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SICOSAS, AN IBM 7090 COMPUTER ASSEMBLY PROGRAM FOR THE CDC 160-A COMPUTER

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ABSTRACT

SICOSAS is a symbolic assembly program designed to operate on the IBM 7090 for the purpose of merging many of the desirable features of two of CDC's programming systems, SICOM and OSAS-A, into a single programming system in order to make the CDC 160-A computer a more versatile tool for many applications. This memo is not intended as a self-sufficient primer. It is aimed at those who have had some background in the IBM 7090 computer and its associated SOS programming system as well as in the CDC 160-A computer with its OSAS-A and SICOM programming systems. Input cards are punched in the familiar SOS format. Output is an SOS-like program listing plus a binary copy of the assembled program on magnetic tape which is readily loaded and executed on the 160-A.

SICOSAS, AN IBM 7090 COMPUTER ASSEMBLY PROGRAM FOR THE CDC 160-A COMPUTER

INTRODUCTION

The present Lincoln Laboratory CDC 160-A computer configuration offers the user a relatively fast (6.4μ cycle time; 12.8μ add time) machine with a 16K, 12-bit-word magnetic core memory. Buffering is available as well as indirect addressing and program interrupt. Input-output media include paper tape, magnetic tape (IBM compatible), and a typewriter. Additionally, real time data may be processed using existing input-output facilities. A scope is also connected for display purposes.

To those who are using or have used some of the Laboratory's larger machines, there may be some disappointing aspect to the 160-A facility among the following.

a. There are no machine-language multiply or divide instructions as such. These functions must be performed in other ways.
b. There are no machine index registers.
c. There is no floating point hardware.
d. The basic machine-language compiler OSAS-A*, while symbolic and mnemonic, is quite separate from the interpretive programming system with which it may interplay.
e. One of the two interpretive programming systems, SICOM†, is decimal but non-mnemonic, non-symbolic, requires paper tape input for compilation, and affords no program listing.
f. The versions of FORTRAN now available for the 160-A do not provide machine-language facility. [New versions of FORTRAN for the 160-A are under development‡, but even these new versions have certain inadequacies. The availability of an adequate version of FORTRAN (e.g., similar to 7090 FORTRAN) might well have obviated the current immediate need for SICOSAS.]

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*Control Data Corporation Publication No. 507, "OSAS-A, The 160-A Assembly System."

† Scientific Computers, Inc., Minneapolis, Minnesota, "SICOM, Scientific and Commercial Programming System for the Control Data 160-A Computer", June 1962.

‡ Control Data Corporation Publication No. 505, "160-A FORTRAN/General Information Manual."

SICOM has been described in the CDC literature* as having the following characteristics.

"SICOM for the Control Data 160-A computer is a general-purpose interpretive system utilizing floating point arithmetic. It effectively converts the 160-A from a binary, fixed-point machine with a 12-bit word length, into a decimal, floating-point machine with 10-decimal digit, plus exponent, word length. SICOM provides full arithmetic, indexing, and logical capabilities... as well as additional features which provide functions and SICOM or machine-language subroutines."

Certainly the prospect of going from a machine with no multiply/divide capability and having no index registers to the same machine possessing full arithmetic, indexing, logical and machine-language-dropout-and-return capabilities even at the reduced speed of an interpretive programming scheme is an enjoyable one for most applications.

It has been the primary intent then of the SICOSAS system to retain all of the desirable operational characteristics of SICOM while making programming for SICOM less of a chore. This has been done in part by by-passing the SICOM compiler completely in assembling the SICOM part of a SICOSAS program. A secondary feature of the SICOSAS system has been the elimination of a separate compilation of the machine-language portion of the SICOM program which would normally be done by OSAS-A since this compilation is also done by SICOSAS at the same time as the compilation of the main SICOM program.

SICOSAS then is really a dual assembler, each mnemonic and symbolic, each capable of independent operation. Each assembler and its ground rules will be considered separately.

GENERAL DESCRIPTION

Although the two assemblers in SICOSAS, SICAP (SICOM Assembly Program) and MLAP (Machine Language Assembly Program) may each be invoked to the exclusion of the other, the SICOSAS programming system was designed primarily for those who require interplay between the SICOM interpretive system with its large decimal capacity (10 decimal digits) and machine-language, hand-coded routines which perform special functions that cannot be accomplished in the SICOM language.

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*Control Data Corporation Publication No. 502, "Programming Systems."

Before SICOSAS, a person with such a problem would prepare the SICOM code by writing it in an absolute numeric format for punching by the flexowriter. His only listing of the program would be the flexowriter printout of the absolute code which would simply be a probably neater copy of the original manuscript. No commentary of any kind would be retained beyond the original manuscript. Thus, a portion of the document from which he would work would appear something as follows:

```
1221003
0251004
0240720
   :
   .
036Y000
4
```

Next he would prepare his machine-language subroutines, coding these symbolically and with machine code mnemonics in the OSAS-A system. His origins for these subroutines would be equated to the effective machine location transferred to by the SICOM "transfer to machine language" instructions. Any reference to the main SICOM program would be made in absolute or quasi absolute in these subroutines since two separate unrelated compilers would prepare these codes for machine loading. Finally, the subroutines would be compiled by OSAS-A (via paper tape or card images on magnetic tape) and a final paper tape containing these subroutines would evolve for machine loading.

Having loaded the subroutines, the next step would be to load the SICOM compiler/interpreter and proceed to compile the main SICOM program from a flexo tape in the format described above over the previously-entered, hand-coded subroutines. If the SICOM program needed library mathematical subroutines, these would finally be loaded over everything else in the manner prescribed in the SICOM manual.

To accomplish the same result in the SICOSAS system, one codes the entire problem together as a single program. Programming is virtually entirely symbolic. Machine-language mnemonics have been carried over entirely from OSAS-A for constructing hand-coded subroutines. MLAP additionally can be made either a decimal compiler or octal compiler and may be switched back and forth from card to card if need be. For SICOM commands, since no mnemonics existed, a full set has been constructed. All of the basic SICOM mathematical library subroutines are now an integral part of SICOSAS so that any or all may be incorporated into the final program automatically at compile time thereby obviating their separate loading at execute time.

In summary, the procedure to be followed to arrive at a SICOSAS program

operating on the 160-A is as follows:

a. Code the entire problem on card-room-provided coding forms.
b. Use the card room facility for punching, verifying, etc.
c. Compile the program on the 7090 either from tape (prestored) or from cards.
d. Print out the BCD listing tape and save the binary tape (map of 160-A bank 1 core storage).
e. At the 160-A call in assembled program for execution from magnetic tape with special SICOSAS loader.

This memo does not pretend to contain all the information required for a person to write a SICOSAS program. It is intended primarily for those who have at least a nodding acquaintance with the referenced literature, rather as a supplement describing a different approach to the solution of a certain class of problems. A limited number of SICOM Manuals are available for reference for those who wish to investigate this approach further. A listing of the SICOSAS program is included as Appendix F.

SICOM ASSEMBLY PROGRAM (SICAP)

The normal numeric format required by the bypassed SICOM compiler is of the following seven-digit form:

KOPADDR(1)

where K = the index register $0 \leq K \leq 9$,
and OP = the Operation code,
and ADDR = the SICOM address.

Two departures from this format occur for those commands in which DR of (1) above is the operation code and for those in which K of (1) above is the operation code.

The basic SICAP symbolic card layout is as follows:

Cols. 1-6	Location Field containing all blanks or an alpha-numeric symbol to be associated with this card. Col. 1 must be non-blank if a symbol is used. At least one character in the symbol must be non-numeric, and none may be + or −.
Col. 7	Blank
Cols. 8-15	Operation Field containing a mnemonic operation code beginning in Col. 8.
Cols. 16 +	Variable Field starting in Col. 16 is composed

of the address field and the tag (or index) field. The address field is separated from the tag field by a comma (,). The address field may or may not include an additive subfield. If it does contain this subfield, it is separated from the pure address by a + or − sign. A blank (b) in variable field is a terminating character. Thus, typical cards appear.

```
1          7 8          1 6
XRAY       CLA      ABLE-10,7
SYMBOL     MPY      P,2
P          STO      BOX+2
           DVP      PI
SPLIT      IDVPC    2345
```

Thus, for card XRAY above, if the symbol ABLE had previously been equated to SICAP location 1000, say, SICAP would consider K = 7, OP = 22 and ADDR = 990. Hence the equivalent numeric code 7220990 would be decoded and inserted into the machine cells assigned to location XRAY.

Cols. b+1 to 72 — Commentary. Any combination of Hollerith characters.

Appendix A lists all of the SICAP mnemonic operation codes along with a description of each. Appendix B is an alphabetic listing of all mnemonics recognized by SICAP including all of the entries in Appendix A plus the SICAP pseudo-operation codes.

Appendix D shows a SICOSAS program in which all coding is in the SICAP language. This program is the symbolic, mnemonic, and documented equivalent of the SICOM program appearing on page 42 of the SICOM Manual. The first line of the listing contains the author identification field (J. D. Drinan Nov. 28, 1962.). The second line identifies the various columns in the listing. The four columns headed by MLOC show the machine-language (octal) location of the SICAP information. SILOC, of course, is the SICAP location (decimal) corresponding to MLOC. The K, OP, ADDR columns depict the decoded seven-digit SICOM instruction. At the far right of the listing appears simply a tabulation of the cards in the symbolic deck. The remainder of the columns contains an image (Cols. 1-72) of each input card.

USE OF $ IN SICAP

In the original SICOM the notation Y000 was used to reference the SICOM accumulator. In SICAP this symbol has been replaced by $ (dollar sign), thus the SICAP

instruction at location ABLE

```
ABLE  OFLTB  $
```

would cause the contents of the accumulator to be output (in floating point followed by a tab) on the previously-selected device.

SICAP LIBRARY SUBROUTINES

The original SICOM system is composed in general of an interpreter/compiler program plus a library of relocatable arithmetic subroutines. Normally the subroutines required by the object program are manually loaded from paper tape into the absolute locations to which the object program will transfer. Control is then manually transferred to the SICOM dynamic start point in the main program for execution.

In SICOSAS a required subroutine is automatically incorporated into the object program upon the encounter of one of the five appropriate SUBROUTINE cards to be described here. Subroutine cards have the following format:

Location Field	A location symbol or all blank
Operation Field	Subroutine Designator
Variable Field	None

The subroutine designator is one of the following five specifying the square root, logarithmic, exponential, sin-cos, and arc tan subroutines, respectively.

```
SQR
LOG
EXP
SIN
ATAN
```

The effect of meeting one of these cards is to cause SICAP to insert one of these five basic subroutines into the object program at the place in the program where the subroutine designator card was met. If a symbol is present in the location field of the SUBROUTINE card, it will be entered into the symbol table and equated to the value of the location counter at the time of meeting. In any case, SICAP inserts a symbol of its own at this location identical to the symbol of the subroutine designator; i.e., SQR, LOG, EXP, SIN or ATAN. Thus, to enter a given subroutine, one may transfer (TSR) either to the program symbol used to identify the start of the subroutine or in the absence of such a symbol to the subroutine designator itself.

The reader's attention is invited to the table on page 55 of the SICOM Manual for information about arguments, entry points, etc., pertaining to these subroutines.

SICAP INFORMATION LAYOUT

The reader is directed to page 83 of the SICOM Manual for information regarding the location and format of the SICOM pseudo accumulator.

The machine layout for SICAP commands and numeric data is given below since a) it does not appear in the SICOM Manual, and b) it is "must" information for those SICOSAS programs which employ SICAP for arithmetic computations and MLAP for logical manipulations of the results.

Suppose the following two cards appear in a SICAP program:

```
        ORG    1000
DATA    DEC    9876.543210
```

The SICAP digit numbering convention is $D_{10}D_9 \ldots D_1$ where D_{10} of DATA is 9 and D_1 is 0. Each D_n occupies 4 bits weighted 8, 4, 2 and 1 from left to right. A SICAP datum is stored in two SICAP locations which take up four machine locations. As a result of the above cards, this numeric datum will be assembled into SICAP locations DATA and DATA+1 (these, of course, are absolute SICAP locations 1000_{10} and 1001_{10} which occupy machine locations 3720_8 through 3723_8) in the following format:

		11	7	3	0	Bit Numbers
DATA	(3720_8)	D3	D2	D1		
		D6	D5	D4		
+1	(3722_8)	D9	D8	D7		
		S	EXPONENT	D10		

The octal representation of this number in cells 3720 through 3723 appears

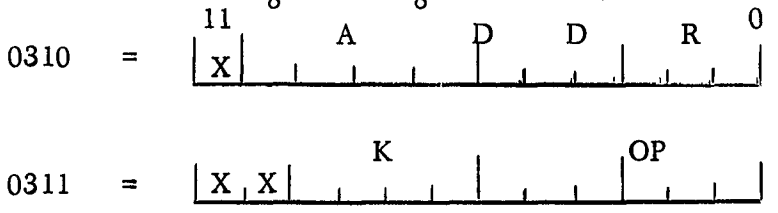
$$1020 = D_3D_2D_1$$
$$2503 = D_6D_5D_4$$
$$4166 = D_9D_8D_7$$
$$2111 = S,\ EXP,\ D_{10}$$

The machine cell assigned to contain the first part ($D_3D_2D_1$) of the datum must be an even SICAP location. This requirement is automatically handled by SICAP and is of no concern to the user.

The SICAP command requires one SICAP location (two machine locations), thus the following two cards:

```
        ORG    100
START   CLA    START+1,7
```

would cause information in the SICOM format KOPADDR to be assembled into the two equivalent machine locations 0310_8 and 0311_8 symbolically as follows:



In the above format bit 11 of the "ADDR" cell and bits 11 and 10 of the "KOP" cell are concerned with bank assignment and are of no interest to the programmer.

Numerically in SICAP these two cells appear

0310 = 0101
0311 = 0722

When examined in core storage, the two cells appear

0310 = 0145
0311 = 0722

MACHINE LANGUAGE ASSEMBLY PROGRAM (MLAP)

In SICOM exists an instruction K74ADDR (transfer to machine language) which, when executed by the SICOM interpreter program, results in uninhibited control being transferred to the SICOM location effective ADDR.

SICAP uses mnemonic CALL Y ± a, k for the same purpose. That is, the interpreter relinquishes control and the machine-language program beginning at SICAP effective location Y ± a, k is free to operate at machine-language speed.

MLAP was included in the SICOSAS system to bypass the need of a separate OSAS-A compilation of the machine-language subroutines needed in many SICOM programs. Every machine-language operation mnemonic used in OSAS-A is present in MLAP. Certain control pseudo operations are different and these will be discussed.

In using MLAP in a SICOSAS program one simply heads the portions of the program that are machine language with an MLAP card (see section entitled SICOSAS Special Purpose Cards) and codes in what is effectively the OSAS-A language. Return to the SICAP interpreter is accomplished through the use of a single machine-language macro instruction RETURN. (See SICOSAS Special Purpose Cards.)

The symbolic card format for MLAP is identical to that for SICAP, excepting, of course, that there is no tag (index) field in MLAP. The field layout then is

Cols. 1-6	Location Field
Col. 7	Blank
Cols. 8-15	Operation Field
Cols. 16 +	Variable Field

with all SICAP format ground rules for each field in effect.

Appendix E shows a SICOSAS program in which there is interplay between the SICAP and MLAP languages.

Because of the inherent differences in the requirements of OSAS-A, the basic assembly system for the 160-A computer and MLAP, whose function is to insert machine-language instructions in a larger over-all interpretive system, certain of the OSAS-A pseudo-operation functions have, in some cases, been dropped. For those pseudo operations which do have a parallel in MLAP, the reader is referred to the section entitled SICOSAS Special Purpose Cards. In summary, the status of the OSAS-A pseudo operations in MLAP is as follows:

OSAS-A	MLAP
ORG	ORG
PRG	None
CON	None
BLR	None
BSS	BSS
WAI	None
END	END
EQU	EQU
REM	*(Col. 1)
BNKX	None
SUPA	None
SUPB	None
BCD	None
BCDR	None
FLX	None
FLXR	None

Appendix C contains a complete alphabetized list of all mnemonics recognized by MLAP.

SICOSAS SPECIAL PURPOSE CARDS

The following cards are not of the command type listed in Appendix A. Some apply only when SICAP is controlling the assembly; others when MLAP is; still others when either is. All of these mnemonic, pseudo-operation codes occupy the operation field of the card unless stated otherwise.

SICAP

The SICAP card has no location field, no variable field. When a compilation is begun by SICOSAS, the assumption is that the initial cards conform to the SICAP mnemonic scheme. (See Appendix A.) When this mode is changed (by an MLAP card), the system is returned to the SICAP mode by a SICAP card. The SICAP card then specifies that the cards following it belong to the SICAP language, and hence, OSAS-A-type cards (recognized by MLAP) will be tagged as erroneous. A SICAP card read by SICAP has no effect.

MLAP (MLAP.....OCTAL)

The MLAP card is a counterpart of the SICAP card. Upon meeting an MLAP card the mode of SICOSAS is changed to expect OSAS-A-type cards (see Appendix C) to follow until another SICAP card is met. The MLAP card has no location field. If the variable field (Cols. 16+) of the MLAP card is blank, the mode of MLAP is set to DECIMAL. If the variable field is alphabetic (such as OCTAL), the mode of MLAP is set to OCTAL. The variable fields of the cards following the MLAP (MLAP....OCTAL) card are converted decimally or octally depending on the mode established. An MLAP card read by MLAP has no effect.

*(ASTERISK IN COLUMN 1)

A card so punched has no effect on SICOSAS other than to reproduce the entire card on the output listing. This then is a remarks card and may be used either with SICAP or MLAP in control. Such cards may appear anywhere in the symbolic deck.

NAME

The NAME card has no location field. The purpose of the card is to identify the output listing. This is done by inserting the contents of columns 16 through 51 of the NAME card into an appropriate place in the first line of every page of the output listing. Normally the program author would use his name and the date. A NAME card may be read by either SICAP or MLAP. A later NAME card will supplant one read earlier.

ORG Y

An origin (ORG) card has the effect of resetting the location counter to the value of the decimal integer Y in the variable field. It is to be remembered that one basic SICOM instruction requires two machine cells. For this reason, Y is always considered a SICOM location so that the location counter $L_8 = 2Y_{10}$. Thus,

resets L to 3720_8.

Any number of ORG cards may appear in the program. SICAP and MLAP treat this card identically.

DEC

The pseudo operation DEC applies only to SICAP. It is used to introduce floating point decimal data into the SICAP portion of the SICOSAS program. The location and variable fields of the DEC card conform to the general rules for these fields. The variable field contains a signed mantissa (+ may be omitted), a mandatory decimal point (·), and an optional signed exponent. Thus the following cards are valid examples of the DEC pseudo operation.

Card	Will Convert To
DEC 123.456E05	$+ .123456 \times 10^8$
DEC -1.23456E-1	$- .123456 \times 10^0$

It is to be remembered that in the variable field a blank is a terminating character so that

DEC 123.456Eb5 produces $+ .123456 \times 10^3$

SICOSAS automatically stores DEC data according to the SICOM ground rules for this type of input.

OCT

The pseudo operation OCT applies only to MLAP. This card is used when the mode of MLAP has been established as DECIMAL (see MLAP card), but it is desired to introduce an octal integer into the program. The variable field has four columns beginning in Col. 16. This field must contain an octal integer I, $0 \leq I \leq 7777$.

BSS Y

The "block starting with symbol" (BSS) pseudo operation is used to reserve a block of one or more words of core storage within the SICOSAS program. The variable field of the BSS card must be absolute. If SICAP is in control when the BSS is met, Y SICOM locations (2 x machine cells) are reserved If MLAP meets the BSS, Y_{10} or Y_8 machine locations are set aside depending on the mode of MLAP.

EQU Y ± a

The general rules for the location and variable field given previously apply to the pseudo operation EQU. Thus Y may be symbolic or absolute and a, if used, may be either octal or decimal. The EQU card, however, must appear in the symbolic deck ahead of any card using the symbol in the location field of the EQU card. Thus the following arrangement will compile correctly:

```
A    EQU   B
     CLA   A
      :
      :
B    DEC   0.
```

MASK

The MASK pseudo operation applies only to SICAP and is used in conjunction with the EXTR (K27 ADDR) instruction. The general rule for the location field applies. The variable field can be thought of as a floating point mask with up to ten sexadecimal numbers and an exponent completely analogous to the one in the DEC pseudo operation.

The sexadecimal numbers 0 through 9 correspond to the four-bit binary configurations 0000 through 1001.

U is 1010	X is 1101
V is 1011	Y is 1110
W is 1100	Z is 1111

Thus if a decimal datum is stored with the DEC pseudo operation

```
           :
A          DEC     123.5
           .
           CLA     A
B          EXTR    MASKA
           :
MASKA      MASK    Z.ZZE1
```

The result of the extraction at location B would result in the number .235 appearing in the accumulator with E = 02; i.e., 23.5 normalized.

Notice that the use of E, (·), and the blank are carried over from the DEC card.

SQR
LOG
EXP
SIN
ATAN

These are SICAP Subroutine Designator cards explained under SICAP Library Subroutines.

CALL Y ± a, k

This is a SICAP command (explained elsewhere but mentioned here in context with the RETURN macro) which links the SICAP portion of the SICOSAS program with the machine-language portion (MLAP). Control is transferred to the machine-language subroutine starting at effective SICAP location Y ± a, k.

RETURN

RETURN is a macro-type, machine-language instruction that is the counterpart of the CALL command. RETURN may have a location field but has no variable field. When MLAP encounters a RETURN, it inserts the following three machine-language instructions into the program.

0040	SDC	Set Direct Bank
2006	LDD	Return Location
0030	IRJ	Jump to SICOM Interpreter

END Y

The variable field of the END pseudo operation is a symbolic location in the SICOSAS program to which control will first be passed upon loading the SICOSAS program from tape on the 160-A. The END card must be present; however, if Y is all blank, the dynamic start point will be set to the first symbolic location encountered in the program.

