A PAPERBYTE™ BOOK

MONDEB

by DON PETERS

AN ADVANCED M6800 MONITOR DEBUGGER

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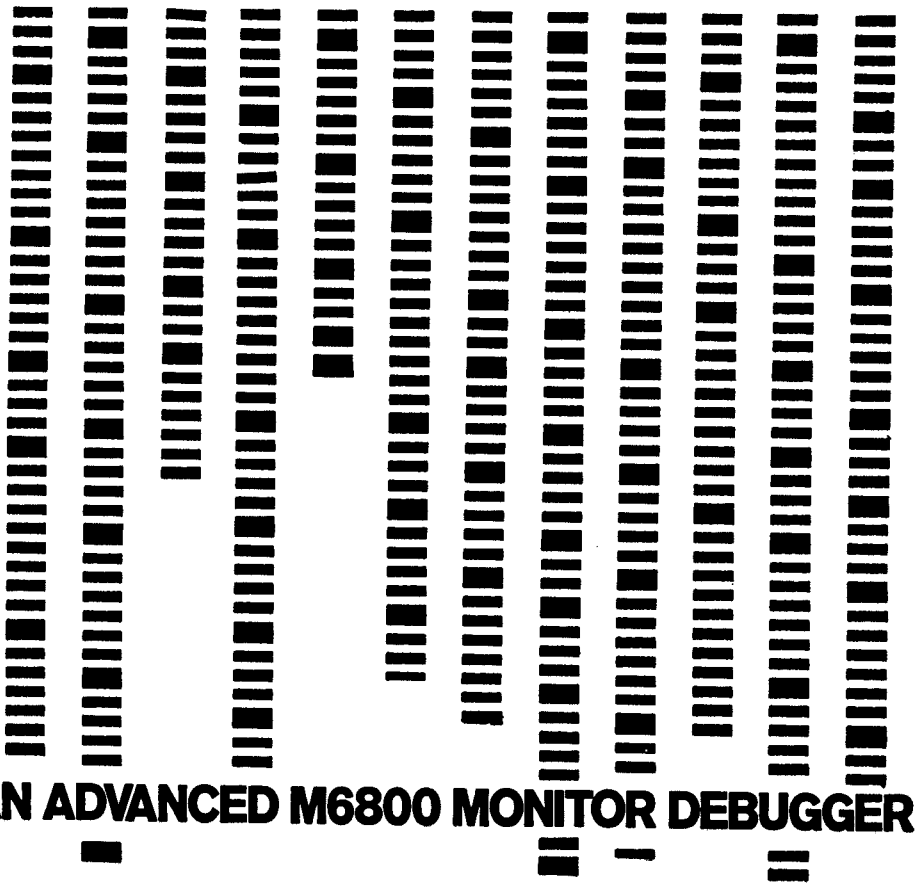

AN ADVANCED M6800 MONITOR DEBUGGER

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MONDEB:

An Advanced M6800 Monitor-Debugger

How It Came About

My start in the microcomputer hobby field involved the acquiring of a set of LSI integrated circuits in Motorola's M6800 microprocessor family. It was a truly happy day when, after a long bout of wire wrapping, I applied power, hit the reset button, and the MIKBUG monitor "spoke" to me. Thus began my hardware-software capability spiral which always seemed to consume much more time and money than my initial expectations. While I found the MIKBUG monitor far superior to a front panel crammed with address and data bus switches, its shortcomings became more and more apparent as time went on.

So I began the search for an alternate monitor-debugger. While this kind of software seems to be an important component of any extensive software development effort, this tool has received little attention. This is surprising in light of a recent survey which found that the prime activity of most computer experimenters is software development. While Motorola does offer a few improved 6800 monitors (MINIBUG II, JBUG, etc), these monitors still do not offer significantly increased capability (at least from my point of view), are generally costly, and are not available with source listings. The source code was necessary to fully understand the published description, as my experience with MIKBUG showed. I also have an irresistible urge to customize the software, especially in the areas of input and output. This in turn often requires many program changes, along with reassembly, if one is to avoid numerous messy "hacks" to the code (the sure road to ruin). Turning to various microcomputer magazines, I found descriptions of several monitor-debuggers. But again, they all seemed to be designed as bare bones implementations, sacrificing many conveniences and useful features.

So, not being satisfied with what was available, I decided to make use of my previous experience in writing user interface software for commercial timesharing application programs and develop an advanced (relatively, that is) monitor-debugger. The title MONDEB was selected as a somewhat arbitrary but meaningful acronym.

The monitor-debugger described in this book incorporates all the general features in Motorola's MIKBUG monitor as well as numerous other capabilities. While extremely versatile, ease of use was a prime design consideration.

Goals

Two prime project goals were minimum memory requirements and maximum versatility. Unfortunately, these goals are generally incompatible, so versatility won out. The final size of MONDEB turned out to be 3 K, implemented on three 2708 type ultraviolet erasable read only memories. This allows frequent alterations and enhancements to be made. Although 2708s have been generally expensive up to now, several manufacturers have recently begun to second source them, bringing the price down considerably.

A more secondary goal was to make this monitor-debugger available to a wide audience of users who could perhaps benefit from and improve upon the design.

General Features

The general features in MONDEB are listed below:

- Liberally commented source code.
- A prompt character signifies readiness to accept a command.
- Commands are generally self-explanatory English words.
- Commands may be abbreviated.
- Commands may be modified by succeeding words called modifiers.
- A space or comma separates a modifier from the command and other modifiers.
- "Rubout" may be used to delete the previous character(s).
- Several commands may be placed on one line, separated from one another by a semicolon.
- "Control-C" may be used to abort the line being typed.
- "Control-Z" will repeat the previous command line.
- Lower case alphabetic input is automatically converted to upper case.
- If a syntax error is made, its position on the input line is pointed to.
- Input lines may be 72 characters long.
- If output lines are over 72 characters long, an automatic carriage return and line feed is inserted after the 72nd character (this is called "folding").
- If a space occurs within the last ten characters on an oversize line, folding occurs on that space.
- One extra null character is sent to the terminal for every eight characters in the output line, allowing ample time for carriage return delays.
- The input and display bases may be set to hexadecimal, decimal, octal or binary (display only).

- ACIA input and output from the terminal or any ACIA address.
- Many routines may be externally accessed through addresses, independent of revision number, decreasing the memory requirements for the application programs.

Command Summary

In the following command summary:

- Capital letters are typed as is.
- Bold faced characters represent the *minimum* abbreviation of a command.
- Lower case text within "<" and ">" represents a variable quantity.
- Text within "[" and "]" is optional.
- An exclamation mark separates alternatives.
- " . . . " represents repetition of the preceding pattern.

REG
SET <address> <value> [<value>. . .]
SET <address range> <value>
SET . <register> <value>
DISPLAY <address range> [DATA ! USED]
DBASE [? ! HEX ! DEC ! OCT ! BIN]
IBASE [? ! HEX ! DEC ! OCT]
GOTO [<address>]
BREAK [? ! <address>]
CONTINUE
TEST <address range>
VERIFY [<address range>]
SEARCH <address range> <value> [<value> . . .]
COPY <address range> <address>
COMPARE <value1> <value2>
DUMP <address range> [TO <address>]
LOAD [FROM <address>]
DELAY <value>
INT <address>
NMI <address>
SWI <address>
SEI
CLI

Command Description

Whenever MONDEB is waiting for a line of input, it prompts with an asterisk (*). When finished typing the line of input, the user types a carriage return and MONDEB begins processing that line. Until the carriage return is typed, the line can be aborted by typing Control-C, or one or more preceding characters can be deleted by typing one or more rubouts. There are two exceptions to this. One is that the first character typed (after the prompt) may be a Control-Z. This will cause the prior line of input to be used for the current line as well. The other exception is that several logical lines may be put on one physical line by separating one logical line from another by a semicolon (;). Any number of spaces may surround this semicolon.

In the descriptions that follow, an address range is often called for. This range may be specified as "a:b" which means "address a through address b", or "a!b" which means "starting at address a and for b more bytes." For example, both 100:103 and 100!3 imply the addresses 100, 101, 102, and 103.

Note also that all commands could conceivably be abbreviated to the point where ambiguity sets in. For example, R, RE or REG might each indicate the "display registers" command. Therefore as noted earlier, those characters necessary to uniquely distinguish the command are in bold type in the following descriptions.

REG

The REG command is used to display the contents of the internal registers, as in the following example:

```
*REG
.CC=3C .B=FF .A=23 .IX=1234 .PC=0156 .SP=70A4
```

The period preceding the register name is used to distinguish its name from an ordinary hexadecimal number.

SET

The SET command is used to set the content of memory or the internal registers to specified data. Example:

```
*SET 150 2 10 AA FF
```

This example sets memory location 150 to 2, location 151 to 10, 152 to AA and location 153 to FF. Note that all values are hexadecimal.

If several locations are to be set, it is sometimes useful to "continue" a line with a line feed (LF). This will cause a typeout on the following line of the next address to be set. Simply continue typing input data. Terminate the last byte with a carriage return (CR). In the following example, which illustrates the line feed mode of data entry, the control characters CR (carriage return) and LF (line feed) are shown surrounded by a gray screen:

```
*SET 100 0 1 2 3 (LF)
0104 4 5 6 (LF)
0107 7 (CR)
```

When more than one memory location is to be set to the same value, specify a range with the SET command. For example, to set locations 100 thru 200 to hexadecimal 3F, enter:

```
*SET 100:200 3F
```

The address range in this form of the SET command may only be followed by one data byte.

The internal registers may be set as in the following example:

```
*SET .A 27 .B FF .PC 1234
```

This causes register A to be set to 27, B to FF and PC to 1234. Again, all values are hexadecimal. Note that a period must precede the register name to distinguish it from a memory address specified in hexadecimal. Those registers that may be set are:

```
CC A B IX PC SP
```

Since these registers correspond to stack locations, they *only* become effective with the issuance of the CONTINUE command. Note also that changing the value of the stack pointer (SP) effectively changes all register values.

DISPLAY

The DISPLAY command is used to display the contents of a memory address range. For example:

```
*DIS 100:104
0100=01 0101=5A 0102=23 0103=00 0104=FF
```

Lines exceeding 72 characters in length are folded.

For faster displays of memory, the DATA modifier may be used. It causes the output of records of 16 bytes of data per line with the address of the first byte preceding the data, as shown in the following example:

```
*DIS 100:123, DATA
0100 01 5A 23 00 FF 01 07 21 00 00 14 14 32 67 00 00
0110 00 00 CE FA AC A5 54 71 39 00 75 88 72 33 11 22
0120 AA 01 00 31
```

For even faster displays, the USED modifier will cause a period (.) to represent a zero byte and a plus sign (+) to represent a nonzero byte, as in the example below:

```
*DISPLAY 100: 123 USED
0100  +++.++++..++++..
0110  ..+++++++ .++++++
0120  ++.+
```

Note that 16 data values per line are printed when the DATA or USED modifiers are specified and the display base is hexadecimal. If the display base is decimal, ten data values per line are output; for octal, eight values per line; and for binary, two values per line. So, the number of values printed per line indicates the base of the numbers.

DBASE

This command sets the display base to HEX (hexadecimal), DEC (decimal), OCT (octal) or BIN (binary). If no modifier follows this command, HEX is assumed. The following example illustrates this command:

```
*DIS 104
0104=80
*DBASE OCT
*DIS 104
000404=200
*DBASE BIN
*DIS 104
0000000100000100=10000000
*DBASE
*DIS 104
0104=80
```

Note that the memory address as well as the value is translated to the desired base, but that the input conversion is still hexadecimal in each case (see IBASE, below).

If there is any doubt as to which display base is in effect, follow the DBASE command with a question mark, as:

```
*DBASE ?
OCT
```

The base in effect will be typed on the succeeding line.

IBASE

Similar in function to the above DBASE command, IBASE is used to set the input base to HEX, (hexadecimal), DEC (decimal), or OCT (octal). Its format is the same as the DBASE command, including the question mark option. Its only difference is that it operates on input values instead of output values.

GOTO

The GOTO command is used to transfer control to a specified memory address, as:

```
*GO 103
```

The address specified is saved so that typing the GOTO command at some future time without a following address value will cause transfer to the last given GOTO address.

BREAK

The BREAK command is used to set a breakpoint at a specified memory address. This is done by replacing the content of the specified address with 3F (hexadecimal), which indicates a "software interrupt" (SWI) instruction. The original content is saved. This saved code is restored when the BREAK command is typed without an address. For example:

```
*BR 763
```

will put an SWI instruction at location 763. Subsequently, typing

```
*BR
```

will remove the SWI code and restore the original instruction.

Upon encountering an SWI instruction, MONDEB will type "SWI:", automatically execute the REG command, and transfer control to command level. The debugged program could be continued, perhaps after exercis-

ing some MONDEB commands, by typing the CONTINUE command, providing that the most recent breakpoint has been removed.

If a breakpoint is set while a prior breakpoint is in effect, the prior breakpoint is automatically removed, ie: only one breakpoint can be set and in effect at a time.

To display the current breakpoint, type BREAK followed by a question mark, as shown in the following example:

```
*BREAK ?
NOT SET
*BR 123
*BR ?
SET @ 0123
```

CONTINUE

This command is used to continue a program that has been interrupted via a breakpoint inserted SWI instruction. Execution will continue at the address of the SWI instruction. Therefore, it is assumed that the SWI instruction at that address has been removed by entering

```
*BREAK
```

alone to restore the former instruction, or by resetting the breakpoint at some other location.

The CONTINUE command also causes the set register command to become effective.

TEST

The TEST command is used to test a programmable memory range for bad memory locations. The test is a simple one in that each location within the range is checked to see if it can store all zeros and then all ones. The addresses of faulty locations and the associated contents are typed out after the check has been completed.

It should be noted that the initial content of the memory location being tested is preserved. Thus, the TEST command doesn't alter memory, making it possible to test memory already loaded with a program or data.

An example of the test command follows. Note that memory locations above hexadecimal FFF are undefined.

```
*TEST 800:1002
1000=00 CANT SET TO ONES
1001=00 CANT SET TO ONES
1002=00 CANT SET TO ONES
1003=00 CANT SET TO ONES
```

VERIFY

The VERIFY command is used to initially compute the checksum of a memory range, and then subsequently to compare this reference checksum to a new one generated for the same address range, as shown below:

```
*VERIFY 0:FFF
3C
*VER
OK
*SET 0013 23
*VER
CHECKSUM ERROR
```

This command is useful when checking out new software to insure that some unforeseen bug has not caused it to destroy part of itself.

The Motorola MIKBUG definition of the checksum of a range is simply the complement of the sum of all the bytes in the range.

SEARCH

SEARCH is used to search a memory range for a specified string of bytes. When the sequence is found, the address of the first matching byte is displayed. The maximum length of a search string is six bytes. Note that the locations of all matching strings in the search range are typed, not just the first.

A good use for this command is in program conversion, where, for instance, all jumps to a certain subroutine must be changed to another subroutine, as in input and output conversions. Example:

```
*SEARCH 800:FFF BD FD 06
```

Note that the address range (800:FFF) is followed by the byte string (BD FD 06, hexadecimal) being searched for.

COPY

The COPY command is used to copy a range of bytes from one memory location to another. The source range is followed by the start of the destination range, as shown in the example below:

```
*COPY 7501I4 20
```

Note that the copy will not work properly if the source range partly overlays the destination range *and* if the first address of the destination range exceeds the first address of the source range. In other works, you can shift a range down a few bytes, but not up.

COMPARE

The COMPARE command simply types out the sum and difference between two specified numbers. This eases the burden of mental computations in nondecimal bases. For example, when trying to patch in a BSR instruction, the relative difference of two addresses may be needed, as in:

```
*COMPARE 53F 4FF
SUM IS 0A3E, DIF IS 0040
```

Note that in subtraction, the second number is subtracted from the first.

INT

This command allows you to define the location to

which control will transfer upon receipt of an interrupt other than a nonmaskable or software interrupt. For example:

```
*INT 6074
```

NMI

Similar to the INT command, NMI defines the location to which control will transfer upon receipt of a nonmaskable interrupt.

SWI

The SWI command is also similar to the INT command, but defines the location to which control will transfer upon encountering a software interrupt (SWI) instruction.

SEI

SEI sets the interrupt mask bit, causing interrupts to be ignored. It has no modifiers.

CLI

CLI clears the interrupt mask bit, causing subsequent interrupts to be processed normally. CLI also has no modifiers.

DUMP

DUMP provides a way to save a portion of memory on paper tape or cassette tape. The format of the dumped data is identical to that of the Motorola MIKBUG monitor, except that header (type S0) and trailer (type S9) records are also included. The example of this command:

```
*DUMP 600:2400
```

will dump the address range 600 thru 2400, inclusive. If an address range is not given, the range stored in RANGLO and RANGHI (see source listing on pages 35 and 36) is used. This provides the capability of having an external program set up this range for a subsequent DUMP by MONDEB.

By default, the dumped information will go to the user's terminal. The dump may be sent to another device (such as a cassette) if that device is interfaced through an ACIA. Use the optional parameter TO keyword followed by the address of the desired ACIA to dump the information to some device other than the terminal. For example, a paper tape punch might be interfaced through an ACIA whose data address is 7F45 (and control address is 7F44). To dump memory locations 1000 through 2000 to the paper tape punch, the following command would be used:

```
*DUMP 1000:2000 TO 7F45
```

Leaders consisting of 30 null characters precede the first record and follow the last record.

Note that the display base should be set to HEX if the dump is to be a normal Motorola MIKBUG hexadecimal dump.

LOAD

Motorola MIKBUG formatted tapes can be loaded with the LOAD command. To load from cassette tapes, simply type the LOAD command with no modifiers.

To load from another ACIA controlled device, append "FROM" and the data address of the ACIA receiving the formatted load information, as:

```
*LOAD FROM 7F41
```

DELAY

The DELAY command will delay the prompt for (and processing of) the next line of input for the specified number of milliseconds. This feature is intended for the testing of peripheral devices. It possibly attains its greatest value when interspersed with several other commands on a composite input line creating delays between the commands. This is done where timing of an event is crucial. For example, the following could be used to send three characters to an ACIA controlled remote terminal at 256 millisecond intervals:

```
*SET 7F45 30; DELAY 100;SET 7F45 31;DELAY
100;SET 7F45 32
```

Note that the values are all hexadecimal.

The delay is generated by an internal loop. The loop time in turn is dependent upon the microprocessor clock rate and a preset variable at memory location TIMCON. This variable should be set to 100 for a 1 MHz clock, or 50 for a 0.5 MHz clock. If your processor clock runs at X MHz, then the closest integer value for TIMCON is found by rounding the result of the following expression:

```
TIMCON = 100 * X
```

Coding Conventions

Good coding conventions simplify the problems of software interface and modification. It is with this in mind that this monitor adheres to the following conventions:

- MONDEB resides in the upper 3 K of a 6800's memory address space (61 K to 64 K) leaving all lower memory available for user memory. See figure 1 for a map layout of the MONDEB memory space.
- Page zero (addresses 0 to 255) is not used at all, eliminating possible storage conflicts with application software.
- The scratch pad memory required for MONDEB resides at about 30 K, but a reassembly could place it almost anywhere.
- Monitor routines for reading and displaying a char-

acter or character string are included.

- Register A is generally used to pass 1 byte data to and from MONDEB. Other registers are generally preserved.
- Jump vectors in high memory define the entry points to frequently used subroutines so that subsequent MONDEB revisions will not affect the access addresses of dependent software.
- A standard Motorola MIKBUG formatted DUMP and LOAD utility is available.
- The source code listing is in standard Motorola format.

Figure 1: Map of MONDEB memory space.

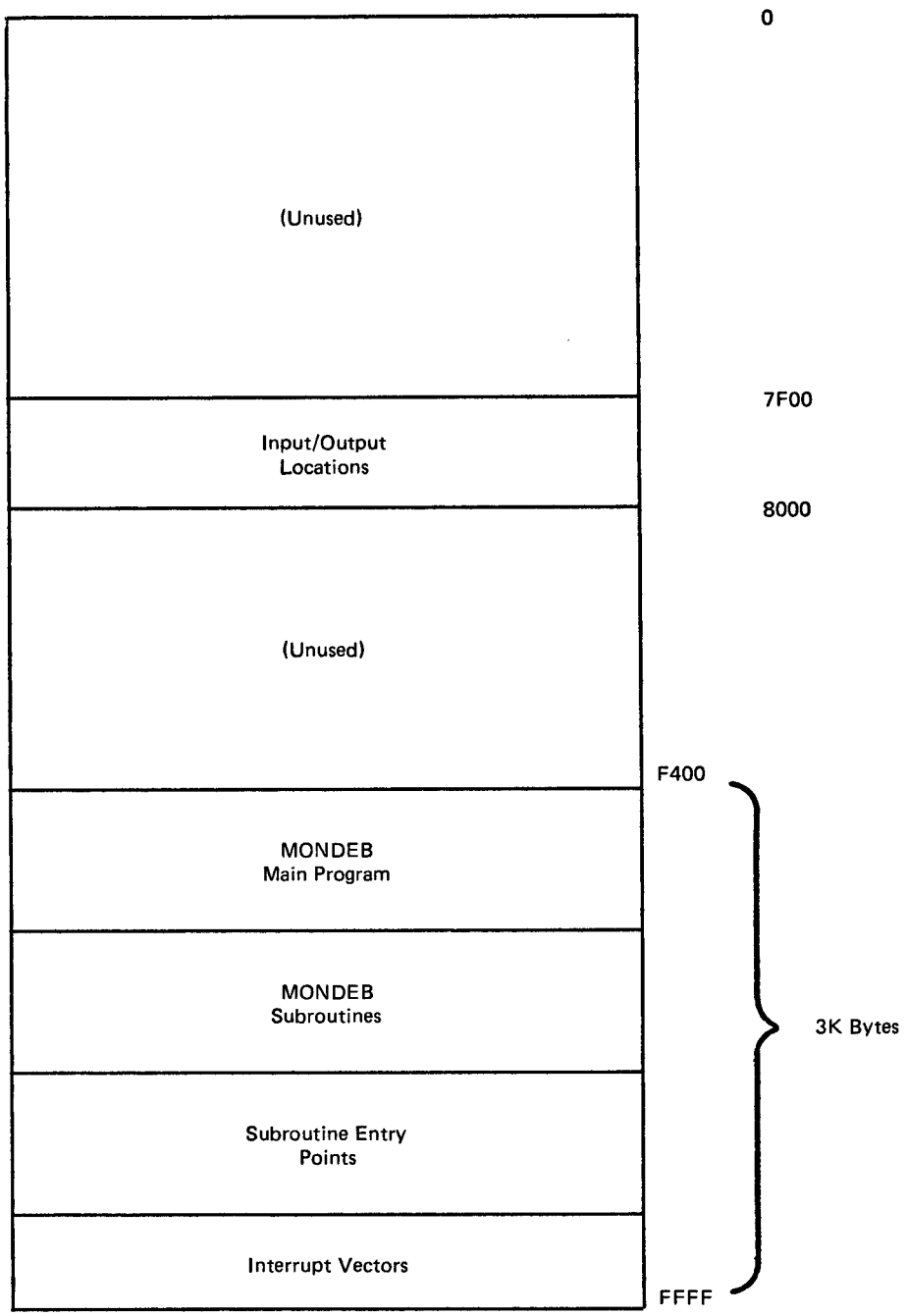

Figure 2: Example of scanning of a line of input.

Assembly Language		Accumulator A Input	Accumulator A Returned	NBRHI	NBRLO	Analysis Pointer
JSR	GETLIN					
LDX	BUFBEG	–	–			↑SET 100 2A
STX	SYNPTR					
LDA A	#1	1	11			
JSR	COMAND	(Search list 1)	(11th command)	–	–	SET ↑100 2A
LDA A	#2	1	-1			
JSR	COMAND	(Search list 1)	(No match)	–	–	SET ↑100 2A
JSR	NUMBER	–	+1	01	00	SET 100↑2A
JSR	NUMBER	–	+1	00	2A	SET 100 2A↑
JSR	NUMBER	–	0	00	00	SET 100 2A↑

Input Line Scanning

The nucleus of MONDEB consists of a number of routines which scan an input line for certain information. Each routine looks for its own specific item of interest and signals success or failure depending upon whether or not the desired item is found. For example, the routine NUMBER looks for a number, ie: a string of digits in the expected base. The result of the scan, or search, is a number which is returned in a predetermined memory location.

The concept of a line or syntax pointer is central to the scanning process. This pointer simply identifies the actual location within the input line at any moment during the scanning process. This pointer is called SYNPTR in the program, and is initialized to the beginning (first character) of the input line (input buffer) when an input line is requested via subroutine GETLIN. At this point the input line is scanned to a point where MONDEB can decide that it has a particular item, such as a number or command, located on the line. Let us return for a moment to the example of scanning for a number.

If a good number were scanned, the pointer would be advanced *through* the sequence of numeric digits, stopping at the next terminator (a nonnumeric character). The pointer would then be in position to pick up the next item on the input line (after skipping over intervening delimiters). However, if the number were not valid (for instance, if 1Z3 were scanned), the pointer would not be advanced at all, allowing an alternate routine to take over. This might be the case if, for example, a number *or* a command could syntactically appear in the scanned position.

All this leads to the necessity of determining the status of the scan. The convention of the line scanning routines is to store the scan status in accumulator A. If accumulator A is positive, the scan was successful, and the pointer advances to the first item delimiter. If it is zero, then the end of an input line has been reached (nothing else to scan), and the pointer is moved to the end of the line. If accumulator A is negative, the scan was unsuccessful, and the pointer remains unaltered.

Since the scanning routines set up the A accumulator, just prior to their exit, they also set up the condition code Z and N bits for testing after the subroutine call, further simplifying the scan status tests.

The following example illustrates the above, using MONDEB (with all of MONDEB's editing facilities available) to get a number from a terminal:

```
10  JSR   GETLIN   Get a line of input
20  LDX   BUFBEG   Get address of beginning of buffer
30  STX   SYNPTR   Get syntax pointer equal to it
40  JSR   NUMBER   Scan for the number
50  BMI   ERROR    To ERROR if bad number
60  BEQ   EOLINE   To EOLINE if end-of-line
```

Here, line 10 gets an input line (with all editing features such as rubout, Control-Z, Control-C, etc) to process. Lines 20 and 30 set the scan pointer to the start of this input line. Line 40 looks for a valid number and sets up the condition code bits appropriately. Line 50 then checks for an error and branches to the label ERROR if a number is not recognized. Line 60 causes a branch to label EOLINE if there is nothing more on the line to scan. If a good number is scanned, the most significant byte of the number would be stored in NBRHI and the least significant byte in NBRLO. To pick up a second number, lines 40, 50 and 60 would be repeated. See figure 2 for an example of scanning a line.

Any good interactive software should be able to handle key words with the same ease as numeric scanning. MONDEB offers this facility through a subroutine called COMAND. COMAND operates on lists of key words. For example, one such list in MONDEB consists of HEX, DEC, OCT and BIN. Each list is associated with a number, and the words in the previous example happen to be (arbitrarily)

assigned to list #3.

The following example, instead of looking for numeric data on the input line, seeks a match on some word (command) within list #3:

```
10  LDA A  #3        Refer to list 3
20  JSR    COMMAND   Look for a match
30  BLT    ERROR     To ERROR if no match
40  BEQ    EOLINE    To EOLINE if end-of-line
```

Note the similarity to the NUMBER routine; the only thing extra needed is the list in which to search for a match. If a match is found, accumulator A contains the positional number of the matched command. For example, if DEC is scanned, accumulator A would be set to 2, since DEC is the second entry in the list. Note that since COMAND permits abbreviations, the user could have scanned for DEC, DE or simply D. Again, remember that the pointer is not advanced on a match failure, so another match on another list can be tried.

