD     MAPLN-MAPBSE,X LAST LINE READ
03460 02161A 14FA 10A3 64       A        CMPD    4,S      1ST LINE TO BE DISPLAYED
03470 02162A 14FD 24   E7    14E6        BCC     MAP2     GO START OVER AT BOF
03480 02163                        * CHECK DISPLAY LOC OPTION
03490 02164A 14FF EC   68       A        LDD     8,S      STARTING DISPLAY LOC
03500 02165A 1501 26   12    1515        BNE     MAP5     IF ADDRESS GIVEN
03510 02166                        * CLEAR THE SCREEN
03520 02167A 1503 CE   0400     A        LDU     #$400
03530 02168A 1506 EF   68       A        STU     8,S      START DISPLAY AT TOP OF SCREEN
03540 02169A 1508 CC   6060     A        LDD     #$6060   BLANKS
03550 02170A 150B 108E 0100     A        LDY     #256
03560 02171A 150F ED   C1       A MAP4   STD     ,U++
03570 02172A 1511 31   3F       A        LEAY    -1,Y
03580 02173A 1513 26   FA    150F        BNE     MAP4
03590 02174                        *
03600 02175                        * READ/DISPLAY LOOP
03610 02176                        * READ A LINE
03620 02177A 1515 CE   0666     A MAP5   LDU     #MSGDCB  POINT AT DCB
03630 02178A 1518 CC   0004     A        LDD     #4       LENGTH OF LINE NBR & MEM ADDR
03640 02179A 151B ED   C8 11    A        STD     DCBRSZ,U SET TO READ 4 BYTE RECORD
03650 02180A 151E                        DOS     READ,RBA
03660 02181A 1524 26   65    158B        BNE     MAPERR   IF I/O ERROR
03670 02182A 1526 10BE 0625     A        LDY     >OLYLOC  (LOGICAL REC BUFFER)
03680 02183A 152A EC   A4       A        LDD     ,Y       GET "MEMORY ADDRESS"
03690 02184A 152C 27   45    1573        BEQ     MAP10    IF AT EOF
03700 02185A 152E EC   22       A        LDD     2,Y      GET LINE NUMBER
03710 02186A 1530 ED   05       A        STD     MAPLN-MAPBSE,X SAVE FOR FUTURE REFERENCE
03720 02187A 1532 34   06       A        PSHS    D
03730 02188A 1534 6F   C8 12    A        CLR     DCBRSZ+1,U SET FOR VARIABLE LENGTH RECORDS
03740 02189A 1537                        DOS     READ,RBA READ A STRING
03750 02190A 153D 35   06       A        PULS    D
03760 02191A 153F 26   4A    158B        BNE     MAPERR   IF I/O ERROR
03770 02192A 1541 10A3 64       A        CMPD    4,S      IS AT LEAST AS FAR AS STARTING LINE NUMBER?
03780 02193A 1544 25   CF    1515        BCS     MAP5     NOT FAR ENOUGH, GO READ ANOTHER
03790 02194A 1546 10A3 66       A        CMPD    6,S      IS IT BEYOND LAST ONE?
03800 02195A 1549 27   02    154D        BEQ     MAP6     IF THIS IS THE LAST ONE
03810 02196A 154B 24   26    1573        BCC     MAP10    IF AT END OF RANGE
03820 02197                        * LINE FOUND - XFER IT TO SCREEN
03830 02198A 154D 34   30       A MAP6   PSHS    X,Y
03840 02199A 154F BE   0625     A        LDX     >OLYLOC
```

```
02200A 1552 30   01        A        LEAX   1,X       (SKIP THE "REM" CODE)
02201A 1554 10AE 6C        A        LDY    8+4,S     DESTINATION ADDRESS
02202                        * MOVE CHARACTER LOOP
02203A 1557 A6   80        A MAP7   LDA    ,X+       GET A CHARACTER
02204A 1559 A1   C8 13     A        CMPA   DCBTRM,U IS IT THE TERMINATOR BYTE?
02205A 155C 27   0A   1568          BEQ    MAP9      IF YES
02206A 155E 81   40        A        CMPA   #$40      IS IT SPL CHR?
02207A 1560 24   02   1564          BCC    MAP8      IF NO
02208A 1562 8A   40        A        ORA    #$40
02209A 1564 A7   A0        A MAP8   STA    ,Y+
02210A 1566 20   EF   1557          BRA    MAP7
02211A 1568 AE   6C        A MAP9   LDX    8+4,S
02212A 156A 30   88 20     A        LEAX   32,X
02213A 156D AF   6C        A        STX    8+4,S
02214A 156F 35   30        A        PULS   X,Y
02215A 1571 20   A2   1515          BRA    MAP5      GO GET NEXT LINE
02216                        * FIND START OF INPUT FIELD
02217A 1573 CE   0400      A MAP10  LDU    #$400
02218A 1576 108E 0200      A        LDY    #512      MAX CHRS TO TEST
02219A 157A 86   5B        A        LDA    #$5B      (LEFT BRACKET ON SCREEN)
02220A 157C A1   C0        A MAP11  CMPA   ,U+
02221A 157E 27   07   1587          BEQ    MAP12
02222A 1580 31   3F        A        LEAY   -1,Y
02223A 1582 26   F8   157C          BNE    MAP11
02224A 1584 CE   0400      A        LDU    #$400     IF NO FIELD FOUND
02225A 1587 EF   68        A MAP12  STU    8,S
02226A 1589 4F                      CLRA
02227A 158A 39                      RTS
02228A 158B 86   19        A MAPERR LDA    #ERR25
02229A 158D 39                      RTS
02230                        *
02231                        **********************************************************
02232                        * INPUT A FIELD FROM THE KEYBOARD (ECHO ON THE SCREEN)
02233                        *
02234                        * GIVEN: (,S = RET TO UNDO)
02235                        *         (2,S = RET TO CALLER
02236                        *         4,S = ADDR OF INPUT FIELD IN WS
02237                        *         6,S = ADDR OF INPUT FIELD ON SCREEN
02238                        **********************************************************
02239A 158E      0140      A B11    FDB    B12-B10   SIZE OF OVERLAY
02240A 1590 EE   66        A        LDU    6,S
02241A 1592 10AE 64        A        LDY    4,S
02242A 1595 1183 0400      A        CMPU   #$400     NO FIELD DEFINED?
02243A 1599 27   10   15AB          BEQ    FLDI2     IF NO FIELD MARKERS
02244                        * MOVE ORIG CONTENTS TO SCREEN
02245A 159B A6   C4        A FLDI1  LDA    ,U        LOOK AT DESTINATION POSITION
02246A 159D 81   5B        A        CMPA   #$5B      LEFT BRACKET?
02247A 159F 27   0A   15AB          BEQ    FLDI2     IF YES
02248A 15A1 81   5D        A        CMPA   #$5D      RIGHT BRACKET?
02249A 15A3 27   06   15AB          BEQ    FLDI2     IF YES
02250A 15A5 A6   A0        A        LDA    ,Y+
02251A 15A7 A7   C0        A        STA    ,U+
02252A 15A9 20   F0   159B          BRA    FLDI1
02253A 15AB BD   1035      A FLDI2  JSR    DERR      WAIT FOR A KEYSTROKE
02254A 15AE 1F   89        A        TFR    A,B
02255A 15B0 EE   66        A        LDU    6,S
02256A 15B2 10AE 64        A        LDY    4,S
02257A 15B5 1183 0400      A        CMPU   #$400     NO FIELD MARKERS?
```