SICOSAS LIMITATIONS AND RESTRICTIONS

a. The present version of SICOSAS was written with a two-bank (0 and 1) 160-A computer in mind. The SICOM compiler/interpreter program perforce occupies all of bank 0. The SICOSAS program is therefore limited to bank 1. This amount of storage is roughly equivalent to 1999 SICAP locations which must be shared with the machine-language portions of the program. SICOM, and therefore, SICAP, is enlargeable but at this writing this size limitation exists.

b. Neither SICAP nor MLAP has the facility directly to accept alphabetic data (which would normally be used for headings by the final 160-A program).

In the case of SICAP, the user may enter this type of data through an input device, while with MLAP the octal equivalents may be compiled directly.

c. Due to the manner in which the SICAP loader operates (see SICOSAS Loader), SICAP locations 0000 to 0005 (octal machine locations 0000 through 0013) may not be used directly by the SICOSAS program at compile time. This is to say that no program instruction or constant should be assigned to these cells; however, these locations may be freely referenced in the coding of the SICOSAS program through the use of the EQU card, for example, (see SICOSAS Special Purpose Cards) and freely used by the program in operation. While all other cells in bank one not explicitly containing the SICOSAS program will contain zeros, these first six SICAP locations will not.

ERROR PRINTOUTS

SICOSAS prints out error indications directly on the program listing as errors are encountered and continues with the assembly. Sources of error and the action taken are the following:

a. Undefined symbol: The symbol is equated to zero.
b. Multiply defined symbol: The symbol is assigned the value given it upon meeting it for the first time.
c. Illegal operation code: A NOP replaces the illegal code.
d. Out of range: In the 160-A machine instruction format EEXX, the XX which is evaluated as out of range is set to zero.
e. Illegal additive field: The additive field is set to zero.
f. OCT card variable field: Variable field is set to zero.
g. Decimal data: Zero is stored for the illegal datum.

SICOSAS LOADER FOR THE 160-A

As a result of the assembly process on the 7090 computer, there exists a binary tape which when read into the 160-A computer will result in bank 1 containing the information necessary to operate the SICOSAS program.

To facilitate the loading of this tape into the 160-A, SICOSAS assembles the following SICAP instructions into the 7090 map of the 160-A bank 1 core memory in

such a fashion that upon read-in they will occupy SICAP locations 0000 through 0005 as follows:

```
0000   SELBIN      0        [Select binary tape 0]
   1   ITAPE      0, 1      [Read in under control of index #1]
   2   TSM4        4        [Error exit; transfer to 0004]
   3   TSM4     [START]     [Read-in o. k. ; transfer to execute]
   4   REW                  [Try again]
   5   TSM4        1        [Reread the tape]
```

When in the assembly process SICOSAS meets the END card, the absolute dynamic start point is determined and stored as the address of the TSM4 instruction in location 0003.

The problem with this tape at the 160-A is simply that of initiating its reading into location 0 of bank 1. This is accomplished by first reading in the SICOM interpreter into bank 0 and then have it call for paper tape input. (See Operation Notes.)

The paper tape which the SICOM interpreter reads contains the following equivalent SICAP instructions:

```
GRPIN     0        [Load following data starting in location 0]
SELBIN    0        [Select binary tape 0]
ITAPE     0, 1     [Read tape 0 under I. R. 1 control]
SIB       0, 1     [Set i base 0, I. R. 1]
SIL       1000, 1  [Set i limit 1999, I. R. 1]
ITYPE              [Select typewriter input]
OTYPE              [Select typewriter output]
TSM4      0        [Transfer to location 0000]
XEQ       2        [Start automatic computation at location 0002]
```

The instructions SELBIN through TSM4 0 are read by the SICOM interpreter/compiler and stored in locations 0000 through 0006 respectively. The XEQ 2 instruction transfers control to the SIB 0,2 instruction at location 0002 under the guidance of the interpreter. The instructions SIL 1999,1; ITYPE; and OTYPE are executed in turn whereupon control goes to location 0000 where the magnetic tape is selected and read-in to location 0000 and successive locations is initiated. The paper tape program is read over and the six order program at the beginning of the magnetic tape is in control. This program transfers to the SICOSAS program dynamic start point at the completion of a successful read-in, or, in the case of a faulty read-in, rewinds the magnetic tape and initiates another loading.

SICOSAS OPERATION NOTES

The procedure to be followed to have a SICOSAS program operate on the 160-A is a twofold one. First, one must run SICOSAS on the 7090 to obtain a) a printout of the listing of the assembled program, and b) a binary magnetic tape which contains a map of the assembled program as it will appear in bank 1 of the 160-A core memory. Second, one must load this binary magnetic tape into the 160-A for execution. These two phases will be discussed in the order outlined.

7090 PROCEDURE

SICOSAS (LA07 is the program identification number) is an SOS program which may be operated as such from the usual squoze deck under control of "Modify and Load". For purposes of minimizing loading time and the number of mediary tapes required for loading, a self-sufficient binary version of SICOSAS has been recorded on magnetic tape. For use with this binary version of LA07 there is available a loader operating through the card reader which calls in SICOSAS from tape drive B9 (high density) and transfers to its dynamic start point for execution.

Irrespective of the method of loading, SICOSAS tape requirements (aside from those required by SOS if this method of loading is elected or the B9 if the binary version is used) are as follows:

A-7 (high density) BCD listing of assembled program.

A-8 (high density) BCD input tape (if program to be assembled has been prestored on tape).

B-7 (high density) Mediary tape.

B-8 (low density) Binary map of assembled program (input to 160-A).

When SICOSAS is first loaded it halts on an HPR at location 35540_8 to allow sense switch settings to be made as follows:

SSW1	UP	Input is on tape A-8.
	DOWN	Input is on cards.
SSW3 (dynamic)	UP	Print listing on-line (as well as off-line).
	DOWN	Do not print on-line.
SSW6	UP	When finished with this assembly, rewind the listing tape.
	DOWN	Do not rewind the listing tape (stack output).

Upon the completion of an assembly, the binary map tape (B8) is rewound and must be replaced since no stacking is done on this tape. At this point the program

announces the completion of the job, halts and awaits the next run.

In addition to the initial HPR stop and the annotated "finished" stop, SICOSAS will stop on persistent input tape redundancies (HPR 1) and persistent output tape redundancies (HPR 2). The user is advised in either case to change tape and/or tape drive and start over. Pressing START at this point transfers to SICOSAS start point.

160-A PROCEDURE

The binary tape produced at the 7090 is mounted as tape 0 low density. The SICOM interpreter is now loaded (from SICOM master paper tape) into bank 0 as follows:

1. Clear and load to read in first block of paper tape. P = 0037, A = 7715, Z = 0.
2. Clear and run to read in remainder of interpreter program. P = 4562, A = 0005, Z = 7777.
3. SICOM is now ready to accept input via PETR. Place SICOSAS loader in reader, clear and run. The loader will now be loaded and will, in turn, load and execute the SICOSAS program.

JDD:pm

APPENDIX A
SICAP INSTRUCTIONS

The basic SICAP instruction card appears

```
1————————6 7 8————————15  16——→  b ————————————————72
SYMBOL     OPCODE          Y ± a , k   COMMENTARY
```

In general the symbol (SYMBOL, above) in the location field (Cols. 1-6), if used, may contain one to six alphanumeric characters at least one of which must be non-numeric. The symbol must not contain + or – and must start in Column 1. The mnemonic operation code (OPCODE, above) in the operation field (Cols. 8-15) must start in Column 8. The variable field (starting in Col. 16 and terminating with a blank) has an address field (Y ± a, above) and may have a tag (or index) field which is separated from the address field by a comma (,). K, where used, must be a decimal integer $0 \leq K \leq 9$. The address field may contain an additive subfield (± a, above). The start of the additive field is signaled by the + or – sign. "a" must be a decimal integer $0 \leq a \leq 1999$. The address field (Y, above) may either be symbolic or a decimal integer $0 \leq Y \leq 9999$. If Y is absolute, no additive subfield is permitted.

The description of each instruction given below follows the ordering of instructions of the SICOM Command List on page (iv) of the SICOM manual. Attention is further invited to Appendix B which alphabetically lists all operations and pseudo operations recognized by SICAP along with references for each operation.

SIB Y ± a, k — Set i Base

The base component of dimension i of index register k is set to the value Y ± a.

SID Y ± a, k — Set i Difference

The difference component of dimension i of index register k is set to the value Y ± a.

SIL Y ± a, k — Set i Limit

The limit component of dimension i of index register k is set to the value Y ± a.

DIB Y ± a, k — Decrement i Base

This command operates on the i dimension of index register k. The base component is decreased by the amount of the difference component. The resulting base is then compared with the limit component. If the base is equal to or larger than the limit, Y ± a is then taken as the location of the next command to be executed. If the base is smaller, the command falls through, that is, the next command in

sequence is executed. During relative mode, operation is similar except Y ± a indicates the number of locations forward to the next command.

IIB Y ± a, k — Increment i Base

This command operates on the i dimension of index register k. The base component is increased by the amount of the difference component. The resulting base is then compared with the limit component. If the base is smaller or equal to the limit, Y ± a is then taken as the location of the next command to be executed. If the base is larger, the command falls through, that is, the next command in sequence is executed. During the relative mode, operation is similar except that Y ± a indicates the number of locations forward to the next command.

SJB Y ± a, k — Set j Base

The base component of dimension j of index register k is set to the value Y ± a.

SJD Y ± a, k — Set j Difference

The difference component of dimension j of index register k is set to the value Y ± a.

SJL Y ± a, k — Set j Limit

The limit component of dimension j of index register k is set to the value Y ± a.

DJB Y ± a, k — Decrement j Base

This command operates similar to "Decrement i Base" except that the j dimension is involved.

IJB Y ± a, k — Increment j Base

This command operates similar to the command "Increment i Base" except that the j dimension is involved.

CADM Y ± a, k — Clear and Add Magnitude

The absolute value of contents of effective Y ± a is copied into the accumulator.

CLS Y ± a, k — Clear and Subtract

The contents of effective Y ± a are copied into the accumulator and the sign reversed.

CLA Y ± a, k — Clear and Add

The contents of effective Y ± a are copied into the accumulator.

IDVP Y ± a, k — Inverse Divide

The contents of effective Y ± a are divided by the contents of the accumulator.

DVP	Y ± a, k	Divide
		The contents of the accumulator are divided by the contents of effective Y ± a.
MPY	Y ± a, k	Multiply
		The contents of the accumulator are multiplied by the contents of effective Y ± a.
EXCH	Y ± a, k	Exchange
		The contents of the accumulator and the contents of effective Y ± a are interchanged.
EXTR	Y ± a, k	Extract
		The accumulator is extracted under control of the extractor in effective Y ± a. All other accumulator bits are cleared. Each decimal digit is represented by four binary bits, therefore, any accumulator bit configuration may be detected by using sexadecimal numbers in the extractor. A "Z" digit in the extractor will extract the corresponding complete digit from the accumulator. The result of the extraction is in normalized (digitally) form with the proper exponent. To extract the sign, a negative extractor must be used. (See Appendix D, MASK pseudo operation.)
ADD	Y ± a, k	Add
		The contents of effective Y ± a are added to the contents of the accumulator.
SUB	Y ± a, k	Subtract
		The contents of effective Y ± a are subtracted from the contents of the accumulator.
ADM	Y ± a, k	Add Magnitude
		The absolute value of the contents of effective Y ± a are added to the contents of the accumulator.
ISUB	Y ± a, k	Inverse Subtract
		The contents of the accumulator are subtracted from the contents of the effective Y ± a. The result is in the accumulator. Effective Y ± a is unchanged.
RAD	Y ± a, k	Replace Add
		The contents of the accumulator are added to the contents of effective Y ± a and the result is stored in effective Y ± a.
CAS	Y ± a, k	Compare Accumulator with Storage
		The contents of the accumulator are compared with the contents of effective Y ± a. (1) If effective Y ± a is the smaller of the two, control goes to the next command in

sequence. (2) If the two are equal, control goes to the second location down, i.e., if the command is at XRAY, an equal control will go to XRAY+2. (3) If effective Y ± a is larger, control goes to the third command down, i.e., XRAY+3. This command cannot be executed from the last three locations in a bank (i.e., 1997, 1998, and 1999) due to the multiple exits.

OFLTB Y ± a, k — Output Floating Point and Tab

The contents of effective Y ± a are put out as a floating point number on the previously selected device. The format is sign, period, 10 digits, exponent, followed by a tab.

OFLCR Y ± a, k — Output Floating Point and Carriage Return

The contents of effective Y ± a are put out as a floating point number on the previously selected device. The format is sign, period, 10 digits, exponent, followed by a carriage return.

OFXTB Y ± a, k — Output Fixed Point and Tab

The contents of effective Y ± a are put out as a fixed point number on the previously selected device. The format is sign, m integer digits, period, n fractional digits, followed by a tab. m and n are set by "OFORM" Command.

OFXCR Y ± a, k — Output Fixed Point and Carriage Return

The contents of effective Y ± a are put out as a fixed point number on the previously selected device. The format is sign, m integer digits, period, n fractional digits, followed by a carriage return. m and n are set by "OFORM" Command.

OFORM Y ± a, k — Set Output Format

If effective Y ± a, k is represented as a decimal integer ADDR, m, $0 \leq m \leq 18$ is set to AD digits and n, $0 \leq n \leq 18$ is set to DR digits. (See OFXTB and OFXCR) AD plus DR cannot exceed 18. If DR is zero, the period is not put out.

OCRTB Y ± a, k — Output Carriage Returns and Tabs

If effective Y ± a, k is represented as a decimal integer ADDR, AD carriage returns followed by DR tabs are put out.

OTBNO Y ± a, k — Output Tabulating Number

The value effective Y ± a is put out without a period followed by a tab. The largest number which may be put out is 9999. This command is useful for automatic numbering of lines and columns of output.

OCMND Y ± a, k — Output a Command from Memory

The command in location effective Y ± a is put out in the standard form (K OP Y ± a) followed by a carriage return.

WRFILE Y ± a,k — Write File Number on Magnetic Tape

An end of file mark and a record containing the number effective Y ± a is written on the previously-selected tape drive. Effective Y ± a is the file number identifying the file which follows. The normal exit is L + 2. The conditional exit (L + 1) is utilized in the event that end of tape has been sensed during this or a previous operation. Since the search operation assumes no files are opened after the end of tape spot, it is recommended that if the end of tape spot is sensed, the file number be erased and the tape ended (backspace 2 records and write the end of tape code number). If bad tape or a drive malfunction prevents the writing of a file number anywhere between the initial position of the tape and the end of the tape, the drive will "hang up" on the conductive trailer at the end of the tape. File numbers must be in increasing size as you proceed to the end of the tape. Zero should not be used as a file number.

SRFILE Y ± a,k — Search Magnetic Tape for File Number

A search for file number effective Y ± a is initiated on the previously-selected tape drive. Upon the conclusion of a successful search, the next command executed is the second one in sequence (L + 2) (normal exit). The conditional exit (L + 1) is used if either of the following occur:

(1) Ten attempts to read a file number have failed due to a parity error. The accumulator is set to zero prior to exiting in this case.

(2) A reflective spot was sensed during the search operation (Load Point or End of Tape). The first file number after the spot is placed in the accumulator.

The search operation starts by backspacing to and reading the first file number back. A comparison of this "tape" file number with Y ± a determines the direction of the search.

If the "tape" number is larger than effective Y ± a, the search will be in the direction of the load point.

If the "tape" number is smaller than Y ± a or if the load point is sensed, the search will be in the direction of the end of the tape. If a subsequent file number indicates that the direction should be changed again, the standard error indication of 0047 is given. Cycling the run switch after this indication will cause the search to restart.

Example: The search for 101 among consecutive numbers of 98, 100 and 103 would cause error 0047.

GRPIN	Y ± a, k	Group Input
		Input is transferred to effective Y ± a and consecutive locations. (See SICOM Manual, paragraph II. B, 6, p. 14, "Normal Input".)
SNGIN	Y ± a, k	Single Input
		Input is transferred only to location effective Y ± a. One word of any type of input may be entered. The input is terminated by either a carriage return or a tab.
IOCTAL	Y ± a, k	Input Octal Tape
		Tape punched by "OOCTAL" Command is read into the receiving field starting at effective Y ± a. The field must fall entirely within a bank. The location of the receiving field may differ from the original source field.
OALPHA	Y ± a, k	Output Alphanumeric Data
		The contents of address effective Y ± a and effective Y ± a + 1 are put out as 8 alphanumeric characters on the previously-selected device. This instruction is not affected by the relative mode.
LDANR	Y ± a, k	Load Alpha Numeric Register (A. N. R.)
		The contents of effective Y ± a are loaded into A. N. R. as alphanumeric data. (See SICOM Manual, paragraph II. B. 9, p. 18, "Manipulating Alphanumeric Data. ")
CMPANR	Y ± a, k	Compare Alpha Numeric Register (A. N. R.)
		(See SICOM Manual, paragraph II. B. 9, p. 18, "Manipulating Alphanumeric Data. ")
MRGANR	Y ± a, k	Merge into Alpha Numeric Register (A. N. R.)
		(See SICOM Manual, paragraph II. B. 9, p. 18, "Manipulating Alphanumeric Data. ")
EXTANR	Y ± a, k	Extract Alpha Numeric Register (A. N. R.)
		(See SICOM Manual, paragraph II. B. 9, p. 18, "Manipulating Alphanumeric Data. ")
TZE	Y ± a, k	Transfer on Accumulator Zero
		If the contents of the accumulator is zero, a mark 60 jump to effective Y ± a occurs. Otherwise, the normal sequence is continued.
TNZ	Y ± a, k	Transfer on Accumulator Non-Zero
		If the contents of the accumulator is not zero, a mark 61 jump to effective Y ± a occurs. Otherwise, normal sequence continues.
TPL	Y ± a, k	Transfer on Accumulator Plus
		If the accumulator contains a positive quantity (including zero), a mark 62 jump to effective Y ± a occurs. Otherwise, normal sequence continues.

TMI	Y ± a, k	Transfer on Accumulator Minus
		If the accumulator contains a negative quantity, a mark 63 jump to effective Y ± a occurs. Otherwise, normal sequence continues.
TSM4	Y ± a, k	Transfer and Set Mark 4
		The next command in sequence is marked for a "return to mark 4" return. Control goes to effective Y ± a.
TSM5	Y ± a, k	Transfer and Set Mark 5
		The next command in sequence is marked for a "return to mark 5" return. Control goes to effective Y ± a.
TSM6	Y ± a, k	Transfer and Set Mark 6
		The next command in sequence is marked for a "return to mark 6" return. Control goes to effective Y ± a.
TNR7	Y ± a, k	Transfer Non-Relative and Set Mark 7
		The next command in sequence is marked for a "return to mark 7" return. Control goes to effective Y ± a. This command is not affected by the relative mode. This makes a jump from relative subroutine to fixed area possible.
TSR	Y ± a, k	Transfer to Subroutine
		This command operates the same as other unconditional transfer commands. It is also used to enter standard SICOM subroutines, thereby disturbing any 70 mark which may have been set previously.
TSJ1	Y ± a, k	Transfer on Selective Jump Switch 1 On
		If selective jump switch number one is ON, the next consecutive command is marked for a return to selective jump one (RSJ1) return and control goes to the location effective Y ± a. If the jump switch is not ON, the normal sequence is continued.
TSJ2	Y ± a, k	Transfer on Selective Jump Switch 2 On
		This command operates similar to the one above except that jump switch two is used and the return is "return to selective jump two" (RSJ2).
TSJ3	Y ± a, k	Transfer on Selective Jump Switch 1 and 2 Both On
		If both jump switch one and two are ON, the next consecutive command is marked for a return to "return to selective jump three (RSJ3)". Control goes to effective Y ± a. If either jump switch if OFF, the next command in sequence is executed.
CALL	Y ± a, k	Transfer to Machine Language Subroutine
		Control is transferred to the machine language subroutine which starts at effective location Y ± a.

TBR	Y ± a, k	Transfer Back Relative
		Control goes backwards Y ± a effective locations regardless of the addressing mode. No mark is set.
STOANR	Y ± a, k	Store A. N. R.
		The contents of A. N. R. are copied into effective Y ± a and effective Y ± a + 1 as alphanumeric data. A. N. R. is unchanged.
STO	Y ± a, k	Store Accumulator
		The contents of the accumulator are copied into effective Y ± a and effective Y ± a + 1. The accumulator remains unchanged.
NOP		No Operation
		This command may be used to reserve a location to be filled conditionally. No operation is performed. The computer proceeds to the next location.
STOP1		Selective Stop 1
		If selective stop switch 1 is on, computation stops with Panel display A = 0001. Resume computation by cycling run switch. If the switch is off, the command has no effect. Computation continues in normal sequence regardless of switch setting.
STOP2		Selective Stop 2
		Same as Selective Stop 1 except under control of Switch 2, Panel Display: A = 0002.
HALT3		Stop Display 3
		Computation stops with Panel Display: A = 0003. It may be resumed at the next sequential location by cycling the run switch.
HALT4		Stop Display 4
		Same as Stop Display 3 only A = 0004.
HPRIN		Halt and Await Input
		If Flexowriter input has been selected, computation stops with A = 0005 and input is when the run switch is cycled. If typewriter input has been selected, input is gated. (See SICOM Manual, paragraph IV. a, p. 71, "Operating Modes. ")
REL		Select Relative Mode
		All subsequent commands are interpreted in the relative addressing mode. Termination is by execution of a "SELECT ABSOLUTE MODE" (ABS), a master clear and run or "Halt and Await Input".

ABS — Select Absolute Mode

Computation returns to the normal absolute addressing mode.

FAST — Select Non-Trace Mode

Tracing is discontinued. This command is normally used to avoid tracing through SICOM subroutines. During non-trace operation this command is the same as a "NO OPERATION". This also discontinues the step mode. Both operations are restored upon execution of "Reset Trace" or a master clear and run.