Setting up these command lists is also fairly easy. They can be entered as text strings with the FCC assembler directive, following each command with a carriage return character, and terminating each list with a line feed character. This is shown in the MONDEB assembly listing. Different lists can be set up in the initialization section of the code section, which could be accomplished as follows:

```
10 LDX #LISTS-1
20 STX COMADR
```

In this example, LISTS is the label of the first command in the first list of the command lists. COMADR is a memory location that always holds the address of the start of the command lists it is to use.

While NUMBER and COMAND are the two subroutines of major importance, there are many other useful routines. All, including the above two, are documented below.

MONDEB Subroutine Summary

Routine name:	TIMDEL.
Entry address:	FFB9.
Description:	Execute a time delay.
Input:	The index register specifies the number of milliseconds to delay.
Output:	None.
Register preserved:	Accumulator B.

Routine name:	CKSUM.
Entry address:	FFBC.
Description:	Compute the checksum of an address range. This routine and the input address storage locations are used by the VERIFY command.
Inputs:	VERFRM holds the address of the beginning of the range. VERTO holds the address of the end of the range.
Output:	Accumulator A holds the computed checksum.
Register preserved:	Accumulator B.

Routine name:	GETCHR.
Entry address:	FFBF.
Description:	Reads a character from memory (input line).
Input:	LINPTR holds the address preceding the address of the character to get.
Output:	Accumulator B holds the character read. LINPTR is left pointing to the address the character came from.
Register preserved:	Accumulator A.

Routine name:	GETLST.
Entry address:	FFC2.
Description:	Reads a character from memory (command list).
Input:	LISPTR holds the address preceding the address of the character to get.
Output:	Accumulator A holds the character read. LISPTR is left pointing to the address the character came from.
Register preserved:	Accumulator B.

Routine name:	GTRANG.
Entry address:	FFC5
Description:	Scan for a pair of numbers. A ":" separating the pair implies "thru". A separating "!" implies "thru the following," eg: 100:105 is equivalent to 100:!5. A single number is valid and gets put into both of the range high and range low address storage locations.
Input:	(input line).
Outputs:	(RANGLO, RANGLO+1) holds the range start. (RANGHI, RANGHI+1) holds the range end.
Registers preserved:	None.

Routine name:	NUMBER.
Entry address:	FFC8.
Description:	Scan for a 1 or 2 byte number in the input base currently in effect.
Input:	(input line).
Outputs:	Accumulator A is negative: Illegal number, pointer not advanced. Accumulator A is zero: End of line reached, pointer set there. Accumulator A is positive: Valid number scanned, pointer advanced to next delimiter. NBRHI: High byte of scanned number. NBRLO: Low byte of scanned number.
Register preserved:	Index register.

Routine name: SKPDLM.
Entry address: FFCB.
Description: Skip over leading delimiters until a nondelimiter or end-of-line character is found.
Input: (input line).
Output: The carry bit is set if an end of line is encountered.
Registers preserved: None.

Routine name: TSTDLM.
Entry address: FFCE.
Description: Test whether specified character is a delimiter.
Inputs: Accumulator B holds the character to be tested. DELIM specifies the delimiter class as follows:

1 = Only space is a delimiter.
2 = Only comma is a delimiter.
3 = Space or comma is a delimiter.
4 = Any nonalphanumeric character is a delimiter.

Output: Accumulator A = 0 : Character is not a delimiter.
Accumulator A = 1 : Character is a delimiter.
Registers preserved: Accumulator B and Index register.

Routine name: TSTEOL.
Entry address: FFD1.
Description: Test for an end-of-line character.
Input: Accumulator A holds the character to be tested.
Output: The Z bit of the condition code is set if the character in accumulator A is a line terminator, ie: a carriage return (CR), line feed (LF) or semicolon (;).
Registers preserved: Accumulator B and index register.

Routine name: COMAND.
Entry address: FFD4.
Description: A match is sought on one of the commands in the list specified by accumulator A on input. The result of the match attempt is reflected by accumulator A and the condition code bits N and Z.
Inputs: (input line).
Accumulator A holds the number of the list to be searched.
Outputs: Accumulator A = −1: Match unsuccessful, pointer not advanced.
Accumulator A = 0 : End of line, pointer advanced to end of line.
Accumulator A = +n : Successful match on command in list position "n." Pointer advanced to command delimiter.
Registers preserved: None.

Routine name: TYPCMD.
Entry address: FFD7.
Description: Types out a given command in a given list.
Inputs: Accumulator A holds the command list number.
COMNUM holds the command number within that list.
Outputs: None.
Registers preserved: Accumulator B and index register.

Routine name: OUT1BY.
Entry address: FFDA.
Description: Outputs a 1 byte number with leading zeros.
Inputs: The index register points to the address of the byte to output.
DBCODE specifies the output base.

DBCODE = 1 : **HEX**adecimal
DBCODE = 2 : **DEC**imal
DBCODE = 3 : **OCT**al
DBCODE = 4 : **BIN**ary

Output: Numeric characters.
Registers preserved: Accumulator A, accumulator B and index register.
Note: See subroutine OUTCHR for destination of output.

Routine name: OUT2BY.
Entry address: FFDD.
Description: Outputs a 2 byte number with leading zeros.
Input: The index register holds the address of the most significant byte of the pair of bytes to output.
DBCODE specifies the output base (see OUT1BY).
Output: Numeric characters.
Registers preserved: Accumulator A, accumulator B and index register.
Note: See subroutine OUTCHR for destination of output.

Routine name: GETLIN.
Entry address: FFE0.
Description: Gets a line of text entered by the user. The line is terminated by entering a carriage return. A carriage return, line feed pair is automatically inserted in the input line after 72 input characters. However, the pair does not get inserted into the input buffer. Exceeding the input buffer length (default is 72 characters) causes the message "TOO LONG" to be typed. The following editing characters are available:

Rubout deletes the previous character. The deleted characters are surrounded by backslashes in the input line echoed to the terminal.
Control-C will abort the line.
Control-Z (as the first character

of an input line) will use the previous line as the current line.

Input: A line of characters entered by the user.

Output: Characters stored in an input line buffer which have a beginning address stored in BUFBEG and an ending address stored in BUFEND.
Accumulator B is set to 3 upon line abort by Control-C.

Registers preserved: None.

Routine name: OUTSTR.
Entry address: FFE3.
Description: Output a character string terminated by a code of 4 (ie: End of Transmission (EOT) or Control-D).

Input: Index register holds the address of the beginning of the string.

Output: Character string to terminal, ACIA or memory (see OUTCHR).

Registers preserved: Accumulator A and accumulator B.

Routine name: DOCRLF.
Entry address: FFE6.
Description: Output a carriage return followed by a line feed to the terminal.
Variable CPLCNT (characters-per-line count) is cleared. After the carriage return and line feed, one null character (a "filler") is sent for every 16 characters of line length, allowing time for the hardware to react.

Input: None.

Output: Carriage return and line feed, plus "fillers" to the terminal.

Registers preserved: Accumulator A, accumulator B and index register.

Routine name: OUTCHR.
Entry address: FFE9.
Description: Output a character to the desired output device or address location, as follows:

OUTFLG = 0: Output is to the terminal (via TOACIA).
OUTFLG = 1: Output is to the ACIA data address stored in OUTADR.
OUTFLG = 2: Output is to the address in OUTADR which is then incremented.

Input: Accumulator A holds the character to be output.

Output: One character is sent to a specified destination. If output is to the terminal, a carriage return followed by a line feed is interjected after every 72 characters, or during a space in the last ten characters in a line.

Registers preserved: Accumulator A, accumulator B and index register.

Routine name: TOACIA.
Entry address: FFEC.
Description: Output a character to the terminal.

Input: Accumulator A holds the character to be sent to the terminal.

Output: One character is sent to the terminal.

Registers preserved: Accumulator A, accumulator B and index register.

Routine name: INPCHR.
Entry address: FFEF.
Description: Input a character from an ACIA, as follows:

INPFLG = 0: Input is from the terminal.
INPFLG = 1: Input is from the ACIA data address stored in INPADR.

Input: A character from an ACIA.

Output: Accumulator A returns with the character.

Registers preserved: Accumulator B and index register.

Conclusion

An extensive "wish list" preceded development of MONDEB. As development progressed, this list shrank, but never as fast as new features were implemented. Knowing development would continue virtually forever through "one plussing," the decision was made to interrupt development at the 3 K byte level, a point where most of the important features were felt to be included.

This monitor-debugger was sort of a "bootstrap" project in that it greatly eases the development of future software. Its much greater power compared to MIKBUG makes it a real pleasure to use.

While the project was interesting and challenging, it also took much longer than planned (slipped schedules seem to be the norm in software development). But then again there is the satisfaction of seeing a complex product developed to your own critical specifications.

It is my hope that this monitor-debugger will be as helpful to others as it has been to me, and that this implementation will lead to bigger, better, and more useful versions. ■

Appendix A:

Conversion of TSC BASIC

The following modifications convert Technical Systems Consultants' BASIC to interface to the MONDEB monitor-debugger. Note that, except for the included "to", the syntax of MONDEB's SET command is used to describe the memory changes required.

To get an echo (MONDEB uses full duplex operation):

SET 106 to BD FF EF
SET 109 to 7E FF E9

SET 450 to 01 09
SET 2D1 to 01 06
SET 7BF to 01 06
SET 7FE to 01 06

To disable the test of the MIKBUG PIA for a break:

SET 452 to 39

To have BASIC set MONDEB's GO command to restart BASIC at 103:

SET 1B4 to 70 19

To cause BASIC's MON command to jump to MONDEB's prompt instead of MIKBUG:

SET 15F to FF F2

To set up for use of MONDEB's stack instead of MIKBUG's stack:

SET 1B7 to 70 B1
Set 946 to 70 9C

To have BASIC set MONDEB's DUMP command to dump a BASIC program:

SET 1C4 to 70 15
SET 1C9 to 70 17

To change "delete last character" from Control-H to rubout:

SET 2D4 to 7F

To change "delete line" from Control-X to Control-C:

SET 2E3 to 3
SET 7C2 to 3

Appendix B:

MONDEB M6800 Assembly Language Source Listing

```
                        NAM     MONDEB
                    *THIS SOURCE CODE WAS SENT TO WALTER BANKS AT
                    *THE UNIVERSITY OF WATERLOO BY DON PETERS ON PAPER TAPE
                    *CROSS ASSEMBLY WAS DONE ON THE U OF W HONEYWELL 66/60
                    *THE BARCODE AND LISTING WERE SET ON A PHOTON PHOTO-
                    *TYPESETTER DRIVEN BY THE HONEYWELL.
                    *
                    *       M O N D E B  - A MONITOR/DEBUGGER FOR THE M6800
                    *                      MICROPROCESSOR


                    * AUTHOR: DON PETERS
                    * DATE: APRIL 1977
                    * MEMORY REQ'D: 3K BYTES AT HIGH END OF ADDRESS SPACE


                    * SEE USER MANUAL FOR CAPABILITIES & INSTRUCTIONS ON
                    *                      USE


                    *       ORG     $400    DEBUG ORG AT 1K
F400                        ORG     $F400   NORMAL ORGIN AT 61K



                    *I/O DEVICE ADDRESSES
     7F43           ACIA1   EQU     $7F43   ACIA #1 - MAIN TERMINAL ACIA
     7F45           ACIA2   EQU     $7F45   ACIA #2 - AUXILIARY TERMINAL
                    *                       ACIA


                    *OTHER CONSTANTS
     000D           CR      EQU     13      CARRIAGE RETURN
     000A           LF      EQU     10      LINE FEED



     F400           START   EQU     *       PROGRAM ENTRY POINT
F400 8E 70B1                LDS     #STACK  INITIALIZE THE STACK POINTER
F403 BF 7006                STS     SP      SAVE THE POINTER
F406 BD FE08                JSR     INITAL  INITIALIZE VARIABLES


                    *TYPE OUT MONITOR NAME & VERSION
F409 BD FEC7                JSR     DOCRLF  ADVANCE TO A CLEAN LINE
F40C CE FEF2                LDX     #MSGHED  GET ADDRESS OF HEADER
F40F BD FE4B                JSR     OUTSTR  TYPE IT


                    *SET UP DESTINATION OF INPUT LINE
                    *DEFINE BEGINNING OF INPUT BUFFER
F412 CE 702F                LDX     #TTYBUF-1   GET ADDRESS OF TERMINAL
                    *                       INPUT BUFFER
F415 FF 702C                STX     BUFBEG  SAVE IT


                    *DEFINE END OF INPUT BUFFER - 72 CHAR CAPACITY, INCL CR
F418 CE 7078                LDX     #TTYEND
F41B FF 702E                STX     BUFEND
```

```
                *DELIMITER CLASS DEFINITION - SPACE OR COMMA (CODE 3)
F41E 86 03              LDA A   #3
F420 B7 700F            STA A   DELIM
F423 20 0F              BRA     PROMP1



                *PREPARE TO GET A NEW COMMAND
F425 BD FEC7 PROMPT     JSR     DOCRLF    TYPE CR-LF
F428 7C 700E            INC     BOLFLG    SET "BEGINNING OF LINE" FLAG
F42B FE 700A            LDX     SYNPTR    POINT TO CURRENT CHARACTER
F42E A6 00              LDA A   X         GET IT
F430 81 3B              CMP A   #';       SEMICOLON?
F432 27 1A              BEQ     GETCMD    CONTINUE SCAN IF IT IS,
                                           SKIPPING THE PROMPT
                *TYPE PROMPT
F434 CE FEFF PROMP1     LDX     #MSGPRM
F437 BD FE4B            JSR     OUTSTR

F43A BD FD8C            JSR     GETLIN    GET LINE OF INPUT

                *ABORT LINE ON A CONTROL-C
F43D C1 03              CMP B   #3
F43F 27 E4              BEQ     PROMPT

                *SET SYNTAX SCANNING POINTER TO BEGINNING OF
                *                           BUFFER/LINE
F441 FE 702C            LDX     BUFBEG
F444 FF 700A            STX     SYNPTR

                *REPROMPT ON AN EMPTY LINE (FIRST CHAR = CR, LF, OR ;)
F447 A6 01              LDA A   1,X       GET FIRST CHAR
F449 BD FA89            JSR     TSTEOL    TEST IT
F44C 27 D7              BEQ     PROMPT    IF IT IS, PROMPT AGAIN

                *USE LIST 1 WHEN MATCHING
F44E 86 01    GETCMD    LDA A   #1

                *NOW GO FOR A MATCH
F450 BD F9C7            JSR     COMAND

                *-AND TEST THE RESULT OF THE SCAN
F453 27 D0              BEQ     PROMPT    REPROMPT IF JUST A CR WAS TYPED
F455 2E 1F              BGT     JMPCMD    GOOD COMMAND IF POSITIVE

                ******
                *UNRECOGNIZABLE SYNTAX - POINT TO ERROR
F457 FE 702C BADSYN     LDX     BUFBEG    GET START OF LINE
                *SPACE OVER TO ERROR IN SYNTAX
F45A BC 700C BADS1      CPX     LINPTR    AT ERROR?
```

```
F45D 27 06           BEQ     BADS2
F45F BD FBF1         JSR     OUTSP      OUTPUT A SPACE
F462 08              INX                NO, MOVE ON
F463 20 F5           BRA     BADS1

                    *THE "EXTRA" CHAR "1" IS COMPENSATED FOR BY THE PROMPT
                    *                    CHAR ON THE PRECEEDING LINE
F465 86 5E   BADS2   LDA A   #'1        AT ERROR - GET AN UP-ARROW
F467 BD FE76         JSR     OUTCHR     PRINT IT
F46A BD FEC7         JSR     DOCRLF
F46D 20 C5           BRA     PROMP1     IGNORE ANY SUCCEEDING PACKED
                    *                    COMMANDS


                    ******
                    *THERE SHOULD BE NO MORE CHARACTERS ON THE INPUT LINE
                    *                    (EXCEPT DELIMITERS)
F46F BD FA69 NOMORE  JSR     SKPDLM
F472 25 B1           BCS     PROMPT     IF CARRY BIT SET, END OF LINE
                    *                    (NORMAL)
                    *THERE IS SOMETHING THERE BUT SHOULDN'T BE
F474 20 E1           BRA     BADSYN


                    ******
                    *EXECUTE A COMPUTED "GOTO" TO THE PROPER COMMAND
F476 16      JMPCMD  TAB                SAVE COMMAND # IN ACCB
F477 48              ASL A              MULTIPLY COMMAND BY 2
F478 1B              ABA                ACCA NOW HOLDS COMMAND #
                    *                    MULTIPLIED BY 3
                    *ADD IT TO BASE OF JUMP TABLE
F479 C6 F4           LDA B   #JMPHI     GET HI BYTE OF START OF JUMP
                    *                    TABLE IN ACCB
F47B 8B 85           ADD A   #JMPLO     ADD LO BYTE OF START OF JUMP
                    *                    TABLE TO ACCA
F47D C9 00           ADC B   #0         ADD CARRY IF THERE WAS
                    *                    ONE
                    *MOVE ACCA & ACCB TO IX  (CODE IS WEIRD, BUT BRIEF)
F47F 36              PSH A
F480 37              PSH B
F481 30              TSX                PUT ADDRESS OF "GOTO" INTO X
F482 EE 00           LDX     X          GET THE ADDRESS ITSELF
F484 33              PUL B              RESTORE THE STACK
F485 32              PUL A


F486 6E 00           JMP     X          JUMP TO RIGHT COMMAND


     F485    JMPTBL  EQU     *-3


     00F4    JMPHI   EQU     JMPTBL/256
     F400    JMP256  EQU     JMPHI*256
     0085    JMPLO   EQU     JMPTBL-JMP256

F488 7E F4C7         JMP     REG
F48B 7E F514         JMP     GOTO
F48E 7E F526         JMP     SEI
F491 7E F529         JMP     CLI
```

```
F494 7E F52C          JMP     COPY
F497 7E F558          JMP     BREAK
F49A 7E F5B8          JMP     IBASE
F49D 7E F5CE          JMP     DBASE
F4A0 7E F604          JMP     CONTIN
F4A3 7E F608          JMP     DISPLA
F4A6 7E F673          JMP     SET
F4A9 7E F720          JMP     VERIFY
F4AC 7E F766          JMP     SEARCH
F4AF 7E F7ED          JMP     TEST
F4B2 7E F844          JMP     INT
F4B5 7E F84C          JMP     NMI
F4B8 7E F854          JMP     SWI
F4BB 7E F85C          JMP     COMPAR
F4BE 7E F885          JMP     DUMP
F4C1 7E F924          JMP     LOAD
F4C4 7E F9B5          JMP     DELAY
                      ******
                      *REG - DISPLAY REGISTERS
      F4C7            REG     EQU     *
                      *PRINT STACK STORED SWI DATA
F4C7 FE 7006          DISREG  LDX     SP        GET SAVED STACK POINTER
F4CA 08                       INX
                      *REGISTER NAME TYPEOUT INITIALIZATION
F4CB 7F 70D6                  CLR     COMNUM    START AT BEGINNING OF THE
                      *                          REGISTER NAME LIST


F4CE 8D 13                    BSR     OUT2      TYPE CONDITION CODES
F4D0 8D 11                    BSR     OUT2      TYPE ACCB
F4D2 8D 0F                    BSR     OUT2      TYPE ACCA

F4D4 8D 14                    BSR     OUT4      TYPE INDEX REG
F4D6 8D 12                    BSR     OUT4      TYPE PROGRAM COUNTER


                      *TYPE THE STACK POINTER LOCATION
F4D8 8D 18                    BSR     OUT2A4    TYPE STACK POINTER ID
F4DA CE 7006                  LDX     #SP
F4DD BD FC04                  JSR     OUT2BY    TYPE THE VALUE


F4E0 7E F46F                  JMP     NOMORE


                      *OUTPUT CONTENT OF A 1 BYTE REGISTER
F4E3 8D 0D            OUT2    BSR     OUT2A4
F4E5 BD FBFD                  JSR     OUT1BY
F4E8 08                       INX
F4E9 39                       RTS


                      *OUTPUT CONTENT OF A 2 BYTE REGISTER
F4EA 8D 06            OUT4    BSR     OUT2A4
F4EC BD FC04                  JSR     OUT2BY
F4EF 08                       INX               SKIP TO NEXT BYTE IN STACK
F4F0 08                       INX               SKIP TO NEXT BYTE IN STACK
```

```
F4F1 39                 RTS
                *MISC SETUP FOR REGISTER DISPLAY
F4F2 BD FBF1 OUT2A4 JSR     OUTSP     OUTPUT A SPACE
F4F5 7C 70D6        INC     COMNUM    SKIP TO NEXT REGISTER NAME
F4F8 86 05          LDA A   #5        REGISTER NAME IS IN LIST 5
F4FA BD FA2E        JSR     TYPCMD    TYPE IT
F4FD BD FBF7        JSR     OUTEQ     TYPE AN "="
F500 39             RTS


                *ENTER HERE FROM SOFTWARE INTERRUPT
F501 CE FF01 TYPSWI LDX     #MSGSWI
F504 BD FE4B        JSR     OUTSTR
                *DECREMENT PC SO IT POINTS TO "SWI" INSTRUCTION
F507 FE 7006        LDX     SP
F50A 6D 07          TST     7,X       TEST LO BYTE OF PC FOR PENDING
                *                       BORROW
F50C 26 02          BNE     TYPSWI
F50E 6A 06          DEC     6,X       NEED TO BORROW, DECR HI BYTE OF
                *                       PC
F510 6A 07    TYPSWI DEC    7,X       DECR LO BYTE OF PC
F512 20 B3          BRA     DISREG    GO DISPLAY REGISTERS
                ******
                *GOTO - GO TO MEMORY ADDRESS
F514 BD FB47 GOTO   JSR     NUMBER    GET DESTINATION
F517 27 08          BEQ     GOTO1     IF NONE, USE DEFAULT
F519 FE 7013        LDX     NBRHI
F51C FF 7019        STX     LASTGO    SAVE IT
F51F 6E 00          JMP     X         GO TO DESTINATION


F521 FE 7019 GOTO1  LDX     LASTGO    GET LAST GOTO ADDRESS
F524 6E 00          JMP     X         GO TO IT
                ******
                *SEI - SET INTERRUPT MASK
F526 0F       SEI   SEI
F527 20 2C          BRA     COPY3


                ******
                *CLI - CLEAR INTERRUPT MASK
F529 0E       CLI   CLI
F52A 20 29          BRA     COPY3


                ******
                *COPY - COPY FROM ONE LOCATION TO ANOTHER
F52C BD FAFC COPY   JSR     GTRANG    GET SOURCE RANGE INTO RANGLO &
                *                       RANGHI
F52F 2F 21          BLE     COPY2     ERROR IF NO SOURCE
F531 BD FB47        JSR     NUMBER    GET DESTINATION
F534 2F 1C          BLE     COPY2     ERROR IF NO DESTINATION


F536 FE 7015        LDX     RANGLO    GET SOURCE ADDRESS POINTER
F539 A6 00    COPY1 LDA A   X         GET BYTE FROM SOURCE
F53B FE 7013        LDX     NBRHI     GET DESTINATION ADDRESS POINTER
F53E A7 00          STA A   X         SAVE BYTE IN DESTINATION
```

```
F540 08              INX             INC DESTINATION POINTER
F541 FF 7013         STX     NBRHI   SAVE IT
F544 FE 7015         LDX     RANGLO  GET SOURCE ADDRESS POINTER
F547 BC 7017         CPX     RANGHI  COMPARE TO END OF INPUT RANGE
F54A 27 09           BEQ     COPY3   DONE IF EQUAL
F54C 08              INX             NOT EQUAL, INC SOURCE POINTER
F54D FF 7015         STX     RANGLO  SAVE IT
F550 20 E7           BRA     COPY1   LOOP FOR NEXT BYTE

F552 7E F457 COPY2   JMP     BADSYN  BAD SYNTAX
F555 7E F46F COPY3   JMP     NOMORE  SHOULD BE NO MORE ON THE INPUT
                     *                LINE

                     ******
                     *BREAK - SET BREAKPOINT AT SPECIFIED ADDRESS & REMOVE
                     *                OLD ONE
F558 BD FB47 BREAK   JSR     NUMBER  GET BREAKPOINT LOCATION
F55B 2B 31           BMI     BREAK3  IF NOT NUMERIC, LOOK FOR "?"
F55D 27 1F           BEQ     BREAK2  IF NO MODIFIER, REMOVE OLD
                     *                BREAKPOINT

                     *CHECK IF A "SWI" IS STORED AT THE BREAK ADDRESS
F55F FE 7020         LDX     BRKADR  GET CURRENT BREAK ADDRESS
F562 A6 00           LDA A   X       AND THE CHAR THERE
F564 81 3F           CMP A   #$3F    COMPARE TO "SWI"
F566 26 05           BNE     BREAK1  EQUAL?
                     *YES, RESTORE THE OLD INSTRUCTION
F568 B6 7022         LDA A   BRKINS  GET IT
F56B A7 00           STA A   X       RESTORE IT

                     *PUT BREAK AT NEWLY SPECIFIED LOCATION
F56D FE 7013 BREAK1  LDX     NBRHI   GET NEW BREAKPOINT (BREAK
                     *                ADDRESS)
F570 FF 7020         STX     BRKADR  SAVE IT
F573 A6 00           LDA A   X       GET INSTRUCTION STORED THERE
F575 B7 7022         STA A   BRKINS  SAVE IT
F578 86 3F           LDA A   #$3F    GET CODE FOR SOFTWARE INTERRUPT
F57A A7 00           STA A   X       PUT IT AT BREAKPOINT
F57C 20 34           BRA     BREAK5  ALL DONE

                     *REMOVE BREAKPOINT
F57E FE 7020 BREAK2  LDX     BRKADR  GET ADDRESS OF BREAK
F581 A6 00           LDA A   X       GET INST. THERE
F583 81 3F           CMP A   #$3F    SWI?
F585 26 2B           BNE     BREAK5  IF NOT, RETURN & PROMPT
F587 B6 7022         LDA A   BRKINS  WAS A SWI - GET PREVIOUS INST.
F58A A7 00           STA A   X       & RESTORE IT
F58C 20 24           BRA     BREAK5

                     *LOOK FOR A QUESTION MARK IN LIST 4
F58E 86 04   BREAK3  LDA A   #4
F590 BD F9C7         JSR     COMAND  SCAN FOR IT
F593 2F 20           BLE     BREAK6  BAD SYNTAX IF NOT "?"
```

```
F595 FE 7020          LDX     BRKADR    IT IS, GET BREAK ADDRESS
F598 A6 00            LDA A   X         GET INSTRUCTION THERE
F59A 81 3F            CMP A   #$3F      IS IT A "SWI"?
F59C 27 08            BEQ     BREAK4    IF YES, SAY SO
                    *NO BREAKPOINT SET
F59E CE FF10          LDX     #MSGNBR    GET THAT MESSAGE
F5A1 BD FE4B          JSR     OUTSTR    SAY IT
F5A4 20 0C            BRA     BREAK5
                    *BREAKPOINT SET
F5A6 CE FF18 BREAK4   LDX     #MSGBAT    GET THAT MESSAGE
F5A9 BD FE4B          JSR     OUTSTR    SAY IT
F5AC CE 7020          LDX     #BRKADR    GET BREAK ADDRESS
F5AF BD FC04          JSR     OUT2BY    TYPE IT


F5B2 7E F46F BREAK5   JMP     NOMORE
F5B5 7E F457 BREAK6   JMP     BADSYN




                    ******
                    *IBASE - SET INPUT BASE
                    *LOOK FOR HEX, DEC, OR OCT IN LIST #3
F5B8 86 03    IBASE   LDA A   #3
F5BA BD F9C7          JSR     COMAND
F5BD 2B 09            BMI     IBASE2    UNRECOGNIZABLE BASE, TRY "?"
F5BF 2E 02            BGT     IBASE1
F5C1 86 01            LDA A   #1        NO BASE GIVEN - DEFAULT TO HEX
F5C3 B7 7010 IBASE1   STA A   IBCODE    SAVE BASE CODE
F5C6 20 EA            BRA     BREAK5


                    *LOOK FOR "?" IN LIST #4
F5C8 B6 7010 IBASE2   LDA A   IBCODE    GET IB CODE IN CASE ITS NEEDED
F5CB 36               PSH A             SAVE IT ON STACK TEMPORARILY
F5CC 20 24            BRA     DBASE4


                    ******
                    *DBASE - SET DISPLAY BASE
                    *LOOK FOR HEX,DEC,OCT, OR BIN IN LIST #3
F5CE 86 03    DBASE   LDA A   #3
F5D0 BD F9C7          JSR     COMAND
F5D3 2B 19            BMI     DBASE3    UNRECOGNIZABLE BASE, TRY "?"
F5D5 2E 02            BGT     DBASE1
F5D7 86 01            LDA A   #1        NO BASE GIVEN - DEFAULT TO HEX
F5D9 B7 7011 DBASE1   STA A   DBCODE
                    *COMPUTE THE NUMERIC DISPLAY BASE (FOR THE "DISPLAY"
                    *                      COMMAND)
F5DC CE F5E9          LDX     #DBTBL-1    POINT TO HEAD OF
                    *                      DISPLAY BASE TABLE
F5DF 08       DBASE2  INX               INC TABLE POINTER
F5E0 4A               DEC A             DECR DISPLAY BASE CODE
F5E1 26 FC            BNE     DBASE2    LOOP IF NOT EQUAL
F5E3 A6 00            LDA A   X         EQUAL - GET NUMERIC BASE FROM
                    *                      TABLE
F5E5 B7 7012          STA A   DBNBR     SAVE IT
F5E8 20 C8            BRA     BREAK5    DONE
```

```
                *DISPLAY BASE TABLE
F5EA 10         DBTBL   FCB     16
F5EB 0A                 FCB     10
F5EC 08                 FCB     8
F5ED 02                 FCB     2


                *LOOK FOR "?" IN LIST #4
F5EE B6 7011    DBASE3  LDA A   DBCODE    GET DB CODE IN CASE ITS NEEDED
F5F1 36                 PSH A             SAVE IT ON STACK TEMPORARILY
F5F2 86 04      DBASE4  LDA A   #4
F5F4 BD F9C7            JSR     COMAND
F5F7 33                 PUL B             RETRIEVE INPUT BASE/DISPLAY
                *                          BASE CODE
F5F8 2F BB              BLE     BREAK6    ERROR IF THE "SOMETHING" WAS
                *                          NOT AN "?"
                *SET UP FOR TYPEOUT OF BASE CODE
F5FA 86 03              LDA A   #3        ITS IN LIST 3
F5FC F7 70D6            STA B   COMNUM    STORE BASE CODE
F5FF BD FA2E            JSR     TYPCMD    TYPE OUT BASE
F602 20 AE              BRA     BREAK5
                ******
                *CONTINUE - CONTINUE FROM A "SWI"
                *RETURN TO LOCATION WHERE SWI WAS
F604 BE 7006    CONTIN  LDS     SP        IN CASE SP WAS MODIFIED VIA SET
                *                          COMMAND
F607 3B                 RTI


                ******
                *DISPLAY - DISPLAY MEMORY DATA
F608 BD FAFC    DISPLA  JSR     GTRANG    GET MEMORY DISPLAY RANGE
F60B 2F 60              BLE     DISPL9    ADDRESS IS REQUIRED


                *INITIALIZE ADDRESS POINTER TO START OF MEMORY
F60D FE 7015            LDX     RANGLO
F610 FF 70B8            STX     MEMADR


                *SEARCH LIST 6 FOR DISPLAY MODIFIERS "DATA" OR "USED"
F613 86 06              LDA A   #6
F615 BD F9C7            JSR     COMAND
F618 2B 53              BMI     DISPL9    ANY OTHER MODIFIER IS ILLEGAL
                *ADJ DISPLAY MODIFIER CODE SO THAT: -1=ADDR & DATA,
                *                           0=DATA, 1=USED
F61A 4A                 DEC A
F61B B7 70D6            STA A   COMNUM    SAVE FOR LATER TESTS
                *INIT "DATA VALUES PER LINE" COUNTER
F61E 5F                 CLR B
F61F 5C                 INC B
F620 CE 70B8    DISPL1  LDX     #MEMADR
F623 7D 70D6            TST     COMNUM    WHICH DISPLAY OPTION?
F626 2B 2C              BMI     DISPL6    IF "ADDRESS & DATA", GO THERE


                *OUTPUT DATA WITH ADDRESS ONLY AT LINE BEGINNING
F628 5A                 DEC B             COUNT DATA VALUES PER LINE
F629 26 0C              BNE     DISPL2    IF COUNT NOT UP, SKIP ADDRESS
                *                          OUTPUT
```

```
F62B BD FEC7          JSR     DOCRLF    GET TO LINE BEGINNING
F62E BD FC04          JSR     OUT2BY    OUTPUT ADDRESS
F631 BD FBF1          JSR     OUTSP     AND A SPACE
F634 F6 7012          LDA B   DBNBR     RESET LINE COUNTER

F637 FE 70B8 DISPL2   LDX     MEMADR    POINT TO DATA AT THAT ADDRESS
F63A 7D 70D6          TST     COMNUM    WANT "DATA" OPTION?
F63D 2E 05            BGT     DISPL3    IF NOT, GO TO "USED" CODE

                *"DATA" OPTION
F63F BD FBF1          JSR     OUTSP     OUTPUT PRECEEDING SPACE
F642 20 1B            BRA     DISPL7
                *"USED" OPTION
F644 A6 00    DISPL3  LDA A   X         GET THE DATA
F646 4D               TST A             EXAMINE IT FOR ZERO
F647 26 04            BNE     DISPL4
F649 86 2E            LDA A   #'        ITS ZERO, GET A "."
F64B 20 02            BRA     DISPL5
F64D 86 2B    DISPL4  LDA A   #'+       ITS NON-ZERO, GET A "+"
F64F BD FE76 DISPL5   JSR     OUTCHR    OUTPUT THE "." OR "+"
F652 20 0E            BRA     DISPL8

F654 BD FBF1 DISPL6   JSR     OUTSP     OUTPUT A PRECEEDING SPACE
F657 BD FC04          JSR     OUT2BY    TYPE ADDRESS
F65A BD FBF7          JSR     OUTEQ     TYPE "="
F65D EE 00            LDX     X         GET CONTENT
F65F BD FBFD DISPL7   JSR     OUT1BY    TYPE IT

F662 BC 7017 DISPL8   CPX     RANGHI    ARE WE DONE?
F665 27 09            BEQ     DISP10    IF YES, BACK TO PROMPT
F667 08               INX               NO, INC MEMORY ADDRESS
F668 FF 70B8          STX     MEMADR    SAVE IT
F66B 20 B3            BRA     DISPL1

F66D 7E F457 DISPL9   JMP     BADSYN
F670 7E F46F DISP10   JMP     NOMORE

                ******
                *SET - SET MEMORY LOCATIONS
F673 BD FAFC SET      JSR     GTRANG    GET MEMORY LOCATION/RANGE
F676 2B 4E            BMI     SET5      IF NOT AN ADDRESS, LOOK FOR A
                *                        REGISTER NAME
F678 27 F3            BEQ     DISPL9    AN ADDRESS MODIFIER IS REQUIRED

                *RANGE OF ADDRESSES SPECIFIED?
F67A FE 7015          LDX     RANGLO
F67D BC 7017          CPX     RANGHI
F680 27 12            BEQ     SET2      IF SINGLE ADDRESS, SET UP
                *                        ADDRESSES INDIVIDUALLY
                *SET A RANGE OF ADDRESSES TO A SINGLE VALUE
F682 BD FB47          JSR     NUMBER    GET THAT VALUE
```

```
F685 2F E6           BLE    DISPL9   ITS REQUIRED
F687 B6 7014         LDA A  NBRLO    PUT IT IN ACCA
F68A A7 00    SET1   STA A  X        STORE IT IN DESTINATION
F68C BC 7017         CPX    RANGHI   END OF RANGE HIT?
F68F 27 DF           BEQ    DISP10   IF YES, ALL DONE
F691 08              INX             NO, ON TO NEXT ADDRESS IN RANGE
F692 20 F6           BRA    SET1     LOOP TO SET IT
                *SET ADDRESSES UP INDIVIDUALLY
F694 FF 70B8  SET2   STX    MEMADR   SAVE MEMORY LOC
F697 BD FB47  SET3   JSR    NUMBER   GET DATA TO PUT THERE
F69A 27 0D           BEQ    SET4     END OF LINE?
F69C 2D CF           BLT    DISPL9   ABORT IF BAD SYNTAX
F69E B6 7014         LDA A  NBRLO    LOAD DATA BYTE
F6A1 FE 70B8         LDX    MEMADR   LOAD ADDRESS
F6A4 A7 00           STA A  X        STORE DATA


                *INCREMENT ADDRESS IN CASE USER WANTS TO INDIVIDUALLY
                *                        SET SEVERAL
                *SUCCESSIVE LOCATIONS
F6A6 08              INX
F6A7 20 EB           BRA    SET2


                *END OF LINE - WAS IT TERMINATED WITH A LINE FEED?
F6A9 FE 700A  SET4   LDX    SYNPTR   POINT TO END OF LINE
F6AC A6 00           LDA A  X        GET CHAR THERE
F6AE 81 0A           CMP A  #LF      LINE FEED?
F6B0 26 6B           BNE    SET12    IF NOT, BACK TO PROMPT
F6B2 CE 70B8         LDX    #MEMADR   YES, GET NEXT ADDRESS TO BE SET
F6B5 BD FC04         JSR    OUT2BY   TYPE IT
F6B8 BD FBF1         JSR    OUTSP    AND A SPACE
F6BB BD FD8C         JSR    GETLIN   GET A NEW LINE
F6BE FE 702C         LDX    BUFBEG   GET BUFFER BEGINNING
F6C1 FF 700A         STX    SYNPTR   EQUATE IT TO SYNTAX SCAN POINTER
F6C4 20 D1           BRA    SET3     GO PICK UP DATA


                *LOOK FOR (REGISTER NAME, REGISTER VALUE) PAIRS
F6C6 86 05    SET5   LDA A  #5
F6C8 BD F9C7         JSR    COMAND   PICK UP A REGISTER NAME
F6CB 2B 4D           BMI    SET11    ERROR IF UNRECOGNIZABLE
F6CD 27 4E           BEQ    SET12    DONE IF END OF LINE
F6CF 36              PSH A           SAVE REGISTER NAME(NUMBER)
F6D0 BD FB47         JSR    NUMBER   GET NEW REGISTER VALUE
F6D3 32              PUL A           RESTORE REGISTER NAME(NUMBER)
F6D4 2F 44           BLE    SET11    GOT GOOD REGISTER VALUE?
F6D6 FE 7006         LDX    SP       YES, POINT TO TOP OF STACK
F6D9 F6 7014         LDA B  NBRLO    GET REGISTER VALUE


                *CONDITION CODES
F6DC 81 01           CMP A  #1
F6DE 26 04           BNE    SET6
F6E0 E7 01           STA B  1,X
F6E2 20 E2           BRA    SET5
                *ACCB
```

```
F6E4 81 02    SET6    CMP A   #2
F6E6 26 04            BNE     SET7
F6E8 E7 02            STA B   2,X
F6EA 20 DA            BRA     SET5

              *ACCA
F6EC 81 03    SET7    CMP A   #3
F6EE 26 04            BNE     SET8
F6F0 E7 03            STA B   3,X
F6F2 20 D2            BRA     SET5

              *IX
F6F4 81 04    SET8    CMP A   #4
F6F6 26 09            BNE     SET9
F6F8 B6 7013          LDA A   NBRHI
F6FB A7 04            STA A   4,X       UPDATE HI BYTE
F6FD E7 05            STA B   5,X       UPDATE LO BYTE
F6FF 20 C5            BRA     SET5

              *PC
F701 81 05    SET9    CMP A   #5
F703 26 09            BNE     SET10
F705 B6 7013          LDA A   NBRHI
F708 A7 06            STA A   6,X       UPDATE HI BYTE
F70A E7 07            STA B   7,X       UPDATE LO BYTE
F70C 20 B8            BRA     SET5

              *SP
F70E 81 06    SET10   CMP A   #6
F710 26 08            BNE     SET11
F712 FE 7013          LDX     NBRHI     DON'T NEED IX TO SET SP
F715 FF 7006          STX     SP
F718 20 AC            BRA     SET5

F71A 7E F457  SET11   JMP     BADSYN
F71D 7E F46F  SET12   JMP     NOMORE
              ******
              *VERIFY - CHECKSUM VERIFY A BLOCK OF MEMORY
F720 BD FAFC  VERIFY  JSR     GTRANG    GET A NUMBER RANGE
F723 27 1B            BEQ     VERIF1    NO MODIFIER MEANS CHECK WHAT WE
              *                          HAVE
F725 2B F3            BMI     SET11     ANYTHING ELSE IS ILLEGAL
              *GOOD RANGE GIVEN, TRANSFER IT TO CHECKSUM ADDRESSES
F727 FE 7015          LDX     RANGLO
F72A FF 701B          STX     VERFRM
F72D FE 7017          LDX     RANGHI
F730 FF 701D          STX     VERTO

F733 8D 22            BSR     CKSUM     COMPUTE CHECKSUM
F735 B7 701F          STA A   CHKSUM    SAVE IT
F738 CE 701F          LDX     #CHKSUM    TYPE THE CHECKSUM
F73B BD FBFD          JSR     OUT1BY
```

```
F73E 20 DD          BRA     SET12

                *NO MODIFIER GIVEN - JUST VERIFY CHECKSUM
F740 8D 15      VERIF1 BSR      CKSUM     COMPUTE CHECKSUM
F742 B1 701F           CMP A    CHKSUM    SAME AS STORED CHECKSUM?
F745 26 08             BNE      VERIF2

                *THEY VERIFY - SAY SO
F747 CE FF1F           LDX      #MSGVER
F74A BD FE4B           JSR      OUTSTR
F74D 20 CE             BRA      SET12

                *THEY DON'T - SAY SO
F74F CE FF22    VERIF2 LDX      #MSGNVE
F752 BD FE4B           JSR      OUTSTR
F755 20 C6             BRA      SET12

                *COMPUTE THE CHECKSUM FROM ADDRESSES VERFRM TO VERTO
                *RETURN THE CHECKSUM IN ACCA
F757 4F         CKSUM  CLR A              INIT CHECKSUM TO ZERO
F758 FE 701B           LDX      VERFRM    GET FIRST ADDRESS
F75B 09                DEX               INIT TO ONE LESS
F75C 08         CKSUM1 INX                START OF CHECKSUM LOOP
F75D AB 00             ADD A    X         UPDATE CHECKSUM IN ACCA WITH
                *                          BYTE POINTED TO
F75F BC 701D           CPX      VERTO     HIT END OF RANGE?
F762 26 F8             BNE      CKSUM1    IF NOT, LOOP BACK
F764 43                COM A              COMPLEMENT THE SUM
F765 39                RTS                RETURN WITH IT
                ******
                *SEARCH - SEARCH MEMORY FOR A BYTE STRING


                *GLOBAL VARIABLES USED
                *LINPTR - INPUT LINE CHARACTER POINTER
                *LISPTR - COMMAND LIST CHARACTER POINTER
                *RANGLO - "SEARCH FROM" ADDRESS
                *RANGHI - "SEARCH TO" ADDRESS


                *LOCAL VARIABLES USED
                *MEMADR - STARTING MEMORY ADDRESS WHERE A MATCH
                *                    OCCURRED
                *BYTPTR - ADDRESS POINTER USED TO FILL BYTSTR AND
