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ALTAIR 680B CROSS-ASSEMBLER

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by

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ABSTRACT

The Altair 680b Cross-Assembler is a program written in the Nova Assembly Language. It can be used to assemble Altair 680b assembly language programs. The object code can be punched on paper-tape for execution on the Altair 680b microcomputer.

This report describes the design and working of the Cross-Assembler. A program listing and a few sample runs are also included.

ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

1.1 Machine Language

"Machine Language" is the basic instruction set of the computer. Each instruction is represented by a pattern of 0's and 1's, which direct the computer, through logic circuits, to perform some action.

Writing a program using instructions of this form can be an extremely tedious process. The programmer has to specify the correct machine code for the instruction, assign locations (or addresses) to every instruction and data-element in the computer memory, and then use these addresses in the instructions. Apart from the difficulty of keeping track of a lot of numbers, it is almost impossible to either understand or make changes to the program, without expending considerable effort.

1.2 Assembly Language

Attempts were made to design better ways of writing computer programs. This led to the development of symbolic languages or assembly languages.

Assembly languages relieve the programmer of tedious book-keeping, and at the same time, allow him to make use of the computer efficiently. In [1] using an assembly language, the programmer refers to the locations of instructions, data and constants, as well as the instructions, by symbolic names. Symbols may be assigned in an arbitrary manner; when

reference is to be made to locations having these names, the symbols are used. Mnemonic symbolism is convenient; i.e. the symbols are suggestive of the function of the instruction, such as LDA (for Load Accumulator A).

An assembly language program is made up of instructions.[2] An instruction can be regarded as being made up of a number of fields; the simplest form would be two fields, opcode and address. To this a label can be added, and possibly a descriptive comment. In a fixed format scheme, the various fields are recognized by their position on the line, while in a free format scheme, they are separated by delimiters. There are many variants of the scheme. A common one is a semi-fixed format in which the label occupies a fixed field, while the rest of the fields are in free format.

The[1] task of converting symbolic operation-codes and addresses is completely straight-forward. For operations, usually the only required process is that of looking up a table for each symbol and replacing it with the numerical operation-code. For the addresses, the process is somewhat more complicated since the choice of symbols is up to the programmer, but it is still essentially a replacement problem. The computer itself could be programmed to do the translation. A program that does this job is called an ASSEMBLER.

1.3 Overview of the Cross-Assembler

This report describes an assembler for the ALTAIR 680b micro-computer, which is based on the Motorola M6800 micro-processor chip. It

is called a "CROSS-ASSEMBLER" since it is implemented on a different computer; i.e. the Data-General Nova.

The motivation behind the project was to develop an assembler to enable effective use of the ALTAIR micro-computer. Since the micro-computer was equipped with only 1k x 8 RAM, it was decided that a Cross-Assembler should be developed on the Nova minicomputer. Again, since the Nova minicomputer available was not equipped with any high level language , the Cross-Assembler was written in the Nova Assembly Language.

The Cross-Assembler is a two pass assembler. In the first pass, the source program is read, one line at a time, and a value of the "location-counter" is associated with each instruction. The length of an instruction is determined from the opcode and the operands, and this is used to update the location counter. If a label is present, it is entered into a symbol table, along with the location-counter value. Some pseudo-instructions (such as ORG, RMB) are processed completely in the first pass, while the rest are partially processed so as to allocate storage space.

The actual machine code and source-listing are produced in the second pass. Again each source line is read, and using the information gathered in pass-1, the object code is assembled. This is written out onto the object-code buffer, which is periodically flushed. The source line along with other useful information (location, value, etc.) is printed out. At the end of the second pass, the symbol-table is sorted

and printed out.

In the later chapters, the Cross-Assembler will be described in more detail. The following section contains a brief introduction to the Altair 680b organization.

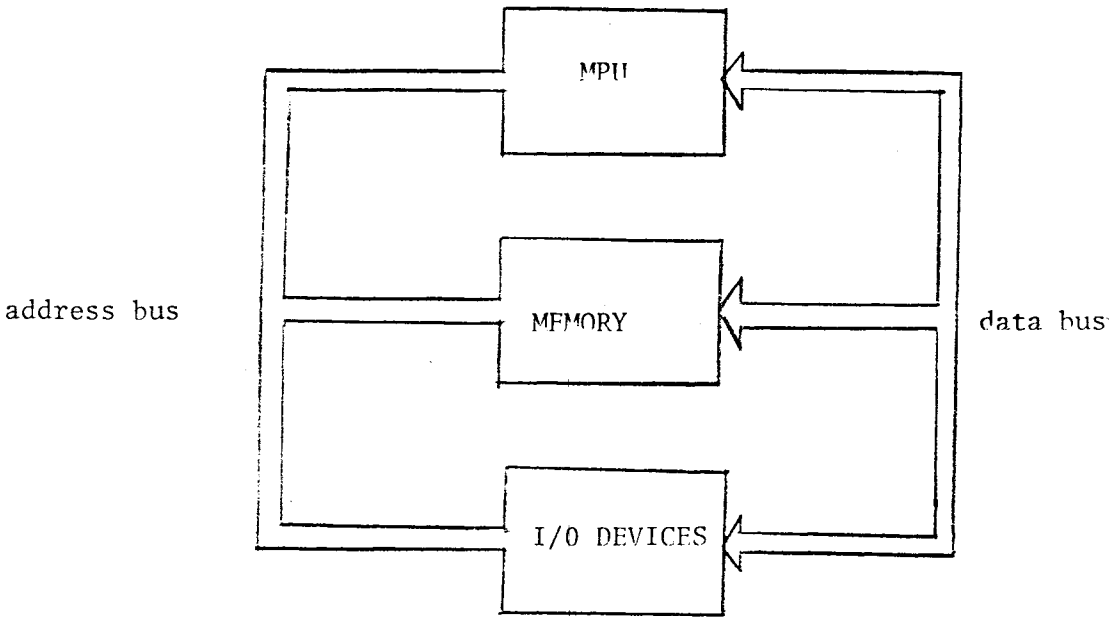
1.4 Altair 680b Micro-Computer [4, 3]

The computer consists of a micro-processing unit (MPU), a memory and a number of input and output devices. These components are linked together by an address bus and data bus. (see Fig. 1-1)

The computer memory is used to store instructions and data for use by the MPU. In the 680b, the memory is organized into 8-bit words, called bytes. Each memory byte is assigned an unique 16-bit address. This address is used by the MPU to gain access to the contents of a particular memory byte.

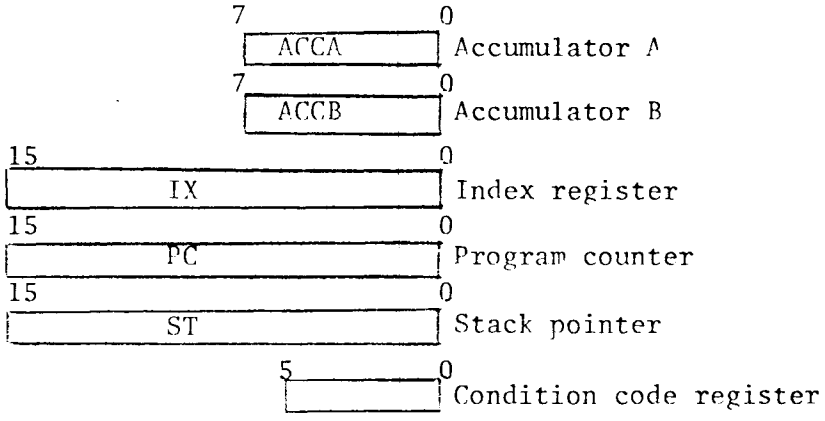
The MPU is a Motorola M6800, which operates on 8-bit binary numbers presented to it via the data bus. A given number (byte) may represent data or an instruction to be executed, depending on where it is encountered in the control program. The M6800 has 72 unique instructions. However, it recognizes and takes action on 197 of the 256 possibilities that can occur using an 8-bit word length. The larger number of instructions results from the fact that many of the executive instructions have more than one addressing mode.

The addressing modes refer to the manner in which the program causes the MPU to obtain instructions and data. The programmer must have a method for addressing the MPU's internal registers and all of the external memory locations. A programming model of the M6800 is



MICROCOMPUTER SYSTEM BLOCK DIAGRAM

Fig. 1-1



PROGRAMMING MODEL OF M6800

Fig. 1-2

shown in Fig. 1-2. The programmable registers consist of: 2 8-bit accumulators; a 6-bit condition code register; a program counter, a stack pointer and an index register, each 16-bits long.

The MPU operates in one of the following addressing modes:

Inherent

Immediate

Direct

Extended

Relative

Indexed

A number of instructions, either alone, or together with an accumulator operand, contain all of the address information required. Such instructions are said to be operating in the "inherent" mode of addressing.

In the Immediate addressing mode, the operand is the value that is to be operated on. No further address reference is required.

In the Direct and Extended modes of addressing, the operand field of the source statement is the address of the value that is to be operated on. The direct and extended modes differ only in the range of memory locations to which they can direct the MPU. Direct addressing generates a single 8-bit operand and can hence address only memory locations 0 through 255; a two byte operand is generated for extended addressing enabling the MPU to reach the remaining memory locations, 256 through 65535.

The Relative addressing mode, implemented for the MPU's branch instruction, specifies a memory location relative to the Program Counter's

current location. One byte is generated for the relative address. Since it is desirable to be able to branch in either direction, the 8-bit address byte is stored as a number in 8-bit, two's complement, binary form, with decimal value in the range from -128 to +127. This results in an effective range of -126 to +129 with respect to the branch instruction itself.

With Indexed addressing, the numerical address is variable and depends on the current contents of the Index-register. A byte is generated for the numerical value, which will be automatically added to the Index-register during execution.

The source statement format contains sufficient information for the selection of the addressing mode. For instructions which use both direct and extended modes, the Assembler selects the direct mode if the operand address is in the range 0 to 255 and the extended mode otherwise. There are a number of instructions for which the extended mode is valid but the direct is not. For these instructions the extended mode is selected, even if the operand address is in the range 0-255.

The assembler directives allow the programmer control of the assembly of the executive instructions into machine code. They provide for the allocation of memory, assignment of values to data, source listing format control and many other useful functions. A list of the assembler directives is given in Appendix-G.

1.5 Approach

The following points were kept in mind while designing and implementing the cross-assembler

(1) "Assembly Language is potentially the most dangerous of programming

languages, because of the variety with which a programmer can solve his problems." (5)

"Write clearly-don't be too clever".(6) Complex code has been kept to a minimum, and clarity and simplicity have been given (almost excessive) importance.

(2) Unconditional branching has been used with a great deal of caution. Except in transferring to the beginning of a loop, unconditional transfers "backwards" have been kept to a bare minimum.

(3) As far as possible, top-down design and testing techniques have been followed.

(4) "There is nothing in the programming field more despicable than an uncommented program" (5)

"...a more subtle problem can exist if the program is heavily laden with comments."(5)

As far as possible, comments have been included only wherever they are necessary.

CHAPTER II

THE ASSEMBLER

2.1 Introduction

This chapter discusses the overall top-level design of the Assembler. The various data-bases and structures used are defined, and the general algorithm for the assembly process is presented.

2.2 Functions

The basic functions which have to be performed by the Assembler are as follows:

(1) Generate object-code.

  (a) Generate machine instructions

  (b) Generate data words, allocate storage

(2) Produce source listing; symbol table.

Since symbolic addresses are permitted, the Assembler has to keep a note of the addresses of all the symbols used by the programmer. Because symbols can appear before they are defined, it is necessary to make two passes over the input. The first pass defines the symbols while the second pass produces the object code and source listing. The functional descriptions of the two passes are given below:

Pass-1:

(1) Obtain lengths of machine instructions.

(2) Allocate storage space.

(3) Maintain a location counter.

(4) Collect symbolic addresses and store them along with their addresses.

Pass-2:

(1) Assemble machine instructions using addresses of the symbols collected in pass-1.

(2) Generate data words.

(3) Generate source listing and symbol-table listing.

2.3 Data-structures

Having defined the functions of the Assembler, the next obvious step is the definition of the various data-structures. The major data-bases used are:

(1) Source-code line--INSLN

(2) Pseudo-operation table--POPTB

(3) Machine operation table--MOPTB

(4) Storage required by current instruction--LENTH

(5) Location-counter--LOCTR

(6) Symbol-table--SYMTB

(7) Error-Tables--ER1TB, ER2TB

(8) Direct-address-table--DIRAD

(9) Print-line--PRTLN

(10) Object-code buffer--BNOUT

INSLN contains the current source line. Since the NOVA has 16-bit words, 2 characters (7 or 8-bit ASCII) can be stored per word. Hence INSLN is a vector of 40 words (or 80 characters).

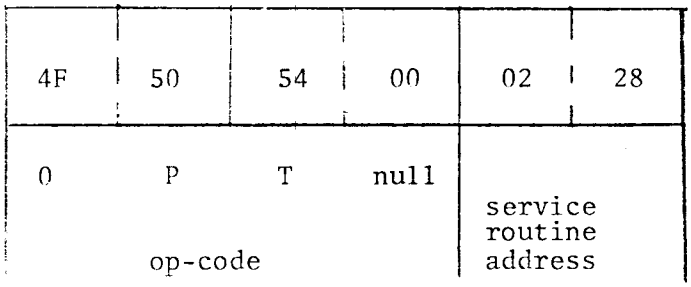
The source-line is checked to determine the type of opcode and operands. Two tables are used for this purpose--the pseudo-operation table and the machine-operation table.

The pseudo-op table contains a list of all pseudo-ops along with the corresponding service routine addresses. Each entry requires three 16-bit words. The first two words contain the pseudo-op mnemonic (3 characters), left justified, right filled with zeroes. The third word contains the service-routine address. A typical entry in the table is shown in Fig. 2-1.

The machine-operation table contains a list of all machine-operation code mnemonics. Each entry requires 3 words. The first two words contain the mnemonic, left justified and right filled with zeroes. The first byte of the third word contains the instruction type (numbered 0 to 8--see Appendix F) while the second byte contains the base value of the instruction. Depending on the mode of addressing used, the base value is modified to obtain the actual opcode. A typical entry is shown in Fig. 2-2.

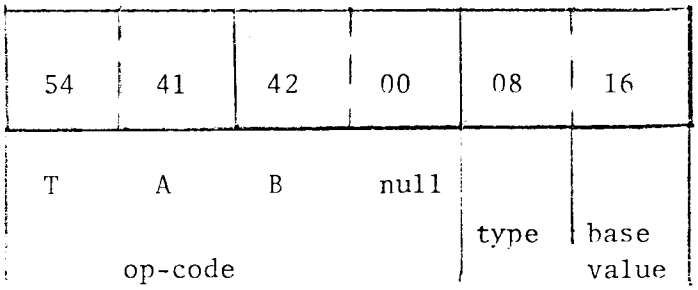
Once the instruction type has been obtained, the number of words required by the instruction is determined and LENTH is set accordingly. Before scanning the subsequent line, LOCTR is incremented by this amount.

If a label is present on a source line, it is stored in the symbol-table (SYMTB) along with the current location counter value. A label can have upto a maximum of six characters. Hence each entry in the table requires four words. The first three words contain the symbol, left justified, right filled with zeroes, while the fourth word contains



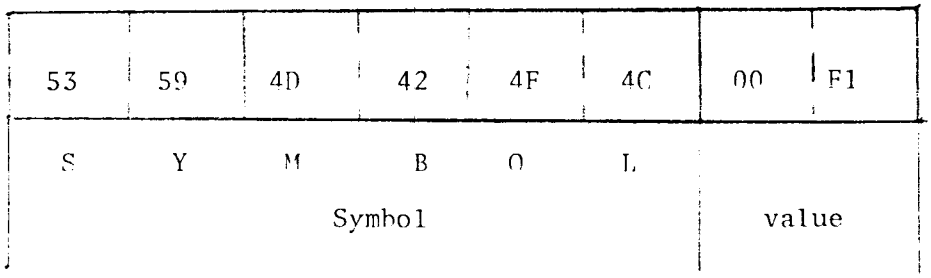
PSEUDO-OP TABLE ENTRY

Fig. 2-1



MACHINE-OP TABLE ENTRY

Fig. 2-2



SYMBOL TABLE ENTRY

Fig. 2-3

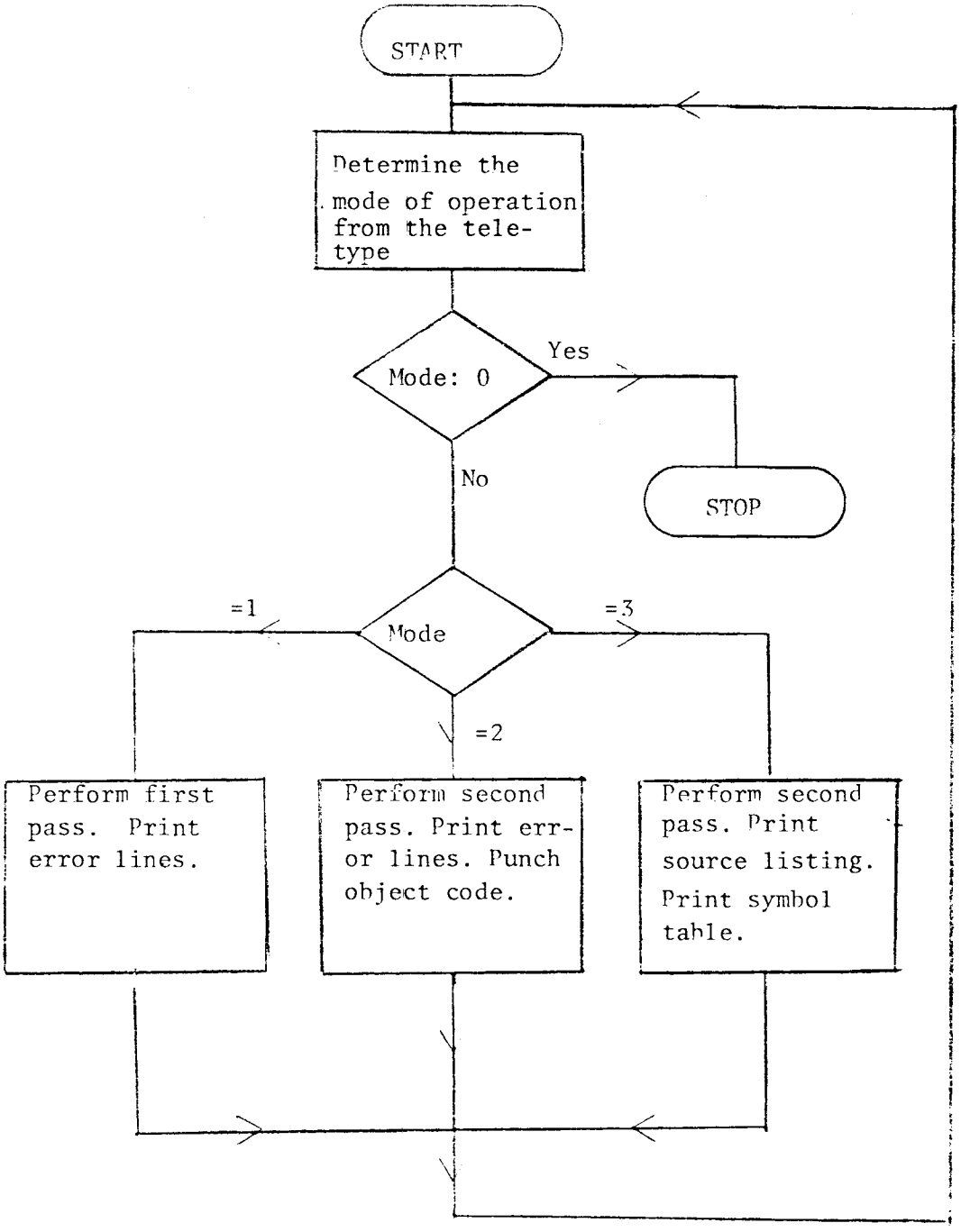
the corresponding location-counter value. The characters are represented by 7-bit ASCII strings. The format of a symbol-table entry is shown in Fig. 2-3.

The error table contains the line-number and the error-word of all of the error lines. A maximum of 25 entries can be accommodated. The direct-address table contains the line numbers of the instructions which use the direct mode of addressing. Such a table is essential, since the Assembler has to decide, in the first pass, whether certain instructions need the direct or extended mode of addressing. This table has space for upto 50 entries.

BNOUT and PRTLN are the object code buffer and the print-line buffer respectively. PRTLN can accommodate upto a maximum of 120 characters, and is flushed at the end of every scan. BNOUT is a vector of 40 words, and is punched only when a data-record (in the Motorola terminology, see Appendix C) has been assembled.

2.4 General Algorithm

The general flow of control is shown in Fig. 2-4. A more detailed description of the algorithm is given in the subsequent chapters.



GENERAL FLOW OF CONTROL

Fig. 2-4

CHAPTER III

FIRST PASS

3.1 Introduction

The general flow of logic was presented in Chapter 2. Here the first pass algorithm will be discussed in detail.

The source-code is processed line by line. The first character of each line is checked to determine whether the line is a comment. If so, no special action is taken. If a label is present, it is stored in the symbol table, along with the current value of the location counter. The operation code is identified, and necessary action is taken. The location counter is updated. The above steps are repeated until the END or MON pseudo-op is encountered. The detailed pass-1 flow chart is shown in Fig. 3-1.

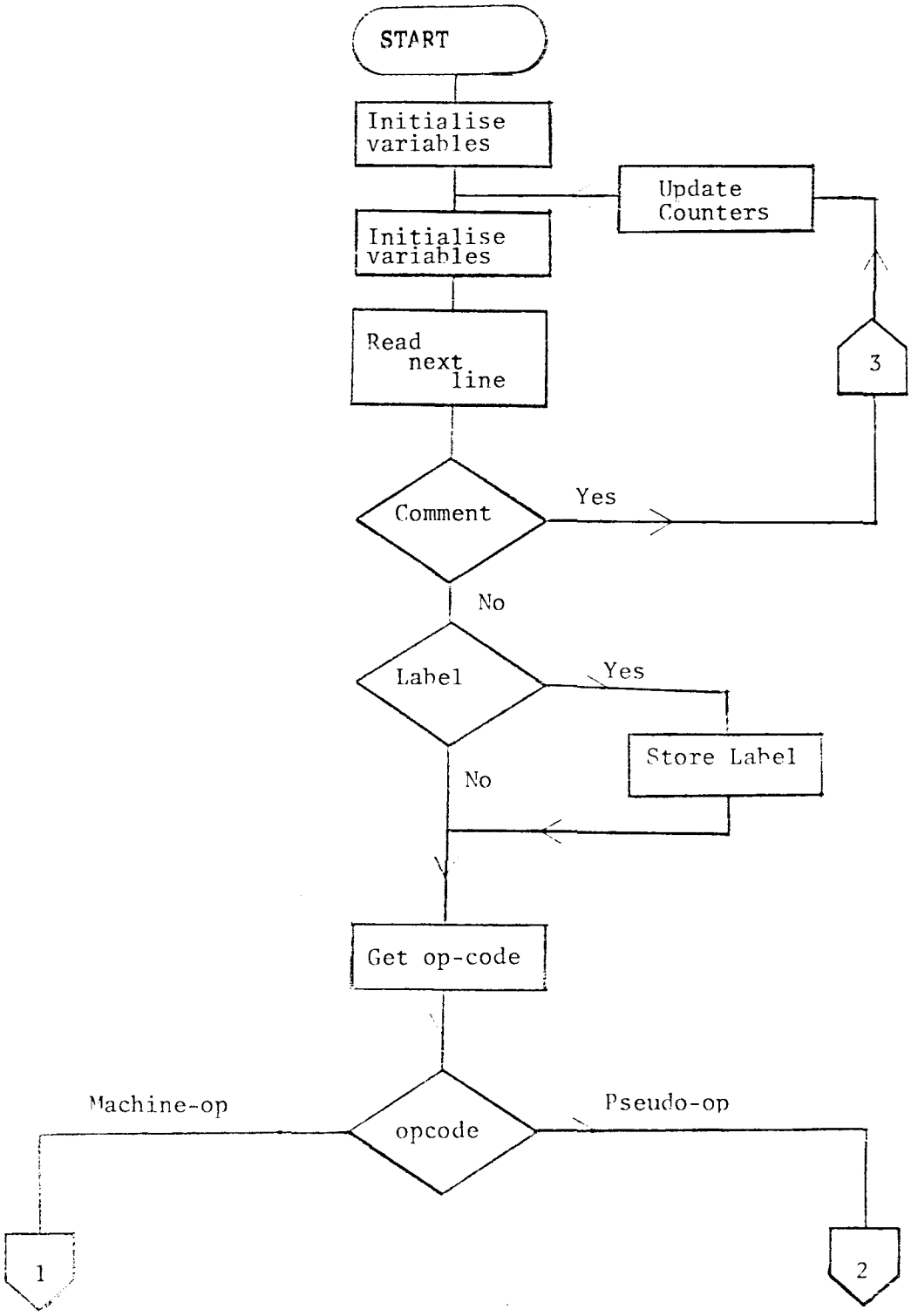
3.2 Machine-instruction processing

In the first pass, the machine-operation code service routines perform two major functions:

(1) Determine the length of the instructions

(2) Maintain the direct-address table.

To determine the length of an instruction, the addressing mode has to be determined. In most cases, an examination of the operands will identify the addressing mode. For instructions which can use either the direct or extended mode, the Assembler has to decide on the mode to be used. If the operand field cannot be evaluated, the



FIRST PASS

Fig. 3-1

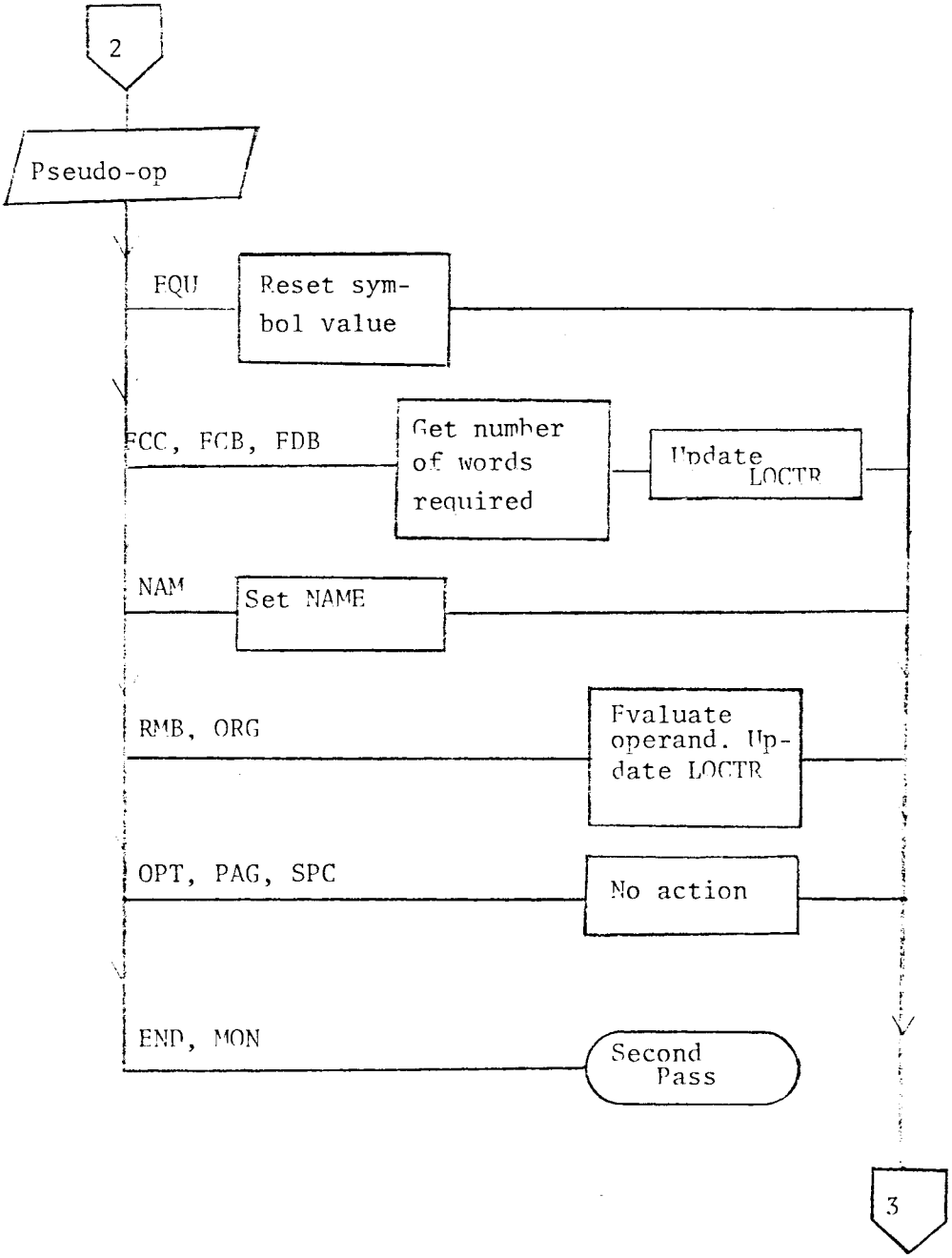

2
Pseudo-op
EQU
Reset symbol value
FCC, FCB, FDB
Get number of words required
Update LOCTR
NAM
Set NAME
RMB, ORG
Evaluate operand. Update LOCTR
OPT, PAG, SPC
No action
END, MON
Second Pass
3

Fig. 3-1 (contd)

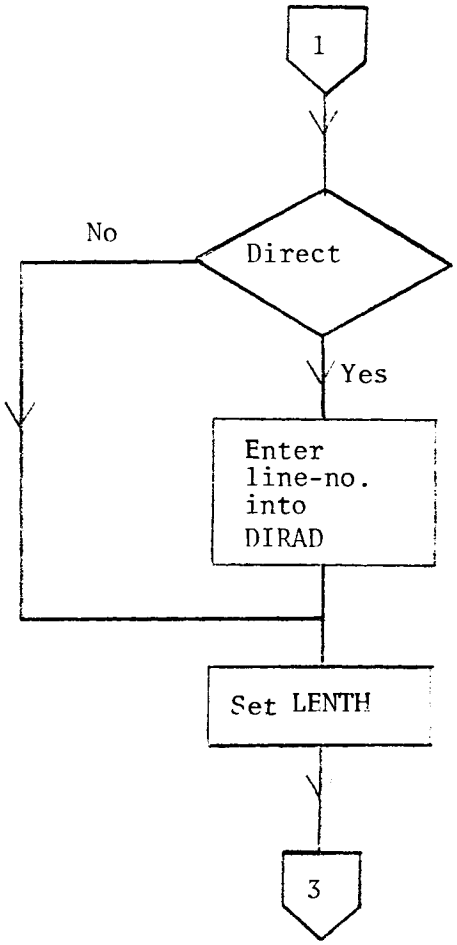


Fig. 3-1 (contd)

instruction is assumed to operate in the extended mode. If the operand field can be evaluated, the value is examined, and if it is less than 256, the direct mode is selected, and the line number of the instruction is entered in the direct-address table; otherwise the extended mode is used.

3.3 Pseudo-instruction Processing:

Basically, the Assembler recognizes about 12 pseudo-instructions (see Appendix G). Some of them result in machine-code, while others provide information regarding listing, storage requirements etc. to the Assembler. Pseudo-instruction processing in the first pass is described below.

END, MON:

These pseudo-ops signify the end of the program. The last line of the source-program should contain one of these instructions. There should be no symbol in the label field, while the characters after the pseudo-op are treated as comments. Pass-1 scanning is terminated and control returns back to the main-program.

EQU:

This pseudo-op defines the value of the symbol in the label-field. The label is initially entered, along with the current location counter value. When an EQU is recognized, the operand field is evaluated. If it can be evaluated, the symbol value is reset, otherwise it is deleted from the symbol table.

FCC, FDB, FCB:

These are constant defining pseudo-ops. They are processed to

determine the amount of storage required, and the location counter is updated accordingly.

NAM:

This pseudo-op defines the name of the program. Six characters after the pseudo-op are entered into "NAME", which is used in pass-2 while generating the source-listing and object code. The default name for the program is "START". Since this does not produce any machine code, the location counter is not incremented.

PAG, SPC:

These pseudo-ops are not processed in pass-1.

ORG:

This specifies the starting address of the following block of instructions/data. If the operand field can be evaluated, the location counter is reset. Otherwise the line is flagged as an error. The label field may not contain a label.

RMB:

This pseudo-op reserves a block of storage for data. If the operand field can be evaluated, the location counter is incremented accordingly; otherwise the line is flagged as an error.

3.4 Conclusion:

This concludes the detailed description of instruction processing in the first pass. At this point, all symbols (except some defined by EQU pseudo-ops) have been defined, and storage requirements established. The data-bases transmitted to pass-2 are:

(1) Direct address table

(2) Symbol table

(3) Error table

Control returns to the main program where the user is requested for further instructions via the tele-type. The second pass is described in the following chapter.

CHAPTER IV

SECOND PASS

4.1 Introduction

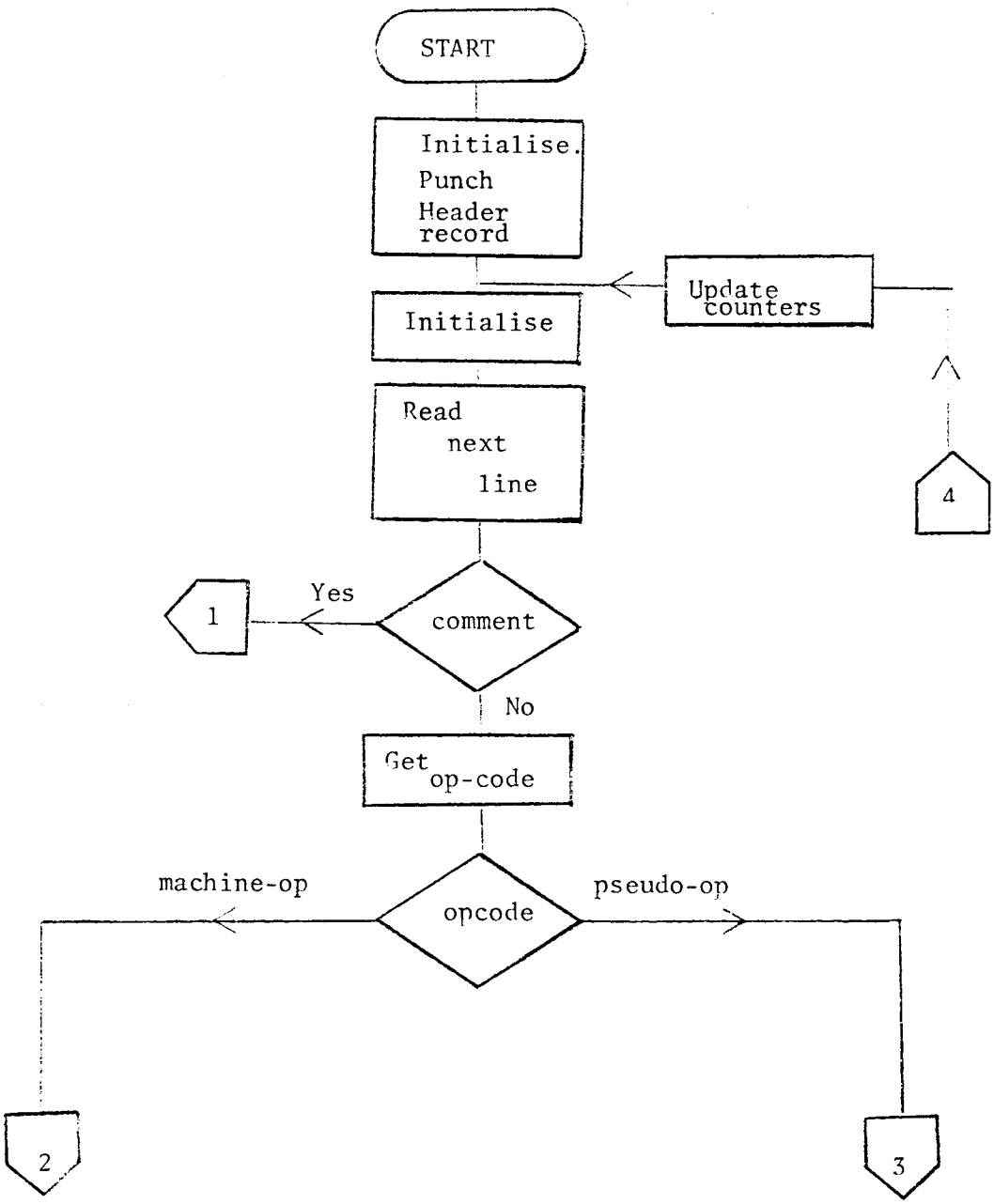
After all the symbols have been defined by pass-1, it is possible to finish the assembly by processing each line and determining the value of the opcode and its operand field. In addition, pass-2 must structure the generated object-code into a format suitable for acceptance by the microcomputer's resident PROM Monitor (See Appendix C), and produce a source-listing containing the original source line numbers, location and value of the bytes generated. A listing of the symbols and their values is also produced. Note that, depending on the mode requested by the user, either the source listing or the object code is generated by the Assembler. This is necessary since both the source-listing and the object-code have to be routed to the tele-type.

A location counter is maintained as in pass-1. The source code is read on a line by line basis. The opcode is examined, and control is transferred to the corresponding service routine.

4.2 Machine Instruction Processing

The major function of the machine instruction service routines is to assemble the instruction. For this the op-code has to be determined and the operand evaluated.

The base value of the opcode can be obtained from the Machine-



SECOND PASS
Fig. 4-1

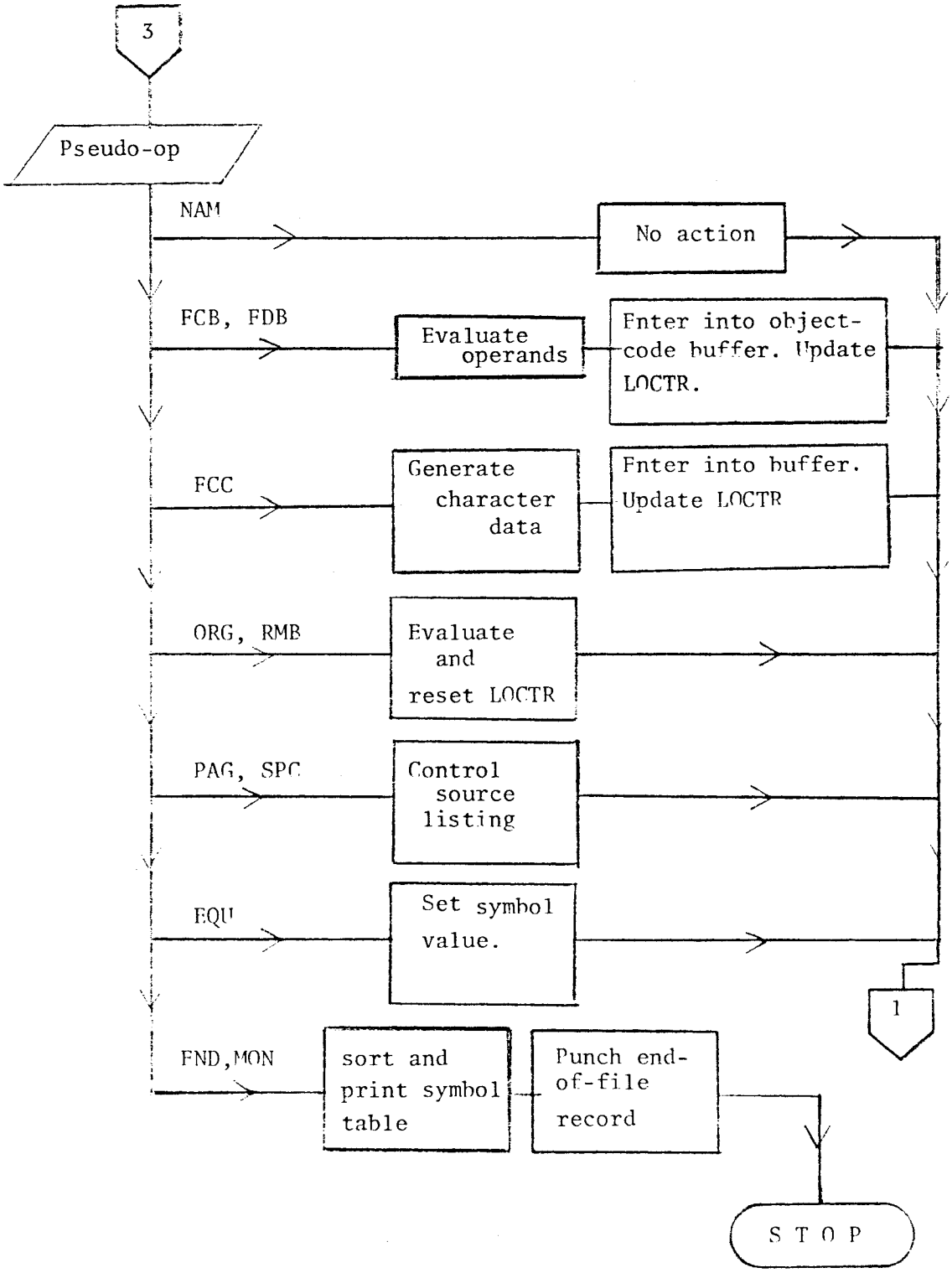

3
Pseudo-op
NAM
No action
FCB, FDB
Evaluate operands
Enter into object-code buffer. Update LOCTR.
FCC
Generate character data
Enter into buffer. Update LOCTR
ORG, RMB
Evaluate and reset LOCTR
PAG, SPC
Control source listing
EQU
Set symbol value.
1
END,MON
sort and print symbol table
Punch end-of-file record
STOP

Fig. 4-1 (contd)

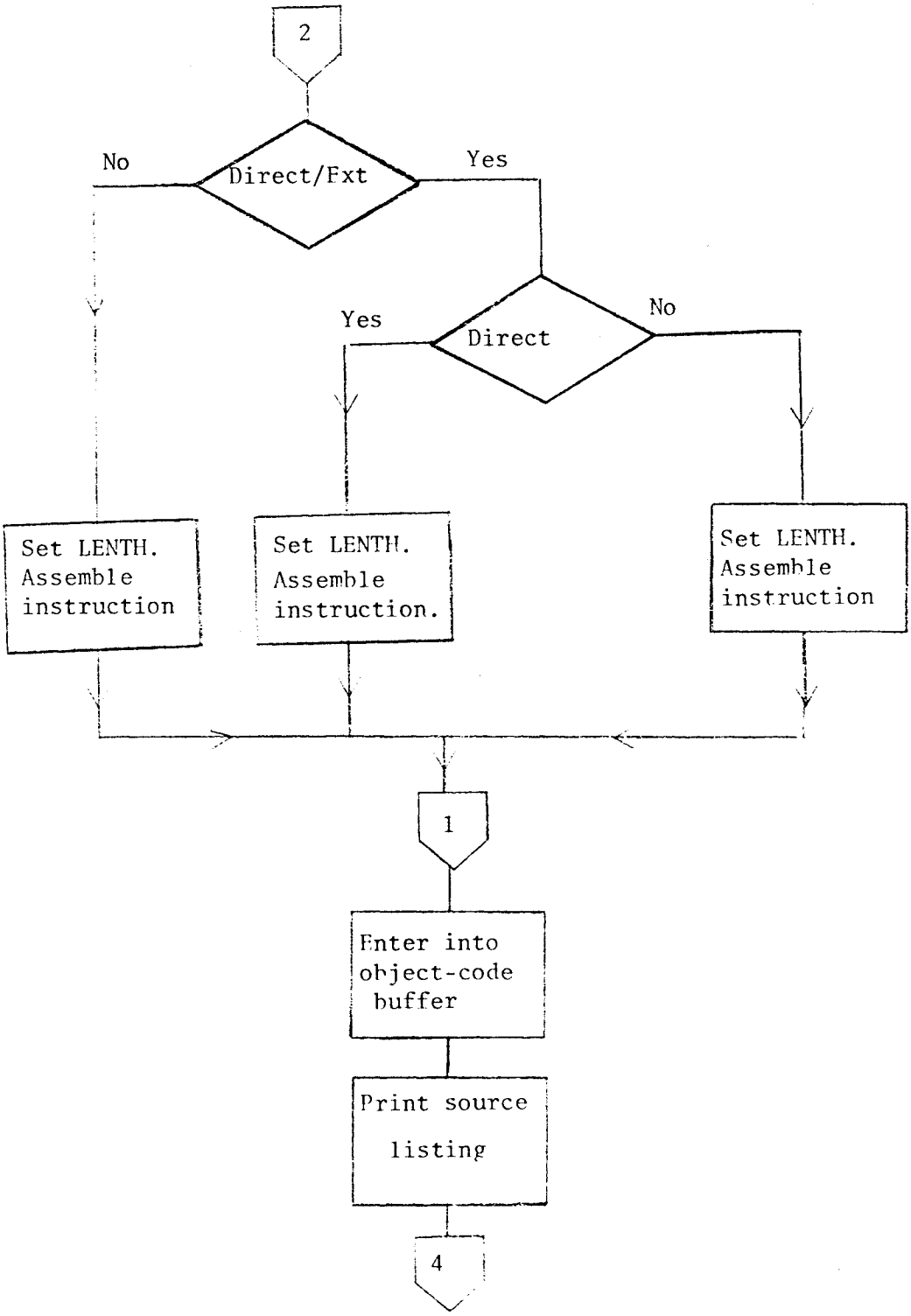

2
No
Direct/Fxt
Yes
Yes
Direct
No
Set LENTH.
Assemble
instruction
Set LENTH.
Assemble
instruction.
Set LENTH.
Assemble
instruction
1
Enter into
object-code
buffer
Print source
listing
4

Fig. 4-1 (contd)

operation table. Depending on the mode of addressing, the actual value can be evaluated. A scan of the operands will establish the mode, except in the case of instructions which can use either the direct or the extended mode of addressing. For this case, the direct address table is first searched to determine whether an entry corresponding to the line is present. If so, the mode of addressing to be used is direct; otherwise the extended mode is used.