TRACE — Reset Trace Mode

Restores the trace and step modes which were in effect prior to the execution of a "SELECT NON-TRACE" (FAST). This command is normally placed at the end of a SICOM subroutine.

ZEROIR — Clear Index Registers

This command sets all components of all index registers to zero.

IFLEX — Select Flexowriter Input

All subsequent normal input commands will be via Flexowriter tape.

OFLEX — Select Flexowriter Output

All subsequent normal output will be punched on Flexowriter tape.

ITYPE — Select Typewriter Input

All subsequent normal input commands will be via the typewriter.

OTYPE — Select Typewriter Output

All subsequent normal output will be printed via the typewriter.

OPRINT — Select Printer

(Not Available.)

SELBCD — Select Tape to Printer

All subsequent normal output is put on magnetic tape drive 1 suitable for off line magnetic tape to printer listing. Only tape drive 1 and print channel 0 can be used. Each line to be printed is recorded as a 120 Binary Coded Decimal character record.

SELBIN Y ± a, k — Select Magnetic Tape Drive Y ± a, k

If k = 0, the j base of index k is added to Y ± a. This new value of Y ± a (or the original value if k = 0) is the number of the drive which will be used in all subsequent

tape operations. The accumulator is not disturbed. This command automatically selects odd parity. Y ± a may have values of 1, 2, 3, or 4. If the power is off on drive Y ± a, or if no drive has been set to Y ± a, the computer hangs up with the select light on. The execution of 0 00 0017 "Select Tape to Printer" SELBCD voids all prior magnetic tape selections.

BSR Y ± a — Backspace Y ± a Records

If Y ± a ≠ 0, the previously-selected drive will be backspaced Y ± a records. Note that an end of file mark and file numbers are each considered a record, and that no indication of load point or end of tape is given. Y ± a may have values up to 99. Backspacing beyond the load point will cause the drive to "hang up" on the conductive leader.

REW — Rewind

The previously-selected drive will rewind to the load point. A rewind from the load point has no effect.

OTAPE 0, k — Write on Magnetic Tape

The field defined by index register k (i Base = 1st location, i Difference = length) is copied on the previously-selected tape drive as one record. The accumulator is not disturbed by either the normal (L + 2) or the conditional (L + 1) exit. The conditional exit indicates that the end of tape spot was sensed on this or a previous command.

If a parity error occurs during a write operation, the record is erased, 6 inches of tape skipped and the record is re-written. This process continues until the record is properly written or the conductive leader is reached. Due to the double exit, this command cannot be executed from the last two locations in a bank, i.e., 1998 and 1999.

ITAPE 0, k — Read Magnetic Tape

One record of information is read from the previously-selected tape drive. It is read into the field defined by index register K (i base = starting location, i difference = the length). If the tape record is longer than the field, the remainder of the record will be read but not stored in memory.

If the record is shorter than the field, all of the remainder of the field will be unchanged except the location immediately following the end of the record. This location will be altered. The normal exit (L + 2) does not disturb the accumulator. The conditional exit (L + 1) is utilized for the following two conditions:

(1) Ten attempts to read the record are unsuccessful due to a parity error. The accumulator is set to zero prior to exiting in this case. The record is stored in memory as it was read on the last attempt.

(2) The end of file was read. In this case, the next file number is placed into the accumulator ready for possible test to determine if the end of the tape has been reached. No end of tape indication as such is given.

An attempt to read beyond the last record on the tape will result in the drive "hanging up" on the conductive trailer. Due to the double exit, this command cannot be executed from the last two locations in a bank, i.e., 1998 and 1999.

BLCPY 0, k — Block Copy

The source field defined by index register k is copied into a receiving field which starts at the address specified by the j base of index k. If the two fields overlap, the j base must be smaller than the i base. The two fields may be in different banks. (See SICOM Manual, paragraph II. B. 19, p. 30, "Block Operations.")

BLCLR 0, k — Block Clear

The field defined by index register k is cleared to zero. (See SICOM Manual, paragraph II. B. 19, p. 30, "Block Operations.")

OOCTAL 0, k — Output Octal Tape

The field defined by index register k is punched, in bi-octal form, followed by two blank frames and the check sum (two frames). This tape may be read with the IOCTAL command. A one-inch trailer is also punched.

OSPEC 0, k — Output Special Tape

The field defined by index k is punched in bi-octal form in the format shown on page 31 of the SICOM Manual.

ISPEC — Input Special Tape

Reads tape punched by the command OSPEC. Reading stops when a leader over 6" long is detected.

RZE — Return to TZE

Control is returned to the location +1 of the most recently executed transfer on accumulator zero (TZE) instruction.

RNZ — Return to TNZ

Control is returned to the location +1 of the most recently executed transfer on accumulator non-zero (TNZ) instruction.

RPL — Return to TPL

Control is returned to the location +1 of the most recently executed transfer on accumulator positive (TPL) instruction.

RMI — Return to TMI

Control is returned to the location +1 of the most recently executed transfer on accumulator negative (TMI) instruction.

RSM4 — Return to TSM4

Control is returned to the location +1 of the most recently executed transfer and set Mark 4 (TSM4) instruction.

RSM5 — Return to TSM5

Control is returned to the location +1 of the most recently executed transfer and set Mark 5 (TSM5) instruction.

RSM6 — Return to TSM6

Control is returned to the location +1 of the most recently executed transfer and set Mark 6 (TSM6) instruction.

RNR7 — Return to TNR7

Control is returned to the location +1 of the most recently executed transfer non-relative and set Mark 7 (TNR7) command.

RSR — Return to TSR

Control is returned to the location +1 of the most recently executed transfer to subroutine (TRS) instruction.

RSJ1 — Return to TSJ1

Control is returned to the location +1 of the most recently executed transfer if selective jump switch one is on (TSJ1) command.

RSJ2 — Return to TSJ2

Control is returned to the location +1 of the most recently executed transfer if selective jump switch two is on (TSJ2) command.

RSJ3 — Return to TSJ3

Control is returned to the location +1 of the most recently executed transfer if selective jump switch three is on (TSJ3) command.

OLOC — Output Last Location

Location of last command executed is put out on the previously-selected device.

PUSTOP		Punch Stop, Check and Leader
		The following are punched on tape: (1) A stop code, (2) The check sum of all normal output punched since the last "Halt Select Manual Mode" or since the last "Punch Stop, Check, and Leader." (3) A one-inch leader. This is useful for Flexowriter output exclusively.
CLAC*	Y ± a	Clear and Add Constant
		The value Y ± a is loaded into the accumulator. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
CLSC*	Y ± a	Clear and Subtract Constant
		The value minus Y ± a is loaded into the accumulator. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
IDVPC*	Y ± a	Divide into Constant
		The contents of the accumulator are divided into the value Y ± a. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
DVPC*	Y ± a	Divide by Constant
		The accumulator is divided by the value Y ± a. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
MPYC*	Y ± a	Multiply by Constant
		The accumulator is multiplied by the value Y ± a. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
ADDC*	Y ± a	Add Constant
		The value Y ± a is added to the accumulator. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
SUBC*	Y ± a	Subtract Constant
		The value Y ± a is subtracted from the accumulator. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.

*The variable field must not contain a decimal point (·).

ISUBC *	Y ± a	Subtract from Constant
		The accumulator is subtracted from the value Y ± a. The Y ± a of these commands is not an address but instead a numeric value between 0 and 9999. It cannot be a fraction. The result is always in the accumulator.
SHIFT*	Y ± a	Shift Accumulator
		If Y ± a is represented as a decimal integer ADDR, the accumulator is multiplied by 10 to the AD power (left shift) and divided by 10 to the DR power (right shift).
SETFWA	Y ± a	Set First Address for Trace
		An internal switch is set so that during the trace mode tracing starts after the execution of the command in location Y ± a.
SETLWA	Y ± a	Set Last Address for Trace
		The address at which tracing will terminate is set to Y ± a.
PXAIB	0, k	Place Index k (i Base) in Accumulator
		The i base component of index register k replaces the contents of the accumulator as a positive floating point number.
PXAID	0, k	Place Index k (i Difference) in Accumulator
		The i difference component of index register k replaces the contents of the accumulator as a positive floating point number.
PXAIL	0, k	Place Index k (i Limit) in Accumulator
		The i limit component of index register k replaces the contents of the accumulator as a positive floating point number.
PXAJB	0, k	Place Index k (j Base) in Accumulator
		The j base component of index register k replaces the contents of the accumulator as a positive floating point number.
PXAJD	0, k	Place Index k (j Difference) in Accumulator
		The j difference component of index register k replaces the contents of the accumulator as a positive floating point number.
PXAJL	0, k	Place Index k (j Limit) in Accumulator
		The j limit component of index register k replaces the contents of the accumulator as a positive floating point number.

*The variable field must not contain a decimal point (·).

PAXIB	0, k	Place the Accumulator in the i Base Component of Index Register k The integral portion of the accumulator is copied into the base component of index register k. The accumulator is unchanged.
PAXID	0, k	Place the Accumulator in the i Difference Component of Index Register k The integral portion of the accumulator is copied into the i difference component of index register k. The accumulator is unchanged.
PAXIL	0, k	Place the Accumulator in the i Limit Component of Index Register k The integral portion of the accumulator is copied into the i limit component of index register k. The accumulator is unchanged.
PAXJB	0, k	Place the Accumulator in the j Base Component of Index Register k The integral portion of the accumulator is copied into the j base component of index register k. The accumulator is unchanged.
PAXJD	0, k	Place the Accumulator in the j Difference Component of Index Register k The integral portion of the accumulator is copied into the j difference component of index register k. The accumulator is unchanged.
PAXJL	0, k	Place the Accumulator in the j Limit Component of Index Register k The integral portion of the accumulator is copied into the j limit component of index register k. The accumulator is unchanged.
XEQ	Y ± a	Execute Automatic computation is begun starting at effective location Y ± a under the guidance of the SICOM interpreter.

APPENDIX B

Below are listed alphabetically all of the mnemonics recognized by SICAP. The + notation for the pseudo operations refers the reader to the section entitled SICOSAS SPECIAL PURPOSE CARDS. Where applicable, the original seven-digit SICOM numeric format is included as well as a page reference to the SICOM manual. Finally, for each mnemonic operation, a page in Appendix A is referenced where a complete description is given.

SICAP MNEMONIC	SICOM FORMAT		SICOM MANUAL PAGE #	SICOSAS APPENDIX A PAGE #
ABS	0 00	0007	24	26
ADD	*K 30	ADDR	10	20
ADDC	6 01	ADDR	33	30
ADM	*K 32	ADDR	10	20
ATAN				+
BLCLR	K 00	0025	30	28
BLCPY	K 00	0024	30	28
BSR	0 00	AD19	27	27
BSS				+
CADM	*K 20	ADDR	09	19
CALL	*K 74	ADDR	22	24
CAS	*K 35	ADDR	10	20
CLA	*K 22	ADDR	09	19
CLAC	1 01	ADDR	33	30
CLS	*K 31	ADDR	10	19
CLSC	2 01	ADDR	33	30
CMPANR	*K 55	ADDR	18	23
DEC				+
DIB	*K 05	ADDR	07	18
DJB	*K 15	ADDR	08	19
DVP	*K 24	ADDR	09	20
DVPC	4 01	ADDR	33	30
END				+
EQU				+
EXCH	*K 26	ADDR	09	20
EXP				+
EXTANR	*K 57	ADDR	19	23
EXTR	*K 27	ADDR	09	20
FAST	0 00	0008	24	26
GRPIN	K 50	ADDR	15	23
HALT3	0 00	0003	23	25
HALT4	0 00	0004	23	25
HPRIN	0 00	0005	24	25
IDVP	*K 23	ADDR	09	19
IDVPC	3 01	ADDR	33	30
IFLEX	0 00	0011	25	26

*Affected by relative mode.

SICAP MNEMONIC	SICOM FORMAT	SICOM MANUAL PAGE #	SICOSAS APPENDIX A PAGE #
IIB	*K 06 ADDR	08	19
IJB	*K 16 ADDR	08	19
IOCTAL	K 52 ADDR	17	23
ISPEC	0 00 0029	31	28
ISUB	*K 33 ADDR	10	20
ISUBC	8 01 ADDR	34	31
ITAPE	K 00 0021	28	27
ITYPE	0 00 0013	25A	26
LDANR	*K 54 ADDR	18	23
LOG			+
MASK			+
MLAP			+
MPY	*K 25 ADDR	09	20
MPYC	5 01 ADDR	33	30
MRGANR	*K 56 ADDR	19	23
NAME			+
NOP	0 00 0000	23	25
OALPHA	K 53 ADDR	17	23
OCMND	K 45 ADDR	12	21
OCRTB	K 43 ADDR	12	21
OFLCR	K 37 ADDR	11	21
OFLEX	0 00 0012	25A	26
OFLTB	K 36 ADDR	11	21
OFORM	K 42 ADDR	12	21
OFXCR	K 41 ADDR	11	21
OFXTB	K 40 ADDR	11	21
OLOC	0 00 0075	32	29
OOCTAL	K 00 0027	30	28
OPRINT	0 00 0016	25A	26
ORG			+
OSPEC	K 00 0028	31	28
OTAPE	K 00 0020	27	27
OTBNO	K 44 ADDR	12	21
OTYPE	0 00 0014	25A	26
PAXIB	K 00 0223	29	32
PAXID	K 00 0323	29	32
PAXIL	K 00 0423	29	32
PAXJB	K 00 1223	29	32
PAXJD	K 00 1323	29	32
PAXJL	K 00 1423	29	32
PUSTOP	0 00 0079	32	30
PXAIB	K 00 0222	29	31
PXAID	K 00 0322	29	31
PXAIL	K 00 0422	29	31
PXAJB	K 00 1222	29	31
PXAJD	K 00 1322	29	31
PXAJL	K 00 1422	29	31
RAD	*K 34 ADDR	10	20
REL	0 00 0006	24	25

*Affected by relative mode.

SICAP MNEMONIC	SICOM FORMAT	SICOM MANUAL PAGE #	SICOSAS APPENDIX A PAGE #
REW	0 00 0019	27	27
RMI	0 00 0063	32	29
RNR7	0 00 0067	32	29
RNZ	0 00 0061	31	28
RPL	0 00 0062	31	29
RSJ1	0 00 0071	32	29
RSJ2	0 00 0072	32	29
RSJ3	0 00 0073	32	29
RSM4	0 00 0064	32	29
RSM5	0 00 0065	32	29
RSM6	0 00 0066	32	29
RSR	0 00 0070	32	29
RZE	0 00 0060	31	28
SELBCD	0 00 0017	26	26
SELBIN	K 00 0018	27	26
SETFWA	Y 01 ADDR	34	31
SETLWA	Z 01 ADDR	34	31
SHIFT	9 01 ADDR	34	31
SIB	K 02 ADDR	07	18
SICAP			+
SID	K 03 ADDR	07	18
SIL	K 04 ADDR	07	18
SIN			+
SJB	K 12 ADDR	08	19
SJD	K 13 ADDR	08	19
SJL	K 14 ADDR	08	19
SNGIN	K 51 ADDR	17	23
SQR			+
SRFILE	K 47 ADDR	13	22
STO	*K 77 ADDR	22	25
STOANR	*K 76 ADDR	22	25
STOP1	0 00 0001	23	25
STOP2	0 00 0002	23	25
SUB	*K 31 ADDR	10	20
SUBC	7 01 ADDR	33	30
TBR	K 75 ADDR	22	25
TMI	*K 63 ADDR	21	24
TNR7	K 67 ADDR	21	24
TNZ	*K 61 ADDR	20	23
TPL	*K 62 ADDR	21	23
TRACE	0 00 0009	24	26
TSJ1	*K 71 ADDR	21	24
TSJ2	*K 72 ADDR	22	24
TSJ3	*K 73 ADDR	22	24
TSM4	*K 64 ADDR	21	24
TSM5	*K 65 ADDR	21	24
TSM6	*K 66 ADDR	21	24

*Affected by relative mode.

SICAP MNEMONIC	SICOM FORMAT	SICOM MANUAL PAGE #	SICOSAS APPENDIX A PAGE #
TSR	K 70 ADDR	21	24
TZE	*K 60 ADDR	20	23
WRFILE	K 46 ADDR	12	22
XEQ	X 01 ADDR	34	32
ZEROIR	0 00 0010	25	26
*(Col. 1)			+

*Affected by relative mode.

APPENDIX C

Below is an alphabetized list of mnemonic operation codes and pseudo operation codes recognized by MLAP (Machine Language Assembly Program).

The referenced page number for the machine instructions is to Control Data 160-A Computer, Programming Manual, # 145A.

The * notation for the "relative" instructions refers the reader to page 27 of CDC Publication # 507 OSAS/A, The 160-A Assembly System.

The + notation for the pseudo operations recognized by MLAP refers the reader to the section entitled SICOSAS SPECIAL PURPOSE CARDS.

In the Y ± a notation, Y may be either symbolic or absolute. If absolute, Y will be considered either decimal or octal depending on the current mode of MLAP. (See MLAP card in Appendix D.) The additive field "a" may be used only if Y is symbolic and must be an absolute integer either octal or decimal again depending on the current mode of MLAP.

			MANUAL #145 PAGE
ACJ	Y ± a	Set direct, indirect, and relative bank control and jump.	36
ADB	Y ± a	Add backward.	30
ADC	Y ± a	Add constant.	30
ADD	Y ± a	Add direct.	30
ADF	Y ± a	Add forward.	30
ADI	Y ± a	Add indirect.	30
ADM	Y ± a	Add memory.	30
ADN	Y ± a	Add no address.	30
ADR	Y ± a	Add relative.	*
ADS		Add specific.	30
AOB	Y ± a	Replace add one backward.	32
AOC	Y ± a	Replace add one constant.	32
AOD	Y ± a	Replace add one direct.	32
AOF	Y ± a	Replace add one forward.	32
AOI	Y ± a	Replace add one indirect.	32
AOM	Y ± a	Replace add one memory.	32
AOR	Y ± a	Replace add one relative.	*
AOS		Replace add one specific.	32

ATE	Y ± a	A to buffer entrance register.	25
ATX	Y ± a	A to buffer exit register.	25
BLS	Y ± a	Block store.	24
BSS		Block starting with symbol.	+
CBC		Clear buffer controls	39
CIL		Clear interrupt lockout.	40
CTA		Bank controls to A.	26
DRJ	Y ± a	Set direct and relative bank control and jump.	36
END		End compilation	+
EQU		Equality	+
ETA		Buffer entrance register to A	25
ERR		Error stop.	45
EXC	Y ± a	External function constant.	44
EXF	Y ± a	External function forward.	44
HLT		Halt	45
HWI	Y ± a	Half write indirect.	29
IBI	Y ± a	Initiate buffer input.	40
IBO	Y ± a	Initiate buffer output.	41
INA		Input to A.	43
IRJ	Y ± a	Set indirect and relative bank control and jump.	36
JFI	Y ± a	Jump forward indirect.	39
JPI	Y ± a	Jump indirect.	38
JPR	Y ± a	Return jump.	38
LCB	Y ± a	Load complement backward.	28
LCC	Y ± a	Load complement constant.	28
LCD	Y ± a	Load complement direct.	28
LCF	Y ± a	Load complement forward.	28
LCI	Y ± a	Load complement indirect.	28
LCM	Y ± a	Load complement memory.	28
LCN	Y ± a	Load complement no address.	28
LCR	Y ± a	Load complement relative.	*

LCS		Load complement specific.	28
LDB	Y ± a	Load backward.	27
LDC	Y ± a	Load constant.	27
LDD	Y ± a	Load direct.	27
LDF	Y ± a	Load forward.	27
LDI	Y ± a	Load indirect.	27
LDM	Y ± a	Load memory.	27
LDN	Y ± a	Load no address.	27
LDR	Y ± a	Load relative.	*
LDS		Load specific.	27
LPB	Y ± a	Logical product backward.	34
LPC	Y ± a	Logical product constant.	34
LPD	Y ± a	Logical product direct.	34
LPF	Y ± a	Logical product forward.	34
LPI	Y ± a	Logical product indirect.	34
LPM	Y ± a	Logical product memory.	34
LPN	Y ± a	Logical product no address.	34
LPR	Y ± a	Logical product relative	*
LPS		Logical product specific.	34
LSB	Y ± a (SCB)	Logical sum backward.	35
LSD	Y ± a (SCD)	Logical sum direct.	35
LSF	Y ± a (SCF)	Logical sum forward.	35
LSI	Y ± a (SCI)	Logical sum indirect.	35
LSN	Y ± a (SCN)	Logical sum no address.	35
LSR	Y ± a (SCR)	Logical sum relative.	*
LS1		Left shift one.	32
LS2		Left shift two.	32
LS3		Left shift three.	32
LS6		Left shift six.	32
MLAP		Set SICOSAS to MLAP mode.	+
MUH		Multiply A by one hundred.	30
MUT		Multiply A by ten.	29
NAME		(Name card)	+
NJB	Y ± a	Negative jump backward.	37

NJF	Y ± a	Negative jump forward.	37
NJR	Y ± a	Negative jump relative.	*
NOP	Y ± a	No operation.	45
NZB	Y ± a	Non-zero jump backward.	37
NZF	Y ± a	Non-zero jump forward.	37
NZR	Y ± a	Non-zero jump relative.	*
ORG		Origin	+
OTA		Output from A.	43
OTN	Y ± a	Output no address.	43
OUT	Y ± a	Output	41
PJB	Y ± a	Positive jump backward.	37
PJF	Y ± a	Positive jump forward.	37
PJR	Y ± a	Positive jump relative.	*
PTA		Transfer P to A.	24
RAB	Y ± a	Replace add backward.	31
RAC	Y ± a	Replace add constant.	31
RAD	Y ± a	Replace add direct.	31
RAF	Y ± a	Replace add forward.	31
RAI	Y ± a	Replace add indirect.	31
RAM	Y ± a	Replace add memory.	31
RAR	Y ± a	Replace add relative.	*
RAS		Replace add specific.	31
RETURN		Return to SICAP.	+
RS1		Right shift one.	32
RS2		Right shift two.	32
SICAP		Set SICOSAS to SICAP mode.	+
SSB	Y ± a	Subtract backward.	30
SBC	Y ± a	Subtract constant.	30
SBD	Y ± a	Subtract direct.	30
SBF	Y ± a	Subtract forward.	30
SBI	Y ± a	Subtract indirect.	30
SBM	Y ± a	Subtract memory.	30
SBN	Y ± a	Subtract no address.	30
SBR	Y ± a	Subtract relative.	*