                *                    SUBSTR BUFFERS
                *NBYTES - NUMBER OF BYTES IN BYTE STRING
                *NBRMAT - NUMBER OF CHARS THAT MATCH SO FAR IN THE
                *                    MATCHING PROCESS
                *BYTSTR - STARTING ADDRESS OF 6 CHARACTER BYTE STRING
                *                    BUFFER


                *THE SEARCH STRING OCCUPIES TEMP4, TEMP5, & TEMP6 (6
                *                    BYTES MAX)
```

```
                *GET SEARCH RANGE BEGINNING (RANGLO) & END (RANGHI)
F766 BD FAFC SEARCH JSR     GTRANG
F769 2F 7C          BLE     SEARC9    ABORT IF NO PAIR

                *INITIALIZE BYTE STRING POINTER
F76B CE 70BE        LDX     #BYTSTR   GET START OF BYTE STRING TO
                *                      SEARCH FOR
F76E FF 70BA        STX     BYTPTR    SET POINTER TO IT

F771 7F 70BC        CLR     NBYTES    ZERO # OF BYTES IN BYTE STRING

                *GET A BYTE STRING
F774 BD FB47 SEARC1 JSR     NUMBER    GET A BYTE
F777 27 1A          BEQ     SEARC2    BEGIN SEARCH IF EOL
F779 2D 6C          BLT     SEARC9

                *GOOD BYTE, ADD IT TO STRING
F77B 7C 70BC        INC     NBYTES    COUNT THIS BYTE
                *DON'T ACCEPT OVER 6 BYTES
F77E B6 70BC        LDA A   NBYTES
F781 81 06          CMP A   #6
F783 2E 62          BGT     SEARC9

F785 B6 7014        LDA A   NBRLO     GET (LOW ORDER) BYTE
F788 FE 70BA        LDX     BYTPTR    GET BYTE POINTER
F78B A7 00          STA A   X         SAVE BYTE
F78D 08             INX               MOVE BYTE POINTER TO NEXT
                *                      LOCATION IN STRING
F78E FF 70BA        STX     BYTPTR    SAVE IT
F791 20 E1          BRA     SEARC1

                *BEGIN SEARCH FOR BYTE STRING
                *IS # OF BYTES TO LOOK FOR >0
F793 7D 70BC SEARC2 TST     NBYTES
F796 27 4F          BEQ     SEARC9    IF NOT, BAD SYNTAX

                *MAKE USE OF INPUT LINE CHARACTER FETCH & COMMAND LIST
                *                      CHAR FETCH ROUTINES

                *INITIALIZE MEMORY POINTER TO START OF SEARCH RANGE
F798 FE 7015        LDX     RANGLO
F79B 09             DEX
F79C FF 700C        STX     LINPTR

                *INITIALIZE BYTE POINTER TO START OF BYTE STRING
F79F CE 70BD SEARC3 LDX     #BYTSTR-1
F7A2 FF 70D7        STX     LISPTR

F7A5 7F 70BD        CLR     NBRMAT    SET "NUMBER OF BYTES THAT
```

```
                *                           MATCHED" TO ZERO
                *GET BYTE FROM BYTE STRING & RETURN IT IN ACCA
F7A8 BD FCCD            JSR     GETLST
                *GET BYTE FROM MEMORY RANGE & RETURN IT IN ACCB
F7AB BD FCC0 SEARC4     JSR     GETCHR


F7AE 11                 CBA             COMPARE MEMORY & BYTE STRING
                *                        CHARACTERS
F7AF 27 07              BEQ     SEARC5  IF NO MATCH, TEST FOR RANGE END
F7B1 BC 7017            CPX     RANGHI  HAVE WE REACHED THE RANGE
                *                        SEARCH UPPER LIMIT?
F7B4 27 34              BEQ     SEAR10  YES, GO PROMPT FOR NEXT COMMAND
F7B6 20 F3              BRA     SEARC4


                *MATCH ACHIEVED - SAVE ADDRESS OF MATCH
F7B8 FF 70B8 SEARC5     STX     MEMADR
F7BB 7C 70BD SEARC6     INC     NBRMAT  BUMP NUMBER MATCHED
F7BE B6 70BD            LDA A   NBRMAT
F7C1 B1 70BC            CMP A   NBYTES  HAVE ALL CHARACTERS MATCHED?
F7C4 27 16              BEQ     SEARC8  IF SO, MATCH ACHIEVED
                *HAVEN'T MATCHED ALL YET, GO GET NEXT PAIR EVEN IF
                *                        PAST "SEARCH TO" ADDRESS
F7C6 BD FCCD            JSR     GETLST
F7C9 BD FCC0            JSR     GETCHR
F7CC 11                 CBA
F7CD 27 EC              BEQ     SEARC6
                *MISMATCH ON SOME BYTE PAST THE FIRST ONE
                *RESET THE MEMORY POINTER TO GET NEXT UNTESTED MEMORY
                *                        LOCATION
F7CF FE 70B8 SEARC7     LDX     MEMADR
                *THIS TEST HANDLES SPECIAL CASE OF A MATCH ON RANGE END
F7D2 BC 7017            CPX     RANGHI
F7D5 27 13              BEQ     SEAR10
F7D7 FF 700C            STX     LINPTR
                *GO RESET THE BYTE STRING POINTER
F7DA 20 C3              BRA     SEARC3


                *MATCH ON BYTE STRING ACHIEVED, TYPE OUT MEMORY ADDRESS
F7DC CE 70B8 SEARC8     LDX     #MEMADR
F7DF BD FC04            JSR     OUT2BY
F7E2 BD FBF1            JSR     OUTSP   AND A SPACE
                *ASSUME A MISMATCH (I.E., RESET MEMORY & BYTE STRING
                *                        POINTERS & CONTINUE
F7E5 20 E8              BRA     SEARC7


F7E7 7E F457 SEARC9     JMP     BADSYN
F7EA 7E F46F SEAR10     JMP     NOMORE


                ******
                *TEST - TEST RAM FOR BAD BYTES
                *GET AN ADDRESS RANGE
F7ED BD FAFC TEST       JSR     GTRANG
```

```
F7F0 2F F5           BLE    SEARC9   ABORT IF NO PAIR
                  * RANGLO HOLDS STARTING ADDRESS OF RANGE
                  * RANGHI HOLDS ENDING ADDRESS OF RANGE
F7F2 FE 7015         LDX    RANGLO
F7F5 FF 70B8         STX    MEMADR
                  *GET BYTE STORED AT TEST LOCATION & SAVE IT
F7F8 A6 00    TEST1  LDA A  X
F7FA 36              PSH A


F7FB 6F 00           CLR    X        ZERO THE LOCATION
F7FD 6D 00           TST    X        TEST IT
F7FF 27 05           BEQ    TEST2    OK IF = ZERO


                  *CAN'T CLEAR LOCATION
F801 CE FF32         LDX    #MSGCCL
F804 20 1E           BRA    TEST4


F806 6A 00    TEST2  DEC    X        SET LOCATION TO FF
F808 86 FF           LDA A  #$FF
F80A A1 00           CMP A  X        DID IT GET SET TO FF?
F80C 27 05           BEQ    TEST3


                  *CAN'T SET LOCATION TO ONE'S
F80E CE FF3D         LDX    #MSGCSO
F811 20 11           BRA    TEST4


F813 FE 70B8  TEST3  LDX    MEMADR   GET LOCATION BEING TESTED
F816 32              PUL A
F817 A7 00           STA A  X        RESTORE PREVIOUS CONTENT


                  *HIT END OF TEST RANGE?
F819 BC 7017         CPX    RANGHI
F81C 27 CC           BEQ    SEAR10   YES, ALL DONE


                  *NO, MOVE TO TEST NEXT LOCATION
F81E 08              INX
F81F FF 70B8         STX    MEMADR
F822 20 D4           BRA    TEST1


                  **LOCATION IS BAD
F824 FF 70BC  TEST4  STX    TEMP3    SAVE ERROR MESSAGE TEMPORARILY


F827 CE 70B8         LDX    #MEMADR
F82A BD FC04         JSR    OUT2BY   TYPE OUT BAD ADDRESS,
F82D BD FBF7         JSR    OUTEQ    AN EQUAL SIGN,


F830 FE 70B8         LDX    MEMADR
F833 BD FBFD         JSR    OUT1BY   ITS CONTENT,
F836 BD FBF1         JSR    OUTSP    A SPACE,
```

```
F839 FE 70BC          LDX     TEMP3
F83C BD FE4B          JSR     OUTSTR    AND THE TYPE OF ERROR

F83F BD FEC7          JSR     DOCRLF    SEND CR-LF
F842 20 CF            BRA     TEST3
                      ******
                      *INT - SET UP INTERRUPT POINTER
F844 BD FB3C INT      JSR     NUMINX    GET POINTER IN IX
F847 FF 7000          STX     INTVEC    SAVE IT
F84A 20 2C            BRA     COMPA1

                      ******
                      *NMI - SET UP NON-MASKABLE INTERRUPT POINTER
F84C BD FB3C NMI      JSR     NUMINX    GET POINTER IN IX
F84F FF 7002          STX     NMIVEC    SAVE IT
F852 20 24            BRA     COMPA1

                      ******
                      *SWI - SET UP SWI POINTER
F854 BD FB3C SWI      JSR     NUMINX    GET POINTER IN IX
F857 FF 7004          STX     SWIVEC    SAVE IT
F85A 20 1C            BRA     COMPA1

                      ******
                      *COMPARE - OUTPUT SUM & DIFFERENCE OF TWO INPUT NUMBERS
F85C BD FB3C COMPAR   JSR     NUMINX    GET FIRST NUMBER
F85F FF 7015          STX     RANGLO    PUT IT IN RANGLO

F862 BD FB3C          JSR     NUMINX    GET SECOND NUMBER
F865 FF 7013          STX     NBRHI     SAVE IT IN NBRHI

                      *COMPUTE AND OUTPUT THE SUM
F868 BD FAD6          JSR     SUMNUM    COMPUTE SUM
F86B CE FF4E          LDX     #MSGSIS    GET ITS TITLE
F86E 8D 0B            BSR     OUTSD     OUTPUT TITLE & SUM

F870 BD FAE9          JSR     DIFNUM    COMPUTE DIFFERENCE
F873 CE FF56          LDX     #MSGDIS    GET ITS TITLE
F876 8D 03            BSR     OUTSD     OUTPUT TITLE & DIFFERENCE

F878 7E F46F COMPA1   JMP     NOMORE

                      *COMPUTE AND OUTPUT THE RESULT
F87B BD FE4B OUTSD    JSR     OUTSTR    OUTPUT IT
F87E CE 7017          LDX     #RANGHI    GET RESULT
F881 BD FC04          JSR     OUT2BY    DISPLAY RESULT
F884 39               RTS
                      ******
                      *DUMP - DUMP PORTION OF MEMORY, IN MIKBUG FORMAT, TO
                      *       A SPECIFIED ACIA ADDRESS
```

```
                *GET ADDRESS RANGE: START IN RANGLO (2 BYTES), END IN
                *                       RANGHI (2 BYTES)
                *IF NO ADDRESS RANGE IS GIVEN, USE WHATEVER IS IN
                *                       RANGLO & RANGHI
F885 BD FAFC DUMP    JSR     GTRANG

F888 7F 70C0         CLR     TEMP5      INITIALIZE TO DUMP TO TERMINAL

                *LOOK FOR A "TO" MODIFIER
F88B 86 02   DUMP1   LDA A   #2
F88D BD F9C7         JSR     COMAND
F890 27 13           BEQ     DUMP4
F892 2F 7C   DUMP2   BLE     DUMP10     ERROR IF BAD SYNTAX
F894 81 01           CMP A   #1         TO?
F896 27 02           BEQ     DUMP3
F898 20 F1           BRA     DUMP1      GO LOOK FOR ANOTHER MODIFIER

F89A BD FB3C DUMP3   JSR     NUMINX     GET "TO" ADDRESS
F89D FF 7027         STX     OUTADR     SAVE IT
F8A0 7C 70C0         INC     TEMP5      REMEMBER THIS
F8A3 20 E6           BRA     DUMP1      GO LOOK FOR ANOTHER MODIFIER

F8A5 7D 70C0 DUMP4   TST     TEMP5
F8A8 27 03           BEQ     DUMP5
F8AA 7C 7026         INC     OUTFLG     SET FLAG FOR PROPER OUTPUT
                *                        DEVICE
F8AD 8D 64   DUMP5   BSR     NULLS      SEND SOME NULLS

                *MIKBUG MODE
                *OUTPUT AN "S0" TYPE RECORD
F8AF CE FF60         LDX     #MSGS0
F8B2 BD FE4B         JSR     OUTSTR

                *COMPUTE # OF BYTES TO OUTPUT (RANGE END - RANGE START
                *                       + 1)
                *SUBTRACT LO BYTES
F8B5 B6 7018 DUMP6   LDA A   RANGHI+1
F8B8 B0 7016         SUB A   RANGLO+1
                *SUBTRACT HI BYTES
F8BB F6 7017         LDA B   RANGHI
F8BE F2 7015         SBC B   RANGLO
                *NON-ZERO HI BYTE IMPLIES LOTS TO OUTPUT
F8C1 26 04           BNE     DUMP7
                *HI BYTE DIFF IS ZERO
F8C3 81 10           CMP A   #16        LO BYTE OF DIFF 0 TO 15
F8C5 25 02           BCS     DUMP8      IF YES, TO DUMP8
F8C7 86 0F   DUMP7   LDA A   #15        NO, LO BYTE IS 16-255: SET
                *                        BYTES TO 15
                *TO GET FRAME COUNT, ADD 1 (DIFF OF 0 IMPLIES 1
                *                       OUTPUT) + # OF DATA BYTES,
                * + 2 ADDR BYTES + 1 CHECKSUM BYTE
F8C9 8B 04   DUMP8   ADD A   #4
```

```
F8CB B7 70BC          STA A  TEMP3     TEMP3 IS THE FRAME COUNT
F8CE 80 03            SUB A  #3
F8D0 B7 70BE          STA A  TEMP4     TEMP4 IS THE RECORD BYTE COUNT
                *OUTPUT A MIKBUG "S1" HEADER DATA RECORD
F8D3 CE FF74          LDX    #MSGS1
F8D6 BD FE4B          JSR    OUTSTR
F8D9 5F               CLR B            ZERO CHECKSUM
                *PUNCH FRAME COUNT
F8DA CE 70BC          LDX    #TEMP3
F8DD 8D 3E            BSR    OUTP2


                *PUNCH ADDRESS
F8DF CE 7015          LDX    #RANGLO
F8E2 8D 39            BSR    OUTP2
F8E4 8D 37            BSR    OUTP2


                *OUTPUT DATA
F8E6 FE 7015          LDX    RANGLO
F8E9 8D 32    DUMP9   BSR    OUTP2     OUTPUT DATA BYTE
F8EB 7A 70BE          DEC    TEMP4     DEC BYTE COUNT
F8EE 26 F9            BNE    DUMP9


                *COMPLEMENT AND PUNCH THE CHECKSUM
F8F0 FF 7015          STX    RANGLO    SAVE MEMORY POINTER
F8F3 53               COM B            COMPLEMENT CHECKSUM
F8F4 37               PSH B            PUT IT ON STACK
F8F5 30               TSX              LET IX POINT TO IT
F8F6 8D 25            BSR    OUTP2     OUTPUT CHECKSUM
F8F8 33               PUL B            PULL IT OFF STACK
F8F9 FE 7015          LDX    RANGLO    RESTORE MEMORY POINTER
F8FC 09               DEX
F8FD BC 7017          CPX    RANGHI    HIT END OF RANGE?
F900 26 B3            BNE    DUMP6


                *YES, OUTPUT AN "S9" RECORD
F902 CE FF7B          LDX    #MSGS9
F905 BD FE4B          JSR    OUTSTR
F908 8D 09            BSR    NULLS     GENERATE BLANK TAPE
F90A 7F 7026          CLR    OUTFLG    SET TO TERMINAL OUTPUT
F90D 7E F46F          JMP    NOMORE    ALL DONE
F910 7E F457 DUMP10   JMP    BADSYN    BAD SYNTAX


                *SEND A STRING OF NULLS
F913 C6 1E    NULLS   LDA B  #30
F915 4F               CLR A
F916 BD FE76 NULLS1   JSR    OUTCHR
F919 5A               DEC B
F91A 26 FA            BNE    NULLS1
F91C 39               RTS


                *OUTPUT A BYTE POINTED TO BY IX AS 2 HEX CHARACTERS
F91D EB 00    OUTP2   ADD B  X         UPDATE CHECKSUM
F91F BD FBFD          JSR    OUT1BY
```

```
F922 08              INX
F923 39              RTS
                *****
                *LOAD - LOAD A MIKBUG TAPE
                *LOOK FOR A "FROM" MODIFIER
F924 86 07    LOAD   LDA A  #7        IN LIST 7
F926 BD F9C7         JSR    COMAND
F929 2B E5           BMI    DUMP10    ERROR, UNRECOGNIZABLE MODIFIER
F92B 27 09           BEQ    LOAD1

F92D BD FB3C         JSR    NUMINX    GET "FROM" ADDRESS
F930 FF 7024         STX    INPADR    SAVE IT
F933 7C 7023         INC    INPFLG    SET FLAG FOR NON-TERMINAL ACIA

                *KEEP READING CHARACTERS UNTIL AN "S" IS READ
F936 BD FE59  LOAD1  JSR    INPCHR    GET A CHAR
F939 81 53           CMP A  #'S       IS IT AN S?
F93B 26 F9           BNE    LOAD1

                *GOT AN "S", EXAMINE NEXT CHARACTER
F93D BD FE59         JSR    INPCHR
F940 81 39           CMP A  #'9       DONE IF ITS A "9"
F942 27 2E           BEQ    LOAD4

F944 81 31           CMP A  #'1       IS IT A "1"?
F946 26 EE           BNE    LOAD1     IF NOT, LOOK FOR NEXT "S"
                *VALID S1 RECORD
F948 7F 70E1         CLR    CKSM      CLEAR CHECKSUM
                *READ RECORD BYTE COUNT
F94B BD F986         JSR    RDBYTE
F94E 80 02           SUB A  #2
F950 B7 70E0         STA A  BYTECT    SAVE COUNT MINUS 2 ADDRESS BYTES

F953 8D 23           BSR    BLDADR    BUILD ADDRESS

F955 8D 2F    LOAD2  BSR    RDBYTE    READ A DATA BYTE INTO ACCA

F957 7A 70E0         DEC    BYTECT    COUNT IT
F95A 27 05           BEQ    LOAD3     IF DONE WITH RECORD, CHECK
                *                       CHECKSUM
F95C A7 00           STA A  X         NOT DONE, STORE BYTE IN MEMORY
F95E 08              INX             ON TO NEXT MEMORY ADDRESS
F95F 20 F4           BRA    LOAD2

                *RECORD READ IN COMPLETE
F961 7C 70E1  LOAD3  INC    CKSM      TEST CHECKSUM BY ADDING 1
F964 27 D0           BEQ    LOAD1     IF OK, RESULT SHOULD BE ZERO

                *RECORD CHECKSUM ERROR
F966 CE FF22         LDX    #MSGNVE   SAY SO
F969 BD FE4B         JSR    OUTSTR
```

```
F96C CE 70B8          LDX     #TEMP1    GET RECORD ADDRESS OF IT
F96F BD FC04          JSR     OUT2BY    TYPE IT TOO
F972 7F 7023 LOAD4    CLR     INPFLG    RESET FLAG TO NORMAL TERMINAL
                      *                   INPUT
F975 7E F46F          JMP     NOMORE


                      *BUILD ADDRESS
F978 8D 0C    BLDADR  BSR     RDBYTE
F97A B7 70B8          STA A   TEMP1
F97D 8D 07            BSR     RDBYTE
F97F B7 70B9          STA A   TEMP1+1
F982 FE 70B8          LDX     TEMP1
F985 39               RTS
F986 8D 10    RDBYTE  BSR     INHEX     GET LEFT HEX DIGIT
                      *MOVE TO HI 4 BITS
F988 48               ASL A
F989 48               ASL A
F98A 48               ASL A
F98B 48               ASL A
F98C 16               TAB               SAVE IT IN ACCA
F98D 8D 09            BSR     INHEX     GET RIGHT HEX DIGIT
F98F 1B               ABA               COMBINE THEM IN ACCA
                      *UPDATE THE CHECKSUM
F990 16               TAB
F991 FB 70E1          ADD B   CKSM
F994 F7 70E1          STA B   CKSM
F997 39               RTS


                      *INPUT A HEX CHAR & CONVERT TO INTERNAL FORM
F998 BD FE59  INHEX   JSR     INPCHR    INPUT A CHAR
F99B 80 30            SUB A   #$30
F99D 2B 0F            BMI     INHEX2    NOT HEX IF BELOW ASCII "1"
F99F 81 09            CMP A   #$09
F9A1 2F 0A            BLE     INHEX1    OK IF ASCII "9" OR LESS
F9A3 81 11            CMP A   #$11      BELOW ASCII "A"?
F9A5 2B 07            BMI     INHEX2    ERROR IF IT IS
F9A7 81 16            CMP A   #$16      OVER ASCII "F"?
F9A9 2E 03            BGT     INHEX2    ERROR IF IT IS
F9AB 80 07            SUB A   #7        CONV ASCII A-F TO HEX A-F
F9AD 39       INHEX1  RTS
                      *ERROR - CHAR NOT HEX, SAY SO
F9AE CE FF8B  INHEX2  LDX     #MSGCNH
F9B1 BD FE4B          JSR     OUTSTR
F9B4 39               RTS


                      ******
                      *DELAY - DELAY SPECIFIED # OF MILLISECONDS
F9B5 BD FB3C  DELAY   JSR     NUMINX    GET DELAY TIME
F9B8 8D 03            BSR     TIMDEL
F9BA 7E F46F          JMP     NOMORE


                      ***
                      *TIME DELAY SUBROUTINE
                      *IX IS INPUT AS THE # OF MILLISECONDS TO DELAY
```

```
                *ACCA IS ALTERED
                *ACCB IS PRESERVED
                *ADJ TIMCON SO (6*TIMCON*CYCLE TIME=1 MS)
F9BD B6 70DE TIMDEL LDA A  TIMCON
                *ENTER A 6 CYCLE LOOP
F9C0 4A      TIMDE1 DEC A
F9C1 26 FD          BNE    TIMDE1

F9C3 09             DEX              DECREMENT MILLISECOND COUNTER
F9C4 26 F7          BNE    TIMDEL
F9C6 39             RTS



                *=======================================================

                *  C O M M A N D     L I S T     S C A N N I N G     R
                *                       O U T I N E

                *THIS ROUTINE SEEKS A MATCH OF THE CHARACTERS POINTED
                *                       AT
                *BY THE INPUT LINE SCANNING POINTER TO ONE OF THE
                *                       COMMANDS
                *IN A LIST SPECIFIED BY ACCA.
                *THE RESULT OF THE SCAN FOR A MATCH IS RETURNED IN
                *                       ACCA,
                * AS FOLLOWS:
                *
                *       ACCA=-1: THE MATCH WAS UNSUCCESSFUL.  THE SYNTAX
                *                POINTER (SYNPTR) WAS NOT UPDATED
                *                       (ADVANCED).
                *
                *       ACCA= 0: THE MATCH WAS UNSUCCESSFUL SINCE THERE
                *                       WERE
                *                NO MORE CHARACTERS, I.E., THE END OF
                *                       THE
                *                LINE WAS REACHED.
                *
                *       ACCA=+N: SUCCESSFUL MATCH.  THE SYNTAX POINTER
                *                       WAS UPDATED
                *                TO THE FIRST CHARACTER FOLLOWING THE
                *                       COMMAND
                *                DELIMITER.  ACCA HOLDS THE NUMBER OF
                *                       THE
                *                COMMAND MATCHED.
                *GLOBAL VARIABLES FOR EXTERNAL COMMUNICATION
                *SYNPTR - GOOD SYNTAX INPUT LINE CHAR POINTER
                *LINPTR - INPUT LINE CHARACTER POINTER
                *DELIM - CLASS OF PERMISSIBLE COMMAND DELIMITERS

                *TEMPORARY 2 BYTE INTERNAL VARIABLES
                *LISPTR - COMMAND LIST CHARACTER POINTER

                *TEMPORARY 1 BYTE INTERNAL VARIABLES
```

```
                *NUMMAT - NUMBER OF CHARACTERS THAT SUCCESSFULLY MATCH
                *LISNUM - # OF LIST WITHIN WHICH A MATCH WILL BE SOUGHT
                *COMNUM - COMMAND NUMBER MATCHED


                *CONSTANTS USED
                *CR - CARRIAGE RETURN
                *LF - LINE FEED


                *ACCB & IX ARE NOT PRESERVED

F9C7 B7 70D5 COMAND STA A  LISNUM   SAVE LIST # TO MATCH WITHIN
                *TEST IF WE ARE AT THE END OF THE LINE
F9CA BD FA69        JSR    SKPDLM
F9CD 24 02          BCC    INILST
F9CF 4F             CLR A
F9D0 39             RTS



                *INITIALIZE THE COMMAND LIST POINTER TO ONE LESS THAN
                *                        THE BEGINNING OF THE COMMAND LI
                *                        STS
F9D1 FE 7008 INILST LDX    COMADR   ENTRY POINT


                *MOVE TO THE BEGINNING OF THE DESIRED COMMAND LIST
F9D4 B6 70D5        LDA A  LISNUM   SEARCH FOR "STRING" # LISNUM
F9D7 C6 0A          LDA B  #LF      USE LF AS A "STRING" TERMINATOR
F9D9 8D 76          BSR    FNDSTR
F9DB FF 70D7        STX    LISPTR


                *THE LIST POINTER, LISPTR, NOW POINTS TO ONE LESS THAN
                *                        THE FIRST CHARACTER
                *OF THE FIRST COMMAND IN THE DESIRED LIST
                * INITIALIZE THE COMMAND # TO 1
F9DE 86 01          LDA A  #1
F9E0 B7 70D6        STA A  COMNUM


                *RESET INPUT LINE POINTER TO: 1) BEGINNING OF LINE, OR
                *                        TO
                *  2) POINT WHERE LAST SUCCESSFUL SCAN TERMINATED
F9E3 FE 700A CMD3   LDX    SYNPTR
F9E6 FF 700C        STX    LINPTR


F9E9 7F 70D4        CLR    NUMMAT   CLEAR NUMBER OF CHARACTERS
                *                    MATCHED
F9EC BD FCC0 CMD4   JSR    GETCHR   GET INPUT LINE CHAR IN ACCB
F9EF BD FA94        JSR    TSTDLM   TEST FOR A DELIMITER
F9F2 26 13          BNE    MATCH    SUCCESS (FOUND DELIMITER) IF
                *                    NOT = ZERO


F9F4 BD FCCD        JSR    GETLST   GET COMMAND LIST CHAR IN ACCA
```

```
F9F7 81 0A          CMP A  #LF       HAS END OF COMMAND LIST BEEN
                    *                 REACHED?
F9F9 27 16          BEQ    NMATCH    IF SO, POTENTIAL MATCH FAILURE
F9FB 81 0D          CMP A  #CR       HAS END OF COMMAND BEEN REACHED?
F9FD 27 12          BEQ    NMATCH    IF SO, POTENTIAL MATCH FAILURE


F9FF 11             CBA              COMPARE THE TWO CHARACTERS
FA00 26 19          BNE    NEXCOM    MATCH NOT POSSIBLE ON THIS
                    *                 COMMAND


                    *THEY MATCH, COMPARE THE SUCCEEDING CHARACTERS
FA02 7C 70D4        INC    NUMMAT    INC NUMBER OF CHARACTERS MATCHED
FA05 20 E5          BRA    CMD4


                    ****
                    *SUCCESSFUL MATCH - RETURN COMMAND NUMBER MATCHED IN
                    *                 ACCA
FA07 B6 70D6 MATCH  LDA A  COMNUM
FA0A FE 700C        LDX    LINPTR
FA0D FF 700A        STX    SYNPTR    UPDATE GOOD SYNTAX POINTER
FA10 39             RTS



                    ****
                    *NO MATCH
                    *DID AT LEAST ONE MATCH?
FA11 7D 70D4 NMATCH TST    NUMMAT
FA14 27 05          BEQ    NEXCOM    TO NEXT COMMAND IF NONE MATCHED


                    *AT LEAST ONE MATCHED - TEST FOR DELIMITER
                    *                 (NON-MATCHING CHAR)
FA16 BD FA94        JSR    TSTDLM
FA19 26 EC          BNE    MATCH     IF A DELIMITER, MATCH HAS BEEN
                    *                 ACHIEVED
                    *ILLEGAL DELIMITER


                    *MOVE TO NEXT COMMAND WITHIN LIST
FA1B BD FCCD NEXCOM JSR    GETLST    GET NEXT COMMAND LIST CHARACTER
FA1E 81 0A          CMP A  #LF       END OF THIS LIST?
FA20 27 09          BEQ    MFAIL     IF SO, NOTHING ON LIST MATCHED
FA22 81 0D          CMP A  #CR       IS IT A CR?
FA24 26 F5          BNE    NEXCOM    IF NOT, MOVE TO NEXT CHARACTER
FA26 7C 70D6        INC    COMNUM    YES, INC COMMAND NUMBER
FA29 20 B8          BRA    CMD3


                    ****
                    *MATCH FAILURE - NO MATCH POSSIBLE WITHIN THIS LIST
FA2B 4F       MFAIL CLR A
FA2C 4A             DEC A
FA2D 39             RTS
```

```
                *=====================================================
                *THIS ROUTINE TYPES OUT COMMAND NUMBER "COMNUM"
                *THE LIST IS SPECIFIED IN ACCA
                *ACCB & IX ARE PRESERVED
FA2E FF 70CE TYPCMD STX     XTEMP
FA31 37              PSH B
FA32 CE FCD6         LDX     #COMLST-1   MOVE TO HEAD OF COMMAND
                *                         LISTS
FA35 C6 0A           LDA B   #LF         AND LIST TERMINATOR
FA37 8D 18           BSR     FNDSTR      GO TO HEAD OF DESIRED LIST
FA39 B6 70D6         LDA A   COMNUM      GET COMMAND NUMBER
FA3C C6 0D           LDA B   #CR         GET COMMAND TERMINATOR
FA3E 8D 11           BSR     FNDSTR      GO TO HEAD OF DESIRED COMMAND

FA40 08      TYPCM1  INX                 MOVE TO NEXT CHARACTER
FA41 A6 00           LDA A   X           GET A COMMAND CHARACTER
FA43 81 0D           CMP A   #CR         IS IT A COMMAND TERMINATOR?
FA45 27 05           BEQ     TYPCM2      IF SO, RETURN
FA47 BD FE76         JSR     OUTCHR      NO, TYPE IT
FA4A 20 F4           BRA     TYPCM1

FA4C FE 70CE TYPCM2  LDX     XTEMP
FA4F 33              PUL B
FA50 39              RTS



                *=====================================================
                *MOVE TO BEGINNING OF DESIRED STRING NUMBER (IN ACCA)
                *EACH STRING IS TERMINATED BY AN END OF STRING
                *                          CHARACTER (IN ACCB)
                *THE INDEX REGISTER IS ASSUMED INITIALIZED POINTING TO
                *ONE LESS THAN THE FIRST CHARACTER OF THE FIRST STRING
                *ACCA, ACCB & IX ARE NOT PRESERVED
                *LOCAL VARIABLES
                *STRNUM - STRING # TO FIND
                *EOSCHR - "END OF STRING" CHARACTER

FA51 B7 70BA FNDSTR STA A   STRNUM      SAVE STRING NUMBER
FA54 F7 70BB         STA B   EOSCHR     SAVE TERMINATOR
FA57 5F              CLR B
FA58 5C      FNDST1  INC B               STRING 1 IS THE FIRST STRING
FA59 F1 70BA         CMP B   STRNUM     IS THIS THE RIGHT STRING?
FA5C 27 0A           BEQ     FNDST3     IF SO, DONE

                *NO, SWALLOW UP CHARACTERS UNTIL AN END OF STRING CHAR
                *                          IS HIT
FA5E 08      FNDST2  INX                 BUMP POINTER TO NEXT ONE
FA5F A6 00           LDA A   X          GET CHAR POINTED AT
FA61 B1 70BB         CMP A   EOSCHR     END OF STRING HIT?
FA64 27 F2           BEQ     FNDST1     IF IT IS, BUMP THE STRING
                *                          COUNTER
FA66 20 F6           BRA     FNDST2     NO, MOVE ON TO NEXT CHAR
```

```
FA68 39       FNDST3 RTS                IX SET PROPERLY, RETURN



               *=======================================================
               *SKIP LEADING DELIMITERS
               *THIS ROUTINE SHOULD BE CALLED PRIOR TO SCANNING FOR
               *                         ANY INFORMATION
               *ON THE INPUT LINE
               *THE CURRENT CHARACTER IS IGNORED IF THE SCANNING
               *                         POINTER IS AT THE
               *BEGINNING OF A LINE.   IF NOT, THE SCANNING POINTER
               *                         SKIPS OVER SPACES
               *AND COMMAS UNTIL AN END OF LINE OR NON-DELIMITER IS
               *                         FOUND.
               *THE CARRY BIT IS SET IF AN END OF LINE IS ENCOUNTERED.

               *ACCA, ACCB, & IX ARE NOT PRESERVED

FA69 0C       SKPDLM CLC
FA6A 7D 700E          TST     BOLFLG    AT BEGINNING OF LINE?
FA6D 2E 0B            BGT     SKPDL2


               *LOOK AT CURRENT INPUT CHARACTER
FA6F FE 700A SKPDL1   LDX     SYNPTR    GET POINTER TO IT
FA72 A6 00            LDA A   X         GET CHAR
FA74 8D 13            BSR     TSTEOL    TEST FOR END OF LINE