The operand is evaluated using the symbol table produced by pass-1. If the instruction requires an 8-bit value, the least significant 8-bits are used. For the relative mode of addressing, the location counter value is used to obtain a relative address. The generated bytes are stored in WSPCE and LENTH is set to the number of bytes of generated code.

4.3 Pseudo-instruction processing

The actions taken for the various pseudo-ops are explained below.

END, MON:

These pseudo-ops signal that there are no more instructions to be processed. Pass-2 now proceeds to do the cleaning-up process.

EQU:

This pseudo-op needs processing in pass-2, since symbols which have not been defined before the instruction can appear in the operand field . If the operand field can be evaluated, the value associated with the label is reset; otherwise, the label is deleted from the symbol-table.

FCB, FDB:

These pseudo-ops generate constant data-bytes. FCB generates an 8-bit byte while FDB generates two 8-bit bytes of data. Since more than one constant can be defined per line, each of the operands is evaluated,

entered into the object-code buffer, and the location counter is updated. If any of the operands cannot be evaluated, the line is flagged as an error.

FCC:

This pseudo-op generates 7-bit ASCII character constants. Basically, there are two ways of defining character strings--by using delimiters or by defining the length. The Assembler generates the 7-bit ASCII equivalents, enters them into the object-code buffer and updates the location-counter.

ORG, RMB:

Processing is identical to that of pass-1.

PAG, SPC:

These pseudo-ops control the assembly source-listing. For the PAG pseudo-ops, the tele-type is positioned at the top of a new page, and the title lines are printed. For the SPC, the operand field is evaluated, and a corresponding number of blank lines are printed. Neither of the pseudo-ops is printed out.

NAM:

No action is necessary in pass-2.

4.4 Conclusion

At the end of each scan, the source-line is printed out. Any machine code generated is entered into the object-code buffer. When the END/MON pseudo-op is encountered, source-line scanning is stopped. The total number of errors is printed. The object-code buffer is flushed, and an end-of-file record is punched. The symbol table is sorted and

listed, and control returns back to the main program.

CHAPTER V

TABLE HANDLING

5.1 Introduction

This chapter describes the handling of the various tables used by the Assembler. The tables discussed are

(1) Symbol-table

(2) Machine-operation-code table.

All the other tables use a linear search technique.

5.2 Symbol-table-Searching

The symbol table is hash-coded. In order to use a hash-coded table, two decisions have to be made:

(1) Choose a hashing function

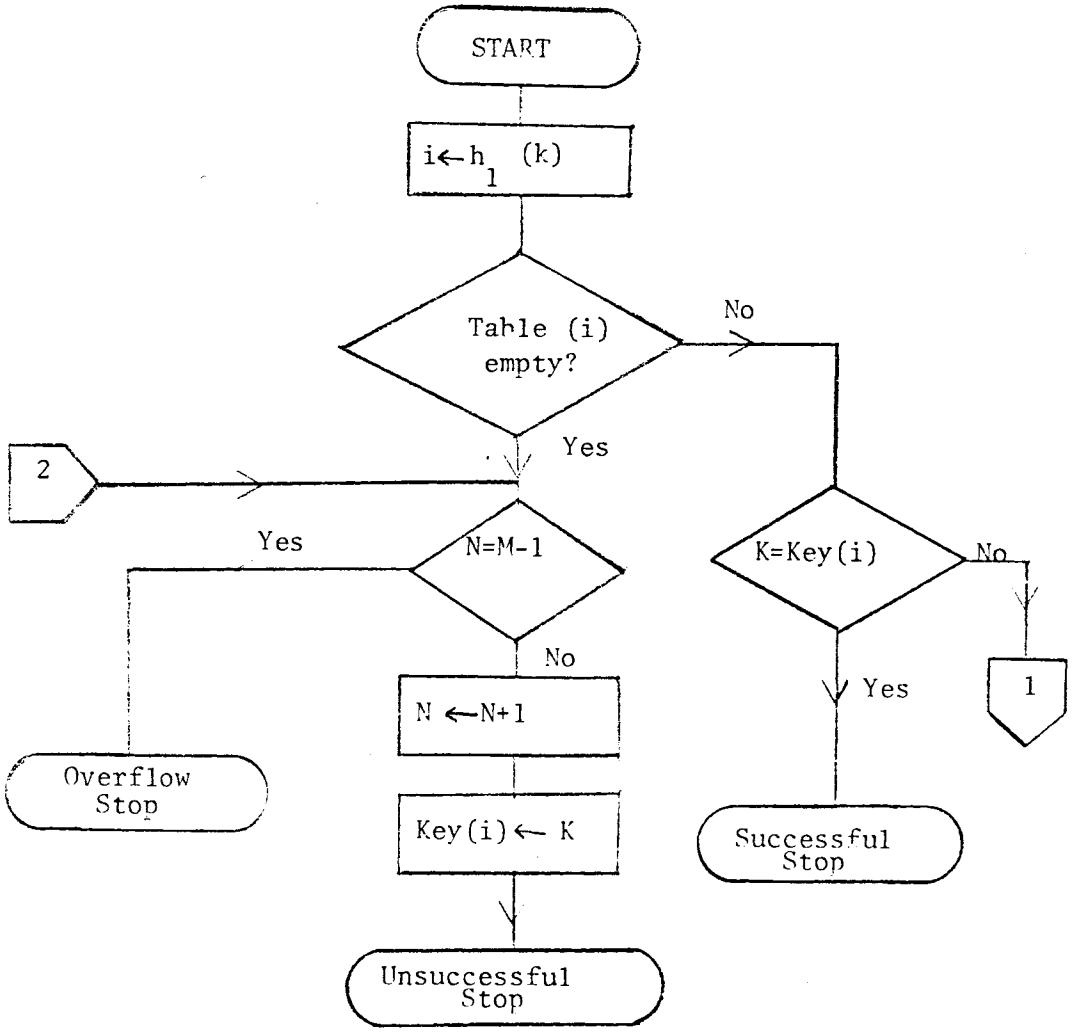
(2) Select a method for handling collisions

The symbol table uses a multiplicative hashing function (pp 508-9; ref 8). If w is the word size of the computer, A is any number relatively prime to w, and $0 \leq h(k) < M = 2^m$, the hashing function,

$$h(k) = \lfloor M((A/w \times k) \bmod 1) \rfloor$$

gives a value between 0 and M-1. Here h(k) consists of the m leading bits of the least significant $\log_2 w$ bits of the product AK.

Collision resolution is done by open-addressing. The idea is to "formulate some rule by which every key K determines a 'probe sequence', namely a sequence of table positions which are to be inspected whenever K



SYMBOL TABLE SEARCHING

Fig. 5-1

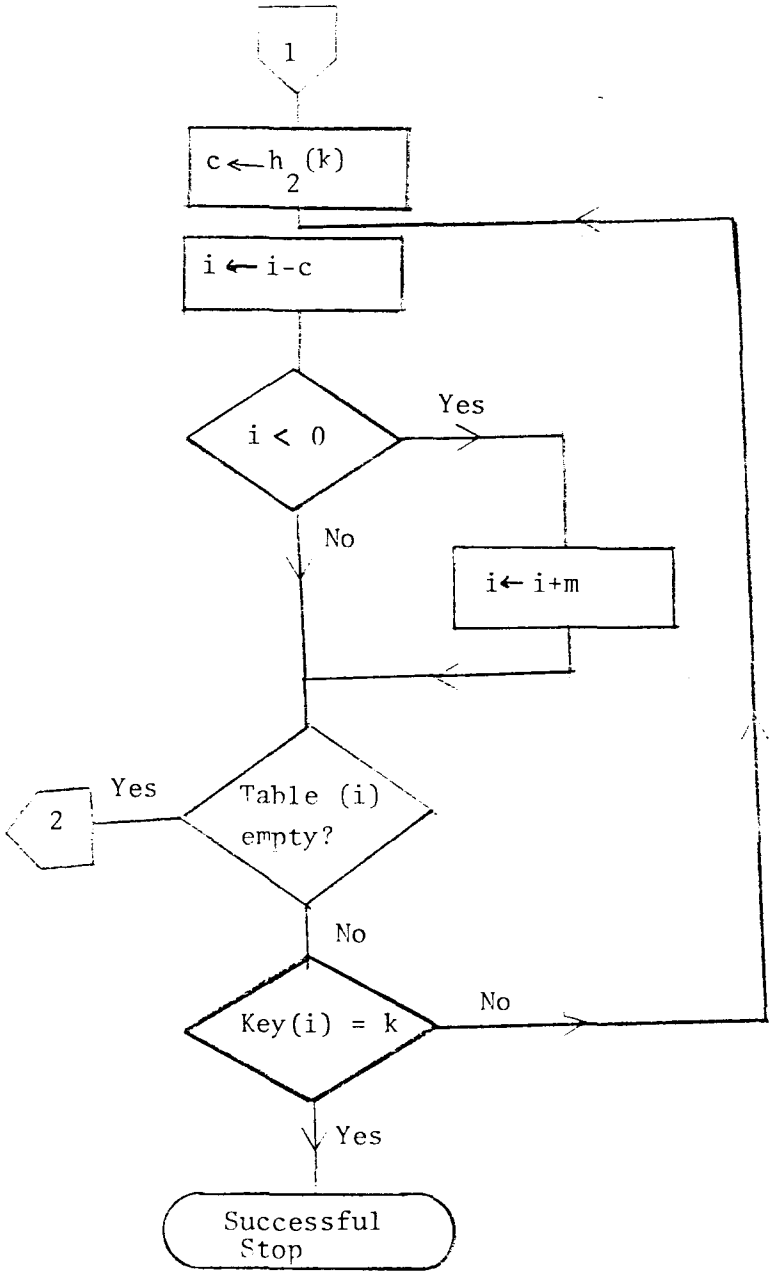

1
c ← h2(k)
i ← i-c
i < 0
Yes
No
i ← i+m
Table (i) empty?
Yes
2
No
Key(i) = k
No
Yes
Successful Stop

Fig 5-1 (contd)

is inserted or looked up" (pp 518, ref. 8). The method used in the Assembler uses 2 hash functions, $h_1(K)$ and $h_2(K)$. $h_1(K)$ produces a value between 0 and M-1, while $h_2(K)$ produces a value between 1 and M-1, relatively prime to M. If $M = 2^m$, $h_2(K)$ can be obtained by shifting AK mod w m more bits to the left and orring in a 1.

The flow chart for the algorithm is given in Fig. 5-1. (N denotes the number of entries in the symbol table).

5.3 Symbol-table Sorting

The sorting algorithm used here is based on two things:

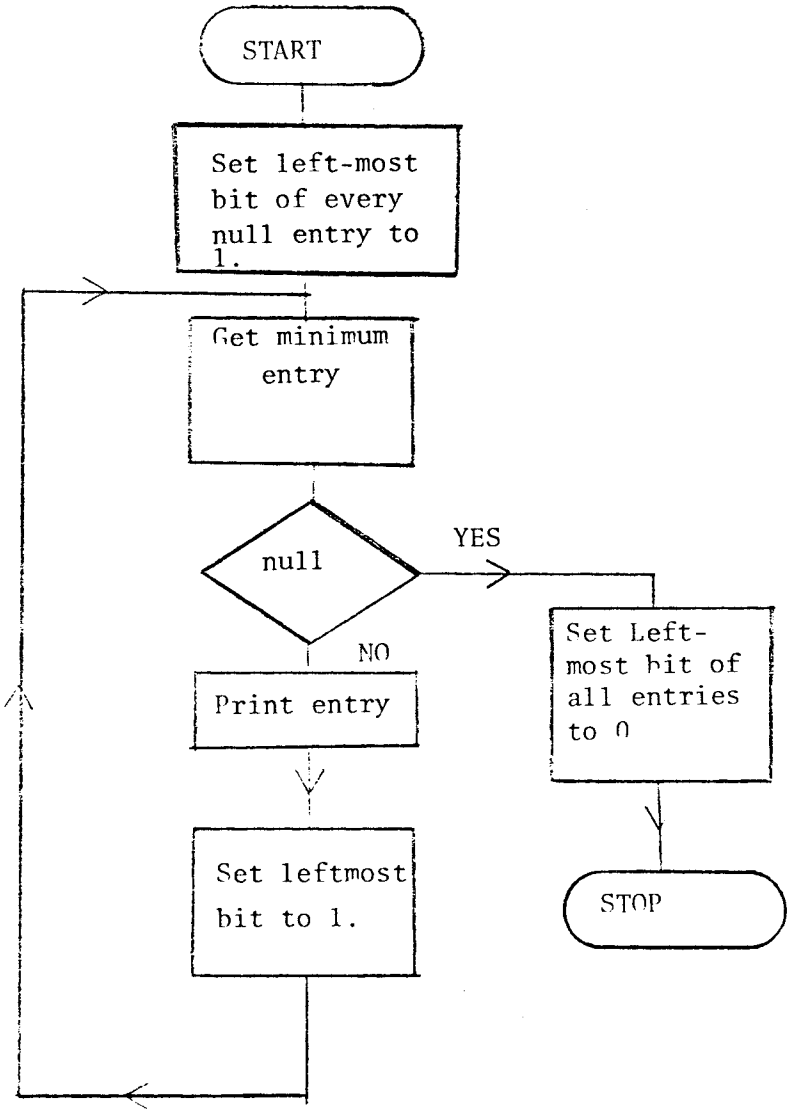
(1) The first bit of all entries is always 0, since 7-bit ASCII representation is used.

(2) The sorting mechanism need not be fast, since the machine will be working in a single user environment, with the Tele-type operated in the SKIP mode.

Initially, the first bit of all entries in the table is 0 . An initial pass is made through the table, and the left most bit of every null entry is set to 1. Thereafter, until the minimum entry in the table is a null with a 1 in the left most bit, the minimum entry is determined, printed out, and a 1 entered in the most significant bit. After all entries have been printed out, one more pass is done in order to reset the left-most bit of every entry in the table to 0 . The flow-chart for the algorithm is shown in Fig. 5-2.

5.4 Machine-operation table searching

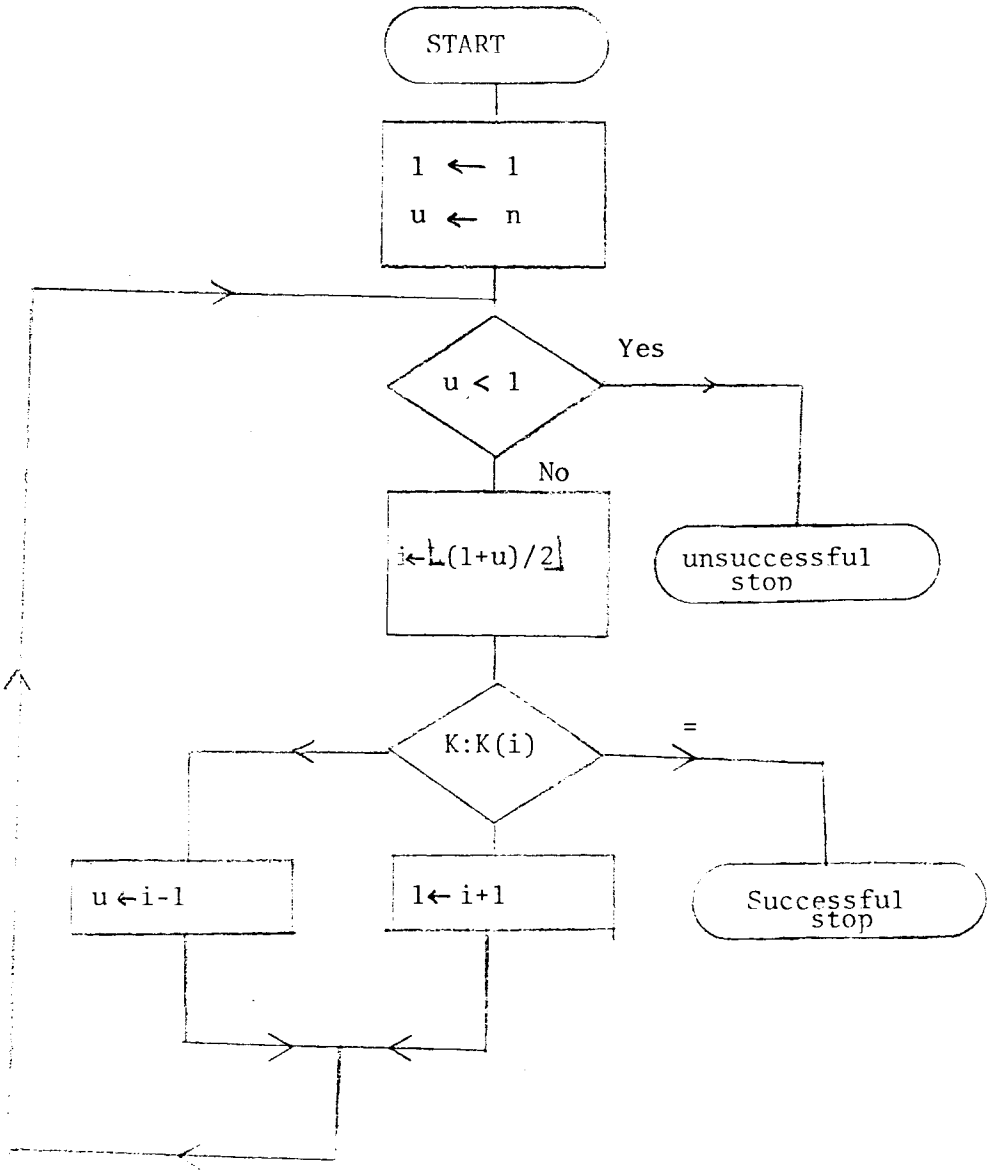
The machine operation table is a static table, with no insertions or deletions. It can be prearranged lexicographically, and hence a



SYMBOL TABLE SORTING

Fig. 5-2

binary search technique is used. The flow chart for the algorithm (pp. 407-408; ref. 8) is given in Fig. 5-3.



MACHINE OPERATION TABLE SEARCHING

FIG 5-3

CHAPTER VI

CONCLUSION

The author regrets the lack of many useful features in the Assembler, such as the OPT pseudo-op, cross-reference table, more detailed error-processing, better source-listing format control etc. These features could not be implemented due to lack of time.

The author found that modular design was very useful in writing software, especially in minimising and locating bugs during testing. Early in the implementation stage, the author learnt the hard way that proper documentation helps a great deal in debugging. The author also feels that proper modular design is more important than structured coding, since any un-structured code present is localised to a module.

Since the project was primarily an exercise in software design and development, the author feels that he has achieved what he had set about to do--get an idea of the problems involved in the design and development of software.

APPENDIX - A

INSTRUCTIONS TO USER

The starting address of the program is 2000_8. When started at this location, the "MODE :=" request is printed out.

The Assembler operates in 4 modes.

Mode 0:- The Assembler halts processing

Mode 1:- Perform pass-1 processing.

Print all error lines.

Mode 2:- Perform pass-2

Print error-lines

Punch object code.

Mode 3:- Perform pass-2

Generate source-listing

List Symbol table.

The Assembler occupies locations

$(40)_8$ thro' $(131)_8$

$(200)_8$ thro' $(341)_8$

$(2000)_8$ thro' $(11464)_8$

$(12000)_8$ thro' $(15060)_8$

APPENDIX - B

ERROR MESSAGES

CODE	MEANING
D	Delimiter not found in FCC
E	Illegal expression
F	Format error
I	Invalid Label
L	String too long in FCC
M	Multiply defined label
N	Label not present in EQU
O	Opcode unrecognizable
P	Label present in ORG, END
R	Expression cannot be evaluated in pass-1, ORG, RMB
S	Symbol too long
U	Undefined Symbol
V	Value overflow, division by 0.

PROGRAMS WITH ERRORS

```
ERR1                                                    PAGE  00001
 ER. LINE. LOC.  VALUE.   INPUT.

     00001                      NAM    ERR1
     00002              *  ERROR-CODES TEST.
     00003              *
     00004              *
     00005              ***** LABEL NOT PRESENT ,CODE-N *****
     00006              *
     00007        00FF  AAA    EQU     $FF
 N   00008        0000         EQU     $FF
     00009              *
     00010              ***** FORMAT ERROR,CODE-F *****
     00011              *
 F   00012 0000               ADCX    #$10
 F   00013 0000               ADC     #$10
 F   00014 0000  9900         ADC A
 F   00015 0002  9700         STA A
 F   00016 0004               STAX    $10
 F   00017 0004               ASLX
 F   00018 0004  00           PSH
 F   00019 0005  00           PSH C
 F   00020 0006               CPXA    #$10
```

```
ERR1                                                    PAGE  00002
 ER. LINE. LOC.  VALUE.   INPUT.

 F   00021 0006                    JMPA       $10
 F   00022 0006                    BCCA       $10
 F   00023 0006          AAK
 F   00024 0006
     00025               *
     00026               ***** EXPRESSION CANNOT BE EVALUATED
     00027               *      IN PASS-1,CODE-R ******
     00028               *
 R   00029 0006  0200              RMB        SSS
 R   00030 0200                    ORG        SSS
     00031         0200  SSS       EQU        $200
     00032               *
     00033               ***** LABEL PRESENT,CODE-P *****
     00034               *
 P   00035 0200          MNO       ORG        $300
 PM  00036               MNO       END
 TOTAL ERRORS  00018
```

```
ERR2                                                    PAGE  00001

 ER. LINE. LOC.  VALUE.   INPUT.

     00001                          NAM    ERR2
     00002              *  ERROR-CODES TEST.
     00003              *
     00004              *
     00005              ***** INVALID LABEL,CODE-I *****
     00006              *
 I   00007 0000  16     A          TAB
 I   00008 0001  16     B          TAB
 I   00009 0002  16     X          TAB
 I   00010 0003  16     1AC        TAB
 I   00011 0004  16     ABCDEFG    TAB
 I   00012 0005  16     AB$        TAB
     00013              *
     00014              ***** MULTIPLY DEFINED LABEL,CODE-M *****
     00015              *
     00016 0006  16     KKK        TAB
 M   00017 0007  16     KKK        TAB
     00018              *
     00019              ***** DELIMITER NOT FOUND,CODE-D *****
     00020              *
```

```
ERR2                                                    PAGE  00002
 ER. LINE. LOC.  VALUE.                 INPUT.

     00021 0008                                 FCC     /TEXT/
 D   00022 000C                                 FCC     /TEXT
     00023                          *
     00024                          ***** STRING TOO LONG,
                                          CODE-L *****
     00025                          *
 L   00026 004A                                 FCC     256
     00027 004A                                 FCC     255,
     00028                          *
     00029                          ***** OPCODE UNRECOGNIZABLE,
                                          CODE-O *****
     00030                          *
     00031 0149  06                             TAP
 O   00032 014A                     TT          ABC
     00033                          *
     00034                          ***** UNDEFINED SYMBOL,
                                          CODE-U *****
     00035                          *
 U   00036 014A  27B4                           BEQ     CDE
     00037 014C  27B2                           BEQ     CED*2
 U   00038 014E  24B0                           BCC X
 U   00039 0150  FF00 00            *           STX A   $10
 U   00040 0153  7E00 00                        JMP     #$10
```

```
ERR2                                                    PAGE  00003
 ER. LINE. LOC.  VALUE.   INPUT.

 U   00041 0156  27A8          BEQ       $10*-$2
     00042              *
     00043              ***** SYMBOL TOO LONG,CODE-S *****
     00044              *
 S   00045 0158  27A6          BEQ       ABCDEFG
     00046              *
     00047              ***** ILLEGAL EXPRESSION,CODE-E *****
     00048              *
 E   00049 015A  27A4          BEQ       $10GH*$2
 E   00050 015C  27A2          BEQ       %112*$3
     00051              *
     00052              ***** VALUE OVERFLOW,CODE-V *****
     00053              *
 V   00054 015E  27A0          BEQ       $10/0
 V   00055 0160  279E          BEQ       $10/$0
     00056                 END
 TOTAL ERRORS  00021
```

APPENDIX - C

ABSOLUTE BINARY FORMAT

The PROM monitor supports the paper-tape format established by Motorola.

The first character of a record is an S. The digit following the S defines the type of record.

S_0 = Header Record

S1 = Data Record

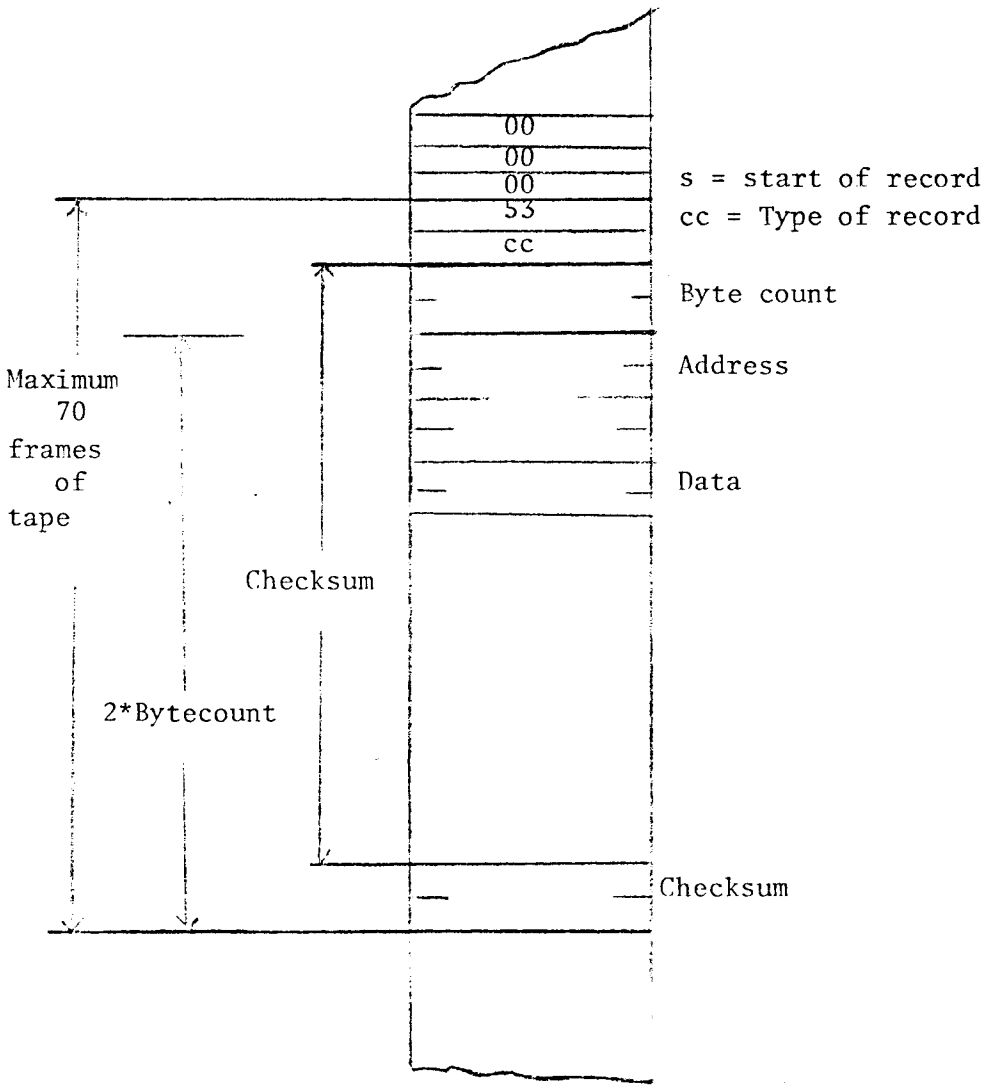
S9 = End of File Record

Header records (type S0) contain the program name, and are ignored by the PROM Monitor. The end of file record (type S9) causes the monitor to terminate the loading process. Data records (type S1) contain the actual data to be loaded and are of the form:

S1 NNAAAADD.....DDCC

where S1 specifies the record is a data-record, NN is a two digit hexadecimal byte count specifying the number of remaining bytes in the record (1 byte = 2 frames of tape), AAAA is the 4 digit hexadecimal starting address of the data-block, each DD pair consists of two hexadecimal digits which are combined to form a byte, and CC is the checksum of all preceding frames (excluding S and 1). The checksum is the 1's complement of the binary sum of the byte count, the address, and the data bytes.

Further information concerning the paper tape is given in Fig. C-1.



MOTOROLA PAPER TAPE FORMAT

Fig. C-1

APPENDIX - D

I-O INTERFACE

The various I-0 devices used by the Assembler are:

(1) BPNDV - Binary punch device. Object code is routed to this device

(2) ECHODV - Echo device. Input characters are echoed onto this device

(3) MDIND - mode input device. Reply to the "Mode=" request is received from this device

(4) MDOTD - "Mode=" message is printed on this device

(5) SCIND - Souce code input device. Source code is accepted from this device

(6) SLOTD - Source Listing is printed on this device

The above are located in locations $(40)_8$ through $(45)_8$ of the Assembler. The default values are $(10)_8$ for all input devices and $(11)_8$ for all output devices. Once the Assembler has been loaded, the user can set these to any desired device-code.

The basic input and output routines are PUT75 and GET78. GET78 gets the next character from the device whose device code is in "INPDV" into accumulator 0 while PUT75 transmits the character in accumulator 0 to the device whose device code is in OUTDV. Any I-0 changes can be implemented by modifying these 2 routines appropriately.

APPENDIX - E

LANGUAGE DESCRIPTION

E-1 Character Set

(1) The alphabet A-Z, integers 0-9 arithmetic operators

+ - * /

(2) Special prefix characters

specifies immediate mode of addressing

$ specifies a hexadecimal number

@ specifies an octal number

% specifies a binary number

' specifies an ASCII character

(3) Separating characters. SPACE, COMMA and CR(Carriage Return)

(4) A comment in the source statement may include any character except the CR and LF (line feed)

(5) In addition to the above, the Assembler has the capability of reading strings of characters and of entering the corresponding 7-bit ASCII code into specified locations in memory. This capability is provided by the Assembler directive FCC.

E-2 Fields of the source statement

A source statement includes from one to four fields. From left to right, the 4 fields are: (1) Label (2) Operator (3) Operand (4) Comment. The comment is optional, and may be used in all source

statements. A label is required for some statements which are involved in the definition of symbols and, in some cases, at the destinations of branches and jump instructions. An operand field may or may not be present depending on the nature of the operator. The mnemonic operator must be present in every statement except when the whole line is a comment. In that case, the first character in the source line should be an * .

With one exception, the successive fields within the statement are separated by one or more SPACE characters. The exception applies to instructions which have an accumulator as an operand. The programmer has the option of including the accumulator character (A or B) along with the op-code mnemonic, resulting in an apparent 4 character format, as for example, "ADCA", "ASRB", "STAA" etc.

A label, if used, must begin in the first character position of the source-statement. A space in the first character position is used to indicate that a label is not included in the statement. Except in some cases when it is used with the mnemonic operator EQU, a label always corresponds to a numerical address. A label consists of 1 to 6 alpha numeric characters, with the first character alphabetic. A label should not consist of anyone of the single characters A, B or X. All labels within a program should be unique.

The mnemonic operators recognized by the Assembler include 72 executable instructions. Each instruction is translated into one to three bytes of machine code. The remaining mnemonic operators are assembler directives of which 3 (FCB, FDB, FCC) are translated into

one or more bytes of machine code.

The kind of information placed in the operand field depends on the particular mnemonic operator. For the 72 executable instructions, the microprocessor uses various modes of addressing for obtaining the operand address. The addressing mode is determined by the mnemonic operator combined with the information in the operand field. The Assembler recognizes numbers, symbols and expressions in the operand field. Numbers are accepted by the assembler in the following formats:

Number (decimal)

$ Number (hexadecimal)

@ Number (octal)

% Number (binary)

where Number is a positive integer.

Symbols, when used in the operand field, must have been defined by appearing in the label field of any of the executable instructions, or the pseudo-ops FCC, FDB, FCC and RMB. The special symbol * represents the program counter. Expressions are combinations of symbols and/or numbers being separated one from the next by one of the arithmetic operators (+, -, * or /). The expressions are evaluated from left to right without any hierarchy of precedence among the operators.

APPENDIX F

GROUPED LISTING

The grouped listing of the 72 machine instructions is given below.

(For further information regarding this, refer to pp. A70-A71, ref. 3)

Type 0:	ADC	ADD	AND	BIT	CMP	
	EOR	LDA	ORA	SBC	SUB	
Type 1:	STA					
Type 2:	ASL	ASR	CLR	COM	DEC	INC
	LSR	NEG	ROL	ROR	TST	
Type 3:	PSH	PUL				
Type 4:	CPX	LDX	LDS			
Type 5:	STS	STX				
Type 6:	JMP	JSR				
Type 7:	BCC	BCS	BEQ	BGE	BGT	
	BHI	BLE	BLS	BLT	BHI	
	BNE	BPL	BRA	BSR	BVC	
	BVS					
Type 8:	ABA	CBA	DAA	SBA	TAB	TBA
	DEX	DES	INX	INS	TXS	TSX
	NOP	RTI	RTS	SWI	WAI	CLC
	CLI	CLV	SEC	SEI	SEV	TAP
	TPA.					

APPENDIX - G

PSEUDO-INSTRUCTIONS

END - End of program: When the assembler directive "END" is used, it marks the end of the source program. No other statement may follow the END directive. The operator in the last statement of the source program must be either MON or END. The END directive must not be written with a label, and it does not have an operand. It is not translated into object code.

EQU - Equate symbol: This is used to assign a value to a symbol. The EQU statement must contain a label, which is identical to the symbol being defined. The operand field may contain an expression which can be evaluated by the Assembler. The statement is not translated into object code.

FCB - Form constant byte: This directive may have one or more operands, separated by commas. An 8-bit unsigned binary number corresponding to each operand is in a byte of the object program. If there is more than one operand, they are stored in successive bytes. The operand field may contain any expression that can be evaluated by the assembler. The directive may be written, with a label. An FCB directive followed by one or more void operands separated by commas will store zeroes for the void operands.

FCC - Form Constant characters: This translates strings of characters into their 7-bit ASCII codes. Any character other than CR and LF can

processed by this directive.

(1) Count, comma, text, where the count specifies how many ASCII characters to generate and the text begins following the first comma of the operand. Should the count be longer than the text, spaces will be inserted to fill the count. Maximum count is 255.

(2) Text enclosed between identical delimiters, each being a single character. (If the delimiters are numbers, the text must not begin with a comma.)

The FCC directive may be written with a label.

FDB - Form double constant byte: This directive is identical to the FCB directive, except that a 16-bit unsigned binary number is stored corresponding to the values of each operand.

MON - Return to monitor: This directive is handled in an identical manner to the END directive.

NAM - Name: Provides a name for the program. The first six characters in the operand field are used. This is used in the top-of-the-page heading, and in the header-record of the object-code file. No object code results from NAM.

OPT - Option: This directive is ignored by the Assembler. No action is taken.

ORG - Origin: This defines the numerical address of the first byte of machine code resulting from the assembly of the immediately subsequent section of the source-program. The program counter is set to the value of the expression in the operand field. The ORG directive should not

have a label and does not translate into object-code.

RMB - Reserve Memory bytes: This causes the location counter to be increased by the value of the expression in the operant field. This reserves a block of memory whose length (in no. of words) is equal to the value of the operand field. The block of memory is changed. A label may be present on the statement.

SPC - Space n lines: This statement does not appear in the listing. The operand field is evaluated, and a corresponding number of lines are left blank.

PAG - Advance to the top of next page: This statement does not appear in the listing. This causes the Assembler to advance the paper to the top of the next page.