```
PAGE  040  OLY      .SA:0          DOS - PAGING & OVERLAYS

04430 02258A 1589 27   4A   1605          BEQ    FLDIXX   IF NO FIELD MARKERS, EXIT WITH KEY IN A & B
04440 02259A 158B 81   20      A          CMPA   #$20     WAS IT LOW CONTROL KEY?
04450 02260A 158D 25   2A   15E9          BCS    FLDIX    IF YES
04460 02261A 158F 81   5B      A          CMPA   #$5B     SPL CHR/NUMBERS/UPPER CASE?
04470 02262A 15C1 25   04   15C7          BCS    FLDI4    IF YES
04480 02263A 15C3 81   60      A          CMPA   #$60     HIGH CONTROL CODES?
04490 02264A 15C5 25   22   15E9          BCS    FLDIX    IF YES
04500 02265                        * FALL THRU WITH LOWER CASE
04510 02266A 15C7 A6   C4      A FLDI4    LDA    ,U
04520 02267A 15C9 81   5B      A          CMPA   #$5B     IS CURSOR OVER START OF FIELD?
04530 02268A 15CB 27   1C   15E9          BEQ    FLDIX    IF YES
04540 02269A 15CD 81   5D      A          CMPA   #$5D     OVER END OF FIELD?
04550 02270A 15CF 27   18   15E9          BEQ    FLDIX    IF YES
04560 02271A 15D1 1F   98      A          TFR    B,A
04570 02272A 15D3 A7   A0      A          STA    ,Y+      SAVE CHR IN INPUT AREA
04580 02273A 15D5 81   40      A          CMPA   #$40     SPL CHR?
04590 02274A 15D7 24   02   15DB          BCC    FLDI5    IF YES
04600 02275A 15D9 8A   40      A          ORA    #$40
04610 02276A 15DB A7   C0      A FLDI5    STA    ,U+
04620 02277A 15DD 10AF 64      A FLDI5A   STY    4,S
04630 02278A 15E0 EF   66      A          STU    6,S
04640 02279A 15E2 5F                      CLRB
04650 02280A 15E3 A6   C4      A          LDA    ,U
04660 02281A 15E5 81   5D      A          CMPA   #$5D     FIELD OVERFLOW?
04670 02282A 15E7 26   C2   15AB          BNE    FLDI2
04680 02283                        *
04690 02284                        * EXIT WITH LAST KEY PUSHED IN B (ZERO IF FIELD OVERFLOW)
04700 02285A 15E9 81   08      A FLDIX    CMPA   #LEFT    (LEFT ARROW?)
04710 02286A 15EB 26   18   1605          BNE    FLDIXX
04720 02287A 15ED 86   20      A          LDA    #$20
04730 02288A 15EF A7   A4      A          STA    ,Y
04740 02289A 15F1 A7   C4      A          STA    ,U
04750 02290A 15F3 A6   5F      A          LDA    -1,U
04760 02291A 15F5 81   5B      A          CMPA   #$5B     IN FIRST POSN NOW?
04770 02292A 15F7 27   04   15FD          BEQ    FLDIX1   IF YES
04780 02293A 15F9 31   3F      A          LEAY   -1,Y
04790 02294A 15FB 33   5F      A          LEAU   -1,U
04800 02295A 15FD 86   20      A FLDIX1   LDA    #$20
04810 02296A 15FF A7   A4      A          STA    ,Y
04820 02297A 1601 A7   C4      A          STA    ,U
04830 02298A 1603 20   D8   15DD          BRA    FLDI5A
04840 02299A 1605 39               FLDIXX RTS
04850 02300                        *
04860 02301                        *******************************************
04870 02302                        * ACTUALLY LOAD AND EXECUTE PROGRAM
04880 02303                        * GIVEN: DCB FOR THE PROGRAM FILE STORED
04890 02304                        *         IN USRDCB
04900 02305                        *******************************************
04910 02306A 1606      0077    A B12      FDB    B13-B12  SIZE OF OVERLAY
04920 02307A 1608 34   10      A          PSHS   X        SAVE MY BASE (LOWEST LOAD ADDRESS ALLOWED)
04930 02308                        * STEP 1 OPEN THE PROGRAM FILE - DOES IT EXIST?
04940 02309A 160A CE   0697    A          LDU    #USRDCB
04950 02310A 160D 86   FF      A          LDA    #$FF
04960 02311A 160F A7   C8 21   A          STA    DCBDRV,U SEARCH ALL DRIVES
04970 02312A 1612                         DOS    OPEN,INPUT
04980 02313A 1618 27   10   162A          BEQ    EX1      IF OK
04990 02314A 161A 81   0D      A          CMPA   #ERR13   NOT PREV CLOSED IS OK
05000 02315A 161C 27   0C   162A          BEQ    EX1
```

```
PAGE  041  OLY      .SA:0          DOS - PAGING & OVERLAYS

05010 02316A 161E AD    9F 0616 A EXERR  JSR    [ERROR]
05020 02317A 1622 35    10      A        PULS   X
05030 02318A 1624                        DOS    GO,MENU
05040 02319                       *
05050 02320                       * READ FILE PREFIX DATA (LOAD ADDR, RBA OF 1ST OVERLAY, ETC)
05060 02321A 162A BE    0625    A EX1    LDX    >OLYLOC  POINT BEYOND ME
05070 02322A 162D AF    C8 27   A        STX    DCBLRB,U USE AS LOGICAL REC BUFFER
05080 02323A 1630 CC    000A    A        LDD    #10      READ 1ST 10 BYTES OF PROGRAM FILE
05090 02324A 1633 ED    C8 11   A        STD    DCBRSZ,U
05100 02325A 1636                        DOS    READ,RBA
05110 02326A 163C 26    E0    161E       BNE    EXERR
05120 02327A 163E 6D    84      A        TST    ,X       IS 1ST BYTE ZERO?
05130 02328A 1640 27    04    1646       BEQ    EX2      IF YES, OK
05140 02329A 1642 86    1B      A        LDA    #ERR27   WRONG TYPE FILE
05150 02330A 1644 20    D8    161E       BRA    EXERR
05160 02331A 1646 EC    03      A EX2    LDD    3,X      (LOAD ADDRESS)
05170 02332A 1648 27    0C    1656       BEQ    EX3A     IF BASED AT ZERO, ASSUME RELOCATABLE
05180 02333A 164A 10A3 E4       A        CMPD   ,S       HE MUST LOAD ABOVE THIS POINT
05190 02334A 164D 24    04    1653       BCC    EX3      IF HE IS OK
05200 02335A 164F 86    1A      A        LDA    #ERR26   LOAD ADDR IS TOO LOW
05210 02336A 1651 20    CB    161E       BRA    EXERR
05220 02337                       * LOAD ADDRESS IS HIGH ENOUGH
05230 02338A 1653 ED    C8 27   A EX3    STD    DCBLRB,U SET THIS AS LOGICAL RECORD BUFFER
05240 02339A 1656 EC    C8 27   A EX3A   LDD    DCBLRB,U
05250 02340A 1659                        INCD
05260 02341A 165C FD    0627    A        STD    >USRBSE
05270 02342A 165F EC    08      A        LDD    8,X      (SHOULD BE RBA OF 1ST OVERLAY)
05280 02343A 1661 ED    C8 11   A        STD    DCBRSZ,U THAT IS ALSO HOW BIG ROOT SECTION IS
05290 02344A 1664 E3    C8 27   A        ADDD   DCBLRB,U RESULT IS WHERE END OF ROOT WILL BE IN MEMORY
05300 02345A 1667 C3    0003    A        ADDD   #3
05310 02346A 166A FD    0625    A        STD    >OLYLOC  SET THIS AS BASE OF FUTURE OVERLAYS
05320 02347A 166D 1F    02      A        TFR    D,Y
05330 02348A 166F 86    FF      A        LDA    #$FF     INVALIDATE WHICH OVERLAY IS IN OVERLAY AREA
05340 02349A 1671 A7    3F      A        STA    -1,Y
05350 02350A 1673 86    05      A        LDA    #5
05360 02351A 1675 A7    C8 2D   A        STA    DCBRBA+2,U START READING WITH 6TH BYTE
05370 02352A 1678 35    10      A        PULS   X
05380 02353A 167A 7E    1096    A        JMP    B12A     GO LOAD ROOT & XFER CONTROL TO IT
05390 02354                       *
00010 02355                       *****************************************************************************
00020 02356                       * RELOCATABLE REAL-TIME CLOCK ROUTINE
00030 02357                       *
00040 02358                       * DESIGNED TO BE LOADED BY MAINLINE OF USER'S PROGRAM, SAVING ITS
00050 02359                       * LOAD ADDRESS.  THEN ACCESSED THRU THE SAVED VECTOR TO PERFORM
00060 02360                       * FUNCTIONS.
00070 02361                       *
00080 02362                       * GIVEN: B=0 - INITIAL CALL, LINK SELF INTO TIME INTERUPT AND PROTECT
00090 02363                       *                MYSELF FROM BEING OVERLAYED
00100 02364                       *          B=FF - UNLINK AND RELEASE OVERLAY SPACE
00110 02365                       *          B=1 - GET TIME
00120 02366                       *          B=2 - SET TIME
00130 02367                       * WITH GET & SET TIME, Y CONTAINS SECONDS AND 60THS OF SECONDS
00140 02368                       *                      U CONTAINS HOURS AND MINUTES
00150 02369                       * WITH INITIAL CALL, U -> DISPLAY ADDRESS (0=NO DISPLAY DESIRED)
00160 02370                       *                    Y = 1 FOR HOURS, 2 FOR MINUTES, 4 FOR SECONDS
00170 02371                       *                          OR ANY COMBINATION (ADDED TOGETHER)
00180 02372                       *****************************************************************************
00190 02373A 167D       00B1    A B13    FDB    B14-B13  OVERLAY SIZE
```