FA76 26 02            BNE     SKPDL2
FA78 0D               SEC               YES, END HIT, SET CARRY
FA79 39               RTS
               *"PEEK" AT NEXT CHAR IN LINE
FA7A E6 01    SKPDL2  LDA B   1,X       GET IT
FA7C 8D 16            BSR     TSTDLM    SEE IF ITS A DELIMITER
FA7E 26 01            BNE     SKPDL3
FA80 39               RTS               ITS NOT, RETURN


               *NEXT CHAR IS A DELIMITER
FA81 BD FCC0 SKPDL3   JSR     GETCHR    MOVE TO NEXT CHAR IN INPUT LINE
FA84 FF 700A          STX     SYNPTR    UPDATE SYNTAX POINTER
FA87 20 E6            BRA     SKPDL1    GO TEST FOR END OF LINE



               *=======================================================
               *TEST FOR END-OF-LINE CHARACTER
               *Z BIT OF CC REG SET IF CHAR IN ACCA IS A TERMINATOR
               *ACCA, ACCB, & IX ARE PRESERVED
FA89 81 0D    TSTEOL  CMP A   #CR       CARRIAGE RETURN?
FA8B 27 06            BEQ     TSTEO1
FA8D 81 0A            CMP A   #LF       LINE FEED? (CONTINUED LINES)
FA8F 27 02            BEQ     TSTEO1
FA91 81 3B            CMP A   #';       FOR SEVERAL COMMANDS ON ONE LINE
FA93 39       TSTEO1  RTS
```

```
                *=====================================================
                *CHECK THE CHARACTER IN ACCB
                *AGAINST THE DELIMITER(S) SPECIFIED BY VARIABLE DELIM
                *ACCB & IX ARE PRESERVED
                *ACCA IS SET TO 0 IF ACCB IS NOT A DELIMITER, TO 1 IF
                *                          IT IS
                *   IF DELIM=1, SPACE IS DELIMITER
                *   IF DELIM=2, COMMA IS DELIMITER
                *   IF DELIM=3, SPACE OR COMMA IS DELIMITER
                *   IF DELIM=4, ANY NON-ALPHANUMERIC IS A DELIMITER
                *TEST FOR END-OF-LINE (LOGICAL OR PHYSICAL)
FA94 37         TSTDLM PSH B
FA95 17                TBA
FA96 8D F1             BSR     TSTEOL
FA98 33                PUL B
FA99 27 35             BEQ     DLMYES

FA9B B6 700F           LDA A   DELIM
FA9E 81 01             CMP A   #1
FAA0 26 06             BNE     ISDLM2
FAA2 C1 20             CMP B   #32       WANT A SPACE - IS IT?
FAA4 26 2D             BNE     DLMNO
FAA6 20 28             BRA     DLMYES

FAA8 81 02      ISDLM2 CMP A   #2
FAAA 26 06             BNE     ISDLM3
FAAC C1 2C      TSTCMA CMP B   #',       WANT A COMMA - IS IT?
FAAE 26 23             BNE     DLMNO
FAB0 20 1E             BRA     DLMYES
FAB2 81 03      ISDLM3 CMP A   #3
FAB4 26 06             BNE     ISDLM4
FAB6 C1 20             CMP B   #32       WANT EITHER, IS IT A SPACE?
FAB8 27 16             BEQ     DLMYES
FABA 20 F0             BRA     TSTCMA    OR A COMMA?

FABC 81 04      ISDLM4 CMP A   #4
FABE 26 15             BNE     ERROR     ERROR IF DELIM NOT 1-4
                *TEST IF CHAR IS 0 TO 9 INCLUSIVE
FAC0 C1 30             CMP B   #'0
FAC2 2D 0C             BLT     DLMYES
FAC4 C1 39             CMP B   #'9
FAC6 2F 0B             BLE     DLMNO

                *TEST IF CHAR IS A TO 9 INCLUSIVE
FAC8 C1 41             CMP B   #'A
FACA 2D 04             BLT     DLMYES
FACC C1 5A             CMP B   #'Z
FACE 2F 03             BLE     DLMNO
                *OVER Z - ITS A DELIMITER

                *CHAR IN ACCB IS A DELIMITER
FAD0 86 01      DLMYES LDA A   #1
FAD2 39                RTS
```

```
                *CHAR IN ACCB IS NOT A DELIMITER
FAD3 4F         DLMNO   CLR A
FAD4 39                 RTS



                *ERROR IN SPECIFYING DELIMITER CLASS
FAD5 3F         ERROR   SWI                 HAVE MONITOR TYPE OUT PERTINENT
                *                            STATISTICS


                *=======================================================
                *ADD THE 2 BYTE NUMBER STORED IN (RANGLO,RANGLO+1) TO
                *                            THE NUMBER
                * STORED IN (NBRHI,NBRLO) AND PUT THE RESULT IN
                *                            (RANGHI,RANGHI+1)
                *ACCB & IX ARE PRESERVED
                *ACCA IS ALTERED


                *ADD LO ORDER BYTES
FAD6 B6 7016 SUMNUM LDA A   RANGLO+1
FAD9 BB 7014        ADD A   NBRLO
FADC B7 7018        STA A   RANGHI+1


                *ADD HI ORDER BYTES
FADF B6 7015        LDA A   RANGLO
FAE2 B9 7013        ADC A   NBRHI
FAE5 B7 7017        STA A   RANGHI


FAE8 39             RTS
                *=======================================================
                *SUBTRACT THE 2 BYTE NUMBER STORED IN (NBRHI,NBRLO)
                *                            FROM THE
                *TWO BYTE NUMBER STORED IN (RANGLO,RANGLO+1) AND PUT
                *                            THE
                *RESULT IN (RANGHI,RANGHI+1)
                *ACCB & IX ARE PRESERVED
                *ACCA IS ALTERED


                *SUBTRACT LO ORDER BYTES
FAE9 B6 7016 DIFNUM LDA A   RANGLO+1
FAEC B0 7014        SUB A   NBRLO
FAEF B7 7018        STA A   RANGHI+1


                *SUBTRACT HI ORDER BYTES
FAF2 B6 7015        LDA A   RANGLO
FAF5 B2 7013        SBC A   NBRHI
FAF8 B7 7017        STA A   RANGHI


FAFB 39             RTS
```

```
                *=====================================================
                *THIS ROUTINE SCANS THE INPUT LINE FOR A PAIR OF
                *                          NUMBERS
                *REPRESENTING AN ADDRESS RANGE.  A COLON SEPARATING THE
                *PAIR IMPLIES "THRU", WHILE AN "!" IMPLIES "THRU THE
                *                          FOLLOWING"
                * E.G., 100:105 IS EQUIVALENT TO 100!5
                *A SINGLE NUMBER IMPLIES A RANGE OF 1
                *
                *ON RETURN (RANGLO,RANGLO+1) HOLDS THE RANGE START, AND
                *          (RANGHI,RANGHI+1) HOLDS THE RANGE END
                *ACCA, ACCB, & IX ARE NOT PRESERVED

FAFC 8D 49    GTRANG BSR     NUMBER    PICK UP FIRST NUMBER
FAFE 2E 03           BGT     GTRAN1
FB00 2D 09           BLT     GTRAN2
FB02 39              RTS               NOTHING MORE ON INPUT LINE

                *GOOD SINGLE NUMBER - TRANSFER IT TO RANGLO
FB03 FE 7013  GTRAN1 LDX     NBRHI
FB06 FF 7015         STX     RANGLO
FB09 20 0D           BRA     GTRAN3    AND TO RANGHI
                *BAD NUMBER, BUT IS IT BAD DUE TO A ":" OR "!"
                *                          DELIMITER?
                *GET THE TERMINATOR FOR THE FIRST NUMBER
FB0B FE 700C  GTRAN2 LDX     LINPTR
FB0E A6 00           LDA A   X
FB10 81 3A           CMP A   #':       WAS IT A COLON?
FB12 26 0C           BNE     GTRAN4    IF NOT, GO TEST FOR "!"

FB14 8D 1A           BSR     GTRAN8    WAS ":", PROCESS FIRST NUMBER &
                *                          GET NEXT ONE
FB16 2F 0E           BLE     GTRAN5    ILLEGAL IF END OF LINE OR
                *                          NON-NUMERIC

                *TRANSFER SECOND NUMBER TO RANGHI
FB18 FE 7013  GTRAN3 LDX     NBRHI
FB1B FF 7017         STX     RANGHI
FB1E 20 0D           BRA     GTRAN7

FB20 81 21    GTRAN4 CMP A   #'!       WAS DELIMITER A "!"?
FB22 27 03           BEQ     GTRAN6    IF YES, GET 2ND NUMBER

                *ILLEGAL DELIMITER, RETURN
FB24 4F              CLR A
FB25 4A              DEC A
FB26 39       GTRAN5 RTS

FB27 8D 07    GTRAN6 BSR     GTRAN8    WAS "!", PROCESS FIRST NUMBER &
                *                          GET NEXT ONE
FB29 2F FB           BLE     GTRAN5
```

```
FB2B 8D A9          BSR     SUMNUM   COMPUTE RANGE END, PUT INTO
                    *                  RANGHI


                    *SUCCESSFUL EXIT
FB2D 86 01    GTRAN7 LDA A  #1
FB2F 39              RTS


                    *UPDATE SYNTAX POINTER, MOVE FIRST NUMBER TO RANGLO, &
                    *                  GET 2ND NUMBER
FB30 FF 700A GTRAN8 STX     SYNPTR   UPDATE SYNTAX POINTER
FB33 FE 7013        LDX     NBRHI    GET FIRST NUMBER OF THE PAIR
FB36 FF 7015        STX     RANGLO   SAVE IT IN "LOW RANGE" VALUE
FB39 8D 0C          BSR     NUMBER   PICK UP THE SECOND NUMBER OF
                    *                  THE PAIR
FB3B 39             RTS


                    *=======================================================
                    *GET A 2 BYTE NUMBER & RETURN IT IN THE INDEX REGISTER
FB3C 8D 09    NUMINX BSR    NUMBER
FB3E 2E 03           BGT    NUMIN1
FB40 7E F457         JMP    BADSYN
FB43 FE 7013 NUMIN1  LDX    NBRHI
FB46 39              RTS
                    *=======================================================
                    *SCAN FOR A NUMBER
                    *RETURN THE MOST SIGNIFICANT BYTE IN NBRHI
                    *  AND THE LEAST SIGNIFICANT BYTE IN NBRLO
                    *THE RESULT OF THE SCAN FOR A NUMBER IS RETURNED IN
                    *ACCA AS FOLLOWS:
                    *
                    *       ACCA=-1: THE MATCH WAS UNSUCCESSFUL.  THE SYNTAX
                    *                POINTER (SYNPTR) WAS NOT UPDATED.
                    *
                    *       ACCA= 0: THE SCAN WAS UNSUCCESSFUL SINCE THERE
                    *                       WERE NO
                    *                MORE CHARACTERS. (I.E., THE END OF THE
                    *                LINE WAS ENCOUNTERED.)
                    *
                    *       ACCA=+1: THE SCAN WAS SUCCESSFUL.  THE SYNTAX
                    *                       POINTER
                    *                WAS UPDATED TO THE FIRST CHARACTER
                    *                       FOLLOWING
                    *                THE COMMAND.


                    *IX IS PRESERVED
                    *GLOBAL VARIABLES FOR EXTERNAL COMMUNICATION
                    *NBRHI - NUMBER HI BYTE
                    *NBRLO - NUMBER LO BYTE
                    *IBCODE - INPUT BASE CODE
                    *DBCODE - DISPLAY BASE CODE


                    *LOCAL VARIABLES
                    *NBR2X - USED IN DECIMAL CONVERSION
                    *XTEMP2 - SAVES IX
```

```
                *INITIALIZE BOTH BYTES TO ZERO
FB47 FF 70D2 NUMBER STX     XTEMP2    SAVE IX
FB4A 7F 7013        CLR     NBRHI
FB4D 7F 7014        CLR     NBRLO


                *INITIALIZE THE LINE SCANNING POINTER
FB50 FE 700A        LDX     SYNPTR
FB53 FF 700C        STX     LINPTR


                *ARE WE AT END OF LINE?
FB56 BD FA69        JSR     SKPDLM
FB59 24 05          BCC     NUMLUP
FB5B FE 70D2        LDX     XTEMP2
FB5E 4F             CLR A               YES, ZERO ACCA
FB5F 39             RTS


FB60 BD FCC0 NUMLUP JSR     GETCHR    GET A CHARACTER FROM THE INPUT
                *                       LINE INTO ACCB


                *TEST FOR A DELIMITER
FB63 BD FA94        JSR     TSTDLM
FB66 26 65          BNE     GUDNUM    GOOD DELIMITER IF ACCA NON-ZERO


                *NOT A DELIMITER, TEST IF CHARACTER IS < ASCII 0
FB68 C0 30          SUB B   #'0       SUBTRACT ASCII 0
FB6A 2B 6D          BMI     CONERR    ERROR IF LESS


                *DETERMINE INPUT BASE & GO TO RIGHT ROUTINE
FB6C B6 7010        LDA A   IBCODE
FB6F 81 01          CMP A   #1
FB71 27 08          BEQ     HEXNUM


FB73 81 02          CMP A   #2
FB75 27 1E          BEQ     DECNUM


FB77 81 03          CMP A   #3
FB79 27 41          BEQ     OCTNUM


                *DEFAULT AN ILLEGAL INPUT BASE TO HEX
                ******
                *INPUT A HEX NUMBER
                *TEST FOR A LEGAL DIGIT
FB7B C1 09      HEXNUM CMP B   #$09
FB7D 2F 0A          BLE     HEXN1     OR IF 9 OR LESS
FB7F C1 11          CMP B   #$11
FB81 2B 56          BMI     CONERR    NOT HEX IF < A
FB83 C1 16          CMP B   #$16
FB85 2E 52          BGT     CONERR    NOT HEX IF > F
FB87 C0 07          SUB B   #7        MOVE A-F ABOVE 0-9
```

```
                *SHIFT LO & HI BYTES LEFT 4 BITS
FB89 8D 54      HEXN1   BSR     SHIFT2
FB8B 8D 52              BSR     SHIFT2

FB8D FA 7014            ORA B   NBRLO
FB90 F7 7014            STA B   NBRLO

FB93 20 CB              BRA     NUMLUP

                ******
                *INPUT A DECIMAL NUMBER
                *TEST FOR A LEGAL DIGIT
FB95 C1 09      DECNUM  CMP B   #$09
FB97 2E 40              BGT     CONERR    NOT DECIMAL IF > 9

                *MULTIPLY SAVED VALUE BY 10 & ADD IN NEW DIGIT
                *NOTE THAT 10X=2X+8X
                *MULTIPLY CURRENT NUMBER BY 2 TO GET 2X VALUE
FB99 8D 49              BSR     SHIFT
                *SAVE THIS *2 NUMBER TEMPORARILY
FB9B FE 7013            LDX     NBRHI
FB9E FF 70DC            STX     NBR2X
                *MULTIPLY THIS # BY 4 TO GET 8X VALUE
FBA1 8D 3C              BSR     SHIFT2
                *(NBRHI,NBRLO) NOW HOLDS *8
                *GENERATE DIGIT+8X+2X
FBA3 4F                 CLR A             ACCA WILL HOLD MS BYTE
FBA4 FB 70DD            ADD B   NBR2X+1    ADD 2X LS BYTE TO DIGIT
FBA7 B9 70DC            ADC A   NBR2X     ADD 2X MS BYTE
FBAA 25 2D              BCS     CONERR    CARRY OUT OF MS BYTE IS AN ERROR
FBAC FB 7014            ADD B   NBRLO     ADD 8X LS BYTE
FBAF B9 7013            ADC A   NBRHI     ADD 8X MS BYTE
FBB2 25 25              BCS     CONERR    CARRY OUT OF MS BYTE IS AN ERROR
FBB4 F7 7014            STA B   NBRLO     SAVE FINAL LS BYTE
FBB7 B7 7013            STA A   NBRHI     SAVE FINAL MS BYTE

FBBA 20 A4              BRA     NUMLUP
                ******
                *INPUT AN OCTAL NUMBER
FBBC C1 07      OCTNUM  CMP B   #$07
FBBE 2E 19              BGT     CONERR    NOT OCTAL IF > 7

                *SHIFT HI & LO BYTES 3 PLACES LEFT - CARRY OUT OF HI
                *                          BYTE IS ILLEGAL
FBC0 8D 1D              BSR     SHIFT2
FBC2 8D 20              BSR     SHIFT

FBC4 FA 7014            ORA B   NBRLO     ADD IN NEW DIGIT
FBC7 F7 7014            STA B   NBRLO

FBCA 7E FB60            JMP     NUMLUP
```

```
                *******
                *GOOD NUMBER - SCAN WAS SUCCESSFUL
                *UPDATE GOOD SYNTAX LINE POINTER
FBCD FE 700C GUDNUM LDX     LINPTR
FBD0 FF 700A        STX     SYNPTR
FBD3 FE 70D2        LDX     XTEMP2
FBD6 86 01          LDA A   #1          SET "GOOD SCAN" FLAG
FBD8 39             RTS


                *******
                *CONVERSION ERROR - SCAN WAS UNSUCCESSFUL
FBD9 FE 70D2 CONERR LDX     XTEMP2
FBDC 4F             CLR A
FBDD 4A             DEC A
FBDE 39             RTS
                *-----------------------------------
                *SHIFT LEFT 2 POSITIONS
FBDF 8D 03   SHIFT2 BSR     SHIFT
FBE1 8D 01          BSR     SHIFT
FBE3 39             RTS
                *-----------------------------------
                *SHIFT A TWO BYTE NUMBER LEFT ONE POSITION
FBE4 78 7014 SHIFT  ASL     NBRLO
FBE7 79 7013        ROL     NBRHI
FBEA 25 01          BCS     SHFTER
FBEC 39             RTS
                *ERROR - HI ORDER BYTE OVERFLOW
                *ABORT NUMBER ROUTINE DIRECTLY THRU STACK ADJ. & A JUMP
FBED 31      SHFTER INS
FBEE 31             INS
FBEF 20 E8          BRA     CONERR


                *=======================================================
                *OUTPUT A SPACE
FBF1 86 20   OUTSP  LDA A   #$20
FBF3 BD FE76        JSR     OUTCHR
FBF6 39             RTS


                *=======================================================
                *OUTPUT AN "=" SIGN
FBF7 86 3D   OUTEQ  LDA A   #'=
FBF9 BD FE76        JSR     OUTCHR
FBFC 39             RTS


                *=======================================================
                *OUTPUT A 1 BYTE NUMBER
                *ACCA, ACCB, & IX ARE PRESERVED
FBFD 37      OUT1BY PSH B
FBFE C6 01          LDA B   #1
FC00 8D 09          BSR     OUTNUM
FC02 33             PUL B
FC03 39             RTS
```

```
                *=======================================================
                *OUTPUT A 2 BYTE NUMBER
                *ACCA, ACCB, & IX ARE PRESERVED
FC04 37         OUT2BY PSH B
FC05 C6 02             LDA B  #2
FC07 8D 02             BSR    OUTNUM
FC09 33                PUL B
FC0A 39                RTS


                *=======================================================
                *DISPLAY THE NUMBER POINTED AT BY THE ADDRESS IN THE
                *                        INDEX REGISTER
                * AND OUTPUT IT ACCORDING TO THE BASE SPECIFIED IN
                *                        "DBCODE"
                *LEADING ZEROES ARE INCLUDED
                *ACCA & IX ARE PRESERVED
                *ACCB IS INPUT AS THE NUMBER OF BYTES COMPRISING THE
                *                        NUMBER
                *GLOBAL VARIABLES FOR EXTERNAL COMMUNICATION
                *IBCODE - INPUT BASE CODE
                *DBCODE - DISPLAY BASE CODE


                *LOCAL VARIABLES
                *DECDIG - DECIMAL DIGIT BEING BUILT
                *NUMBHI - HI BYTE OF NUMBER BEING OUTPUT
                *NUMBLO - LO BYTE OF NUMBER BEING OUTPUT


FC0B FF 70D0 OUTNUM STX    XTEMP1
FC0E 36             PSH A
FC0F EE 00          LDX    X          GET THE TWO BYTES AT THAT
                *                      ADDRESS
FC11 FF 70DA        STX    NUMBHI     PUT THEM IN A SCRATCH AREA FOR
                *                      PROCESSING
FC14 B6 7011        LDA A  DBCODE     GET DISPLAY BASE


FC17 81 01          CMP A  #1
FC19 27 0C          BEQ    OUTHEX
FC1B 81 02          CMP A  #2
FC1D 27 1E          BEQ    OUTDEC
FC1F 81 03          CMP A  #3
FC21 27 5E          BEQ    OUTOCT
FC23 81 04          CMP A  #4
FC25 27 78          BEQ    OUTBIN


                ******
                *OUTPUT A HEX NUMBER
FC27 58         OUTHEX ASL B           1 BYTE=2 CHARS, 2 BYTES=4 CHARS
                *GET NEXT 4 BITS
FC28 BD FCB3 DISNU1 JSR    LSH2
FC2B BD FCB3        JSR    LSH2


FC2E 84 0F          AND A  #$F        EXTRACT 4 BITS
```

```
FC30 81 09          CMP A  #9
FC32 2F 02          BLE    DISNU2
FC34 8B 07          ADD A  #7        CONVERT 10:15 TO A:F

FC36 8D 75   DISNU2 BSR    OUTIT
FC38 5A             DEC B
FC39 26 ED          BNE    DISNU1
FC3B 20 35          BRA    OUTDE5

                    ******
                    *OUTPUT A DECIMAL NUMBER
FC3D 5A      OUTDEC DEC B            TEST # OF BYTES TO OUTPUT
FC3E 27 0B          BEQ    OUTDE1
                    *INITIALIZE FOR OUTPUT OF A 2 BYTE NUMBER
FC40 CE FC77        LDX    #C10K
FC43 B6 70DA        LDA A  NUMBHI
FC46 F6 70DB        LDA B  NUMBLO
FC49 20 07          BRA    OUTDE2

                    *INITIALIZE FOR OUTPUT OF A 1 BYTE NUMBER
FC4B CE FC7B OUTDE1 LDX    #C100
FC4E 4F             CLR A
FC4F F6 70DA        LDA B  NUMBHI

FC52 7F 70D9 OUTDE2 CLR    DECDIG   CLEAR THE DIGIT TO OUTPUT

                    *SUBTRACT THE POWER OF 10 CONVERSION CONSTANT
FC55 E0 01   OUTDE3 SUB B  1,X
FC57 A2 00          SBC A  0,X
FC59 25 05          BCS    OUTDE4   TEST FOR BORROW (CARRY)

FC5B 7C 70D9        INC    DECDIG   NO BORROW YET - INC DIGIT BEING
                    *                BUILT
FC5E 20 F5          BRA    OUTDE3   REPEAT LOOP
                    *BORROW GENERATED - CANCEL LAST SUBTRACTION
FC60 EB 01   OUTDE4 ADD B  1,X
FC62 A9 00          ADC A  0,X

                    *BUILDING OF DIGIT TO OUTPUT IS COMPLETE - PRINT IT
FC64 36             PSH A            SAVE LO BYTE OF NUMBER BEING
                    *                 OUTPUT
FC65 B6 70D9        LDA A  DECDIG    GET DIGIT
FC68 8D 43          BSR    OUTIT     PRINT IT
FC6A 32             PUL A            RESTORE LO BYTE
                    *GET NEXT LOWER POWER OF 10
FC6B 08             INX
FC6C 08             INX
FC6D 8C FC81        CPX    #C10K+10   ARE WE THRU WITH UNITS
                    *                 CONVERSION?
FC70 26 E0          BNE    OUTDE2    IF NOT, BACK TO GET NEXT DIGIT
FC72 32      OUTDE5 PUL A             IF YES, RESTORE REGISTERS & RETU
```

```
FC73 FE 70D0          LDX     XTEMP1
FC76 39               RTS

                *DECIMAL OUTPUT CONVERSION CONSTANTS
FC77 2710     C10K    FDB     10000
FC79 03E8             FDB     1000
FC7B 0064     C100    FDB     100
FC7D 000A             FDB     10
FC7F 0001             FDB     1

                ******
                *OUTPUT AN OCTAL NUMBER
                *FIRST DIGIT IS A ONE OR A ZERO
FC81 58       OUTOCT  ASL B           FIRST APPROXIMATION OF # OF
                *                       DIGITS TO OUTPUT
FC82 4F               CLR A
FC83 C1 02            CMP B   #2
FC85 2E 06            BGT     OUTOC1
FC87 8D 2A            BSR     LSH2      1 BYTE - GET FIRST 2 BITS
FC89 8D 22            BSR     OUTIT
FC8B 20 05            BRA     DISNU3    GO OUTPUT LAST 2 DIGITS
                *TWO BYTE # - OUTPUT HI ORDER BIT/DIGIT
FC8D 8D 29    OUTOC1  BSR     LEFSHF
FC8F 8D 1C            BSR     OUTIT
FC91 5C               INC B             5 MORE DIGITS TO GO
                *GET NEXT 3 BITS
FC92 8D 1F    DISNU3  BSR     LSH2
FC94 8D 22            BSR     LEFSHF


FC96 84 07            AND A   #7        EXTRACT 3 BITS
FC98 8D 13            BSR     OUTIT
FC9A 5A               DEC B             COUNT THIS DIGIT
FC9B 26 F5            BNE     DISNU3    ARE WE DONE?
FC9D 20 D3            BRA     OUTDE5    YES
                ******
                *OUTPUT A BINARY NUMBER
FC9F 58       OUTBIN  ASL B
FCA0 58               ASL B
FCA1 58               ASL B
                *GET NEXT BIT
FCA2 8D 14    DISNU4  BSR     LEFSHF
FCA4 84 01            AND A   #1        EXTRACT THE BIT


FCA6 8D 05            BSR     OUTIT     OUTPUT IT
FCA8 5A               DEC B             COUNT IT
FCA9 26 F7            BNE     DISNU4    ARE WE DONE?
FCAB 20 C5            BRA     OUTDE5    YES


                ***
                *CONVERT TO A NUMERIC ASCII DIGIT & OUTPUT IT
FCAD 8B 30    OUTIT   ADD A   #$30
FCAF BD FE76          JSR     OUTCHR
FCB2 39               RTS
                ***
                *LEFT SHIFT 2 BITS
```

```
FCB3 8D 03    LSH2    BSR     LEFSHF
FCB5 8D 01            BSR     LEFSHF
FCB7 39               RTS

                      ***
                      *LEFT SHIFT THE 3 BYTE NUMBER 1 BIT
FCB8 78 70DB LEFSHF   ASL     NUMBLO
FCBB 79 70DA          ROL     NUMBHI
FCBE 49               ROL A
FCBF 39               RTS

                      *=======================================================
                      *THIS ROUTINE GETS THE NEXT CHARACTER FROM THE INPUT
                      *                          LINE BUFFER
                      *ACCA IS PRESERVED
                      *ACCB IS LOADED WITH THE CHARACTER
                      *IX IS INCREMENTED & LEFT POINTING TO THE CHARACTER
                      *                          RETURNED
FCC0 FE 700C GETCHR   LDX     LINPTR
FCC3 08               INX
FCC4 E6 00            LDA B   X
FCC6 FF 700C          STX     LINPTR
FCC9 7F 700E          CLR     BOLFLG    SET FLAG TO NOT AT "BEGINNING
                      *                          OF LINE"
FCCC 39               RTS

                      *=======================================================
                      *THIS ROUTINE GETS THE NEXT CHARACTER IN THE COMMAND
                      *                          LISTS
                      *ACCA IS THE CHARACTER RETRIEVED
                      *ACCB IS PRESERVED
                      *IX IS INCREMENTED & LEFT POINTING TO THE CHARACTER
                      *                          RETURNED
FCCD FE 70D7 GETLST   LDX     LISPTR    GET CURRENT LIST POINTER
FCD0 08               INX               MOVE POINTER TO NEXT CHAR
FCD1 A6 00            LDA A   X         GET CHARACTER POINTED AT
FCD3 FF 70D7          STX     LISPTR    SAVE POINTER
FCD6 39               RTS               AND RETURN

                      *=======================================================
                      * COMMAND LISTS
                      *  A CARRIAGE RETURN SIGNIFIES END-OF-COMMAND
                      *  A LINE FEED SIGNIFIES END-OF-COMMAND-LIST
                      *LIST 1 - MAJOR COMMANDS
     FCD7             COMLST  EQU     *
FCD7 52               FCC     'REG'     DISPLAY REGISTERS
FCD8 45
FCD9 47
FCDA 0D               FCB     CR
FCDB 47               FCC     'GOTO'    GO TO MEMORY ADDRESS
FCDC 4F
FCDD 54
FCDE 4F
FCDF 0D               FCB     CR
FCE0 53               FCC     'SEI'     SET INTERRUPT MASK
```

```
FCE1 45
FCE2 49
FCE3 0D             FCB     CR
FCE4 43             FCC     'CLI'     CLEAR INTERRUPT MASK
FCE5 4C
FCE6 49
FCE7 0D             FCB     CR
FCE8 43             FCC     'COPY'    COPY FROM ONE LOCATION TO
FCE9 4F
FCEA 50
FCEB 59
                *                       ANOTHER
FCEC 0D             FCB     CR
FCED 42             FCC     'BREAK'   SET BREAKPOINT (SWI CODE)
FCEE 52
FCEF 45
FCF0 41
FCF1 4B
FCF2 0D             FCB     CR
FCF3 49             FCC     'IBASE'   SET INPUT BASE
FCF4 42
FCF5 41
FCF6 53
FCF7 45
FCF8 0D             FCB     CR
FCF9 44             FCC     'DBASE'   SET DISPLAY BASE
FCFA 42
FCFB 41
FCFC 53
FCFD 45
FCFE 0D             FCB     CR
FCFF 43             FCC     'CONTINUE'  CONTINUE FROM "SWI"
FD00 4F
FD01 4E
FD02 54
FD03 49
FD04 4E
FD05 55
FD06 45
FD07 0D             FCB     CR
FD08 44             FCC     'DISPLAY'  DISPLAY MEMORY DATA
FD09 49
FD0A 53
FD0B 50
FD0C 4C
FD0D 41
FD0E 59
FD0F 0D             FCB     CR
FD10 53             FCC     'SET'     SET MEMORY DATA
FD11 45
FD12 54
FD13 0D             FCB     CR
FD14 56             FCC     'VERIFY'  VERIFY THAT MEMORY
FD15 45
FD16 52
FD17 49
```

```
FD18 46
FD19 59
                *                                   CONTENT IS UNCHANGED
FD1A 0D             FCB     CR
FD1B 53             FCC     'SEARCH'    SEARCH MEMORY FOR A
FD1C 45
FD1D 41
FD1E 52
FD1F 43
FD20 48
                *                                   BYTE STRING
FD21 0D             FCB     CR
FD22 54             FCC     'TEST'      TEST A RANGE OF MEMORY
FD23 45
FD24 53
FD25 54
FD26 0D             FCB     CR
FD27 49             FCC     'INT'       SET INTERRUPT POINTER
FD28 4E
FD29 54
FD2A 0D             FCB     CR
FD2B 4E             FCC     'NMI'       SET NON-MASKABLE
FD2C 4D
FD2D 49
                *                                   INTERRUPT POINTER
FD2E 0D             FCB     CR
FD2F 53             FCC     'SWI'       SET SOFTWARE INTERRUPT
FD30 57
FD31 49
                *                                   POINTER
FD32 0D             FCB     CR
FD33 43             FCC     'COMPARE'   PRINT SUM & DIFFERENCE
FD34 4F
FD35 4D
FD36 50
FD37 41
FD38 52
FD39 45
                *                                   OF 2 NUMBERS
FD3A 0D             FCB     CR
FD3B 44             FCC     'DUMP'      DUMP MEMORY IN MIKBUG OR IMAGE
FD3C 55
FD3D 4D
FD3E 50
                *                                   FORMAT
FD3F 0D             FCB     CR
FD40 4C             FCC     'LOAD'      LOAD MIKBUG TAPE
FD41 4F
FD42 41
FD43 44
FD44 0D             FCB     CR
FD45 44             FCC     'DELAY'     DELAY SPECIFIED # OF BYTES
FD46 45
FD47 4C
FD48 41
FD49 59
```

```
FD4A 0D             FCB     CR
FD4B 0A             FCB     LF          END OF LIST 1
                *LIST 2 - MODIFIER TO DUMP
FD4C 54             FCC     'TO'        DESTINATION ACIA
FD4D 4F
FD4E 0D             FCB     CR
FD4F 0A             FCB     LF          END OF LIST 2



                *LIST 3 - NUMBER BASE SPECIFIERS
FD50 48             FCC     'HEX'       BASE 16
FD51 45
FD52 58
FD53 0D             FCB     CR
FD54 44             FCC     'DEC'       BASE 10
FD55 45
FD56 43
FD57 0D             FCB     CR
FD58 4F             FCC     'OCT'       BASE 8
FD59 43
FD5A 54
FD5B 0D             FCB     CR
FD5C 42             FCC     'BIN'       BASE 2
FD5D 49
FD5E 4E
FD5F 0D             FCB     CR
FD60 0A             FCB     LF          END OF LIST 3
                *LIST 4 - INFORMATION REQUEST