APPENDIX H

Program Listing

SUBROUTINE-INDEX

```
;*****************************************************************
;
;   ***   6800 MICRO-PROCESSOR ASSEMBLER   ***
;   ***   WRITTEN BY:      P.S.KU AM
;   ***   DATE:            DEC. 1977
;
;*****************************************************************
;
; THIS PROGRAM ASSEMBLES THE 6800 MICRO-PROCESSOR
; SYMBOLIC CODE AS DEFINED IN THE REPORT,AND PRODUCES
; A LISTING AND OBJECT CODE. THE OBJECT CODE IS IN
; PAPER-TAPE FORMAT,AS DEFINED BY MOTOROLA.
;
;*****************************************************************

        .LOC    40

;*****************************************************************
;
; THE FOLLOWING GLOBAL VARIABLES ARE USED IN THE
; PROGRAM. THESE ARE PLACED IN PAGE ZERO FOR EASY
; ACCESS BY VARIOUS ROUTINES.
;
;*****************************************************************

;*****************************************************************
;
; THE SIX GLOBAL VARIABLES DEFINED BELOW REPRESENT
; THE VARIOUS DEVICE CODES.
;
;*****************************************************************

PNCV:           11                      ;BINARY PUNCH
                                        ; OUTPUT DEVICE.
ECOCV:          0                       ;ECHO DEVICE
                                        CODE.
MCINC:          10                      ; CODE QUERY
                                         INPUT DEVICE.
```

```
;
;DCTO:          11                      ; MODE QUERY
;                                       ; OUTPUT DEVICE.
;SCIND:         11                      ; SOURCE CODE
;                                        INPUT DEVICE.
;SLCTO:         11                      ; SOURCE LISTING
;                                       ; OUTPUT DEVICE.
;
;*****************************************************
;
;
;ASFLG:   .BLK   1                      ; THIS FLAG IS
;                                       ; USED TO FIND
;                                       ; OUT WHETHER
;                                       ; THE INPUT HAS
;                                       ; ASCII A,B OR
;                                       ; NEITHER.
;ADLBL:   .BLK   1                      ; ADDRESS OF CURR
;                                       ; ENT LABEL.
;BNFLG:   .BLK   1                      ; WHETHER OBJECT
;                                       ; CODE HAS TO BE
;                                       ; FUNCTIONED.
;BNOUT:          BNOU1                  ; ADDRESS OF
;                                        OBJECT CODE
;                                        BUFFER.
;BREAK:   .BLK    1                     ; CONTAINS THE
;                                        CURRENT BREAK
;                                        CHARACTER.
;BSVAL:   .BLK   1                      ;BASE VALUE OF
;                                        CURRENT INST.
;CHPTR:   .BLK   1                      ;POINTS TO NEXT
;                                        POSITION IN
;                                        INPUT LINE.
;CMSAD:   .BLK   1                      ;STARTING ADD.
;                                        OF COMMENTS IN
;                                        INPUT LINE.
;CMFLG:   .BLK   1                      ;FLAG INDICATING
;                                        WHETHER COMMENT.
;DEFNM:          DEFN1                  ; POINTS TO NAME ADD.
;DIRAD:          DIRA1                  ; ADDRESS OF
;                                        #DIRAD#.
;DEFPT:   .BLK   1                      ; POINTS LAST ENTRY IN
;                                        #DIRAD#.
;R1PT:    .BLK   1                      ; POINTS LAST ENTRY OF
;                                        #ER1TB#.
;R2PT:    .BLK   1                      ; POINTS LAST ENTRY OF
;                                        #ER2TB#.
;
```

```
ENCAD:    .BLK    1
;
ENDFG:    .BLK    1
;
ER1TB:            ER1T1
;
ER2TB:            ER2T1
;
I.POV:    .BLK    1
INSLN:            INSL1
;
LBFLG:    .BLK    1
;
LCFLG:    .BLK    1
;
LNTH:     .BLK    1
;
LNCTR:    .BLK    1
LOCAL:    .BLK    1
;
LOCTN:    .BLK    1
;
LOCTR:    .BLK    1
;
LTFLG:    .BLK    1
;
MOPTB:            MOPT1
NAME:             NAME1
;
NEMOT:            111
;
NOSYM:    .BLK    1
;
NOWDS:            25
;
OPRLG:    .BLK    1
;
OPOTB:            OPOT1
;
OPPTR:            OPPT1
;
OPRBG:    .BLK    1
;
```

```
;  ERROR PASS IS
   REQUIRED.
;  WHETHER CURR.
   PASS HAS ENDED.
;  ADD. OF PASS1
   ERROR TABLE.
;  ADD. OF PASS2
   ERROR TABLE.
;INP. BUF.
;  ADD. OF INPUT
   LINE.
;  WHETHER LABEL
   IS PRESENT IN
   CURR. LINE.
;  WHETHER LOCTR
   HAS TO BE
   LISTED.
;  LENGTH OF CURR
   ENT INST.
;  CURR.LINE NO.
;  NO. OF WDS. IN
   OBJECT BUFFER.
;  VALUE ENTERED
   IN THE LOC.
   FIELD.
;  ADD. OF CURR.
   INSTRUCTION.
;WHETHER LISTING
   IS REQD.
;  ADD. OF M.O.T.
;  ADD. OF CURR.
   NAME.
;  NO. OF ENTRIES
   IN M.O.T.
;  NO. OF SYMBOLS
   IN SYM.TABLE.
;  NO. OF WDS.
   PER DATA REC.
;POINTS TO OPCDE
   IN INPUT LINE.
;  ADD. OF DEF.
   OPTIONS TABLE.
;  ADD. OF CURR.
   OPTIONS TABLE.
;  POINTS TO OPER
   -ANDS IN
   INPUT LINE.
```

```
OUTDV:    .BLK    1                       ;OUTPT DV.
P1ERR:    .BLK    1                       ;ERROR WD CORR.
                                           TO PASS1.
PAGNO:    .BLK    1                       ; CURR. PAGE OF
                                           LISTING.
PNFLG:    .BLK    1                       ; WHETHER BUFFER
                                           HAS TO BE
                                           FLUSHED.
POEPT:            PCPT1+41                ; P.O.T. END
                                           POINTER.
POPTB:            PCPT1                   ; ADD. OF P.O.T.
PPERR:    .BLK    1                       ;ERROR WD OF
                                           CURR. PASS.
PRPTR:    .BLK    1                       ; POINTS TO NEXT
                                           CH. IN PRTLN.
PRTLN:            PRTL1                   ; ADD. OF PRINT
                                           LINE.
PSFLG:    .BLK    1                       ; WHETHER PASS
                                           1 OR 2.

SCFLG:    .BLK    1                       ; WHETHER LIST-
                                           -ING IS NECC.
                                           IN THIS SCAN.
SYMTB:            SYMT1                   ;ADD. OF SYMTB.
                                           (SYMBOL TABLE).
VALUE:    .BLK    1                       ; VALUE TO BE
                                           PRINTED IN A
                                           RMB/EQU INST.
VLFLG:    .BLK    1                       ; WHETHER VALUE
                                           HAS TO BE
                                           PRINTED.
WSPCE:            WSPC1                   ; ADD. OF SPACE
                                           WHERE INST. IS
                                           ASSEMBLED.



;*****************************************************

          .LOC    200

;*****************************************************

; THE FOLLOWING REPRESENT THE ADDRESSES OF VARIOUS
; ROUTINES USED ,SO THAT THEY CAN BE ACCESSED
; INDIRECTLY THRO THE BASE PAGE.
```

```
;
;**************************************************
;
;
ADD88:          AC188
ASSMB:          ASSM
BDC46:          BC146
BHX47:          BH147
BIN15:          BI115
BNY93:          BN193
CAC22:          CA122
CEF14:          CE114
CHCL6:          CH106
CHK73:          CH173
CLB76:          CL176
CVT84:          CV184
CVT96:          CV196
DEC91:          DE191
DIS00:          D1800
DIV90:          DI190
EBN36:          EB136
ELC29:          EL129
END52:          EN152
ENE26:          EN126
ENET9:          EN109
EPT83:          EP183
EQU53:          EQ153
EFL28:          ER128
ESC32:          ES132
EVL97:          EV197
EWS31:          EW131
EX802:          E1802
FCB54:          FC154
FCC55:          FC155
FCB56:          FC156
FVF34:          FV134
GCH81:          GC181
GET78:          GE178
GLB41:          GL141
GNC87:          GN187
HEX94:          HE194
HSH80:          HS180
IBN35:          IB135
IMM99:          IM199
INP01:          I1801
INIT0:          IN100
INFS4:          IN104
```

```
INT13:          IN113
LAC21:          LA121
MPY72:          MP172
LOC30:          LC130
LSM18:          LS118
MOD85:          MC185
NAM57:          NA157
NEF17:          NE117
OCT92:          OC192
OPT58:          OP158
ORG59:          OR159
ORF77:          OR177
PAG60:          PA160
PASS1:          PA101
PASS2:          PA102
PCH37:          PC137
PED20:          PE120
PLF08:          PL108
PN303:          P1303
PNL12:          PN112
PROP7:          PR107
PFT82:          PR182
PSC10:          PS110
PSY39:          PS139
PUN40:          PU140
PUT75:          PU175
RED74:          RE174
RMB61:          RM161
RNC05:          RN105
SAB98:          SA198
SCP23:          SC123
SMT44:          SM144
SPC62:          SP162
SPM25:          SP125
SPT43:          SP143
SST51:          SS151
STAC4:          S13C4
STB79:          ST179
SUB89:          SU189
SUM50:          SU150
SYM95:          SY195
UPC11:          UP111
VLB42:          VL142
VTP24:          VT124
WOUP3:          WC103
WRT86:          WR186
;
```

```
;*****************************************************
;
; THE FOLLOWING REPRESENT THE ADDRESSES OF THE SERVICE
; ROUTINES FOR THE NINE DIFFERENT TYPES OF MACHINE-
; -OPERATION-CODES OF THE M6800.
;
;*****************************************************

ACC63:          AC163
STA64:          ST164
ASL65:          AS165
PSH66:          PS166
CPX67:          CP167
STS68:          ST168
JMP69:          JM169
BCC70:          BC170
ABA71:          AB171

;*****************************************************

        .LOC    2000

;*****************************************************

; NAME.                         ASSMB
; FUNCTION.                     CROSS ASSEMBLER.
; INPUT.                        SOURCE-CODE AS DEFINED IN
;                               THE REPORT.
; OUTPUT.                       SOURCE-LISTING.
;                               OBJECT CODE IN THE MOTOROLA
;                               PAPER-TAPE FORMAT.
; CALLS.                        MODES,PASS1,PASS2
; CALLED-BY.                    NONE.
; GLOBAL-VARIABLES-USED.        ENDAD.
; GLOBAL-VARIABLES-CHANGED.
```

```
                                        NONE.
ERROR-BITS-SET.
                                        NONE.


MOD85 IS CALLED TO DECIDE  PASS1 OR PASS2 IS TO BE
CALLED.MOD85 ALSO SETS FLAGS TO DENOTE WHETHER OBJECT
CODE OR LISTING IS NEED.

ASSM:   JSR$    #MOD85
        LDA     0,ENDAD
        NOV     0,0,SZR

ENDAD=1,PASS2 IS NEED

        JMP     NEXT

ENDAD=0,PASS1

        JSR$    PASS1
        JMP     ASSM

PASS2.

NEXT:   JSR$    PASS2
        JMP     ASSM

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


NAME.
                                        INITO.
FUNCTION.
                                        INITIALISES VARIABLES BEFOR
                                        PASS1.
INPUT.
                                        NONE.
OUTPUT.
                                        NONE.
CALLS.
                                        NONE.
CALLED-BY.
                                        PASS1.
GLOBAL-VARIABLES-USED.
                                        DIRAD,DEFNM,ERITB,NAME,
                                        OPDTB,OPFTB,SYMTB.
```

```
;GLOBAL-VARIABLES-CHANGED.
;                                BNFLG,DEFL1,DIRA1,DREPT,
;                                E1EPT,ENDFG,ER1T1,LFCTR,
;                                LOCTN,LOCTR,LTFLG,NAME1,
;                                NOSYM,OPFT1,SYMT1.
;ERROR-BITS-SET.
;                                NONE.
;
;SPACE FOR SAVING ACC. CONTENTS.
;
AC0000:    .BLK    1
AC1000:    .BLK    1
AC2000:    .BLK    1
AC3000:    .BLK    1
;
;CONSTANTS,COUNTERS.
;
CN0000:            0
CN1000:            1
CN2000:            62                      ; DEC. 50.
CN3000:    .BLK    1
CN4000:            6
CN5000:    .BLK    1
CN6000:            3
CN7000:            5
CN8000:            400                     ;DEC  256
CN9000:            4                       ;DEC  4
CTR000:    .BLK    1                       ;COUNTER
;
;SAVE ACCS.,ENTRY.
;
IN1000:    STA     0,AC0000
           STA     1,AC1000
           STA     2,AC2000
           STA     3,AC3000
;
;INITIALISE BNFLG,LOCTR,LTFLG TO 0.
;INITIALISE ENDFG,LOCTN, TO 0.
;
           SUB     0,CN0000
           STA     0,BNFLG
           STA     0,ENDFG
           STA     0,LOCTN
           STA     0,LOCTR
           STA     0,LTFLG
```

```
;
;
; INITIALISE DIRAD,ERITE TO ALL ZEROES.
;
        LDA     3,CM200
        STA     3,CM300
        LDA     2,DIRAD
        LDA     3,ER1TB
;
        STA     0,0,2
        STA     0,0,3
        INC     2,2
        INC     3,3
        DSZ     CM300
        JMP     .-5
;
;
; INITIALISE LNCTR,PSFLG,TO 1.
;
        LDA     0,CM100
        STA     0,LNCTR
        STA     0,PSFLG
;
; INITIALISE DREPT
;
        LDA     0,DIRAD
        STA     0,DREPT
;
; INITIALISE E1EPT.
;
        LDA     0,ER1TB
        STA     0,E1EPT
;
; INITIALISE NAME TO DEFNM.
;
        LDA     2,DEFNM
        LDA     3,NAME
        LDA     0,0,2
        STA     0,0,3
        LDA     0,1,2
        STA     0,1,3
        LDA     0,2,2
        STA     0,2,3
;
;
; INITIALISE OPTION FLAG TABLE (OPFTB) TO
; DEFAULT VALUES (OPDTB).
```

```
; CN400 CONTAINS DEC. 6.
;
        LDA     0,CN400
        STA     0,CN500
        LDA     2,OPDTB
        LDA     3,OPFTB
;
        LDA     0,0,2
        STA     0,0,3
        INC     2,2
        INC     3,3
        DSZ     CN500
        JMP     .-5
;
; INITIALISE NOSYM.
; CN600 HAS VALUE DECIMAL 3;
;
        LDA     2,OPDTB
        LDA     0,CN600
        ADC     0,2
        LDA     0,0,2
        STA     0,NOSYM
;
; INITIALISE SYMBOL TABLE,256 ENTRIES,FIRST WORD OF
; EACH ENTRY IS CLEARED.
;
        LDA     0,CN500                 ;DEC 256
        STA     0,CTR00
;
;
        LDA     3,SYMTB
        LDA     1,CN900
        LDA     0,CN000                 ; VALUE 0
;
        STA     0,0,3                   ;CLR NEXT ENTRY.
        ADD     1,3                     ;ADD 4
        DSZ     CTR00
        JMP     .-3
;
; RESTORE ACC CONTENTS AND RETURN.
;
        LDA     0,AC000
        LDA     1,AC100
        LDA     2,AC200
        JMPS    AC300
;
```

```
;*****************************************************
;
; NAME.                          PASS1.
; FUNCTION.                      PERFORMS THE PASS1 FUNCTION
;                                OF SETTING UP SYMBOL TABLE
;                                AND ERROR TABLE.ALSO SETS
;                                UP ≠DIRECT ADDRESS≠TABLE.
; INPUT.                         SOURCE CODE.
; OUTPUT.                        SYMBOL TABLE,ERROR TABLE
;                                AND ≠DIRECT ADDRESS≠ TABLE.
; CALLS.                         INIT0,INPS4,RNC05,CHOL6,
;                                PROP7,ENET3,PSC10,UPD11,
;                                NER17.
; CALLED-BY.                     ASSMB.
; GLOBAL-VARIABLES-USED.         CMFLG,ENDFG.
; GLOBAL-VARIABLES-CHANGED.      NONE.
; ERROR-BITS-SET.                NONE.

; LOCATIONS FOR STORING ACC CONTENTS.
AC001:    .BLK    1
AC101:    .BLK    1
AC201:    .BLK    1
AC301:    .BLK    1
; STORE ACC CONTENTS.
PA101:    STA     0,AC001
          STA     1,AC101
          STA     2,AC201
          STA     3,AC301
; INITIALISE NECC. VARIABLES.
          JSRS    INIT0
;
```

```
;
; CALL NECC. ROUTINES UNTIL END PSEUDO-OP
; IS ENCOUNTERED.
;
LB101:  JSR$    INPS4
        JSR$    ENCD5
        JSR$    CHCL6
;
; CHECK WHETHER COMMENT OR NOT
;
        LDA     0,CMFLG
        MOV     0,0,SNR
;
; NOT A COMMENT.
;
        JSR$    PROP7
        JSR$    ENET9
        JSR$    PSC10
        JSR$    UPD11
;
; CHECK FOR END OF PASS.
;
        LDA     0,ENDFG
        MOV     0,0,SNR
        JMP     LB101
;
; END OF PASS-1.
; LIST OUT TOTAL NO. OF ERRORS.
;
        JSR$    NER17
;
; RESTORE ACCS. AND RETURN.
;
        LDA     0,AC001
        LDA     1,AC101
        LDA     2,AC201
        JMP$    AC301
;
;*****************************************************
;
; NAME.                   INI13
; FUNCTION.               INITIALISES THE NECC. VARIA
```

```
;
;  INPUT.                          -BLES BEFORE PASS2.
;
;  OUTPUT.                         NONE.
;
;  CALLS.                          NONE.
;
;  CALLED-BY.                      PASS4.
;
;  GLOBAL-VARIABLES-USED.          PASS2.
;
;  GLOBAL-VARIABLES-CHANGED.       BNOUT,ER2TB.
;                                  BNOL1;E2EPT,ER2TB,LINCTR,
;                                  LOCAL;LOCTN;LOCTR,PAGNO,
;                                  PSFLG,ENDFG.
;  ERROR-BITS-SET.                 NONE.
;
;  SPACE FOR SAVING ACCS.
;
AC013:    .BLK    1
AC113:    .BLK    1
AC213:    .BLK    1
AC313:    .BLK    1
;
;  CONSTANTS.
;
CNC13:            50                    ; DEC. 40.
CN113:            62                    ; DEC. 50
CTR13:    .BLK    1
;
;  SAVE ACCS. ENTRY.
;
IN113:    STA     0,AC013
          STA     1,AC113
          STA     2,AC213
          STA     3,AC313
;
;  INITIALISE E2EPT.
;
          LDA     0,ER2TB
          STA     0,E2EPT
;
;  INITIALISE LOCTR,LOCAL,LOCTN,PAGNO,ENDFG TO 0.
;
          SUB     0,0
```

```
        STA     0,LOCAL
        STA     0,LOCTR
        STA     0,LOCTN
        STA     0,PAGNO
        STA     0,ENDFG
;
;;INITIALISE LNCTR TO 1.
;
        INC     0,0
        STA     0,LNCTR
;
;;INITIALISE PSFLG TO 2.
;
        INC     0,0
        STA     0,PSFLG
;
;;INITIALISE ER2TB,CN113=50.
;
        LDA     0,CN113
        STA     0,CTR13
;
        LDA     2,ER2TB
        SUB     0,0
;
LB113:  STA     0,0,2
        INC     2,2
        DSZ     CTR13
        JMP     LB113
;
;;INITIALISE BNOUT.CN013=40.
;
        LDA     0,CN013
        STA     0,CTR13
;
        LDA     2,BNOUT
        SUB     0,0
;
LB213:  STA     0,0,2
        INC     2,2
        DSZ     CTR13
        JMP     LB213
;
;;CALL ON ROUTINE TO PUNCH OUT START RECORD.
;
        JSRS    PN303
;;
```

```
;CALL ON ROUTINE TO PRINT OUT HEADING.
;
        JSRS    PAGEJ
;
;RESTORE ACCS AND RETURN.
;
        LDA     0,AC013
        LDA     1,AC113
        LDA     2,AC213
        JMPS    AC313
;
;*****************************************************
;
;NAME.                                  PASS2
;FUNCTION.                              PRODUCES SOURCE-LISTING,
;                                       OBJECT CODE,SYMBOL TABLE.
;INPUT.                                 SYMBOL TABLE,SOURCE-CODE,
;                                       #DIRECT-ADDRESS TABLE.
;OUTPUT.                                OBJECT CODE,SOURCE LISTING,
;                                       ERROR LISTING,SYMBOL TABLE.
;CALLS.                                 INT13,INPS4,ANNC5,CHOL6,
;                                       PROP7,CEP14,ENET9,BIN15,
;                                       PSC10,UPD11,WOUP3.
;CALLED-BY.                             ASSMB.
;GLOBAL-VARIABLES-USED.                 CMFLG,ENDFG.
;GLOBAL-VARIABLES-CHANGED.              NONE.
;ERROR-BITS-SET.                        NONE.
;
;LOCATIONS FOR STORING ACC CONTENTS.
;
AC0C2:  .BLK    1
AC102:  .BLK    1
AC202:  .BLK    1
AC302:  .BLK    1
;
```

```
;
; SAVE ACC CONTENTS.
;
PA102:  STA     0,AC002
        STA     1,AC102
        STA     2,AC202
        STA     3,AC302
;
; INITIALISE NEDC. VARIABLES.
;
        JSR$    INT13
;
; SCAN SOURCE CODE LINE BY LINE UNTIL
; END PSEUDO-OP IS ENCOUNTERED.
;
LBL02:  JSR$    INPS4                   ; INITIALISE.
;
; READ FROM INPUT
;
        JSR$    RNCD9
;
; CHECK COL 1 AND TAKE ACTION.
;
        JSR$    CHCL6
;
; CHECK WHETHER COMMENT OR NOT.
;
        LDA     0,CMFLG
        MOV     0,0,SNR
;
; NOT A COMMENT,PROCESS OP-CODE,CHECK ERROR WORD,
; ENTER INTO ERROR TABLE.
;
        JSR$    PROP7
        JSR$    CER14
        JSR$    ENET9
;
; CALL ON ROUTINES TO PRODUCE OBJECT CODE/LISTING.
;
        JSR$    BIN15
        JSR$    PSC10
;
; UPDATE COUNTERS.
;
        JSR$    UPD11
;
```

```
;
; CHECKK FOR END OF PASS
;
        LDA     0,ENDFG
        MOV     0,0,SNR
        JMP     LBL02
;
; END OF PASS 2,CLEAN-UP,RESTORE ACCS AND RETURN.
;
        JSR@    WDUP3
;
        LDA     0,AC002
        LDA     1,AC102
        LDA     2,AC202
        JMP@    AC302
;
;*****************************************************
;
; NAME.                         WDUP3
; FUNCTION.                     DOES THE CLEARING UP.
; INPUT.                        SYMBOL TABLE,ERROR TABLE.
; OUTPUT.                       EOF RECORD,SYMBOL TABLE,
;                               NO. OF ERRORS.
; CALLS.                        NEW17,LSM16,PED20.
; CALLED-BY.                    PASS2.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               NONE.
;
;  LOCATIONS TO STORE ACC CONTENTS.
AC303:  .BLK    1
; SAVE ACC CONTENTS
WD103:  STA     3,AC303
;
```

```
PUNCH OUT EOF RECORD.
        JSR$    PE320
PRINT OUT TOTAL NO. OF ERRORS.
        JSR$    ME317
LIST SYMBOL TABLE.
        JSR$    LSM16
RESTORE ACCS AND RETURN.
        JMP$    AC303
```

****

NAME. INPS4

FUNCTION. INITIALISE VARIABLES ON EACH SCAN.

INPUT. NONE.

OUTPUT. NONE.

CALLS. NONE.

CALLED-BY. PASS1,PASS2.

GLOBAL-VARIABLES-CHANGED. ABFLG,ABVAL,CMPTR,CMBEG, CMFLG,INSL1,LBFLG,LCFLG, LENTH,OPBEG,OPFLG,P1ERR, PMFLG,PREMD,PRPTR,PFTL1, SCFLG,VALUE,VLFLG,WSPC1.

GLOBAL-VARIABLES-USED. WSPCE,PFTLN,INSLN.

ERROR-BITS-SET. NONE.