SBS		Subtract specific.	30
SBU	Y ± a	Set buffer bank control.	36
SCB	Y ± a (LSB)	Selective complement backward.	35
SCC	Y ± a	Selective complement constant.	35
SCD	Y ± a (LSD)	Selective complement direct.	35
SCF	Y ± a (LSF)	Selective complement forward.	35
SCI	Y ± a (LSI)	Selective complement indirect.	35
SCM	Y ± a	Selective complement memory.	35
SCN	Y ± a (LSN)	Selective complement no address.	35
SCR	Y ± a (LSR)	Selective complement relative.	*
SCS		Selective complement specific.	35
SDC	Y ± a	Set direct bank control	36
SIC	Y ± a	Set indirect bank control.	36
SID	Y ± a	Set indirect and direct bank control.	36
SLJ	Y ± a	Selective jump.	45
SLS	Y ± a	Selective stop.	45
SJS	Y ± a	Selective stop and jump.	45
SRB	Y ± a	Shift replace backward.	33
SRC	Y ± a	Shift replace constant.	33
SRD	Y ± a	Shift replace direct.	33
SRF	Y ± a	Shift replace forward.	33
SRI	Y ± a	Shift replace indirect.	33
SRJ	Y ± a	Set relative bank control and jump.	36
SRM	Y ± a	Shift replace memory.	33
SRR	Y ± a	Shift replace relative.	*
SRS		Shift replace specific	33
STB	Y ± a	Store backward.	28
STC	Y ± a	Store constant.	28
STD	Y ± a	Store direct.	28
STE	Y ± a	Store buffer entrance register at Location 6X and transfer A to buffer entrance register.	27
STF	Y ± a	Store forward.	28
STI	Y ± a	Store indirect.	28
STM	Y ± a	Store memory.	28

			MANUAL #145 PAGE
STP	Y ± a	Store P at location 5X.	26
STR	Y ± a	Store relative.	*
STS		Store specific.	28
ZJB	Y ± a	Zero jump backward.	37
ZJF	Y ± a	Zero jump forward.	37
ZJR	Y ± a	Zero jump relative.	*
*(Col. 1)		REMARKS Card.	+

APPENDIX D

```
THIS IS A 7090 TRANSFORMATION OF A SICOM PROGRAM WRITTEN FOR THE 160-A COMPUTER BY J.D. DRINAN   DEC.20,1962
 MLOC   SILOC K OP ADDR    SYMBOL OPCODE  VARIABLE FIELD              COMMENTARY                        PAGE  1

                          * THIS IS A SAMPLE SICOSAS PROGRAM SHOWING SICAP COMMANDS ONLY                    1
                          * THE ORIGINAL PROGRAM CODED IN SICOM LANGUAGE APPEARS ON PAGE 42 OF             2
                          * THE SICOM MANUAL.                                                             3
0000   0000                       ORG     0                                                               4
0000   0000  0 00 0010    START  ZEROIR                  ZERO ALL COMPONENTS OF ALL INDEX REGISTERS       5
0002   0001  1 03 0004           SID     4,1             SET I.R. 1 TO PICK UP X AND Y VALUES             5
0004   0002  1 04 0008           SIL     8,1                                                              7
0006   0003  1 13 0100           SJD     100,1                                                            8
0010   0004  1 14 0100           SJL     100,1                                                            9
0012   0005  2 03 0002           SID     2,2             SET I.R. 2 TO PICK UP Z VALUES (DIVISORS)       10
0014   0006  2 04 0004           SIL     4,2                                                             11
0016   0007  3 03 0002           SID     2,3             SET I.R. 3 FOR STORING RESULTS                  12
                          * NOTE THAT IT IS NOT NECESSARY TO SET THE I LIMIT OF INDEX REGISTER 3           13
                          * BECAUSE THE NEXT COMMAND IN SEQUENCE IS TO BE EXECUTED REGARDLESS OF          14
                          * THE INCREMENTING COMPARISON                                                   15
0020   0008  1 22 1200    CYCLE  CLA     DATA,1               PICK UP X(I)                               16
0022   0009  1 32 1202           ADD     DATA+2,1             ADD     Y(I)                               17
0024   0010  2 24 1400           DVP     DVISOR,2             DIVIDE SUM X(I)+Y(I) BY Z(I)               18
0026   0011  3 77 1500           STO     RESULT,3             STORE RESULT                               19
0030   0012  3 06 0013           IIB     NEXT,3               INDEX RESULT STORING                       20
0032   0013  2 06 0008    NEXT   IIB     CYCLE,2              CYCLE THROUGH DIVISORS                     21
0034   0014  2 02 0000           SIB     0,2                  RESET DIVISOR INDEX                        22
0036   0015  1 26 0008           IIB     CYCLE,1              NEXT X(I)+Y(I)                             23
0040   0016  1 02 2000           SIB     0,1                  RESET                                      24
0042   0017  1 16 0008           IJB     CYCLE,1              NEXT PORTION OF DATA                       25
0044   0018  0 00 0003           HALT3                        DONE                                       26
0046   0019  0 64 1502           TSM4    NXTJOB               DUMMY OJT                                  27
4540   1200                       ORG     1200            DATA IS STORED HERE                             28
4540   1200               DATA    DEC     1.15E+30             X1                                         29
4544   1202                       DEC     2.14E-29             Y1                                         30
4550   1204                       DEC     3.13E+28             X2                                         31
4554   1206                       DEC     4.12E-27             Y2                                         32
4560   1208                       DEC     5.11E+26             X3                                         33
4564   1210                       DEC     6.10E-25             Y3                                         34
5050   1300                       ORG     1300            SECOND PART OF DATA STORED HERE                 35
5050   1300                       DEC     7.9E+20              X4                                         36
5054   1302                       DEC     8.8E-19              Y4                                         37
5060   1304                       DEC     9.7E+18              X5                                         38
5064   1306                       DEC     10.6E+17             Y5                                         39
5070   1308                       DEC     11.5E-16             X6                                         40
5074   1310                       DEC     12.4E+15             Y6                                         41
5360   1400                       ORG     1400            DIVISORS ARE STORED HERE                        42
5360   1400               DVISOR  DEC     13.3E-9              Z1                                         43
5364   1402                       DEC     14.2E+28             Z2                                         44
5370   1404                       DEC     15.1E-37             Z3                                         45
5670   1500                       ORG     1500            RESULTS TO BE STORED HERE                       45
5670   1500               RESULT  DEC     0.                   X(I)+Y(I)/Z(I)                             47
5674   1502  0 02 0004    NXTJOB HALT4                        DUMMY END                                  48
                0000               END     START                                                          49
```

APPENDIX E

```
THIS IS A 7090 TRANSFORMATION OF A SICOM PROGRAM WRITTEN FOR THE 160-A COMPUTER BY ANYONE U. WISH   DEC.20,1962
 MLOC   SILOC K OP ADDR     SYMBOL OPCODE  VARIABLE FIELD              COMMENTARY                      PAGE  1

                           * THIS SAMPLE PROGRAM DEMONSTRATES COMMUNICATION BETWEEN A MAIN PROGRAM          1
                           * AND ITS SUBROUTINES, ONE OF WHICH (OUTPUT) IS IN MACHINE LANGUAGE.           2
 0310   0100                       ORG     100                                                           3
 0310   0100   0 64 0122   BEGIN  TSM4    INPUT          PICK UP A,E AND V                              4
 0312   0101   0 60 0123          TZE     DONE           FINISHED IF AC IS ZERO                         5
 0314   0102   0 65 0105          TSM5    SUBR           COMPUTE RHO USING A,E AND V                    6
 0316   0103   0 74 0214          CALL    OUTPUT         MACHINE LANGUAGE OUTPUT SUBROUTINE             7
 0320   0104   0 66 0100          TSM6    BEGIN          RECYCLE                                        8
 0322   0105   0 21 0210   SUBR   CLS     E              ECCENTRICITY                                   9
 0324   0106   0 25 0210          MPY     E              -E**2 IN AC                                   10
 0326   0107   6 01 0001          ADDC    1              1-E**2                                        11
 0330   0108   0 25 0208          MPY     A              SEMI-MAJOR AXIS                               12
 0332   0109   0 77 0118          STO     DIVDND         A(1-E**2)                                     13
 0334   0110   0 22 0212          CLA     V              TRUE ANOMOLY                                  14
 0336   0111   0 70 0126          TSR     COSDEG         FIND COSINE V                                 15
 0340   0112   0 25 0210          MPY     E              E COS(V)                                      16
 0342   0113   6 01 0001          ADDC    1              1+E COS(V)                                    17
 0344   0114   0 23 0118          IDVP    DIVDND         DIVIDE INTO A(1-E**2)                         18
 0346   0115   0 77 0120          STO     RHO            STORE ANSWER                                  19
 0350   0116   0 00 0065          RSM5                   RETURN TO MAIN PROGRAM                        20
 0354   0118                      DIVDND  DEC    0.                                                    21
 0360   0120                      RHO     DEC    0.                                                    22
 0364   0122   0 00 0064   INPUT  RSM4                   DUMMY SUBROUTINE TO PICK UP INPUT DATA        23
 0366   0123   0 00 0004   DONE   HALT4                                                                24
 0370   0124   0 66 0100          TSM6    BEGIN                                                         25
 0374   0126                      COSDEG  SIN                    SIN-COS SUBROUTINE ENTRY +0 =COSINE   26
 0640   0208                      A       DEC    0.                                                    27
 0644   0210                      E       DEC    0.                                                    28
 0650   0212                      V       DEC    0.                                                    29
                                  MLAP                                                                 30
 0654                 7500   OUTPUT EXC     2402           EXTERNAL DEVICE                            31
 0655                 4542
 0656                 7301          OUT     1              OUTPUT LOCATION RHO+3                      32
 0657                 0363                  RHO+3                                                      33
 0660                               RETURN                 BACK TO MAIN PROGRAM                       34
                      0100          END     BEGIN                                                      35
```

```
* THIS PROGRAM (LA07) ACCEPTS SYMBOLIC CODING IN BOTH A PSEUDO SICOM
* LANGUAGE AND 160-A MACHINE LANGUAGE AND PRODUCES A PROGRAM LISTING
* THE 160-A COMPUTER FOR EXECUTION
* PROGRAM TAPES...
* THIS PROGRAM (LA07) ACCEPTS SYMBOLIC CODING IN BOTH A PSEUDO SICOM
* LANGUAGE AND 160-A MACHINE LANGUAGE AND PRODUCES A PROGRAM LISTING
* AND A BINARY MAP OF THE PROGRAM ON MAGNETIC TAPE WHICH READS INTO
* THE 160-A COMPUTER FOR EXECUTION.
* PROGRAM TAPES...
*                 A7 HI DENSITY..PROGRAM LISTING..PRINT PROGRAM CONTROL.
*                 B7 HI DENSITY.. PROGRAM MEDIARY TAPE.
*                 A8 HI DENSITY.. INPUT TAPE IF INPUT IS PRESTORED.
*                 B8 LO DENSITY.. BINARY MAP OF ASSEMBLED PROGRAM.
          ORG     15200
START     HPR
          OTPEND  OTPEND
     +1   STL     22
     +4   SWT     1                          CARD OR TAPE INPUT
     +5   TRA     SETOFF                     TAPE
     +6   STZ     ONOFF                      CARD
     +7   STZ     MODE
     +8   CLA     CARD
     +9   STO     INUNIT
    +10   TRA     NOWIN
SETOFF    STL     ONOFF
     +1   CLA     INTAPE
     +2   STO     INUNIT
          IIMAGE  INPUT,,28
NOWIN     STL     43
          OIMAGE  OUTPUT,,28
     +4   STL     22
          IFILE   READ1
     +8   STL     43
    +11   AXT     20,4
    +12   CLA     NAME+20,4
    +13   STO     HEAD1+20,4
    +14   TIX     *-2,4,1
          ISCRIB  INUNIT
READ1     STL     43
          IFILE   READ2
     +4   STL     43
     +7   AXT     0,1                        COUNT SYMBOLS
          ICHAR   ALLBNK,,2                  NO SYMBOL
     +8   STL     43
          ICHAR   ISSYM,,13                  NOT BLANK IN COLS 1-6
    +12   STL     43
    +16   CLA     ATE
    +17   STO     ICNTR
          ISCRIB  INUNIT
READ2     STL     43
          IBCW    WORK,,1,14
     +4   STL     43
     +8   STZ     TEMP
          OBCW    WORK,,1,14
```