FD61 3F             FCC     '?'
FD62 0D             FCB     CR
FD63 0A             FCB     LF          END OF LIST 4



                *LIST 5 - REGISTER NAMES
FD64 2E             FCC     '.CC'
FD65 43
FD66 43
FD67 0D             FCB     CR
FD68 2E             FCC     '.B'
FD69 42
FD6A 0D             FCB     CR
FD6B 2E             FCC     '.A'
FD6C 41
FD6D 0D             FCB     CR
FD6E 2E             FCC     '.IX'
FD6F 49
FD70 58
FD71 0D             FCB     CR
FD72 2E             FCC     '.PC'
FD73 50
FD74 43
FD75 0D             FCB     CR
FD76 2E             FCC     '.SP'
FD77 53
```

```
FD78 50
FD79 0D             FCB     CR
FD7A 0A             FCB     LF          END OF LIST 5



                   *LIST 6 - MODIFIERS TO "DISPLAY"
FD7B 44             FCC     'DATA'
FD7C 41
FD7D 54
FD7E 41
FD7F 0D             FCB     CR
FD80 55             FCC     'USED'
FD81 53
FD82 45
FD83 44
FD84 0D             FCB     CR
FD85 0A             FCB     LF          END OF LIST 6



                   *LIST 7 - MODIFIER TO "LOAD"
FD86 46             FCC     'FROM'      SOURCE ACIA
FD87 52
FD88 4F
FD89 4D
FD8A 0D             FCB     CR
FD8B 0A             FCB     LF          END OF LIST 6
                   *=============================================================



                   * THIS ROUTINE CONSTRUCTS A LINE OF INPUT BY GETTING
                   *                          ALL INPUT
                   * CHARACTERS UP TO AND INCLUDING A CARRIAGE RETURN
                   *                          (WHICH THEN
                   * DESIGNATES "END OF LINE").
                   * TYPING RUBOUT WILL DELETE THE PREVIOUS CHARACTER
                   * TYPING CONTROL-C WILL ABORT THE LINE
                   * TYPING CONTROL-Z WILL USE THE PREVIOUS LINE
                   * THE INPUT LINE IS STORED BEGINING AT THE ADDRESS
                   *                          STORED IN BUFBEG
                   * AND ENDING AT THE ADDRESS STORED IN BUFEND
                   *ACCA, ACCB, & IX ARE NOT PRESERVED
                   *
                   *GLOBAL VARIABLES
                   *BUFBEG - INPUT LINE START OF BUFFER
                   *BUFEND - INPUT LINE END OF BUFFER


                   *LOCAL CONSTANTS
        005C       BAKSLA EQU     92       A BACKSLASH
        007F       DELETE EQU     127      CODE TO DELETE THE PREVIOUS
                   *                        CHARACTER
                   *
                   *
```

```
                    **** ROUTINE ENTRY POINT

FD8C FE 702C GETLIN LDX     BUFBEG    SET POINTER TO ONE LESS THAN
                    *                  THE BEGINNING OF THE LINE BUFFE
                    *                  R
FD8F 5F             CLR B             ACCB HOLDS LAST INPUT CHAR
                    *
FD90 BC 702E NXTCHR CPX     BUFEND    CHECK CURRENT LINE END AGAINST
                    *                  BUFFER END
FD93 26 09          BNE     GETIT

                    * LINE TOO LONG - ABORT IT AS IF A CONTROL-C HAD BEEN
                    *                  TYPED
FD95 CE FF07        LDX     #MSGLTL   GET MESSAGE
FD98 BD FE4B        JSR     OUTSTR    OUTPUT IT
FD9B C6 03          LDA B   #3        PUT CTL-C IN ACCB
FD9D 39             RTS

FD9E BD FE59 GETIT  JSR     INPCHR    GET A CHARACTER (RETURNED IN
                    *                  ACCA)
FDA1 84 7F          AND A   #127      DROP PARITY BIT

                    *CONTROL-Z COPIES FROM PRESENT POSITION TO PREVIOUS
                    *                  END OF LINE
FDA3 81 1A          CMP A   #26       IS CHAR A CONTROL-Z?
FDA5 26 04          BNE     TSTCR
FDA7 BD FEC7        JSR     DOCRLF    YES, TYPE CR-LF
FDAA 39             RTS
FDAB 81 0D  TSTCR   CMP A   #13       IS CHAR A CR?
FDAD 27 04          BEQ     TSTCR1
FDAF 81 0A          CMP A   #10       OR A LF?
FDB1 26 0C          BNE     NOTEOL
FDB3 08     TSTCR1  INX
FDB4 A7 00          STA A   X         YES, STORE THE TERMINATOR
FDB6 7D 7029        TST     HDXFLG    TEST FOR HALF-DUPLEX TERMINAL
FDB9 26 03          BNE     TSTCR2
FDBB BD FEC7        JSR     DOCRLF    TYPE CR-LF
FDBE 39     TSTCR2  RTS               NOW RETURN
                    *
FDBF 81 03  NOTEOL  CMP A   #3        IS CHAR A CONTROL-C?
FDC1 26 07          BNE     NOTCTC
                    *ECHO AN UP-ARROW
FDC3 16             TAB               RETURN CONTROL-C IN ACCB
FDC4 86 5E          LDA A   #'↑
FDC6 BD FE76        JSR     OUTCHR
FDC9 39             RTS

FDCA 81 7F  NOTCTC  CMP A   #DELETE    NO, IS IT DELETE?
FDCC 27 25          BEQ     RUBNOW    IF YES, GO TO RUBNOW

                    *CONVERT LOWER CASE TO UPPER CASE
FDCE 81 60          CMP A   #$60      BELOW L.C. A?
```

```
FDD0 23 06           BLS     STORIT
FDD2 81 7A           CMP A   #$7A        ABOVE L.C. Z?
FDD4 22 02           BHI     STORIT
FDD6 80 20           SUB A   #32         CONV L.C. ALPHABETIC TO U.C.

FDD8 08        STORIT INX                NOT A DELETE, SO ADVANCE TO
                    *                     NEXT CHARACTER
FDD9 A7 00           STA A   X           STORE IT IN INPLIN

FDDB C1 7F           CMP B   #DELETE     IS LAST CHAR A DELETE?
FDDD 27 03           BEQ     OUTBAK      IF SO, GO TO OUTBAK
FDDF 16              TAB                 ITS NOT, UPDATE LAST CHAR
FDE0 20 07           BRA     ECHO        GO ECHO IT
                    *
                    * LAST CHAR WAS A DELETE, BUT THIS ONE ISN'T
FDE2 16        OUTBAK TAB                UPDATE LAST CHAR
FDE3 86 5C           LDA A   #BAKSLA     PRINT A -
FDE5 BD FE76         JSR     OUTCHR      BACKSLASH
FDE8 17              TBA                 RESTORE CURRENT CHAR FOR ECHO
FDE9 7D 7029 ECHO    TST     HDXFLG      TEST FOR HALF DUPLEX TERMINAL
FDEC 26 03           BNE     ECHO1
FDEE BD FE76         JSR     OUTCHR      NOW ECHO IT
FDF1 20 9D     ECHO1 BRA     NXTCHR      GET ANOTHER
                    *
                    * CURRENT CHARACTER IS A DELETE
                    * TEST LINE LENGTH - IF ITS ZERO, IGNORE THIS DELETE
                    *                     SINCE
                    * WE CAN'T DELETE PRIOR TO FIRST CHARACTER IN INPUT
                    *                     LINE
FDF3 BC 702C RUBNOW CPX     BUFBEG
FDF6 27 98           BEQ     NXTCHR
FDF8 C1 7F           CMP B   #DELETE     WAS LAST CHAR A DELETE?
FDFA 27 06           BEQ     LASWAS

                    *LAST CHAR WASN'T A DELETE
FDFC 16              TAB                 UPDATE LAST CHAR (WITH A DELETE)
FDFD 86 5C           LDA A   #BAKSLA     PRINT A -
FDFF BD FE76         JSR     OUTCHR      BACKSLASH
                    *LAST CHAR WAS A DELETE
FE02 A6 00     LASWAS LDA A  X           GET THE CHAR TO BE DELETED
FE04 09              DEX                 DECREMENT LINE POINTER
FE05 20 E2           BRA     ECHO        ECHO DELETED CHARACTER



                    *=====================================================
                    *INITIALIZATION ROUTINE
                    *DISABLE INTERRUPTS
FE07 0F              SEI
FE08 86 01     INITAL LDA A  #1
FE0A B7 7010         STA A   IBCODE      SET INPUT BASE TO HEX
FE0D B7 7011         STA A   DBCODE      SET DISPLAY BASE TO HEX
                    *SET UP DISPLAY BASE NUMBER
FE10 86 10           LDA A   #16
```

```
FE12 B7 7012          STA A  DBNBR
                   *MAX # OF CHARACTERS PER LINE
FE15 86 48            LDA A  #72
FE17 B7 702B          STA A  CPLMAX
FE1A 7F 7023          CLR    INPFLG    DEFAULT INPUT FROM THE TERMINAL
FE1D 7F 7026          CLR    OUTFLG    DEFAULT OUTPUT TO THE TERMINAL
FE20 7F 7029          CLR    HDXFLG    CLEAR HALF-DUPLEX FLAG
                   *INITIALIZE ACIA1 & ACIA2 TO 7 BITS & EVEN PARITY
                   *RESET BOTH
FE23 86 03            LDA A  #3
FE25 B7 7F42          STA A  ACIA1-1
FE28 B7 7F44          STA A  ACIA2-1
                   *SET EM UP
FE2B 86 02            LDA A  #2
FE2D B7 7F42          STA A  ACIA1-1
FE30 B7 7F44          STA A  ACIA2-1
                   *SET UP SWI INTERRUPT ADDRESS POINTER
FE33 CE F501          LDX    #TYPSWI   TYPE "SWI" & DO "REG" COMMAND
FE36 FF 7004          STX    SWIVEC
                   *INITIALIZE TO MONDEB'S COMMAND LISTS
FE39 CE FCD6          LDX    #COMLST-1
FE3C FF 7008          STX    COMADR
                   *TIME CONSTANT FOR A 2 MICROSECOND CLOCK
FE3F 86 53            LDA A  #83
FE41 B7 70DE          STA A  TIMCON
                   *ALLOW TIME FOR TTY MOTOR TO COME UP TO SPEED
FE44 CE 01F4          LDX    #500
FE47 BD F9BD          JSR    TIMDEL
FE4A 39               RTS
                   *=======================================================
                   *OUTPUT A CHARACTER STRING WHICH BEGINS AT THE ADDRESS
                   *                        IN THE INDEX REGISTER
                   *ACCA & ACCB ARE PRESERVED
                   *IX IS LEFT POINTING TO THE STRING TERMINATOR
FE4B 36            OUTSTR PSH A
FE4C A6 00         OUTST1 LDA A  X         GET CHAR POINTED TO
FE4E 81 04            CMP A  #4         IS IT A STRING TERMINATOR?
FE50 27 05            BEQ    OUTEND     DONE IF IT IS
FE52 8D 22            BSR    OUTCHR     ISN'T, OUTPUT IT
FE54 08               INX               ON TO NEXT CHARACTER
FE55 20 F5            BRA    OUTST1
FE57 32            OUTEND PUL A
FE58 39               RTS               RETURN


                   *=======================================================
                   *INPUT A CHARACTER FROM AN ACIA TO ACCA
                   *IF INPFLG = 0, INPUT IS FROM TERMINAL ACIA
                   *IF INPFLG = 1, INPUT IS FROM ANY ACIA
                   *ACCB & IX ARE PRESERVED


FE59 FF 70CE INPCHR STX    XTEMP     SAVE IX
FE5C 7D 7023          TST    INPFLG    TEST INPUT SOURCE FLAG
FE5F 26 05            BNE    INPCH1
                   *INPFLG=0: INPUT FROM TERMINAL ACIA
FE61 CE 7F43          LDX    #ACIA1
```

```
FE64 20 03          BRA     INPCH2
                *INPFLG=1: INPUT FROM ANY ACIA
FE66 FE 7024 INPCH1 LDX     INPADR    GET ITS ADDRESS
FE69 09      INPCH2 DEX               POINT TO CONTROL REG
FE6A A6 00   INPCH3 LDA A   X         GET ACIA STATUS BYTE
FE6C 85 01          BIT A   #1        CHAR WAITING?
FE6E 27 FA          BEQ     INPCH3    IF NOT, TRY AGAIN
FE70 A6 01          LDA A   1,X       YES, GET IT
FE72 FE 70CE        LDX     XTEMP     RESTORE IX
FE75 39             RTS
                *=====================================================
                *OUTPUT THE CHARACTER IN ACCA TO THE DESIRED OUTPUT
                *                      DEVICE/LOCATION
                * IF OUTFLG = 0, OUTPUT IS TO TERMINAL
                * IF OUTFLG = 1, OUTPUT IS TO ACIA ADDRESS STORED IN
                *                      OUTADR
                * IF OUTFLG = 2, OUTPUT IS TO ADDRESS IN OUTADR & THIS
                *                      ADDR IS THEN INCREMENTED
                *ACCA, ACCB, & IX ARE PRESERVED
FE76 37      OUTCHR PSH B             SAVE ACCB
FE77 7D 7026        TST     OUTFLG    TEST OUTPUT DESTINATION FLAG
FE7A 27 21          BEQ     OUTCH4    SKIP THIS CODE IF TERMINAL
                *                      OUTPUT


                *OUTPUT TO SOMETHING OTHER THAN TERMINAL
FE7C FF 70CE        STX     XTEMP     SAVE IX
FE7F FE 7027        LDX     OUTADR    GET OUTPUT CHAR DESTINATION
                *                      ADDRESS
FE82 C6 02          LDA B   #2
FE84 F1 7026        CMP B   OUTFLG
FE87 27 09          BEQ     OUTCH2


                *OUTFLG = 1: ANY ACIA OUTPUT
FE89 09             DEX               POINT TO ACIA STATUS REG
FE8A E5 00   OUTCH1 BIT B   X         TEST TDRE BIT
FE8C 27 FC          BEQ     OUTCH1    LOOP IF NOT READY TO ACCEPT A
                *                      NEW CHAR
FE8E A7 01          STA A   1,X       NOW READY - SEND IT
FE90 20 06          BRA     OUTCH3


                *OUTFLG = 2: MEMORY OUTPUT
FE92 A7 00   OUTCH2 STA A   X         SAVE CHAR IN MEMORY
FE94 08             INX
FE95 FF 7027        STX     OUTADR    UPDATE OUTPUT ADDRESS


FE98 FE 70CE OUTCH3 LDX     XTEMP     RESTORE IX
FE9B 33             PUL B             RESTORE ACCB
FE9C 39             RTS


                *OUTFLG = 0: TERMINAL ACIA OUTPUT
                *IGNORE LINE FEEDS
FE9D 81 0A   OUTCH4 CMP A   #LF
FE9F 26 02          BNE     OUTCH5
```

```
FEA1 33              PUL B
FEA2 39              RTS


FEA3 81 0D   OUTCH5 CMP A  #CR       TEST FOR CARRIAGE RETURN
FEA5 26 04          BNE    OUTCH6
FEA7 8D 1E          BSR    DOCRLF
FEA9 33             PUL B
FEAA 39             RTS


FEAB F6 702A OUTCH6 LDA B  CPLCNT   GET "CHARACTERS PER LINE" COUNT
FEAE F1 702B        CMP B  CPLMAX   COMPARE TO MAX PERMISSIBLE
FEB1 2C 0B          BGE    OUTCH7   SEND CR-LF IF GREATER
                   *LESS THAN MAX, BUT ALSO SEND CR-LF IF 10 FROM END AND
                   *                          PRINTING A SPACE
FEB3 CB 0A          ADD B  #10
FEB5 F1 702B        CMP B  CPLMAX
FEB8 2D 06          BLT    OUTCH8
FEBA 81 20          CMP A  #$20      NEAR END, TEST IF ABOUT TO
                   *                          PRINT A SPACE
FEBC 26 02          BNE    OUTCH8


                   *TERMINAL LINE FULL OR NEARLY FULL - INTERJECT A CR-LF
FEBE 8D 07   OUTCH7 BSR    DOCRLF
FEC0 7C 702A OUTCH8 INC    CPLCNT   BUMP COUNTER
FEC3 8D 20          BSR    TOACIA   SEND IT TO ACIA1
FEC5 33             PUL B
FEC6 39             RTS


                   *=========================================================
                   *SEND A CARRIAGE RETURN-LINE FEED TO THE TERMINAL
                   *ACCA, ACCB, & IX ARE PRESERVED
FEC7 36       DOCRLF PSH A
FEC8 37              PSH B
FEC9 86 0D           LDA A  #CR
FECB 8D 18           BSR    TOACIA
FECD 86 0A           LDA A  #LF
FECF 8D 14           BSR    TOACIA


                   *ALLOW TIME FOR THE CARRIAGE TO RETURN BY SENDING NULL
                   *                          CHARACTERS
                   *SEND 1 NULL PER 16 CHARACTERS
                   *DIVIDE CPLCNT BY 16
FED1 F6 702A         LDA B  CPLCNT
FED4 54              LSR B
FED5 54              LSR B
FED6 54              LSR B
FED7 54              LSR B
FED8 5C              INC B            ALWAYS SEND AT LEAST 1 NULL
FED9 4F       DOCRL1 CLR A            GET A NULL
FEDA 8D 09           BSR    TOACIA   SEND IT
FEDC 5A              DEC B
FEDD 26 FA           BNE    DOCRL1
FEDF 7F 702A         CLR    CPLCNT   ZERO "CHARACTERS PER LINE" COUNT
```

```
FEE2 33              PUL B
FEE3 32              PUL A
FEE4 39              RTS


                     *=======================================================
                     *PUT CHAR IN ACCA INTO TERMINAL ACIA
                     *ACCA, ACCB, & IX ARE PRESERVED
FEE5 36        TOACIA PSH A              SAVE CHAR
FEE6 86 02           LDA A  #2           GET ACIA TRANSMIT REG STATUS BIT
FEE8 B5 7F42 TOACI1  BIT A  ACIA1-1       REGISTER EMPTY?
FEEB 27 FB           BEQ    TOACI1       IF NOT, LOOP BACK
FEED 32              PUL A               YES, RESTORE CHARACTER
FEEE B7 7F43         STA A  ACIA1        SEND IT
FEF1 39              RTS
                     *=======================================================
                     *MISC TEXT
FEF2 4D        MSGHED FCC     'MONDEB 1.00'  MONITOR HEADER TYPEOUT
FEF3 4F
FEF4 4E
FEF5 44
FEF6 45
FEF7 42
FEF8 20
FEF9 31
FEFA 2E
FEFB 30
FEFC 30
FEFD 0D              FCB     CR,4
FEFE 04
FEFF 2A        MSGPRM FCB     '*,4       PROMPT STRING
FF00 04
FF01 0D        MSGSWI FCB     CR
FF02 53              FCC     'SWI:'
FF03 57
FF04 49
FF05 3A
FF06 04              FCB     4
FF07 54        MSGLTL FCC     'TOO LONG'  TYPED IF INPUT LINE IS
FF08 4F
FF09 4F
FF0A 20
FF0B 4C
FF0C 4F
FF0D 4E
FF0E 47
                     *                              TOO LONG
FF0F 04              FCB     4
FF10 4E        MSGNBR FCC     'NOT SET'  BREAK NOT SET
FF11 4F
FF12 54
FF13 20
FF14 53
FF15 45
FF16 54
FF17 04              FCB     4
FF18 53        MSGBAT FCC     'SET @ '  BREAK AT -
```

```
FF19 45
FF1A 54
FF1B 20
FF1C 40
FF1D 20
FF1E 04             FCB     4
FF1F 4F      MSGVER FCC     'OK'      CHECKSUM VERIFIES
FF20 4B
FF21 04             FCB     4
FF22 43      MSGNVE FCC     'CHECKSUM ERROR '  FOR VERIFY &
FF23 48
FF24 45
FF25 43
FF26 4B
FF27 53
FF28 55
FF29 4D
FF2A 20
FF2B 45
FF2C 52
FF2D 52
FF2E 4F
FF2F 52
FF30 20
                    *                       LOAD COMMANDS
FF31 04             FCB     4
FF32 43      MSGCCL FCC     'CANT CLEAR'  TEST COMMAND
FF33 41
FF34 4E
FF35 54
FF36 20
FF37 43
FF38 4C
FF39 45
FF3A 41
FF3B 52
FF3C 04             FCB     4
FF3D 43      MSGCSO FCC     'CANT SET TO ONES'  TEST COMMAND
FF3E 41
FF3F 4E
FF40 54
FF41 20
FF42 53
FF43 45
FF44 54
FF45 20
FF46 54
FF47 4F
FF48 20
FF49 4F
FF4A 4E
FF4B 45
FF4C 53
FF4D 04             FCB     4
FF4E 53      MSGSIS FCC     'SUM IS '  COMPARE COMMAND
 FF4F 55
```

```
FF50 4D
FF51 20
FF52 49
FF53 53
FF54 20
FF55 04              FCB     4
FF56 2C       MSGDIS FCC     ', DIF IS '  COMPARE COMMAND
FF57 20
FF58 44
FF59 49
FF5A 46
FF5B 20
FF5C 49
FF5D 53
FF5E 20
FF5F 04              FCB     4
FF60 0D       MSGS0  FCB     CR,LF,0
FF61 0A
FF62 00
FF63 53              FCC     'S00600004844521B'
FF64 30
FF65 30
FF66 36
FF67 30
FF68 30
FF69 30
FF6A 30
FF6B 34
FF6C 38
FF6D 34
FF6E 34
FF6F 35
FF70 32
FF71 31
FF72 42
FF73 04              FCB     4
FF74 0D       MSGS1  FCB     CR,LF,0,0,'S,'1,4
FF75 0A
FF76 00
FF77 00
FF78 53
FF79 31
FF7A 04
FF7B 0D       MSGS9  FCB     CR,LF,0
FF7C 0A
FF7D 00
FF7E 53              FCC     'S9030000FC'
FF7F 39
FF80 30
FF81 33
FF82 30
FF83 30
FF84 30
FF85 30
FF86 46
FF87 43
```

```
FF88 0D                FCB     CR,LF,4
FF89 0A
FF8A 04
FF8B 43        MSGCNH  FCC     'CHAR NOT HEX'  USED IN LOAD COMMAND
FF8C 48
FF8D 41
FF8E 52
FF8F 20
FF90 4E
FF91 4F
FF92 54
FF93 20
FF94 48
FF95 45
FF96 58
FF97 0D                FCB     CR,4
FF98 04


                *=======================================================
                *INTERRUPT HANDLING CODE
FF99 FE 7000    INTADR  LDX     INTVEC
FF9C 6E 00              JMP     X
                ******
FF9E FE 7002    NMIADR  LDX     NMIVEC
FFA1 6E 00              JMP     X
                ******
FFA3 7E F400    RESADR  JMP     START
                ******
FFA6 BF 7006    SWIADR  STS     SP          SAVE STACK POINTER OF PROGRAM
                *                            BEING DEBUGGED
FFA9 FE 7004            LDX     SWIVEC
FFAC 6E 00              JMP     X
                ******


                *       RMB      START+$C00-8-63-*       BLANK SPACE TO
                *                                 INTERRUPT VECTORS
FFB9                    ORG     $FFB9           AS CALCULATED
                *                                 BY PREVIOUS LINE


                ***************************************
FFB9 7E F9BD            JMP     TIMDEL      TIME DELAY FOR # OF MS
                *                            SPECIFIED BY IX
FFBC 7E F757            JMP     CKSUM       RETURN CHECKSUM OF AN ADDRESS
                *                            RANGE IN ACCA
FFBF 7E FCC0            JMP     GETCHR      RETURN (IN ACCB) CHAR POINTED
                *                            TO BY LINPTR
FFC2 7E FCCD            JMP     GETLST      RETURN (IN ACCA) CHAR POINTED
                *                            TO BY LISPTR
FFC5 7E FAFC            JMP     GTRANG      PICK UP AN ADDRESS RANGE IN
                *                            RANGLO & RANGHI
FFC8 7E FB47            JMP     NUMBER      PICK UP A NUMBER & RETURN IT IN
                *                            NBRHI & NBRLO
FFCB 7E FA69            JMP     SKPDLM      SKIP OVER INPUT LINE DELIMITERS
FFCE 7E FA94            JMP     TSTDLM      TEST CHAR IN ACCB FOR A
```

```
                *                                DELIMITER
FFD1 7E FA89            JMP     TSTEOL   TEST CHAR IN ACCA FOR
                *                                END-OF-LINE
FFD4 7E F9C7            JMP     COMAND   SEARCH SPECIFIED COMMAND LIST
                *                                FOR A COMMAND
FFD7 7E FA2E            JMP     TYPCMD   TYPES OUT COMMAND NUMBER
                *                                "COMNUM" IN LIST ACCA
FFDA 7E FBFD            JMP     OUT1BY   DISPLAY THE 1 BYTE NUMBER
                *                                POINTED AT BY IX
FFDD 7E FC04            JMP     OUT2BY   DISPLAY THE 2 BYTE NUMBER
                *                                POINTED AT BY IX
FFE0 7E FD8C            JMP     GETLIN   GET A LINE OF INPUT INTO THE
                *                                TTY BUFFER
FFE3 7E FE4B            JMP     OUTSTR   OUTPUT CHAR STRING IX POINTS TO
FFE6 7E FEC7            JMP     DOCRLF   SEND CR-LF WITH DELAY & ZERO
                *                                LINE COUNT
FFE9 7E FE76            JMP     OUTCHR   LIKE TOACIA, BUT WITH FOLDING,
                *                                CR DELAY, & LF INSERTION
FFEC 7E FEE5            JMP     TOACIA   SEND ACCA TO ACIA1
FFEF 7E FE59            JMP     INPCHR   GET A CHAR FROM AN ACIA &
                *                                RETURN IT IN ACCA
FFF2 7E F425            JMP     PROMPT   TO PROMPT FOR NEW COMMAND
FFF5 7E F400            JMP     START    START OF MONDEB
                ****************************************
                *INTERRUPT VECTORS
FFF8 FF99       FFF8    FDB     INTADR   REGULAR INTERRUPT
FFFA FFA6               FDB     SWIADR   SOFTWARE INTERRUPT
FFFC FF9E               FDB     NMIADR   NON-MASKABLE INTERRUPT
FFFE FFA3               FDB     RESADR   RESET INTERRUPT


                *=======================================================
                *VARIABLES FOR INTER-ROUTINE COMMUNICATION
7000                    ORG     $7000
7000 0002       INTVEC  RMB     2        INTERRUPT ADDRESS POINTER
7002 0002       NMIVEC  RMB     2        NON-MASKABLE INTERUPT ADDRESS
                *                        POINTER
7004 0002       SWIVEC  RMB     2        SOFTWARE INTERRUPT ADDRESS
                *                        POINTER


7006 0002       SP      RMB     2        SAVED STACK POINTER


7008 0002       COMADR  RMB     2        ADDRESS OF BEGINNING OF COMMAND
                *                        LISTS FOR COMAND


700A 0002       SYNPTR  RMB     2        INPUT LINE CHARACTER POINTER
                *                        FOR GOOD SYNTAX
700C 0002       LINPTR  RMB     2        INPUT LINE CHARACTER POINTER
                *                    (CONTENT = OR > CONTENT OF SYNP
                *                        TR)
700E 0001       BOLFLG  RMB     1        "BEGINNING OF LINE" FLAG


700F 0001       DELIM   RMB     1        CHARACTER(S) PERMITTED AS VALID
                *                        COMMAND/MODIFIER DELIMITER
```

```
7010 0001     IBCODE RMB     1          INPUT BASE    (1=HEX, 2=DEC,
              *                          3=OCT)
7011 0001     DBCODE RMB     1          DISPLAY BASE (1=HEX, 2=DEC,
              *                          3=OCT, 4=BIN)
7012 0001     DBNBR  RMB     1          DISPLAY BASE NUMBER (E.G.,
              *                          16,10,8, OR 2)

7013 0001     NBRHI  RMB     1          MOST SIGNIFICANT BYTE OF
              *                          SCANNED NUMBER
7014 0001     NBRLO  RMB     1          LEAST SIGNIFICANT BYTE OF
              *                          SCANNED NUMBER

7015 0002     RANGLO RMB     2          RANGE LOWER LIMIT PICKED UP BY
              *                          GTRANG
7017 0002     RANGHI RMB     2          RANGE UPPER LIMIT PICKED UP BY
              *                          GTRANG

7019 0002     LASTGO RMB     2          LAST SPECIFIED GOTO ADDRESS

701B 0002     VERFRM RMB     2          BEGINNING ADDRESS OF RANGE TO
              *                          CHECKSUM VERIFY
701D 0002     VERTO  RMB     2          ENDING ADDRESS OF RANGE TO
              *                          CHECKSUM VERIFY

701F 0001     CHKSUM RMB     1          CHECKSUM OF RANGE GIVEN IN THE
              *                          VERIFY COMMAND

7020 0002     BRKADR RMB     2          ADDRESS OF INSERTED BREAKPOINT
7022 0001     BRKINS RMB     1          INSTRUCTION WHICH SHOULD BE
              *                          THERE NORMALLY

7023 0001     INPFLG RMB     1          ALTERNATE INPUT DESTINATION FLAG
7024 0002     INPADR RMB     2          ALTERNATE ADDRESS THAT THE
              *                      INPUT CHARACTERS ARE TO COME FR
              *                          OM

7026 0001     OUTFLG RMB     1          ALTERNATE OUTPUT DESTINATION
              *                          FLAG
7027 0002     OUTADR RMB     2          ALTERNATE ADDRESS THAT THE
              *                     OUTPUT CHARACTERS ARE TO GO TO

7029 0001     HDXFLG RMB     1          HALF-DUPLEX TERMINAL FLAG (IF
              *                          NON-ZERO, NO ECHO)

702A 0001     CPLCNT RMB     1          "CHARACTERS PER LINE" COUNT
702B 0001     CPLMAX RMB     1          "CHARACTERS PER LINE" MAXIMUM
702C 0002     BUFBEG RMB     2          INPUT LINE START OF BUFFER
702E 0002     BUFEND RMB     2          INPUT LINE END OF BUFFER
7030 0048     TTYBUF RMB     72         START OF INPUT LINE BUFFER
7078 0001     TTYEND RMB     1          END OF INPUT LINE BUFFER
7079 0038            RMB     56         MAIN STACK STORAGE
```

```
70B1 0007    STACK   RMB     7          STACK STORAGE FOR RTI
             *                           INSTRUCTION


             *TEMPORARY (LOCALLY USED) VARIABLES
70B8 0002    TEMP1   RMB     2          IN: MAIN
70BA 0002    TEMP2   RMB     2          IN: MAIN
70BC 0002    TEMP3   RMB     2          IN: FNDSTR,MAIN
70BE 0002    TEMP4   RMB     2          IN: MAIN
70C0 0002    TEMP5   RMB     2          IN: MAIN
70C2 0002    TEMP6   RMB     2          IN: MAIN
70C4 0002    TEMP7   RMB     2          IN: MAIN
70C6 0002    TEMP8   RMB     2          IN: MAIN
70C8 0002    TEMP9   RMB     2          IN: MAIN
70CA 0002    TEMP10  RMB     2          IN: MAIN
70CC 0002    TEMP11  RMB     2          IN: MAIN


             *XTEMP IS NOT TO BE USED TO SAVE IX BETWEEN ROUTINES
70CE 0002    XTEMP   RMB     2          USED BY DUMP,TYPCMD,OUTNUM
70D0 0002    XTEMP1  RMB     2          USED BY OUTNUM
70D2 0002    XTEMP2  RMB     2          USED BY NUMBER
70D4 0001    NUMMAT  RMB     1          USED IN COMMAND
70D5 0001    LISNUM  RMB     1          USED ON COMMAND
70D6 0001    COMNUM  RMB     1          USED IN COMMAND
70D7 0002    LISPTR  RMB     2          USED IN COMMAND
70D9 0001    DECDIG  RMB     1          DECIMAL DIGIT BEING BUILT
             *                           (DECIMAL OUTPUT BASE)
70DA 0001    NUMBHI  RMB     1          USED BY OUTNUM
70DB 0001    NUMBLO  RMB     1          USED BY OUTNUM
70DC 0002    NBR2X   RMB     2          USED BY NUMBER
70DE 0002    TIMCON  RMB     2          DELAY TIME CONSTANT
70E0 0001    BYTECT  RMB     1          RECORD BYTE COUNT USED IN LOAD
             *                           COMMAND
70E1 0001    CKSM    RMB     1          RECORD CHECKSUM USED IN LOAD
             *                           COMMAND


             *CONVENIENT EQUIVALENCES FOR LOCAL VARIABLES
     70B8    MEMADR  EQU     TEMP1      DISPLAY,SET,SEARCH,TEST
     70BA    STRNUM  EQU     TEMP2      FNDSTR
     70BB    EOSCHR  EQU     TEMP2+1     FNDSTR


             *FOR "SEARCH" COMMAND
     70BA    BYTPTR  EQU     TEMP2
     70BC    NBYTES  EQU     TEMP3
     70BD    NBRMAT  EQU     TEMP3+1
     70BE    BYTSTR  EQU     TEMP4



                     END
```