SPACE FOR SAVING ACC CONTENTS.

```
AC004:    .BLK    1
AC104:    .BLK    1
AC204:    .BLK    1
AC304:    .BLK    1
;
; CONSTANTS,COUNTERS.
;
CN204:            2
CN304:            50                          ;DEC 40
CN404:            74                          ;DEC 60
CN504:            20040                       ; 2 BLANKS
CTR04:    .BLK    1                           ;COUNTER
;
; SAVE ACC CONTENTS.
;
IN104:    STA     0,AC004
          STA     1,AC104
          STA     2,AC204
          STA     3,AC304
;
;
; INITIALISE CMFLG,LBFLG,LENTH,PNFLG,PRERR,ABFLG,
; BSVAL,VLFLG,VALUE ,VLFLG TO 0.
;
          SUB     0,0
          STA     0,CMFLG
          STA     0,LBFLG
          STA     0,LENTH
          STA     0,PNFLG
          STA     0,PRERR
          STA     0,ABFLG
          STA     0,BSVAL
          STA     0,VALUE
          STA     0,VLFLG
;
; INITIALISE CHPTR,CMBEG,PRPTR,OPBEG,OPRBG,
; LCFLG,SCFLG TO 1.
;
          INC     0,0
          STA     0,CHPTR
          STA     0,CMBEG
          STA     0,PRPTR
          STA     0,OPBEG
          STA     0,OPRBG
          STA     0,SCFLG
          STA     0,LCFLG
;
```

```
;
; INITIALISE WSPCE TO 0.
;
        LDA     2,WSPCE
        STA     0,0,2
        STA     0,1,2
;
; INITIALISE PRTLN TO ALL BLANKS.CN404=60,CN504=BLANKS.
;
        LDA     1,CN404
        STA     1,CTR04
;
        LDA     2,PRTLN
        LDA     0,CN504
;
LB104:  STA     0,0,2
        INC     2,2
        DSZ     CTR04
        JMP     LB104
;
; INITIALISE INSLN TO ALL BLANKS.CN304=40,CN504=BLANKS.
;
        LDA     0,CN304                 ;DEC 40.
        STA     0,CTR04
;
        LDA     0,CN504                 ;BLANKS
        LDA     2,INSLN
;
LB204:  STA     0,0,2
        INC     2,2
        DSZ     CTR04
        JMP     LB204
;
; SET VALUE FOR PIERR IF PASS2.CN204=2.
;
        LDA     0,PSFLG
        LDA     1,CN204
;
; CHECK FOR PASS=2
;
        SUB     0,1,SZR
        JMP     END04                   ; PASS IS 1,
;                                         DO NOTHING.
; PASS IS 2.SET VALUE FOR PIERR.
;
        LDA     1,LNCTR
```

```
          LDA     2,ER1TE
          LDA     3,E1EPT
;
LB304:    SUBE    2,3,SNR                 ; CHECK FOR
;                                         ; END OF TABLE.
          JMP     NFD04                   ; NOT FOUND.
;
; WHOLE TABLE HAS NOT BEEN SEARCHED.
;
          LDA     0,0,2
          SUBE    0,1,SNR                 ; EQUALITY TEST.
          JMP     FND04                   ; FOUND.
          INC     2,2
          INC     2,2                     ; CHECK NEXT
;                                          ENTRY.
          JMP     LB304
;
; FOUND IN TABLE. INITIALISE P1ERR.
;
FND04:    INC     2,2
          LDA     0,0,2
          STA     0,P1ERR
          JMP     END04
;
; NOT FOUND,SET TO 0.
;
NFD04:    SUB     0,0
          STA     0,P1ERR
;
; RESTORE ACC CONTENTS AND RETURN.
;
END04:    LDA     0,AC004
          LDA     1,AC104
          LDA     2,AC204
          JMPS    AC304
;
;*****************************************************
;
; NAME.                                 RNCC5.
; FUNCTION.                             GET NEXT CARD FROM INPUT
;                                       DEVICE INTO INSLN.
; INPUT.                                NONE.
; OUTPUT.
```

```
;
;  CALLS.                          INSLN.
;
;  CALLED-BY.                      REC74,CHK73.
;
;  GLOBAL-VARIABLES-USED.          PASS1,PASS2.
;
;  GLOBAL-VARIABLES-CHANGED.       SCINO,ECODV,INSLN.
;
;  ERROR-BITS-SET.                 INPDV,OUTDV,INSL1.
;                                  NONE.
;
;  LOCATIONS FOR SAVING ACC CONTENTS.
;
AC005:    .BLK    1
AC105:    .BLK    1
AC205:    .BLK    1
AC305:    .BLK    1
;
;  CONSTANTS. 40,BLANK
;
CN005:            51                        ; DEC  41
BLK05:            40                        ;  BLANK
CTR05:    .BLK    1
;
;  SAVE ACC CONTENTS.
;
PN105:    STA     0,AC005
          STA     1,AC105
          STA     2,AC205
          STA     3,AC305
;
;  SET INPUT AND OUTPUT DEVICE CODES.
;
          LDA     0,SCINO
          STA     0,INPDV
          LDA     0,ECODV
          STA     0,OUTDV
;
;  SET COUNTER VALUE.
;  CN005= 40 DEC
;
          LDA     0,CN005
          STA     0,CTR05
;
          LDA     2,INSLN
```

```
;
LB1C5:  SUB     0,0                     ;CLEAR ACC 0.
        JSR@    RED74
;
; ACC 0 HAS CH IN RIGHT HALF.
;
        JSR@    CHK73                   ;CHECK IF CR,LF
        JMP     CR1C5                   ;CH IS CR,LF
        MOVS    0,1                     ; CH. IS OKAY,
;                                        SWAP AND MOVE.
        SUB     0,0                     ; CLEAR ACC0
        JSR@    RED74                   ; GET NEXT CH.
        JSR@    CHK73
        JMP     CR2C5                   ;CR CR LF
        ADD     0,1                     ;CH IS OKAY.
        STA     1,0,2                   ;STORE IN INSLN.
        INC     2,2
        DSZ     CTR05
        JMP     LB1C5
;
; COUNT OF 60 CHARACTERS.
;
        JMP     END05
;
; ODD CHARACTER IS CR.SO NO CH. TO BE SAVED.
;
CR1C5:  JMP     END05
;
; EVEN CHARACTER IS CR.SAVE 1 CH AND RETURN.
;
CR2C5:  MOV     1,0
        LDA     1,BLK05
        ADD     1,0
        STA     0,0,2
;
;
; RESTORE ACC AND RETURN.
;
END05:  LDA     0,AC005
        LDA     1,AC105
        LDA     2,AC205
        JMP@    AC305
;
;*****************************************************
;
; NAME.
```

```
;
;  FUNCTION.                    CHK73
;                               CHECKS WHETHER CH. IN
;                               ACC 0 IS CR,LF OR FF.
;  INPUT.
;                               CH. RIGHT ADJUSTED IN
;                               ACC 0 WITH BIT 8 SET TO 0 .
;  OUTPUT.
;                               IF CH. IS CR,LF OR FF,
;                               PUT OUT A LF AND TAKE
;                                 ≠AC 3 ≠RETURN.
;                               OTHERWISE TAKE
;                               ≠ACC 3 + 1≠ RETURN.
;  CALLS.
;                               PUT75
;  CALLED-BY.
;                               RNCC5.
;  GLOBAL-VARIABLES-USED.
;                               NONE.
;  GLOBAL-VARIABLES-CHANGED.
;                               NONE.
;  ERROR-BITS-SET.
;                               NONE.
;
;  LOCATIONS FOR SAVING ACC CONTENTS.
;
AC073:    .BLK    1
AC173:    .BLK    1
AC273:    .BLK    1
AC373:    .BLK    1
;
;  CONSTANTS.
;
CN173:          015                     ;CR
CN273:          014                     ;FF
CN373:          012                     ;LF
;
;  SAVE ACC CONTENTS.
;
CH173:    STA     0,AC073
          STA     1,AC173
          STA     2,AC273
          STA     3,AC373
;
;  CHECK TO SEE WHETHER CH. IS FF,CR OR LF.
;
```

```
        LDA     1,CN173                 ; CR
        SUBE    0,1,SNR
        JMP     CRT73                   ; CH. IS CR.
;
        LDA     1,CN273                 ; FF
        SUBE    0,1,SNR
        JMP     CRT73                   ;CH IS FF.
        LDA     1,CN373                 ; LF
        SUBE    0,1,SNR
        JMP     CRT73                   ; CH. IS LF.
;
; CH IS NEITHER. TAKE NORMAL RETURN
;
        INC     3,3
        STA     3,AC373
        JMP     END73
;
; CH IS FF OR CR.PUT OUT A LF AND TAKE AC3 RETURN.
;
CRT73:  LDA     0,CN373                 ; LF
        JSRS    PUT75
;
END73:  LDA     0,AC073
        LDA     1,AC173
        LDA     2,AC273
        JMPS    AC373
;
;*****************************************************
;
; NAME.                         CHCL6.
; FUNCTION.                     CHECKS COL 1 AND DECIDES
;                               IF LINE IS A COMMENT OR
;                               LABEL AND TAKE CORR. ACTION
; INPUT.                        INSLN.
; OUTPUT.                       NONE.
; CALLS.                        CAC21,CAC22,GCH31.
; CALLED-BY.                    PASS1,PASS2.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.
```

```
;
; ERROR-BITS-SET.                    NONE.
;                                    NONE.
;
; LOCATIONS FOR SAVING ACC CONTENTS.
;
AC006:    .BLK    1
AC106:    .BLK    1
AC206:    .BLK    1
AC306:    .BLK    1
;
; CH CODES FOR BLANK,* ,AND MASK
;
CN106:            40                        ; BLANK
CN206:            52                        ; *
CN306:            377                       ; MASK
;
; SAVE ACC CONTENTS.
;
CH106:    STA     0,AC006
          STA     1,AC106
          STA     2,AC206
          STA     3,AC306
;
; GET FIRST CHARACTER.
;
          JSRS    GCH61
;
; ACC CONTAINS FIRST CHARACTER.CHECK THE CHARACTER.
;
          LDA     1,CN106                   ; BLANK
          SUBE    0,1,SNR
;
; CHARACTER IS A BLANK. TAKE NO ACTION.
;
          JMP     END06
;
; CHECK WHETHER * OR NOT.
;
          LDA     1,CN206                   ; *
          SUBE    0,1,SNR
          JMP     CMT06                     ; COMMENT.
;
          JSRS    LAC21                     ; LABEL.
          JMP     END06
;
```

```
; COMMENT ACTION.
CMT06:  JSR$    CAC22

; RESTORE ACC AND RETURN.
END06:  LDA     0,AC006
        LDA     1,AC106
        LDA     2,AC206
        JMP$    AC306

;*****************************************************

; NAME.                          CAC22.
; FUNCTION.                      SET CMFLG.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         NONE.
; CALLED-BY.                     CHCL6.
; GLOBAL-VARIABLES-USED.         NONE.
; GLOBAL-VARIABLES-CHANGED.      CMFLG,LCFLG.
; ERROR-BITS-SET.                NONE.
; LOCATIONS FOR STORING ACC CONTENTS.
AC022:  .BLK    1
CNC22:          1
; SAVE ACCS AND SET FLAG.
CA122:  STA     0,AC022

        LDA     0,CNC22
        STA     0,CMFLG
;
```

```
; SET LCFLG TO 0.

        SUB     0,0
        STA     0,LCFLG

; RESTORE ACC CONTENTS.

        LDA     0,AC022
        JMP     0,3

;*****************************************************

; NAME.                                 LAC21.
; FUNCTION.                             SET L3FLG,CHECK LABEL,
                                        AND TAKE ACTION.
; INPUT.                                INSLN.
; OUTPUT.                               NONE.
; CALLS.                                GL341,VLS42.
; CALLED-BY.                            CHCL6.
; GLOBAL-VARIABLES-USED.                NONE.
; GLOBAL-VARIABLES-CHANGED.             L3FLG.
; ERROR-BITS-SET.                       NONE.

; LOCATIONS FOR SAVING ACC CONTENTS.

AC021:  .BLK    1
AC121:  .BLK    1
AC221:  .BLK    1
AC321:  .BLK    1

; CONSTANTS.

CN021:          1

; SAVE ACC CONTENTS.
```

```
;
LA121:  STA     0,AC021
        STA     1,AC121
        STA     2,AC221
        STA     3,AC321
;
; SET LABEL FLAG.
;
        LDA     0,CN021                 ; DEC 1
        STA     0,LBFLG
;
; GET LABEL. IE. SET CHPTR TO POINT TO END
; OF LABEL(CH AFTER LABEL).
;
        JSR@    GL341
;
; CHPTR HAS BEEN SET.CALL ON ROUTINE TO CHECK
; VALIDITY OF LABEL,AND IF VALID TAKE ACTION.
;
        JSR@    VL342
;
; RESTORE ACC CONTENTS AND RETURN.
;
        LDA     0,AC021
        LDA     1,AC121
        LDA     2,AC221
        JMP@    AC321
;
;*****************************************************
;
; NAME.                         CL376.
; FUNCTION.                     CHECKS WHETHER CH IN
;                               ACC 0 IS ALPHANUMERIC.
; INPUT.                        CH. IN RIGHT HALF OF ACC 0.
; OUTPUT.                       #AC 3 + 1 #RETURN IF ALPHA
;                               #AC 3 # RETURN OTHERWISE.
; CALLS.                        NONE.
; CALLED-BY.                    VL342.
; GLOBAL-VARIABLES-USED.        NONE.
```

```
;
; GLOBAL-VARIABLES-CHANGED.                    NONE.
; ERROR-BITS-SET.                              NONE.
;
;
; LOCATIONS FOR STORING ACC CONTENTS.
;
AC076:    .BLK    1
AC176:    .BLK    1
AC276:    .BLK    1
AC376:    .BLK    1
;
; CONSTANTS.
;
CN076:            60                          ;≠0≠
CN176:            71                          ;≠9≠
CN276:            101                         ;≠A≠
CN376:            132                         ;≠Z≠
;
; SAVE ACC CONTENTS.
;
CL176:    STA     0,AC076
          STA     1,AC176
          STA     2,AC276
          STA     3,AC376
;
; CHARACTER IS IN RIGHT HALF OF ACC.
;
          LDA     1,CN076                     ; ≠0≠
          SUBLE   1,0,SZC
          JMP     NXT76                       ; NOT NUMERIC.
;
          LDA     1,CN176                     ;≠9≠
          SUBLE   0,1,SZC                     ; CHECK.
          JMP     NXT76                       ; NOT NUMERIC.
          JMP     VL076                       ; VALID CH,
;                                             NUMERIC.
; CHECK WHETHER ALPHABETIC.
;
NXT76:    LDA     1,CN276                     ; ≠A≠
          SUBLE   1,0,SZC                     ; CHECK
          JMP     ERR76                       ; NOT ALPHA-
;                                             NUMERIC,ERROR.
          LDA     1,CN376                     ; ≠Z≠
```

```
          SUBLE   0,1,SZC
          JMP     ERR76                   ; NOT ALPHA-
;                                         NUMERIC,ERROR.
          JMP     VLD76                   ; ALPHABETIC.
;
; VALID CHARACTER,TAKE AC3+1 RETURN.
;
VLD76:    LDA     0,AC376
          INC     0,0
          STA     0,AC376
;
ERR76:    LDA     0,AC076
          LDA     1,AC176
          LDA     2,AC276
          JMPS    AC376
;
;*****************************************************
;
; NAME.                          VLB42.
; FUNCTION.                      CHECKS VALIDITY OF LABEL
;                                AND TAKES CORR. ACTION.
; INPUT.                         CHPTR POINTS TO CH. AFTER
;                                LABEL.
; OUTPUT.                        NONE.
; CALLS.                         SST51,ENE26,CLB76.
; CALLED-BY.                     LAC21.
; GLOBAL-VARIABLES-USED.         INSLN.
; GLOBAL-VARIABLES-CHANGED.      NONE.
; ERROR-BITS-SET.                BIT 0 (I).
;
; LOCATIONS FOR SAVING ACC CONTENTS.
;
AC042:    .BLK    1
AC142:    .BLK    1
AC242:    .BLK    1
```

```
AC342:   .BLK    1
;
; CONSTANTS AND COUNTERS.
;
CN042:           10                     ;DEC 8
CN242:           377                    ;MASK
CN342:           101                    ; 'A'
CN442:           132                    ;'Z'
CTR42:   .BLK    1
;
; SAVE ACC CONTENTS.
;
VL142:   STA     0,AC042
         STA     1,AC142
         STA     2,AC242
         STA     3,AC342
;
; CHECK FOR VALIDITY OF LENGTH.
;
         LDA     0,CHPTR
         LDA     1,CN042                ;DEC 6
         SUBLE   1,0,SNC
         JMP     ERR42                  ;INVALID LENGTH
;
; CHECK FOR FIRST CHARACTER ALPHABETIC.
;
         LDA     2,INSLN
         LDA     0,0,2
         MOVS    0,0
         LDA     1,CN242                ; MASK
         AND     1,0
;
         LDA     1,CN342                ;'A'
         SUBLE   1,0,SZC
         JMP     ERR42                  ; NOT ALPHA.
         LDA     1,CN442                ; 'Z'
         SUBLE   0,1,SZC
         JMP     ERR42                  ; NOT ALPHA.
;
; FIRST CH. IS OKAY,CHECK OTHERS FOR ALPHANUMERIC.
;
         LDA     0,CHPTR
         STA     0,CTR42
         DSZ     CTR42                  ; SET UP CTR.
;
         LDA     2,INSLN
```

```
;
LB142:  LDA     0,J,2
        MOVC    0,0
        LDA     1,CH242                 ; MASK
        AND     1,J
;
        JSR@    CLB76                   ; CHECK FOR
;                                         ALPHA-NUMERIC.
        JMP     ERR42                   ; NOT ALPHA.
;
        DSZ     CTR42
        JMP     .+2
        JMP     NXT42                   ; ALL CH CHECKED
;
        LDA     0,J ,2
        LDA     1,CH242                 ; MASK
        AND     1,J
;
        JSR@    CLB76                   ; CHECK
        JMP     ERR42                   ; NOT ALPHA.
        INC     2,2
        DSZ     CTR42
        JMP     LB142
;
; LABEL CHECKED AND VALID.
;
NXT42:  JSR@    SST51
        JMP     END42
;
; ERROR IN LABEL, ENTER IT.
;
ERR42:  SUB     0,J
        STA     0,ARG42
        JSR@    ERE26
ARG42:  .BLK    1
;
; RESTORE ACC AND RETURN.
;
END42:  LDA     0,AC042
        LDA     1,AC142
        LDA     2,AC242
        JMP@    AC342
;*****************************************************
;
;
; NAME.
```

```
;
;  FUNCTION.                        ENE26.
;
;  INPUT.                           SETS ERROR BIT.
;
;  OUTPUT.                          IN LOCATION AAC 3 + 1A
;
;  CALLS.                           NONE.
;
;  CALLED-BY.                       DSP77.
;                                   SST51,VLS42,FCC95,ST378,
;                                   SPM25,SYN95,EVL97,CIV90,
;                                   VTR24,BCC70,PSH66,ST304,
;                                   SA898,RMB61,ORG59,END52,
;                                   EQU53.
;  GLOBAL-VARIABLES-USED.           NONE.
;
;  GLOBAL-VARIABLES-CHANGED.        PRERR.
;
;  ERROR-BITS-SET.                  BIT CORR. TO VALUE
;                                   IN LOC. AAC 3 + 1A.
;
;  LOCATIONS FOR SAVING ACC CONTENTS.
;
AC026:    .BLK    1
AC126:    .BLK    1
AC226:    .BLK    1
AC326:    .BLK    1
;
;  CONSTANTS FOR SETTING BIT IN PRERR.
;
ERS26:              1
                    2
                    4
                   10
                   20
                   40
                  100
                  200
                  400
                 1000
                 2000
                 4000
                10000
                20000
```

```
                        40000
                        100000
ERA26:                  ERS26
;
;  SAVE ACC CONTENTS.
;
EN126:    STA       0,ACC26
          STA       1,AC126
          STA       2,AC226
          STA       3,AC326
;
;  LOAD FLAG NUMBER.
;
          LDA       0,0,3
;
;  LOAD CORR. VALUE.
;
          LDA       2,ERA26
          ADD       0,2
          LDA       0,0,2
;
;  FORM THE BIT IN.
;
          STA       0,AG126
          LDA       0,PRERR
          STA       0,AG226
          JSRR      ORR77
AG126:    .BLK      1
AG226:    .BLK      1
AG326:    .BLK      1
;
;  SAVE IT BACK IN PRERR.
;
          LDA       0,AG326
          STA       0,PRERR
;
;  RESTORE ACC AND RETURN.
;
          LDA       0,ACC26
          LDA       1,AC126
          LDA       2,AC226
          LDA       3,AC326
;
          JMP       1,3
;
;*****************************************************************
```

```
;
;  NAME.                          REC74.
;  FUNCTION.                      READ NEXT CH AND
;                                 ECHO IT OUT.
;  INPUT.                         NONE.
;  OUTPUT.                        CH. IN AC2 , RIGHT
;                                 ADJUSTED WITH BIT 0 SET
;                                 TO 0.
;  CALLS.                         GET74,PUT75.
;  CALLED-BY.                     RNCC5,MOD85.
;  GLOBAL-VARIABLES-USED.         NONE.
;  GLOBAL-VARIABLES-CHANGED.      NONE.
;  ERROR-BITS-SET.                NONE.
;
;  LOCATIONS FOR SAVING ACC CONTENTS.
;
AC174:   .BLK    1
AC274:   .BLK    1
AC374:   .BLK    1
;
;  SAVE ACC CONTENTS.
;
RE174:   STA     1,AC174
         STA     2,AC274
         STA     3,AC374
;
;  GET NEXT CHARACTER AND PRINT IT OUT
;
         JSRS    GET74
         JSRS    PUT75
;
;  RESTORE ACC CONTENTS AND RETURN.
;
         LDA     1,AC174
         LDA     2,AC274
         LDA     3,AC374
```

```
;
        JMP     0,3
;
;*****************************************************
;
; NAME.                         PUT75.
; FUNCTION.                     PUTS OUT NEXT CH. ONTO
;                               OUTPUT DEVICE(OUTDV).
; INPUT.                        IN ACC 3 RIGHT ADJUSTED.
; OUTPUT.                       NONE.
; CALLS.                        NONE.
; CALLED-BY.                    LOTS OF ROUTINES.
; GLOBAL-VARIABLES-USED.        OUTDV.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               NONE.
;
; LOCATIONS FOR SAVING ACC CONTENTS.
;
AC075:  .BLK    1
AC175:  .BLK    1
DOA75:          61100
SKN75:          63600
;
;    SAVE ACC CONTENTS.
;
PU175:  STA     3,AC075
        STA     1,AC175
;
; SET UP INST. DEP ON DEVICE.
;
        LDA     0,OUTDV
        IOV     3,3,SKR
        JMP     END75
        LDA     1,DOA75
        ADC     3,1
        STA     1,INO75
```

```
;
            LDA     1,SC.75
            ADD     0,1
            STA     1,INT75
;
            LDA     0,AC075
IAC75:      .BLK    1
INT75:      .BLK    1
            JMP     .-1
;
;
;  RESTORE ACC CONTENTS AND RETURN.
;
ENC75:      LDA     0,AC075
            LDA     1,AC175
            JMP     0,3
;
;*****************************************************
;
; NAME.                             GET76.
; FUNCTION.                         GET NEXT CH. FROM
;                                   INPUT DEVICE(INPDV)
; INPUT.                            NONE.
; OUTPUT.                           CH. IN ACC 0 RIGHT ADJUSTED
;                                   WITH BIT 8 SET TO 0.
; CALLS.                            NONE.
; CALLED-BY.                        REQ74.
; GLOBAL-VARIABLES-USED.            INPDV.
; GLOBAL-VARIABLES-CHANGED.         NONE.
; ERROR-BITS-SET.                   NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
AC176:      .BLK    1
;
```

```
; MASK
;
MSK78:          177
NIO78:          60100
SKM78:          63600
DIA78:          60400
LFD78:          12
;
; SAVE ACC CONTENTS
;
GE178:  STA     1,AC178
        LDA     0,INPDV
        MOV     0,0,SNR
        JMP     END78
        LDA     1,NIO78
        ADC     0,1
        STA     1,INO78
        LDA     1,SKM78
        ADC     0,1
        STA     1,INT78
        LDA     1,DIA78
        ADC     0,1
        STA     1,INF78
;
;
INO78:  .BLK    1
INT78:  .BLK    1
        JMP     .-1
INF78:  .BLK    1
        LDA     1,MSK78
        AND     1,0
        LDA     1,LFD78
        SUBE    0,1,SNR
        JMP     INO78
;
;
; RESTORE ACC CONTENTS AND RETURN.
;
END78:  LDA     1,AC178
        JMP     0,3
;
;*****************************************************
;
; NAME.                         SST-1.
; FUNCTION.
```

```
;                                  SEARCHES SYMBOL TABLE AND
;                                  INSERTS .IF ALREADY PRESENT
;                                  ERROR BIT IS SET.
;  INPUT.                          CHPTR VALUE BETWEEN 2
;                                  AND 7.
;  OUTPUT.                         NONE.
;  CALLS.                          STB75,ERR26.
;  CALLED-BY.                      VL342.
;  GLOBAL-VARIABLES-USED.          INSLN,CHPTR,PSFLG.
;  GLOBAL-VARIABLES-CHANGED.       NONE.
;  ERROR-BITS-SET.                 BIT NO. 0(I), 1(M).


;  SPACE FOR SAVING ACS CONTENTS.

AC051:    .BLK    1
AC151:    .BLK    1
AC251:    .BLK    1
AC351:    .BLK    1

;  CONSTANTS.

CN051:            0
CN151:            1
CN251:            2
CN351:            3

MSK51:            77400
CNA51:            40400                    ;  ≠A≠
CNB51:            41000                    ;  ≠B≠
CNX51:            54000                    ;  ≠X≠
CTF51:    .BLK    1

;  SPACE FOR SAVING LABEL

LBL51:    .BLK    3
LBA51:            LBL51

;  SAVE ACS CONTENTS.
```

```
;
SS151:  STA     0,AC051
        STA     1,AC151
        STA     2,AC251
        STA     3,AC351
;
;  CLEAR LBL51
;
;
        LDA     2,LBA51
        SUB     0,0
        STA     0,0,2
        STA     0,1,2
        STA     0,2,2
;
;  SET UP INDEX REGISTERS AND COUNTER.
;
        LDA     2,INSLN
        LDA     3,LBA51
        LDA     0,CHPTR
        STA     0,CTR51
        DSZ     CTR51
;
;  ACC 2 CONTAINS STARTING ADDRESS OF LABEL IN INSLN.
;  ACC 3 CONTAINS STARTING ADDRESS OF
;  LOCAL SPACE FOR LABEL.
;  CTR51 CONTAINS LENGTH OF LABEL.
;
;  MOVE LABEL INTO LOCAL SPACE.
;
NXT51:  LDA     0,0,2
        DSZ     CTR51
        JMP     EVN51
;
        LDA     1,MSK51
        AND     1,0
        STA     0,0,3
        JMP     OKY51
;
;
EVN51:  STA     0,1,3
        INC     3,3
        INC     2,2
        DSZ     CTR51
        JMP     NXT51
        JMP     OKY51
;
```

```
;
; WHOLE LABEL HAS BEEN TRANSFERRED.LBL51 CONTAINS LABEL
; PADDED ON RIGHT BY NULLS.
; CHECK FOR VALIDITY OF LABEL,
; ( A,B OR X)
;
OKY51:  LDA     0,LBL51
        LDA     1,CNA51                 ; CH A.
        SUBE    0,1,SNR                 ;TEST
        JMP     ERR51                   ; CH. A,ERROR.
;
        LDA     1,CNB51                 ; CH B.
        SUBE    0,1,SNR                 ;TEST
        JMP     ERR51                   ;IT IS CH B.
;
        LDA     1,CNX51                 ; CH X.
        SUBE    0,1,SNR                 ;TEST
        JMP     ERR51                   ; CH. X,ERROR.
;
; LABEL IS OKAY.
;
; CALL ON ROUTINE TO CHECK WHETHER LABEL IS PRESENT
; OR NOT,AND IF NOT PRESENT,INSERT LABEL.
;
        LDA     0,LBA51
        STA     0,AG151                 ; STARTING ADD.
;                                        OF LABEL.
;
        LDA     0,PSFLG
        LDA     1,CN151
        SUB     1,0
        STA     0,AG251                 ;FLAG DENOTING
;                                        WHETHER LABEL
;                                        HAS TO BE
;                                        INSERTED.
        JSRS    ST379
AG151:  .BLK    1
AG251:  .BLK    1
AG351:  .BLK    1
FLG51:  .BLK    1
;
; CHECK RETURNED VALUE TO SEE WHETHER FOUND ,IF AG351
; IS NEGATIVE,NOT FOUND.
;
        LDA     0,FLG51
        IOVLE   0,0,SZC
        JMP     NFD51                   ; NOT FOUND.
;
```

```
;
; FOUND.
;
FND51:  LDA     0,PSFLG
        LDA     1,CN151                 ; CONSTANT 1.
        SUBE    0,1,SZR
        JMP     END51                   ; PASS-2,
;                                         DO NOTHING.
; PASS-1,ENTER INTO BIT 1 OF PREFR.
        LDA     0,CN151
        STA     0,AG451
        JSRS    ENE26
AG451:  .BLK    1
        JMP     END51
;
; NOT FOUND IN TABLE.
;
NFD51:  LDA     0,PSFLG
        LDA     1,CN151                 ; CONSTANT 1.
        SUBE    0,1,SNR                 ; TEST FOR PASS.
        JMP     END51                   ; PASS-1,
;                                         DO NOTHING.
; PASS IS 2.
;
        JMP     .+1
        JMP     .+1
        JMP     .+1
        JMP     .+1
        JMP     .+1
        JMP     END51
;
; ERROR IN LABEL,ENTER AS BIT 0.
;
ERR51:  SUB     0,0
        STA     0,AG651
        JSRS    ENE26
AG651:  .BLK    1
;
; RESTORE ACC CONTENTS AND RETURN.
;
END51:  LDA     0,AC051
        LDA     1,AC151
        LDA     2,AC251
        JMPS    AC351
;
```

```
;*****************************************************************
;
; NAME.                          HS160.
; FUNCTION.                      PERFORMS THE SHIFTING PART
;                                OF THE HASHING OPERATION
;                                USING THE SYMBOL TABLE
;                                LENGTH AND PRODUCES THE
;                                HASH VALUE IN ACC1.
; INPUT.                         ACC 0.
; OUTPUT.                        ACC 1.
; CALLS.                         NONE.
; CALLED-BY.                     STB79.
; GLOBAL-VARIABLES-USED.         OPFTB.
; GLOBAL-VARIABLES-CHANGED.      NONE.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC360:  .BLK    1
AC280:  .BLK    1
;
; SAVE ACC CONTENTS.
;
HS160:  STA     3,AC360
        STA     2,AC280
        LDA     3,OPFTB
        LDA     2,3,3           ; LOAD SYMBOL
;                                 TABLE LENGTH.
        SUBZ    1,1             ; CLEAR ACC 1
        MOVZ    0,0             ; CLEAR CARRY.
        MOVZ    2,2
;
LP160:  MOVR#   2,2,SZC
        JMP     NXT60
```

```
          ICVL2   0,0
          ICVL    1,1
          JMP     LP180
NXT80:    ADD     1,0

;ACC 1 CONTAINS HASH VALUE H(K)
;ACC 0 RETURNS THE CHANGD K.

          LDA     2,AC280
          JMPS    AC380

;*****************************************************

;NAME.                          STB79.
;FUNCTION.                      DOES THE ACTUAL SEARCHING
;                               AND INSERTING OPERATIONS
;                               ON THE HASHED TABLE.
;INPUT.                         ADDRESS OF LABEL IN
;                               LOCATION ≠ACC 3 ≠.
;                               FLAG VALUE IN LOCATION
;                               ≠ ACC 3 + 1 ≠.
;                               FLAGED DENOTES INSERTION
;                               NEGC.
;OUTPUT.                        VALUE IN LOCATION ACC 3 + 2,
;                               NEGATIVE NO. IN LOCATION
;                               ACC 3 + 3 IF NOT FOUND.
;                               RETURNS TO LOC. ACC 3 + 4.
;CALLS.                         HSH80,ORR77,WRT86.
;CALLED-BY.                     SYM95,SST91.
;GLOBAL-VARIABLES-USED.         SYMTB,OPFTB,SLOTD
;GLOBAL-VARIABLES-CHANGED.      SYMT1,ADLBL,NOSYM,OUTOV.
;ERROR-BITS-SET.                NONE.

;CONSTANTS.
```

```
CM.179:             177777
CM.179:             4
CM.379:             1
KEY79:    .BLK      1
VAL79:    .BLK      1
HS2791    .BLK      1
CM.279:             3
;
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC079:    .BLK      1
AC179:    .BLK      1
AC279:    .BLK      1
AC379:    .BLK      1
; SAVE ACC CONTENTS.
;
ST179:    STA       0,AC079
          STA       1,AC179
          STA       2,AC279
          STA       3,AC379
;
; CLEAR FLAG.
;
          SUB       0,0
          STA       0,3,3
;
; GET A SINGLE WORD BY ORRING.
;
          LDA       2,0,3                   ;LOAD ADDRESS.
          LDA       0,0,2
          LDA       1,1,2
;
          STA       0,AG179
          STA       1,AG279
          JSR@      ORR77                   ; OR THEM.
AG179:    .BLK      1
AG279:    .BLK      1
AG379:    .BLK      1
;
;
          LDA       0,AG379                 ; LOAD RESULT.
          LDA       1,2,2
          STA       0,AG479
          STA       1,AG579
          JSR@      ORR77
AG479:    .BLK      1
```

```
AG579:  .BLK    1
AG679:  .BLK    1
;
;  GET HASH VALUE CALCULATED THROUGH
;  H(K)=(M(A DIV W  *K) MOD 1)
;  WITH A=3,M=LENGTH OF SYMTB,K AS IN AG679,W=16.
;
        LDA     0,AG679                 ; K
        MOV     0,1
        ADDZ    1,0
        ADDZ    1,0                     ; MPY BY 4.
;
;  ACC 0 HAS AK MOD W.
;
;  THE NEXT SEQ OF INSTRUCTIONS EXTRACT THE MSCO BITS
;  FROM ACC 0,AND PUTS THEM IN ACC 1.
;
;
        JSRS    HS480
;
;  ACC 0 CONTAINS THE CHANGED AK#.
;  ACC 1 CONTAINS H(K).
;  MULTIPLY BY 4 SINCE EACH ENTRY HAS 4 WDS,
;
        MOVLZ   1,1
        MOVLZ   1,1
;
;
        STA     0,VAL79
        STA     1,KEY79
;
;
        LDA     3,SYMTB
        ADDZ    1,3
        MOV     3,2
;
;
        LDA     0,0,2                   ; LOAD FIRST WD.
        MOV     0,0,SNR                 ; CHK FOR EPY.
        JMP     EPY79
;
;  CHECK WHETHER KEY MATCHES.
;
        LDAS    3,AG379
;
        LDA     0,0,3
        LDA     1,0,2
```

```
            SUBE    0,1,SZR                 ; CHECK
            JMP     NCM79
;
            LDA     0,1,3
            LDA     1,1,2
            SUBE    0,1,SZR
            JMP     NCM79                   ; NO MATCH
;
            LDA     0,2,3
            LDA     1,2,2
            SUBE    0,1,SZR                 ; CHECK
            JMP     NCM79                   ;NO MATCH.
;
;;; ENTRY FOUND.
;
            JMP     FND79
;
;;; NO MATCH. REHASH.
;
NOM79:      LDA     0,VAL79
            JSRS    HSH80
;
;;; ACC 1 CONTAINS H(K).
;;; INTRODUCE 1 IN BIT 0.
;
            LDA     0,CN379
            STA     0,AG779
            STA     1,AG879
            JSRS    OR877
AG779:      .BLK    1
AG879:      .BLK    1
AG979:      .BLK    1
;
            LDA     1,AG979
            MOVZL   1,1
            MOVZL   1,1
            STA     1,HS279
;
;;; HS279 CONTAINS VALUE H2(K).
;
NXT79:      LDA     3,OPFTB; LOAD OPFTB ADRESS.
            LDA     2,3,3                   ; LENGTH.
            MOVZL   2,2
            MOVZL   2,2
            LDA     1,HS279
            LDA     0,KEY79
            SUB     1,0                     ;I=I-H2(K)
```

```
          ISZ     0,3,SZC
          ADD     2,3                     ; IF SO ADD N.
          STA     3,KEY79                 ; STORE BACK
          MOV     0,3
;
;  CHECK IF EMPTY.
;
          LDA     2,SYMTB
          ADC     3,2
          LDA     0,0,2                   ;LOAD FIRST WD.
          MOV     0,0,SNR
          JMP     EPY79                   ; EMPTY ENTRY.
;
;  CHECK WHETHER KEY MATCHES.
;
          LDAS    3,AC379
;
          LDA     0,0,3
          LDA     1,0,2
          SUBE    0,1,SZR
          JMP     NMT79
;
          LDA     0,1,3
          LDA     1,1,2
          SUBE    0,1,SZR                 ; CHECK
          JMP     NMT79                   ; NO MATCH.
;
          LDA     0,2,3
          LDA     1,2,2
          SUBE    0,1,SZR
          JMP     NMT79                   ;NO MATCH
;
;  MATCH FOUND,LOAD LOCTR VALUE.
;
          JMP     FND79
;
;  EMPTY ENTRY,INSERT IF FLAG PERMITS.
;  ADDRESS IS IN AC 2.
;
EPY79:    LDA     0,CNC79
          STA     2,ADLBL
          LDA     3,AC379
          STA     0,3,3                   ; SET FLAG.
;
;  CHECK FLAG TO SEE IF INSERTION IS NEED.
;
```

```
        LDA     0,1,3
        LDA     1,CN379             ; DEC 1
        SUBZ    0,1,SNR
        JMP     END79
;
; INSERT LABEL.
;
; NCSYM IS A COUNTER FOR CHECKING OVERFLOW.
;
        DSZ     NCSYM
        JMP     .+2
        JMP     ERR79               ; OVERFLOW.
;
; INSERT LABEL .
;
; ACC 2 CONTAINS ADDRESS.
;
        LDAS    3,AC379
        LDA     0,0,3
        STA     0,0,2
        LDA     0,1,3
        STA     0,1,2
        LDA     0,2,3
        STA     0,2,2
        LDA     0,LOCTR
        STA     0,3,2
        JMP     END79
;
; ENTRY FOUND .SET VALUE FOR LOCTR.
;
FND79:  LDA     0,3,2
        STA     2,ADLBL
        LDA     3,AC379
        STA     0,2,3
;
; RESTORE ACC CONTENTS AND RETURN
;
END79:  LDA     0,AC079
        LDA     1,AC179
        LDA     2,AC279
        LDA     3,AC379
;
        JMP     4,3
;
; ERROR ,OVERFLOW IN TABLE.
;
MES79:  .TXT    /<012><015>OVERFLOW,ABORT/
```

```
MEA79:          MES79
ES279:  LDA     2,1EA79
;
        LDA     0,SLOTO
        STA     0,OUTOV
;
        JSRS    WRT66
        HALT
;*****************************************************
;
; NAME.                         ORA77.
;
; FUNCTION.                     PERFORMS THE LOGICAL
;                               OR OPERATION ON INPUTS.
; INPUT.                        LOCATIONS #AC 3# #AC 3 + 1#
;
; OUTPUT.                       LOCATION #AC 3 + 2#.
;
; CALLS.                        NONE.
;
; CALLED-BY.                    STB79,EME26,CER14.
;
; GLOBAL-VARIABLES-USED.        NONE.
;
; GLOBAL-VARIABLES-CHANGED.     NONE.
;
; ERROR-BITS-SET.               NONE.
;
;
; LOCATIONS FOR SAVING ACC CONTENTS.
;
AC077:  .BLK    1
AC177:  .BLK    1
AC277:  .BLK    1
AC377:  .BLK    1
;
; SAVE ACC CONTENTS.
;
ORA77:  STA     0,AC077
        STA     1,AC177
        STA     2,AC277
        STA     3,AC377
;
; LOAD IN AND PERFORM OR FUNCTION.
```

```
;
        LDA     0,0,3
        LDA     1,1,3
        COM     0,0
        COM     1,1
        AND     0,1
        COM     1,1
        STA     1,2,3
;
; RESTORE ACC AND RETURN.
;
        LDA     0,AC077
        LDA     1,AC177
        LDA     2,AC277
        LDA     3,AC377
;
        JMP     3,3
;
;*************************************************************
;
; NAME.                           UPD11.
; FUNCTION.                       UPDATES LNCTR,LOCTR,LOCTN.
; INPUT.                          NONE.
; OUTPUT.                         NONE.
; CALLS.                          NONE.
; CALLED-BY.                      PASS1,PASS2.
; GLOBAL-VARIABLES-USED.          LENTH.
; GLOBAL-VARIABLES-CHANGED.       LOCTN,LOCTR,LNCTR.
; ERROR-BITS-SET.                 NONE.
;
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC011:  .BLK    1
AC111:  .BLK    1
;
```

```
CNG11:          1
;
;  SAVE ACC CONTENTS.
;
UP111:  STA     0,ACC11
        STA     1,AC111
;
;  UPDATE COUNTERS.
;
        LDA     0,LNCTR
        LDA     1,CNG11
        ADDZ    1,0
        STA     0,LNCTR
;
        LDA     0,LOCTR
        LDA     1,LENTH
        ADDZ    1,0
        STA     0,LOCTR
        STA     0,LOCTN
;
;  RESTORE ACC CONTENTS AND RETURN.
;
        LDA     0,ACC11
        LDA     1,AC111
;
        JMP     0,3
;
;*****************************************************
;
; NAME.                         ENETS.
; FUNCTION.                     ENTER PRERR INTO ERROR
;                               TABLE.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        NONE.
; CALLED-BY.                    PASS1,PASS2.
; GLOBAL-VARIABLES-USED.        PRERR,ER1TB,ER2TB,PSFLG.
; GLOBAL-VARIABLES-CHANGED.
```

```
;
;  ERROR-BITS-SET.                    ER1T1,ER2T1,E1EPT,E2EPT.
;                                     NONE.
;
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC0SV9:     .BLK     1
AC1SV9:     .BLK     1
AC2SV9:     .BLK     1
AC3SV9:     .BLK     1
;
;  CONSTANTS.
;
CN0S9:              62                          ; DEC 50
CN1S9:              1
;
;  SAVE ACC CONTENTS,ENTRY.
;
EN1S9:      STA     0,AC0SV9
            STA     1,AC1SV9
            STA     2,AC2SV9
            STA     3,AC3SV9
;
;  CHECK WHETHER PRERR IS ZERO.IF SO ,RETURN.
;
            LDA     0,PRERR
            MOV     0,0,SNR
            JMP     EN0S9
;
;  CHECK WHICH PASS AND SET ACC 3,ACC 2,TO
;  ER1TB OR ER2TB AND E1EPT OR E2EPT ACCORDINGLY.
;
            LDA     0,PSFLG
            LDA     1,CN1S9
            SUBZ    0,1,SZR
            JMP     PS2S9
;
;   PASS IS 1.SET CORR. VALUES.
;
            LDA     3,ER1TB
            LDA     2,E1EPT
            JMP     NXTS9
;
;  PASS IS 2.SET CORR. VALUES.
;
```

```
PS209:  LDA     3,ER2TB
        LDA     2,E2EPT
;
; CHECK WHETHER TABLE IS FULL.IF SO , RETURN.
;
NXT09:  LDA     0,CN009                 ; DEC 50.
        MOV     3,1
        ADC     0,1
        SUBZ    1,2,SNR
        JMP     EN009
;
; TABLE NOT FULL,ENTER ERROR NO.
;
        LDA     0,ENCTR
        STA     0,0,2
        LDA     0,PSERR
        STA     0,1,2
;
;  UPDATE E1EPT OR E2EPT.
;
        INC     2,2
        INC     2,2
;
; REPLACE DEPENDING ON PASS.
;
        LDA     0,PSFLG
        LDA     1,CN109                 ; DEC   1
        SUBZ    0,1,SZR
        JMP     P2E09                   ; PASS IS 2.
;
; PASS IS 1 . REPLACE AS E1EPT.
;
        STA     2,E1EPT
        JMP     EN009
;
; PASS IS 2.REPLACE AS E2EPT.
;
P2E09:  STA     2,E2EPT
;
;  RESTORE ACC CONTENTS AND RETURN.
;
EN009:  LDA     0,AC009
        LDA     1,AC109
        LDA     2,AC209
        JMPS    AC309
;
;
```

```
;*****************************************************
;
; NAME.                          GLB41.
; FUNCTION.                      GET CHPTR TO THE FIRST
;                                BLANK CHARACTER IN ITSLN
;                                AFTER THE CURRENT VALUE.
; INPUT.                         NONE.
; OUTPUT.                        CHPTR POINTS TO BLANK CH.
; CALLS.                         GCH41.
; CALLED-BY.                     LAC21.
; GLOBAL-VARIABLES-USED.         NONE.
; GLOBAL-VARIABLES-CHANGED.      CHPTR.
; ERROR-BITS-SET.                NONE.
;
; SPACE  FOR SAVING AC
; SPACE  FOR SAVING ACC CONTENTS.
;
AC041:   .BLK    1
AC141:   .BLK    1
AC241:   .BLK    1
AC341:   .BLK    1
;
;  CONSTANTS.
;
CH.041:          40                    ;  BLANK
;
; SAVE ACC CONTENTS,ENTRY POINT.
;
GL141:   STA     0,AC041
         STA     1,AC141
         STA     2,AC241
         STA     3,AC341
;
; GET NEXT WORD.
;
NXT41:   JSRS    GCH41
; CHECK WHETHER BLANK OR NOT.
         LDA     1,CH.041              ; BLANK.
```

```
          SUBE    0,1,SNR
          JMP     FND41

;  CH. IS NOT BLANK,GET NEXT CHARACTER.

          ISZ     CHPTR
          JMP     NXT41

;  SEPARATOR FOUND,RESTORE ACC CONTENTS AND RETURN.

FND41:    LDA     0,AC041
          LDA     1,AC141
          LDA     2,AC241
          JMPS    AC341

;*****************************************************

;  NAME.                          SCP23.
;  FUNCTION.                      SETS CHPTR TO NEXT
;                                 NON-BLANK CHARACTER.
;  INPUT.                         NONE.
;  OUTPUT.                        CHPTR POINTING TO NON-BLANK
;                                 CHARACTER.
;                                 TAKES  # ACC 3 # RETURN
;                                 IF ERROR.
;                                 TAKES #ACC 3 + 1# RETURN
;                                 OTHERWISE.
;  CALLS.                         ENE26,SCH31.
;  CALLED-BY.                     LOTS.
;  GLOBAL-VARIABLES-USED.         NONE.
;  GLOBAL-VARIABLES-CHANGED.      CHPTR.
;  ERROR-BITS-SET.                BIT NO. 10 (F).

;  SPACE FOR SAVING ACC CONTENTS.

ACC23:    .BLK    1
```

```
AC123:    .BLK    1
AC223:    .BLK    1
AC323:    .BLK    1
;
; CONSTANTS.
;
CN123:            40                    ; BLANK
CN223:            120                   ; DEC '80
CTR23:    .BLK    1
TEN23:            12
;
; SAVE ACS CONTENTS.
;
SC123:    STA     0,AC023
          STA     1,AC123
          STA     2,AC223
          INC     3,3
          STA     3,AC323
;
; SET COUNTER TO COUNT UPTO END OF LINE.
;
          LDA     0,CHPTR
          LDA     1,CN223
          SUB     0,1
          INC     1,1
          STA     1,CTR23
;
; GET NEXT CH. AND CHECK.
;
NXT23:    JSRS    GCH61
;
; CHECK OUT CHARACTER.
;
          LDA     1,CN023               ; BLANK.
          SUBE    0,1,SNR
          JMP     BLK23
          JMP     FND23
;
; CH. IS A BLANK,GET NEXT CH.
;
BLK23:    ISZ     CHPTR
          DSZ     CTR23
          JMP     NXT23
;
; ENTER ERROR BIT NO. 10.
; (NO NON-BLANK CH. FOUND).
;
```

```
            LDA     0,TEN23
            STA     0,ARG23
            JSRS    EME26
ARG23:      .BLK    1
            DSZ     AC323
;
;   CH. IS NOT BLANK.
;   RESTORE ACCS AND RETURN.
;
FNC23:      LDA     0,AC023
            LDA     1,AC123
            LDA     2,AC223
            JMPS    AC323
;
;
;*****************************************************
;
;   NAME.                           PASP7.
;   FUNCTION.                       PROCESS OP-CODE,OPERANDS.
;                                   IN PASS 1 ,GET LENTH.
;                                   IN PASS 2 ,GET LENTH
;                                   AND SET WSPCE(ASSEMBLE WD).
;   INPUT.                          NONE.
;   OUTPUT.                         NONE.
;   CALLS.                          SCP23,ITR24,SPM25.
;   CALLED-BY.                      PASS-1,PASS-2
;   GLOBAL-VARIABLES-USED.          ABFLG.
;   GLOBAL-VARIABLES-CHANGED.       CNBEG.
;   ERROR-BITS-SET.                 NONE.
;
;   SPACE FOR SAVING ACC CONTENTS.
;
AC027:      .BLK    1
AC127:      .BLK    1
AC227:      .BLK    1
AC327:      .BLK    1
;
```

```
; SAVE ACC CONTENTS,ENTRY POINT.
;
PR107:  STA     0,AC007
        STA     1,AC107
        STA     2,AC207
        STA     3,AC307
;
; SET CHPTR.
;
        JSR@    SCP23
        JMP     END07                   ; ERROR RETURN.
;
; LINE IS OKAY,CHECK VALID TERMINATOR.
;
        JSR@    VTR24
;
; CHECK ABFKG TO SEE IF LINE IS QUESTIONABLE.
;
        LDA     0,ABFLG
        MOV     0,0,SNR
        JMP     END07
;
; LINE IS OKAY,SEARCH TABLES AND SERVICE,.
;
        JSR@    SP125
;
; SET CHBEG AND RESTORE ACCS,RETURN.
;
END07:  LDA     0,CHPTR
        STA     0,CHBEG
        LDA     0,AC007
        LDA     1,AC107
        LDA     2,AC207
        JMP@    AC307
;
;*****************************************************
;
; NAME.                         GCH21.
; FUNCTION.                     GETS CHARACTER POINTED AT
;                               BY CHPTR FROM INSLN.
; INPUT.                        NONE.
; OUTPUT.                       IN ACC 0,RIGHT  ADJUSTED.
```

```
;
; CALLS.                          NONE.
; CALLED-BY.                      LOTS.
; GLOBAL-VARIABLES-USED.          CHPTR,INSLN.
; GLOBAL-VARIABLES-CHANGED.       NONE.
; ERROR-BITS-SET.                 NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC1S61:   .BLK    1
AC2S61:   .BLK    1
AC3S61:   .BLK    1
;
; CONSTANTS.
;
MSK061:           377
CN1S61:           1
CHKS61:           121
BLKS61:           40
;
; ENTRY POINT,SAVE ACC CONTENTS.
;
GC1S61:   STA     1,AC1S61
          STA     2,AC2S61
          STA     3,AC3S61
;
; CHECK CHPTR GREATER THAN 81
;
          LDA     0,CHPTR
          LDA     1,CHKS61
          SUBLE   1,0,SNC
          JMP     ERRS61
;
; FIND OUT WHICH WORD AND WHICH HALF.
;
          LDA     0,CHPTR
          LDA     1,CN1S61
          SUB     1,0
          MOVZR   0,0,SZC
;
; CARRY IS NON-ZERO,SECOND HALF TO BE LOADED.
;
```

```
          JMP     NZC61

;CARRY IS ZERO,FIRST  IS NEED.
;ACC 3 CONTAINS THE WD TO BE LOADED.

          LDA     2,INSLN
          ADD     0,2
          LDA     0,0,2
          IOVS    3,3
          LDA     1,MSK61
          ANC     1,0

;ACC 3 CONTAINS REQD. WD.

          JMP     END61

;CARRY IS NON-ZERO.SECOND HALF TO BE
;LOADED.ACC 0 CONTAINS WORD TO BE LOADED.

NZC61:    LDA     2,INSLN
          ADD     3,2
          LDA     0,0,2
          LDA     1,MSK81
          ANC     1,3
          JMP     END61

;CHPTR GREATER THAN 80.
;SEND MASK BLANK.
;SET CHPTR TO 81.

ERR61:    LDA     3,CHK81
          STA     0,CHPTR
          LDA     0,BLK81

;ACC 3 CONTAINS REQD, WD,

END61:    LDA     1,AC161
          LDA     2,AC261
          JMPS    AC361

;*****************************************************

;NAME.                    VTR24.
;FUNCTION.                CHECK VALIDITY OF OP-CODE
```

```
;                                       TERMINATOR .I.E. CHECK IF
;                                       IT IS ≠A ≠,≠B ≠,≠ ≠.
;  INPUT.
;                                       CHPTR POINTING TO FIRST
;                                       CHARACTER IN OP-CODE.
;  OUTPUT.
;                                       ABFLG SET TO 0,1,2, OR 3.
;                                       0 IF INVALID.
;                                       1 IF ≠A ≠.
;                                       2 IF ≠B ≠.
;                                       3 IF ≠ ≠.
;                                       CHPTR POINTS TO FIRST CH.
;                                       OF OP-CODE.
;  CALLS.                               ENE86,GCH81.
;  CALLED-BY.                           PROF7.
;  GLOBAL-VARIABLES-USED.               NONE.
;  GLOBAL-VARIABLES-CHANGED.            ABFLG,CHPTR.
;  ERROR-BITS-SET.                      10(F),13(Q).

;  SPACE FOR SAVING ACC CONTENTS.

AC024:    .BLK    1
AC124:    .BLK    1
AC224:    .BLK    1
AC324:    .BLK    1

;  CONSTANTS.

BLK24:              40                  ;  BLANK
CHA24:              101
CHB24:              102
CNC24:              12
CN124:              120                 ; DEC 80
CN324:              1
CN424:              2
CN524:              15                  ; DEC. 13.
THR24:              3

;  SAVE ACC CONTENTS.

VT124:    STA       0,AC024
```

```
          STA     1,AC124
          STA     2,AC224
          STA     3,AC324
;
; INCREMENT CHPTR TO POINT TO CH AFTER OPCODE.
;
          ISZ     CHPTR
          ISZ     CHPTR
          ISZ     CHPTR
;
; CHECK IF CHPTR GREATER THAN 80.
;
          LDA     2,CHPTR
          LDA     1,CH.124                ; DEC 80
          SUBLE   2,1,SZC
;
; CARRY IS NON-ZERO,LINE IS QUESTIONABLE.
;
          JMP     QN324
;
; LINE IS OKAY,CHECK CH. TO SEE IF IT IS BLANK.
;
          JSRS    GC161                   ; GET CHARACTER.