APPENDIX F

```
    +9  STL     22
        CSCRIB  MEDTAP
   +13  STL     22
        IBCC    TEMP,,1,1           WHAT KIND OF CARD
SKIP    STL     43
    +4  CLA     TEMP                   TEST FOR  COMMENT
    +5  SUB     STAR
    +6  TZE     READ2                  IS COMMEN IGNORE IT
        IBCW    CODE,,8,1           LOOK AT OPCODE
    +7  STL     43
   +11  CLA     CODE
   +12  CAS     SSQR
   +13  TRA     *+2
   +14  TRA     FORSQR
   +15  CAS     SLOG
   +16  TRA     *+2
   +17  TRA     FORLOG
   +18  CAS     SEXP
   +19  TRA     *+2
   +20  TRA     FOREXP
   +21  CAS     SSIN
   +22  TRA     *+2
   +23  TRA     FORSIN
   +24  CAS     SATN
   +25  TRA     *+2
   +26  TRA     FORATN
   +27  CAS     SICOM
   +28  TRA     CASGOB
   +29  TRA     *+2                    IS SICOM CARD
   +30  TRA     CASGOB
   +31  STZ     MODE
   +32  TRA     READ2
CASGOB  CAS     GOBACK                 CHECK RETURN CARD
    +1  TRA     CAS160
    +2  TRA     *+2                    IS IGNORE FIRST
    +3  TRA     CAS160
    +4  CLA     ICNTR
    +5  ADD     TWO
    +6  STO     ICNTR
    +7  TRA     ISOP
CAS160  CAS     160A                   MACHINE MODE
    +1  TRA     CASNAM
    +2  TRA     *+2
    +3  TRA     CASNAM
    +4  STL     MODE
    +5  TRA     READ2
CASNAM  CAS     NAMER
    +1  TRA     CASORG
    +2  TRA     *+2
    +3  TRA     CASORG
        IBCW    HEAD1+14,,16,6
    +4  STL     43
    +8  TRA     READ2
CASORG  CAS     ORIGIN
```

```
      +1  TRA    *+2
      +2  TRA    ISORG
      +3  CAS    DECDAT
      +4  TRA    *+2
      +5  TRA    ISDEC
      +6  CAS    EXTMSK
      +7  TRA    *+2
      +8  TRA    ISDEC
      +9  CAS    END
     +10  TRA    *+2
     +11  TRA    ISEND
     +12  CAS    EQU
     +13  TRA    *+2
     +14  TRA    READ2
     +15  CAS    BSS
     +16  TRA    *+2
     +17  TRA    ISBSS
     +18  NZT    MODE
     +19  TRA    ISOP
     +20  AXT    BTYPE-MINSTR,4
CASBTY  CAS    BTYPE,4
      +1  TRA    *+2
      +2  TRA    LITEIT
      +3  TIX    CASBTY,4,1
      +4  TRA    ISOP
LITEIT  SLN    1
        IINT    TEMP+1,,1,6          LOOK FOR SYMBOL
ISOP    STL    43
ALLBNK  CLA    ICNTR                    MACHINE LOCATION COUNTER
      +1  ADD    TWO
      +2  ZET    MODE
      +3  SUB    ONE
      +4  STO    ICNTR
      +5  SLT    1                        WAS THIS DEC DATA CARD
      +6  TRA    READ2                    NO
      +7  TRA    ALLBNK+1
        IBCW    SYMTAB,1,1,1
ISSYM   STL    43
      +4  CLA    ICNTR
      +5  STO    LOCTAB,1
      +6  TXI    *+1,1,-1
      +7  SXA    SYMCNT,1                 -SYMBOL COUNT
      +8  CLA    ICNTR
AGN     ADD    TWO
      +1  ZET    MODE
      +2  SUB    ONE
      +3  STO    ICNTR
      +4  SLT    1
      +5  TRA    READ2
      +6  TRA    AGN                      WAS DEC DATA
        IBCW    SYMTAB,1,1,1
ISBSS   STL    43
      +4  CLA    ICNTR
      +5  STO    LOCTAB,1
```

```
     +6   TXI     **+1,1,-1
     +7   SXA     SYMCNT,1
          IINT     TEMP+3,,16
     +8   STL     43
    +12   CLA     TEMP+3
    +13   ZET     MODE
    +14   TRA     **+2
    +15   ALS     1
    +16   ADD     ICNTR
    +17   STO     ICNTR
    +18   TRA     READ2
          IINT     ICNTR,,16
ISORG     STL     43
     +4   CLA     ICNTR                  MAKE AN EVEN MACHINE LOCATION
     +5   ALS     1                      2XSICOM LOC = MACHINE LOCATION
     +6   STO     ICNTR
     +7   TRA     READ2
ISDEC     ZET     MODE
     +1   TRA     ISOP
     +2   SLN     1
     +3   TSX     EVENUP,4
     +4   TRA     ISOP
          IBCW     DYNAMO,,16,1
ISEND     STL     43
     +4   REWB    7
     +5   TSX     FNDSYM,4
     +6   TNZ     **+2
     +7   CLA     LOCTAB
     +8   ARS     1
     +9   STA     GO2
    +10   CLA     ATE
    +11   STO     ICNTR
          CBLANK   120,,1
    +12   STL     22
          CREADY
    +15   STL     22
          CBLANK   120,,1
    +17   STL     22
          CEOR     DUMP,,132
    +20   STL     22
          IFILE    NOWGO
    +24   STL     43
    +27   AXT     4096,4
    +28   STZ     SIMAP+4096,4
    +29   TIX     *-1,4,1
    +30   AXT     56,4
    +31   CLA     BLANK
    +32   STO     INPUT+56,4
    +33   TIX     *-1,4,1
    +34   WPDA
    +35   SPRA    1
          CHEAD    CASE1,,1,,1
    +36   STL     22
    +41   STZ     PAGENO
```

```
   +42  STZ     MODE
IMAGE1  EQU     OUTPUT+21              COLS 121-126 OF OUTRAN REGIONS
IMAGE2  EQU     IMAGE1+28
        ICHAR    0
    -4  STL     43
        ISCRIB   MEDTAP
NOWGO   STL     43
        IREADY
    +4  STL     43
        IBCW     TEMP,,8,1
    +6  STL     43
   +10  CLA     TEMP
   +11  SUB     BLANK
   +12  TZE     NOWGO
        IREADY
   +13  STL     43
        IFILE    CYCLE
   +15  STL     43
   +18  CLA     ONE
   +19  STO     NUMBER
        ISCRIB   MEDTAP
CYCLE   STL     43
        IBCW     WORK,,1,12
    +4  STL     43
        OBCW     WORK,,28,12
    +8  STL     22
        OINT     NUMBER,,115,4
   +12  STL     22
   +16  CLA     NUMBER
   +17  ADD     ONE
   +18  STO     NUMBER
   +19  STZ     TEMP
        IBCC     TEMP,,1,1          TEST FOR COMMENT CARD
   +20  STL     43
   +24  CLA     TEMP
   +25  SUB     STAR
   +26  TZE     CMTCRD                FOUND ONE
        IBCW     CODE,,8,1          TEST NOW FOR
   +27  STL     43
   +31  CLA     CODE
   +32  CAS     SSQR
   +33  TRA     *+2
   +34  TRA     SQRFOR
   +35  CAS     SLOG
   +36  TRA     *+2
   +37  TRA     LOGFOR
   +38  CAS     SEXP
   +39  TRA     *+2
   +40  TRA     EXPFOR
   +41  CAS     SSIN
   +42  TRA     *+2
   +43  TRA     SINFOR
   +44  CAS     SATN
   +45  TRA     *+2
```

```
    +46   TRA     ATNFOR
    +47   CAS     SICCM
    +48   TRA     Z1
    +49   TRA     **2
    +50   TRA     Z1
    +51   STZ     MODE
    +52   STZ     IMODE
    +53   TRA     CMTCRD
Z1        CAS     GOBACK
     +1   TRA     Z2
     +2   TRA     FORART                    FOUND A RETURN CARD
Z2        CAS     160A
     +1   TRA     Z3
     +2   TRA     **2
     +3   TRA     Z3
     +4   STL     MODE
          ICHAR    0
     +5   STL     43
          ICHAR    YISOCT,,8
     +9   STL     43
          IINT     NEWTEM,,16,6
    +13   STL     43
    +17   STZ     IMODE
    +18   TRA     CMTCRD
          ICHAR    0
YISOCT    STL     43
     +4   STL     IMODE
     +5   TRA     CMTCRD
Z3        CAS     OCTAL
     +1   TRA     Z4
     +2   TRA     OCTCRD
Z4        CAS     BLANK
     +1   TRA     Z5
     +2   TRA     BNKCRD
Z5        CAS     NAMER
     +1   TRA     **2
     +2   TRA     CYCLEX
     +3   CAS     ORIGIN                    ORIGIN CARD
     +4   TRA     **2
     +5   TRA     ORGCRD
     +6   CAS     DECDAT                    DEC DATA CARD
     +7   TRA     **2
     +8   TRA     DATCRD
     +9   CAS     EXTMSK
    +10   TRA     BSSCAS
    +11   TRA     **2
    +12   TRA     BSSCAS
    +13   STL     MASKER
    +14   TRA     DATCRD
CYCLEX    CLA     NUMBER
     +1   SUB     ONE
     +2   STO     NUMBER
     +3   TRA     CYCLE
BSSCAS    CAS     BSS
```

```
     +1   TRA     *+2
     +2   TRA     BSSCRD
     +3   CAS     EQU                     EQU CARD
     +4   TRA     *+2
     +5   TRA     EQUCRD
     +6   CAS     END                     END CARD
     +7   TRA     *+2
     +8   TRA     ENDCRD
     +9   NZT     MODE
    +10   TRA     STABLE
    +11   AXT     LSTINS-MINSTR,1         IS MACHINE CODE
GOLOOK   CAS     LSTINS,1
     +1   TRA     *+2
     +2   TRA     THANX
     +3   TIX     GOLOOK,1,1
     +4   TRA     BADCOD
THANX    CLA     LSTINS,1
     +1   STO     RITEOP
     +2   CLA     LSTKEY,1
     +3   STO     RITEKY
     +4   LAC     RITEKY,2
     +5   TRA*    AFORK,2
AFORK    PZE     0TYPE                   EG  BLS  0100 YYYY
     +1   PZE     1TYPE                   EG  PTA  0101
     +2   PZE     2TYPE                   EG  STP  015X
     +3   PZE     3TYPE                   EG  LDN  04XX
     +4   PZE     4TYPE                   EG  SLJ  77X0
     +5   PZE     5TYPE                   RELATIVE
STABLE   AXT     ENDOP-OPCODE,1
CMPCOD   CAS     ENDOP,1                 FIND CORRECT CODE IN TABLE
     +1   TRA     *+2
     +2   TRA     FNDOP                   MATCHED
     +3   TIX     CMPCOD,1,1
     +4   TRA     BADCOD
FNDOP    CLA     ENDOP,1
     +1   STO     RITEOP
     +2   CLA     ENDKEY,1
     +3   STO     RITEKY
     +4   LAC     RITEKY,2
     +5   TRA*    FORK,2
FORK     PZE     TYPE0                   KOPADDR  E.G. CLA MPY ETC
     +1   PZE     TYPE1                   OP=DR    E.G. NOP TMK5
     +2   PZE     TYPE2                   K   D18  SEL MAG TAPE
     +3   PZE     TYPE3                   K    DR  E.G.  BLOCK COPY
     +4   PZE     TYPE4                         AD19  BACKSPACE
     +5   PZE     TYPE5                   KOOAD2R  PXA PAX
     +6   PZE     TYPE6                   KOP=OP   EG CLAC GO ETC
          ICHAR   YESSYM,,8
TYPE0    STL     43
          IINT    SIADDR,,16,6
     +4   STL     43
          ICHAR   0
     +8   STL     43
    +12   TSX     VARFRM,4
```

```
   +13  NOP
   +14  TRA    NOPE
        ICHAR   Ø
YESSYM  STL    43
    +4  TSX    FNDSYM,4
    +5  ARS    1
    +6  STO    SIADDR
    +7  SLT    2                    WAS IT AC SYMBOL
    +8  TRA    NOPE                 NO
    +9  CAL    ACLIST               $ØØØØØ
   +1Ø  ORS    RITEKY
   +11  SLN    2                    FOR BINARY ROUTINE
   +12  TRA    TSXS
NOPE    CAL    INDEXR
    +1  ORS    RITEKY
TSXS    TSX    STOKOP,4
ALMSTØ  TSX    CNVSAD,4             SET UP HOLLERITH ADDR
ASIFØ   TSX    OKTODR,4             MOVE K OP ADDR TO OUTRAN OUTPUT REGI1Ø
    +1  TSX    LOCMCH,4             PUT MACHINE LOCATION IN OUTRAN REGION
    +2  TSX    LOCSIC,4             PUT SICOM LOCATION IN OUTPUT REGION
    +3  TSX    WRLIST,4             WRITE ONE LINE ON LISTING TAPE
    +4  SLT    3
    +5  TRA    GOAHED
    +6  CLA    RETURN
    +7  ADD    ONE
    +8  STA    *+1
    +9  TRA    **Ø
GOAHED  TSX    STOCMD,4
REBACK  CLA    ICNTR
    +1  ADD    TWO
    +2  ZET    MODE
    +3  SUB    ONE
    +4  STO    ICNTR
    +5  SLT    1
    +6  TRA    CYCLE
    +7  TRA    REBACK+1
TYPE1   AXT    5,4                  ZERO K O P A D  FOR TYPE 1 INSTR
    +1  STZ    K+5,4
    +2  TIX    *-1,4,1
    +3  CLA    ZERO
    +4  LDQ    RITEKY
    +5  RQL    6
    +6  LGL    6
    +7  STO    D2
    +8  CLA    ZERO
    +9  LGL    6
   +1Ø  STO    R
   +11  TSX    OKTODR,4             MOVE ØØØØØDR TO OUTPUT REGION
   +12  TSX    LOCMCH,4
   +13  TSX    LOCSIC,4
   +14  TSX    WRLIST,4
   +15  LDQ    D2
   +16  MPY    DECMAL+2
   +17  XCA
```

```
      +18   ASI     R
      +19   STO     SIADDR
      +20   TSX     STCCMC,4
      +21   TRA     REBACK                  DONE THIS CARD
TYPE2       STZ     0                       SEL MAC TAPE
      +1    STZ     P
      +2    STZ     A
      +3    CLA     ONE
      +4    STO     D2
      +5    CLA     ATE
      +6    STO     R
      +7    TSX     VARFRM,4
      +8    NOP
            IMASK   0
      +9    STL     43
     +10    LDQ     D1
     +11    MPY     DECMAL+1
     +12    STQ     TEMP
     +13    LDQ     D2
     +14    MPY     DECMAL+2
     +15    XCA
     +16    ADD     R
     +17    ADD     TEMP
     +18    STO     SIADDR
     +19    TRA     ASIF0
TYPE3       TSX     WIPE,4
      +1    TSX     VARFRM,4
      +2    NOP
      +3    LDQ     RITEKY
      +4    CLA     ZERO
      +5    RQL     6
      +6    LGL     6
      +7    STO     D2
      +8    CLA     ZERO
      +9    LGL     6
     +10    STO     R
     +11    LDQ     D2
     +12    MPY     DECMAL+2
     +13    XCA
     +14    ADD     R
     +15    STO     SIADDR
     +16    TRA     ASIF0
TYPE4       TSX     WIPE,4                  BACKSPACE AD19
      +1    CLA     ONE
      +2    STO     D2
      +3    CLA     NINE
      +4    STO     R
            IINT    AD,,16
      +5    STL     43
      +9    LDQ     AD
     +10    CLA     ZERO
     +11    DVH     DECMAL+2
     +12    STQ     A
     +13    STO     D1
```

```
   +14  XCA
   +15  ALS    3
   +16  STO    K
   +17  LDQ    D1
   +18  MPY    DECMAL+1
   +19  XCA
   +20  ADD    D19
   +21  STO    SIADDR
   +22  TRA    ASIFØ
TYPE5  TSX    WIPE,4                  PAX,PXA 22 OR 23
    +1  TSX    VARFRM,4
    +2  NOP
    +3  CLA    TWO
    +4  STO    D2
    +5  LDQ    RITEKY
    +6  CLA    ZERO
    +7  LGL    6
    +8  STO    A
    +9  CLA    ZERO
   +10  LGL    6
   +11  STO    D1
   +12  CLA    ZERO
   +13  LGL    6
   +14  STO    R
   +15  AXT    3,4
LDQA   LDQ    A+3,4
    +1  MPY    DECMAL+3,4
    +2  STQ    TEMP+3,4
    +3  TIX    LDQA,4,1
    +4  CLA    R
    +5  ADD    TEMP
    +6  ADD    TEMP+1
    +7  ADD    TEMP+2
    +8  STO    SIADDR
    +9  TRA    ASIFØ
TYPE6  TSX    WIPE,4                  KOP = OP    ADDR
    +1  AXT    3,4
    +2  LDQ    RITEKY
LOOP   CLA    ZERO
    +1  LGL    6
    +2  STO    K+3,4
    +3  TIX    LOOP,4,1
        ICHAR   NOTK,,8            ADDR MAY BE SYMBOLIC OR A CONSTANT
    +4  STL    43
        IINT    SIADDR,,16,6
    +8  STL    43
        ICHAR   Ø
   +12  STL    43
   +16  TRA    SEEIF
NOTK   TSX    FNDSYM,4                ADDR IS SYMBOLIC
    +1  ARS    1
    +2  STO    SIADDR
        ICHAR   Ø
    +3  STL    43
```

```
SEEIF    CLA     SIADDR
    +1   CAS     D1999
    +2   TRA     FIXIT
    +3   TRA     ALMST0
    +4   TRA     ALMST0
FIXIT    SLN     3
    +1   STL     RETURN
    +2   TRA     ALMST0
BACKIN   LDQ     SIADDR
    +1   CLA     ZERO
    +2   DVH     D2000
    +3   STO     SIADDR              2000 OR LESS
    +4   STQ     CVRAGE              NUMBER OF 2000 NDS
    +5   XCA
    +6   LRS     2                   TEST FOR 8000
    +7   LBT
    +8   TRA     NOT8
    +9   CLA     8IND                IS 8000
   +10   ORS     SIADDR              4000
   +11   TRA     GOAHED
NOT8     LLS     2
    +1   ALS     4
    +2   ORS     K
    +3   TRA     GOAHED
         BEGIN    1,4
WIPE     TXL     *+3,0,0                  SUBROUTINE LINKAGE
    +4   AXT     7,4
    +5   STZ     K+7,4
    +6   TIX     *-1,4,1
         RETURN   WIPE
    +7   TRA     WIPE+1
         BEGIN    1,4            SET UP HOLLERITH K,O,P
STOKCP   TXL     *+3,0,0                  SUBROUTINE LINKAGE
    +4   LDQ     RITEKY
    +5   AXT     3,4
CLAZ     CLA     ZERO
    +1   LGL     6
    +2   STO     K+3,4
    +3   TIX     CLAZ,4,1
         RETURN   STOKCP
    +4   TRA     STOKCP+1
         BEGIN    1,4
CNVSAD   TXL     *+3,0,0                  SUBROUTINE LINKAGE
    +4   AXT     3,4              CONVER BINARY SICOM ADDR TO BCD
    +5   LDQ     SIADDR
NXTONE   CLA     ZERO
    +1   DVH     DECMAL+3,4
    +2   STQ     A+3,4
    +3   XCA
    +4   TIX     NXTONE,4,1
    +5   STQ     R
         RETURN   CNVSAD
    +6   TRA     CNVSAD+1
         BEGIN    1,4
```

```
CKTCDR  TXL     *+3,0,0                         SUBROUTINE LINKAGE
        OMASK    6,,31
    +4  STL     22
        OBCC     K,,15,1
    +8  STL     22
        CBCC     C,,17,1
   +12  STL     22
        OBCC     P,,18,1
   +16  STL     22
   +20  AXT     4,4
        CCOLR    20
   +21  STL     22
        OBCC     A+4,4,,1
COTATR  STL     22
    +4  TIX     OUTATR,4,1
        OMASK    0
    +5  STL     22
        RETURN   CKTCDR
    +9  TRA     OKTCDR+1
IREDUN  HPR     1
    +1  TRA     START
CREDLN  HPR     2
    +1  TRA     START
CTPEND  HPR     3
    +1  TRA     WRLIST
NOEND   HPR     4
    +1  TRA     ENDCRD
        BEGIN    1,4
LOCMCH  TXL     *+3,0,0                             SUBROUTINE LINKAGE
    +4  CLA     ICNTR                       CONVER LOCATION COUTER IN OUTPUT REGIO
    +5  ADD     OCTGND                      OCTAL 10000
    +6  STO     TEMP+4
        OOCTAL   TEMP+4,,2,5
    +7  STL     22
        OBCC     BLANK,,2,1
   +11  STL     22
        RETURN   LOCMCH
   +15  TRA     LOCMCH+1
        BEGIN    1,4
LOCSIC  TXL     *+3,0,0                         SUBROUTINE LINKAGE
    +4  CLA     ICNTR
    +5  ARS     1
    +6  ADD     10THOU                      DECIMAL 10000
    +7  STO     TEMP+3
        CINT     TEMP+3,,7,5
    +8  STL     22
        OBCC     BLANK,,8,1
   +12  STL     22
        RETURN   LOCSIC
   +16  TRA     LOCSIC+1
        BEGIN    1,4
WRLIST  TXL     *+3,0,0                         SUBROUTINE LINKAGE
        CSCRIB   CUTAPE,,20,1
    +4  STL     22
```

```
     +8   SWT     3
     +9   TRA     OBLANK
          OREADY
    +10   STL     22
          OSCRIB   PRINTR,,20
    +12   STL     22
          OBLANK   120,,1
OBLANK    STL     22
          RETURN   WRLIST
     +3   TRA     WRLIST+1
CMTCRD    TSX     WRLIST,4                FOUND A COMMENT CARD ON 2ND PASS
     +1   TRA     CYCLE
          IINT     ICNTR,,16
ORGCRD    STL     43
     +4   CLA     ICNTR
     +5   ALS     1
     +6   STO     ICNTR
     +7   TSX     LOCMCH,4
     +8   TSX     LOCSIC,4
     +9   TSX     WRLIST,4
    +10   TRA     CYCLE
BSSCRD    TSX     LOCMCH,4
     +1   NZT     MODE
     +2   TSX     LOCSIC,4
     +3   TSX     WRLIST,4
          IINT     NEWTEM,,16
     +4   STL     43
     +8   CLA     NEWTEM
     +9   NZT     MODE
    +10   ALS     1
    +11   ADD     ICNTR
    +12   STO     ICNTR
    +13   TRA     CYCLE
          ICHAR    SYMBOL,,8
EQUCRD    STL     43
     +4   LXA     SYMCNT,1
          IBCW     SYMTAB,1,1,1
     +5   STL     43
          IMASK    0
     +9   STL     43
          IINT     NEWTEM+1,,16,6
    +13   STL     43
    +17   CLA     NEWTEM+1
    +18   ZET     MODE
    +19   TRA     FORMCH
    +20   ALS     1
    +21   STO     LOCTAB,1
    +22   ARS     1
REVRS     TXI     *+1,1,-1
     +1   SXA     SYMCNT,1
     +2   ADD     10THOU
     +3   STO     NEWTEM+2
          OINT     NEWTEM+2,,18,5
     +4   STL     22
```

```
         OBCC    BLANK,,19,1
    +8   STL     22
         ICHAR   0
   +12   STL     43
   +16   TSX     WRLIST,4
   +17   TRA     CYCLE
FORMCH   STO     LOCTAB,1
         COCTAL  LOCTAB,1,20,4
    +1   STL     22
    +5   TXI     *+1,1,-1
    +6   SXA     SYMCNT,1
         ICHAR   0
    +7   STL     43
   +11   TSX     WRLIST,4
   +12   TRA     CYCLE
SYMBOL   TSX     FNDSYM,4
    +1   ZET     MODE
    +2   TRA     FORMCH
    +3   STO     LOCTAB,1
    +4   ARS     1
    +5   TRA     REVRS
DATCRD   ZET     MODE
    +1   TRA     BNKCRD
    +2   SLN     1
    +3   TSX     EVENUP,4
    +4   TSX     SCANIT,4                WRITE THIS DEC ISCAN ROUTINE
    +5   TSX     LOCMCH,4
    +6   TSX     LOCSIC,4
    +7   TSX     WRLIST,4
    +8   TRA     REBACK
ENDCRD   CLA     GC2
    +1   ADD     10THOU
    +2   STO     TEMP
    +3   REWB    7
         OINT    TEMP,,18,5
    +4   STL     22
         OBCC    BLANK,,19,1
    +8   STL     22
   +12   TSX     WRLIST,4
   +13   WEFA    7
   +14   TSX     RITOUT,4
   +15   SWT     6
   +16   TRA     *+2
   +17   TRA     *+2
   +18   REWA    7
         OBCW    ALLDUN,,1,20
   +19   STL     22
         OSCRIB  PRINTR,,20
   +23   STL     22
   +27   WPDA
   +28   SPRA    1
   +29   HTR     START+1
         BEGIN   1,4
BADCOD   TXL     *+3,0,0                 SUBROUTINE LINKAGE
```

```
        +4   STO     NOCODE
             OREADY
        +5   STL     22
             OBCW     NOCODE,,1,20
        +7   STL     22
       +11   TSX     ERROR,4
       +12   AXT     0,1
       +13   ZET     MODE
       +14   TRA     THANX
       +15   TRA     FNDOP
* THIS ROUTINE WILL SET UP TWO REGISTERS COMPRISING A SICOM COMMAND
             BEGIN   1,7
    STOCMD   TXL     *+5,0,0                      SUBROUTINE LINKAGE
        +8   CLA     WHRMAP
        +9   ADD     ICNTR
       +10   STA     STOREV                       EVEN LOCATION = SIADDR
       +11   ADD     ONE
       +12   STA     STOROD                       ODD LOCATION = KOP
       +13   CLA     SIADDR
    STOREV   STO     **0
        +1   SLT     2                            IS AC
        +2   TRA     NOTAC                        NO
        +3   CLA     ABLNK                        YES    000000B
    ALS3     ALS     3
        +1   ORA     0
        +2   ALS     3
        +3   ORA     P
    STOROD   STO     **0
             RETURN  STOCMD
        +1   TRA     STOCMD+1
    NOTAC    CLA     RITEKY
        +1   TMI     *+3                          IS XEQ,SETFWA,SETLWA
        +2   CLA     K
        +3   TRA     ALS3
        +4   SSP
        +5   ARS     30
        +6   SUB     OCT12
        +7   TRA     ALS3
    OCT12    OCT     12
             BEGIN   1,7
    FNDSYM   TXL     *+5,0,0                      SUBROUTINE LINKAGE
        +8   TSX     VARFRM,4
        +9   TRA     *+2                          SPECIAL RETURN
       +10   TRA     NORMAL
       +11   CLA     MYOWN
       +12   ALS     1
             RETURN  FNDSYM
       +13   TRA     FNDSYM+1
    NORMAL   AXT     0,4
        +1   LAC     SYMCNT,1                     NUMBER SYMBOLS STORED THUS FAR
        +2   CLA     AFIELD
        +3   CAS     ACCODE                       CHECK FOR AC = SIADDR
        +4   TRA     *+2
        +5   TRA     ISAC
```

```
LOCKAT   CAS     SYMTAB,4
    +1   TRA     *+2
    +2   TRA     FOUND
    +3   TXI     *+1,4,-1
    +4   TIX     LOOKAT,1,1
    +5   STO     UNDEF                    SYMBOL IS UNDEFINED
         OREADY
    +6   STL     22
         OBCW     UNDEF,,1,20
    +8   STL     22
   +12   TSX     ERROR,4
   +13   CLA     ZERO
   +14   TRA     FOUNDX
ISAC     SLN     2
    +1   CLA     ACNUM
         RETURN   FNDSYM
    +2   TRA     FNDSYM+1
FOUND    CLA     LOCTAB,4
    +1   STO     EQUSYM
    +2   CLA     AFIELD
    +3   TXI     *+1,4,-1
    +4   TNX     FINE,1,1
CMPSYM   CAS     SYMTAB,4
    +1   TRA     *+2
    +2   TRA     STUPID
    +3   TXI     *+1,4,-1
    +4   TIX     CMPSYM,1,1
FINE     CLA     EQUSYM
    +1   ADD     ADDIT
         RETURN   FNDSYM
FOUNDX   TRA     FNDSYM+1
STUPID   STO     DOUBLE
         OREADY
    +1   STL     22
         OBCW     DOUBLE,,1,20
    +3   STL     22
    +7   TSX     ERROR,4
    +8   TRA     FINE
         BEGIN    1,4
ERROR    TXL     *+3,0,0                  SUBROUTINE LINKAGE
         OSCRIB   OUTAPE,,20,1
    +4   STL     22
    +8   SWT     3
         RETURN   ERROR
    +9   TRA     ERROR+1
         OREADY
   +10   STL     22
         OSCRIB   PRINTR,,20
   +12   STL     22
         RETURN   ERROR
   +16   TRA     ERROR+1
         BEGIN    2,7
VARFRM   TXL     *+5,0,0                  SUBROUTINE LINKAGE
         IMASK    ,,31
```

```
     +8   STL     43
    +12   AXT     15,4
          ICOLR    16
    +13   STL     43
RAVEL     STZ     DATA+15,4
          IBCC     DATA+15,4,,1
     +1   STL     43
     +5   TIX     RAVEL,4,1
          IMASK    Ø                COLS 16-3Ø UNPACKED
     +6   STL     43
    +1Ø   STZ     CCMCOL                          Ø=COL 16
    +11   STZ     ADDIT
    +12   STZ     ADDCOL
    +13   STZ     INDEXR
    +14   AXT     15,4
    +15   AXT     Ø,1
    +16   CLA     ISBLNK                          LOOK FOR BLANK
LOG1      CAS     DATA+15,4
     +1   TRA     *+2
     +2   TRA     FNDBNK                          FOUND BLANK
     +3   TXI     *+1,1,1
     +4   TIX     LOG1,4,1
     +5   AXT     Ø,1
FNDBNK    SXA     BNKCOL,1                        COLUMN NO-16 OF BLANK
     +1   LXA     BNKCOL,4
     +2   CLA     BNKCOL
     +3   ADD     WHRDAT
     +4   STA     REFADD
     +5   AXT     Ø,1
LOG2      CLA     ISPOS                           LOOK FOR ADDITIVE SYMBOL
     +1   CAS*    REFADD
     +2   TRA     *+2
     +3   TRA     FNDADD
     +4   CLA     ISNEG
     +5   CAS*    REFADD
     +6   TRA     *+2
     +7   TRA     FNDADD
     +8   TXI     *+1,1,1
     +9   TIX     LOG2,4,1
    +1Ø   AXT     Ø,1
FNDADD    SXA     ADDCOL,1                        COL NO (-16) OF ADDITIVE SYMBOL
     +1   LXA     BNKCOL,4
     +2   AXT     Ø,1
     +3   CLA     ISCOM                           LOOK FOR COMMA
LOG3      CAS*    REFADD
     +1   TRA     *+2
     +2   TRA     FNDCOM
     +3   TXI     *+1,1,1
     +4   TIX     LOG3,4,1
     +5   AXT     Ø,1
FNDCOM    SXA     CCMCOL,1                        COMMA IN THIS COLUMN
     +1   ZET     CCMCOL
     +2   TRA     YSCOMA                          WAS A COMMA
ZETADD    ZET     ADDCOL                          NO COMMA
```

```
    +1  TRA     YESADD                          WAS AN ADDITIVE FIELD
        IBCW     AFIELD,,16,1  SYMBOL AS IT STANDS IS OK
    +2  STL     43
        RETURN   VARFRM        NO ADD NO COMMA
    +6  TRA     VARFRM+1
YESADD  CLA     SIXX                            = MAYBE     COMMA BUT ADDITIVE FIRST
    +1  SUB     ADDCOL                          ISOLATE SYMBOL FROM + OR -
INTPL   TPL     **+2
    +1  CLA     ZERO                            ERROR
    +2  XCA
    +3  MPY     SIXX
    +4  XCA
    +5  STA     SHFTR                           (6-C)X6 = NO BITS TO RIGHT OF SYMBOL
    +6  LXA     ADDCOL,1                        NO CHARACTERS IN SYMBOL
    +7  AXT     0,2
    +8  CLA     ZERO
ROTAT   ALS     6
    +1  ORA     DATA,2
    +2  TXI     **+1,2,-1
    +3  TIX     ROTAT,1,1
    +4  LDQ     BLANK                           6 BCD BLANKS
SHFTR   LGL     **0
    +1  SLW     AFIELD                          SYMBOL UNDRESSED STORED FOR LOOK UP
    +2  SLT     2
    +3  TRA     **+2
    +4  TRA     ISTAG
    +5  CLA     ADDCOL                          NOW GET ADDITIVE FIELD
    +6  ADD     COLDIF
    +7  STA     IFDEC+3                         I MACROS
    +8  STA     IFOCT+3
    +9  CLA     COMCOL
   +10  ZET     COMCOL
   +11  TRA     **+2
   +12  CLA     BNKCOL
   +13  SUB     ADDCOL
   +14  ALS     18
   +15  STD     IFDEC+3
   +16  STD     IFOCT+3
   +17  ZET     IMODE                           ZERO = DEC MODE
   +18  TRA     ACKOCT
        ICHAR    NONOCT,,8
   +19  STL     43
        IINT     ADDIT,,**,**
IFDEC   STL     43
    +4  ZET     MODE
    +5  TRA     MOVEON
    +6  CLA     ADDIT
    +7  ALS     1
    +8  STO     ADDIT
MOVEON  NZT     COMCOL                          IS THERE A TAG FIELD
        RETURN   VARFRM        SYMBOL SET IN AFIELD +OR- IN ADDIT
    +1  TRA     VARFRM+1
    +2  TRA     ISTAG
        ICHAR    NONOCT,,8
```

```
ACKOCT   STL     43
         IOCTAL  ADDIT,,**,**
IFOCT    STL     43
         RETURN  VARFRM
    +4   TRA     VARFRM+1
         ICHAR   Ø
NONOCT   STL     43
         OREADY
    +4   STL     22
         OBCW    BADVAR,,1,2Ø
    +6   STL     22
   +1Ø   TSX     ERROR,4
   +11   STZ     ADDIT
         RETURN  VARFRM
   +12   TRA     VARFRM+1
YSCOMA   ZET     ADDCOL                    IS THERE ADDITIVE BESIDED TAG
    +1   TRA     YESADD                    PROCES TAG FIELD LATER
    +2   TRA     HARD1                     FIRST FIELD MAY NUMERIC
ISTAG    CLA     COMCOL
    +1   ADD     COLDIF
    +2   ADD     ONE
    +3   STA     PROTAG+3
         IINT    K,,**,1
PROTAG   STL     43
    +4   CLA     K
    +5   ALS     3Ø
    +6   SLW     INDEXR
    +7   SLT     1
         RETURN  VARFRM
    +8   TRA     VARFRM+1
         RETURN  VARFRM,1
    +9   AXT     1,4
         ICHAR   Ø              THIS CASE HAS NO ADD BUT TAG + MAYBE N
HARD1    STL     43
         ICHAR   ISALPH,,8
    +4   STL     43
    +8   CLA     COMCOL
    +9   ALS     18
   +1Ø   STD     TRYIT+3
         IINT    MYOWN,,16,**
TRYIT    STL     43
    +4   SLN     1
    +5   TRA     ISTAG
         ICHAR   Ø
ISALPH   STL     43
    +4   SLN     2
    +5   CLA     COMCOL
    +6   STO     ADDCOL
    +7   CLA     SIXX
    +8   SUB     COMCOL
    +9   TRA     INTPL
COMCOL   PZE
BNKCOL   PZE
ADDCOL   PZE
```

```
ISCOM    BCI     1,00000,
INDEXR   PZE
SIXX     DEC       6
ADDIT    PZE
COLDIF   DEC       16
MYCWN    PZE
         BEGIN   1,7
SCANIT   TXL     *+5,0,0                    SUBROUTINE LINKAGE
    +8   CLA     WHRMAP                     ASSEMBLE + STORE DEC CARD COLS 16+
    +9   ADD     ICNTR
   +10   STA     D890
   +11   ADD     ONE
   +12   STA     D567
   +13   ADD     ONE
   +14   STA     D234
   +15   ADD     ONE
   +16   STA     EXPD1
         IMASK   ,,31
   +17   STL     43
   +21   AXT     15,4                       UNPACK 15 COLS STARTING COL 16
         ICOLR   16
   +22   STL     43
UNPACK   STZ     DATA+15,4
         IBCC    DATA+15,4,,1
    +1   STL     43
    +5   TIX     UNPACK,4,1
         IMASK   0
    +6   STL     43
   +10   CLA     EXP0                       OCT 100
   +11   STO     EXPCNT
   +12   AXT     10,4
   +13   STZ     DIGIT+10,4
   +14   TIX     *-1,4,1
   +15   STZ     MANSGN
   +16   STZ     EPART
   +17   STZ     1STNZ
   +18   STZ     DPTIND
   +19   AXT     15,1                       LOOK AT 15 COLUMNS
   +20   AXT     0,2                        COLUMN COUNTER
   +21   AXT     0,4                        DIGIT STORER
   +22   STZ     DPTIND
LOOKC    CLA     DATA+15,1                  LOOK AT A COLUMN
    +1   CAS     ISBLNK
    +2   TRA     *+2
    +3   TRA     GETOUT                     FOUND A BLANK
    +4   CAS     TEN
    +5   TRA     GR10
    +6   HPR                                ERROR
    +7   TNZ     MARKIT                     GR0 IS BETWEEN 1 AND 9
    +8   ZET     1STNZ                      IS THIS A LEADING 0
    +9   TRA     *+2                        NO
   +10   TRA     MORCLM                     YES IGNORE IT
MARKIT   NZT     1STNZ
    +1   TRA     1STONE
```

```
STODIG   STO    DIGIT,4
    +1   TXI    *+1,4,-1
MORCLM   TXI    *+1,2,1
    +1   TIX    LOOKC,1,1
    +2   TRA    ILEGAL
GR10     CAS    ISPOS
    +1   TRA    *+2
    +2   TRA    YESPOS                  IS A + SIGN
    +3   CAS    ISNEG
    +4   TRA    *+2
    +5   TRA    YESNEG                        - SING
    +6   CAS    ISE
    +7   TRA    *+2
    +8   TRA    YESE                          E
    +9   CAS    ISDCPT
   +10   TRA    *+2
   +11   TRA    YESDPT
   +12   NZT    MASKER
   +13   TRA    ILEGAL
   +14   SUB    DELTA
   +15   ZET    1STNZ
   +16   TRA    STODIG
   +17   TRA    1STONE
YESPOS   STZ    MANSGN
    +1   TRA    MORCLM
YESNEG   STL    MANSGN
    +1   TRA    MORCLM
YESDPT   SXA    DECCLM,2
    +1   STL    DPTIND
    +2   TRA    MORCLM
1STONE   SXA    NZCOLM,2
    +1   STL    1STNZ
    +2   TRA    STODIG
YESE     SXA    ECOLMN,2                E FOUND WILL TERMINATE SEARCH
    +1   STL    EPART
    +2   LAC    ECOLMN,4
         ICOLR   17,4
    +3   STL    43
         ICHAR   ILEGAL,,8
    +6   STL    43
         IINT    EEXP,,,3
   +10   STL    43
GETOUT   CLA    DECCLM
    +1   CAS    NZCOLM
    +2   TRA    DECGR                   DEC PT COLUMN IS LARGER
    +3   HPR                            OH REALLY
    +4   CLA    NZCOLM                  NON ZERO COLUMN IS LARGER
    +5   SUB    DECCLM
    +6   SUB    ONE
    +7   SSM
TESTE    NZT    EPART                   WAS THERE AN EPART
    +1   TRA    *+2                     NO
    +2   ADD    EEXP                    YES ADD IN
    +3   ADD    EXPONT                  OCT 100
```

```
     +4  STO    EXPONT
     +5  TPL    ASSMBL
     +6  CLA    EXPØ
     +7  SUB    EXPONT
     +8  STO    EXPONT
     +9  TRA    ASSMBL
DECGR    CLA    DECCLM
     +1  SUB    NZCOLM
     +2  TRA    TESTE
ASSMBL   CLA    ZERO                    ASSEMBLE SIGN EXP + D1
     +1  ZET    MANSGN
     +2  CLA    ONE                     NEG MANTISSA
     +3  ALS    7
     +4  ORA    EXPONT
     +5  ALS    4
     +6  ORA    DIGIT
EXPD1    STO    **Ø
     +1  CLA    DIGIT+1
     +2  ALS    4
     +3  ORA    DIGIT+2
     +4  ALS    4
     +5  ORA    DIGIT+3
D234     STO    **Ø
     +1  CLA    DIGIT+4
     +2  ALS    4
     +3  ORA    DIGIT+5
     +4  ALS    4
     +5  ORA    DIGIT+6
D567     STO    **Ø
     +1  CLA    DIGIT+7
     +2  ALS    4
     +3  ORA    DIGIT+8
     +4  ALS    4
     +5  ORA    DIGIT+9
D89Ø     STO    **Ø
     +1  STZ    MASKER
         RETURN  SCANIT
     +2  TRA    SCANIT+1
         ICHAR   Ø
ILEGAL   STL    43
         OREADY
     +4  STL    22
         OBCW    BADDEC,,1,2Ø
     +6  STL    22
    +1Ø  TSX    ERROR,4
    +11  STZ    MASKER
         RETURN  SCANIT
    +12  TRA    SCANIT+1
EVENUP   CAL    ICNTR
     +1  ANA    2BITS
     +2  SSM
     +3  ADD    D4
     +4  ANA    2BITS
     +5  ADD    ICNTR
```

```
     +6   STO    ICNTR
     +7   TRA    1,4
2BITS     PZE    3
D4        PZE    4
          BEGIN   1,7
RITOUT    TXL    *+5,Ø,Ø                          SUBROUTINE LINKAGE
REWB      REWB   8
     +1   SDLB   8
     +2   AXT    12,4
     +3   CLA    RIMAP+12,4
     +4   STO    SIMAP+12,4
     +5   TIX    *-2,4,1
     +6   AXT    1365,1
     +7   AXT    Ø,2
CLASIM    CLA    SIMAP,2
     +1   ALS    12
     +2   ORA    SIMAP+1,2
     +3   ALS    12
     +4   ORA    SIMAP+2,2
     +5   SLW    OREGIN+1365,1
     +6   TXI    *+1,2,-3
     +7   TIX    CLASIM,1,1
     +8   WTBB   8
     +9   RCHB   SCRIBE
    +1Ø   TCOB   *
    +11   TRCB   REWB
    +12   REWB   8
          RETURN  RITOUT
    +13   TRA    RITOUT+1
ØTYPE     CAL    RITEKY                    EG   BLS   Ø1ØØ YYYY
     +1   ARS    21
     +2   STO    FOROUT
     +3   ANA    M7777
     +4   STO    FORMAP
     +5   TSX    OUTCOD,4
     +6   TSX    LOCMCH,4
     +7   TSX    MAPIT,4
     +8   TSX    WRLIST,4
     +9   CLA    ICNTR
    +1Ø   ADD    ONE
    +11   STO    ICNTR
          ICHAR   Ø
BNKCRD    STL    43
          ICHAR   DILLY,,8
     +4   STL    43
     +8   NZT    IMODE
     +9   TRA    QDECM
          IOCTAL  TEMP,,16,4
    +1Ø   STL    43
    +14   TRA    PICKUP
          IINT   TEMP,,16,4
QDECM     STL    43
PICKUP    CLA    TEMP
     +1   ANA    M7777
```

```
    +2  TRA     STOFOR
        ICHAR    Ø
DILLY   STL     43
    +4  TSX     FNDSYM,4
    +5  ANA     M7777
    +6  TRA     STOFOR
1TYPE   CAL     RITEKY                  EG  PTA  Ø1Ø1 NO SYMBOLIC FIELD
    +1  ARS     21
STOFOR  STO     FORCUT
    +1  ANA     M7777
    +2  STO     FORMAP
    +3  TSX     OUTCOD,4
    +4  TSX     LOCMCH,4
    +5  TSX     MAPIT,4
    +6  TSX     WRLIST,4
    +7  TRA     REBACK
        ICHAR    Ø                  EG  STP Ø15X
2TYPE   STL     43
        ICHAR    SILLY,,8
    +4  STL     43
        IINT     TEMP,,16,6
    +8  STL     43
CLAM7   CLA     M7
    +1  ANS     TEMP
CALRIT  CAL     RITEKY
    +1  ARS     21
    +2  ORA     TEMP
    +3  TRA     STOFOR
        ICHAR    Ø
SILLY   STL     43
    +4  TSX     FNDSYM,4
    +5  STO     TEMP
    +6  TRA     CLAM7
        ICHAR    Ø                  EG   LDN  Ø4XX
3TYPE   STL     43
        ICHAR    NILLY,,8
    +4  STL     43
    +8  NZT     IMODE
    +9  TRA     QQDEC
        IOCTAL   TEMP,,16,6
   +1Ø  STL     43
   +14  TRA     CLAM77
        IINT     TEMP,,16,6
QQDEC   STL     43
CLAM77  CLA     M77
    +1  CAS     TEMP
    +2  TRA     CALRIT                  WITHIN RANGE
    +3  TRA     CALRIT
STZTEM  STZ     TEMP
    +1  TSX     OCRNG,4
    +2  TRA     CALRIT
        ICHAR    Ø
NILLY   STL     43
    +4  TSX     FNDSYM,4
```

```
      +5  TNZ    JDD
      +6  STZ    TEMP
      +7  TRA    CALRIT
JDD       STO    TEMP
      +1  CAL    RITEKY
      +2  ANA    TGMASK
      +3  TZE    CLAM77                  IS NOT FWD OR BACK
      +4  SUB    ITAG
      +5  TNZ    ISBACK                  REF BACKWARDS
      +6  CLA    TEMP                    THIS REFS FWD
      +7  SUB    ICNTR
TMIS      TMI    STZTEM
      +1  STO    TEMP
      +2  TRA    CLAM77
ISBACK    CLA    ICNTR
      +1  SUB    TEMP
      +2  TRA    TMIS
          ICHAR   Ø
4TYPE     STL    43
          ICHAR   TILLY,,8
      +4  STL    43
          IINT    TEMP,,16,1
      +8  STL    43
     +12  CLA    TEMP
     +13  ALS    3
     +14  STO    TEMP
     +15  TRA    CALRIT                  EG  SLJ  77XØ
TILLY     TSX    FNDSYM,4
      +1  TNZ    *+3
      +2  STZ    TEMP
      +3  TRA    CALRIT
      +4  ALS    3
      +5  STO    TEMP
      +6  TRA    CLAM77
5TYPE     TSX    FNDSYM,4                RELATIVE MODE
      +1  SUB    ICNTR
      +2  TMI    ISREV                   BACKWARD REFERENCE
      +3  STO    TEMP
      +4  TRA    CLAM77
ISREV     SSP
      +1  STO    TEMP
      +2  CAL    TGMASK
      +3  ANA    RITEKY
      +4  ALS    12
      +5  ACL    RITEKY
      +6  SLW    RITEKY
      +7  TRA    CLAM77
          BEGIN   1,4
OUTCOD    TXL    *+3,Ø,Ø                      SUBROUTINE LINKAGE
          OOCTAL  FOROUT,,2Ø,4
      +4  STL    22
          RETURN  OUTCOD
      +8  TRA    OUTCOD+1
          BEGIN   1,4
```

```
MAPIT    TXL     *+3,0,0                          SUBROUTINE LINKAGE
    +4   CLA     WHRMAP
    +5   ADD     ICNTR
    +6   STA     *+2
    +7   CLA     FORMAP
    +8   STO     **0
         RETURN   MAPIT
    +9   TRA     MAPIT+1
         BEGIN    1,4
OORNG    TXL     *+3,0,0                          SUBROUTINE LINKAGE
         OREADY
    +4   STL     22
         OBCW     RANGER,,1,20
    +6   STL     22
   +10   TSX     ERROR,4
         RETURN   CORNG
   +11   TRA     OORNG+1
         ICHAR    GOOF,,8
OCTCRD   STL     43
         IOCTAL   TEMP,,16,4
    +4   STL     43
    +8   CLA     TEMP
    +9   TRA     STOFOR
         OREADY
GOOF     STL     22
         OBCW     GOON,,1,20
    +2   STL     22
    +6   TSX     ERROR,4
    +7   CLA     ZERO
    +8   TRA     STOFOR
FORART   AXT     3,1
    +1   TSX     LOCMCH,4
    +2   TSX     WRLIST,4
CLABAC   CLA     BACKTO+3,1
    +1   STO     FORMAP
    +2   TSX     MAPIT,4
    +3   CLA     ICNTR
    +4   ADD     ONE
    +5   STO     ICNTR
    +6   TIX     CLABAC,1,1
    +7   TRA     CYCLE
INSTR    EQU     ICNTR
         DETAIL
         DETAIL
         QSUBRA   SSQR,BBB1,ENDSQR,DD1
FORSQR   TSX     EVENUP,4
    +1   CLA     SSQR
    +2   STO     SYMTAB,1
    +3   CLA     ICNTR
    +4   STO     LOCTAB,1
    +5   TXI     *+1,1,-1
    +6   SXA     SYMCNT,1
         ICHAR BBB1,,8
    +7   STL     43
```

```
     +8  TXL    44,0,12
     +9  HTR    BBB1,0
    +10  PZE    8
         IINT TEMP,,1,6
    +11  STL    43
    +12  TXL    44,0,4
    +13  STO    TEMP,0
    +14  PZE    1,,6
DD1      CLA    ENDSQR
     +1  ADD    INSTR
     +2  STO    INSTR
     +3  TRA    READ2
         IBCW SYMTAB,1,1,1
BBB1     STL    43
     +1  TXL    44,0,2
     +2  HTR    SYMTAB,1
     +3  PZE    1,,1
         ICHAR ALLBNK,,2
     +4  STL    43
     +5  TXL    44,0,12
     +6  HTR    ALLBNK,0
     +7  PZE    2
         ICHAR ISSYM,,8
     +8  STL    43
     +9  TXL    44,0,12
    +10  HTR    ISSYM,0
    +11  PZE    8
    +12  CLA    ICNTR
    +13  STO    LOCTAB,1
    +14  TXI    *+1,1,-1
    +15  SXA    SYMCNT,1
    +16  TRA    DD1
         LIST
         QSUBRA  SLOG,BBB2,ENDLOG,DD2
FORLOG   TSX    EVENUP,4
         QSUBRA  SEXP,BBB3,ENDEXP,DD3
FOREXP   TSX    EVENUP,4
         QSUBRA  SSIN,BBB4,ENDSIN,DD4
FORSIN   TSX    EVENUP,4
         QSUBRA  SATN,BBB5,ENDATN,DD5
FORATN   TSX    EVENUP,4
         DETAIL
         QSUBRB  ENDSQR
SQRFOR   TSX    EVENUP,4
     +1  CLA    WHRMAP
     +2  ADD    ICNTR
     +3  ADD    ENDSQR
     +4  STA    *+3
     +5  LXA    ENDSQR,4
     +6  CLA    ENDSQR,4
     +7  STO    **0,4
     +8  TIX    *-2,4,1
     +9  TSX    LOCMCH,4
    +10  TSX    LOCSIC,4
```

```
   +11  TSX    WRLIST,4
   +12  CLA    ENDSQR
   +13  ADD    INSTR
   +14  STO    INSTR
   +15  TRA    CYCLE
        LIST
        QSUBRB  ENDLOG
LOGFOR  TSX    EVENUP,4
        QSUBRB  ENDEXP
EXPFOR  TSX    EVENUP,4
        QSUBRB  ENDSIN
SINFOR  TSX    EVENUP,4
        QSUBRB  ENDATN
ATNFOR  TSX    EVENUP,4
SSQR    BCI    1,SQR
SLOG    BCI    1,LOG
SEXP    BCI    1,EXP
SSIN    BCI    1,SIN
SATN    BCI    1,ATAN
IMODE   PZE
EQUSYM  PZE
DOUBLE  BCI    9,       HAS BEEN MULTIPLY DEFINED....THE VALUE ASSIGNED
    +9  BCI    9, TO THE SYMBOL ON FIRST ENCOUNTER WILL BE USED...*****
   +18  BCI    2,************
        LIST
MODE    PZE                              0= SICOM NON ZERO= MACHINE LANGUAGE
EXTMSK  BCI    1,MASK
MASKER  PZE                              NON ZERO FOR MASK CARD
DELTA   OCT    52
SICOM   BCI    1,SICAP
GOBACK  BCI    1,RETURN                  RETURN TO MACHINE LANGUAGE
160A    BCI    1,MLAP
THREE   DEC       3
FOROUT  PZE
FORMAP  PZE
M7777   OCT    7777
M7      OCT    7
BADVAR  BCI    9,THIS CARD HAS VIOLATED THE RULES FOR THE ADDITIVE SUBF
    +9  BCI    9,IELD.... IT WILL BE SET TO ZERO..   ****************
   +18  BCI    2,******
RANGER  BCI    9,THE FOLLOWING CARD HAS AN OUT OF RANGE CONDITION. THE
    +9  BCI    9,XX OF THE EEXX FORMAT HAS BEEN REPLACED BY ZERO...****
   +18  BCI    2,************
M77     OCT    77
GOON    BCI    9,THE VARIABLE FIELD OF THE FOLLOWING OCT CARD IS IN ERR
    +9  BCI    9,OR... ZERO HAS BEEN SUBSTITUTED.... ****************
   +18  BCI    2,***********
ALLDUN  BCI    9,THIS IS THE END OF THIS ASSEMBLY.  REMOVE BINARY B8.
    +9  BCI    9,REMOVE LISTING TAPE A7 (UNLESS STACKING). PRESS START
   +18  BCI    2,FOR NEXT JOB
BACKTO  OCT    40
    +1  OCT    2006
    +2  OCT    30
MINSTR  BCI    1,BLS                    TYPE A TWO REGISTERS
```

```
      +1   BCI     1,ATE
      +2   BCI     1,ATX
      +3   BCI     1,LDM
      +4   BCI     1,LDC
      +5   BCI     1,LCM
      +6   BCI     1,LCC
      +7   BCI     1,STM
      +8   BCI     1,STC
      +9   BCI     1,ADM
     +10   BCI     1,ADC
     +11   BCI     1,SBM
     +12   BCI     1,SBC
     +13   BCI     1,RAM
     +14   BCI     1,RAC
     +15   BCI     1,AOM
     +16   BCI     1,ACC
     +17   BCI     1,SRM
     +18   BCI     1,SRC
     +19   BCI     1,LPM
     +20   BCI     1,LPC
     +21   BCI     1,SCM
     +22   BCI     1,SCC
     +23   BCI     1,JPR
     +24   BCI     1,IBI
     +25   BCI     1,IBO
     +26   BCI     1,EXC
BTYPE      BCI     1,PTA                  THIS TYPE (B) HAS NO VARIABLE FI
      +1   BCI     1,ETA
      +2   BCI     1,CTA
      +3   BCI     1,LDS
      +4   BCI     1,LCS
      +5   BCI     1,STS
      +6   BCI     1,MUT
      +7   BCI     1,MUH
      +8   BCI     1,ADS
      +9   BCI     1,SBS
     +10   BCI     1,RAS
     +11   BCI     1,AOS
     +12   BCI     1,LS1
     +13   BCI     1,LS2
     +14   BCI     1,LS3
     +15   BCI     1,LS6
     +16   BCI     1,RS1
     +17   BCI     1,RS2
     +18   BCI     1,SRS
     +19   BCI     1,LPS
     +20   BCI     1,SCS
     +21   BCI     1,CBC
     +22   BCI     1,CIL
     +23   BCI     1,INA
     +24   BCI     1,OTA
     +25   BCI     1,ERR
     +26   BCI     1,HLT
     +27   BCI     1,HPR
```

```
+28  BCI   1,STP                    TYPE C FILL IN LO ORDER OCTAL DIGIT
+29  BCI   1,STE
+30  BCI   1,SRJ
+31  BCI   1,SIC
+32  BCI   1,IRJ
+33  BCI   1,SDC
+34  BCI   1,DRJ
+35  BCI   1,SID
+36  BCI   1,ACJ
+37  BCI   1,SBU
+38  BCI   1,NOP
+39  BCI   1,SLS
+40  BCI   1,LDN                    TYPE D FILL IN TWO LO ORDER OCTAL DIGI
+41  BCI   1,LDD
+42  BCI   1,LDI
+43  BCI   1,LDF
+44  BCI   1,LDB
+45  BCI   1,LCN
+46  BCI   1,LCD
+47  BCI   1,LCI
+48  BCI   1,LCF
+49  BCI   1,LCB
+50  BCI   1,STD
+51  BCI   1,STI
+52  BCI   1,STF
+53  BCI   1,STB
+54  BCI   1,HWI
+55  BCI   1,ADN
+56  BCI   1,ADD
+57  BCI   1,ADI
+58  BCI   1,ADF
+59  BCI   1,ADB
+60  BCI   1,SBN
+61  BCI   1,SBD
+62  BCI   1,SBI
+63  BCI   1,SBF
+64  BCI   1,SBB
+65  BCI   1,RAD
+66  BCI   1,RAI
+67  BCI   1,RAF
+68  BCI   1,RAB
+69  BCI   1,AOD
+70  BCI   1,AOI
+71  BCI   1,AOF
+72  BCI   1,AOB
+73  BCI   1,SRD
+74  BCI   1,SRI
+75  BCI   1,SRF
+76  BCI   1,SRB
+77  BCI   1,LPN
+78  BCI   1,LPD
+79  BCI   1,LPI
+80  BCI   1,LPF
+81  BCI   1,LPB
```

```
     +82   BCI     1,SCN
     +83   BCI     1,SCD
     +84   BCI     1,SCI
     +85   BCI     1,SCF
     +86   BCI     1,SCB
     +87   BCI     1,ZJF
     +88   BCI     1,NZF
     +89   BCI     1,PJF
     +90   BCI     1,NJF
     +91   BCI     1,ZJB
     +92   BCI     1,NZB
     +93   BCI     1,PJB
     +94   BCI     1,NJB
     +95   BCI     1,JPI
     +96   BCI     1,JFI
     +97   BCI     1,INP
     +98   BCI     1,OUT
     +99   BCI     1,OTN
    +100   BCI     1,EXF
    +101   BCI     1,SJS
    +102   BCI     1,SLJ
    +103   BCI     1,ADR
    +104   BCI     1,AOR
    +105   BCI     1,LCR
    +106   BCI     1,LDR
    +107   BCI     1,LPR
    +108   BCI     1,LSR
    +109   BCI     1,NJR
    +110   BCI     1,NZR
    +111   BCI     1,PJR
    +112   BCI     1,RAR
    +113   BCI     1,SBR
    +114   BCI     1,SCR
    +115   BCI     1,SRR
    +116   BCI     1,STR
    +117   BCI     1,ZJR
    +118   BCI     1,LSB
    +119   BCI     1,LSD
    +120   BCI     1,LSF
    +121   BCI     1,LSI
    +122   BCI     1,LSN
LSTINS   PZE
         VFD     015/100,21/0
MCODE
         VFD     015/105,21/0
     +1
         VFD     015/106,21/0
     +2
         VFD     015/2100,21/0
     +3
         VFD     015/2200,21/0
     +4
         VFD     015/2500,21/0
     +5
```

```
      VFD     015/2600,21/0
 +6
      VFD     015/4100,21/0
 +7
      VFD     015/4200,21/0
 +8
      VFD     015/3100,21/0
 +9
      VFD     015/3200,21/0
+10
      VFD     015/3500,21/0
+11
      VFD     015/3600,21/0
+12
      VFD     015/5100,21/0
+13
      VFD     015/5200,21/0
+14
      VFD     015/5500,21/0
+15
      VFD     015/5600,21/0
+16
      VFD     015/4500,21/0
+17
      VFD     015/4600,21/0
+18
      VFD     015/1100,21/0
+19
      VFD     015/1200,21/0
+20
      VFD     015/1500,21/0
+21
      VFD     015/1600,21/0
+22
      VFD     015/7100,21/0
+23
      VFD     015/7200,21/0
+24
      VFD     015/7300,21/0
+25
      VFD     015/7500,21/0
+26
      VFD     015/101,21/1
+27
      VFD     015/107,21/1
+28
      VFD     015/130,21/1
+29
      VFD     015/2300,21/1
+30
      VFD     015/2700,21/1
+31
      VFD     015/4300,21/1
+32
```

```
      VFD     015/112,21/1
+33
      VFD     015/113,21/1
+34
      VFD     015/3300,21/1
+35
      VFD     015/3700,21/1
+36
      VFD     015/5300,21/1
+37
      VFD     015/5700,21/1
+38
      VFD     015/102,21/1
+39
      VFD     015/103,21/1
+40
      VFD     015/110,21/1
+41
      VFD     015/111,21/1
+42
      VFD     015/114,21/1
+43
      VFD     015/115,21/1
+44
      VFD     015/4700,21/1
+45
      VFD     015/1300,21/1
+46
      VFD     015/1700,21/1
+47
      VFD     015/104,21/1
+48
      VFD     015/120,21/1
+49
      VFD     015/7600,21/1
+50
      VFD     015/7677,21/1
+51
      VFD     015/,21/1
+52
      VFD     015/7700,21/1
+53
      VFD     015/7700,21/1
+54
      VFD     015/150,21/2
+55
      VFD     015/160,21/2
+56
      VFD     015/10,21/2
+57
      VFD     015/20,21/2
+58
      VFD     015/30,21/2
+59
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      VFD     015/40,21/2
+60
      VFD     015/50,21/2
+61
      VFD     015/60,21/2
+62
      VFD     015/70,21/2
+63
      VFD     015/140,21/2
+64
      VFD     015/,21/2
+65
      VFD     015/7700,21/2
+66
      VFD     015/400,21/3
+67
      VFD     015/2000,21/3
+68
      VFD     015/2100,21/3
+69
      VFD     021/220001,15/3
+70
      VFD     021/230002,15/3
+71
      VFD     015/500,21/3
+72
      VFD     015/2400,21/3
+73
      VFD     015/2500,21/3
+74
      VFD     021/260001,15/3
+75
      VFD     021/270002,15/3
+76
      VFD     015/4000,21/3
+77
      VFD     015/4100,21/3
+78
      VFD     021/420001,15/3
+79
      VFD     021/430002,15/3
+80
      VFD     015/7600,21/3
+81
      VFD     015/600,21/3
+82
      VFD     015/3000,21/3
+83
      VFD     015/3100,21/3
+84
      VFD     021/320001,15/3
+85
      VFD     021/330002,15/3
+86
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      VFD     015/700,21/3
+87
      VFD     015/3400,21/3
+88
      VFD     015/3500,21/3
+89
      VFD     021/360001,15/3
+90
      VFD     021/370002,15/3
+91
      VFD     015/5000,21/3
+92
      VFD     015/5100,21/3
+93
      VFD     021/520001,15/3
+94
      VFD     021/530002,15/3
+95
      VFD     015/5400,21/3
+96
      VFD     015/5500,21/3
+97
      VFD     021/560001,15/3
+98
      VFD     021/570002,15/3
+99
      VFD     015/4400,21/3
+100
      VFD     015/4500,21/3
+101
      VFD     021/460001,15/3
+102
      VFD     021/470002,15/3
+103
      VFD     015/200,21/3
+104
      VFD     015/1000,21/3
+105
      VFD     015/1100,21/3
+106
      VFD     021/120001,15/3
+107
      VFD     021/130002,15/3
+108
      VFD     015/300,21/3
+109
      VFD     015/1400,21/3
+110
      VFD     015/1500,21/3
+111
      VFD     021/160001,15/3
+112
      VFD     021/170002,15/3
+113
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        VFD     021/600001,15/3
+114
        VFD     021/610001,15/3
+115
        VFD     021/620001,15/3
+116
        VFD     021/630001,15/3
+117
        VFD     021/640002,15/3
+118
        VFD     021/650002,15/3
+119
        VFD     021/660002,15/3
+120
        VFD     021/670002,15/3
+121
        VFD     015/7000,21/3
+122
        VFD     021/710001,15/3
+123
        VFD     021/720001,15/3
+124
        VFD     021/730001,15/3
+125
        VFD     015/7400,21/3
+126
        VFD     015/7500,21/3
+127
        VFD     015/7700,21/3
+128
        VFD     015/7700,21/4
+129
        VFD     021/320001,15/5
+130
        VFD     021/560001,15/5
+131
        VFD     021/260001,15/5
+132
        VFD     021/220001,15/5
+133
        VFD     021/120001,15/5
+134
        VFD     021/160001,15/5
+135
        VFD     021/630004,15/5
+136
        VFD     021/610004,15/5
+137
        VFD     021/620004,15/5
+138
        VFD     021/520001,15/5
+139
        VFD     021/360001,15/5
+140
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          VFD     021/160001,15/5
   +141
          VFD     021/460001,15/5
   +142
          VFD     021/420001,15/5
   +143
          VFD     C21/610003,15/5
   +144
          VFD     021/170002,15/3
   +145
          VFD     021/140000,15/3
   +146
          VFD     021/160001,15/3
   +147
          VFD     C21/150000,15/3
   +148
          VFD     021/30000,15/3
   +149
          VFD     C15/1,21/1
LSTKEY
SCRXXX    OCT     10,0,6,0,27,74,47,77
     +8   OCT     52,30,53,23,54,30,45,77
    +16   OCT     42,23,43,30,2,401,41,35
    +24   OCT     5,75,2,64,7,75,4000,6025
    +32   OCT     32,33,2,401,32,24,31,30
    +40   OCT     22,74,37,25,7,0,11,0
    +48   OCT     106,0,40,2024,6116,2023,6021,114
    +56   OCT     740,4221,2023,201,4217,2200,100,4023
    +64   OCT     2006,70,423,5002,2200,4374,70,423
    +72   OCT     5002,6511,0,0,40,2303,5023,2304
    +80   OCT     6520,401,5002,6523,0,0,4000,2004
    +88   OCT     1060,1003,4450,2006,1506,4501,1106,2021
    +96   OCT     3407,1562,1231,6022,2510,1464,43,2022
   +104   OCT     3140,1167,542,2023
ENDSCR    PZE     *-SCRXXX
LOGXXX    OCT     10,0,6,0,74,74,37,30
     +8   OCT     40,77,41,31,36,24,35,77
    +16   OCT     4000,6025,37,77,40,25,41,30
    +24   OCT     34,25,41,30,32,25,41,30
    +32   OCT     30,25,41,30,26,25,41,30
    +40   OCT     24,25,41,30,22,25,41,30
    +48   OCT     20,25,41,30,12,25,5,31
    +56   OCT     40,30,7,0,11,0,106,0
    +64   OCT     1,0,0,2005,3140,1167,542,2003
    +72   OCT     511,163,2606,6004,1440,2525,1444,2006
    +80   OCT     2620,120,1501,2002,4123,2065,3131,2001
    +88   OCT     4170,4471,1111,5761,1601,204,4022,1770
    +96   OCT     3505,4520,2447,1767,4041,3422,3210,1771
   +104   OCT     4631,3026,1100,2001,406,605,3467,2001
   +112   OCT     2102,1226,4225,2002,3071,4211,3205,2010
   +120   OCT     0,0,0,2021,60,2021,6003,2024
   +128   OCT     6004,2200,4374,70,4312,4312,2023,3600
   +136   OCT     100,4077,6034,6206,2200,6020,4323,2477
   +144   OCT     6105,2200,2020,4330,2077,3200,3546,4077
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  +152  OCT    2177,4077,277,4076,2077,111,277,6013
  +160  OCT    620,5346,2076,111,103,4353,2336,4023
  +168  OCT    2006,70,2076,5360,6506,0
  +174  OCT    0,0,0,0
ENDLOG  PZE    *-LOGXXX
EXPXXX  OCT    10,0,6,0,66,77,100,701
    +8  OCT    45,62,177,601,41,63,61,20
   +16  OCT    62,27,55,77,56,20,53,31
   +24  OCT    62,25,35,77,4000,6025,55,77
   +32  OCT    16,401,12,601,52,23,6,601
   +40  OCT    50,23,2,601,24,31,23,23
   +48  OCT    4000,6030,1,601,4000,6025,4000,6025
   +56  OCT    32,26,21,74,32,22,6,62
   +64  OCT    1,101,25,24,7,0,11,0
   +72  OCT    106,0,21,22,4,75,0,101
   +80  OCT    6,75,3,74,42,74,0,0
   +88  OCT    2200,4376,70,101,40,2023,6013,3704
   +96  OCT    6005,2021,112,3020,6102,2021,103,103
  +104  OCT    5207,2006,70,0,2124,30,442,2121
  +112  OCT    0,0,400,2024,0,0,7400,2057
  +120  OCT    0,0,0,2024,3462,2142,3526,2005
ENDEXP  PZE    *-EXPXXX
SINXXX  OCT    132,1001,550,401,6,0,5,64
    +8  OCT    6,0,101,33,6,0,101,25
   +16  OCT    10,0,105,77,100,27,103,33
   +24  OCT    2,62,1,601,42,60,4,501
   +32  OCT    76,77,1,701,41,60,13,63
   +40  OCT    1,1001,71,77,32,60,7,62
   +48  OCT    1,601,34,60,4,62,1,601
   +56  OCT    4000,6021,61,77,60,22,4000,6025
   +64  OCT    60,77,27,25,30,30,55,25
   +72  OCT    30,30,53,25,30,30,51,25
   +80  OCT    30,30,47,25,30,30,45,25
   +88  OCT    30,30,43,25,30,30,37,25
   +96  OCT    7,0,11,0,106,0,1,101
  +104  OCT    4,75,1,201,6,75,0,1760
  +112  OCT    420,65,3210,5566,4442,562,3222,1625
  +120  OCT    1065,4103,2630,5663,4110,2021,3004,1721
  +128  OCT    465,3524,3201,5744,3044,1142,4551,1767
  +136  OCT    4565,3100,2131,6006,1447,3626,2560,2021
  +144  OCT    2061,2511,2621,2001,7760,7777,7777,6237
  +152  OCT    0,0,0,1760,0,0,0,1760
  +160  OCT    0,0,0,1760
ENDSIN  PZE    *-SINXXX
ATANXX  OCT    10,0,6,0,43,74,1,301
    +8  OCT    62,77,55,31,11,63,61,77
   +16  OCT    56,22,51,25,1,601,55,23
   +24  OCT    52,77,47,22,2,64,0,101
   +32  OCT    72,77,45,22,4000,6025,45,77
   +40  OCT    46,30,47,23,50,30,41,30
   +48  OCT    50,23,51,30,36,30,51,23
   +56  OCT    52,30,31,25,54,30,51,33
   +64  OCT    20,74,7,0,11,0,106,0
   +72  OCT    51,33,40,2024,4223,400,4024,2023
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    +80   OCT    3600,101,6307,2313,4326,2314,4327,2006
    +88   OCT    70,5402,400,4334,400,4337,6607,0
    +96   OCT    40,2302,4024,6614,3044,465,502,2004
   +104   OCT    4027,4620,4446,2003,421,421,421,2001
   +112   OCT    4401,2547,1064,1761,2600,3531,1470,2021
   +120   OCT    1571,4071,2405,6001,2044,1220,3430,2022
   +128   OCT    3511,1425,4450,6023,2470,1050,2006,2025
   +136   OCT    140,4120,423,2023,2544,440,23,2002
   +144   OCT    1447,3626,2560,2021,3174,52,3326,52
ENDATN  PZE    *-ATANXX
CREGIN  BSS    1400,0
SCRIBE  IOCD   OREGIN,,1365
        RETURN  SCANIT
     +1 TRA    SCANIT+1
UNDEF   BCI    9,          IS AN UNDEFINED SYMBOL. IT WILL BE EQUATED TO
    +9  BCI    3, ZERO.
   +12  BCI    8,    **********************************
NEWTEM  BSS    5,H
NOCODE  BCI    9,          IS AN ILLEGAL OPCODE. A NOP HAS BEEN USED.
    +9  BCI    3,
   +12  BCI    8,    **********************************
XXX     BCI    1,XXXXXX
D19     DEC       19
RITEOP  BCI    1,
RITEKY  PZE    0
ACCODE  BCI    1,$
AFIELD  BCI    1,
DATA    BSS    15,C
DIGIT   BSS    10,C
MANSGN  PZE
EXPONT  PZE
EXP0    OCT    100
EXPSGN  PZE
ISPOS   BCI    1,00000+
ISNEG   BCI    1,00000-
ISE     BCI    1,00000E
ISBLNK  BCI    1,00000
ISTNZ   PZE                          ZERO= FIRST NON ZERO COLUMN NOT MET
MANSET  PZE                          ZERO = MANTISSA SIGN NOT SET
EPART   PZE                          ZERO = NO E PART
DECCLM  PZE
NZCOLM  PZE
TEN     DEC       10
ECCLMN  PZE
ISDCPT  BCI    1,00000.
DPTIND  PZE                          ZERO = NO DEC PT FOUND
D17     DEC       17
EEXP    DEC       0                 E PART OF EXPONENT
BADDEC  BCI    9, THE FOLLOWING DEC CARD VIOLATES THE RULES FOR DATA IN
    +9  BCI    9,PUT... A ZERO HAS BEEN STORED.
   +18  BCI    2,
MCHLCC  PZE    0
NAME    BCI    9, THIS IS A 7090 TRANSFORMATION OF A SICOM PROGRAM WRIT
    +9  BCI    9,TEN FOR THE 160-A COMPUTER BY SOMEONE WHO CHOOSES TO
```

```
   +18  BCI    2,BE UNKNOWN.
HEAD1   BSS    20,0
HEAD2   BCI    9,  MLOC  SILOC K OP ADDR    SYMBOL OPCODE  VARIABLE FIE
    +9  BCI    9,LD              COMMENTARY                        PAGE
PAGE    BCI    2,
NAMER   BCI    1,NAME
PAGENO  PZE
CASE1   CLA    22
    +1  SUB    ONE
    +2  STA    SWTCN+1
        CHEAD   CASE1,,1,55,1
    +3  STL    22
        OREADY
    +8  STL    22
        OBCW    HEAD1,,1,20
   +10  STL    22
        OSCRIB  OUTAPE,,20,1
   +14  STL    22
        OREADY
   +18  STL    22
   +20  CLA    PAGENO
   +21  ADD    ONE
   +22  STO    PAGENO
        OBCW    HEAD2,,1,20
   +23  STL    22
        OINT    PAGENO,,109,2
   +27  STL    22
        OSCRIB  OUTAPE,,20,1
   +31  STL    22
        OREADY
   +35  STL    22
        OBLANK  120,,1
   +37  STL    22
        OSCRIB  OUTAPE,,20,1
   +40  STL    22
SWTON   SWT    3
    +1  TRA    **0
    +2  WPDA
    +3  SPRA   1
        OREADY
    +4  STL    22
        OBCW    HEAD1,,1,20
    +6  STL    22
        OSCRIB  PRINTR,,20
   +10  STL    22
        OREADY
   +14  STL    22
        OBCW    HEAD2,,1,20
   +16  STL    22
        OINT    PAGENO,,109,2
   +20  STL    22
        OSCRIB  PRINTR,,20
   +24  STL    22
        OREADY
```

```
    +28   STL     22
          OBLANK  120,,1
    +30   STL     22
          OSCRIB  PRINTR,,20
    +33   STL     22
    +37   TRA*    SWTON+1
SICLOC    DEC       0
TGMASK    PZE     ,7
ITAG      PZE     ,1
D1999     DEC       1999
D2000     DEC       2000
SIADDR    DEC       0
K         PZE                          NORMAL SICOM COMMAND = 7 CHARACTERS
C         PZE
P         PZE
A         PZE
D1        PZE
D2        PZE
R         PZE
ZERO      DEC       0
DECMAL    DEC       1000,100,10
OCTGND    OCT     10000
BLANK     BCI     1,
ATE       DEC       12
OVRAGE    PZE
BIND      OCT     4000
NINE      DEC       9
AD        DEC
ACNUM     DEC       4096
ACLIST    BCI     1,$00000
KOP       PZE
RETURN    PZE
ABLNK     BCI     1,00000
CARD      OCT     1321                 CARD READER
PRINTR    OCT     1361                 PRINTER
INUNIT    PZE                          CARD OR TAPE
OUTAPE    DEC       647
INTAPE    DEC       648
MEDTAP    DEC       1159               B7 FOR COPY CARD INPUT
EQU       BCI     1,EQU
10THOU    DEC       10000
CNOFF     PZE                          ZERO = ON LINE CARD INPUT
INPUT     BSS     56,H
OUTPUT    BSS     56,H
WORK      BSS     14,H
TEMP      BSS     5,H
STAR      BCI     1,*00000
ORIGIN    BCI     1,ORG
DECDAT    BCI     1,DEC
END       BCI     1,END
CODE      PZE
ICNTR     PZE
TWO       PZE     2
DYNAMC    PZE
```

```
ONE     PZE     1
SYMCNT  PZE
        VFD     012/12,24/0
LEADER
ENABLE  OCT     2000
OCTAL   BCI     1,OCT
NUMBER  PZE
SIMAP   BSS     4096,0
WHRMAP  HTR     SIMAP
WHRDAT  HTR     DATA
REFADD  PZE     0,4
RIMAP   DEC       18            READ IN PROGRAM
    +1  OCT     0
    +2  DEC       21            READ TAE 0
    +3  OCT     100
    +4  DEC       4
    +5  OCT     64
GO2     DEC       0
    +1  OCT     64
    +2  DEC       19
    +3  DEC       0
    +4  DEC       1
    +5  OCT     64
BSS     BCI     1,BSS
OPCODE  BCI     1,SIB
    +1  BCI     1,SID
    +2  BCI     1,SIL
    +3  BCI     1,DIB
    +4  BCI     1,IIB
    +5  BCI     1,SJB
    +6  BCI     1,SJD
    +7  BCI     1,SJL
    +8  BCI     1,DJB
    +9  BCI     1,IJB
   +10  BCI     1,CADM
   +11  BCI     1,CLS
   +12  BCI     1,CLA
   +13  BCI     1,IDVP
   +14  BCI     1,DVP
   +15  BCI     1,MPY
   +16  BCI     1,EXCH
   +17  BCI     1,EXTR
   +18  BCI     1,ADD
   +19  BCI     1,SUB
   +20  BCI     1,ADM
   +21  BCI     1,ISUB
   +22  BCI     1,RAD
   +23  BCI     1,CAS
   +24  BCI     1,OFLTB
   +25  BCI     1,OFLCR
   +26  BCI     1,OFXTB
   +27  BCI     1,OFXCR
   +28  BCI     1,OFORM
   +29  BCI     1,OCRTB
```

```
+30  BCI     1,OTBNO
+31  BCI     1,OCMND
+32  BCI     1,WRFILE
+33  BCI     1,SRFILE
+34  BCI     1,GRPIN
+35  BCI     1,SNGIN
+36  BCI     1,IOCTAL
+37  BCI     1,OALPHA
+38  BCI     1,LDANR
+39  BCI     1,CMPANR
+40  BCI     1,MRGANR
+41  BCI     1,EXTANR
+42  BCI     1,TZE
+43  BCI     1,TNZ
+44  BCI     1,TPL
+45  BCI     1,TMI
+46  BCI     1,TSM4
+47  BCI     1,TSM5
+48  BCI     1,TSM6
+49  BCI     1,TNR7
+50  BCI     1,TSR
+51  BCI     1,TSJ1
+52  BCI     1,TSJ2
+53  BCI     1,TSJ3
+54  BCI     1,CALL
+55  BCI     1,TBR
+56  BCI     1,STOANR
+57  BCI     1,STO
+58  BCI     1,NOP
+59  BCI     1,STOP1
+60  BCI     1,STOP2
+61  BCI     1,HALT3
+62  BCI     1,HALT4
+63  BCI     1,HPRIN
+64  BCI     1,REL
+65  BCI     1,ABS
+66  BCI     1,FAST
+67  BCI     1,TRACE
+68  BCI     1,ZEROIR
+69  BCI     1,IFLEX
+70  BCI     1,OFLEX
+71  BCI     1,ITYPE
+72  BCI     1,OTYPE
+73  BCI     1,OPRINT
+74  BCI     1,SELBCD
+75  BCI     1,SELBIN
+76  BCI     1,BSR
+77  BCI     1,REW
+78  BCI     1,OTAPE
+79  BCI     1,ITAPE
+80  BCI     1,BLCPY
+81  BCI     1,BLCLR
+82  BCI     1,OOCTAL
+83  BCI     1,OSPEC
```

```
    +84   BCI     1,ISPEC
    +85   BCI     1,RZE
    +86   BCI     1,RNZ
    +87   BCI     1,RPL
    +88   BCI     1,RMI
    +89   BCI     1,RSM4
    +90   BCI     1,RSM5
    +91   BCI     1,RSM6
    +92   BCI     1,RNR7
    +93   BCI     1,RSR
    +94   BCI     1,RSJ1
    +95   BCI     1,RSJ2
    +96   BCI     1,RSJ3
    +97   BCI     1,OLOC
    +98   BCI     1,PUSTOP
    +99   BCI     1,CLAC
   +100   BCI     1,CLSC
   +101   BCI     1,IDVPC
   +102   BCI     1,DVPC
   +103   BCI     1,ADDC
   +104   BCI     1,SUBC
   +105   BCI     1,ISUBC
   +106   BCI     1,SHIFT
   +107   BCI     1,XEQ
   +108   BCI     1,SETFWA
   +109   BCI     1,SETLWA
   +110   BCI     1,MPYC
   +111   BCI     1,PXAIB
   +112   BCI     1,PXAID
   +113   BCI     1,PXAIL
   +114   BCI     1,PXAJB
   +115   BCI     1,PXAJD
   +116   BCI     1,PXAJL
   +117   BCI     1,PAXIB
   +118   BCI     1,PAXID
   +119   BCI     1,PAXIL
   +120   BCI     1,PAXJB
   +121   BCI     1,PAXJD
   +122   BCI     1,PAXJL
ENDOP    PZE
OPKEY    BCI     1,002000          THIS IS SIB IST OF TYPE 1 INSTRUCTIONS
SID      BCI     1,003000
SIL      BCI     1,004000
DIB      BCI     1,005000
IIB      BCI     1,006000
SJB      BCI     1,012000
SJD      BCI     1,013000
SJL      BCI     1,014000
DJB      BCI     1,015000
IJB      BCI     1,016000
CADM     BCI     1,020000
CLS      BCI     1,021000
CLA      BCI     1,022000
IDVP     BCI     1,023000
```

```
DVP       BCI     1,024000
MPY       BCI     1,025000
EXCH      BCI     1,026000
EXTR      BCI     1,027000
ADD       BCI     1,030000
SUB       BCI     1,031000
ADM       BCI     1,032000
ISUB      BCI     1,033000
RAD       BCI     1,034000
CAS       BCI     1,035000
OFLTB     BCI     1,036000
OFLCR     BCI     1,037000
OFXTB     BCI     1,040000
OFXCR     BCI     1,041000
OFORM     BCI     1,042000
OCRTB     BCI     1,043000
OTBNO     BCI     1,044000
OCMND     BCI     1,045000
WFNMT     BCI     1,046000
SFNMT     BCI     1,047000
GRPIN     BCI     1,050000
SNGIN     BCI     1,051000
ROCTT     BCI     1,052000
ALNUO     BCI     1,053000
CLAANR    BCI     1,054000
CMPANR    BCI     1,055000
MRGANR    BCI     1,056000
EXTANR    BCI     1,057000
TZE       BCI     1,060000
TNZ       BCI     1,061000
TPL       BCI     1,062000
TMI       BCI     1,063000
TSM4      BCI     1,064000
TSM5      BCI     1,065000
TSM6      BCI     1,066000
TSM7      BCI     1,067000
TSR       BCI     1,070000
TSW1      BCI     1,071000
TSW2      BCI     1,072000
TSW3      BCI     1,073000
TML       BCI     1,074000
TBR       BCI     1,075000
STOANR    BCI     1,076000
STO       BCI     1,077000          END OF TYPE 0 INSTRUCTIONS
NOP       BCI     1,000001          TYPE 1 INSTR OP CODE =DR
HLTSW1    BCI     1,001001
HLTSW2    BCI     1,002001
HALT3     BCI     1,003001
HALT4     BCI     1,004001
HLTGIN    BCI     1,005001
SELREL    BCI     1,006001
SELABS    BCI     1,007001
SELNTR    BCI     1,008001
RESTR     BCI     1,009001
```

```
CLIR     BCI     1,010001
RDFLW    BCI     1,011001
WRFLW    BCI     1,012001
RDTPW    BCI     1,013001
WRTPW    BCI     1,014001
WRPRN    BCI     1,016001
SELTTP   BCI     1,017001
SELMTD   BCI     1,018002          TYPE 2 INSTR
BSR      BCI     1,019004
REW      BCI     1,019001
WRMT2    BCI     1,020003
RDMT2    BCI     1,021003
BLCPY    BCI     1,024003
BLCLR    BCI     1,025003
POT      BCI     1,027003
PST      BCI     1,028003
RDST     BCI     1,029001
RZERO    BCI     1,060001
RNZERO   BCI     1,061001
RPOS     BCI     1,062001
RNEG     BCI     1,063001
RMK4     BCI     1,064001
RMK5     BCI     1,065001
RMK6     BCI     1,066001
RMK7     BCI     1,067001
RSR      BCI     1,070001
RSW1     BCI     1,071001
RSW2     BCI     1,072001
RSW3     BCI     1,073001
CLCC     BCI     1,075001
PUSTOP   BCI     1,079001
CLAC     BCI     1,101006          TYPE 6
CLSC     BCI     1,201006
IDVPC    BCI     1,301006
DVPC     BCI     1,401006
ADDC     BCI     1,601006
SUBC     BCI     1,701006
ISUBC    BCI     1,801006
SHFTAC   BCI     1,901006
    +1   BCI     1,X01006
SETTRC   BCI     1,Y01006
STPTRC   BCI     1,Z01006
MPYC     BCI     1,501006
PXIBA    BCI     1,022005
PXIDA    BCI     1,032005
PXILA    BCI     1,042005
PXJBA    BCI     1,122005
PXJDA    BCI     1,132005
PXJLA    BCI     1,142005
ATXIB    BCI     1,023005
ATXID    BCI     1,033005
ATXIL    BCI     1,043005
ATXJB    BCI     1,123005
ATXJD    BCI     1,133005
```

```
ATXJL    BCI     1,143005
ENDKEY   PZE     1
SYMTAB   BSS     1000,H
LOCTAB   BSS     1000,C
         CRC     32256
         CORE     START,-1
DUMP     STL     2169
         CORE     43,43
     +4  STL     2169
         CORE     22,22
     +8  STL     2169
    +12  TRA     110
         END     START
```