```
PAGE  042  OLY2     .SA:0         DOS - PAGING & OVERLAYS

02374                  167D     A CLK     EQU    B13       (TO ALLOW CHANGING TO DIFFERENT OVERLAY DURING DEVELOPMENT)
02375A 167F 20     07    1688       BRA    CLK1      JUMP OVER LOCALS
02376A 1681        00       A HRS     FCB    0         HOURS (COUNTS TO 255)
02377A 1682        00       A MIN     FCB    0         MINUTES (ALL VALUES SET TO ZERO WHEN LOADED)
02378A 1683        00       A SEC     FCB    0         SECONDS
02379A 1684        00       A CNT     FCB    0
02380A 1685        0000     A TMELOC  FDB    0         TIME DISPLAY LOC
02381A 1687        00       A TMEOPT  FCB    0         HR,MIN,SEC OPTION
02382A 1688 5D                CLK1    TSTB             WHICH OPTION?
02383A 1689 27     16    16A1         BEQ    CLKGO
02384A 168B 30     1E       A         LEAX   -2,X
02385A 168D 5D                        TSTB
02386A 168E 2B     2B    16BB         BMI    CLKSTP
02387A 1690 5A                        DECB
02388A 1691 27     07    169A         BEQ    CLKGET
02389A 1693 EF     04       A CLKSET  STU    HRS-CLK,X
02390A 1695 10AF 06         A         STY    SEC-CLK,X
02391A 1698 4F                        CLRA
02392A 1699 39                        RTS
02393A 169A EE     04       A CLKGET  LDU    HRS-CLK,X
02394A 169C 10AE 06         A         LDY    SEC-CLK,X
02395A 169F 4F                        CLRA
02396A 16A0 39                        RTS
02397                           *
02398A 16A1 EF     08       A CLKGO   STU    TMELOC-CLK,X SAVE DISPLAY ADDRESS
02399A 16A3 1F     20       A         TFR    Y,D
02400A 16A5 E7     0A       A         STB    TMEOPT-CLK,X SAVE DISPLAY OPTION
02401A 16A7 33     89 004E  A         LEAU   CLKTME-CLK,X POINT AT INTERVAL ROUTINE
02402A 16AB AF     44       A         STX    4,U       SET LDX COMMAND TO LOAD CURRENT X VALUE
02403A 16AD                           DOS    TIME,ON   PLUG IN THE CLOCK
02404A 16B3 EC     62       A         LDD    2,S       RET ADDR TO CALLER
02405A 16B5 34     06       A         PSHS   D         PUT IN TOP OF STACK TO BYPASS NORMAL EXIT OF OVERLAY
02406A 16B7 4F                        CLRA
02407A 16B8 30     02       A         LEAX   2,X       TELL USER WHERE TO ENTER ME
02408A 16BA 39                        RTS              RETURN TO CALLER
02409                           *
02410A 16BB 33     89 004E  A CLKSTP  LEAU   CLKTME-CLK,X POINT AT INTERVAL ROUTINE
02411A 16BF                           DOS    TIME,OFF  PULL THE PLUG
02412A 16C5 35     06       A         PULS   D         RET ADDR TO CALLER
02413A 16C7 ED     62       A         STD    2,S       SET TO RET TO HIM AFTER EXITING FROM OVERLAY
02414A 16C9 4F                        CLRA
02415A 16CA 39                        RTS
02416                           *
02417A 16CB 7E     0000     A CLKTME  JMP    >0
02418A 16CE 8E     0000     A         LDX    #0        THIS INSTR MODIFIED BY ABOVE ROUTINE
02419A 16D1 EC     06       A         LDD    SEC-CLK,X LOAD SEC & 60THS
02420A 16D3 5C                        INCB
02421A 16D4 ED     06       A         STD    SEC-CLK,X
02422A 16D6 C1     38       A         CMPB   #56       FULL SECOND?
02423A 16D8 25     F1    16CB         BCS    CLKTME    IF NO, EXIT
02424A 16DA 5F                        CLRB
02425A 16DB 8B     01       A         ADDA   #1
02426A 16DD 19                        DAA
02427A 16DE ED     06       A         STD    SEC-CLK,X
02428A 16E0 81     60       A         CMPA   #$60      FULL MINUTE?
02429A 16E2 25     1A    16FE         BCS    CLKDSP    IF NO
02430A 16E4 4F                        CLRA
02431A 16E5 A7     06       A         STA    SEC-CLK,X
```

```
PAGE  043  OLY2    .SA:0          DOS - PAGING & OVERLAYS

00780 02432A 16E7 EC   04      A         LDD    HRS-CLK,X
00790 02433A 16E9 CB   01      A         ADDB   #1
00800 02434A 16EB 1E   89      A         EXG    A,B
00810 02435A 16ED 19                     DAA
00820 02436A 16EE 1E   89      A         EXG    A,B
00830 02437A 16F0 E7   05      A         STB    MIN-CLK,X
00840 02438A 16F2 C1   60      A         CMPB   #$60      FULL HOUR?
00850 02439A 16F4 25   08   16FE         BCS    CLKDSP    IF NO
00860 02440A 16F6 5F                     CLRB
00870 02441A 16F7 8B   01      A         ADDA   #1
00880 02442A 16F9 19                     DAA
00890 02443A 16FA ED   04      A         STD    HRS-CLK,X
00900 02444A 16FC 20   CD   16CB         BRA    CLKTME
00910 02445                      * DISPLAY RESULTS IF NECESSARY
00920 02446A 16FE EE   08      A CLKDSP LDU    TMELOC-CLK,X DISPLAY LOC
00930 02447A 1700 27   C9   16CB         BEQ    CLKTME    EXIT
00940 02448A 1702 E6   0A      A         LDB    TMEOPT-CLK,X DISPLAY OPTION
00950 02449A 1704 54                     LSRB
00960 02450A 1705 24   04   170B         BCC    CLK2      IF NO
00970 02451A 1707 A6   04      A         LDA    HRS-CLK,X
00980 02452A 1709 8D   10   171B         BSR    CLKEDT
00990 02453A 170B 54             CLK2    LSRB             MINUTES DESIRED?
01000 02454A 170C 24   04   1712         BCC    CLK3      IF NO
01010 02455A 170E A6   05      A         LDA    MIN-CLK,X
01020 02456A 1710 8D   09   171B         BSR    CLKEDT
01030 02457A 1712 54             CLK3    LSRB             SECONDS DESIRED?
01040 02458A 1713 24   B6   16CB         BCC    CLKTME    IF NO
01050 02459A 1715 A6   06      A         LDA    SEC-CLK,X
01060 02460A 1717 8D   02   171B         BSR    CLKEDT
01070 02461A 1719 20   B0   16CB         BRA    CLKTME
01080 02462                      * EDIT THE BCD NUMBER IN A - DISPLAY AT U
01090 02463A 171B 34   02      A CLKEDT PSHS   A
01100 02464A 171D 44                     LSRA
01110 02465A 171E 44                     LSRA
01120 02466A 171F 44                     LSRA
01130 02467A 1720 44                     LSRA
01140 02468A 1721 8B   30      A         ADDA   #$30
01150 02469A 1723 A7   C0      A         STA    ,U+
01160 02470A 1725 35   02      A         PULS   A
01170 02471A 1727 84   0F      A         ANDA   #$0F
01180 02472A 1729 8B   30      A         ADDA   #$30
01190 02473A 172B A7   C1      A         STA    ,U++
01200 02474A 172D 39                     RTS
01210 02475                      *
01220 02476                      ******************************************************************
01230 02477                      * DOS MAIN MENU DISPLAY
01240 02478                      ******************************************************************
01250 02479A 172E      0027    A B14     FDB    B15-B14   SIZE OF OVERLAY
01260 02480                      * DISPLAY DOS MENU SCREEN
01270 02481A 1730 CC   0064    A         LDD    #100      STARTING LINE NUMBER
01280 02482A 1733 108E 00C7    A         LDY    #199      END OF RANGE
01290 02483A 1737 CE   0000    A         LDU    #0        SAY CLEAR SCREEN FIRST
01300 02484A 173A BD   103C    A         JSR    DOMAP     DISPLAY MENU MAP
01310 02485A 173D                MENU1   SYSTEM POLCAT
01320 02486A 1741 27   FA   173D         BEQ    MENU1
01330 02487A 1743 80   31      A         SUBA   #$31      LESS THAN 1?
01340 02488A 1745 27   0B   1752         BEQ    MENU2     IF 1 ENTERED (RET TO BASIC)
01350 02489A 1747 25   F4   173D         BCS    MENU1     IF YES
```