SYMBOL TABLE

ACIA1	7F43	DISPL2	F637	INPCH3	FE6A	NUMLUP	FB60	SET3	F697		
ACIA2	7F45	DISPL3	F644	INPCHR	FE59	NUMMAT	70D4	SET4	F6A9		
BADS1	F45A	DISPL4	F64D	INPFLG	7023	NXTCHR	FD90	SET5	F6C6		
BADS2	F465	DISPL5	F64F	INT	F844	OCTNUM	FBBC	SET6	F6E4		
BADSYN	F457	DISPL6	F654	INTADR	FF99	OUT1BY	FBFD	SET7	F6EC		
BAKSLA	005C	DISPL7	F65F	INTVEC	7000	OUT2	F4E3	SET8	F6F4		
BLDADR	F978	DISPL8	F662	ISDLM2	FAA8	OUT2A4	F4F2	SET9	F701		
BOLFLG	700E	DISPL9	F66D	ISDLM3	FAB2	OUT2BY	FC04	SHFTER	FBED		
BREAK	F558	DISPLA	F608	ISDLM4	FABC	OUT4	F4EA	SHIFT	FBE4		
BREAK1	F56D	DISREG	F4C7	JMP256	F400	OUTADR	7027	SHIFT2	FBDF		
BREAK2	F57E	DLMNO	FAD3	JMPCMD	F476	OUTBAK	FDE2	SKPDL1	FA6F		
BREAK3	F58E	DLMYES	FAD0	JMPHI	00F4	OUTBIN	FC9F	SKPDL2	FA7A		
BREAK4	F5A6	DOCRL1	FED9	JMPLO	0085	OUTCH1	FE8A	SKPDL3	FA81		
BREAK5	F5B2	DOCRLF	FEC7	JMPTBL	F485	OUTCH2	FE92	SKPDLM	FA69		
BREAK6	F5B5	DUMP	F885	LASTGO	7019	OUTCH3	FE98	SP	7006		
BRKADR	7020	DUMP1	F88B	LASWAS	FE02	OUTCH4	FE9D	STACK	70B1		
BRKINS	7022	DUMP10	F910	LEFSHF	FCB8	OUTCH5	FEA3	START	F400		
BUFBEG	702C	DUMP2	F892	LF	000A	OUTCH6	FEAB	STORIT	FDD8		
BUFEND	702E	DUMP3	F89A	LINPTR	700C	OUTCH7	FEBE	STRNUM	70BA		
BYTECT	70E0	DUMP4	F8A5	LISNUM	70D5	OUTCH8	FEC0	SUMNUM	FAD6		
BYTPTR	70BA	DUMP5	F8AD	LISPTR	70D7	OUTCHR	FE76	SWI	F854		
BYTSTR	70BE	DUMP6	F8B5	LOAD	F924	OUTDE1	FC4B	SWIADR	FFA6		
C100	FC7B	DUMP7	F8C7	LOAD1	F936	OUTDE2	FC52	SWIVEC	7004		
C10K	FC77	DUMP8	F8C9	LOAD2	F955	OUTDE3	FC55	SYNPTR	700A		
CHKSUM	701F	DUMP9	F8E9	LOAD3	F961	OUTDE4	FC60	TEMP1	70B8		
CKSM	70E1	ECHO	FDE9	LOAD4	F972	OUTDE5	FC72	TEMP10	70CA		
CKSUM	F757	ECHO1	FDF1	LSH2	FCB3	OUTDEC	FC3D	TEMP11	70CC		
CKSUM1	F75C	EOSCHR	70BB	MATCH	FA07	OUTEND	FE57	TEMP2	70BA		
CLI	F529	ERROR	FAD5	MEMADR	70B8	OUTEQ	FBF7	TEMP3	70BC		
CMD3	F9E3	FFF8	FFF8	MFAIL	FA2B	OUTFLG	7026	TEMP4	70BE		
CMD4	F9EC	FNDST1	FA58	MSGBAT	FF18	OUTHEX	FC27	TEMP5	70C0		
COMADR	7008	FNDST2	FA5E	MSGCCL	FF32	OUTIT	FCAD	TEMP6	70C2		
COMAND	F9C7	FNDST3	FA68	MSGCNH	FF8B	OUTNUM	FC0B	TEMP7	70C4		
COMLST	FCD7	FNDSTR	FA51	MSGCSO	FF3D	OUTOC1	FC8D	TEMP8	70C6		
COMNUM	70D6	GETCHR	FCC0	MSGDIS	FF56	OUTOCT	FC81	TEMP9	70C8		
COMPA1	F878	GETCMD	F44E	MSGHED	FEF2	OUTP2	F91D	TEST	F7ED		
COMPAR	F85C	GETIT	FD9E	MSGLTL	FF07	OUTSD	F87B	TEST1	F7F8		
CONERR	FBD9	GETLIN	FD8C	MSGNBR	FF10	OUTSP	FBF1	TEST2	F806		
CONTIN	F604	GETLST	FCCD	MSGNVE	FF22	OUTST1	FE4C	TEST3	F813		
COPY	F52C	GOTO	F514	MSGPRM	FEFF	OUTSTR	FE4B	TEST4	F824		
COPY1	F539	GOTO1	F521	MSGS0	FF60	PROMP1	F434	TIMCON	70DE		
COPY2	F552	GTRAN1	FB03	MSGS1	FF74	PROMPT	F425	TIMDE1	F9C0		
COPY3	F555	GTRAN2	FB0B	MSGS9	FF7B	RANGHI	7017	TIMDEL	F9BD		
CPLCNT	702A	GTRAN3	FB18	MSGSIS	FF4E	RANGLO	7015	TOACI1	FEE8		
CPLMAX	702B	GTRAN4	FB20	MSGSWI	FF01	RDBYTE	F986	TOACIA	FEE5		
CR	000D	GTRAN5	FB26	MSGVER	FF1F	REG	F4C7	TSTCMA	FAAC		
DBASE	F5CE	GTRAN6	FB27	NBR2X	70DC	RESADR	FFA3	TSTCR	FDAB		
DBASE1	F5D9	GTRAN7	FB2D	NBRHI	7013	RUBNOW	FDF3	TSTCR1	FDB3		
DBASE2	F5DF	GTRAN8	FB30	NBRLO	7014	SEAR10	F7EA	TSTCR2	FDBE		
DBASE3	F5EE	GTRANG	FAFC	NBRMAT	70BD	SEARC1	F774	TSTDLM	FA94		
DBASE4	F5F2	GUDNUM	FBCD	NBYTES	70BC	SEARC2	F793	TSTEO1	FA93		
DBCODE	7011	HDXFLG	7029	NEXCOM	FA1B	SEARC3	F79F	TSTEOL	FA89		
DBNBR	7012	HEXN1	FB89	NMATCH	FA11	SEARC4	F7AB	TTYBUF	7030		
DBTBL	F5EA	HEXNUM	FB7B	NMI	F84C	SEARC5	F7B8	TTYEND	7078		
DECDIG	70D9	IBASE	F5B8	NMIADR	FF9E	SEARC6	F7BB	TYPCM1	FA40		

```
DECNUM FB95    IBASE1 F5C3    NMIVEC 7002    SEARC7 F7CF    TYPCM2 FA4C
DELAY  F9B5    IBASE2 F5C8    NOMORE F46F    SEARC8 F7DC    TYPCMD FA2E
DELETE 007F    IBCODE 7010    NOTCTC FDCA    SEARC9 F7E7    TYPSW1 F510
DELIM  700F    INHEX  F998    NOTEOL FDBF    SEARCH F766    TYPSWI F501
DIFNUM FAE9    INHEX1 F9AD    NULLS  F913    SEI    F526    VERFRM 701B
DISNU1 FC28    INHEX2 F9AE    NULLS1 F916    SET    F673    VERIF1 F740
DISNU2 FC36    INILST F9D1    NUMBER FB47    SET1   F68A    VERIF2 F74F
DISNU3 FC92    INITAL FE08    NUMBHI 70DA    SET10  F70E    VERIFY F720
DISNU4 FCA2    INPADR 7024    NUMBLO 70DB    SET11  F71A    VERTO  701D
DISP10 F670    INPCH1 FE66    NUMIN1 FB43    SET12  F71D    XTEMP  70CE
DISPL1 F620    INPCH2 FE69    NUMINX FB3C    SET2   F694    XTEMP1 70D0
```

```
type cross.ref

CROSS REFERENCE TABLE

ACIA1     00600* 80040  80200  81800  86160  86280
ACIA2     00640* 80080  80240
BADS1     03480* 03640
BADS2     03520  03760*
BADSYN    03400* 04160  09960  12200  17160  21320  27360  35240  55760
BAKSLA    75600* 78240  79000
BLDADR    37120  38080*
BOLFLG    01920  47960  70360  90240*
BREAK     05440  10160*
BREAK1    10480  10760*
BREAK2    10240  11120*
BREAK3    10200  11480*
BREAK4    11720  11960*
BREAK5    11000  11240  11360  11880  12160* 12640  13600  14360
BREAK6    11560  12200* 14160
BRKADR    10360  10800  11120  11600  12040  91080*
BRKINS    10600  10880  11280  91120*
BUFBEG    01400  02600  03400  19040  75840  78680  91600*
BUFEND    01560  75960  91640*
BYTECT    37040  37280  92920*
BYTPTR    24160  24840  24960  93280*
BYTSTR    24120  25600  93400*
C100      66120  67560*
C10K      65880  67200  67480*
CHKSUM    21920  21960  22200  91000*
CKSM      36880  37560  38800  38840  92960*
CKSUM     21880  22160  22800* 88600
CKSUM1    22920* 23040
CLI       05360  09040*
CMD3      43160* 45040
CMD4      43360* 43960
COMADR    42520  80480  90080*
COMAND    03080  11520  12440  13120  14080  15120  19280  32080  36040
          42160* 88920
COMLST    45600  71160* 80440
COMNUM    06440  07680  14280  15280  15480  16000  43000  44120  45000
          45760  92640*
COMPA1    30080  30320  30560  31320*
COMPAR    05920  30720*
CONERR    58080  58920  59000  59640  60280  60400  60760  61600* 62400
CONTIN    05560  14560*
COPY      05400  09240*
```

```
SHFTER    62160  62320*
SHIFT     59840  60920  61880  61920  62080*
SHIFT2    59160  59200  60040  60880  61880*
SKPDL1    48120* 48760
SKPDL2    48000  48240  48440*
SKPDL3    48520  48680*
SKPDLM    04040  42240  47920* 57520  88800
SP        00960  06320  06880  08080  14560  19560  21200  88240  90000*
STACK     00920  91800*
START     00880* 88160  88440  89360
STORIT    77640  77720  77840*
STRNUM    46800  47000  93120*
SUMNUM    31000  52000* 55080
SWI       05880  30480*
SWIADR    88240* 89520
SWIVEC    30520  80360  88280  89920*
SYNPTR    01960  02640  18720  19080  43160  44200  48120  48720  55360
          57360  61320  90160*
TEMP1     37800  38120  38200  38240  91920* 93080
TEMP10    92280*
TEMP11    92320*
TEMP2     91960* 93120  93160  93280
TEMP3     29280  29680  33600  33960  92000* 93320  93360
TEMP4     33680  34400  92040* 93400
TEMP5     31920  32440  32560  92080*
TEMP6     92120*
TEMP7     92160*
TEMP8     92200*
TEMP9     92240*
TEST      05760  27600*
TEST1     27920* 29160
TEST2     28120  28360*
TEST3     28480  28720* 29840
TEST4     28280  28640  29280*
TIMCON    40160  80600  92880*
TIMDE1    40240* 40280
TIMDEL    39800  40160* 40400  80720  88560
TOACI1    86160* 86200
TOACIA    84680  85080  85160  85640  86080* 89240
TSTCMA    50280* 50600
TSTCR     76520  76680*
TSTCR1    76720  76840*
TSTCR2    76960  77040*
TSTDLM    43400  44600  48480  49680* 57880  88840
TSTEO1    49040  49120  49200*
TSTEOL    02800  48200  49000* 49760  88880
TTYBUF    01360  91680*
TTYEND    01520  91720*
TYPCM1    45920* 46120
TYPCM2    46040  46200*
TYPCMD    07760  14320  45520* 88960
TYPSW1    08160  08240*
TYPSWI    07960* 80320
VERFRM    21720  22840  90880*
VERIF1    21560  22160*
VERIF2    22240  22560*
VERIFY    05680  21520*
VERTO     21800  23000  90920*
XTEMP     45520  46200  81640  82160  82720  83440  92440*
XTEMP1    64320  67320  92480*
XTEMP2    57160  57600  61360  61600  92520*

END OF LISTING
```

Appendix C:

PAPERBYTE™ Bar Code Representation of MONDEB Object Code

Beginning on page 85 is a complete machine readable representation of the object code for *Mondeb*, as assembled in the listing found on pages 19 to 72 of this book.

This representation uses the absolute loader format, in which each bar code frame (one line of bars running from top to bottom of the page) contains a two byte address followed by data which is loaded in ascending order starting at that address.

The object code listing shown below gives the information in hexadecimal form, for use as a confirmation copy or for manual entry of this program.

For details on the frame format and absolute loader format used in this and all PAPERBYTE™ books, see the PAPERBYTE publication *Bar Code Loader* by Ken Budnick. This book contains a brief history on bar codes, a general bar code loader algorithm with flow charts and complete program listings for 6800, 6502 and 8080 or Z-80 based systems.

```
F400 8E 70 B1 BF 70 06 BD FE 08 BD FE C7 CE FE F2 BD
F410 FE 4B CE 70 2F FF 70 2C CE 70 78 FF 70 2E 86 03
F420 B7 70 0F 20 0F BD FE C7 7C 70 0E FE 70 0A A6 00
F430 81 3B 27 1A CE FE FF BD FE 4B BD FD 8C C1 03 27
F440 E4 FE 70 2C FF 70 0A A6 01 BD FA 89 27 D7 86 01
F450 BD F9 C7 27 D0 2E 1F FE 70 2C BC 70 0C 27 06 BD
F460 FB F1 08 20 F5 86 5E BD FE 76 BD FE C7 20 C5 BD
F470 FA 69 25 B1 20 E1 16 48 1B C6 F4 8B 85 C9 00 36
F480 37 30 EE 00 33 32 6E 00 7E F4 C7 7E F5 14 7E F5
F490 26 7E F5 29 7E F5 2C 7E F5 58 7E F5 B8 7E F5 CE
F4A0 7E F6 04 7E F6 08 7E F6 73 7E F7 20 7E F7 66 7E
F4B0 F7 ED 7E F8 44 7E F8 4C 7E F8 54 7E F8 5C 7E F8
F4C0 85 7E F9 24 7E F9 B5 FE 70 06 08 7F 70 D6 8D 13
F4D0 8D 11 8D 0F 8D 14 8D 12 8D 18 CE 70 06 BD FC 04
F4E0 7E F4 6F 8D 0D BD FB FD 08 39 8D 06 BD FC 04 08
F4F0 08 39 BD FB F1 7C 70 D6 86 05 BD FA 2E BD FB F7
F500 39 CE FF 01 BD FE 4B FE 70 06 6D 07 26 02 6A 06
F510 6A 07 20 B3 BD FB 47 27 08 FE 70 13 FF 70 19 6E
F520 00 FE 70 19 6E 00 0F 20 2C 0E 20 29 BD FA FC 2F
F530 21 BD FB 47 2F 1C FE 70 15 A6 00 FE 70 13 A7 00
F540 08 FF 70 13 FE 70 15 BC 70 17 27 09 08 FF 70 15
F550 20 E7 7E F4 57 7E F4 6F BD FB 47 2B 31 27 1F FE
F560 70 20 A6 00 81 3F 26 05 B6 70 22 A7 00 FE 70 13
F570 FF 70 20 A6 00 B7 70 22 86 3F A7 00 20 34 FE 70
F580 20 A6 00 81 3F 26 2B B6 70 22 A7 00 20 24 86 04
F590 BD F9 C7 2F 20 FE 70 20 A6 00 81 3F 27 08 CE FF
F5A0 10 BD FE 4B 20 0C CE FF 18 BD FE 4B CE 70 20 BD
F5B0 FC 04 7E F4 6F 7E F4 57 86 03 BD F9 C7 2B 09 2E
F5C0 02 86 01 B7 70 10 20 EA B6 70 10 36 20 24 86 03
F5D0 BD F9 C7 2B 19 2E 02 86 01 B7 70 11 CE F5 E9 08
F5E0 4A 26 FC A6 00 B7 70 12 20 C8 10 0A 08 02 B6 70
F5F0 11 36 86 04 BD F9 C7 33 2F BB 86 03 F7 70 D6 BD
F600 FA 2E 20 AE BE 70 06 3B BD FA FC 2F 60 FE 70 15
F610 FF 70 B8 86 06 BD F9 C7 2B 53 4A B7 70 D6 5F 5C
F620 CE 70 B8 7D 70 D6 2B 2C 5A 26 0C BD FE C7 BD FC
F630 04 BD FB F1 F6 70 12 FE 70 B8 7D 70 D6 2E 05 BD
F640 FB F1 20 1B A6 00 4D 26 04 86 2E 20 02 86 2B BD
F650 FE 76 20 0E BD FB F1 BD FC 04 BD FB F7 EE 00 BD
F660 FB FD BC 70 17 27 09 08 FF 70 B8 20 B3 7E F4 57
```

```
F670 7E F4 6F BD FA FC 2B 4E 27 F3 FE 70 15 BC 70 17
F680 27 12 BD FB 47 2F E6 B6 70 14 A7 00 BC 70 17 27
F690 DF 08 20 F6 FF 70 B8 BD FB 47 27 0D 2D CF B6 70
F6A0 14 FE 70 B8 A7 00 08 20 EB FE 70 0A A6 00 81 0A
F6B0 26 6B CE 70 B8 BD FC 04 BD FB F1 BD FD 8C FE 70
F6C0 2C FF 70 0A 20 D1 86 05 BD F9 C7 2B 4D 27 4E 36
F6D0 BD FB 47 32 2F 44 FE 70 06 F6 70 14 81 01 26 04
F6E0 E7 01 20 E2 81 02 26 04 E7 02 20 DA 81 03 26 04
F6F0 E7 03 20 D2 81 04 26 09 B6 70 13 A7 04 E7 05 20
F700 C5 81 05 26 09 B6 70 13 A7 06 E7 07 20 B8 81 06
F710 26 08 FE 70 13 FF 70 06 20 AC 7E F4 57 7E F4 6F
F720 BD FA FC 27 1B 2B F3 FE 70 15 FF 70 1B FE 70 17
F730 FF 70 1D 8D 22 B7 70 1F CE 70 1F BD FB FD 20 DD
F740 8D 15 B1 70 1F 26 08 CE FF 1F BD FE 4B 20 CE CE
F750 FF 22 BD FE 4B 20 C6 4F FE 70 1B 09 08 AB 00 BC
F760 70 1D 26 F8 43 39 BD FA FC 2F 7C CE 70 BE FF 70
F770 BA 7F 70 BC BD FB 47 27 1A 2D 6C 7C 70 BC B6 70
F780 BC 81 06 2E 62 B6 70 14 FE 70 BA A7 00 08 FF 70
F790 BA 20 E1 7D 70 BC 27 4F FE 70 15 09 FF 70 0C CE
F7A0 70 BD FF 70 D7 7F 70 BD BD FC CD BD FC C0 11 27
F7B0 07 BC 70 17 27 34 20 F3 FF 70 B8 7C 70 BD B6 70
F7C0 BD B1 70 BC 27 16 BD FC CD BD FC C0 11 27 EC FE
F7D0 70 B8 BC 70 17 27 13 FF 70 0C 20 C3 CE 70 B8 BD
F7E0 FC 04 BD FB F1 20 E8 7E F4 57 7E F4 6F BD FA FC
F7F0 2F F5 FE 70 15 FF 70 B8 A6 00 36 6F 00 6D 00 27
F800 05 CE FF 32 20 1E 6A 00 86 FF A1 00 27 05 CE FF
F810 3D 20 11 FE 70 B8 32 A7 00 BC 70 17 27 CC 08 FF
F820 70 B8 20 D4 FF 70 BC CE 70 B8 BD FC 04 BD FB F7
F830 FE 70 B8 BD FB FD BD FB F1 FE 70 BC BD FE 4B BD
F840 FE C7 20 CF BD FB 3C FF 70 00 20 2C BD FB 3C FF
F850 70 02 20 24 BD FB 3C FF 70 04 20 1C BD FB 3C FF
F860 70 15 BD FB 3C FF 70 13 BD FA D6 CE FF 4E 8D 0B
F870 BD FA E9 CE FF 56 8D 03 7E F4 6F BD FE 4B CE 70
F880 17 BD FC 04 39 BD FA FC 7F 70 C0 86 02 BD F9 C7
F890 27 13 2F 7C 81 01 27 02 20 F1 BD FB 3C FF 70 27
F8A0 7C 70 C0 20 E6 7D 70 C0 27 03 7C 70 26 8D 64 CE
F8B0 FF 60 BD FE 4B B6 70 18 B0 70 16 F6 70 17 F2 70
F8C0 15 26 04 81 10 25 02 86 0F 8B 04 B7 70 BC 80 03
F8D0 B7 70 BE CE FF 74 BD FE 4B 5F CE 70 BC 8D 3E CE
F8E0 70 15 8D 39 8D 37 FE 70 15 8D 32 7A 70 BE 26 F9
F8F0 FF 70 15 53 37 30 8D 25 33 FE 70 15 09 BC 70 17
F900 26 B3 CE FF 7B BD FE 4B 8D 09 7F 70 26 7E F4 6F
F910 7E F4 57 C6 1E 4F BD FE 76 5A 26 FA 39 EB 00 BD
F920 FB FD 08 39 86 07 BD F9 C7 2B E5 27 09 BD FB 3C
F930 FF 70 24 7C 70 23 BD FE 59 81 53 26 F9 BD FE 59
F940 81 39 27 2E 81 31 26 EE 7F 70 E1 BD F9 86 80 02
F950 B7 70 E0 8D 23 8D 2F 7A 70 E0 27 05 A7 00 08 20
F960 F4 7C 70 E1 27 D0 CE FF 22 BD FE 4B CE 70 B8 BD
F970 FC 04 7F 70 23 7E F4 6F 8D 0C B7 70 B8 8D 07 B7
F980 70 B9 FE 70 B8 39 8D 10 48 48 48 48 16 8D 09 1B
F990 16 FB 70 E1 F7 70 E1 39 BD FE 59 80 30 2B 0F 81
F9A0 09 2F 0A 81 11 2B 07 81 16 2E 03 80 07 39 CE FF
F9B0 8B BD FE 4B 39 BD FB 3C 8D 03 7E F4 6F B6 70 DE
F9C0 4A 26 FD 09 26 F7 39 B7 70 D5 BD FA 69 24 02 4F
F9D0 39 FE 70 08 B6 70 D5 C6 0A 8D 76 FF 70 D7 86 01
F9E0 B7 70 D6 FE 70 0A FF 70 0C 7F 70 D4 BD FC C0 BD
F9F0 FA 94 26 13 BD FC CD 81 0A 27 16 81 0D 27 12 11
```