ENDCRD	0014	LOCSIC	0012	RITOUT	0023	1TYPE	0024
ENDEXP	0038	LOCTAB	0047	RNZERO	*0046	2BITS	0023
ENDKEY	0047	LOGFOR	0028	SCANIT	0020	2TYPE	0024
ENDLOG	0038	LOGXXX	0037	SCRIBE	0039	3TYPE	0024
ENDSIN	0038	LOOKAT	0016	SELABS	*0045	4TYPE	0025
ENDSQR	0037	LSTINS	0031	SELMTD	*0046	5TYPE	0025
EQUCRD	0013	LSTKEY	0037	SELNTR	*0045	8IND	0041
EQUSYM	0028	MANSET	*0039	SELREL	*0045	A	0041
EVENUP	0022	MANSGN	0039	SELTTP	*0046	ABLNK	0041
EXPFOR	0028	MARKIT	0020	SETOFF	0001	ACNUM	0041
EXPONT	0039	MASKER	0028	SETTRC	*0046	AD	0041
EXPSGN	*0039	MCHLOC	*0039	SHFTAC	*0046	ADD	*0045
EXPXXX	0038	MEDTAP	0041	SIADDR	0041	ADDC	*0046
EXTANR	*0045	MINSTR	0028	SICLOC	*0041	ADDIT	0020
EXTMSK	0028	MORCLM	0021	SINFOR	0028	ADM	*0045
FNDADD	0017	MOVEON	0018	SINXXX	0038	AFORK	0007
FNDBNK	0017	MRGANR	*0045	SQRFOR	0027	AGN	0003
FNDCOM	0017	NEWTEM	0039	SQRXXX	0037	ALNUO	*0045
FNDSYM	0015	NOCODE	0039	STABLE	0007	ALS3	0015
FORART	0026	NONOCT	0019	STOANR	*0045	ASIF0	0008
FORATN	0027	NORMAL	0015	STOCMD	0015	ATE	0041
FOREXP	0027	NUMBER	0042	STODIG	0021	ATXIB	*0046
FORLOG	0027	NXTONE	0011	STOFOR	0024	ATXID	*0046
FORMAP	0028	NZCOLM	0039	STOKOP	0011	ATXIL	*0046
FORMCH	0014	OBLANK	0013	STOREV	0015	ATXJB	*0046
FOROUT	0028	OCTCRD	0026	STOROD	0015	ATXJD	*0046
FORSIN	0027	OCTGND	0041	STPTRC	*0046	ATXJL	*0047
FORSQR	0026	OKTODR	0012	STUPID	0016	BBB1	0027
FOUNDX	0016	OPCODE	0042	STZTEM	0024	BBB2	0027
GETOUT	0021	OREDUN	*0012	SYMBOL	0014	BBB3	0027
GOAHED	0008	OREGIN	0039	SYMCNT	0042	BBB4	0027
GOBACK	0028	ORGCRD	0013	SYMTAB	0047	BBB5	0027
GOLOCK	0007	ORIGIN	0041	TGMASK	0041	BLANK	0041
HLTGIN	*0045	OTPEND	0012	UNPACK	0020	BLCLR	*0046
HLTSW1	*0045	OUTAPE	0041	VARFRM	0016	BLCPY	*0046
HLTSW2	*0045	OUTATR	0012	WHRDAT	0042	BSR	*0046
ILEGAL	0022	OUTCOD	0025	WHRMAP	0042	BSS	0042
IMAGE1	0005	OUTPUT	0041	WRLIST	0012	BTYPE	0029
IMAGE2	*0005	OVRAGE	0041	YESADD	0018	CADM	*0044
INDEXR	0020	PAGENO	0040	YESDPT	0021	CARD	0041
INTAPE	0041	PICKUP	0023	YESNEG	0021	CAS	*0045
INUNIT	0041	PRINTR	0041	YESPOS	0021	CASE1	0040
IREDLN	*0012	PRCTAG	0019	YESSYM	0008	CLA	*0044
ISALPH	0019	PUSTOP	*0046	YISOCT	0006	CLAC	*0046
ISBACK	0025	RANGER	0028	YSCOMA	0019	CLAM7	0024
ISBLNK	0039	REBACK	0008	ZETADD	*0017	CLAZ	0011
ISDCPT	0039	REFADD	0042	0TYPE	0023	CLIR	*0046
LEADER	*0042	RETURN	0041	160A	0028	CLS	*0044
LITEIT	0003	RITEKY	0039	1STNZ	0039	CLSC	*0046
LOCMCH	0012	RITEOP	0039	1TAG	0041	CODE	0041