          LDA     1,BLK24
          SUBE    0,1,SNR
          JMP     OKY24
;
          LDA     1,CHA24
          SUBE    0,1,SNR
          JMP     CKA24
;
          LDA     1,CHB24
          SUBE    0,1,SNR
          JMP     CKB24
;
          JMP     NTR24
;
; CH. IS A,SET ABFLG TO 1.
;
CKA24:    LDA     0,CH.524                ; DEC  1.
          STA     0,ABFLG
          JMP     CHK24
;
; CH. IS B,SET ABFLG TO 2.
```

```
;
CKF24:  LDA     0,CH424                 ; DEC.  2
        STA     0,ABFLG
        JMP     CHK24
;
; CHARACTER IS A #,SET ABFLG  TO 5,RETURN.
;
CKY24:  LDA     0,THR24
        STA     0,ABFLG
        JMP     LE224
;
; CH. IS A OR B.CHECK NEXT CHARACTER.
;
CHK24:  ISZ     CHPTR
        JSRS    GCH61
;
; ACC 0 CONTAINS CHARACTER.
;
        LDA     1,BLK24
        SUBZ    0,1,SNR
        JMP     LE124
;
;
; INVALID TERMINATOR.
; SET BIT NO. 10(F) OF ERROR WORD.
; SET ABFLG TO 0.
;
NTR24:  LDA     0,CH624                 ; DEC. 16.
        STA     0,AG124
        JSRS    ENE26
AG124:  .BLK    1
        SUB     0,0
        STA     0,ABFLG
        JMP     END24
;
; LINE IS QUESTIONABLE.
; SET BIT NO.13(Q).
; SET ABFLG TO 0.
;
CHB24:  SUB     0,0
        STA     0,ABFLG
        LDA     0,CH524
        STA     0,AG224
        JSRS    ENE26
AG224:  .BLK    1
        JMP     END24
;
```

```
; SET CHPTR T O P CINT TO BEG OF OPCODE.
;
LB124:    DSZ       CHPTR
LB224:    DSZ       CHPTR
          DSZ       CHPTR
          DSZ       CHPTR
;
; RESTORE ACC CONTENTS AND RETURN.
;
END24:    LDA       0,AC024
          LDA       1,AC124
          LDA       2,AC224
          JMPS      AC324
;
;*****************************************************
;
; NAME.                              SPM25.
; FUNCTION.                          SEARCHES POT,NOT,
;                                    AND IF FOUND TRANSFERS TO
;                                    SERVICE ROUTINE.
; INPUT.                             CHPTR POINTS TO FIRST CH.
;                                    IN OP-CODE.
; OUTPUT.                            LENGTH,NOPOE SET.
; CALLS.                             END25,DCH31,CPT43,SPT44,
;                                    SERVICE ROUTINES.
; CALLED-BY.                         PROPY.
; GLOBAL-VARIABLES-USED.             NONE.
; GLOBAL-VARIABLES-CHANGED.          CHPTR.
; ERROR-BITS-SET.                    4 (0).
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC025:    .BLK      1
AC125:    .BLK      1
AC225:    .BLK      1
AC325:    .BLK      1
```

```
;
; CONSTANTS.
;
CNG25:          4
;
; SPACE FOR SAVING OPCODE.
;
OP125:  .BLK    1
OP225:  .BLK    1
OPA25:          OP125
;
; SAVE ACC CONTENTS,ENTRY.
;
SP125:  STA     0,AC025
        STA     1,AC125
        STA     2,AC225
        STA     3,AC325
;
; SAVE OPCODE.
;
; CHPTR POINTS TO FIRST CH. GET CHARACTER.
;
        JSR@    GCH81
;
; CHARACTER IS IN ACC 0.
;
        MOVS    0,1
        ISZ     CHPTR
        JSR@    GCH81
        MOVS    0,1
        STA     1,OP125                 ; FIRST WD.
        ISZ     CHPTR
        JSR@    GCH81
        MOVS    0,1
        STA     0,OP225                 ; SECOND WD.
; SET CHPTR TO POINT TO END OF OP-CODE.
        ISZ     CHPTR
;
;  CALL OI ROUTINE TO SEARCH POT.
;
        LDA     0,OPA25
        STA     0,AG125
        JSR@    SPT43
AG125:  .BLK    1
AG225:          0
        LDA     0,AG225
;
```

```
;
; TEST WHETHER PRESENT IN POT.
;
        MOV     0,0,SZR
;
; IS PRESENT.TRANSFER TO ROUTINE.
;
        JMP     PRS25
;
; NOT PRESENT,SEARCH NOT.
;
        LDA     0,OPA25
        STA     0,AG325
        JSRS    SMT44
AG325:  .BLK    1
AG425:          0
;
; TEST WHETHER PRESENT IN NOT.
;
        LDA     0,AG425
        MOV     0,0,SZR
;
; RESULT IS NON ZERO,OPCODE IS PRESENT.
;
        JMP     PRS25
;
; ERROR,NOT PRESENT IN EITHER TABLES.
;  ENTER ERROR BIT NO. 4
;
        LDA     0,CNJ25                 ; DEC  4
        STA     0,AG525
        JSRS    ERR25
AG525:  .BLK    1
        JMP     END25
;
; ACC CONTAINS SERVICE  ROUTINE ADDRESS.
;
PRS25:  MOV     0,2
        JSR     0,2
;
; RESTORE ACC CONTENTS AND RETURN.
;
END25:  LDA     0,AC025
        LDA     1,AC125
        LDA     2,AC225
        JMPS    AC325
;
```

```
;*****************************************************
;
; NAME.                          SPT43.
; FUNCTION.                      SEARCHES THE P.O.T.
; INPUT.                         STARTING ADDRESS OF LOCAL
;                                SPACE WHERE OP-CODE IS
;                                STORED(IN ACC. #AC 3 #.)
; OUTPUT.                        SERVICE ROUTINE ADDRESS IF
;                                PRESENT. 0 OTHERWISE(IN ACC
;                                #AC 3 + 1).
;                                RETURNS TO ADD. #AC 3 + 2#.
; CALLS.                         NONE.
; CALLED-BY.                     SP125.
; GLOBAL-VARIABLES-USED.         POEPT,PORTB.
; GLOBAL-VARIABLES-CHANGED.      NONE.
; ERROR-BITS-SET.                NONE.

; SPACE FOR SAVING ACC CONTENTS.
AC043:    .BLK     1
AC143:    .BLK     1
AC243:    .BLK     1
AC343:    .BLK     1

; CONSTANT.
CN043:            0

; TEMPORARY LOCATIONS.
POR43:    .BLK     1
POE43:    .BLK     1

; SAVE ACC CONTENTS,ENTRY POINT.
SP143:    STA      3,AC043
```

```
          STA     1,AC143
          STA     2,AC243
          STA     3,AC343
;
;  SEARCH TABLE FOR MATCH.
;  STORE POPTB,POEPT IN TEMPORARY LOCATIONS.
;
          LDA     0,POEPT
          STA     0,POE43
          LDA     0,POPTB
          STA     0,POP43
;
LOP43:    LDA     0,@POE43
          LDA     2,@POP43
          SUBE    0,2,SNR
          JMP     NFD43                   ;WHOLE TABLE HAS
;                                         ; BEEN SEARCHED.
;  COMPARE.
;
          LDA     1,2,2
          LDA     3,AC343
          LDA     0,0,3
          SUBE    0,1,SZR
          JMP     NMT43                   ; NO MATCH
;
;  FIRST WD MATCHES TRY SECOND WD.
;
          LDA     1,1,2
          LDA     0,1,3
          SUBE    0,1,SZR
          JMP     NMT43                   ; NO MATCH
;
;  MATCH FOUND,LOAD SERVICE ROUTINE ADDRESS.
;
          LDA     0,2,2
          LDA     3,AC343
          STA     0,1,3
          JMP     END43
;
;  NO MATCH .TRY NEXT ENTRY.
;
NMT43:    LDA     0,POP43
          INC     0,0
          INC     0,0
          INC     0,0
```

```
          STA     0,POP43
          JMP     LOP43
;
; NOT FOUND,SET RETURNING VALUE TO 0.
;
NFO43:    LDA     0,ON143
          LDA     3,AC343
          STA     0,1,3
;
; RESTORE ACC CONTENTS AND RETURN.
;
END43:    LDA     0,AC043
          LDA     1,AC143
          LDA     2,AC243
          LDA     3,AC343
;
          JMP     2,3
;
;*****************************************************
;
; NAME.                         PRT32.
; FUNCTION.                     PRINTS OUT THE OUTPUT
;                               LINE,AFTER DELETING TRAILING
;                               BLANKS.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        PUT79.
; CALLED-BY.                    PSC10,WER17,PAG60.
; GLOBAL-VARIABLES-USED.        SCFLG,SLOTD
; GLOBAL-VARIABLES-CHANGED.     OUTDV.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR ACC CONTENTS.
;
AC032:    .BLK    1
AC132:    .BLK    1
```

```
AC282:  .BLK    1
AC382:  .BLK    1
;
; CONSTANTS AND COUNTERS.
;
CL6082:         74                      ; DEC 60
CTR82:  .BLK    1
CN2882:         15
CN3882:         12
BLK582:         20045
CT1282: .BLK    1
;
; SAVE ACC CONTENTS,ENTRY.
;
PR1282: STA     0,AC082
        STA     1,AC182
        STA     2,AC282
        STA     3,AC382
;
; CHECK IF NECC.
;
        LDA     0,SCFLG
        MOV     0,0,SNR
        JMP     END82
;
; SET DEVICE CODE.
;
        LDA     0,SLOTC
        STA     0,OUTDV
;
; PRINT OUT CR,LF.
;
        LDA     0,CN282
        JSR@    PCT75
        LDA     0,CN382
        JSR@    PCT75
;
; SET UP COUNTER TO COUNT UP TO 60 WORDS.
;
        LDA     0,CN382
        STA     0,CTR82
;
; PRINT OUT.
;
        LDA     2,PRTLN
        LDA     0,CN082
        ADD     0,2
```

```
            STA     2,CT1&2
            DSZ     CT1&2
;
LBL&2:      LDA&    0,CT1&2
            LDA     1,BLK&2
            SUBZ    0,1,SZR
            JMP     OKY&2
            DSZ     CT1&2
            DSZ     CT2&2
            JMP     LBL&2
            JMP     END&2
OKY&2:      JMP     .+1
            LDA     2,PRTLN
;
;
; PRINT OUT NEXT WORD.
;
LOP&2:      LDA     0,0,2
            MOVS    0,0
            JSR&    PUT75
;
            LDA     0,0,2
            JSR&    PUT75
;
; CHECK WHETHER ALL CHARACTERS HAVE BEEN PRINTED OUT.
;
            INC     2,2
            DSZ     CT2&2
            JMP     LOP&2
;
; PRINT OUT CR,LF.
;
END&2:      LDA     0,CN2&2
            JSR&    PUT75
            LDA     0,CN3&2
            JSR&    PUT75
;
; RESTORE ACCS,RETURN.
;
            LDA     0,AC0&2
            LDA     1,AC1&2
            LDA     2,AC2&2
            JMP&    AC3&2
;
```

```
;*****************************************************
;
; NAME.                          SMT44.
; FUNCTION.                      SEARCHES M.C.T.
; INPUT.                         STARTING ADDRESS OF LOCAL
;                                SPACE WHERE OP-CODE IS
;                                STORED(IN ADD. #AC 3 #).
; OUTPUT.                        SERVICE ROUTINE ADDRESS IF
;                                PRESENT.0 OTHERWISE.(IN ADD.
;                                #AC 3 + 1).
;                                RETURNS TO ADDRESS AC 3 + 2
; CALLS.                         NONE.
; CALLED-BY.                     SPM25.
; GLOBAL-VARIABLES-USED.         NEWOT,.OPTB.
; GLOBAL-VARIABLES-CHANGED.      BSVAL.
; ERROR-BITS-SET.                NONE.
;
; CONSTANTS.COUNTERS.
SEE44:              ADDR3
LNE44:    .BLK      1
UPE44:    .BLK      1
IND44:    .BLK      1
KEY44:    .BLK      1
MOP44:    .BLK      1
MSK44:              377                    ; MASK
CNC44:              0
CN144:              1
; SPACE FOR SAVING ACC CONTENTS.
AC044:    .BLK      1
AC144:    .BLK      1
AC244:    .BLK      1
AC344:    .BLK      1
```

```
;
; SAVE ACC CONTENTS,ENTRY POINT.
;
SM144:  STA     0,AC044
        STA     1,AC144
        STA     2,AC244
        STA     3,AC344
;
; INITIALISE LWR44,UPR44,KEY44,IND44,MOP44
;
        LDA     0,J,3
        STA     0,KEY44
        LDA     0,REMOT
        STA     0,UPR44
        LDA     0,CH144
        STA     0,LWR44
        LDA     0,CHC44
        STA     0,IND44
        LDA     0,MOPTB
        STA     0,MOP44
;
; CHECK IF UPR44 IS LESS THAN LWR44.
; IF SO,SEARCH HAS ENDED UNSUCCESSFULLY.
;
LA244:  LDA     0,LWR44
        LDA     1,UPR44
        SUBLE   0,1,SZC
        JMP     NF044                   ;UNSUCCESSFULL
;
; SET INDEX (IND44) TO  LOWER BOUND OF (LWR44+UPR44)/2.
;
        ADD     1,0
        MOVZR   0,0
        STA     0,IND44
;
; LOAD ADDRESS OF ENTRY COMP. TO INDEX.
;
        LDA     0,IND44
        LDA     1,CH144
        SUB     1,0
        MOV     0,1
        ADDZ    0,1
        ADDZ    0,1                     ; MULTIPLY BY 3.
        LDA     3,MOP44                 ;LOAD STARTING
;                                        ADDRESS OF MOT.
        ADD     1,3                     ;ADD(3*INDEX).
        LDA     2,KEY44
;
```

```
;  AC3 CONTAINS ADDRESS OF ENTRY.
;  AC2 CONTAINS ADDRESS OF KEY.
;  CHECK FIRST WD.
;
            LDA     0,,,3
            LDA     1,0,2
            SUBE    0,1,SZR
            JMP     NMT44
;
;  CHECK SECOND WD.
;
            LDA     0,1,3
            LDA     1,1,2
            SUBE    0,1,SNR
            JMP     FND44
;
;  NO MATCH,GET NEXT ENTRY TO BE CHECKED.
;  AC0 CONTAINS  MISMATCHED NO OF ENTRY.
;  AC1 CONTAINS MISMATCHED NO OF KEY.
;
;  CHECK WHETHER K LESS THAN K(I).
;
NMT44:      SUBLE   0,1,SNC
            JMP     LE544                   ; K GREATER
                                              THAN K(I).
;
;  K LESS THAN K(I).SET UPR44 = IND44-1
;
            LDA     0,IND44
            LDA     1,CN144
            SUB     1,0
            STA     0,UPR44
            JMP     LE244
;
;  K GREATER THAN K(I),SET LWR44=IND44+1
;
LE544:      LDA     0,IND44
            INC     0,0
            STA     0,LWR44
            JMP     LE244
;
;  MATCH NOT FOUND,SET RETURNING VALUE TO 0.
;
NFD44:      LDA     0,CN144
            LDA     3,AC344
            STA     0,1,3
```

```
          JMP     END44
;
; ENTRY FOUND.AC 3 CONTAINS ADD. OF MATCHING ENTRY.
; LEFT HALF OF VALUE CONTAINS FORMAT NO.
; RIGHT HALF CONTAINS BASE VALUE.
;
; ISOLATE BASE VALUE.
;
FND44:    LDA     0,2,3                   ; LOAD VALUE
          LDA     1,MSK44                 ; LOAD MASK
          AND     1,0
          STA     0,BSVAL
;
; ISOLATE FORMAT NO.
;
          LDA     0,2,3
          LDA     1,MSK44
          MOVS    0,0
          AND     1,0
;
; LOAD SERVICE ROUTINE ADDRESS.
;
          LDA     3,SER44
          ADD     0,3
          LDA     1,0,3
;
; SET RETURNING VALUE.
;
          LDA     3,AC344
          STA     1,1,3
;
; RESTORE ACC CONTENTS AND RETURN.
;
END44:    LDA     0,AC044
          LDA     1,AC144
          LDA     2,AC244
          LDA     3,AC344
;
          JMP     2,3
;
;*************************************************************
;
; NAME.                   PSC1J.
; FUNCTION.               PRINT OUT LISTING.
```

```
;INPUT.                                 NONE.
;OUTPUT.                                NONE.
;CALLS.                                 ERL28,ELC29,LOC30,EWS31,
;                                       ESC32,FJR34,PRT62.
;CALLED-BY.                             PASS1,PASS2.
;GLOBAL-VARIABLES-USED.                 LTFLG,PAGE#.
;GLOBAL-VARIABLES-CHANGED.              NONE.
;ERROR-BITS-SET.                        NONE.


;SPACE FOR SAVING ACC CONTENTS.

AC01C:    .BLK      1
AC11C:    .BLK      1
AC21C:    .BLK      1
AC31C:    .BLK      1

;SAVE ACC CONTENTS,ENTRY POINT.

PS11C:    STA       0,AC01C
          STA       1,AC11C
          STA       2,AC21C
          STA       3,AC31C
;
;CHECK WHETHER LISTING IS REQD.
;
          LDA       0,LTFLG
          MOV       0,0,SNR
          JMP       LNN1C
;
;LISTING IS REQD.
;
          JSR@      ERL28
          JSR@      ELC29
          JSR@      LOC30
          JSR@      EWS31
          JSR@      ESC32
          JSR@      PRT62
```

```
          JSR@    FWF34
          JMP     ERC1J
;
; CHECK WHETHER ERROR-LINE.
;
LNN1J:    LDA     J,PRERR
          MOV     J,J,SNR
          JMP     ERC1J
;
; IT IS AN ERROR-LINE.
;
          JSR@    ERL2J
          JSR@    ELC2J
          JSR@    EWS31
          JSR@    ESC32
          JSR@    PRT62
;
; RESTORE ACCS AND RETURN.
;
ERC1J:    LDA     J,AC0IJ
          LDA     1,AC11J
          LDA     2,AC21J
          JMP@    AC31J
;
;*****************************************************
;
; NAME.                          ELC29.
; FUNCTION.                      ENTERS LINE COUNTER
;                                INTO PATLN AFTER CONVERSION
;                                INTO DECIMAL INTO
;                                POSITIONS 6-1J.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         BCC46.
; CALLED-BY.                     PSC1J.
; GLOBAL-VARIABLES-USED.         LNCTR.
; GLOBAL-VARIABLES-CHANGED.      PRPTR.
```

```
; ERROR-BIT-SET.                    NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC029:    .BLK    1
AC129:    .BLK    1
AC229:    .BLK    1
AC329:    .BLK    1
;
; CONSTANTS.
;
CNS29:            6
;
; SAVE ACC CONTENTS,ENTRY.
;
EL129:    STA     0,AC029
          STA     1,AC129
          STA     2,AC229
          STA     3,AC329
;
; CONVERT INTO DECIMAL AND ENTER.
;
          LDA     0,LNCTR
          LDA     1,CNS29
          STA     1,PRPT29
          JSRS    BCC46
;
; RESTORE ACC CONTENTS AND RETURN.
;
          LDA     0,AC029
          LDA     1,AC129
          LDA     2,AC229
          JMPS    AC329
;
;*****************************************************
;
; NAME.                             BHX47.
; FUNCTION.                         CONVERTS WORD INTO 4
;                                   HEX CHARACTERS.
; INPUT.                            ACC 0.
```

```
; OUTPUT.                                2 WORDS IN LOCATIONS
                                        #AC 3#,#AC 3 + 1#.
                                        RETURNS TO ACC 3 + 2.
; CALLS.                                NONE.
; CALLED-BY.                            ERS31,CVT54,PCH37,PI503.
; GLOBAL-VARIABLES-USED.                NONE.
; GLOBAL-VARIABLES-CHANGED.             NONE.
; ERROR-BITS-SET.                       NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC047:    .BLK    1
AC147:    .BLK    1
AC247:    .BLK    1
AC347:    .BLK    1

MSK47:            17

; CHARACTER CODES FOR HEX CHARACTERS.

CHR47:            60
                  61
                  62
                  63
                  64
                  65
                  66
                  67
                  70
                  71
                  101
                  102
                  103
                  104
                  105
                  106
CHA47:            CHR47

; SAVE ACC CONTENTS,ENTRY.
```

```
;
CH147:  STA     0,AC047
        STA     1,AC147
        STA     2,AC247
        STA     3,AC347
;
;  ACC 0 CONTAINS NO TO BE  BE CONVERTED.
;  CONVERT NOBE BY SHIFTING ,MASKING,AND INDEXING.
;
;
        LDA     1,MSK47
        ADD     0,1
        LDA     2,CHA47
        ADD     1,2
        LDA     1,0,2
;
        MOVZR   0,0
        MOVZR   0,0
        MOVZR   0,0
        MOVZR   0,0
        LDA     3,MSK47
        AND     0,3
        LDA     2,CHA47
        ADD     3,2
        LDA     3,0,2
        MOVS    3,3
        ADD     1,3
        LDA     2,AC347
        STA     3,1,2
;
;
        MOVZR   0,0
        MOVZR   0,0
        MOVZR   0,0
        MOVZR   0,0
        LDA     1,MSK47
        AND     0,1
        LDA     2,CHA47
        ADD     1,2
        LDA     1,0,2
;
        MOVZR   0,0
        MOVZR   0,0
        MOVZR   0,0
```

```
            MOVZR   0,0
            LDA     3,MSK47
            ANDCM   0,3
            ADOC    2,CHA47
            ADOC    3,2
            LDA     0,0,2
            MOVS    0,0
            ADD     1,0
            LDA     3,AC347
            STA     0,0,3
;
;   RESTORE ACC AND RETURN.
;
            LDA     0,AC047
            LDA     1,AC147
            LDA     2,AC247
            LDA     3,AC347
;
            JMP     2,3
;
;
;*****************************************************
;   NAME.                           ESC32.
;   FUNCTION.                       ENTER SOURCE CODE
;                                   INTO PRTLN FROM 23-130.
;   INPUT.                          NONE.
;   OUTPUT.                         NONE.
;   CALLS.                          PSC10.
;   CALLED-BY.                      EPT33.
;   GLOBAL-VARIABLES-USED.          INSLN.
;   GLOBAL-VARIABLES-CHANGED.       PRPTR.
;   ERROR-BITS-SET.                 NONE.
;
;   SPACE FOR SAVING ACC CONTENTS.
;
AC032:  .BLK    1
AC132:  .BLK    1
```

```
AC232:    .BLK    1
AC332:    .BLK    1
;
;  CONSTANTS AND COUNTERS.
;
CN032:            5.                        ; DEC 40
CN132:            33                        ; DEC 27
MSK32:            377
CTR32:    .BLK    1
;
;  SAVE ACS CONTENTS,ENTRY.
;
ES132:    STA     0,AC032
          STA     1,AC132
          STA     2,AC232
          STA     3,AC332
;
;  SET UP COUNTER TO COUNT UPTO 40 WORDS.
;
          LDA     0,CN032
          STA     0,CTR32
;
;  SET  PRPTR VALUE.
;
          LDA     0,CN132
          STA     0,PRPTR
;
          LDA     2,INSLN
;
;  GET NEXT WORD AND INTRODUCE IN PRTLN.
;
LOP32:    LDA     0,J,2
          MOVS    0,0
          LDA     1,MSK32
          AND     1,J
          JSR@    EPT03                     ; LEFT HALF
;
          ISZ     PRPTR
          LDA     0,0,2
          LDA     1,MSK32
          AND     1,J
          JSR@    EPT33                     ; RIGHT HALF.
;
;  UPDATE COUNTERS,INDICES.
;  CHECK WHETHER ALL WDS HAVE BEEN ENTERED.
;
```

```
        ISZ     PNPTR
        INC     2,2
        DSZ     CTR32
        JMP     LCP32

; RESTORE ACC CONTENTS AND RETURN.

        LDA     0,AC032
        LDA     1,AC132
        LDA     2,AC232
        JMP@    AC332

;*****************************************************

; NAME.                                 EPT03.
; FUNCTION.                             ENTERS THE CH. IN ACC 0
;                                       INTO PNTLN,IN THE POSTION
;                                       POINTED AT BY PNPTR.
; INPUT.                                CH. IN ACC 0.
; OUTPUT.                               NONE.
; CALLS.                                NONE.
; CALLED-BY.                            LOTS.
; GLOBAL-VARIABLES-USED.                PNPTR,PNTLN.
; GLOBAL-VARIABLES-CHANGED.             PNT_1.
; ERROR-BITS-SET.                       NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC003:  .BLK    1
AC103:  .BLK    1
AC203:  .BLK    1
AC303:  .BLK    1

CNT03:          1                       ; DEC 1
MSK03:          377
```

```
MS183:          177400
;
; SAVE ACC CONTENTS,ENTRY.
;
EP183:  STA     0,AC083
        STA     1,AC183
        STA     2,AC283
        STA     3,AC383
;
; GET THE WORD POINTED TO BY PRPTR.
;
        LDA     0,PRPTR
        LDA     1,CN083                 ; DEC 1
        SUB     1,0
        MOVZR   0,0,SZC
;
; ACC 0 CONTAINS WD TO BE LOADED.
; VALUE BETWEEN 0 AND 59.
;
        JMP     NZC83                   ; RIGHT HALF
;
; CARRY IS ZERO,LEFT HALF TO BE REPLACED.
; ACC 0 CONTAINS THE WD TO BE LOADED.
;
        LDA     3,PRTLN
        ADD     0,3
        LDA     0,0,3
        LDA     1,MSK83                 ; LOAD MASK.
        AND     1,0                     ; LEFT HALF.
;
; AC 0 CONTAINS RIGHT HALF,LEFT HALF IS 0.
;
        LDA     1,AC183
        LDA     2,MSK83
        AND     2,1
        MOVS    1,1
;
; AC 1 CONTAINS RECD LEFT HALF,RIGHT HALF IS 0.
;
; FORM WD.
;
        ADD     1,0
        STA     0,0,3
        JMP     END83
;
; CARRY IS NON-ZERO,RIGHT HALF TO BE REPLACED.
; AC 0 CONTAINS WD TO BE REPLACED.
```

```
;
NZC83:  LDA     3,PRTLN
        ADD     0,3
        LDA     0,0,3
        LDA     1,MS183
        AND     1,0
;
;  AC 0 CONTAINS LEFT HALF OF WD ,RIGHT HALF IS 0.
;
        LDA     1,AC083
        LDA     2,MSK83
        AND     2,1
;
;  AC 1 CONTAINS RIGHT HALF,LEFT HALF IS 0.
;  FORM WORD AND REPLACE.
;
        ADD     1,0
        STA     0,0,3
;
;  RESTORE ACC CONTENTS AND RETURN.
;
END83:  LDA     0,AC083
        LDA     1,AC183
        LDA     2,AC283
        JMPS    AC383
;
;*****************************************************
;
;  NAME.                          EPL20.
;  FUNCTION.                      ENTER ERROR LETTERS UPTO A
;                                 MAXIMUM OF 4 INTO
;                                 PATLN FROM 1-4.
;  INPUT.                         NONE.
;  OUTPUT.                        NONE.
;  CALLS.                         EPT83.
;  CALLED-BY.                     PSC10.
;  GLOBAL-VARIABLES-USED.         PATLN,PNERR.
;  GLOBAL-VARIABLES-CHANGED.
```

```
;                                       PARTN,PRT_1.
; ERROR-BITS-SET.                       NONE.
;
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC028:    .BLK     1
AC128:    .BLK     1
AC228:    .BLK     1
AC328:    .BLK     1
;
; CONSTANTS.
;
CN028:             20                          ; DEC 16
CN128:             1
CN228:             4
CTR28:    .BLK     1
CNT28:    .BLK     1
;
; CHARACTER CODES FOR ERROR LETTERS.
;
CHC28:             111
                   115
                   104
                   114
                   117
                   125
                   123
                   105
                   126
                   116
                   106
                   122
                   120
                   121
                   105
                   106
CHA28:             CHC28
;
; SAVE ACC CONTENTS,ENTRY
;
ER128:    STA      0,AC028
          STA      1,AC128
          STA      2,AC228
          STA      3,AC328
;
```

```
;
; SET UP COUNTERS TO COUNT UPTO 16,4
;
        LDA     3,CN328
        STA     3,CTR28
        LDA     3,CN228
        STA     3,CNT28
;
; SET PRPTR VALUE.
;
        LDA     3,CN128
        STA     0,PRPTR
;
; CHECK AND INTRODUCE INTO PRTLN.
;
        LDA     1,PRERR
        LDA     2,CHA28
;
LOP28:  MOVL    1,1,SNC
        JMP     ZCY28
;
; CARRY IS NON-ZERO,ENTER LETTER,UPDATE CTR.
;
        LDA     3,CTR28
        LDA     0,CN128
        SUB     0,3
        ADD     2,3
        LDA     0,0,3
        JSR@    EPT83
        ISZ     PRPTR
        DSZ     CNT28
        JMP     .+2
        JMP     END28
;
; UPDATE COUNTER TO CNT UPTO 16.
;
ZCY28:  DSZ     CTR28
        JMP     LOP28
;
; RESTORE ACC CONTENTS AND RETURN.
;
END28:  LDA     0,AC028
        LDA     1,AC128
        LDA     2,AC228
        JMP@    AC328
```

```
;*****************************************************
;
; NAME.                          LOC30.
; FUNCTION.                      ENTERS LOCTN INTO PRTLN
;                                INTO POSITIONS 12-15 AFTER
;                                CONVERSION INTO HEX.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         CVT64.
; CALLED-BY.                     PSC10.
; GLOBAL-VARIABLES-USED.         PRTLN,LOFLG,LOCTN.
; GLOBAL-VARIABLES-CHANGED.      PRTL1,PRPTR.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC030:    .BLK    1
AC130:    .BLK    1
AC230:    .BLK    1
AC330:    .BLK    1
;
; CONSTANTS.
;
CN030:          14                      ; DEC 12
;
; SAVE ACC CONTENTS,ENTRY.
;
L0130:    STA     0,AC030
          STA     1,AC130
          STA     2,AC230
          STA     3,AC330
;
; SET PRPTR VALUE.
; SET ACC 3 VALUE TO LOCTN.
```

```
; CHECK WHETHER THE ENTERING IS NEGC.
;
        LDA     0,CNV30
        STA     0,PRPTR
        LDA     0,LOCTN
        LDA     1,LOCFLG
        MOV     1,1,SZR
;
; CALL ON ROUTINE TO CONVERT AND ENTER.
;
        JSRS    CVT64
;
; RESTORE ACC CONTENTS AND RETURN
;
        LDA     0,AC030
        LDA     1,AC130
        LDA     2,AC230
        JMPS    AC330
;
;*****************************************************
;
; NAME.                         CVT64.
; FUNCTION.                     CONVERT WORD IN ACC 3
;                               INTO 4 HEX CH. AND ENTER
;                               THEM INTO PATTN STARTING
;                               FROM PRPTR.
; INPUT.                        ACC 3.
; OUTPUT.                       NONE.
; CALLS.                        EPT33,EHX47.
; CALLED-BY.                    LOC30,ENS31.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     PRPTR.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
```

```
AC084:    .BLK    1
AC184:    .BLK    1
AC284:    .BLK    1
AC384:    .BLK    1
;
MSK84:            377
;
; SAVE ACC CONTENTS,ENTRY.
;
CV184:    STA     0,AC084
          STA     1,AC184
          STA     2,AC284
          STA     3,AC384
;
; PRPTR VALUE ALREADY SET.
; ACC 0 CONTAINS WORD TO BE ENTERED.
;
; CONVERT INTO HEX,ACC 0 CONTAINS WORD.
;
          JSRS    BMX47
AG084:    .BLK    1
AG184:    .BLK    1
;
; ENTER WORD INTO PRTLN,CALL ON EPT63
;
          LDA     0,AG084
          MOVS    0,0
          LDA     1,MSK84
          AND     1,0
          JSRS    EPT63
          ISZ     PRPTR
          LDA     0,AG084
          LDA     1,MSK84
          AND     1,0
          JSRS    EPT63
          ISZ     PRPTR
          LDA     0,AG184
          MOVS    0,0
          LDA     1,MSK84
          AND     1,0
          JSRS    EPT63
          ISZ     PRPTR
          LDA     0,AG184
          LDA     1,MSK84
          AND     1,0
```

```
        JSR$    EPT83
;
; RESTORE ACC CONTENTS AND RETURN.
;
        LDA     0,AC086
        LDA     1,AC186
        LDA     2,AC286
        JMP$    AC386
;
;*****************************************************
;
; NAME.                         WPT86.
; FUNCTION.                     PUTS OUT A STRING OF
;                               CH. ,TERMINATED BY A NULL,
;                               PACKED RIGHT TO LEFT.
; INPUT.                         IN ACC 2,STARTING ADD.
; OUTPUT.                       NONE.
; CALLS.                        PUT7S.
; CALLED-BY.                    LOTS.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     NONE
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC086:  .BLK    1
AC186:  .BLK    1
AC286:  .BLK    1
AC386:  .BLK    1
;
MSK86:          177
;
; SAVE ACC CONTENTS,ENTRY POINT.
;
WR186:  STA     0,AC086
```

```
          STA     1,AC186
          STA     2,AC286
          STA     3,AC386
;
; GET NEXT WORD.AC2 CONTAINS ADDRESS.
;
LCP66:    LDA     1,0,2
          LDA     0,MSK66
          AND     1,0,SNR
          JMP     END66                   ;CH. IS 0
          JSR@    PUT76
          MOVS    1,1
          LDA     0,MSK66
          ANC     1,0,SNR
          JMP     END66                   ; CH. IS 1.
          JSR@    PUT76
          INC     2,2
          JMP     LCP66
;
; ALL CHARACTERS PRINTED OUT,RETURN.
;
END66:    LDA     0,AC086
          LDA     1,AC186
          LDA     2,AC286
          JMP@    AC386
;
;*****************************************************
;
; NAME.                         MOD66.
; FUNCTION.                     PRINTS OUT MODE= QUERY.
;                               GETS REPLY AND SETS BNFLG,
;                               LTFLG,ENDAD ACCORDINGLY.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        PUT66,REC74.
; CALLED-BY.                    ASCII
; GLOBAL-VARIABLES-USED.        LOCTB,MODNB.
; GLOBAL-VARIABLES-CHANGED.     INPDV,OUTDV,ENDAD,
```

```
;                                       LTFLG,.NFLG.
;  ERROR-BITS-SET.                      NONE.
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC0S5:    .BLK    1
AC1S5:    .BLK    1
AC2S5:    .BLK    1
AC3S5:    .BLK    1
;
MESS5:    .TXT    .<J13><J12> MODE != .
MEA55:            MESS5
;
CNC55:            0
CN155:            1
CN255:            60
CRT55:            15
LFC55:            12
;
;  SAVE ACC CONTENTS ,ENTRY.
;
MO155:    STA     0,AC055
          STA     1,AC155
          STA     2,AC255
          STA     3,AC355
          LDA     0,.+3,SND
          STA     0,INPDV
          LDA     0,MCOTC
          STA     0,OUTDV
;
;  PRINT OUT QUERY.
;
RPT55:    LDA     2,MEA55
          JSR@    WRT56
;
;  GET REPLY.
;
          JSR@    RED74
;
;  REPLY IS IN ACC 0.
;  CHECK WHAT REPLY IS AND TAKE ACTION.
;
          LDA     1,CN255                 ; 60 OCTAL
          SUB     1,0,SNR
          HALT
;
```

```
            LDA     1,CH185
            SUB     1,0,SNR
            JMP     MCH85                   ; MODE IS 1
            SUB     1,0,SNR
            JMP     MTH85                   ; MODE IS 2
            SUB     1,0,SNR
            JMP     MTH85                   ; MODE IS 3
            JMP     RPT85                   ; REPEAT QUERY.
;
;  MODE = 1,SET ENDAD TO 0,RETURN.
;
MCH85:      LDA     0,CH085
            STA     0,ENDAD
            JMP     END85
;
;  MODE = 2,SET ENDAD TO 1,LTFLG TO 0,BNFLG TO 1.
;
MTH85:      LDA     0,CH185
            STA     0,LTFLG
            LDA     0,CH185
            STA     0,ENDAD
            STA     0,BNFLG
            JMP     END85
;
;  MODE IS 3,SET ENDAD TO 1,LTFLG TO 1,BNFLG TO 1.
;
MTH85:      LDA     0,CH085
            STA     0,BNFLG
            LDA     0,CH185
            STA     0,ENDAD
            STA     0,LTFLG
;
;  PRINT OUT LF AND CR.
;  RESTORE ACC CONTENTS AND RETURN.
;
END85:      LDA     0,CRT85
            JSRS    PUT75
            LDA     0,LFD85
            JSRS    PUT75
            LDA     0,AC085
            LDA     1,AC185
            LDA     2,AC285
            JMPS    AC385
;
;*****************************************************************
;
```

```
; NAME.                          END52.
; FUNCTION.                      SERVICE THE PSEUDO-OP
                                 MON,END.SET ENDFG,PNFLG.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         ENE26.
; CALLED-BY.                     SA 25.
; GLOBAL-VARIABLES-USED.         LBFLG.
; GLOBAL-VARIABLES-CHANGED.      ENDFG,LOFLG,PNFLG.
; ERROR-BITS-SET.                 BIT 10 12(P).

; SPACE FOR SAVING ACC CONTENTS.
AC052:   .BLK    1
AC152:   .BLK    1
AC252:   .BLK    1
AC352:   .BLK    1

TWL52:           14                          ; DEC 12

; SAVE ACC CONTENTS,ENTRY.
En152:   STA     0,AC052
         STA     1,AC152
         STA     2,AC252
         STA     3,AC352

; SET LOFLG TO 0.
; SET ENDAD,PNFLG TO 1.

         SUB     0,0
         STA     0,LOFLG
         INC     0,0
         STA     0,ENDFG
         STA     0,PNFLG

; CHECK LBFLG TO SEE IF ERROR.
```

```
;
          LDA       0,.3FLG
          MOV       0,0,SNR
          JMP       STP52
;
; SET BIT NO. 12(P).
;
          LDA       0,TWL52
          STA       0,ARG52
          JSRS      ERE26
ARG52:    .BLK      1
;
; RESTORE ACC CONTENTS AND RETURN.
;
STP52:    LDA       3,AC352
          LDA       1,AC152
          LDA       2,AC252
          JMPS      AC352
;
;*****************************************************
;
; NAME.                          A:A71.
; FUNCTION.                      SERVICES INHERENT TYPE
;                                OF ADDRESSING.FORMAT NO.6.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         NONE.
; CALLED-BY.                     SPM25.
; GLOBAL-VARIABLES-USED.         BSVAL.
; GLOBAL-VARIABLES-CHANGED.      LENTH,WSPCE.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC.71:    .BLK    1
;
```

```
CN171:          1
;SAVE ACC CONTENTS AND ENTRY POINT.
AB171:  STA     0,ACC71
;SET LENTH TO 1
        LDA     0,CN171
        STA     0,LENTH
;SET WSPCE.
        LDA     0,BSVAL
        ICVS    0,0
        STAS    0,WSPCE
;RESTORE ACC CONTENTS,RETURN.
        LDA     0,ACC71
        JMP     0,3
;*****************************************
;NAME.                          BTN15.
;FUNCTION.                      TAKES CARE OF OBJECT-CODE.
;                               FILLS UP BUFFER AND FLUSHES
;                               IT PERIODICALLY OR IF
;                               PNFLG IS SET.
;INPUT.                         NONE.
;OUTPUT.                        NONE.
;CALLS.                         IBN35,EBN36,PCN37.
;CALLED-BY.                     PASS2,FCC55,FCC56,FC354.
;GLOBAL-VARIABLES-USED.         BNFLG,PNFLG,NOWDS.
;GLOBAL-VARIABLES-CHANGED.      LOCAL.
;ERROR-BITS-SET.                NONE.
```

```
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC015:    .BLK      1
AC115:    .BLK      1
AC215:    .BLK      1
AC315:    .BLK      1
;
;
CN.115:             1
;
;  ENTRY POINT,SAVE ACC CONTENTS.
;
EI115:    STA       0,AC015
          STA       1,AC115
          STA       2,AC215
          STA       3,AC315
;
;  CHECK BNFLG .
;
          LDA       0,BNFLG
          LDA       1,CN115
          SUBZE     0,1,SZR
          JMP       END15
;
;  CHECK IF LOCAL IS 0.
;
          LDA       0,LOCAL
          MOV       0,0,SNR
          JSRS      IEN35
;
;  CHECK PNFLG.
;
          LDA       0,PNFLG
          LDA       1,CN115
          SUBZE     0,1,SNR
          JMP       PCH15
;
;  CALL ON ROUTINE TO ENTER NOPCB INTO BNOUT.
;  CHECK LOCAL AGAINST NOWDS.
;
          JSRS      EEN36
          LDA       0,NOWDS
          LDA       1,LOCAL
          SUBLE     0,1,SNC
PCH15:    JSRS      PCH37
;
```

```
; RESTORE ACC CONTENTS AND RETURN.
;
ENC15:  LDA     0,AC315
        LDA     1,AC115
        LDA     2,AC215
        JMPS    AC315
;
;*****************************************************
;
; NAME.                         ISN15.
; FUNCTION.                     INITIALISE BNOUT,(OBJECT-
                                -CODE BUFFER).
                                CALLED WHEN LOCAL IS ..
                                CLEARS BNOUT,SETS C1,SETS
                                ADDRESS AND SETS LOCAL TO .
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        NONE.
; CALLED-BY.                    BIN15.
; GLOBAL-VARIABLES-USED.        BNOUT,LOCTR.
; GLOBAL-VARIABLES-CHANGED.     LOCAL,BNOUT.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC015:  .BLK    1
AC115:  .BLK    1
AC215:  .BLK    1
AC315:  .BLK    1
;
; CONSTANTS.
;
CN015:          0
CN115:          51461
CN315:          50
CN415:          4
```

```
CTR35:  .BLK    1
MSK35:          377
;
;  SAVE ACC CONTENTS,ENTRY.
;
IB135:  STA     0,ACC35
        STA     1,AC135
        STA     2,AC235
        STA     3,AC335
;
;  INITIALISE BNOUT.
;
        LDA     0,CN335
        STA     0,CTR35
;
        LDA     2,BNOUT
        LDA     0,CN035
;
LB135:  STA     0,0,2
        INC     2,2
        DSZ     CTR35
        JMP     LB135
;
;  SET S1.
;
        LDA     0,CN135
        LDA     2,BNOUT
        STA     0,0,2
;
;  SET ADDRESS VALUE.
;
        LDA     0,LOCTR
        MOVS    0,0
        LDA     1,MSK35
        AND     1,0
        STA     0,2,2
        LDA     0,LOCTR
        AND     1,0
        STA     0,3,2
;
;  SET LOCAL TO 4
;
        LDA     0,CN435
        STA     0,LOCAL
;
;  RESTORE ACCS AND RETURN.
;
```

```
        LDA     0,AC135
        LDA     1,AC135
        LDA     2,AC235
        JMPS    AC336
;
;*****************************************************
;
; NAME.                         ES136.
; FUNCTION.                     ENTERS LENTH BYTES FROM
;                               WSPCE INTO BNOUT.
;                               UPDATES LOCAL.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        NONE.
; CALLED-BY.                    BIN15.
; GLOBAL-VARIABLES-USED.        BNOUT,LENTH.
; GLOBAL-VARIABLES-CHANGED.     LOCAL,BNOU1.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC036:  .BLK    1
AC136:  .BLK    1
AC236:  .BLK    1
AC336:  .BLK    1
CTR36:  .BLK    1
MSK36:          377
;
; SAVE ACC CONTENTS,ENTRY.
;
ES136:  STA     0,AC036
        STA     1,AC136
        STA     2,AC236
        STA     3,AC336
;
; ENTER LENTH BYTES INTO BNOUT.
```

```
;
            LDA     0,LENTH
            STA     0,CTR36
            MOV     0,0,SNR
            JMP     END36
            LDA     3,BNDOUT
            LDA     0,LOCAL
            ADD     0,3
;
            LDA     2,WSPCE
            LDA     0,0,2
            MOVO    0,0
            LDA     1,MSK36
            ANC     1,0
            STA     0,0,3
            DSZ     CTR36
            JMP     .+2
            JMP     END36
;
;
            LDA     0,1,2
            ANC     1,0
            STA     0,1,3
            DSZ     CTR36
            JMP     .+2
            JMP     END36
;
;
            LDA     0,1,2
            MOVO    0,0
            ANC     1,0
            STA     0,2,3
;
;  SET LOCAL RESTORE ACC CONTENTS,RETURN.
;
END36:      LDA     0,LOCAL
            LDA     1,LENTH
            ADCC    1,0
            STA     0,LOCAL
;
            LDA     0,AC036
            LDA     1,AC136
            LDA     2,AC236
            JMPS    AC336
;
;
;+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
;
; NAME.                          SUBSO.
; FUNCTION.                      GETS CHARACTER, UNITED IT
;                                INTO BINOUT AND UPDATES
;                                LOCAL.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         NONE.
; CALLED-BY.                     PCH87.
; GLOBAL-VARIABLES-USED.         BINOUT.
; GLOBAL-VARIABLES-CHANGED.      BLOCK,LOCAL.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC0S0:    .BLK    1
AC1S0:    .BLK    1
AC2S0:    .BLK    1
AC3S0:    .BLK    1
CTRS0:    .BLK    1
MSKS0:            377
;
; SAVE ACC CONTENTS,ENTRY
;
SUBS0:    STA     0,AC0S0
          STA     1,AC1S0
          STA     2,AC2S0
          STA     3,AC3S0
;
          LDA     0,LOCAL
          STA     0,CTRS0
          MOV     0,0,SNR
          JMP     ENDS0
;
          SUBZ    0,0
          DSZ     CTRS0
          JMP     .+2
```

```
          JMP     ENDSU
;
          LDA     2,BNOUT
          INC     2,2
          LDA     0,0,2
          DSZ     CTR50
          JMP     .+2
          JMP     ENDSU
;
LBL50:    INC     2,2
          LDA     1,0,2
          ADD     1,0
          DSZ     CTR50
          JMP     LBL50
;
; ACC 0 CONTAINS THE SUM.MASK OUT AND COMPLIMENT FOR CHECKSUM.
;
ENDSU:    COM     0,0
          LDA     1,MSK50
          AND     1,0
          STA     0,1,2
          ISZ     LOCAL
;
; RESTORE ACC CONTENTS AND RETURN.
;
          LDA     0,AC050
          LDA     1,AC150
          LDA     2,AC250
          JMPS    AC350
;
;*****************************************************
;
; NAME.                         PCH37.
;
; FUNCTION.                     FLUSHES THE OBJECT CODE
;                               BUFFER,BNOUT.
;                               GETS CHECKSUM ,CONVERTS
;                               INTO HEX. AND PUNCHES OUT.
;
; INPUT.                        NONE.
;
; OUTPUT.                       NONE.
;
; CALLS.                        SUM50,PUN40,BHX47.
```

```
;CALLED-BY.                          BIN15.
;GLOBAL-VARIABLES-USED.              BINOUT.
;GLOBAL-VARIABLES-CHANGED.           LOCAL,BNOL1.
;ERROR-BITS-SET.                     NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC037:   .BLK    1
AC137:   .BLK    1
AC237:   .BLK    1
AC337:   .BLK    1

; CONSTANTS

CN037:           0
CN237:           2
CTF37:   .BLK    1
FIV37:           5

; STORE ACC CONTENTS,ENTRY.

PC137:   STA     0,AC037
         STA     1,AC137
         STA     2,AC237
         STA     3,AC337

; GET CHECKSUM

; INTRODUCE BYTE COUNT.

         LDA     2,BINOUT
         LDA     0,LOCAL
         INC     0,0
         LDA     1,CN237
         SUB     1,0
         STA     0,1,2
         JSR@    SC15J

; CONVERT BINOUT

         LDA     0,LOCAL
```

```
                LDA     1,FI/37
                ISUBE   0,1,SNE
                JMP     NXT37
                STA     0,CTR37
                LDA     2,BNOUT
                DSZ     CTR37
                INC     2,2
;
LBL37:          LDA     0,0,2
                JSRS    SHX47
AG137:          .BLK    1
AG237:          .BLK    1
                STA     0,AG237
                STA     0,0,2
                INC     2,2
                DSZ     CTR37
                JMP     LBL37
;
; ALL WDS ARE CONVERTED,PUNCH OUT
;
                JSRS    PNL12
                JSRS    PUN40
                JSRS    PNL12
;
; SET LOCAL TO 0.
;
NXT37:          LDA     0,CNS37
                STA     0,LOCAL
;
;RESTORE ACC CONTENTS AND RETURN.
;
                LDA     0,AC037
                LDA     1,AC137
                LDA     2,AC237
                JMPS    AC337
;
;*****************************************************
;
; NAME.                         PUN40.
;
; FUNCTION.                     PUNCHES OUT ALL WORDS
;                               IN BNOUT FROM 1 TO LOCAL.
;
; INPUT.                        NONE.
;
; OUTPUT.
```

```
;
;  CALLS.                          NONE.
;  CALLED-BY.                      PCH37.
;  GLOBAL-VARIABLES-USED.          PUT75.
;  GLOBAL-VARIABLES-CHANGED.       SPRCV,LOCAL,SROUT.
;  ERROR-BITS-SET.                 OUTCV.
;                                  NONE.
;
;  SPACE FOR SAVING ACC CONTENTS,
;
AC040:    .BLK     1
AC140:    .BLK     1
AC240:    .BLK     1
AC340:    .BLK     1
;
;  CONSTANTS.
;
CTR40:    .BLK      1
MSK40:              377
;
;  SAVE ACC CONTENTS.
;
PU140:    STA      0,AC040
          STA      1,AC140
          STA      2,AC240
          STA      3,AC340
;
;  PUNCH OUT NULLS.
;
          JSRS     PNL12
;
;  SET DEVICE CODE.
;
          LDA      0,SPRDV
          STA      0,OUTDV
;
;  SET UP COUNTER.
;
          LDA      0,LOCAL
          STA      0,CTR40
;
```

```
        LDA     2,BNOUT
;
; PUNCH OUT.
;
        LDA     1,MSK40
LBL40:  LDA     0,0,2
        ADDO    0,0
        AND     1,0
        JSR@    PUT75
        LDA     0,0,2
        AND     1,0
        JSR@    PUT75
        INC     2,2
        DSZ     CTR40
        JMP     LBL40
;
; PUNCH OUT NULLS.
;
        JSR@    PNL12
;
; RESTORE ACC CONTENTS AND RETURN.
;
        LDA     0,AC040
        LDA     1,AC140
        LDA     2,AC240
        JMP@    AC340
;
;*****************************************************
;
; NAME.                         GCH=7
; FUNCTION.                     GET NEXT CH. FROM
;                               INSLN.
; INPUT.                        CHPTR POINTING TO CH. BEFOR
;                               REQD. ONE.
; OUTPUT.                       RETURNS THE CH. IN ACC 0.
;                               RETURNS A BLANK IF GREATER
;                               THAN 60.
; CALLS.                        GCH61 .
; CALLED-BY.                    LOTO.
; GLOBAL-VARIABLES-USED.
```

```
;
; GLOBAL-VARIABLES-CHANGED.          INCHR.
;                                    CHPTR.
; ERROR-BITS-SET.                    NONE.
;
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC187:    .BLK    1
AC287:    .BLK    1
AC387:    .BLK    1
;
; CONSTANTS.
;
CNS87:            121                       ; DEC 81
BLK87:            40                        ; BLANK
;
; ENTRY POINT,SAVE ACCS.
;
GN187:    STA     2,AC287
          STA     1,AC187
          STA     3,AC387
;
; INC CHPTR AND CHECK.
;
          ISZ     CHPTR
          LDA     0,CHPTR
          LDA     3,CNS87
          SUBLE   3,0,SNC
          JMP     ERR87
;
; CHPTR OKAY,GET CH.
;
          JSRS    GCH81
;
; AC 0 CONTAINS CH.RETURN.
;
          JMP     END87
;
; CHPTR IS 81.
;
ERR87:    LDA     0,BLK87
          STA     3,CHPTR
;
; RESTORE ACC .RETURN.
;
```

```
ENC67:  LDA     1,AC187
        LDA     2,AC287
        JMPS    AC367

;*****************************************************

; NAME.                         BNY66.
; FUNCTION.                     CONVERTS A SERIES OF ASCII
                                BIN. CH. INTO A BINARY NO.
; INPUT.                        CHPTR POINTS TO CH.
                                BEFORE STRING.
                                CH. ARE REQUESTED THRO
                                A CALL TO GNC67.
; OUTPUT.                       CHPTR POINTS AT BREAK.
                                ACC 0 CONTAINS BREAK.
                                ACC 1 CONTAINS VALUE.
; CALLS.                        GNC67.
; CALLED-BY.                    CVT66.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC293:  .BLK    1
AC393:  .BLK    1

; CONSTANTS.

CH093:          61                      ;CH 1
CH793:          60                      ; CH 0
BSM93:  .BLK    1

; SAVE ACC,ENTRY,INITIALISE RUNNING SUM.

BN193:  STA     2,AC293
```

```
        STA     3,AC393
        SUB     0,0
        STA     0,RSM93
;
; GET NEXT CH AND UPDATE RUNNING SUM.
;
LBL93:  JSRS    GNC87
        LDA     1,CHZ93
        LDA     2,CHO93
        ASZCZE  2,J,SNC
        ASZCZE  J,1,SZC
        JMP     BRK93
;
;
        SUB     1,J                     ; REDUCE CH
        LDA     1,RSM93
;
; MULTIPLY BY 2 AND ADD
;
        MOVZL   1,1
        ADD     J,1
        STA     1,RSM93
;
        JMP     LBL93
;
; ACC 0 CONTAINS BREAK CH ,RETURN .
;
BRK93:  LDA     1,RSM93
        LDA     2,AC293
        JMPS    AC393
;
;*****************************************************
;
; NAME.                         HEX94.
;
; FUNCTION.                     CONVERTS A SERIES OF ASCII
;                               HEX CH. INTO A BINARY NO.
;
; INPUT.                        CHPTR POINTS TO CH.