```
A 1749 81   06        A        CMPA   #6        NUMBER OF MENU SELECTIONS THAT HAVE BEEN WRITTEN
A 174B 24   F0    173D         BCC    MENU1     IF NOT IN RANGE
A 174D 4C                      INCA             TO GET OVERLAY NUMBER OF SERVICE ROUTINE
A 174E AD   9F 060C A          JSR    [GO]      PAGE IT IN & GO TO IT
A 1752 7E   0FF6      A MENU2  JMP    OBASIC
                        *
                        ************************************************************
                        * BUFFERED PRINT I/O OVERLAY
                        *
                        * TO ACTIVATE:
                        *               LDU #SIZE (TOTAL MEMORY TO USE FOR THIS PURPOSE)
                        *               DOS DO,BUFPRT
                        *
                        * TO USE:
                        *          LDA CHARACTER TO PRINT
                        *    AGAIN CLRB (SAYS "I AM NOT SHUTTING DOWN")
                        *          JSR [PRNT]
                        *          BNE AGAIN IF BUFFER WAS FULL, TRY AGAIN (OR GO DISPLAY MSG)
                        *
                        * TO TERMINATE:
                        *                LDB #1 (ANY NON-ZERO SAYS SHUT DOWN)
                        *                JSR [PRNT]
                        ************************************************************
A 1755      00D3      A B15    FDB    B16-B15   SIZE OF OVERLAY
            1755      A BP     EQU    B15       (FOR USE IN RELATIVE ADDRESSING
A 1757 20   0C    1765         BRA    BP1       JUMP OVER LOCALS
A 1759      0000      A PRTBUF FDB    0         POINTER TO PRINT BUFFER
A 175B      0000      A BUFSZ  FDB    0         SIZE OF PRINT BUFFER
A 175D      0000      A BUFCNT FDB    0         NUMBER OF CHRS IN BUFFER
A 175F      0000      A SNDCHR FDB    0         POINTER INTO BUFFER FOR CHR BEING SENT
A 1761      0000      A STRCHR FDB    0         POINTER INTO BUFFER FOR CHR BEING STORED
A 1763      0000      A PRNTSV FDB    0         SAVE AREA FOR VECTOR TO ORIG PRNT ROUTINE
                        *
                        * SEE IF ENOUGH ROOM PROVIDED
A 1765 1F   30        A BP1    TFR    U,D       PUT SPACE ALLOWED IN D
A 1767 83   00D8      A        SUBD   #BPSZ+5   AMOUNT NOT AVAILABLE FOR BUFFER
A 176A 24   03    176F         BCC    BP1A      IF ROOM FOR AT LEAST 1 BYTE BUFFER
A 176C 86   18        A        LDA    #ERR24    BUFFER NOT BIG ENOUGH
A 176E 39                      RTS
                        * SET UP FOR BUFFERED PRINTING
A 176F C3   0001      A BP1A   ADDD   #1        (ACTUAL SIZE OF BUFFER)
A 1772 ED   06        A        STD    BUFSZ-BP,X SAVE BUFFER SZ
A 1774 31   89 00D6 A          LEAY   BPSZ+3,X POINT AT BASE OF BUFFER
A 1778 10AF 04        A        STY    PRTBUF-BP,X SAVE IT
A 177B 31   AB        A        LEAY   D,Y       POINT BEYOND END OF BUFFER
A 177D 6F   A0        A        CLR    ,Y+       SAY NO VALID OVERLAY FOLLOWS
A 177F 10BF 0625      A        STY    >OLYLOC   THIS IS WHERE NEXT OVERLAY GOES
A 1783 AF   89 00AB A          STX    BPTME+4-BP,X MODIFY LDX COMMAND
A 1787 AF   89 0055 A          STX    BPOUT+3-BP,X (SO IT KNOWS WHERE LOCAL WS IS)
A 178B 33   89 00A7 A          LEAU   BPTME-BP,X POINT AT TIME ROUTINE
A 178F                         DOS    TIME,ON   PLUG IT IN
A 1795 FE   061A      A        LDU    >PRNT     GET ADDR OF ORIGINAL PRINT ROUTINE
A 1798 EF   0E        A        STU    PRNTSV-BP,X SAVE IT
A 179A 33   89 0052 A          LEAU   BPOUT-BP,X POINT AT ENTRY FOR BUFFERED PRINT
A 179E FF   061A      A        STU    >PRNT
A 17A1 EE   62        A        LDU    2,S       RET ADR TO USER
A 17A3 34   40        A        PSHS   U         (BYPASS NORMAL RETURN THRU UN-DO)
A 17A5 4F                      CLRA             SAY DONE OK
```

```
PAGE  045  OLY2   .SA:0        DOS - PAGING & OVERLAYS

02548A 17A6 39                     RTS
02549                        *
02550                        * SEND A CHARACTER TO THE PRINTER VIA BUFFERED I/O
02551A 17A7 34    52       A BPOUT  PSHS   A,X,U
02552A 17A9 8E    0000     A        LDX    #0         (THIS INSTR MODIFIED BY SETUP LOGIC)
02553A 17AC 5D                      TSTB              REQUEST TO SHUT DOWN?
02554A 17AD 26    30   17DF         BNE    BPO3
02555A 17AF EC    08       A BPO1   LDD    BUFCNT-BP,X
02556A 17B1 10A3 06        A        CMPD   BUFSZ-BP,X ROOM FOR MORE?
02557A 17B4 25    06   17BC         BCS    BPO1A      IF ROOM
02558A 17B6 86    01       A        LDA    #1         SET NON-Z COND
02559A 17B8 35    52       A        PULS   A,X,U
02560A 17BA 24    F3   17AF         BCC    BPO1       IF NO ROOM
02561A 17BC                  BPO1A  DSABLI
02562A 17BE EE    04       A        LDU    PRTBUF-BP,X
02563A 17C0 EC    0C       A        LDD    STRCHR-BP,X DISPLACEMENT IN BUFFER
02564A 17C2 33    CB       A        LEAU   D,U        POINT AT NEXT STORE POSITION
02565A 17C4 C3    0001     A        ADDD   #1
02566A 17C7 10A3 06        A        CMPD   BUFSZ-BP,X WRAP AROUND?
02567A 17CA 25    02   17CE         BCS    BPO2       IF NO
02568A 17CC                         CLRD
02569A 17CE ED    0C       A BPO2   STD    STRCHR-BP,X
02570A 17D0 A6    E4       A        LDA    ,S         (CHR TO BE PRINTED)
02571A 17D2 A7    C4       A        STA    ,U
02572A 17D4 EC    08       A        LDD    BUFCNT-BP,X
02573A 17D6 C3    0001     A        ADDD   #1
02574A 17D9 ED    08       A        STD    BUFCNT-BP,X
02575A 17DB                         ENABLI
02576A 17DD 35    D2       A        PULS   A,X,U,PC
02577                        * WAIT FOR BUFFER TO EMPTY
02578A 17DF EC    08       A BPO3   LDD    BUFCNT-BP,X EMPTY YET?
02579A 17E1 26    FC   17DF         BNE    BPO3       IF NO WAIT
02580A 17E3 33    89 00A7 A         LEAU   BPTME-BP,X POINT AT TIME ROUTINE
02581A 17E7                         DOS    TIME,OFF UN PLUG IT
02582A 17ED EC    0E       A        LDD    PRNTSV-BP,X GET ADDR OF ORIG DRIVER
02583A 17EF FD    061A     A        STD    >PRNT      RESTORE IT
02584A 17F2 EC    04       A        LDD    PRTBUF-BP,X WHERE NEXT OVERLAY SHOULD HAVE GONE
02585A 17F4 FD    0625     A        STD    >OLYLOC
02586A 17F7 35    40       A        PULS   U          (RET ADDR)
02587A 17F9 ED    62       A        STD    2,S        I'M SET TO RETURN VIA UN-DO)
02588A 17FB 39                      RTS
02589                        *
02590                        * TIME INTERVAL DRIVEN PRINT LOGIC
02591A 17FC 7E    0000     A BPTME  JMP    >0         (TO NEXT TIME ROUTINE)
02592A 17FF 8E    0000     A        LDX    #0         (INSTRUCTION MODIFIED BY ABOVE LOGIC)
02593                        * IS THERE DATA IN THE BUFFER TO BE SENT TO PRINTER?
02594A 1802 EC    08       A        LDD    BUFCNT-BP,X
02595A 1804 27    F6   17FC         BEQ    BPTME      IF NO, EXIT
02596                        * TRY TO SEND IT (PRINTER MIGHT NOT BE READY)
02597A 1806 EE    04       A        LDU    PRTBUF-BP,X POINT AT BUFFER
02598A 1808 EC    0A       A        LDD    SNDCHR-BP,X DISPLACEMENT WITHIN BUFFER
02599A 180A A6    CB       A        LDA    D,U        GET CHR OUT OF BUFFER
02600A 180C AD    98 0E    A        JSR    [PRNTSV-BP,X]
02601A 180F 26    EB   17FC         BNE    BPTME      IF PRINTER WAS NOT READY
02602                        * ADVANCE BUFFER POINTER
02603A 1811 EC    0A       A        LDD    SNDCHR-BP,X
02604A 1813 C3    0001     A        ADDD   #1
02605A 1816 10A3 06        A        CMPD   BUFSZ-BP,X IS POINTER WRAPPING AROUND END OF BUFFER?
```