HALT4	*0045	MYOWN	0020	RDTPW	*0046	TEMP	0041
HARD1	0019	NAME	0039	READ1	0001	TEN	0039
HEAD1	0040	NAMER	0040	READ2	0001	TESTE	0021
HEAD2	0040	NILLY	0024	RESTR	*0045	THANX	0007
ICNTR	0041	NINE	0041	REVRS	0013	THREE	*0028
IDVP	*0044	NCEND	*0012	REW	*0046	TILLY	0025
IDVPC	*0046	NCP	*0045	REWB	0023	TMI	*0045
IFDEC	0018	NOPE	0008	RIMAP	0042	TMIS	0025
IFOCT	0019	NCT8	0011	RMK4	*0046	TML	*0045
IIB	*0044	NCTAC	0015	RMK5	*0046	TNZ	*0045
IJB	*0044	NCTK	0010	RMK6	*0046	TPL	*0045
IMODE	0028	NCWGO	0005	RMK7	*0046	TRYIT	0019
INPUT	0041	NCWIN	0001	RNEG	*0046	TSM4	*0045
INSTR	0026	O	0041	ROCTT	*0045	TSM5	*0045
INTPL	0018	OCMND	*0045	ROTAT	0018	TSM6	*0045
ISAC	0016	OCRTB	*0045	RPOS	*0046	TSM7	*0045
ISBSS	0003	OCT12	0015	RSR	*0046	TSR	*0045
ISCOM	0020	OCTAL	0042	RSW1	*0046	TSW1	*0045
ISDEC	0004	OFLCR	*0045	RSW2	*0046	TSW2	*0045
ISE	0039	OFLTB	*0045	RSW3	*0046	TSW3	*0045
ISEND	0004	OFORM	*0045	RZERO	*0046	TSXS	0008
ISNEG	0039	OFXCR	*0045	SATN	0028	TWO	0041
ISOP	0003	OFXTB	*0045	SEEIF	0011	TYPE0	0007
ISORG	0004	OLOC	*0046	SEXP	0028	TYPE1	0008
ISPOS	0039	ONE	0042	SFNMT	*0045	TYPE2	0009
ISREV	0025	ONOFF	0041	SHFTR	0018	TYPE3	0009
ISSYM	0003	OORNG	0026	SICOM	0028	TYPE4	0009
ISTAG	0019	OPKEY	*0044	SID	*0044	TYPE5	0010
ISUB	*0045	OTBNO	*0045	SIL	*0044	TYPE6	0010
ISUBC	*0046	P	0041	SILLY	0024	TZE	*0045
JDD	0025	PAGE	*0040	SIMAP	0042	UNDEF	0039
K	0041	PCT	*0046	SIXX	0020	WFNMT	*0045
KOP	*0041	PST	*0046	SJB	*0044	WIPE	0011
LDQA	0010	PXIBA	*0046	SJD	*0044	WORK	0041
LOG1	0017	PXIDA	*0046	SJL	*0044	WRFLW	*0046
LOG2	0017	PXILA	*0046	SKIP	*0002	WRMT2	*0046
LOG3	0017	PXJBA	*0046	SLOG	0028	WRPRN	*0046
LOOKC	0020	PXJDA	*0046	SNGIN	*0045	WRTPW	*0046
LOOP	0010	PXJLA	*0046	SSIN	0028	XXX	*0039
M7	0028	QDECM	0023	SSQR	0028	YESE	0021
M77	0028	QQDEC	0024	STAR	0041	Z1	0006
M7777	0028	R	0041	START	0001	Z2	0006
MAPIT	0026	RAD	*0045	STO	*0045	Z3	0006
MCODE	*0031	RAVEL	0017	SUB	*0045	Z4	0006
MODE	0028	RDFLW	*0046	SUBC	*0046	Z5	0006
MPY	*0045	RDMT2	*0046	SWTON	0040	ZERO	0041
MPYC	*0046	RDST	*0046	TBR	*0045		