;                               BEFORE STRING.
;                               CH. ARE REQUESTED THRO
;                               A CALL TO GNC87.
;
; OUTPUT.                       CHPTR POINTS AT BREAK.
;                               ACC 0 CONTAINS BREAK.
```

```
;                                       ACC 1 CONTAINS VALUE.
;  CALLS.                               GNC87.
;  CALLED-BY.                           CVT96.
;  GLOBAL-VARIABLES-USED.               NONE.
;  GLOBAL-VARIABLES-CHANGED.            NONE.
;  ERROR-BITS-SET.                      NONE.

;  SPACE FOR SAVING ACC CONTENTS.

AC294:    .BLK    1
AC394:    .BLK    1

;  CONSTANTS.

CNS94:            67                    ;USED TO
                                         ;REDUCE A-F.
CHZ94:            60                    ; CH 0
CH994:            71                    ; CH 9
CHA94:            101                   ; CH A
CHF94:            106                   ; CH F
RSM94:    .BLK    1                     ; RUNNING SUM

;  SAVE ACC,ENTRY,INITIALISE RSM94

HE194:    STA     2,AC294
          STA     3,AC394
          SUB     0,0
          STA     0,RSM94

;  GET NEXT CHARACTER,CHECK IT OUT,MULTIPLY BY
;  16 AND ADD .

LBL94:    JSRS    GNC87
          LDA     1,CHZ94
          LDA     2,CH994
          ADCZE   2,0,SNC
          ADCZE   0,1,SZC
          JMP     CHK94
          JMP     MAD94

;  CH NOT NUMERIC,CHECK IF IT IS IN A-F.
```

```
;
CHK94:  LDA     1,CHA94
        LDA     2,CHF94
        ADCZE   2,J,SNC
        ADCZE   J,1,SZC
        JMP     BRK94
        LDA     1,CHG94                 ; VALUE USED TO
                                        ;REDUCE A-F.
;
; CH IS OKAY,REDUCE ,MULTIPLY,AND ADD.
;
MAD94:  SUB     1,J
        LDA     1,RS194
        MOVZL   1,1
        MOVZL   1,1
        MOVZL   1,1
        MOVZL   1,1
        ADD     0,1
        STA     1,RS194
        JMP     LEL94
;
; AC 0 CONTAINS BREAK CH.RESTORE ACC,RETURN.
;
BRK94:  LDA     1,RS194
        LDA     2,AC294
        JMPS    AC394
;
;*****************************************************
;
; NAME.                         OCT92.
; FUNCTION.                     CONVERTS A SERIES OF ASCII
;                               DECIMAL CH. INTO A BINARY
;                               NUMBER.
; INPUT.                        CHRTR POINTS TO CH.
;                               BEFORE STRING.
;                               CH. ARE REQUESTED THRO
;                               A CALL TO GNC87.
; OUTPUT.                       CHRTR POINTS AT BREAK.
;                               ACC 0 CONTAINS BREAK.
;                               ACC 1 CONTAINS VALUE.
; CALLS.                        GNC87.
```

```
;
; CALLED-BY.                          CVT96.
; GLOBAL-VARIABLES-USED.              NONE.
; GLOBAL-VARIABLES-CHANGED.           NONE.
; ERROR-BITS-SET.                     NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC296:  .BLK    1
AC396:  .BLK    1
;
; CONSTANTS
;
CHS96:          67                  ; CH 7
CH796:          60                  ;  CH
RSM96:  .BLK    1
;
; SAVE ACC ,ENTRY,INITIALISE RUNNING SUM.
;
CC196:  STA     2,AC296
        STA     3,AC396
        SUB     0,0
        STA     0,RSM96
;
; GET NEXT CH AND UPDATE RUNNING SUM.
;
LOL96:  JSR     GNC87
        LDA     1,CHZ96
        LDA     2,CHS96
        ADCZE   2,0,SNC
        ADCZE   0,1,SZC
        JMP     BRK96
;
;
        SUB     1,0
        LDA     1,RSM96
;
; MULTIPLY BY 6 AND ADD
;
        MOVZL   1,1
        MOVZL   1,1
        MOVZL   1,1
        ADD     0,1
```

```
;
        STA     1,RS192
        JMP     L&L92
;
; ACC 0 CONTAINS BREAK CH, SET ACC 1 VALUE AND RETURN.
;
BRK92:  LDA     1,RS192
        LDA     2,AC292
        JMPS    AC392
;
;*****************************************************
;
; NAME.                         DEC91.
; FUNCTION.                     CONVERTS A SERIES OF ASCII
;                               OCTAL CH. INTO A BINARY
;                               NUMBER.
; INPUT.                        CHPTR POINTS TO CH.
;                               BEFORE STRING.
;                               CH. ARE REQUESTED THRO
;                               A CALL TO GNC87.
; OUTPUT.                       CHPTR POINTS AT BREAK.
;                               ACC 0 CONTAINS BREAK.
;                               ACC 1 CONTAINS VALUE.
; CALLS.                        GNC87.
; CALLED-BY.                    CVT96,PAG60,MER17.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC291:  .BLK    1
AC391:  .BLK    1
;
; CONSTANTS.
;
```

```
CHN91:          71                      ; CH 9
CHZ91:          60                      ; CH 0
RSM91:  .BLK    1                       ; RUNNING SUM.
;
; SAVE ACC CONTENTS,ENTRY POINT,INITIALISE RS 91.
;
DE191:  STA     2,AC291
        STA     3,AC391
        SUB     0,0
        STA     0,RSM91
;
;
; EVALUATE BY SUCCESSIVE CALLS TO GNCE7 AND MULTIPLYING
; BY 10.
;
LBL91:  JSRS    GNCE7
        LDA     1,CHZ91
        LDA     2,CH991
        ADCZE   2,0,SNC                 ; SKIP IF > 9
        ADCZE   0,1,SZC                 ; SKIP IF >= 0
        JMP     BRK91
;
; CH IS NOT BREAK
;
        SUB     1,0
        LDA     1,RSM91
;
; MULTIPLY BY 10 AND ADD
;
        MOVZL   1,2
        MOVZL   2,2
        ADC     2,1
        MOVZL   1,1
        ADD     0,1
;
;
        STA     1,RSM91
        JMP     LBL91
;
; ACC 0 CONTAINS BREAK CH.,RETURN.
;
BRK91:  LDA     1,RSM91
        LDA     2,AC291
        JMPS    AC391
;
```

```
;*****************************************************
;
; NAME.                         SYM95.
; FUNCTION.                     GETS THE VALUE OF
;                               THE SYMBOL FROM SYMTB.
; INPUT.
;                               CHPTR POINTS TO CH.
;                               BEFORE SYMBOL.
; OUTPUT.
;                               CHPTR POINTS TO BREAK CH.
;                               ACC 0 CONTAINS BREAK (=0 IF
;                               ERROR).
;                               ACC 1 CONTAINS VALUE.
; CALLS.                        STB79,GNC87,ERR26.
; CALLED-BY.                    C/T96.
; GLOBAL-VARIABLES-USED.        LOCTR,PSFLG.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               5(S),9(U).

; SPACE FOR SAVING ACC CONTENTS.

AC295:    .BLK    1
AC395:    .BLK    1

; CONSTANTS

AST95:            52
CST95:            1
CN595:            5
CN695:            6
CNT95:            7

; COUNTERS AND SPACE FOR STORING LABEL

CTR95:    .BLK    1
LBL95:    .BLK    3
LBA95:            LBL95

; SAVE ACC CONTENTS,ENTRY
```

```
;
SY195:  STA     2,AC295
        STA     3,AC395
        JSRS    GNC87
        LDA     1,AST95
        SUBE    0,1,SNR
        JMP     ASK95
        DSZ     CHRTR
;
;;;;;;  SET UP COUNTER TO COUNT UPTO 6
;
        LDA     0,CNT95
        STA     0,CTR95
;
;;;;;;  CLEAR LABEL SPACE
;
        LDA     2,LBA95
        SUB     0,0
        STA     0,0,2
        STA     0,1,2
        STA     0,2,2
;
;;;;;;  GET CH AND SAVE
;
LOP95:  JSRS    GNC87
        JSRS    CLB76
        JMP     BRK95
;
;;;;;;  CH IS ALPHANUMERIC,CHECK FOR LENGTH.
;
        DSZ     CTR95
        JMP     .+2
        JMP     ERR95
;
;;;;;;  CHECK WHICH HALF
;
        LDA     3,CT395
        MOVR    3,3,SNC
        JMP     ZCY95
;
;;;;;;  CARRY IS NON ZERO,STORE AND UPDATTE ACC 2
;
        ADD     1,0
        STA     0,0,2
        INC     2,2
        JMP     LOP95
```

```
;
; CARRY IS ZERO,SAVE IN ACC 1
;
ZCY95:  MOVS    0,1
        JMP     LCP95
;
; CH IN ACC 0 IS BREAK,SEARCH TABLE AFTER POSSIBLY
; SAVING ACC 1
;
B-KB5:  LDA     3,CT595
        STA     0,BREAK
        MOVR    3,3,SNC
        STA     1,0,2
;
        LDA     1,LSA95
        STA     1,AGD95
        LDA     1,CST95
        STA     1,AG195
        JSR@    ST379
AGL95:  .BLK    1
AG195:  .BLK    1
AG295:  .BLK    1
FLG95:  .BLK    1
;
; CHECK WHETHER FOUND OR NOT
;
        LDA     1,AG295
        LDA     2,FLG95
        MOVLE   2,2,SNC
        JMP     END95
;
; NOT FOUND.
; ENTER ERROR NO 5
; IF PASS IS 2.
; SET NULL BREAK CHARACTER.
;
        LDA     2,PSFLG
        LDA     1,CST95
        SUBE    2,1,SNR
        JMP     SET95                   ; DO IT SET
                                        ERROR BIT.
;
; PASS IS 2,SET ERROR BIT 5.
;
        LDA     2,CN595
        STA     2,AG395
        JSR@    ERR26
```

```
AG395:    .BLK    1

SET95:    SUB     0,0
          SUB     1,1
          JMP     END95

; SYMBOL TOO LONG,ENTER ERROR BIT 6.

ERR95:    LDA     2,ON595
          STA     2,AG495
          JSRS    ERE26
AG495:    .BLK    1
          SUB     1,1
          SUB     0,0
          JMP     END95
ASK95:    LDA     1,LOCTS
          JSRS    GNC07

; RESTORE ACC,RETURN

END95:    LDA     2,AC295
          JMPS    AC395

;*****************************************************

; NAME.                          EVL07.
; FUNCTION.                      EVALUATE AN EXPN.
; INPUT.                         CHPTR POINTS TO FIRST CH.
                                 OF EXPN.
; OUTPUT.                        CHPTR POINTS TO BREAK.
                                 ACC 0 CONTAINS BREAK,NULL
                                 IF ERROR.
                                 ACC 1 CONTAINS VALUE.
; CALLS.                         ERE26,CVT96,ADD43,
                                 SUB69,MPY72,DIV96.
; CALLED-BY.                     LOTS.
; GLOBAL-VARIABLES-USED.         NONE.
; GLOBAL-VARIABLES-CHANGED.
```

```
;
;  ERROR-BITS-SET.                    CHPTR.
;                                     7(3).
;
;  SPACE FOR SAVING ACC CONTENT.
;
AC297:    .BLK     1
AC397:    .BLK     1
;  OTHER CONSTANTS.
PLS97:             53                        ; CH +
MIN97:             55                        ; CH -
SLH97:             57
ASC97:             52
BLK97:             40                        ;CH. BLANK
COM97:             54                        ;CH. COMMA
SEV97:             7                         ;SEC  7
;
;  SPACE FOR BREAK,VALUE
;  AND ADDRESS OF SERVICE ROUTINE.
;
ADR97:    .BLK     1
BRK97:    .BLK     1
VAL97:    .BLK     1
;
;  SAVE ACC CONTENTS,ENTRY,SET CHPTR.
;
EV197:    STA      2,AC297
          STA      3,AC397
          DSZ      CHPTR
;
;  INITIALISE VAL97,BRK97 TO 0,+
;
          SUB      0,0
          STA      0,VAL97
          LDA      0,PLS97
          STA      0,BRK97
;
;  CHECK BREAK CHARACTER .
;
LBL97:    LDA      0,BRK97
          MOVE     0,0,SZR
          STA      0,BREAK
;
;  CHECK IF I IS +
;
          LDA      1,PLS97
```

```
          SUBE    0,1,SNR
          JMP     ACC97                   ; CHARACTER IS +
;
;  CHECK IF IT IS -
;
          LDA     1,MIN97
          SUBE    0,1,SNR
          JMP     SLC97
;
;  CHECK IF  IT IS  SLASH.
;
          LDA     1,SLH97
          SUBE    0,1,SNR
          JMP     DIV97                   ; CH. IS /.
;
;  CHECK IF CH. IS *
;
          LDA     1,AST97
          SUBE    0,1,SNR
          JMP     MUL97                   ; CH IS *
;
;  CHECK IF IT IS BLANK OR COMMA.
;
          LDA     1,BLK97
          SUBE    0,1,SNR
          JMP     NXT97
          LDA     1,COM97
          SUBE    0,1,SNR
          JMP     NXT97                   ; CH IS COMMA
;
;  CHARACTER IS NONE OF ABOVE,SEE IF IT IS
;  A NULL.  IF SO DO NOTT SET ERROR BIT SINCE
;  IT HAS BEEN ALREADY SET.
;
          MOV     0,0,SNR
          JMP     ER197
;
;  CHARACTER IS NONE OF ABOVE.SET ERROR BIT NO. 7
;  EXPRESSION ERROR.
;
          LDA     0,SEV97
          STA     0,ACC97
          JSRS    ENE26
ACC97:    .BLK    1
;
;  SET AC 0 AND AC 1 TO 0.
;
```

```
E~197:  SUB     0,0
        SUB     1,1
        JMP     EN097
;
; ADDITION SYMBOL.SET ADDRESS.
;
ADD97:  LDA     1,ADD86
        STA     1,ADR97
        JMP     GVL97
;
; SUBTRACTION SYMBOL.SET ADDRESS.
;
SUB97:  LDA     1,SUB89
        STA     1,ADR97
        JMP     GVL97
;
; MULTIPLICATION SYMBOL,SET ADDRESS.
;
MUL97:  LDA     1,MPY72
        STA     1,ADR97
        JMP     GVL97
;
; DIVISION SYMBOL,SET ADDRESS.
;
DIV97:  LDA     1,DIV83
        STA     1,ADR97
;
; CALL ON ROUTINE TO CONVERT NEXT OPERAND.
;
GVL97:  JSRS    CVT96
;
; AC 0 CONTAINS BREAK CHARACTER .
; AC 1 CONTAINS VALUE.
; ACC 0 CONTAINS NULL IF EXP CANNOT BE EVALUATED.
;
        STA     0,BRK97
;
; PERFORM OPERATION.
; ACC 0 CONTTAINS FINAL RESULT.
; ACC 0 AND ACC 1 ARE INPUTS NEEDED BY ROUTINE.
;
        LDA     0,VAL97
        JSRS    ADR97
        STA     0,VAL97
        JMP     LBL97
;
; CH. IS BLANK,END OF EXPN.
```

```
; BREAK CH. IS IN ACC 0,RETURN.

NXT97:  LDA     1,/AL97
END97:  LDA     2,AC297
        JMPS    AC397

;*****************************************************

; NAME.                         C/T96.
; FUNCTION.                     EVALUATES THE NEXT
                                OPERAND IF POSSIBLE.
; INPUT.                        CHPTR POINTING TO
                                CH. BEFORE SYMBOL/NUMBER.
; OUTPUT.                       CHPTR POINTS TO BREAK.
                                VALUE IN ACC 1.
                                BREAK IN ACC 0,NULL
                                IF ERROR.
; CALLS.                        GNC97,SNT93,DEC91,
                                HEX94,OCT92,SYM95.
; CALLED-BY.                    E/L97.
; GLOBAL-VARIABLES-USED.        NONE
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-BITS-SET.               NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC296:  .BLK    1
AC396:  .BLK    1

; CONSTANTS.

PER96:          45              ; %
ATT96:          100             ; @
DOL96:          44              ; $
BLK96:          40              ; BLANK
CHZ96:          60              ; CH 0
```

```
CHR96:  71                      ;CH 9
COM96:  54                      ; ,
;
; SAVE ACC CONTENTS,ENTRY POINT
;
CV196:  STA     2,AC296
        STA     3,AC396
;
; GET FIRST CHARACTER OF NUMBER-SYMBOL AND DECIDE
; WHICH ROUTINE TO CALL.
;
        JSR@    GNC3Y
        LDA     1,PER96
        SUBE    0,1,SNR
        JMP     BIN96                   ; CH IS %
;
        LDA     1,COL96
        SUBE    0,1,SNR
        JMP     HEX96                   ; CH IS $
;
        LDA     1,ATT96
        SUBE    0,1,SNR
        JMP     OCT96                   ; CH IS <
;
; CHECK IF CH IS BLANK OR COMMA
;
        LDA     1,BLK96
        SUBE    0,1,SNR
        JMP     NXT96                   ; CH IS BLANK
;
        LDA     1,COM96
        SUBE    0,1,SNR
        JMP     NXT96                   ; CH IS COMMA
;
; CHECK IF DECIMAL OR SYMBOL
;
        LDA     1,CHZ96
        LDA     2,CHN96
        ADCZE   2,0,SNC
        ADCZE   0,1,SZC
        JMP     SYM96                   ; IT ISA SYMBOL
;
; CH IS BETWEEN 0-9,TRANSFER TO CONVERSION ROUTINE
; AFTER ADJUSTING CHPTR.
;
        DSZ     CHPTR
        JSR@    DEC91
```

```
          JMP     END96
;
; CH IS BINARY,TRANSFER TO ROUTINE.
;
BIN96:    JSR$    BNY93
          JMP     END96
;
; CH IS HEXADECIMAL.
;
HEX96:    JSR$    HEX94
          JMP     END96
;
; CH IS OCTAL.
;
OCT96:    JSR$    OCT92
          JMP     END96
;
; CH IS SYMBOL
;
SYM96:    DSZ     CHPTR
          JSR$    SYM95
          JMP     END96
;
; CH IS BLANK OR COMMA,,SET VALUE TO 0
;
NXT96:    SUB     1,1
;
; RESTORE ACC CONTENTS,RETURN
;
END96:    LDA     2,AC296
          JMP$    AC396
;
;*****************************************************
;
; NAME.                     MPY72.
;
; FUNCTION.                 MULTIPLY TWO NUMBERS.
;                           ACC 0 = ACC 0 * ACC 1.
;
; INPUT.                    ACC 0,ACC 1.
;
; OUTPUT.                   ACC 0.
;
; CALLS.                    NONE.
;
; CALLED-BY.
```

```
;
;                                       EVL87.
; GLOBAL-VARIABLES-USED.                NONE.
; GLOBAL-VARIABLES-CHANGED.             NONE.
; ERROR-BITS-SET.                       NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC272:  .BLK    1
AC372:  .BLK    1
;
; CONSTANTS.
;
CNS72:          -20                     ; DEC  -16
;
; ENTRY POINT,SAVE ACC CONTENTS.
;
MP172:  STA     3,AC372
        STA     2,AC272
;
        SUBC    2,2
        LDA     3,CNS72                 ;16 TIMES THRO
;                                       THE LOOP.
;
;
LBL72:  MOVR    0,0,SNC                 ;CHECK NEXT
;                                       MULTIPLIER BIT.
        MOVR    2,2,SKP                 ;0,SKIP.
        ADDZR   1,2                     ; 1,ADD AND
;                                       SHIFT.
        INC     3,3,SZR                 ; CHECK FOR 16
;                                       TIME THRO LOOP.
        JMP     LBL72
        MOVOR   0,0                     ; YES,SHIFT
;                                       LAST BIT.
;
; RETURN.
;
        LDA     2,AC272
        JMPS    AC372
;
;*****************************************************
```

```
;NAME.                                  IMM99.
;FUNCTION.                              TAKES CARE OF IMMEDIATE
                                        MODE OF ADDRESSING.
;INPUT.                                 CHPTR POINTS TO FIRST CH.
                                        OF EXPRESSION.
;OUTPUT.                                CHPTR UNCHANGED IF NOT IMM.
                                        CHPTR SET TO BREAK IF IMM.
                                        LENTH SET ,WDPCE SET
                                        ACC 0 = 0,IF IMM,
                                              =1,OTHERWISE.
;CALLS.
;CALLED-BY.                             GCH;1.
;GLOBAL-VARIABLES-USED.                 LOTS.
;GLOBAL-VARIABLES-CHANGED.              WSPCE.
;ERROR-BITS-SET.                        WDPC1,LENTH.
                                        NONE.

;SPACE FOR SAVING ACCS.

AC199:    .BLK    1
AC299:    .BLK    1
AC399:    .BLK    1

;CONSTANT

CH299:            2
MLT99:            43                    ; CH = E
LTT99:            47                    ; CH < E
MSK99:             377                   ; MASK

;SAVE ACC CONTENTS.

IM199:    STA     1,AC199
          STA     2,AC299
          STA     3,AC399

;CHECK IF CH IS E
```

```
          JSR<      GCH81
          LDA       1,NL099
          SUBE      0,1,SZR
          JMP       NXT99
;
;  CH IS =.CHECK IF NEXT IS #
;
          JSR<      GNC87
          LDA       1,LIT99
          SUBE      0,1,SZR
          JMP       EXP99
;
;  CH. IS A LITERAL,STORE IN WSPCE AS IT IS.
;
          JSR<      GNC87
          STA<      0,WSPCE
          MOVS      0,1
          JSR<      GNC87
          ADDO      0,1
          LDA       3,WSPCE
          STA       1,1,3
          SUBO      0,0
          LDA       1,CH299
          STA       1,LENTH
          JMP       END99
;
;   CH IS NOT LITERAL,EVAL EXPRESSION.
;
EXP99:    JSR<      EVL97
          LDA       0,MSK99
          AND       1,0
          STA<      0,WSPCE
          LDA       3,WSPCE
          STA       1,1,3
          SUB       0,0
          LDA       1,CH299
          STA       1,LENTH
          JMP       END99
;
;  SET TO 1 ACC 0
;
NXT99:    SUB       0,0
          INC       0,0
;
;  RESTORE ACC CONTENTS.
;
END99:    LDA       1,AC199
```

```
        LDA     2,.+2
        JMP*    AC399

;*****************************************************

; NAME.                         BCC7J.
; FUNCTION.                     SERVICES THE RELATIVE MODE
                                OF ADDRESSING.FORMAT 6.
                                INSTRUCTIONS SERVICED ARE
                                BCC BCS BEQ BGE BGT BHI
                                BLE BLS BLT BMI BNE BPL
                                BRA BSR BVC BVS.
; INPUT.                        CHPTR POINTS TO OP. AFTER
                                OP-CODE.
; OUTPUT.                       LENTH,MSPCE SET.
                                CHPTR POINTS TO BREAK.
; CALLS.                        EVL97,ENE26.
; CALLED-BY.                    SPC25.
; GLOBAL-VARIABLES-USED.        MSPCE,LOCTR,BSVAL,ASFLG.
; GLOBAL-VARIABLES-CHANGED.     LENTH,MSPC1.
; ERROR-BITS-SET.               15(F).

; SPACE FOR SAVING ACC CONTENTS.

AC070:    .BLK    1
AC170:    .BLK    1
AC270:    .BLK    1
AC370:    .BLK    1

; CONSTANTS.

CN270:          2
CN370:          3
CN470:          12
MSK70:          377
;
```

```
;SAVE ACC CONTENTS.
;
BC17C:  STA     0,ACC7C
        STA     1,AC17C
        STA     2,AC27C
        STA     3,AC37C
;
;IF ABFLG IS SET,PROCEED
;IF ABFLG = 3 ,PROCEED,OTHERWISE FORMAY ERROR.
;
        JSRS    SCP23
        JMP     END7C
        LDA     0,ABFLG
        LDA     1,CN37C
        SUBE    0,1,SZR
        JMP     ERR7C
;
;EVALUATE EXP
;
        JSRS    EVL97
;
;SET LENTH
;
        LDA     2,CN27C
        STA     2,LENTH
;
;GET VALUE
;
        LDA     2,LOCTR
        SUB     2,1
        LDA     2,CN27C
        SUB     2,1
        LDA     2,MSK7C
        AND     1,2
        LDA     1,BSVAL
        MOVS    1,1
        ADC     1,2
        STAS    2,WSPCE
        JMP     END7C
ERR7C:  LDA     0,CL47C
        STA     3,AGC7C
        JSRS    ENE26
AGC7C:  .BLK    1
;
;RESTORE ACC,RETURN
;
END7C:  LDA     3,AGC7C
```

```
          LDA     1,AC17J
          LDA     2,AC27J
          JMPS    AC37J

;*****************************************************

; NAME.                                 EXS.2.
; FUNCTION.                             SERVICES EXTENDED MODE OF
                                        ADDRESSING.
; INPUT.                                CHPTR POINTS TO FIRST CH.
                                        OF EXPRESSION.
; OUTPUT.                               CHPTR POINTS TO BREAK.
                                        LENTH SET TO 3.
                                        WSPCE BYTES 2 AND 3 SET.
; CALLS.                                EVL97.
; CALLED-BY.                            EVTS.
; GLOBAL-VARIABLES-USED.                WSPCE.
; GLOBAL-VARIABLES-CHANGED.             WSPC1,LENTH.
; ERROR-BITS-SET.                       NONE.

; SPACE FOR SAVING ACC CONTENTS.

A0EC2:    .BLK    1
A1EC2:    .BLK    1
A2EC2:    .BLK    1
A3EC2:    .BLK    1

; CONSTANTS.

CHEC2:            3
MKEC2:            377

; SAVE ACC CONTENTS.

E1EC2:    STA     0,A0EJ2
          STA     1,A1EJ2
```

```
        STA     2,A2800
        STA     3,A3800
;
; EVALUATE EXP .
;
        JSRS    EVL97
;
; SET LENTH
;
        LDA     2,D3800
        STA     2,LENTH
;
; SET MSPCE
;
        LDA     3,MSPCE
        LDA     2,MK800
        ANDS    1,2
        STA     2,1,3
        LDA     2,MK800
        MOVS    1,1
        ANC     1,2
        STA     2,0,3
;
; RESTORE ACC CONTENTS.
;
        LDA     0,A0800
        LDA     1,A1800
        LDA     2,A2800
        JMPS    A3800
;
;*****************************************************
;
; NAME.                         DIR00.
; FUNCTION.                     SERVICES THE DIRECT MODE
;                               OF ADDRESSING.
; INPUT.                        CHPTR POINTS TO FIRST CH.
;                               OF EXPRESSION.
; OUTPUT.                       CHPTR POINTS TO BREAK.
;                               LENTH SET ,MSPCE SET.
; CALLS.                        EVL97.
; CALLED-BY.
```

```
;
;  GLOBAL-VARIABLES-USED.                LOTS.
;
;                                        NSPOS,DIRAD,PSFLG,OPERT,
;                                        LNCTR.
;  GLOBAL-VARIABLES-CHANGED.
;                                        DIRA1,NSPO1,LENTH.
;  ERROR-BITS-SET.
;                                        NONE.
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC0000:    .BLK     1
A16000:    .BLK     1
A26000:    .BLK     1
A36000:    .BLK     1
;
;  CONSTANTS.
;
C17700:             377
C20000:             2
C30000:             3
C40000:             62                          ; DEC 50
C60000:             177400
VL8000:    .BLK     1
;
;  SAVE ACC CONTENTS.
;
D16000:    STA      0,AC0000
           STA      1,A16000
           STA      2,A26000
           STA      3,A36000
;
;  EVALUATE  EXPRESSION.
;
           JSRS     EVL97
           STA      1,VL8000
;
;  AC 1 CONTAINS VALUE,AC 0 CONTAINS BREAK.
;  AC 0 = 0 IF ERROR IN EVALUATION.
;
           MOV      0,0,SNR
           JMP      EX8000
;
           LDA      0,PSFLG
           LDA      2,C20000
           SUBE     0,2,SNR
```

```
          JMP     P2000
;
; PASS = 1,CHECK IF DIRAD IS FULL.AC 1 CONTAINS VALUE
;
          LDA     1,DIRAD
          LDA     2,C40000
          ADD     1,2
          LDA     0,DREPT
          SUBE    2,1,SNR
          JMP     EX800
;
; TABLE NOT FULL,CHECK IF ACC IS BETWEEN    00 AND  FF.
;
          LDA     0,C0000
          ANDE    0,1,SZR
          JMP     EX800
;
; PASS = 1,DIRAD IS NOT FULL ,VALUE LESS THAN FF.
;
          LDA     0,LNGTH
          STA     0,DREPT
          ISZ     DREPT
          JMP     DR000
;
; PASS TO 2
; CHECK IF LINE PRESENT IN DIRAD,IF SO DIRECT ELSE EXTENDED.
;
P2000:    LDA     2,DIRAD
          LDA     3,DREPT
          LDA     0,LNGTH
;
LB000:    SUBE    2,3,SNR
          JMP     EX800                   ; NOT FOUND
          LDA     1,0,2
          SUBE    0,1,SNR
          JMP     DR000                   ; FOUND
          INC     2,2
          JMP     LB000
;
; ENTER WORD,SETLENTH,STORE VALUE.
;
EX800:    LDA     0,C3000
          STA     0,LENTH
          LDA     2,WSPCE
          LDA     1,VL000
          LDA     0,C1800
```

```
          ADDS    1,0
          STA     0,1,2
          LDA     0,C1000
          MOVS    1,1
          ADC     1,0
          STA     0,0,2
          JMP     EN800

;
; DIRECT MODE,SET LENTH ,STORE VALUE
;
EP8001    LDA     1,VL800
          LDA     0,C1800
          ADD     1,0
          STA     0,WSPCE
          LDA     0,C2800
          STA     0,LENTH
          ISZ     A3800
;
; RESTORE ACC AND RETURN.
;
EN8001    LDA     0,A0800
          LDA     1,A1800
          LDA     2,A2800
          JMPS    A3800
;
;*****************************************************
;
; NAME.                         INDX1.
;
; FUNCTION.                     SERVICES THE INDEXED
;                               MODE OF ADDRESSING.
;
; INPUT.                        CHRTR POINTS TO FIRST
;                               CHARACTER OF EXPN.
;
; OUTPUT.                       CHRTR POINTS TO BREAK.
;                               IF INDEXED,CHRTR POINTS TO
;                               BREAK,ACC 0 = 0,LENTH SET
;                               TO 2,WSPCE SET.
;                               IF NOT INDEXED ACC 0 = 1,
;                               CHRTR UNCHANGED.
;
; CALLS.                        SCH01,GNC87,EVL87,GL841.
;
; CALLED-BY.                    LOTS.
```

```
;GLOBAL-VARIABLES-USED.                  NSPCE.
;GLOBAL-VARIABLES-CHANGED.               LENTH,NSPC1,CHPTR.
;ERROR-BITS-SET.                         NONE.


;SPACE FOR SAVING ACC.

A1SC1:    .BLK    1
A2SC1:    .BLK    1
A3SC1:    .BLK    1
TMSC1:    .BLK    1

;CONSTANTS.

C1SC1:            121
C2SC1:            2
C3SC1:            26130                   ; CHR.    #,X#
C4SC1:            54340                   ;  CHS   #X #
MKSC1:            377

;SAVE ACC CONTENTS,ENTRY

I1SC1:    STA     1,A1SC1
          STA     2,A2SC1
          STA     3,A3SC1

;CHECK IF ERROR

          LDA     0,CHPTR
          LDA     1,C1SC1
          SUBE    0,1,SNR
          JMP     NISC1

;CHECK IF CH IS X

          JSRS      GCHSC1
          MOVS      0,2
          JSRS    GNCSC7
          ADDC      0,2
          LDA     1,C4SC1
          SUBE    2,1,SNR
          JMP     LESC1
;
```

```
;
; GET NEXT NON-BLANK CHARACTER.
;
          DSZ       CHPTR
          LDA       0,CHPTR
          STA       0,TM801
          JSR@      GL841
          DSZ       CHPTR
          JSR@      GCH81
          MOV       0,1
          DSZ       CHPTR
          JSR@      GCH81
          MOVS      0,0
          ADD       0,1
;
; CHECK IF #,XA.
;
          LDA       0,C3801
          SUBE      0,1,SZR
          JMP       NI801
;
;
; INDEXED.
; EVALUATE EXP AND SET LENTH,AC 0,WSPCE
;
IDEC1:    LDA       0,TM801
          STA       0,CHPTR
          JSR@      VL97
LBEC1:    LDA       2,C2801
          STA       2,LENTH
          LDA       2,MK801
          ANC       2,2
          STA@      2,WSPCE
          SUB       0,0
          JMP       EN801
;
; NOT INDIRECT,SET AC 0
;
NIEC1:    SUB       0,0
          INC       0,0
          LDA       1,TM801
          STA       1,CHPTR
;
; RESTORE ACC AND RETURN.
;
ENDC1:    LDA       1,A1801
          LDA       2,A2801
          JMP@      A3801
```

```
;*****************************************************
;
; NAME.                         SAB88.
; FUNCTION.                     SETS ABFLG IF IT IS NOT
;                               ALREADY SET.
;                               IE. IF ABFLG = 3,THEN
;                               SET IT TO EITHER 2 OR 1.
; INPUT.                        CHPTR POINTS TO CH. AFTER
;                               OP-CODE.
; OUTPUT.                       ABFLG SET TO 2 OR 3,
;                               CHPTR POINTS TO FIRST CH.
;                               OF EXPRESSION.
;                               RETURNS TO ACC 3 IF ERROR.
;                               RETURNS TO ACC 3 + 1
;                               OTHERWISE.
; CALLS.                        GLB41,SCP83.
; CALLED-BY.                    LOTS.
; GLOBAL-VARIABLES-USED.        NONE.
; GLOBAL-VARIABLES-CHANGED.     ABFLG.
; ERROR-BITS-SET.               1,(F).

; SPACE FOR SAVING ACC CONTENTS.

AC098:    .BLK    1
AC198:    .BLK    1
AC298:    .BLK    1
AC398:    .BLK    1

; CONSTANTS.

CN398:            12                    ; DEC 10
CN298:            2
CN198:            1
CN098:            121                   ;DEC 81
CNA98:            40440                 ;"A "
```

```
CN898:          41,4J                   ;#B 4
;
; ENTRYY POINT,SAVE ACC CONTENTS.
;
SA198:  STA     0,AC098
        STA     1,AC198
        STA     2,AC298
        STA     3,AC398
;
; SEE IF ABFLG IS 2 OR 1
;
        LDA     0,ABFLG
        LDA     1,CN298
        SUBE    0,1,SNR
        JMP     SET98
;
        LDA     1,CN198
        SUBE    0,1,SNR
        JMP     SET98
;
; ABFLG NOT SETT.SET IT. CALL SCP23 TO SET CHPTR TO
; NEXT NON BLANK CHARACTER.
;
        JSRS    SCP23
        JMP     END98                   ; ERROR.
;
;
        JSRS    GCH81
        MOVS    0,1
        JSRS    GNC87
        LDA     1,0
        LDA     1,CNABF
        SUBE    0,1,SNR
        JMP     OKA98
;
;
        LDA     1,CNB98
        SUBE    0,1,SNR
        JMP     OKB98
;
; ERROR(FORMAT),BIT NO. 10 SET.
;
        LDA     0,CN898
        STA     0,AG098
        JSRS    ENE26
AG198:  .BLK    1
        JMP     END98                   ;ERROR RETURN
```

```
;
; CH IS ^A ^
;
OKA98:  LDA     1,CH198
        STA     1,ABFLG
        ISZ     AC398
        JSR^    SCP23
        JMP     END98
        JMP     END98
;
; CH IS ^B ^
;
OKB98:  LDA     1,CH298
        STA     1,ABFLG
        ISZ     AC398
        JSR^    SCP23
        JMP     END98
        JMP     END98
;
; SET CHPTR
;
SET98:  JSM^    GL341
        JSR^    SCP23
        JMP     END98
        ISZ     AC398
;
; RESTORE ACC AND RETURN.
;
END98:  LDA     0,ACC0
        LDA     1,AC198
        LDA     2,AC298
        JMP^    AC398
;
; ***************************************************
;
; NAME.                         AC098.
; FUNCTION.                     ACC 0 = ACC 0 + ACC 1.
; INPUT.                        ACC 0,ACC 1.
; OUTPUT.                       ACC 0.
; CALLS.                        NONE.
; CALLED-BY.
```

```
                                        EVL87.
GLOBAL-VARIABLES-USED.                  NONE.
GLOBAL-VARIABLES-CHANGED.               NONE.
ERROR-BITS-SET.                         NONE.

ADD86:  ADD     1,0
        JMP     0,3

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

NAME.                                   SUB89.
FUNCTION.                               ACC 0 = ACC 0-ACC 1.
INPUT.                                  ACC 0,ACC 1.
OUTPUT.                                 ACC 0.
CALLS.                                  NONE.
CALLED-BY.                              EVL87.
GLOBAL-VARIABLES-USED.                  NONE.
GLOBAL-VARIABLES-CHANGED.               NONE.
ERROR-BITS-SET.                         NONE.

SUB89:  SUB     1,0
        JMP     0,3

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

NAME.                                   DIV90.
FUNCTION.                               ACC 0 = ACC 0 / ACC 1.
INPUT.                                  ACC 0,ACC 1.
```

```
;
; OUTPUT.                          ACC 0.
; CALLS.                          ENE26.
; CALLED-BY.                      EVL87.
; GLOBAL-VARIABLES-USED.          NONE.
; GLOBAL-VARIABLES-CHANGED.       NONE.
; ERROR-BITS-SET.                 3 (V).
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC290:   .BLK    1
AC390:   .BLK    1
;
; CONSTANTS
;
CNS90:           -20                    ; DEC -16
CNS80:           10                     ;DEC 8
;
; ENTRY POINT,SAVE ACC
;
DI190:   STA     2,AC290
         STA     3,AC390
;
; CHECK ACC 1 IF IT IS 0
;
         MOV     1,1,SNR
         JMP     ERR90                  ; OVERFLOW ERROR
;
; ACC 1 IS NON ZERO,CLEAR ACC 2,SET UP COUNTER FOR 16.
;
         SUB     2,2
         LDA     3,CNS90
         MOVZL   0,0                    ;SHIFT LOW
                                        DIVIDEND.
;
;
;
LOL90:   MOVL    2,2                    ; SHIFT HIGH
                                        DIVIDEND.
         SUBZ    1,2,SZC                ; DOES DIVIDEND
                                         GO IN.
;
```

```
          SNB       1,2                         ;YES
          MOVL      0,0
          INC       3,3,SZR
          JMP       LBL90

;
; DONE,RETURN
;
          JMP       END90
;
; SET OVERFLOW ERROR,SET AC 0.
;
ERR90:    LDA       0,ON890
          STA       0,AG190
          JSRS      ERE25
AG190:    .BLK      1
;
          SUB       0,0
;
; RESTORE ACC CONTENTTS.
;
END90:    LDA       2,AC290
          JMPS      AC390
;
;*****************************************************
;
; NAME.                         ADD64.
; FUNCTION.                     SERVICES THE INSTNS.
;                               WITH FORMAT NO. 1.
;                               THE INSTNS. SERVICED ARE
;                                ADC ADD AND BIT CMP
;                                EOR LDA ORA SBC SUB.
; INPUT.                        CHPTR POINTS TO CH. AFTER
;                               OP-CODE.
; OUTPUT.                       NSPCE,LEITH SET.
;                               CHPTR POINTS TO END OF EXPN
; CALLS.                        SAB66,IN.99,DIB00,IN.901.
; CALLED-BY.                    SPM25.
; GLOBAL-VARIABLES-USED.        NSPCE,ADFLG,BOVAL.
; GLOBAL-VARIABLES-CHANGE..
```

```
;                                       MSPC1,LENGTH.
; ERROR-BITS-SET.                       NONE.
;
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC063:  .BLK    1
AC163:  .BLK    1
AC263:  .BLK    1
AC363:  .BLK    1
;
;  CONSTANTS.
;
FOR63:          4
TWO63:          2
;
; SAVE ACC,ENTRY
;
AD163:  STA     0,AC063
        STA     1,AC163
        STA     2,AC263
        STA     3,AC363
;
; CALL ON ROUTINE TO SET CHPTR,ABFLG.
;
        JSRS    SA300
        JMP     END63                   ; ERROR.
;
; CHECK WHICH OF THE FOUR ADDRESSING TYPES .
;
        SUB     1,1
        JSRS    IM199
        MOV     0,0,SNR
        JMP     IM163
;
;
        JSRS    IN301
        MOV     0,0,SNR
        JMP     IN063
;
;
        JSRS    DI300
        JMP     EXT63                   ; EXTENDED MODE
        JMP     DIR63
EXT63:  INC     1,1
IND63:  INC     1,1
```

```
DIF63:   INC     1,1
;
; CHECK WHETHR A OR B.
;
INR.63:  LDA     0,ABFLG
         LDA     2,FOR63
         LDA     3,TWO63
         SUBE    0,3,SNR
         ADC     2,1
;
; FORM FIRST BYTE.
;
         MOVLZ   1,1
         MOVLZ   1,1
         MOVLZ   1,1
         MOVLZ   1,1
         LDA     0,BSVAL
         ADDS    0,1
         LDAS    0,WSPCE
         ADD     1,0
         STAS    0,WSPCE
;
; RETURN.
;
END63:   LDA     3,AC063
         LDA     1,AC163
         LDA     2,AC263
         JMPS    AC363
;
;
; ********************************************************
;
; NAME.                         RMB61.
; FUNCTION.                     SERVICES THE PSEUDO-OP RMB.
;                               ALLOCATES STORAGE SPACE.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        STR04,EVL07,ERR26.
; CALLED-BY.                    SPR25.
; GLOBAL-VARIABLES-USED.        NONE.
```

```
;
; GLOBAL-VARIABLES-CHANGED.                VALUE,VLFLG,PNFLG.
; ERROR-BITS-SET.                          11(F).
;
;
; SPACE FOR SAVING ACS CONTENTS
; ON ENTRY CHRTE IS SET TO CH AFTER OPCODE
;
AC061:    .BLK    1
AC161:    .BLK    1
AC261:    .BLK    1
AC361:    .BLK    1
;
; CONSTANTS
;
EVL61:            13
;
; SAVE ACS ,ENTRY
;
FN161:    STA     0,AC061
          STA     1,AC161
          STA     2,AC261
          STA     3,AC361
          ISZ     VLFLG
;
; SET CHRTE AND EVALUATE
;
          JSRS    ST304
          JMP     END61
          JSRS    EVL97
;
; CHECK IF IT CAN BE EVALUATED
;
          MOVS    0,0,SNR
          JMP     ERR61
;
; SET LOCTR AND PNFLG
;
          STA     1,VALUE
          LDA     0,LOCTR
          ADD     1,0
          STA     0,LOCTR
;
          ISZ     PNFLG
          JMP     END61
```

```
;SET BIT 11
;
EVA61:  LDA     0,EV061
        STA     0,AR061
        JSRS    ERE26
AR061:  .BLK    1
;
;  RESTORE ACC AND RETURN
;
EVC61:  LDA     0,AC061
        LDA     1,AC161
        LDA     2,AC261
        JMPS    AC361
;
;*****************************************************
;
;NAME.                          OPG59.
;
;FUNCTION.                      THIS ROUTINE SERVICES THE
;                               PSEUDO-OP .ORG.SETS THE
;                               PROGRAM COUNTER.
;
;INPUT.                         NONE.
;
;OUTPUT.                        NONE.
;
;CALLS.                         STO04,EVL07,ERE26.
;
;CALLED-BY.                     SPM25.
;
;GLOBAL-VARIABLES-USED.         LBFLG.
;
;GLOBAL-VARIABLES-CHANGED.      LOCTR,LOCTN,PMFLG.
;
;ERROR-BITS-SET.                12(P),11(R).
;
;
;SPACE FOR SAVING ACC CONTENTS.
;
AC359:  .BLK    1
AC159:  .BLK    1
AC259:  .BLK    1
AC059:  .BLK    1
;
```

```
; CONSTANTS.
;
TWL59:          14
ONE59:          1
EVN59:          13
;
; SAVE ACCS. ENTRY
;
OPE59:  STA     0,AC059
        STA     1,AC159
        STA     2,AC259
        STA     3,AC359
;
; CHECK IF LABEL IS PRESENT
;
        LDA     0,LBFLG
        LDA     1,ONE59
        SUBE    0,1,SNR
        JMP     ER259
;
; SET CHPTR AND EVALUATE EXP.
;
        JSR@    ST$04
        JMP     END59
        JSR@    EVL97
        ICV     0,0,SNP
        JMP     ERR59
;
        STA     1,LOCTR
        STA     1,LOCTN
        ISZ     PNFLG
        JMP     END59
;
; ERROR,SET BIT NO. 12
;
ER259:  LDA     0,TWL59
        STA     0,AG259
        JSR@    ENE26
AG259:  .BLK    1
        JMP     END59
;
; SET ERROR BIT NO. 11(R).
;
ERR59:  LDA     0,EVN59
        STA     0,ARG59
        JSR@    ENE26
ARG59:  .BLK    1
```

```
ENDSS:  LDA     0,AC0S9
        LDA     1,AC1S9
        LDA     2,AC2S9
        JMPS    AC3S9

;*****************************************************

; NAME.                         EQUS3.
; FUNCTION.                     SERVICES THE PSEUDO-OP EQU.
;                               SETS SYMBOL VALUE.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        STO34,EVL37.
; CALLED-BY.                    SP25.
; GLOBAL-VARIABLES-USED.        LBFLG,ABFLG.
; GLOBAL-VARIABLES-CHANGED.     VLFLG,LCFLG,VALUE.
; ERROR-BITS-SET.               8(11).

;  SPACE FOR AVING ACC CONTENTS.

AC0S3:  .BLK    1
AC1S3:  .BLK    1
AC2S3:  .BLK    1
AC3S3:  .BLK    1

;  CONSTANTS

MIN3S:          11                      ; DEC 9.
ONES3:          1

;  SAVE ACCS ,ENTRY

EQ1S3:  STA     0,AC0S3
        STA     1,AC1S3
        STA     2,AC2S3
        STA     3,AC3S3
```

```
        ISZ     VLFLG
        SUB     1,1
        STA     1,LOFLG
;
; CHECK IS THERE IS LABEL.IF SO OKAY.
;
        LDA     3,LBFLG
        MOV     3,0,SNR
        JMP     ERR53
;
; SET CHPTR AND EVALUATE
;
        JSRS    ST004
        JMP     END53
        JSRS    EVL97
;
; CHECK IF EVALUATED PROPERLY
;
        MOV     0,0,SNR
        JMP     IMP53
;
;  EVALUATION IS OKAY,SET VALUE
;
        LDA     3,ADLBL
        STA     1,3,3
        STA     1,VALUE
        JMP     END53
;
; SET BIT NO. 9.
;
ERR53:  LDA     3,MIN53
        STA     3,ARG53
        JSRS    ERR26
ARG53:  .BLK    1
        JMP     END53
;
; EXPN. CANNOT BE EVALUATED,SET FIRST NO TO ZERO.
;
IMP53:  LDA     3,ADLBL
        SUB     0,0
        STA     0,0,3
;
; RESTORE ACC AND RETURN
;
END53:  LDA     0,AC053
        LDA     1,AC153
        LDA     2,AC253
```

```
        JMPS    AC353

;*****************************************************

; NAME.                                 OER14.
; FUNCTION.                             OR THE ERROR WORDS
                                        P1ERR,PRERR.
; INPUT.                                NONE.
; OUTPUT.                               NONE.
; CALLS.                                ORR77.
; CALLED-BY.                            PASS2.
; GLOBAL-VARIABLES-USED.                P1ERR.
; GLOBAL-VARIABLES-CHANGED.             PRERR.
; ERROR-BITS-SET.                       NONE.

; SPACE FOR ACC CONTENTS
AC314:  .BLK    1
; ENTRY POINT
OE114:  STA     3,AC314

        LDA     3,P1ERR
        STA     3,AG114
        LDA     3,PRERR
        STA     3,AG214
        JSRS    ORR77
AG114:  .BLK    1
AG214:  .BLK    1
AG314:  .BLK    1
        LDA     3,AG314
        STA     3,PRERR
; RETURN
```

```
;*****************************************************************
; NAME.                          STA64.
; FUNCTION.                      SERVICES THE INSTNS.
;                                WITH FORMAT NO. 1.
;                                IE. STA.
; INPUT.
; OUTPUT.                        CNPTR POINTS TO BREAK.
;                                WSPCE,LENTH SET.
; CALLS.                         SAB9E,DIBUJ,INCJ1.
; CALLED-BY.                     SPM25.
; GLOBAL-VARIABLES-USED.         BSVAL,ABFLG,WSPCE.
; GLOBAL-VARIABLES-CHANGED.      WSPC1.
; ERROR-BITS-SET.                NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC064:    .BLK    1
AC164:    .BLK    1
AC264:    .BLK    1
AC364:    .BLK    1

; CONSTANTS.

TWO64:            2
FOR64:            4

; SAVE ACC CONTENTS,ENTRY.

ST164:    STA     0,AC064
          STA     1,AC164
          STA     2,AC264
          STA     3,AC364

; CALL ON ROUTINE TO SET CNPTR AND ABFLG.
;
```

```
          JSR$    CABU8
          JMP     END64
;
;  CHECK WHICH MODE AND SET ACC 1 ACCORDINGLY.
;
          SUB     1,1
          JSR$    INB01
          MOV     0,0,SNR
          JMP     IND64
          JSR$    DIS00
          JMP     EXT64
          JMP     DIR64
;
EXT64:    INC     1,1
IND64:    INC     1,1
;
;  CHECK WHETHER ACC A OR ACC B.
;
DIR64:    LDA     0,ABFLG
          LDA     2,FOR64
          LDA     3,TWO64
          SUBE    0,3,SNR
          ADC     2,1
;
;  FORM FIRST BYTE.
;
          MOVLZ   1,1
          MOVLZ   1,1
          MOVLZ   1,1
          MOVLZ   1,1
          LDA     0,BSVAL
          ADDZS   0,1
          LDA$    0,WSPCE
          ADC     1,0
          STA$    0,WSPCE
;
;  RESTORE ACC AND RETURN.
;
END64:    LDA     0,AC064
          LDA     1,AC164
          LDA     2,AC264
          JMP$    AC364
;
;*****************************************************
;
;  NAME.
```

```
;
;  FUNCTION.                        ASL65.
;
;                                   SERVICES THE INSTRS. WITH
;                                   FORMAT NO. 2.
;                                   ASL ASR CLR COM DEC
;                                   INC LSR NEG ROL ROR TST.
;  INPUT.
;                                   CMPTR POINTS TO CH. AFTER
;                                   OP-CODE.
;  OUTPUT.
;                                   CMPTR POINTS TO BREAK,
;                                   WSPCE,LENTH SET.
;  CALLS.
;                                   SCR23,GCHR1,GNC07,
;                                   INS01,EXS02.
;  CALLED-BY.
;                                   SP425.
;  GLOBAL-VARIABLES-USED.
;                                   ADFLG,DSVAL,WSPCE.
;  GLOBAL-VARIABLES-CHANGED.
;                                   LENTH,WSPC1.
;  ERROR-BITS-SET.
;                                   NONE.
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC065:    .BLK    1
AC165:    .BLK    1
AC265:    .BLK    1
AC365:    .BLK    1
;
;  CONSTANTS.
;
CHA65:          40440                   ; ≠A ≠
CHB65:          41040                   ;  ≠B ≠
ONE65:          1
TWO65:          2
;
;  SAVE ACC CONTENTS,ENTRY.
;
AS165:    STA     0,AC065
          STA     1,AC165
          STA     2,AC265
          STA     3,AC365
          LDA     0,ONE65
          STA     0,LENTH
```

```
;
;   CHECK IF ABFLG IS SET
;
        SUB     1,1
;
        LDA     0,ABFLG
        LDA     2,ONE65
        SUBE    0,2,SNR
        JMP     AST65
        LDA     2,TWO65
        SUBE    0,2,SNR
        JMP     BST65
;
;  ABFLG IS 3,SEE IF A OR B IS PRESENT.
;
        JSRS    SCP23
        JMP     END65
        JSRS    GCH81
        MOVS    0,2
        JSRS    GNC87
        ADDO    2,0
        LDA     2,CHA65
        SUBE    0,2,SNR
        JMP     AST65
        LDA     2,CHB65
        SUBE    0,2,SNR
        JMP     BST65
        JSZ     CHPTR
;
;   IT IS NOT A,B. SEE WHAT TYPE OF ADDRESSING.
;
        JSRS    IN301
        MOV     0,0,SNR
        JMP     IN065
        JSRS    EX302
        INC     1,1
IN065:  INC     1,1
BST65:  INC     1,1
;
;  FORM FIRST BYTE
;
AST65:  MOVLZ   1,1
        MOVLZ   1,1
        MOVLZ   1,1
        MOVLZ   1,1
        LDA     0,BSTAL
```

```
          ADCS    0,1
          LDAS    0,WSPCE
          ACC     1,0
          STAS    0,WSPCE
;
; RETURN AFTER SAVING ACC CONTENTS.
;
ENC65:    LDA     0,AC065
          LDA     1,AC165
          LDA     2,AC265
          JMPS    AC365
;
;
;*****************************************************
;
; NAME.                                 PSH66.
; FUNCTION.                             SERVICES THE INSTNS.
;                                       PSH,PUL HAVING FORMAT NO.3.
; INPUT.                                CHPTR POINTS TO CH. AFTER
;                                       OP-CODE.
; OUTPUT.                               CHPTR POINTS TO BREAK.
;                                       LENTH,WSPCE SET.
; CALLS.                                SCH23,GCH31,GAC07,ENC26.
; CALLED-BY.                            SPH25.
; GLOBAL-VARIABLES-USED.                BSVAL,ACFLG,WSPCE.
; GLOBAL-VARIABLES-CHANGED.             LENTH,WSPC1.
; ERROR-BITS-SET.                       10(F).
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC066:    .BLK    1
AC166:    .BLK    1
AC266:    .BLK    1
AC366:    .BLK    1
;
; CONSTANTS.
;
```

```
CHA66:          40440
CHB66:          41040
ONE66:          1
TWO66:          2
TEN66:          12
;
;  ENTRY,SAVE ACC CONTENTS.
;
PS166:  STA     0,AC066
        STA     1,AC166
        STA     2,AC266
        STA     3,AC366
;
;  SET  LENTH
;
        LDA     0,ONE66
        STA     0,LENTH
        LDA     1,BSVAL
;
;  CHECK WHETHER ABFLG IS SET.
;
        LDA     0,ABFLG
        LDA     2,ONE66
        SUBE    0,2,SNR
        JMP     AST66
        LDA     2,TWO66
        SUBE    0,2,SNR
        JMP     BST66
;