```
PAGE  046  OLY2    .SA:0          DOS - PAGING & OVERLAYS

02520 02606A 1819 25    02   181D         BCS    BPT1      IF NO
02530 02607A 181B                         CLRD
02540 02608A 181D ED    0A      A BPT1    STD    SNDCHR-BP,X SAVE POINTER TO NEXT CHR
02550 02609                       * ADJUST BUFFER COUNT
02560 02610A 181F EC    08      A         LDD    BUFCNT-BP,X
02570 02611A 1821 83    0001    A         SUBD   #1
02580 02612A 1824 ED    08      A         STD    BUFCNT-BP,X
02590 02613A 1826 20    D4   17FC         BRA    BPTME     EXIT (ONLY SEND ONE CHR PER INTERUPT!)
02600 02614                       *
02610 02615                       **********************************
02620 02616                       * BUFFERED KEYBOARD INPUT OVERLAY
02630 02617                       **********************************
02640 02618A 1828       00C5    A B16     FDB    B17-B16
02650 02619             00D3    A BPSZ    EQU    B16-B15   (FOR PREVIOUS ROUTINE'S USE)
02660 02620             1828    A BK      EQU    B16
02670 02621A 182A 20    0C   1838         BRA    BK1       JUMP OVER LOCALS
02680 02622A 182C       0000    A KEYBUF  FDB    0         ADDR OF KEYBOARD BUFFER
02690 02623A 182E       0000    A KEYSZ   FDB    0         SIZE OF KBD BUFFER
02700 02624A 1830       0000    A KEYCNT  FDB    0         NUMBER OF KEYSTROKES IN BUFFER
02710 02625A 1832       0000    A SNDKEY  FDB    0         DISPLACEMENT TO NEXT KEY TO GIVE USER
02720 02626A 1834       0000    A STRKEY  FDB    0         DISPLACEMENT FOR STORING NEXT KEYSTROKE
02730 02627A 1836       0000    A KEYSV   FDB    0         SAVE AREA FOR ADDR OF ORIGINAL KBD ROUTINE
02740 02628                       *
02750 02629                       * SET UP FOR BUFFERED KBD
02760 02630A 1838 1F    30      A BK1     TFR    U,D       PUT SPACE ALLOWED IN D
02770 02631A 183A 83    00CA    A         SUBD   #BKSZ+5   AMOUNT NOT AVAILABLE FOR BUFFER
02780 02632A 183D 24    03   1842         BCC    BK1A      IF ROOM FOR AT LEAST 1 BYTE BUFFER
02790 02633A 183F 86    1C      A         LDA    #ERR28    BUFFER NOT BIG ENOUGH
02800 02634A 1841 39                      RTS
02810 02635A 1842 C3    0001    A BK1A    ADDD   #1        (ACTUAL SIZE OF BUFFER)
02820 02636A 1845 ED    06      A         STD    KEYSZ-BK,X SAVE BUF SZ
02830 02637A 1847 31    89 00C8 A         LEAY   BKSZ+3,X POINT AT BASE OF BUFFER
02840 02638A 184B 10AF 04       A         STY    KEYBUF-BK,X
02850 02639A 184E 31    AB      A         LEAY   D,Y
02860 02640A 1850 6F    A0      A         CLR    ,Y+       SAV NO VALID OVERLAY FOLLOWS
02870 02641A 1852 10BF 0625     A         STY    >OLYLOC   NEXT OVERLAY GOES HERE
02880 02642A 1856 AF    89 0082 A         STX    BKTME+4-BK,X MODIFY LDX INSTR
02890 02643A 185A AF    89 0055 A         STX    BKGIVE+3-BK,X DITTO
02900 02644A 185E 33    89 007E A         LEAU   BKTME-BK,X
02910 02645A 1862                         DOS    TIME,ON  PLUG IN TIME RTN
02920 02646A 1868 FE    061C    A         LDU    >KEYIN
02930 02647A 186B EF    0E      A         STU    KEYSV-BK,X
02940 02648A 186D 33    89 0052 A         LEAU   BKGIVE-BK,X
02950 02649A 1871 FF    061C    A         STU    >KEYIN
02960 02650A 1874 EE    62      A         LDU    2,S
02970 02651A 1876 34    40      A         PSHS   U
02980 02652A 1878 4F                      CLRA
02990 02653A 1879 39                      RTS
03000 02654                       *
03010 02655                       * POLL FOR A CHARACTER TO GIVE USER
03020 02656A 187A 34    54      A BKGIVE  PSHS   B,X,U
03030 02657A 187C 8E    0000    A         LDX    #0        (THIS INSTRUCTION MODIFIED BY SETUP)
03040 02658A 187F EC    08      A         LDD    KEYCNT-BK,X COUNT OF BUFFERED CHRS
03050 02659A 1881 26    02   1885         BNE    BKG1      IF ONE TO SEND
03060 02660A 1883 35    D4      A         PULS   B,X,U,PC IF NONE, EXIT WITH A=ZERO
03070 02661A 1885 EE    04      A BKG1    LDU    KEYBUF-BK,X ADDR OF BUFFER
03080 02662A 1887 EC    0A      A         LDD    SNDKEY-BK,X DISPLACEMENT
03090 02663A 1889 33    CB      A         LEAU   D,U       POINT AT CHARACTER
```

```
PAGE  047  OLY2    .SA:0         DOS - PAGING & OVERLAYS

03100 02664                      * ADJUST POINTER TO NEXT POSITION
03110 02665A 188B C3   0001    A        ADDD   #1
03120 02666A 188E 10A3 06      A        CMPD   KEYSZ-BK,X WRAP AROUND?
03130 02667A 1891 25   F2   1885        BCS    BKG1      IF NO
03140 02668A 1893                       CLRD
03150 02669A 1895 ED   0A      A BKG2   STD    SNDKEY-BK,X
03160 02670A 1897 A6   C4      A        LDA    ,U
03170 02671A 1899 34   02      A        PSHS   A
03180 02672A 189B EC   08      A        LDD    KEYCNT-BK,X
03190 02673A 189D 83   0001    A        SUBD   #1
03200 02674A 18A0 ED   08      A        STD    KEYCNT-BK,X
03210 02675A 18A2 6D   E4      A        TST    ,S
03220 02676A 18A4 35   D6      A        PULS   D,X,U,PC
03230 02677                      *
03240 02678                      * TIME INTERVAL KEYBOARD SCAN ROUTINE
03250 02679A 18A6 7E   0000    A BKTME  JMP    >0        TO NEXT TIME ROUTINE
03260 02680A 18A9 8E   0000    A        LDX    #0        (MODIFIED BY SETUP)
03270 02681A 18AC EC   08      A BKTMEA LDD    KEYCNT-BK,X
03280 02682A 18AE 10A3 06      A        CMPD   KEYSZ-BK,X IS BUFFER FULL?
03290 02683A 18B1 25   13   18C6        BCS    BKT1      IF NO
03300 02684                      * BUFFER IS FULL - GO BEEP
03310 02685A 18B3 8E   FF22    A        LDX    #U4BDR
03320 02686A 18B6 A6   84      A        LDA    ,X
03330 02687A 18B8 88   02      A        EORA   #2        COMPLIMENT SOUND BIT
03340 02688A 18BA A7   84      A        STA    ,X
03350 02689A 18BC 108E 0020    A        LDY    #$20      PULSE WIDTH
03360 02690A 18C0 31   3F      A BKT0   LEAY   -1,Y
03370 02691A 18C2 26   FC   18C0        BNE    BKT0
03380 02692A 18C4 20   E0   18A6        BRA    BKTME     EXIT
03390 02693A 18C6 AD   98 0E   A BKT1   JSR    [KEYSV-BK,X] GO POLL KEYBOARD
03400 02694A 18C9 4D                    TSTA
03410 02695A 18CA 27   DA   18A6        BEQ    BKTME     IF NO NEW KEYSTROKES, EXIT
03420 02696A 18CC 34   02      A        PSHS   A         SAVE KEY
03430 02697A 18CE EE   04      A        LDU    KEYBUF-BK,X
03440 02698A 18D0 EC   0C      A        LDD    STRKEY-BK,X DISPLACEMENT TO SAVE LOC
03450 02699A 18D2 33   CB      A        LEAU   D,U       POINT AT SAVE LOC
03460 02700A 18D4 C3   0001    A        ADDD   #1        POINT TO NEXT SAVE LOC
03470 02701A 18D7 10A3 06      A        CMPD   KEYSZ-BK,X WRAP AROUND?
03480 02702A 18DA 25   02   18DE        BCS    BKT2      IF NO
03490 02703A 18DC                       CLRD
03500 02704A 18DE ED   0C      A BKT2   STD    STRKEY-BK,X
03510 02705A 18E0 EC   08      A        LDD    KEYCNT-BK,X
03520 02706A 18E2 C3   0001    A        ADDD   #1
03530 02707A 18E5 ED   08      A        STD    KEYCNT-BK,X
03540 02708A 18E7 35   02      A        PULS   A
03550 02709A 18E9 A7   C4      A        STA    ,U
03560 02710A 18EB 20   BF   18AC        BRA    BKTMEA    GO CHECK FOR ANOTHER KEY DOWN
03570 02711                      *
03580 02712                      ************************************************************
03590 02713                      * COPY FILE OVERLAY
03600 02714                      * GIVEN: B (BIT 0) = ZERO IF NO DISK SWAPPING, 1 IF SWAPPING
03610 02715                      *         U-> SOURCE FILE DCB (UNOPENED)
03620 02716                      *         Y-> DEST FILE DCB (UNOPENED)
03630 02717                      * USES MEMORY FROM "OLYLOC" TO "MAXMEM"
03640 02718                      * USES LAST LINE ON SCREEN FOR PROMPTS IF SWAPPING DISKETTES
03650 02719                      ************************************************************
03660 02720A 18ED      01BF    A B17    FDB    B18-B17
03670 02721A 18EF 34   76      A        PSHS   D,X,Y,U
```