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Group 315

W. Danforth
M. Devane
L. Ricardi

Group 41

N. Doucett
J. Fielding

Group 42

J. Cogdell
J. Dinsmore

Group 46

C. Freed
C. Muehe

Group 47

C. Berger
S. Catalano
H. Jones
R. Wishner

Group 48

C. Guay

Group 51

P. Fergus
J. Frankovich
J. Heart
S. Ornstein

Group 52

G. Blustein
S. Larkin
F. Nagy
M. Wendell

Group 55

F. Slagle
J. Slagle

Group 58

E. Freed
M. Goodman
L. Klem
C. McElwain
R. Mitchell
G. Mueser
J. Smith
M. Smith
A. Stowe
F. Trask
B. White
D. Yntema

Group 71

E. Boyce
W. Fanning
C. Pappas
D. Regillo
F. Wan

Group 75

D. Moore
P. Stetson

Group 81

M. Durgin
V. Mason
N. Rawson
S. Sillers
C. Work

Group 84

M. Dresselhaus
W. Mason

Group 22 Central Depository

J. FitzGerald

AFSSD

Col. L. S. Normar
Capt. J. Kieper (1)

Lockheed

H. Batten (5)

Philco WDL

F. Harris (5)

CDC

P. O. Cioffi (10)
A. Wilkonson (10)