;  ABFLG NOT SET,SEE WHETHER AOR B IS PRESENT.
;
        JSR@    SCP23
        JMP     END66
        JSR@    GCH51
        MOVS    0,2
        JSR@    GNC57
        ADD     2,0
        LDA     2,CHA66
        SUBE    0,2,SNR
        JMP     AST66
        LDA     2,CHB66
        SUBE    0,2,SNR
        JMP     BST66
;
;  ERROR,SET ERROR BIT NO 10
;
        LDA     0,TEN66
```

```
            STA     0,ARG66
            JSRS    ENE26
ARG66:      .BLK    1
            JMP     END66
BST66:      INC     1,1
AST66:      MOVS    1,1
            LDAS    0,WSPCE
            ADD     0,1
            STAS    1,WSPCE
;
; RETURN AFTER RESTORING ACCD.
;
END66:      LDA     0,AC066
            LDA     1,AC166
            LDA     2,AC266
            JMPS    AC366
;
;
; ********************************************************
;
; NAME.                          CPX67.
; FUNCTION.                      SERVICES THE INSTNS. CPX,
;                                LDS,LDX,HAVING FORMAT NO.4.
; INPUT.                         CHPTR POINTS TO CH. AFTER
;                                OP-CODE.
; OUTPUT.                        CHPTR POINTS TO BREAK.
;                                LENTH,WSPCE SET.
; CALLS.                         ST004,INM39,IN801,CI300.
; CALLED-BY.                     SPM25.
; GLOBAL-VARIABLES-USED.         WSPCE,BSVAL.
; GLOBAL-VARIABLES-CHANGED.      LENTH,WSPC1.
; ERROR-BITS-SET.                NONE.
;
;     SPACE FOR SAVING ACC CONTENTS.
;
AC067:      .BLK    1
AC167:      .BLK    1
```

```
AC267:    .BLK    1
AC367:    .BLK    1
MSK67:            377
;
;  SAVE ACC CONTENTS,ENTRY
;
CP167:    STA     0,AC067
          STA     1,AC167
          STA     2,AC267
          STA     3,AC367
;
;   CHECK IF ABFLG =3
;
          JSR@    ST804
          JMP     END67
          SUB     1,1
;
;  CHECK WHICH MODE OF ADDRESSING,
;
          JSR@    IMM03
          MOV     0,0,SNR
          JMP     IMM67
          JSR@    IN801
          MOV     0,0,SNR
          JMP     IND67
          JSR@    DIR00
          JMP     EXT67
          JMP     DIR67
IMM67:    LDA     3,WSPCE
          LDA     0,1,3
          LDA     2,MSK67
          ANDS    0,2
          STA     2,1,3
          LDA     2,MSK67
          MOVS    0,0
          AND     0,2
          STA@    2,WSPCE
          ISZ     LENTH
          JMP     NXT67
EXT67:    INC     1,1
IND67:    INC     1,1
DIR67:    INC     1,1
;
;  FORM FIRST BYTE
;
NXT67:    MOVLZ   1,1
          MOVLZ   1,1
```

```
          NCVLZ   1,1
          NCVLZ   1,1
          LDA     0,BSVAL
          ADCS    0,1
          LDAS    0,NSPCE
          ADD     1,J
          STAS    J,NSPCE

; RETURN,AFTER RESTORING ACCS.

ERR67:    LDA     J,AC367
          LDA     1,AC167
          LDA     2,AC267
          JMPS    AC367

;*****************************************************

; NAME.                          STS6C.
; FUNCTION.                      SERVICES THE INSTRC. STS
                                 STX HAVING FORMAT NO.5.
; INPUT.                         CHPTR POINTS TO CH. AFTER
                                 OP-CODE.
; OUTPUT.                        CHPTR POINTS TO BREAK.
                                 LENTH,NSPCE SET.
; CALLS.                         STR04,IN001,DI000.
; CALLED-BY.                     SPN25.
; GLOBAL-VARIABLES-USED.         BSVAL,NSPCE.
; GLOBAL-VARIABLES-CHANGED.      NSPC1.
; ERROR-BITS-SET.                NONE.

; SPACE FOR SAVCNF ACC CONTENTS,ENTRY

AC168:    .BLK    1
AC168:    .BLK    1
AC268:    .BLK    1
AC368:    .BLK    1
```

```
;
;  SAVE ACS CONTENTS,ENTRY.
;
ST168:  STA     0,AC.68
        STA     1,AC168
        STA     2,AC268
        STA     3,AC368
;
;  SEE WHETHER ABFLG = 3
;
        JSRS    ST804
        JMP     END68
;
;
        SUB     1,1
;
;  CHECK WHICH MODE OF ADDRESSING.
;
        JSRS    IN801
        IOV     0,0,SNR
        JMP     IND68
        JSRS    DI800
        JMP     EXT68
        JMP     DIR68
;
;
EXT68:  INC     1,1
IND68:  INC     1,1
;
;  FORM FIRST BYTE
;
DIR68:  MOVLZ   1,1
        MOVLZ   1,1
        MOVLZ   1,1
        MOVLZ   1,1
;
        LDA     0,BVAL
        ADCS    0,1
        LDAS    0,WSPCE
        ADC     1,0
        STAS    0,WSPCE
;
;   RETURN AFTER RESTORING ACCS.
;
END68:  LDA     0,AC068
```

```
        LDA     1,AC16S
        LDA     2,AC26S
        JMPS    AC36S

;*****************************************************

; NAME.                                 JMP69.
; FUNCTION.                             SERVICES THE INSTRS. JMP
                                        JSR HAVING FORMAT NO.6.
; INPUT.                                CHPTR POINTS TO CH. AFTER
                                        OP-CODE.
; OUTPUT.                               CHPTR POINTS TO BREAK.
                                        LENTH,WSPCE SET.
; CALLS.                                ST8J4,INCJ1,EX6J2.
; CALLED-BY.                            SPM25.
; GLOBAL-VARIABLES-USED.                BSVAL,WSPCE.
; GLOBAL-VARIABLES-CHANGED.             WSPC1.
; ERROR-BITS-SET.                       NONE.

; SPACE FOR SAVING ACC CONTENTS.

AC069:  .BLK    1
AC169:  .BLK    1
AC269:  .BLK    1
AC369:  .BLK    1

; ENTRY,SAVE ACC CONTENTS.

JM169:  STA     0,AC069
        STA     1,AC169
        STA     2,AC269
        STA     3,AC369

; CHECK ABFLG AND SET CHPTR
```

```
          JSR$    ST304
          JMP     END69
;
; CHECK WHICH MODE
;
          SUB     1,1
          JSR$    IND01
          MOV     0,0,SNR
          JMP     IND69
          JSR$    EX802
          INC     1,1
;
; FORM FIRST BYTE
;
IND69:    MOVLZ   1,1
          MOVLZ   1,1
          MOVLZ   1,1
          MOVLZ   1,1
;
          LDA     0,BSVAL
          ADDS    0,1
          LDAS    0,WSPCE
          ADD     1,0
          STAS    0,WSPCE
END69:    LDA     0,AC069
          LDA     1,AC169
          LDA     2,AC269
          JMPS    AC369
;
;*****************************************************
;
; NAME.                         ST304.
;
; FUNCTION.                     CHECKS WHETHER ABFLG = 3.
;
; INPUT.                        CHPTR POINTS TO CH. AFTER
;                               OP-CODE.
;
; OUTPUT.                       CHPTR POINTS TO BEG.
;                               OF EXPRESSION.
;                               ACC 3 RETURN IF ERROR.
;                               AC 3 + 1 RETURN OTHERWISE.
;
; CALLS.                        SCP23,ENE26.
;
; CALLED-BY.
```

```
;
;  GLOBAL-/ARIABLES-USED.                LOTS.
;  GLOBAL-/ARIABLES-CHANGED.             ABFLG.
;  ERROR-BITS-SET.                       ONE.
;                                        10(F).
;
;  SPACE FOR SAVING ACC CONTENTS.
;
A0B04:   .BLK    1
A3B04:   .BLK    1
;
;  CONSTANTS.
;
THB04:           3
TNB04:           12
;
;  SAVE ACC,ENTRY
;
S1B04:   STA     0,A0B04
         STA     3,A3B04
;
;  CHECK ABFLG=3
;
         LDA     0,ABFLG
         LDA     3,THB04
         SUBE    0,3,SZR
         JMP     ERB04
;
;  SET CHPTR AND RETURN
;
         JSRS    SCP23
         JMP     ENB04
         ISZ     A3B04
         JMP     ENB04
;
;  SET BIT 10
;
ERB04:   LDA     0,TNB04
         STA     0,AGB04
         JSRS    ENE26
AGB04:   .BLK    1
;
;  RETURN AFTER RESTORING ACCS.
```

```
ENFL4:  LDA     0,A3B04
        JMP*    A3B04

;*****************************************************

; NAME.                         FCC55.
; FUNCTION.                     SERVICES THE PSEUDO-OP
                                FCC.
; INPUT.                        CHPTR POINTS TO DM.
                                AFTER OP-CODE.
; OUTPUT.                       WSPCE CLEARED.LENTH SET TO
                                ZERO.LOCTR UPDATED.
; CALLS.                        GCH01,GNC07,BIN15,
                                ENE26,SCP23,DEC01.
; CALLED-BY.                    SP025.
; GLOBAL-VARIABLES-USED.        PSFLG,WSPCE.
; GLOBAL-VARIABLES-CHANGED.     CHPTR,LENTH,WSPC1,LOCTR.
; ERROR-BITS-SET.               2(C),3

; SPACE FOR SAVING ACC CONTENTS

AC055:  .BLK    1
AC155:  .BLK    1
AC255:  .BLK    1
AC355:  .BLK    1

; CONSTANTS

CHP55:  .BLK    1
DEL55:  .BLK    1
COM55:          54                      ; COMMA
CHZ55:          60                      ; CH 0
CHN55:          71                      ; CH 9
CST55:          121
CHK55:          400                     ; DEC 256
```

```
TWO55:          2
THR55:          3
;
;  ENTRY SAVE ACCS.
;
FC155:  STA     0,AC055
        STA     1,AC155
        STA     2,AC255
        STA     3,AC355
;
; SET CHPTR
;
        JSRS    SCR23
        JMP     END55                   ; ERROR RETURN.
;
; CHPTR SET,SAVE VALUE,
; AND CHECK WHICH TYPE OF FAC.
;
        LDA     0,CHPTR
        STA     0,CHR55
        JSRS    GCH81
        STA     0,DEL55
;
; CHECK WHETHER CH IS DECIMAL
;
        LDA     1,CHZ55
        LDA     2,CHN55
        ADCZE   2,0,SNC
        ADCZE   0,1,SZC
        JMP     LCP55                   ; NOT DEC.
;
; CH. IS DECIMAL.
; EVALUATE AND CHECK IF BREAK IS #,$.
;
        DSZ     CHPTR
        JSRS    DEC31
;
; ACC 1 CONTAINS VALUE,ACC0 CONTAINS BREAK.
; CHECK WHETHER BREAK IS #,$.
;
        LDA     2,COM55
        SUBE    0,2,SZR
        JMP     LCP55                   ; NOT COMMA.
;
; VALUE IS IN ACC 1.
; CHECK WHETHER VALUE IS LESS THAN 256.
;
```

```
          LDA     0,CH<55
          SUBLE   0,1,SNC
          JMP     VGT55
;
;  GET CHARACTER AND PUNCH IT OUT
;
          NEG     1,1
LBL55:    IOV     1,1,SNR
          JMP     END55
          JSR@    GNC87
          MOVS    0,0
          STA@    0,WSPCE
          LDA     1,LENTH
          JSR@    BIN15
          SUB     0,0
          STA@    0,WSPCE
          STA     0,LENTH
          LDA     0,LOCTR
          INC     0,0
          STA     0,LOCTR
          INC     1,1
          JMP     LBL55
;
;  DELIMITER IS IN DEL55,CHPTR VALUE IS IN CHP55.
;  PUNCH IT OUT.
;
LOP55:    LDA     1,DEL55
          LDA     0,CHP55
          STA     0,CHPTR
;
;
;
NXT55:    JSR@    GNC87
          LDA     3,CHPTR
          LDA     2,CST55
          SUBE    3,2,SNR
          JMP     ERR55
;
;  CHECK IF DELIMITER
;
          SUBE    0,1,SNR
          JMP     END55
;
;  CHARACTER IS NOT DELIMITER,PUNCH IT OUT
;
          MOVS    0,0
          STA@    0,WSPCE
```

```
          ISZ       LENTH
          JSR$      BIN15
;
; SET LENTH AND WSPCE TO 0
;
          SUB       0,0
          STA$      0,WSPCE
          STA       0,LENTH
          LDA       0,LOCTR
          INC       0,0
          STA       0,LOCTR
          JMP       NXT55
;
; SET BIT NO. 3.
;
NOT55:    LDA       0,THR55
          STA       0,ARG55
          JSR$      ERR26
ARG55:    .BLK      1
          JMP       END55
;
; ERROR .SET BIT NO 2
;
ERR55:    LDA       0,TWO55
          STA       0,ARG55
          JSR$      ERR25
ARG55:    .BLK      1
;
; RESTORE ACC AND RETURN
;
END55:    LDA       0,AC055
          LDA       1,AC155
          LDA       2,AC255
          JMP$      AC355
;
;
;
; ********************************************************
;
; NAME.                          FCB54.
;
; FUNCTION.                      THIS ROUTINE SERVICES THE
;                                PSEUDO-OP FCB.
;
; INPUT.                         CHPTR POINTS TO CH.
;                                AFTER OP-CODE.
```

```
;  OUTPUT.                          CHPTR POINTS TO BREAK.
;                                   LENTH ,WSPCE SET TO 0.
;  CALLS.
;                                   ST304,EVL97,BIN15.
;  CALLED-BY.
;                                   SPR25.
;  GLOBAL-VARIABLES-USED.
;                                   WSPCE,PSTLG.
;  GLOBAL-VARIABLES-CHANGED.
;                                   LENTH,WSPC1,LOCTR.
;  ERROR-BITS-SET.
;                                   NONE.

;  SPACE FOR SAVING ACC CONTENTS.

AC054:    .BLK    1
AC154:    .BLK    1
AC254:    .BLK    1
AC354:    .BLK    1

;  CONSTANTS

ONE54:            1
CON54:            54
BRK54:    .BLK    1

;  ENTRY,SAVE ACC CONTENTS

FC154:    STA     0,AC054
          STA     1,AC154
          STA     2,AC254
          STA     3,AC354

;  SET CHPTR

          JSRS    ST304
          JMP     END54

;  EVALUATE EXPRESSION.

LBL54:    JSRS    EVL97

;  EXP HAS BEEN    EVALUATED.STORE IN WSPCE

          LDA     0,BREAK
```

```
        STA     0,BRK54
        MOVS    1,1
        STAS    1,WSPCE

;INCREMENT LENTH,LOCTR

        ISZ     LENTH

;CALL ON ROUTINE TO PUNCH IT OUT

        JSRS    BIN16

;SET LENTH TO 0,CLEAR WSPCE

        SUB     1,1
        STA     1,LENTH
        STAS    1,WSPCE
        LDA     1,LOCTR
        INC     1,1
        STA     1,LOCTR

;CHECK ON BREAK CHARACTER.

        LDA     0,BRK54
        LDA     1,COM54
        SUBE    0,1,SZR
        JMP     END54

;CHARACTER IS A COMMA,EVALUATE NEXT EXP

        ISZ     CHPTR
        JMP     LBL54

;RESTORE ACC CONTENTS AND RETURN

END54:  LDA     0,AC054
        LDA     1,AC154
        LDA     2,AC254
        JMPS    AC354

;*****************************************************

;NAME.                   F0856.
;FUNCTION.               THIS ROUTINE SERVICES THE
```

```
;  INPUT.                          PSEUDO-OP FCB.

                                   CHPTR POINTS TO CH.
                                   AFTER OP-CODE.
;  OUTPUT.

                                   LENTH ,WSPCE SET TO 1.
                                   CHPTR POINTS TO BREAK.
;  CALLS.

                                   STC64,EVL97,BIN15.
;  CALLED-BY.

                                   OPR25.
;  GLOBAL-VARIABLES-USED.

                                   WSPCE,PSFLG.
;  GLOBAL-VARIABLES-CHANGED.

                                   LENTH,WSPC1,LOCTR.
;  ERROR-BITS-SET.

                                   NONE.


;  SPACE FOR SAVING ACC CONTENTS

AC056:    .BLK     1
AC156:    .BLK     1
AC256:    .BLK     1
AC356:    .BLK     1

;  CONSTANTS

ONE56:              1
CON56:              54
BFK56:    .BLK     1

;  ENTRY,SAVE ACCS.

FB156:    STA      0,AC056
          STA      1,AC156
          STA      2,AC256
          STA      3,AC356

;  SET CHPTR

          JSRS     ST664
          JMP      END56

;  EVALUATE EXPRESSION.

LBL56:    JSRS     EVL97
```

```
;
;  EXP HAS BEEN    EVALUATED.STORE IN WSPCE
;
        LDA     0,BREAK
        STA     0,BRK56
        STAS    1,WSPCE
;
; INCREMENT LENTH,SET LOCTR
;
        ISZ     LENTH
        ISZ     LENTH
;
; CALL ON ROUTINE TO PUNCH IT OUT
;
        JSRS    BI,15
;
; SET LENTH TO 0,CLEAR WSPCE
;
        SUB     1,1
        STA     1,LENTH
        STAS    1,WSPCE
        LDA     1,LOCTR
        INC     1,1
        INC     1,1
        STA     1,LOCTR
;
; CHECK ON BREAK CHARACTER.
;
        LDA     0,BRK56
        LDA     1,COM56
        SUBE    0,1,SZR
        JMP     END56
;
; CHARACTER IS A COMMA,EVALUATE NEXT EXP
;
        ISZ     CHPTR
        JMP     LBL56
;
; RESTORE ACC CONTENTS AND RETURN
;
END56:  LDA     0,AC056
        LDA     1,AC156
        LDA     2,AC256
        JMPS    AC356
;
; ***************************************************
```

```
;
;  NAME.                          BDC46.
;  FUNCTION.                      CONVERTS A BINARY NO.
;                                 INTO A SERIES OF
;                                 ASCII DECIMAL CHARACTERS.
;  INPUT.                         BINARY NO. IN ACC 0.
;  OUTPUT.                        ASCII CH. ARE INSERTED
;                                 INTO PATH STARTING FROM
;                                 PNTR.
;  CALLS.                         EPTBS.
;  CALLED-BY.                     PAG60,ELOBJ,LER17.
;  GLOBAL-VARIABLES-USED.         NONE.
;  GLOBAL-VARIABLES-CHANGED.      PNTR.
;  ERROR-BITS-SET.                NONE.
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC046:    .BLK    1
AC146:    .BLK    1
AC246:    .BLK    1
AC346:    .BLK    1
;
;  POWERS OF TEN
;
          .RDX    10
PTN46:              10000
                    1000
                    100
                    10
                    1
                    0
          .RDX    8
PTA46:              PTN46
TEM46:    .BLK    1
ZER46:              60
;
;SAVE ACCS,ENTRY
```

```
;
BC146:  STA     0,AC046
        STA     1,AC146
        STA     2,AC246
        STA     3,AC346
;
; SET UP ADDRESS IN TEM46
;
        LDA     3,PTA46
        STA     3,TEM46
        MOV     0,2
;
; GET NEXT DIGIT AND GIVE IT OUT
;
LOP46:  LDAS    1,TEM46
        MOV     1,1,SNR
        JMP     END46
;
;
;
        LDA     0,ZER46
;
; ACC 2 CONTAINS RUNNING VALUE,ACC 0 CONTAINS COUNT
;
LEL46:  SUBZ    1,2,SZC
        INC     0,0,SKP
        ADCZ    1,2,SKP
        JMP     LEL46
;
; CH. IS IN ACC 0,GIVE IT OUT
;
        JSRS    EPTSS
        ISZ     PRPTR
        DSZ     TE146
        JMP     LOP46
;
; RESTORE ACC AND RETURN
;
END46:  LDA     0,AC046
        LDA     1,AC146
        LDA     2,AC246
        JMPS    AC346
;
;*****************************************************
;
; NAME.
```

```
;
;  FUNCTION.                        NA.57.
;
;                                   SERVICES THE PSEUDO-OP
;                                   NAM.GETS THE FIRST SIX CH.
;                                   AND PUTS THEM INTO NAME.
;  INPUT.
;                                   CHPTR POINTS TO CH.
;                                   AFTER OP-CODE.
;  OUTPUT.
;                                   NONE.
;  CALLS.
;                                   SCP23,GNC57.
;  CALLED-BY.
;                                   SPM25.
;  GLOBAL-VARIABLES-USED.
;                                   NAME.
;  GLOBAL-VARIABLES-CHANGED.
;                                   LCFLG,NAME1.
;  ERROR-BITS-SET.
;                                   NONE.
;
;  SPACE FOR SAVING ACCS.
;
AC057:    .BLK    1
AC157:    .BLK    1
AC257:    .BLK    1
AC357:    .BLK    1
;
;  CONSTANTS
;
THR57:            3
CTR57:    .BLK    1
;
;  ENTRY POINT,SAVE ACCS.
;
NA157:    STA     0,AC057
          STA     1,AC157
          STA     2,AC257
          STA     3,AC357
          SUB     0,0
          STA     0,LCFLG
;
;  SET CHPTR AND ENTER
;
          JSRS    SCP23
          JMP     END57
```

```
;
;
          LDA       0,TMR57
          STA       0,CTR57
          DSZ       CHPTR
          LDA       2,NAME
;
; ENTER INTO NAME
;
LBL57:    JSR@      GNC67
          MOVS      0,1
          JSR@      GNC67
          ADD       0,1
          STA       1,0,2
          INC       2,2
          DSZ       CTR57
          JMP       LBL57
;
; RESTORE ACCS AND RETURN
;
END57:    LDA       0,AC057
          LDA       1,AC157
          LDA       2,AC257
          JMP@      AC357
;
; ***********************************************************
;
; NAME.                          ENS31.
;
; FUNCTION.                      ENTERS WSPCE VALUE AFTER
;                                CONVERSION INTO HEX INTO
;                                LOCATIONS 16-24 OF PRTLN.
;
; INPUT.                         NONE.
;
; OUTPUT.                        NONE.
;
; CALLS.                         CVT84,BHX47,EPT63.
;
; CALLED-BY.                     PSC10.
;
; GLOBAL-VARIABLES-USED.         LENTH,WSPCE,VLFLG,VALUE.
;
; GLOBAL-VARIABLES-CHANGED.      PRPTR.
;
; ERROR-BITS-SET.
```

```
;                                       NONE.
;
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC031:    .BLK    1
AC131:    .BLK    1
AC231:    .BLK    1
AC331:    .BLK    1
;
; CONSTANTS.
;
CN031:            22                        ; DEC 18
CN131:            27
MSK31:            377
ONE31:            1
;
; SAVE ACC CONTENTS ,ENTRY POINT.
;
EN131:    STA     0,AC031
          STA     1,AC131
          STA     2,AC231
          STA     3,AC331
;
; SET UP PRPTR VALUE
;
          LDA     0,CN031
          STA     0,PRPTR
;
; CHECK VALUE OF LENTH
;
          LDA     0,LENTH
          MOV     0,0,SNR
          JMP     LZR31                     ; LENTH IS 0
;
; LENTH IS NOT ZERO,SET UP
; ADDRESS IN ACC 2,DETERMINE LENTH VALUE.
;
          LDA     2,NSPCE
          LDA     1,ONE31
;
          SUB     1,0,SNR
          JMP     LCN31                     ; LENTH IS 1
;
          SUB     1,0,SNR
          JMP     LTW31                     ; LENTH IS 2
;
```

```
;
; LENTH IS 3.
; ACC 2 CONTAINS ADDRESS OF BYTES.
; PRINT OUT FIRST TWO BYTES.
;
;
          LDA     0,J,2
          JSR@    CVT64
          LDA     0,CN131
          STA     0,PRPTR
          INC     2,2
;
; PUT OUT BYTE  1 OR 3
;
LCN31:    LDA     0,J,2
          JSR@    BHX47
AG131:    .BLK    1
AG231:    .BLK    1
;
; MOST SIGNIFICANT HALF IS ,GOO.
;
          LDA     0,AG131
          MOVS    0,J
          LDA     1,MSK31
          ANC     1,0
          JSR@    EPT83
          ISZ     PRPTR
;
          LDA     0,AG131
          ADD     1,J
          JSR@    EPT83
          JMP     END31
;
; LENTH IS TWO.
;
LTW31:    LDA     0,J,2
          JSR@    CVT64
          JMP     END31
;
; LENTH IS J,CHECK VALUE FLAG TO SEE IF
; VALUE HAS TO BE PRINTED.
;
LZF31:    LDA     0,VLFLG
          MOV     0,J,SNR
          JMP     END31
;
; VALUE FLAG IF NON ZERO.
;
```

```
          LDA     0,VALUE
          JSR@    CVT64

;  RESTORE ACCS AND RETURN.

END31:    LDA     0,AC031
          LDA     1,AC131
          LDA     2,AC231
          JMP@    AC331

;  ********************************************************

;  NAME.                              PED20.
;  FUNCTION.                          PUNCHES E-O-F RECORD.
;  INPUT.                             NONE.
;  OUTPUT.                            NONE.
;  CALLS.                             PRL12,WRT36.
;  CALLED-BY.                         WOUP3.
;  GLOBAL-VARIABLES-USED.             BFNOV,BNFLG.
;  GLOBAL-VARIABLES-CHANGED.          OUTOV.
;  ERROR-BITS-SET.                    NONE.

;  SPACE FOR SAVING ACC CONTENTS

AC320:    .BLK    1
AC020:    .BLK    1

;  CONSTANTS

EOF20:              34523
                    31460
                    30060
                    30060
                    41506
                    0
EOA20:              EOF20
```

```
;
; ENTRY,SAVE ACCS.
;
PE120:  STA     0,AC020
        STA     3,AC320
;
; CHECK BNFLG TO SEE IF NECC.
;
        LDA     0,BNFLG
        IOV     0,0,SNR
        JMP     END20
;
; PUNCH OUT NULLS.
;
        JSRS    PNL12
;
; PUNCH OUT RECORD
;
        LDA     0,BPNOV
        STA     0,OUTOV
        LDA     2,EOA20
        JSRS    WRT86
;
; RESTORE ACCS AND RETURN
;
END20:  LDA     0,AC020
        JMPS    AC320
;
;*****************************************************
;
; NAME.                         SPC62.
;
; FUNCTION.                     SERVICE THE PSEUDO-OP
;                               SPC.
;
; INPUT.                        CHPTR POINTS TO CH.
;                               BEFORE OP-CODE.
;
; OUTPUT.                       CHPTR POINTS TO BREAK.
;
; CALLS.                        PLF06,ST804,EVL07.
;
; CALLED-BY.                    SPM25.
;
; GLOBAL-VARIABLES-USED.        NONE.
;
```

```
; GLOBAL-VARIABLES-CHANGED.
;                                   SCFLG.
; ERROR-BITS-SET.
;                                   NONE.


; SPACE FOR SAVING ACC CONTENTS.

AC062:    .BLK    1
AC162:    .BLK    1
AC262:    .BLK    1
AC362:    .BLK    1

; SAVE ACCS,ENTRY

SP162:    STA     0,AC062
          STA     1,AC162
          STA     2,AC262
          STA     3,AC362

; EVALUATE AFTER SETTING CHPTR

          JSR@    ST804
          JMP     END62

; EVALUATE EXP.NUMBER IS INTERPRETED AS A BIN NO.

          JSR@    EVL97
          MOV     0,0,SNR
          JMP     END62

; NO ERROR IN EVALUATION,CALL CH
; ROUTINE TO PRINT OUT LFDS.

          MOV     1,0
          JSR@    PLF08

; SET SCFLG .

          SUB     1,1
          STA     1,SCFLG

; RESTORE ACCS,RETURN.

END62:    LDA     0,AC062
          LDA     1,AC162
          LDA     2,AC262
```

```
          JMPS    AC362

;*****************************************************
;
; NAME.                          PR803.
; FUNCTION.                      PUNCHES OUT THE *START*
;                                RECORD WITH 3 WORDS
;                                OF *NAME*.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         W-T56,PRL12,SHX47.
; CALLED-BY.                     INT13.
; GLOBAL-VARIABLES-USED.         BPNCV,SWFLG,NAME.
; GLOBAL-VARIABLES-CHANGED.      OUTCV.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
;
AC803:    .BLK    1
A1803:    .BLK    1
A2803:    .BLK    1
A3803:    .BLK    1
;
; CONSTANTS AND COUNTERS.
;
ST803:              30123          ;  S,
                    33060          ;  BYTE COUNT
                    30060          ; ADDRESS
                    30060          ; ADDRESS
NMB03:    .BLK    3
CHB03:    .BLK    1
                    0
NAB03:                NMB03
SAB03:              ST803
CTR03:              3
CNB03:    .BLK    1
```

```
SM803:              113220
MS803:              377
NC803:    .BLK      1
LC803:    .BLK      1
;
; SAVE ACCS,ENTRY
;
P1803:    STA       0,A0803
          STA       1,A1803
          STA       2,A2803
          STA       3,A3803
;
; CHECK IF PUNCHING IS NEED.
;
          LDA       0,BNFLG
          MOV       0,0,SNR
          JMP       EM803
;
; PUNCH OUT NULLS.
;
          JSR@      PNL12.
;
; SET UP DEVICE CODES.
;
          LDA       0,BPNDV
          STA       0,OUTDV
;
; SET UP ADDRESSES
;
          LDA       0,NAME
          STA       0,NC803
          LDA       0,NA803
          STA       0,LC803
          LDA       0,CT803
          STA       0,CN803
;
          LDA       1,MS803
          LDA       2,SM803
;
; GET NAME,STORE IT,UPDATE SUM
;
LBP03:    LDA@      0,NC803
          MOVS      0,J
          STA@      J,LC803
;
          AND       1,J
```

```
            ADC     0,2
            LDA     0,NC803
            AND     1,0
            ADD     0,2
;
            ISZ     NC803
            ISZ     LC803
            DSZ     CN803
            JMP     LB803
;
; ALL WORDS ENTERED,GET CHECKSUM
;
            COM     2,2
            MOV     2,0
            JSRS    @FX47
G1803:      .BLK    1
G2803:      .BLK    1
            LDA     2,G2803
            MOVS    2,2
            STA     2,CM803
;
; PUNCH OUT
;
            LDA     2,SA803
            JSRS    WRT86
;
; RESTORE ACCS AND RETURN
;
EN803:      LDA     0,A0803
            LDA     1,A1803
            LDA     2,A2803
            JMPS    A3803
; ********************************************************
;
; NAME.                         PAG80.
; FUNCTION.                     SERVICES THE PSEUDO-OP PAG.
;                               PRINTS OUT HEADING AFTER
;                               UPDATING PAGNO.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        PLF86,PRT82,BDC46,WRT86.
; CALLED-BY.
```

```
;
;  GLOBAL VARIABLES USED.                SP.25,FV.SA.
;                                        LTFLG,SLOTD,PRTL1,NAME.
;                                        ENDFG.
;  GLOBAL-VARIABLES-CHANGED.             OUTDV,PRTL1,SOFLG,PRPTR.
;  ERROR-BITS-SET.                       NONE.
;
;  SPACE FOR SAVING ACC CONTENTS.
;
AC060:    .BLK     1
AC160:    .BLK     1
AC260:    .BLK     1
AC360:    .BLK     1
;
;  CONSTANTS,COUNTERS
;
MES60:    .TXT     - ER. LINE. LOC.   VALUE.        INPUT.-
MEA60:             MES60
BLK60:             20040
CNT60:             74
NBK60:             0
NLE60:             4
NLA60:             4
NCH60:             3
SPN60:             74                          ;DEC 60.
PVL60:             102                         ;DEC 66.
PGE60:             120                         ;PAGE
                   101                         ;
                   107                         ;
                   105                         ;
PGA60:             PGE60
CST60:             4
CTR60:    .BLK     1
;
;  ENTRY,SAVE ACCS.
;
PA160:    STA      0,AC060
          STA      1,AC160
          STA      2,AC260
          STA      3,AC360
;
;  CHECK WHETHER RECO.
;
          LDA      0,LTFLG
```

```
            NOV     0,0,SNR
            JMP     END60
            LDA     0,ENDFG
            NOV     0,0,SZR
            JMP     END60
;
;   PRINT OUT LFDS.
;
            LDA     0,NL360
            JSRS    PLF08
;
;   SET OUTPUT DEVICE CODE
;
            LDA     0,SLOTD
            STA     0,OUTDV
;
;   CLEAR PRINT LINE
;
            LDA     1,CNT60
            NEG     1,1
            LDA     2,PRTLN
            LDA     0,BLK60
LBL60:      STA     0,0,2
            INC     2,2
            INC     1,1,SZR
            JMP     LBL60
;
;   INTRODUCE NAME
;
            LDA     2,PRTLN
            LDA     1,NBK60
            ADD     1,2
            LDA     3,NAME
            LDA     1,NCH60
            NEG     1,1
            LDA     0,0,3
            STA     0,0,2
            INC     3,3
            INC     2,2
            INC     1,1,SZR
            JMP     .-5
;
;   ENTER 4PAGE4.
;
            LDA     0,CST60
            STA     0,CTR60
;
```

```
          LDA      0,SPN60
          STA      0,PRPTR
;
          LDA      2,PGA60
;
LOP60:    LDA      0,0,2
          JSR@     EPT63
          INC      2,2
          ISZ      PRPTR
          DSZ      CTR60
          JMP      LOP60
;
; ENTER PAGE NO.
;
          LDA      0,PAGNO
          INC      0,0
          STA      0,PAGNO
          LDA      1,PVL60
          STA      1,PRPTR
          JSR@     RCC46
;
; ALL WORDS ARE ENTERED,PRINT OUT
;
          JSR@     PRT62
;
          SUB      0,0
          INC      0,0
          JSR@     PLF08
          LDA      2,MEA60
          JSR@     WPT66
; PRINT OUT LINE-FEEDS.
;
          LDA      0,NLA60
          JSR@     PLF08
;
; SET FLAG SO THAT LINE IS NOT PRINTED OUT
;
          SUB      0,0
          STA      0,SCFLG
;
; RESTORE ACCS AND RETURN.
;
END60:    LDA      0,AC060
          LDA      1,AC160
          LDA      2,AC260
          JMP@     AC360
; ***************************************************
```

```
;
; NAME.                          MES17.
; FUNCTION.                      LISTS OUT THE
;                                TOTAL NO. OF ERRORS.
; INPUT.                         NONE.
; OUTPUT.                        NONE.
; CALLS.                         BOOT6,PRT32.
; CALLED-BY.                     PASS1,WOOPS.
; GLOBAL-VARIABLES-USED.         PRTLN,SLOTD,PDFLG,ERITB,
;                                E1ERT,ER2TB,E2ERT.
; GLOBAL-VARIABLES-CHANGED.      PRTL1,OUTCV,PRPTR.
; ERROR-BITS-SET.                NONE.
;
; SPACE FOR SAVING ACCS.
;
AC017:    .BLK    1
AC117:    .BLK    1
AC217:    .BLK    1
AC317:    .BLK    1
;
; MESSAGE
;
MES17:            52117          ; TO
                  52101          ; TA
                  46040          ; L
                  42522          ; ER
                  51117          ; RO
                  51123          ; RS
                  20040          ;     .
MEA17:            MES17
CST17:            20
CNT17:            74
BLK17:            20040
CME17:            1
NWD17:            7
;
; SAVE ACCS,ENTRY
```

```
;
NE117:  STA     0,AC017
        STA     1,AC117
        STA     2,AC217
        STA     3,AC317
;
;;; SET DEVICE CODES
;
        LDA     0,SLOTD
        STA     0,OUTDV
;
;;; CLEAR TABLE
;
        LDA     2,PRTLN
        LDA     0,BLK17
        LDA     1,CNT17
        NEG     1,1
;
        STA     0,0,2
        INC     2,2
        INC     1,1,SZR
        JMP     .-3
;
;;; STORE MESSAGE
;
        LDA     2,PRTLN
        LDA     3,MEA17
        LDA     1,NWD17
        NEG     1,1
        LDA     0,0,3
        STA     0,0,2
        INC     2,2
        INC     3,3
        INC     1,1,SZR
        JMP     .-5
;
;;; GET NO OF ERRORS CONVERT AND ENTER
;
        LDA     0,PSFLG
        LDA     1,ONE17
        SUBZ    0,1,SNR
        JMP     PCN17
;
;;; PASS OS 2
;
        LDA     1,ER2TB
        LDA     0,E2EPT
```

```
        JMP     NXT17
;
; PASS IS 1
;
PGM17:  LDA     1,ER1TB
        LDA     0,E1EPT
;
;
NXT17:  SUBOR     1,0
        LDA     1,CST17
        STA     1,PRPTR
        JSRS    BC046
        JSRS     PRTS2
;
; RESTORE ACCS AND RETURN
;
        LDA     0,AC017
        LDA     1,AC117
        LDA     2,AC217
        JMPS    AC317
;
;*****************************************************
;
; NAME.                         PLFOS.
; FUNCTION.                     PRINTS OUT CRT AND LFDS.
; INPUT.                        ACC 0,CONTAINS THE I.D.
;                               OF LFDS TO BE PUT OUT.
; OUTPUT.                       NONE.
; CALLS.                        PUTFS.
; CALLED-BY.                    LDTS.
; GLOBAL-VARIABLES-USED.        LTFLG,SLOTD.
; GLOBAL-VARIABLES-CHANGED.     OUTCV.
; ERROR-BITS-SET.               NONE.
;
; SPACE FOR SAVING ACC CONTENTS.
```

```
AC0C8:    .BLK    1
AC208:    .BLK    1
AC308:    .BLK    1
;
; CONSTANTS
;
LFC08:            12
CRT08:            15
;
; SAVE ACCS,ENTRY
;
PL108:    STA     0,AC008
          STA     2,AC208
          STA     3,AC308
;
; CHECK LTFLG
;
          LDA     0,LTFLG
          MOV     0,0,SNR
          JMP     END08
;
; SET DEVICE CODES.
;
          LDA     3,SLOTD
          STA     3,OUTDV
;
;   PRINT LF AND CR
;
          LDA     0,CRT08
          JSR@    PUT75
          LDA     0,LFC08
          LDA     2,AC208
          NEG     2,2
          JSR@    PUT75
          INC     2,2,SZR
          JMP     .-3
;
;  RETURN
;
END08:    LDA     0,AC008
          LDA     2,AC208
          JMP@    AC308
;
;*****************************************************
; NAME.
```

```
;
;  FUNCTION.                        PRL12.
;
;  INPUT.                           PUNCHES OUT CR,LF AND NULLS
;
;  OUTPUT.                          NONE.
;
;  CALLS.                           NONE.
;
;  CALLED-BY.                       PUT75.
;
;  GLOBAL-VARIABLES-USED.           PED20,PUR40,PRB38.
;
;  GLOBAL-VARIABLES-CHANGED.        BNFLG,BPNDV.
;
;  ERROR-BITS-SET.                  OUTDV.
;                                   NONE.
;
;  SPACE FOR SAVING ACCS.
;
AC012:    .BLK     1
AC212:    .BLK     1
AC312:    .BLK     1
;
;  CONSTANTS
;
CRT12:             15
LFD12:             12
NNL12:             6
;
;  ENTRY,SAVE ACCS.
;
PRI12:    STA      0,AC012
          STA      2,AC212
          STA      3,AC312
;
;  CHECK BNFLG
;
          LDA      0,BNFLG
          MOV      0,0,SNR
          JMP      END12
;
;  SET OUTPUT DEVICE ADDRESS
;
          LDA      0,BPNDV
          STA      0,OUTDV
```

```
;
; PRINT OUT CR,LF
;
        LDA     0,CRT12
        JSR@    PUT75
        LDA     0,LFD12
        JSR@    PUT75
;
; PRINT OUT NULLS
;
        SUB     0,0
        LDA     2,NNL12
        NEG     2,2
        JSR@    PUT75
        INC     2,2,SZR
        JMP     .-2
;
; RESTORE ACCS AND RETURN
;
END12:  LDA     0,AC012
        LDA     2,AC212
        JMP@    AC312
;
;*****************************************************
;
; NAME.                         FVA 84.
; FUNCTION.                     DOES VERTICAL FORMATTING.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        PAGE0.
; CALLED-BY.                    PSC10.
; GLOBAL-VARIABLES-USED.        OPFTB,LNCTR.
; GLOBAL-VARIABLES-CHANGED.     NONE.
; ERROR-EXITS-SET.              NONE.
;
; SPACE FOR SAVING ACC. CONTENTS.
```

```
;
AC034:    .BLK     1
AC134:    .BLK     1
AC234:    .BLK     1
AC334:    .BLK     1
;
; CONSTANTS,COUNTERS.
;
CTR34:    .BLK     1
CNT34:             24                    ; DEC 20.
ONE34:             1
;
; ENTRY,SAVE ACCS.
;
FV134:    STA      0,AC034
          STA      1,AC134
          STA      2,AC234
          STA      3,AC334
;
; CHECK IF FORMATTING IS NEED.
;
          LDA      3,OPFTB
          LDA      0,5,3
          LDA      1,ONE34
          SUBE     0,1,SNR
          JMP      END34
;
; CHECK FIRST TIME THRO.
;
          LDA      0,LNCTR
          LDA      1,ONE34
          SUBE     0,1,SZR
          JMP      NXT34
;
; FIRST TIME THRO,INITIALISE CTR34.
;
          LDA      0,CNT34
          STA      0,CTR34
;
; CHECK IF END OF PAGE.
;
NXT34:    DSZ      CTR34
          JMP      END34
;
; PRINT HEADING.
;
          JSRS     PAGEO
```

```
;
; RESET COUNTER.
;
        LDA     0,CNT34
        STA     0,CTR34
;
; RESTORE ACCS AND RETURN.
END34:  LDA     0,AC034
        LDA     1,AC134
        LDA     2,AC234
        JMPS    AC334
;
;
;
;*****************************************************
;
; NAME.                         LSM16.
; FUNCTION.                     LISTS OUT THE SYMBOL TABLE.
; INPUT.                        NONE.
; OUTPUT.                       NONE.
; CALLS.                        PSY39,PLF16.
; CALLED-BY.                    GOUP3.
; GLOBAL-VARIABLES-USED.        LTFLG,SYMT3,OPFTB,SLOTD.
; GLOBAL-VARIABLES-CHANGED.     OUTCV.
;
; SPACE FOR SAVING ACC. CONTENTS.
AC018:  .BLK    1
AC118:  .BLK    1
AC218:  .BLK    1
AC318:  .BLK    1
;
; CONSTANTS,COUNTERS.
```

```
LEN18:  .BLK    1                       ; SYMBOL TABLE
                                          LENGTH.
;
CTR18:  .BLK    1
FOR18:          4
SET18:          100000
SYM18:  .BLK    1
FIN18:  .BLK    1
LAD18:          LSP18
LSP18:  .BLK    3
BLN18:          10
;
;  SAVE ACCS. ENTRY.
;
LS118:  STA     0,AC018
        STA     1,AC118
        STA     2,AC218
        STA     3,AC318
;
;  CHECK WHETHER LISTING IS NEED.
;
        LDA     0,LTFLG
        MOV     0,0,SNR
        JMP     END18
;
;  SET DEVICE CODES.
;
        LDA     0,SLOTC
        STA     0,OUTDV
;
;  PRINT OUT BLANK LINES.
;
        LDA     0,BLN18
        JSRS    PLF08
;
;  SYMBOL TABLE LISTING IS NEED.
;
;  A METHOD WHICH DOES NOT USE EXTRA STORAGE ,BUT
;  USES A LOT OF REDUNDANT COMPARISONS HAS BEEN USED.
;
;  SET LEN18 TO SYMBOL TABLE LENGTH.
;
        LDA     3,OPETB
        LDA     0,3,3
        STA     0,LEN18
;
```

```
;SET ALL ZERO ENTRIES TO 100000.
;
          LDA     0,LEN18
          STA     0,CTR18
;
          LDA     3,SYMTB
          LDA     2,FOR18
          LDA     1,SET18
;
LB118:    LDA     0,0,3
          MOV     0,0,SNR
          STA     1,0,3
;
          ADD     2,3
          DSZ     CTR18
          JMP     LB118
;
;
;ALL NULL ENTRIES HAVE BEEN SET TO 100000.
;DETERMINE MINIMUM ENTRY.
;GET OUT OF LOOP IF MINIMUM VALUE IS 100000.
;
LB218:    LDA     2,SYMTB
          LDA     3,LAD18
          LDA     0,LEN19
          STA     0,CTR18
          LDA     0,SET18
          STA     0,LSP18
          SUB     0,0
          STA     0,FIN18
;
;
;ALL VALUES HAVE BEEN INITIALISED.
;ACC 2 CONTAINS ADDRESS OF SYMBOL TABLE.
;ACC 3 CONTAINS ADDRESS OF LOCAL SPACE.
;GO INTO LOOP TO DETERMINE MINIMUM VALUE.
;
LB318:    LDA     0,0,2
          LDA     1,0,3
          SUBZ    0,1,SNR
          JMP     ZR118
;
;RESULT IS NOT ZERO.COMPARE ENTRIES.
;
          SUBLE   0,1,SZC
          JMP     NXT18
```

```
          JMP     REP18
;
;  FIRST WORD MATCHES. CHECK SECOND WORD.
;
ZR118:    LDA     0,1,2
          LDA     1,1,3
          SUBE    0,1,SNR
          JMP     ZR218
;
;  COMPARE ENTRIES.
;
          SUBLE   0,1,SZC
          JMP     NXT18
          JMP     REP18
;
;  FIRST TWO ENTRIES MATCH.
;
ZR218:    LDA     0,2,2
          LDA     1,2,3
          SUBLE   1,0,SNC
          JMP     NXT18
;
;  REPLACE MINIMUM VALUE.
;
REP18:    STA     2,FIN18
          LDA     0,0,2
          STA     0,0,3
          LDA     0,1,2
          STA     0,1,3
          LDA     0,2,2
          STA     0,2,3
;
;  MINIMUM VALUE REPLACED.
;  UPDATE ACC 2,CHECK WHETHER ALL
;  ENTRIES HAVE BEEN CHECKED.
;
NXT18:    LDA     0,FOUR
          ADD     0,2
          DSZ     CTR18
          JMP     LB318
;
;  FIN18 CONTAINS ADDRESS OF MINIMUM VALUE.
;  LSP18 CONTAINS MINIMUM VALUE.
;  CHECK WHETHER FIRST WORD IS 100000
;
          LDA     0,LSP18
          LDA     1,SET18
```

```
          SUBE    0,1,SNR
          JMP     OVR18
;
; ALL ENTRIES HAVE NOT BEEN PRINTED OUT.
; PRINT OUT THIS ENTRY AND SET FIRST BIT TO 1.
; CALL ON ROUTINE PSM39 TO PRINT OUT THE ENTRY.
; PSM39 NEEDS AS INPUT THE ADDRESS OF ENTRY IN ACC 2.
;
          LDA     2,FIN18
          JSRS    PSY39
;
; SET BIT 0 TO 1.
;
          LDAS    0,FIN18
          LDA     1,SET18
          ADD     1,0
          STAS    0,FIN18
;
; GET NEXT MINIMUM VALUE.
;
          JMP     LB218
;
; ALL ENTRIES HAVE BEEN PRINTED OUT.
; CLEAR BIT 0 OF ALL ENTRIES.
; IE. SUBTRACT 100000 FROM ALL ENTRIES.
;
OVR18:    LDA     0,LEN18
          STA     0,CTR18
          LDA     3,SYMTB
          LDA     2,FOP18
          LDA     1,SET18
;
LB418:    LDA     0,0,3
          SUB     1,0
          STA     0,0,3
;
          ADD     2,3
          DSZ     CTR18
          JMP     LB418
;
; RESTORE ACCS AND RETURN.
;
END18:    LDA     0,AC018
          LDA     1,AC118
          LDA     2,AC218
          JMPS    AC318
;
```

```
;*****************************************************
;
; NAME.                          PSY39
; FUNCTION.                      PRINTS OUT AN ENTRY OF
;                                THE SYMBOL TABLE.
; INPUT.                         AC2 CONTAINS THE STARTING
;                                ADDRESS OF ENTRY.
; OUTPUT.                        NONE.
; CALLS.                         PUT79,SHX47.
; CALLED-BY.                     LSN16.
; GLOBAL-VARIABLES-USED.         SYMTB.
; GLOBAL-VARIABLES-CHANGED.      NONE.
;
; SPACE FOR SAVING ACC. CONTENTS.
;
AC039:    .BLK    1
AC139:    .BLK    1
AC239:    .BLK    1
AC339:    .BLK    1
;
; CONSTANTS,COUNTERS.
;
BLK39:            40
MSK39:            177
CNT39:            3
CTR39:    .BLK    1
CPT39:            15
LFD39:            12
NBK39:            10                    ; NO. OF BLANKS
                                          ; NECESSARY.
;
; ENTRY POINT,SAVE ACC CONTENTS.
;
PS139:    STA     0,AC039
          STA     1,AC139
          STA     2,AC239
```

```
          STA     3,AC339
;
; PRINT OUT ENTRY.
; ACC 2 CONTAINS STARTING ADDRESS.
;
          LDA     0,CNT39
          STA     0,CTR39
          LDA     1,MSK39
;
LB139:    LDA     0,0,2
          MOVS    0,0
          ANC     1,0,SNR
          LDA     0,BLK39
          JSRS    PUT75
;
; PRINT OUT SECOND CHARACTER.
;
          LDA     0,0,2
          ANC     1,0,SNR
          LDA     0,BLK39
          JSRS    PUT75
;
          INC     2,2
          DSZ     CTR39
          JMP     LB139
;
; ALL WORDS PRINTED OUT.
; PRINT OUT BLANKS.
;
          LDA     0,BLK39
          LDA     1,MSK39
          STA     1,CTR39
          JSRS    PUT75
          DSZ     CTR39
          JMP     .-2
;
; ALL BLANKS PRINTED OUT.
; CONVERT LOC. VALUE INTO HEX. AND PRINT OUT.
;
          LDA     2,AC239
          LDA     0,3,2
          JSRS    3HX47
AC139:    .BLK    1
AC239:    .BLK    1
;
```

```
;
; PRINT OUT 4 CHARACTERS.
;
            LDA     0,AG139
            MOVS    0,0
            JSRS    PUT75
            MOVS    0,0
            JSRS    PUT75
;
            LDA     0,AG239
            MOVS    0,0
            JSRS    PUT75
            MOVS    0,0
            JSRS    PUT75
;
; PRINT OUT CR,LF.
;
            LDA     0,CRT39
            JSRS    PUT75
            LDA     0,LFD39
            JSRS    PUT75
;
; ALL WORDS PRINTED OUT.
; RESTORE ACCS. AND RETURN.
;
END39:      LDA     0,AC039
            LDA     1,AC139
            LDA     2,AC239
            JMPS    AC339
;
;*****************************************************
;
;
            .LOC    12000
;
;*****************************************************
;
;               TABLES (ARRAYS).
;
;*****************************************************
;
```

```
; SYMBOL TABLE.
SYMT1:  .BLK    2000

        .RCX    10

; OBJECT-CODE BUFFER.
OBCU1:  .BLK    40

        .TXT*   1

; DEFAULT-NAME.
DEFN1:  .TXT    /START /

; DIRECT ADDRESS TABLE.
DIRA1:  .BLK    50

; ERROR TABLE FOR PASS-1.
ERT1:   .BLK    50

; ERROR-TABLE FOR PASS-2.
ERT2:   .BLK    50

; INPUT SOURCE-LINE.
INBL1:  .BLK    40

; ********************************************************

; MACHINE-OPERATION TABLE.
```

```
OPT1:   .TXT    .A3A.
                2075
        .TXT    /ADC/
                137
        .TXT    /ADD/
                139
        .TXT    /AND/
                132
        .TXT    /ASL/
                534
        .TXT    /ASR/
                533
        .TXT    /BCC/
                1828
        .TXT    /BCS/
                1823
        .TXT    /BEQ/
                1831
        .TXT    /BGE/
                1836
        .TXT    /BGT/
                1835
        .TXT    /BHI/
                1826
        .TXT    /BIT/
                136
        .TXT    /BLE/
                1839
        .TXT    /BLS/
                1827
        .TXT    /BLT/
                1837
        .TXT    /BMI/
                1835
        .TXT    /BNE/
                1830
        .TXT    /BPL/
                1834
        .TXT    /BRA/
                1824
        .TXT    /BSR/
                1833
        .TXT    /BVC/
                1832
        .TXT    /BVS/
                1833
        .TXT    /CBA/
```

```
        2065
.TXT    /CLC/
        2066
.TXT    /CLI/
        2062
.TXT    /CLR/
         591
.TXT    /CLV/
        2058
.TXT    /CMP/
         129
.TXT    /COM/
         579
.TXT    /CPX/
        1164
.TXT    /DAA/
        2073
.TXT    /DEC/
         596
.TXT    /DES/
        2100
.TXT    /DEX/
        2057
.TXT    /EOR/
         136
.TXT    /INC/
         586
.TXT    /INS/
        2097
.TXT    /INX/
        2056
.TXT    /JMP/
        1646
.TXT    /JSR/
        1709
.TXT    /LDA/
         134
.TXT    /LDS/
        1166
.TXT    /LDX/
        1230
.TXT    /LSR/
         580
.TXT    /NEG/
         576
.TXT    /NOP/
        2049
```

```
.TXT    /CMA/
          1560
.TXT    /PSH/
          8222
.TXT    /PUL/
          8218
.TXT    /ROL/
          5855
.TXT    /ROR/
          5832
.TXT    /RTI/
          2107
.TXT    /RTS/
          2105
.TXT    /SBA/
          2094
.TXT    /SBC/
          1300
.TXT    /SEC/
          2061
.TXT    /SEI/
          2063
.TXT    /SEV/
          2059
.TXT    /STA/
          4097
.TXT    /STS/
          1439
.TXT    /STX/
          1503
.TXT    /SUB/
          1283
.TXT    /SWI/
          2111
.TXT    /TAB/
          2076
.TXT    /TAP/
          2054
.TXT    /TBA/
          2071
.TXT    /TPA/
          2055
.TXT    /TST/
          5839
.TXT    /TSX/
          2036
.TXT    /TXS/
```

```
                    21,1
          .TXT      /WAI/
                    2113

;*****************************************************

; NAME(CURRENT).

NAME1:    .BLK      3

; OPTIONS DEFAULT TABLE.

OPT1:               2
                      1
                    2
                    256
                    2
                    2

; OPTION-FLAG TABLE.

OPFT1:    .BLK      6

;*****************************************************

; PSEUDO-OP TABLE.

POPT1:    .TXT        /END/
                    EN152
          .TXT        /EQU/
                    EQ153
          .TXT        /FCB/
                    FC154
          .TXT        /FCC/
                    FC155
          .TXT        /FDB/
                    FC156
          .TXT        /NAM/
                    NA157
          .TXT        /OPT/
```

```
                OP158
        .TXT      /ORG/
                OR158
        .TXT    /PAG/
                PA160
        .TXT    .RMB.
                RM161
        .TXT      /SPC/
                SP162

;*****************************************************

; PRINT LINE.

PRTL1:  .BLK    60

; WORKING SPACE.SPACE FOR
; ASSEMBLING INSTRUCTION.

WSPC1:  .BLK    2

        .RDX    8

        .TXTM   0

;*****************************************************

; STUBS FOR OTHER ROUTINES.

OP158:  JMP     3,3

;*****************************************************

        .END
```