```
PAGE  048  OLY2    .SA:0         DOS - PAGING & OVERLAYS

03680 02722A 18F1 32   7A       A        LEAS    -6,S
03690 02723A 18F3 20   60   1955         BRA     B17A
03700 02724                     * ,S COUNT OF SECTORS IN MEMORY
03710 02725                     * 1,S EOF SW
03720 02726                     * 2,S=NEXT INPUT PRN
03730 02727                     * 4,S=NEXT OUTPUT PRN
03740 02728                     * 6,S=PGS AVAIL
03750 02729                     * 7,S=SWAP SW
03760 02730                     * 8,S=BASE
03770 02731                     * 10,S=DEST DCB ADDR
03780 02732                     * 12,S=SOURCE DCB ADDR
03790 02733                     * 14,S=RET ADDR
03800 02734A 18F5      4C       A B17M1  FCC     /LOAD SOURCE DISKETTE          /
03810 02735A 1915      4C       A B17M2  FCC     /LOAD DESTINATION DISKETTE     /
03820 02736A 1935      4C       A B17M3  FCC     /LOAD  S Y S T E M  DISKETTE   /
03830 02737                     *
03840 02738                     * SETUP STACK
03850 02739A 1955 C4   01       A B17A   ANDB    #1        SET TO 1 OR 0
03860 02740A 1957 A6   C8 21    A        LDA     DCBDRV,U
03870 02741A 195A A1   A8 21    A        CMPA    DCBDRV,Y SAME DRIVE?
03880 02742A 195D 27   01   1960         BEQ     B17B      IF YES
03890 02743A 195F 5F                     CLRB
03900 02744A 1960 E7   67       A B17B   STB     7,S
03910 02745A 1962 4F                     CLRA
03920 02746A 1963 5F                     CLRB
03930 02747A 1964 ED   E4       A        STD     ,S
03940 02748A 1966 ED   62       A        STD     2,S       STARTING INPUT PRN
03950 02749A 1968 ED   64       A        STD     4,S       STARTING OUTPUT PRN
03960 02750A 196A FC   08DC     A        LDD     >MAXMEM
03970 02751A 196D B3   0625     A        SUBD    >OLYLOC   HOW MUCH MEM TO WORK WITH
03980 02752A 1970 25   03   1975         BCS     B17B1     IF NOT ENOUGH
03990 02753A 1972 4D                     TSTA
04000 02754A 1973 26   51   19C6         BNE     B17C      IF AT LEAST 1 PAGE
04010 02755A 1975 86   1D       A B17B1  LDA     #ERR29    NOT ENOUGH MEM
04020 02756                     *
04030 02757                     * COMMON EXIT
04040 02758A 1977 A7   66       A B17X   STA     6,S
04050 02759A 1979 6D   67       A        TST     7,S
04060 02760A 197B 27   10   198D         BEQ     B17XIT
04070 02761                     * RECOVER SYSTEM DISKETTE
04080 02762A 197D AE   68       A        LDX     8,S
04090 02763A 197F 30   88 48    A        LEAX    B17M3-B17,X
04100 02764A 1982 8D   0D   1991         BSR     B17WTE
04110 02765A 1984 CE   0666     A        LDU     #MSGDCB
04120 02766A 1987                        DOS     OPEN,INPUT TO RE-LOAD FAT TABLE
04130 02767A 198D 32   66       A B17XIT LEAS    6,S
04140 02768A 198F 35   F6       A        PULS    D,X,Y,U,PC
04150 02769                     *
04160 02770                     * DISPLAY FLASHING MSG & WAIT FOR DISKETTE SWAP
04170 02771A 1991 108E 05E0     A B17WTE LDY     #$400+512-32 (LAST LINE)
04180 02772A 1995 C6   20       A        LDB     #32
04190 02773A 1997 A6   80       A B17WT1 LDA     ,X+
04200 02774A 1999 A7   A0       A        STA     ,Y+
04210 02775A 199B 5A                     DECB
04220 02776A 199C 26   F9   1997         BNE     B17WT1
04230 02777A 199E 7F   0621     A        CLR     >CLOCK+1
04240 02778A 19A1                 B17WT2 SYSTEM POLCAT     WAIT FOR KEYSTROKE
04250 02779A 19A5 81   0D       A        CMPA    #$0D
```

```
PAGE  049  OLY2    .SA:0          DOS - PAGING & OVERLAYS

02780A 19A7 27    1C   19C5         BEQ     B17WTX
02781A 19A9 8E    05E0      A       LDX     #$400+512-32
02782A 19AC B6    0621      A       LDA     >CLOCK+1
02783A 19AF 84    20        A       ANDA    #$20
02784A 19B1 48                      LSLA
02785A 19B2 34    02        A       PSHS    A
02786A 19B4 C6    20        A       LDB     #32
02787A 19B6 A6    84        A B17WT3 LDA    ,X
02788A 19B8 84    BF        A       ANDA    #%10111111
02789A 19BA AA    E4        A       ORA     ,S
02790A 19BC A7    80        A       STA     ,X+
02791A 19BE 5A                      DECB
02792A 19BF 26    F5   19B6         BNE     B17WT3
02793A 19C1 35    02        A       PULS    A
02794A 19C3 20    DC   19A1         BRA     B17WT2
02795A 19C5 39              B17WTX RTS
02796                       *
02797A 19C6 A7    66        A B17C  STA     6,S       PAGES AVAILABLE
02798                       *
02799                       * LOOP TO COPY FILE
02800A 19C8 EE    6C        A B17D  LDU     12,S      SOURCE
02801A 19CA FC    0625      A       LDD     >OLYLOC
02802A 19CD ED    C8 24     A       STD     DCBBUF,U
02803A 19D0 6D    67        A       TST     7,S       SWAPPING?
02804A 19D2 27    06   19DA         BEQ     B17D0     IF NO
02805                       * WAIT FOR SOURCE DISKETTE
02806A 19D4 AE    68        A       LDX     8,S
02807A 19D6 30    08        A       LEAX    B17M1-B17,X
02808A 19D8 8D    B7   1991         BSR     B17WTE
02809A 19DA                 B17D0  DOS     OPEN,INPUT
02810A 19E0 26    95   1977         BNE     B17X      IF NOT FOUND
02811A 19E2 EC    62        A       LDD     2,S
02812A 19E4 ED    C8 29     A       STD     DCBPRN,U SET STARTING SECTOR NUMBER
02813A 19E7 26    12   19FB         BNE     B17E      IF NOT FIRST TIME
02814                       * FIRST TIME - SAVE DIRECTORY DATA IN OUTPUT DCB
02815A 19E9 10AE 6A         A       LDY     10,S
02816A 19EC 33    4B        A       LEAU    11,U
02817A 19EE 31    2B        A       LEAY    11,Y      EXCEPT FOR NAME
02818A 19F0 C6    15        A       LDB     #32-11
02819A 19F2 A6    C0        A B17D1 LDA     ,U+
02820A 19F4 A7    A0        A       STA     ,Y+
02821A 19F6 5A                      DECB
02822A 19F7 26    F9   19F2         BNE     B17D1
02823A 19F9 EE    6C        A       LDU     12,S      SOURCE
02824A 19FB 6F    E4        A B17E  CLR     ,S        SECTORS IN MEMORY
02825                       *
02826                       * LOAD LOOP
02827A 19FD BD    0D9F      A B17F  JSR     CSENT     XLATE PRN INTO TRACK & SECTOR
02828A 1A00 26    1E   1A20         BNE     B17F1     IF OUT OF RANGE
02829A 1A02 BD    0CE7      A       JSR     DSKRED    DO PHYSICAL I/O
02830A 1A05 26    16   1A1D         BNE     B17XX     IF I/O ERR
02831A 1A07 EC    C8 29     A       LDD     DCBPRN,U
02832A 1A0A C3    0001      A       ADDD    #1
02833A 1A0D ED    C8 29     A       STD     DCBPRN,U
02834A 1A10 6C    C8 24     A       INC     DCBBUF,U
02835A 1A13 6C    E4        A       INC     ,S        COUNT SECTORS READ
02836A 1A15 E6    E4        A       LDB     ,S
02837A 1A17 E1    66        A       CMPB    6,S       IS BUFFER FULL
```