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FA00 26 19 7C 70 D4 20 E5 B6 70 D6 FE 70 0C FF 70 0A
FA10 39 7D 70 D4 27 05 BD FA 94 26 EC BD FC CD 81 0A
FA20 27 09 81 0D 26 F5 7C 70 D6 20 B8 4F 4A 39 FF 70
FA30 CE 37 CE FC D6 C6 0A 8D 18 B6 70 D6 C6 0D 8D 11
FA40 08 A6 00 81 0D 27 05 BD FE 76 20 F4 FE 70 CE 33
FA50 39 B7 70 BA F7 70 BB 5F 5C F1 70 BA 27 0A 08 A6
FA60 00 B1 70 BB 27 F2 20 F6 39 0C 7D 70 0E 2E 0B FE
FA70 70 0A A6 00 8D 13 26 02 0D 39 E6 01 8D 16 26 01
FA80 39 BD FC C0 FF 70 0A 20 E6 81 0D 27 06 81 0A 27
FA90 02 81 3B 39 37 17 8D F1 33 27 35 B6 70 0F 81 01
FAA0 26 06 C1 20 26 2D 20 28 81 02 26 06 C1 2C 26 23
FAB0 20 1E 81 03 26 06 C1 20 27 16 20 F0 81 04 26 15
FAC0 C1 30 2D 0C C1 39 2F 0B C1 41 2D 04 C1 5A 2F 03
FAD0 86 01 39 4F 39 3F B6 70 16 BB 70 14 B7 70 18 B6
FAE0 70 15 B9 70 13 B7 70 17 39 B6 70 16 B0 70 14 B7
FAF0 70 18 B6 70 15 B2 70 13 B7 70 17 39 8D 49 2E 03
FB00 2D 09 39 FE 70 13 FF 70 15 20 0D FE 70 0C A6 00
FB10 81 3A 26 0C 8D 1A 2F 0E FE 70 13 FF 70 17 20 0D
FB20 81 21 27 03 4F 4A 39 8D 07 2F FB 8D A9 86 01 39
FB30 FF 70 0A FE 70 13 FF 70 15 8D 0C 39 8D 09 2E 03
FB40 7E F4 57 FE 70 13 39 FF 70 D2 7F 70 13 7F 70 14
FB50 FE 70 0A FF 70 0C BD FA 69 24 05 FE 70 D2 4F 39
FB60 BD FC C0 BD FA 94 26 65 C0 30 2B 6D B6 70 10 81
FB70 01 27 08 81 02 27 1E 81 03 27 41 C1 09 2F 0A C1
FB80 11 2B 56 C1 16 2E 52 C0 07 8D 54 8D 52 FA 70 14
FB90 F7 70 14 20 CB C1 09 2E 40 8D 49 FE 70 13 FF 70
FBA0 DC 8D 3C 4F FB 70 DD B9 70 DC 25 2D FB 70 14 B9
FBB0 70 13 25 25 F7 70 14 B7 70 13 20 A4 C1 07 2E 19
FBC0 8D 1D 8D 20 FA 70 14 F7 70 14 7E FB 60 FE 70 0C
FBD0 FF 70 0A FE 70 D2 86 01 39 FE 70 D2 4F 4A 39 8D
FBE0 03 8D 01 39 78 70 14 79 70 13 25 01 39 31 31 20
FBF0 E8 86 20 BD FE 76 39 86 3D BD FE 76 39 37 C6 01
FC00 8D 09 33 39 37 C6 02 8D 02 33 39 FF 70 D0 36 EE
FC10 00 FF 70 DA B6 70 11 81 01 27 0C 81 02 27 1E 81
FC20 03 27 5E 81 04 27 78 58 BD FC B3 BD FC B3 84 0F
FC30 81 09 2F 02 8B 07 8D 75 5A 26 ED 20 35 5A 27 0B
FC40 CE FC 77 B6 70 DA F6 70 DB 20 07 CE FC 7B 4F F6
FC50 70 DA 7F 70 D9 E0 01 A2 00 25 05 7C 70 D9 20 F5
FC60 EB 01 A9 00 36 B6 70 D9 8D 43 32 08 08 8C FC 81
FC70 26 E0 32 FE 70 D0 39 27 10 03 E8 00 64 00 0A 00
FC80 01 58 4F C1 02 2E 06 8D 2A 8D 22 20 05 8D 29 8D
FC90 1C 5C 8D 1F 8D 22 84 07 8D 13 5A 26 F5 20 D3 58
FCA0 58 58 8D 14 84 01 8D 05 5A 26 F7 20 C5 8B 30 BD
FCB0 FE 76 39 8D 03 8D 01 39 78 70 DB 79 70 DA 49 39
FCC0 FE 70 0C 08 E6 00 FF 70 0C 7F 70 0E 39 FE 70 D7
FCD0 08 A6 00 FF 70 D7 39 52 45 47 0D 47 4F 54 4F 0D
FCE0 53 45 49 0D 43 4C 49 0D 43 4F 50 59 0D 42 52 45
FCF0 41 4B 0D 49 42 41 53 45 0D 44 42 41 53 45 0D 43
FD00 4F 4E 54 49 4E 55 45 0D 44 49 53 50 4C 41 59 0D
FD10 53 45 54 0D 56 45 52 49 46 59 0D 53 45 41 52 43
FD20 48 0D 54 45 53 54 0D 49 4E 54 0D 4E 4D 49 0D 53
FD30 57 49 0D 43 4F 4D 50 41 52 45 0D 44 55 4D 50 0D
FD40 4C 4F 41 44 0D 44 45 4C 41 59 0D 0A 54 4F 0D 0A
FD50 48 45 58 0D 44 45 43 0D 4F 43 54 0D 42 49 4E 0D
FD60 0A 3F 0D 0A 2E 43 43 0D 2E 42 0D 2E 41 0D 2E 49
FD70 58 0D 2E 50 43 0D 2E 53 50 0D 0A 44 41 54 41 0D
```

```
FD80 55 53 45 44 0D 0A 46 52 4F 4D 0D 0A FE 70 2C 5F
FD90 BC 70 2E 26 09 CE FF 07 BD FE 4B C6 03 39 BD FE
FDA0 59 84 7F 81 1A 26 04 BD FE C7 39 81 0D 27 04 81
FDB0 0A 26 0C 08 A7 00 7D 70 29 26 03 BD FE C7 39 81
FDC0 03 26 07 16 86 5E BD FE 76 39 81 7F 27 25 81 60
FDD0 23 06 81 7A 22 02 80 20 08 A7 00 C1 7F 27 03 16
FDE0 20 07 16 86 5C BD FE 76 17 7D 70 29 26 03 BD FE
FDF0 76 20 9D BC 70 2C 27 98 C1 7F 27 06 16 86 5C BD
FE00 FE 76 A6 00 09 20 E2 0F 86 01 B7 70 10 B7 70 11
FE10 86 10 B7 70 12 86 48 B7 70 2B 7F 70 23 7F 70 26
FE20 7F 70 29 86 03 B7 7F 42 B7 7F 44 86 02 B7 7F 42
FE30 B7 7F 44 CE F5 01 FF 70 04 CE FC D6 FF 70 08 86
FE40 53 B7 70 DE CE 01 F4 BD F9 BD 39 36 A6 00 81 04
FE50 27 05 8D 22 08 20 F5 32 39 FF 70 CE 7D 70 23 26
FE60 05 CE 7F 43 20 03 FE 70 24 09 A6 00 85 01 27 FA
FE70 A6 01 FE 70 CE 39 37 7D 70 26 27 21 FF 70 CE FE
FE80 70 27 C6 02 F1 70 26 27 09 09 E5 00 27 FC A7 01
FE90 20 06 A7 00 08 FF 70 27 FE 70 CE 33 39 81 0A 26
FEA0 02 33 39 81 0D 26 04 8D 1E 33 39 F6 70 2A F1 70
FEB0 2B 2C 0B CB 0A F1 70 2B 2D 06 81 20 26 02 8D 07
FEC0 7C 70 2A 8D 20 33 39 36 37 86 0D 8D 18 86 0A 8D
FED0 14 F6 70 2A 54 54 54 54 5C 4F 8D 09 5A 26 FA 7F
FEE0 70 2A 33 32 39 36 86 02 B5 7F 42 27 FB 32 B7 7F
FEF0 43 39 4D 4F 4E 44 45 42 20 31 2E 30 30 0D 04 2A
FF00 04 0D 53 57 49 3A 04 54 4F 4F 20 4C 4F 4E 47 04
FF10 4E 4F 54 20 53 45 54 04 53 45 54 20 40 20 04 4F
FF20 4B 04 43 48 45 43 4B 53 55 4D 20 45 52 52 4F 52
FF30 20 04 43 41 4E 54 20 43 4C 45 41 52 04 43 41 4E
FF40 54 20 53 45 54 20 54 4F 20 4F 4E 45 53 04 53 55
FF50 4D 20 49 53 20 04 2C 20 44 49 46 20 49 53 20 04
FF60 0D 0A 00 53 30 30 36 30 30 30 30 34 38 34 34 35
FF70 32 31 42 04 0D 0A 00 00 53 31 04 0D 0A 00 53 39
FF80 30 33 30 30 30 30 46 43 0D 0A 04 43 48 41 52 20
FF90 4E 4F 54 20 48 45 58 0D 04 FE 70 00 6E 00 FE 70
FFA0 02 6E 00 7E F4 00 BF 70 06 FE 70 04 6E 00
FFB9 7E F9 BD 7E F7 57 7E
FFC0 FC C0 7E FC CD 7E FA FC 7E FB 47 7E FA 69 7E FA
FFD0 94 7E FA 89 7E F9 C7 7E FA 2E 7E FB FD 7E FC 04
FFE0 7E FD 8C 7E FE 4B 7E FE C7 7E FE 76 7E FE E5 7E
FFF0 FE 59 7E F4 25 7E F4 00 FF 99 FF A6 FF 9E FF A3
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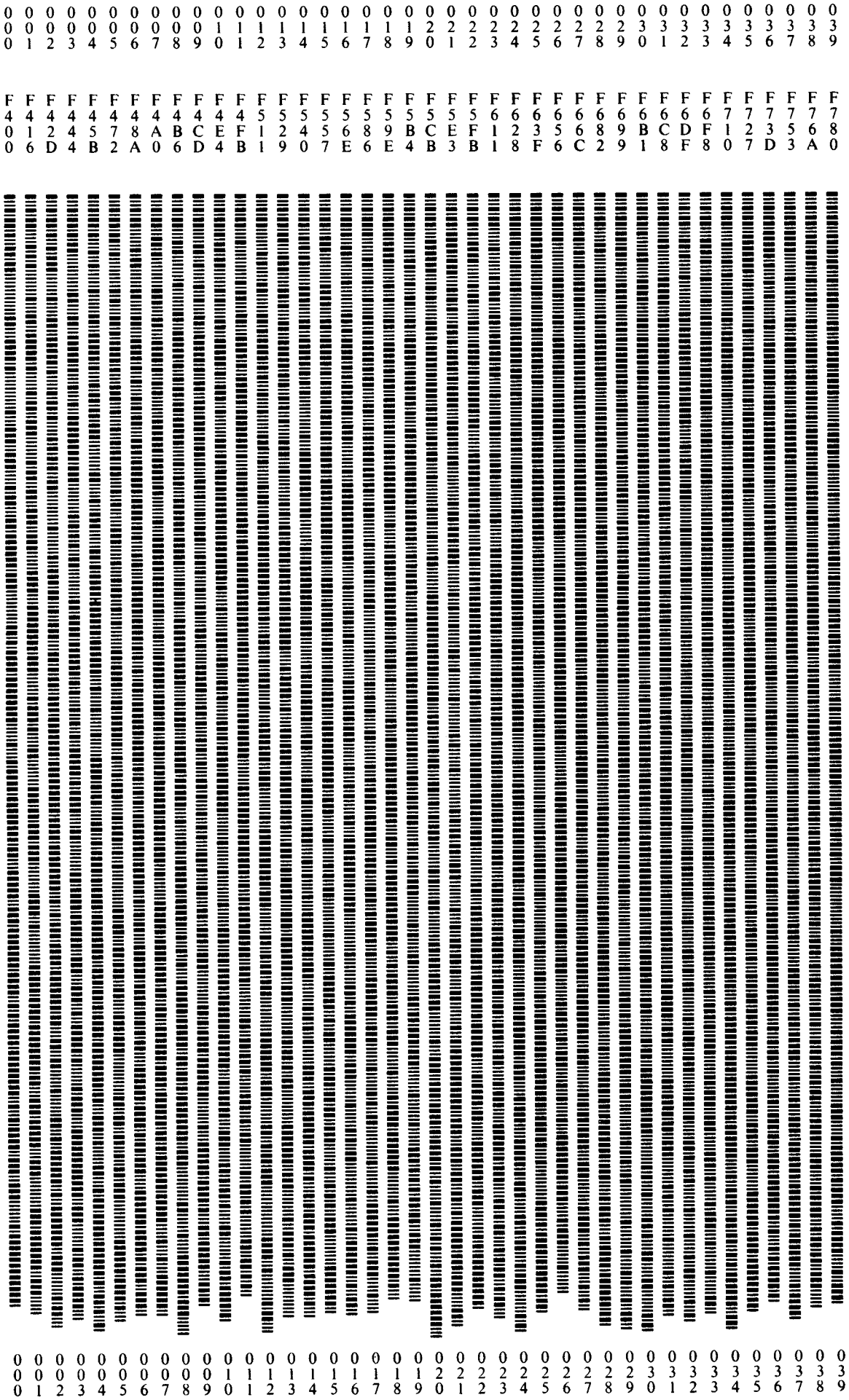
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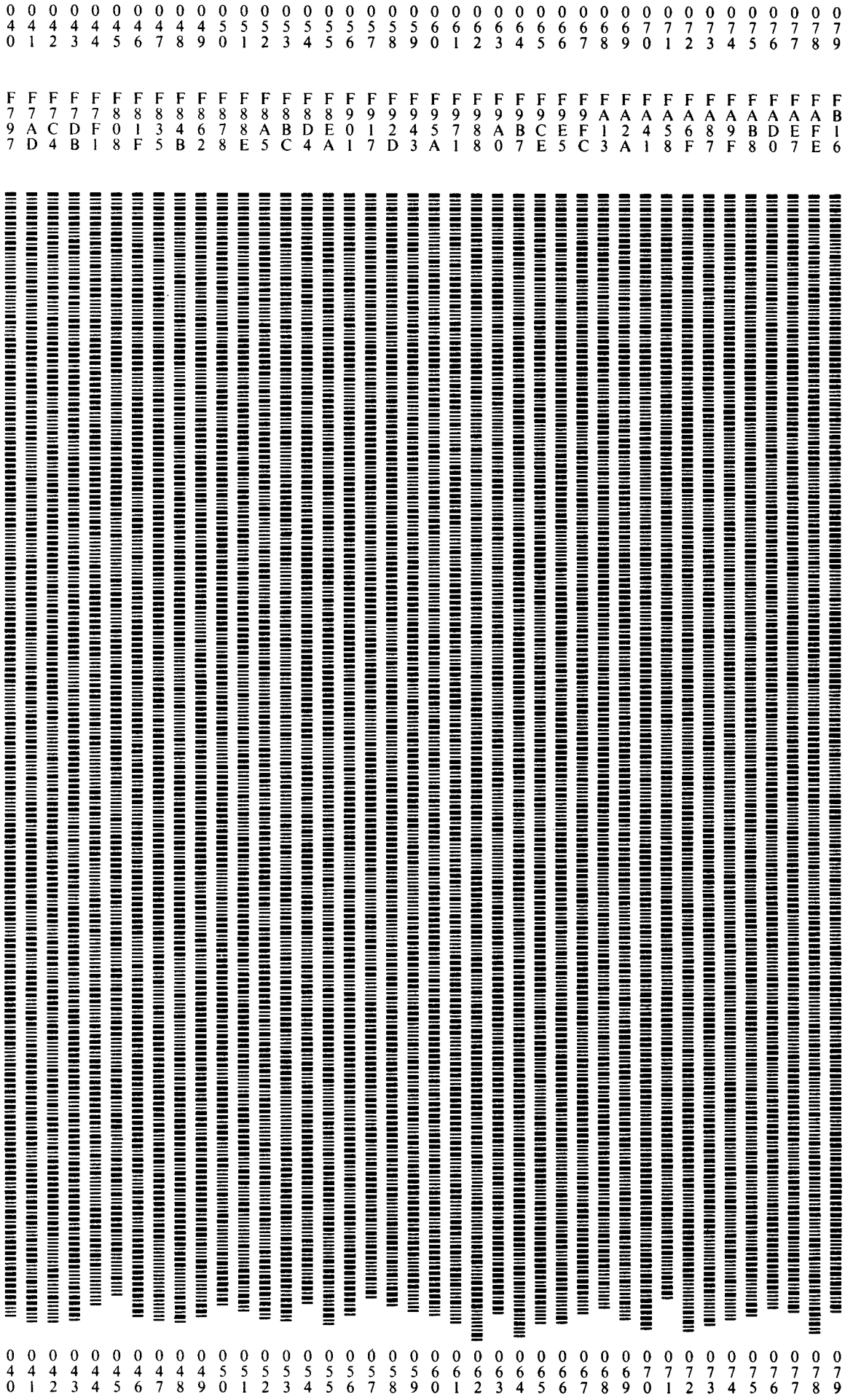
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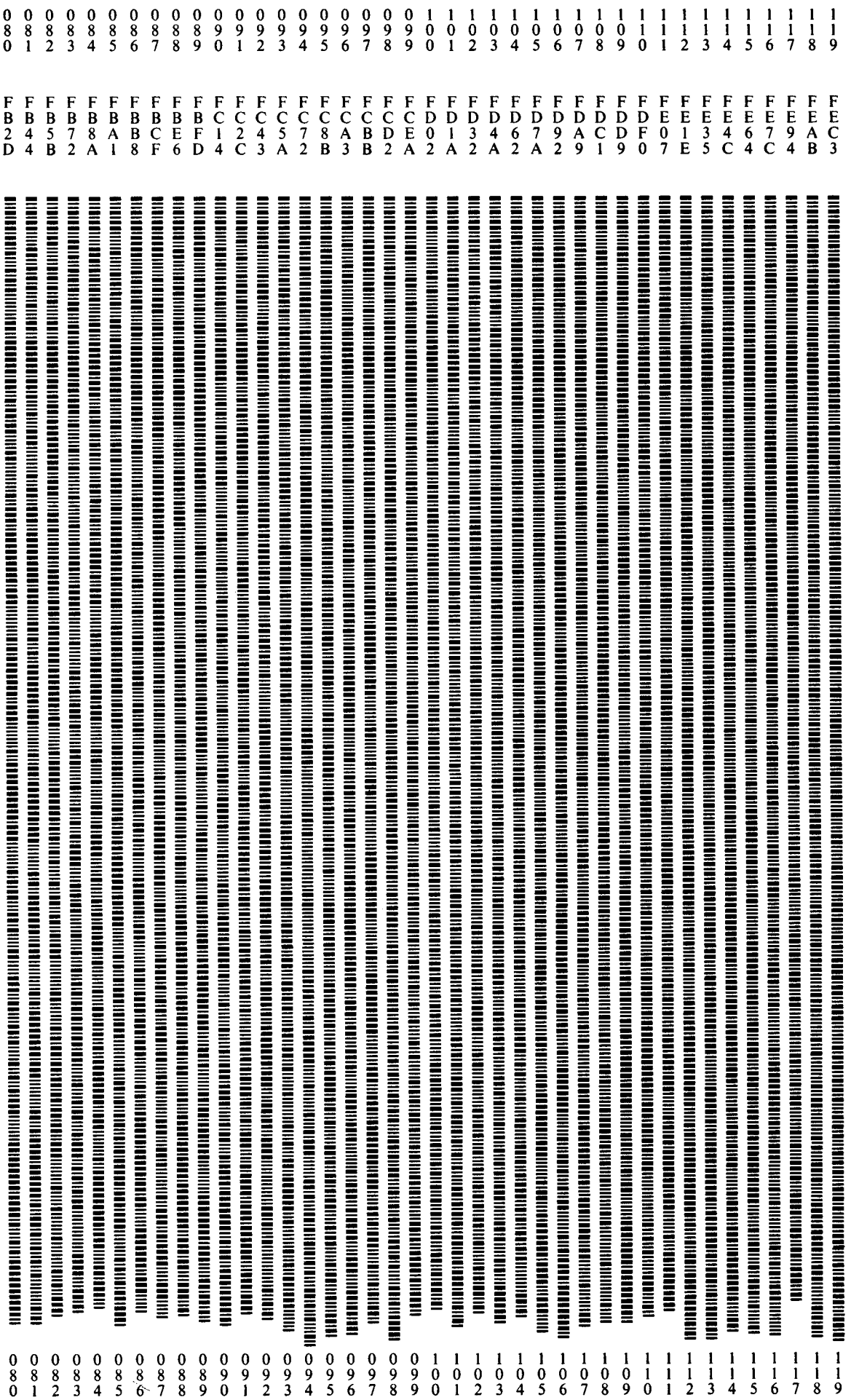
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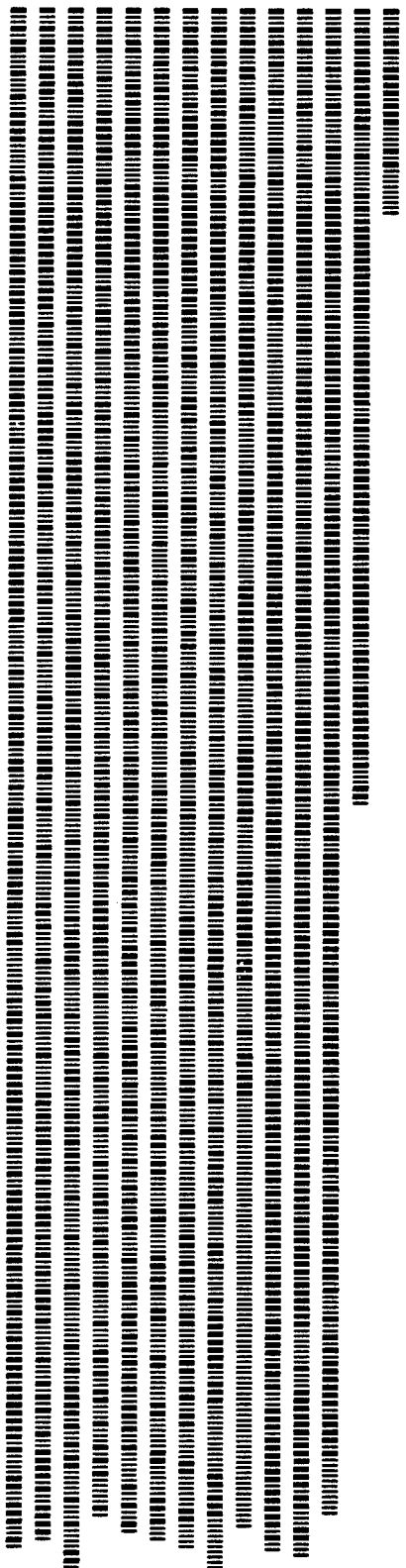

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A Note About Bar Codes . . .

Bar codes are the newest form of machine readable data representation. They are used in all PAPERBYTE™ software products in BYTE magazine articles and self contained book publications and combine efficiency of space, low cost, and ease of data entry with the need for mass produced machine readable representations of software. Bar codes were originally used for product identification in inventory control and supermarket checkout applications. Today, because of their direct binary representation of data, they are an ideal computer compatible communications medium. In the application of bar codes to software distribution (such as PAPERBYTE books and articles), the use of a simple but reliable optical scanning wand and an appropriate program provides a convenient means for the user to acquire software.

Our intent in making PAPERBYTE software available in bar code form is to provide a method of conveying machine readable information from documentation to the memories and mass storage of a user's system on a one time basis. We suggest that the user of software obtained in this manner should locally record the data on the mass storage devices of his system after the data has been scanned from the printed page. The PAPERBYTE bar code representations provide a standardized means of obtaining the data, but they cannot be compared to the convenience of local mass storage devices such as floppy disks, digital cassettes or audio cassettes. Thus if repeated use of the software obtained from bar code is anticipated, we recommend that the user make a copy on some form of magnetic medium.

Bar Code Loader by Ken Budnik, the first in the PAPERBYTE series of software books, provides a brief history of bar codes, a look at the PAPERBYTE bar code format including flowcharts, a general bar code loader algorithm and well documented programs with complete implementation and checkout procedures for 6800, 6502 and 8080/Z-80 based systems.

MONDEB,

AN ADVANCED M6800 MONITOR-DEBUGGER incorporates all the general features of Motorola's MIKBUG monitor as well as numerous other capabilities. While extremely versatile, ease of use was a prime design consideration. The other primary goal was minimum memory requirements while retaining maximum versatility. The size of the entire MONDEB program is less than 3 K.

Some of the command capabilities of MONDEB include displaying and setting the contents of registers, setting interrupts for debugging, testing a programmable memory range for bad memory locations, changing the display and input base of numbers, displaying the contents of memory, searching for a specified string, copying a range of bytes from one location in memory to another, and defining the location to which control will transfer upon receipt of an interrupt.