APPENDIX I

SAMPLE PROGRAMS

SAMPLE PROGRAM #1

Exhaustive testing of

Various Instruction Types

and Addressing Modes

START PAGE 00001

```
 ER. LINE. LOC.  VALUE.  INPUT

     00001              **
     00002              * TEST INSTRUCTIONS
     00003              **
     00004              *
     00005              *
     00006        0010  AAA    EQU     $10
     00007        0110  BBB    EQU     $110
     00008        FFAB  CCC    EQU     $FFAB
     00009        0300  DDD    EQU     $300
     00010              *
     00011              *
     00012 0100               ORG     $100
     00013              *
     00014              * FORMAT NO. 0
     00015              **
     00016              *
     00017              * IMMEDIATE
     00018              **
     00019 0100  8190         ADC A   #$10
     00020 0102  C910         ADC B   #AAA
```

```
 ER. LINE. LOC.  VALUE.          INPUT.

     00021 0104  8920                    ADC A   #AAA+$10
     00022 0106  C931                    ADC B   #'1
     00023               **/
     00024               * DIRECT
     00025               **
     00026 0108  9910                    ADC A   $10
     00027 010A  D910                    ADC B   AAA
     00028 010C  990B                    ADC A   AAA-$5
     00029               *
     00030               * EXTENDED
     00031               *
     00032 010E  F901 00                 ADC B   $100
     00033 0111  B9FF AB                 ADC A   CCC
     00034 0114  F9FF 00                 ADC B   CCC-$AB
     00035               *
     00036               * INDEXED
     00037               *
     00038 0117  A900                    ADC A   X
     00039 0119  E900                    ADC B   ,X
     00040 011B  A910                    ADC A   $10,X
```

START PAGE 00003

```
 ER. LINE. LOC.  VALUE.          INPUT.

     00041 011D  E910                    ADC B   AAA,X
     00042 011F  A920                    ADC A   AAA*$2,X
     00043               *
     00044               *
     00045               * FORMAT NO. 1
     00046               *
     00047               *
     00048               * DIRECT
     00049               *
     00050 0121  9710                    STA A   $10
     00051 0123  D710                    STA B   AAA
     00052 0125  970B                    STA A   AAA-$5
     00053               *
     00054               * EXTENDED
     00055               *
     00056 0127  F701 00                 STA B   $100
     00057 012A  B7FF AB                 STA A   CCC
     00058 012D  F7FF 00                 STA B   CCC-$AB
     00059               *
     00060               * INDEXED
```

```
 ER. LINE. LOC.  VALUE.     INPUT.

     00061              *
     00062 0130  A700             STA A          X
     00063 0132  E700             STA B          ,X
     00064 0134  A710             STA A          $10,X
     00065 0136  E710             STA B          AAA,X
     00066 0138  A708             STA A          AAA/$2,X
     00067              *
     00068              *
     00069              * FORMAT NO. 2
     00070              *
     00071              *
     00072              * ACC A,B
     00073              *
     00074 013A  48               ASL A
     00075 013B  58               ASL B
     00076              *
     00077              * EXTENDED
     00078              *
     00079 013C  7801 00          ASL            $100
     00080 013F  78FF AB          ASL            CCC
```

```
START                                                    PAGE  00005
 ER. LINE. LOC.  VALUE.              INPUT.

     00081 0142  78FF 00                     ASL   CCC-$AB
     00082                          *
     00083                          * INDEXED
     00084                          *
     00085 0145  6800                        ASL   X
     00086 0147  6800                        ASL   ,X
     00087 0149  6810                        ASL   $10,X
     00088 014B  6810                        ASL   AAA,X
     00089 014D  6812                        ASL   AAA+$2,X
     00090                          **
     00091                          * FORMAT NO. 3
     00092                          **
     00093                          *
     00094                          * ACC A,B
     00095                          *
     00096 014F  36                          PSH A
     00097 0150  37                          PSH B
     00098                          *
     00099                          * FORMAT NO. 4
     00100                          *
```

START PAGE 00006

```
 ER. LINE. LOC.  VALUE.          INPUT.

     00101                  *
     00102                  * IMMEDIATE
     00103                  *
     00104 0151  8C01  00           CPX       #$100
     00105 0154  8CFF  AB           CPX       #CCC
     00106 0157  8C00  10           CPX       #AAA
     00107 015A  8CFF  00           CPX       #CCC-$AB
     00108 015D  8C31  20           CPX       #'1
     00109                  *
     00110                  * DIRECT
     00111                  *
     00112 0160  9C10               CPX       $10
     00113 0162  9C10               CPX       AAA
     00114 0164  9C12               CPX       AAA+$2
     00115                  *
     00116                  * EXTENDED
     00117                  *
     00118 0166  BC01 00            CPX       $100
     00119 0169  BCFF AB            CPX       CCC
     00120 016C  BCFF 00            CPX       CCC-$AB
```

```
 ER. LINE. LOC.  VALUE.          INPUT.

     00121            *
     00122            *
     00123            * INDEXED
     00124            *
     00125 016F  AC00          CPX     X
     00126 0171  AC00          CPX     ,X
     00127 0173  AC10          CPX     $10,X
     00128 0175  AC10          CPX     AAA,X
     00129 0177  AC12          CPX     AAA+$2,X
     00130            *
     00131            * FORMAT NO. 5
     00132            *
     00133            *
     00134            * DIRECT
     00135            *
     00136 0179  9F10          STS     $10
     00137 017B  9F10          STS     AAA
     00138 017D  9F12          STS     AAA+$2
     00139            *
     00140            * EXTENDED
```

```
 ER. LINE. LOC.  VALUE.              INPUT.

     00141                  *
     00142 017F  BF01 00                    STS   $100
     00143 0182  BFFF AB                    STS   CCC
     00144 0185  BFFF 00                    STS   CCC-$AB
     00145                  *
     00146                  *** INDEXED
     00147                  *
     00148 0188  AF00                       STS   X
     00149 018A  AF00                       STS   ,X
     00150 018C  AF10                       STS   $10,X
     00151 018E  AF10                       STS   AAA,X
     00152 0190  AF12                       STS   AAA+$2,X
     00153                  *
     00154                  * FORMAT NO, 6
     00155                  *
     00156                  *
     00157                  * EXTENDED
     00158                  *
     00159 0192  7E01  00                   JMP   $100
     00160 0195  7EFF  AB                   JMP   CCC
```

START PAGE 00009

```
 ER. LINE. LOC.  VALUE.                  INPUT.

     00161 0198  7EFF  00                      JMP   CCC-$AB
     00162                     *
     00163                     *
     00164                     * INDEXED
     00165                     *
     00166 019B  6E00                          JMP   X
     00167 019D  6E00                          JMP   ,X
     00168 0197  6E10                          JMP   $10,X
     00169 01A1  6E10                          JMP   AAA,X
     00170 01A3  6E12                          JMP   AAA+$2,X
     00171                     *
     00172                     * FORMAT NO. 7
     00173                     *
     00174 0300                      ORG       $300
     00175 0300  2404                BCC       $306
     00176 0302  24FC                BCC       DDD
     00177 0304  240A                BCC       DDD+$10
     00178                     *
     00179                     * FORMAT NO. 8
     00180                     *
```

START PAGE 00010

```
 ER. LINE. LOC.  VALUE.          INPUT.

     00181 0306  01                      NOP
     00182 0307  19                      DAA
     00183               *
     00184               * OTHER
     00185               *
     00186 0308  8910                    ADCA    #AAA
     00187 030A  D910                    ADCB    AAA
     00188 030C  36                      PSHA
     00189 030D  58                      ASLB
     00190               *
     00191 030E  9903                    ADC A   %11
     00192 0310  9909                    ADC A   @11
     00193 0312  9911                    ADC A   $11
     00194 0314  990B                    ADC A   11
     00195               *
     00196 0316  9905                    ADC A   %11+%10
     00197 0318  9901                    ADC A   %11/%11
     00198 031A  9901                    ADC A   %11-%10
     00199 031C  9909                    ADC A   %11*%11
     00200               *
```

```
START                                                  PAGE  00011
 ER. LINE. LOC.  VALUE.          INPUT.

     00201 0200                          ORG    $200
     00202                         *
     00203                         *
     00204 0200                          FCB    $FF,10,,%11
     00205 0204                          FDB    ,$F,$FFFF,,%11
     00206                         *
     00207                         *
     00208 020E                          FCC    /TEXT/
     00209 0212                          FCC    6,TEXT
     00210 0218  0010                    RMB    $10
     00211 0228  16                      TAB
     00212                               END
TOTAL ERRORS   00000


AAA             0010
BBB             0110
CCC             FFAB
DDD             0300
```

SAMPLE PROGRAM #2

Hexa-Decimal

Memory Dump

Program

```
 ER. LINE. LOC.  VALUE.   INPUT.

     00001               NAM     DMP
     00002           **
     00003           *   ALTAIR 680B HEXADECIMAL MEMORY
                         DUMP PROGRAM.
     00004           **
     00005           *   LOAD VIA PROM MONITOR.
     00006           **
     00007           *   USE MONITOR J COMMAND TO
     00008           *   START EXECUTION AT 0005.
     00009           **
     00010           *   ENTER ADDRESS OF FIRST BYTE TO DUMP.
     00011           **
     00012           *   ENTER ADDRESS OF LAST BYTE TO DUMP.
     00013           **
     00014           *   TYPE ANY CHARACTER TO ABORT WHILE
                         RUNNING.
     00015           **
     00016           *   CONTROL RETURNS TO PROM MONITOR.
     00017           **
     00018 00F3          ORG     $F3
     00019 00F3          FCB     $FF TURN OFF TTY ECHO
     00020           *
```

```
 ER. LINE. LOC.  VALUE.   INPUT.

     00021              * MONITOR ROUTINES.
     00022              * ADDRESSES ARE FOR ACIA VERSION OF
                          MONITOR.
     00023              *
     00024        FF81  OUTCH  EQU @177601
     00025        FF6D  OUT2H  EQU @177555
     00026        FF62  BADDR  EQU @177542
     00027        FF82  OUTS   EQU @177602
     00028        FFAB  MONIT  EQU @177653
     00029        FF24  POLCAT EQU @177444
     00030 0000         ORG 0
     00031 0000  0001   XHI    RMB 1       TEMP FOR HIGH BYTE OF X
     00032 0001  0001   XLO    RMB 1       TEMP FOR LOW BYTE OF X
     00033 0002  0002   LSTBYT RMB 2       ADDRESS OF LAST BYTE
     00034 0004  0001   COUNT  RMB 1       COLUMN COUNTER
     00035 0005  8D40   GO     BSR GETADR  GET FIRST ADDR
     00036 0007  DF00          STX XHI     STORE IT
     00037 0009  8D3C          BSR GETADR  GET LAST ADDR
     00038 000B  08            INX         ADJUST IT
     00039 000C  DF02          STX LSTBYT  STORE IT
     00040 000E  DE00          LDX XHI     POINT TO FIRST BYTE
```

DMP PAGE 00003

ER. LINE. LOC. VALUE. INPUT.

```
00041 0010 C60D     CRLF   LDA B  #@15   SEND CRLF
00042 0012 BDFF 81         JSR    OUTCH
00043 0015 C60A            LDA B  #@12
00044 0017 BDFF 81         JSR    OUTCH
00045 001A C611            LDA B  #17
00046 001C D704            STA B  COUNT   INIT COUNTER
00047 001E DF00            STX    XHI     PRINT ADDR
ooo48 0020 9600            LDA A  XHI
00049 0022 BDFF 6D         JSR    OUT2H
00050 0025 9601            LDA A  XLO
00051 0027 BDFF 6D         JSR    OUT2H
00052 002A 7A00 04 NXTBYT  DEC    COUNT
00053 002D 27E1            BEQ    CRLF
00054 002F BDFF 82         JSR    OUTS    SEND A SPACE
00055 0032 A600            LDA    X       BYTE TO A
00056 0034 BDFF 6D         JSR    OUTZH   PRINT IT
00057 0037 08              INX            BUMP POINTER
00058 0038 9C02            CPX    LSTBYT  ARE WE DONE
00059 003A 2708            BEQ    JMONIT  YES,RETURN TO
                                          MONITOR
00060 003C BDFF 24         JSR    POLCAT  NO, WANT TO QUIT
```

```
DMP.                                                    PAGE  00004
 ER. LINE. LOC.  VALUE.   INPUT.

     00061 003F  24E9          BCC NXTBYT
     00062 0041  B6F0 01       LDA $F001 YES, READ CHAR
     00063 0044  7EFF AB JMONIT JMP MONIT AND RETURN TO MONITOR
     00064               *
     00065               * GETADR LOADS X WITH ADDRESS
     00066               * READ FROM TTY
     00067               *
     00068 0047  BDFF 82 GETADR JSR    OUTS  SEND SPACE
     00069 004A  C63F          LDA B  #'?   SEND QUESTION MARK
     00070 004C  BDFF 81       JSR    OUTCH
     00071 004F  BDFF 62       JSR    BADDR GET ADDRESS
     00072 0052  39            RTS          RETURN
     00073               *
     00074               * RESTORE TTY ECHO AFTER LOAD
     00075               *
     00076 00F3                ORG    $F3
     00077 00F3                FCB    00
     00078                     END

TOTAL ERRORS   00000
```

BADDR	FF62
COUNT	0004
CRLF	0010
GETADR	0047
GO	0005
JMONIT	0044
LSTBYT	0002
MONIT	FFAB
NXTBYT	002A
OUT2H	FF6D
OUTCH	FF81
OUTS	FF82
POLCAT	FF24
XHI	0000
XLO	0001

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