```
04840 02838A 1A19 26    E2   19FD        BNE    B17F      IF NO
04850 02839A 1A1B 20    05   1A22        BRA    B17G      GO WRITE IT
04860 02840A 1A1D 16    FF57 1977 B17XX  LBRA   B17X      THIS STMT USED AS AN UP-LINK
04870 02841                       *
04880 02842                       * INPUT AT END - SET EOF SW
04890 02843A 1A20 6C    61      A B17F1  INC    1,S
04900 02844                       *
04910 02845                       * CLOSE INPUT
04920 02846A 1A22 EC    C8 29   A B17G   LDD    DCBPRN,U
04930 02847A 1A25 ED    62      A        STD    2,S       SAVE FOR NEXT BATCH
04940 02848A 1A27                        DOS    CLOSE,IT
04950 02849A 1A2D A6    E4      A        LDA    ,S        ANY SECTORS READ?
04960 02850A 1A2F 27    EC   1A1D        BEQ    B17XX     IF NO, I'M DONE
04970 02851                       *
04980 02852                       * OPEN OUTPUT
04990 02853A 1A31 6D    67      A        TST    7,S       SWAPPING?
05000 02854A 1A33 27    08   1A3D        BEQ    B17H      IF NO
05010 02855A 1A35 AE    68      A        LDX    8,S
05020 02856A 1A37 30    88 28   A        LEAX   B17M2-B17,X
05030 02857A 1A3A 17    FF54 1991        LBSR   B17WTE    WAIT FOR DESTINATION DISKETTE
05040 02858A 1A3D EE    6A      A B17H   LDU    10,S      OUTPUT FILE DCB
05050 02859A 1A3F FC    0625    A        LDD    >OLYLOC   START OF BUFFER
05060 02860A 1A42 ED    C8 24   A        STD    DCBBUF,U
05070 02861A 1A45                        DOS    OPEN,OUTPUT+FAST
05080 02862A 1A4B 27    06   1A53        BEQ    B17H1     IF FILE EXISTS
05090 02863A 1A4D 81    0C      A        CMPA   #12
05100 02864A 1A4F 27    10   1A61        BEQ    B17H2     IF CREATED
05110 02865A 1A51 20    CA   1A1D        BRA    B17XX     IF OTHER ERROR
05120 02866                       *
05130 02867                       * FILE EXISTS
05140 02868A 1A53 EC    64      A B17H1  LDD    4,S
05150 02869A 1A55 26    12   1A69        BNE    B17I      IF NOT FIRST TIME, ITS OK
05160 02870A 1A57                        DOS    CLOSE,IT
05170 02871A 1A5D 86    1E      A        LDA    #ERR30
05180 02872A 1A5F 20    BC   1A1D        BRA    B17XX
05190 02873                       *
05200 02874                       * FILE CREATED
05210 02875A 1A61 EC    64      A B17H2  LDD    4,S
05220 02876A 1A63 27    04   1A69        BEQ    B17I      IF FIRST TIME, OK
05230 02877A 1A65 86    1F      A        LDA    #ERR31    MISC ERR
05240 02878A 1A67 20    B4   1A1D        BRA    B17XX
05250 02879                       *
05260 02880A 1A69 ED    C8 29   A B17I   STD    DCBPRN,U
05270 02881                       *
05280 02882                       * WRITE LOOP
05290 02883A 1A6C BD    0D9F    A B17J   JSR    CSENT     XLATE PRN INTO TRACK & SECTOR
05300 02884A 1A6F 26    AC   1A1D        BNE    B17XX
05310 02885A 1A71 BD    0CEA    A        JSR    DSKWRT    WRITE SECTOR
05320 02886A 1A74 1026  FEFF 1977        LBNE   B17X
05330 02887A 1A78 EC    C8 29   A        LDD    DCBPRN,U
05340 02888A 1A7B C3    0001    A        ADDD   #1
05350 02889A 1A7E ED    C8 29   A        STD    DCBPRN,U
05360 02890A 1A81 6C    C8 24   A        INC    DCBBUF,U
05370 02891A 1A84 6A    E4      A        DEC    ,S        COUNT DOWN SECTORS WRITTEN
05380 02892A 1A86 26    E4   1A6C        BNE    B17J
05390 02893                       *
05400 02894                       * CLOSE OUTPUT
05410 02895A 1A88 EC    C8 29   A        LDD    DCBPRN,U
```

```
PAGE  051  OLY2    .SA:0          DOS - PAGING & OVERLAYS

05420 02896A 1A8B ED    64       A          STD     4,S     ' SAVE FOR NEXT BATCH
05430 02897A 1A8D 83    0001     A          SUBD    #1
05440 02898A 1A90 ED    C8 14    A          STD     DCBMRB,U
05450 02899A 1A93 AE    6C       A          LDX     12,S      SOURCE DCB
05460 02900A 1A95 EC    0E       A          LDD     DCBNLS,X
05470 02901A 1A97 ED    4E       A          STD     DCBNLS,U
05480 02902A 1A99 E7    C8 16    A          STB     DCBMRB+2,U
05490 02903A 1A9C                           DOS     CLOSE,IT
05500 02904A 1AA2 4F                        CLRA
05510 02905A 1AA3 6D    61       A          TST     1,S       AT EOF?
05520 02906A 1AA5 1026 FF74 1A1D            LBNE    B17XX     I'M DONE
05530 02907A 1AA9 16    FF1C 19C8           LBRA    B17D      GO COPY ANOTHER BATCH OF SECTORS
05540 02908                          *
05550 02909                          **************************
05560 02910                          * GET MULTIPLE USER INPUTS
05570 02911                          * GIVEN B=NUMBER OF INPUTS
05580 02912                          **************************
05590 02913A 1AAC       0099     A B18      FDB     B19-B18
05600 02914             0012     A INPTS    EQU     18
05610 02915A 1AAE 86    01       A          LDA     #1
05620 02916A 1AB0 34    06       A          PSHS    D
05630 02917A 1AB2 CE    0400     A B18B     LDU     #$400
05640 02918A 1AB5 E6    E4       A          LDB     ,S
05650 02919A 1AB7 A6    C0       A B18C     LDA     ,U+
05660 02920A 1AB9 81    5B       A          CMPA    #$5B      [
05670 02921A 1ABB 27    09    1AC6          BEQ     B18D
05680 02922A 1ABD 1183 0600      A          CMPU    #$600
05690 02923A 1AC1 25    F4    1AB7          BCS     B18C
05700 02924A 1AC3 CE    0401     A          LDU     #$401
05710 02925A 1AC6 5A                 B18D   DECB
05720 02926A 1AC7 26    EE    1AB7          BNE     B18C
05730 02927                          * INPUT A FIELD
05740 02928A 1AC9 7F    0621     A          CLR     CLOCK+1
05750 02929A 1ACC 30    5F       A          LEAX    -1,U
05760 02930A 1ACE F6    0621     A B18E     LDB     CLOCK+1
05770 02931A 1AD1 C4    10       A          ANDB    #16
05780 02932A 1AD3 27    04    1AD9          BEQ     B18E1
05790 02933A 1AD5 86    5B       A          LDA     #$5B
05800 02934A 1AD7 20    02    1ADB          BRA     B18E2
05810 02935A 1AD9 86    1B       A B18E1    LDA     #$1B
05820 02936A 1ADB A7    84       A B18E2    STA     ,X
05830 02937A 1ADD 34    50       A          PSHS    X,U
05840 02938A 1ADF                           SYSTEM  POLCAT
05850 02939A 1AE3 35    50       A          PULS    X,U
05860 02940A 1AE5 4D                        TSTA
05870 02941A 1AE6 27    E6    1ACE          BEQ     B18E
05880 02942A 1AE8 81    03       A          CMPA    #BREAK
05890 02943A 1AEA 27    50    1B3C          BEQ     B18X
05900 02944A 1AEC 81    0A       A          CMPA    #DOWN
05910 02945A 1AEE 27    1A    1B0A          BEQ     B18F
05920 02946A 1AF0 81    5E       A          CMPA    #UP
05930 02947A 1AF2 27    21    1B15          BEQ     B18G
05940 02948A 1AF4 81    0D       A          CMPA    #ENTER
05950 02949A 1AF6 27    44    1B3C          BEQ     B18X
05960 02950A 1AF8 81    08       A          CMPA    #LEFT
05970 02951A 1AFA 27    34    1B30          BEQ     B18I
05980 02952A 1AFC 81    20       A          CMPA    #$20
05990 02953A 1AFE 25    CE    1ACE          BCS     B18E
```

```
PAGE  052  OLY2    .SA:0         DOS - PAGING & OVERLAYS

06000 02954A 1B00 81    5B      A        CMPA    #$5B
06010 02955A 1B02 25    20    1B24       BCS     B18H
06020 02956A 1B04 81    60      A        CMPA    #$60
06030 02957A 1B06 25    1C    1B24       BCS     B18H
06040 02958A 1B08 20    C4    1ACE       BRA     B18E
06050 02959                     * DOWN
06060 02960A 1B0A A6    E4      A B18F   LDA     ,S
06070 02961A 1B0C A1    61      A        CMPA    1,S
06080 02962A 1B0E 24    0E    1B1E       BCC     B18G1     IF AT END ALREADY
06090 02963A 1B10 4C                     INCA
06100 02964A 1B11 A7    E4      A        STA     ,S
06110 02965A 1B13 20    09    1B1E       BRA     B18G1
06120 02966                     * UP
06130 02967A 1B15 A6    E4      A B18G   LDA     ,S
06140 02968A 1B17 81    01      A        CMPA    #1
06150 02969A 1B19 27    03    1B1E       BEQ     B18G1
06160 02970A 1B1B 4A                     DECA
06170 02971A 1B1C A7    E4      A        STA     ,S
06180 02972A 1B1E 86    5B      A B18G1  LDA     #$5B
06190 02973A 1B20 A7    84      A        STA     ,X
06200 02974A 1B22 20    8E    1AB2       BRA     B18B
06210 02975                     * TEXT CHR
06220 02976A 1B24 8A    40      A B18H   ORA     #$40
06230 02977A 1B26 A7    C0      A        STA     ,U+
06240 02978A 1B28 A6    C4      A        LDA     ,U
06250 02979A 1B2A 81    5D      A        CMPA    #$5D      ]
06260 02980A 1B2C 27    DC    1B0A       BEQ     B18F
06270 02981A 1B2E 20    9E    1ACE       BRA     B18E
06280 02982                     * BACK ARROW
06290 02983A 1B30 A6    C2      A B18I   LDA     ,-U
06300 02984A 1B32 84    BF      A        ANDA    #$BF
06310 02985A 1B34 81    1B      A        CMPA    #$1B
06320 02986A 1B36 26    96    1ACE       BNE     B18E
06330 02987A 1B38 A6    C0      A        LDA     ,U+
06340 02988A 1B3A 20    F4    1B30       BRA     B18I
06350 02989                     * BREAK OR ENTER
06360 02990A 1B3C 1F    89      A B18X   TFR     A,B
06370 02991A 1B3E 32    62      A        LEAS    2,S
06380 02992A 1B40 86    5B      A        LDA     #$5B
06390 02993A 1B42 A7    84      A        STA     ,X
06400 02994A 1B44 39                     RTS
06410 02995                     *
06420 02996                     **********************************
06430 02997                     * SCAN FOR SELECTED DIRECTORY ENTRY
06440 02998                     **********************************
06450 02999A 1B45       0089    A B19    FDB     B20-B19
06460 03000             0013    A SCNDIR EQU     19
06470 03001A 1B47 BE    C006    A        LDX     $C006     PARAMETER AREA
06480 03002A 1B4A 86    02      A        LDA     #2        READ
06490 03003A 1B4C A7    80      A        STA     ,X+
06500 03004A 1B4E A6    C4      A        LDA     ,U        DRIVE
06510 03005A 1B50 A7    80      A        STA     ,X+
06520 03006A 1B52 CC    1103    A        LDD     #$1103    TRACK & SECTOR
06530 03007A 1B55 ED    80      A        STD     ,X+       LEAVE X -> SECTOR
06540 03008A 1B57 108E 06C8     A        LDY     #SYSBUF
06550 03009A 1B5B 10AF 01       A        STY     1,X
06560 03010A 1B5E A6    41      A        LDA     1,U       STARTING OCCURANCE
06570 03011A 1B60 81    48      A B19A   CMPA    #72       ANY MORE ON THIS DRIVE?
```

```
PAGE  053  OLY2    .SA:0         DOS - PAGING & OVERLAYS

06580 03012A 1B62 24    65    1BC9         BCC    B19NO
06590 03013A 1B64 80    08       A B19B    SUBA   #8
06600 03014A 1B66 25    04    1B6C         BCS    B19C      IF IN THIS SECTOR
06610 03015A 1B68 6C    84       A         INC    ,X
06620 03016A 1B6A 20    F8    1B64         BRA    B19B
06630 03017A 1B6C 8B    08       A B19C    ADDA   #8
06640 03018A 1B6E 27    07    1B77         BEQ    B19D
06650 03019A 1B70 C6    20       A         LDB    #32
06660 03020A 1B72 3D                       MUL              DISPLACEMENT IN THIS SECTOR
06670 03021A 1B73 31    AB       A         LEAY   D,Y       OFFSET TO 1ST ENT TO SCAN
06680 03022A 1B75 20    0C    1B83         BRA    B19D1
06690 03023A 1B77 34    70       A B19D    PSHS   X,Y,U
06700 03024A 1B79 AD    9F C004 A          JSR    [$C004]
06710 03025A 1B7D 35    70       A         PULS   X,Y,U
06720 03026A 1B7F A6    03       A         LDA    3,X       RESULT
06730 03027A 1B81 26    46    1BC9         BNE    B19NO     IF I/O ERR
06740 03028                        * COMPARE AGAINST ARGUMENT
06750 03029                        * REGISTERS:X->SECTOR NBR
06760 03030                        *            Y->ENTRY IN BUFFER
06770 03031                        *            U->SEARCH ARGUMENT
06780 03032A 1B83 34    60       A B19D1   PSHS   Y,U
06790 03033A 1B85 C6    0B       A         LDB    #11       BYTES TO COMPARE
06800 03034A 1B87 33    42       A         LEAU   2,U       TO START OF ARGUMENT
06810 03035A 1B89 A6    A4       A         LDA    ,Y
06820 03036A 1B8B 27    0C    1B99         BEQ    B19E1     IF EMPTY ENTRY
06830 03037A 1B8D 2B    0A    1B99         BMI    B19E1     IF END OF DIRECTORY
06840 03038A 1B8F A6    C0       A B19E    LDA    ,U+
06850 03039A 1B91 81    2A       A         CMPA   #'*       WILDCARD?
06860 03040A 1B93 27    1F    1BB4         BEQ    B19F
06870 03041A 1B95 A1    A0       A         CMPA   ,Y+
06880 03042A 1B97 27    1D    1BB6         BEQ    B19G
06890 03043                        * NO MATCH
06900 03044A 1B99 35    60       A B19E1   PULS   Y,U
06910 03045A 1B9B 6C    41       A         INC    1,U
06920 03046A 1B9D A6    41       A         LDA    1,U
06930 03047A 1B9F 81    48       A         CMPA   #72       ANY MORE?
06940 03048A 1BA1 24    26    1BC9         BCC    B19NO
06950 03049A 1BA3 31    A8 20    A         LEAY   32,Y      POINT AT NEXT ENTRY
06960 03050A 1BA6 108C 07C8      A         CMPY   #SYSBUF+256
06970 03051A 1BAA 25    D7    1B83         BCS    B19D1
06980 03052                        * READ NEXT SECTOR
06990 03053A 1BAC 108E 06C8      A         LDY    #SYSBUF
07000 03054A 1BB0 6C    84       A         INC    ,X
07010 03055A 1BB2 20    C3    1B77         BRA    B19D
07020 03056A 1BB4 A6    A0       A B19F    LDA    ,Y+       BYPASS SOURCE CHR
07030 03057A 1BB6 5A               B19G    DECB
07040 03058A 1BB7 26    D6    1B8F         BNE    B19E
07050 03059                        * MATCH FOUND
07060 03060A 1BB9 35    60       A         PULS   Y,U
07070 03061A 1BBB 6C    41       A         INC    1,U       SEARCH CONTINUES WITH NEXT ENTRY
07080 03062A 1BBD 33    4D       A         LEAU   2+11,U
07090 03063A 1BBF C6    20       A         LDB    #32
07100 03064A 1BC1 A6    A0       A B19H    LDA    ,Y+
07110 03065A 1BC3 A7    C0       A         STA    ,U+
07120 03066A 1BC5 5A                       DECB
07130 03067A 1BC6 26    F9    1BC1         BNE    B19H
07140 03068A 1BC8 39                       RTS
07150 03069A 1BC9 86    FF       A B19NO   LDA    #$FF
```

```
PAGE  054  OLY2     .SA:0           DOS - PAGING & OVERLAYS

07160 03070A 1BCB A7    41       A          STA    1,U       SAY NO MORE
07170 03071A 1BCD 39                        RTS
07180 03072                        *
07190 03073A 1BCE        0001    A B20      RMB    1
07200 03074A 1BCF        0001    A B21      RMB    1
07210 03075                        *
07220 03076                                 OPT    L
07230 03077A 1BD0        0001    A LASTPG RMB    1         END OF OVERLAYS
07240 03078              1BD0    A B22      EQU    LASTPG
07250 03079              00C5    A BKSZ     EQU    B17-B16
07260 03080              0718    A PGMSZ    EQU    OVRLAY-ORGIN-1
07270 03081              1246    A TOTSZ    EQU    LASTPG-ORGIN-1
07280 03082              0EA4    A START    EQU    DOS       START OF DISK FILE
07290 03083              20EB    A END      EQU    LASTPG+DOS-ORGIN END OF DISK FILE
07300 03084              10A2    A ENTRY    EQU    OVRLAY   INITIAL ENTRY POINT INTO PROGRAM
07310 03085              10A5    A LOWUSR EQU    OVRLAY+3 LOWEST POINT WHERE USER PGM CAN LOAD
07320 03086              0BB9    A FIXIT    EQU    $1E00-LASTPG+ORGIN POINT THAT BASIC CLOBBERS
07330 03087                                 TTL    DOS - CROSS REFERENCE
07340 03088                                 END
TOTAL ERRORS 00000--00000
TOTAL WARNINGS 00000--00000
```

Index

RADIO SHACK, A DIVISION OF TANDY CORPORATION

U.S.A.: FORT WORTH, TEXAS 76102
CANADA: BARRIE, ONTARIO L4M 4W5

TANDY CORPORATION

AUSTRALIA	BELGIUM	U. K.
91 KURRAJONG ROAD MOUNT DRUITT, N.S.W. 2770	PARC INDUSTRIEL DE NANINNE 5140 NANINNE	BILSTON ROAD WEDNESBURY WEST MIDLANDS WS10 7JN

263254-12/83-TM

Printed in U.S.A.