The 141 Data Processing System-An Educational Computer
for Instruction in Basic Programming

13.0.015

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1620
Correction

13.0.015
April 15, 1965

The program decks have been revised and the listings reflecting these changes are attached. These pages replace pages A2 through A27 that are currently in the writeup.

1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter or pencil, do not use ink)

Program No. _____ Date _____

Program Name: _____

1. Does the abstract adequately describe what the program is and what it does? Yes___ No___
   Comment _____

2. Does the program do what the abstract says? Yes___ No___
   Comment _____

3. Is the Description clear, understandable, and adequate? Yes___ No___
   Comment _____

4. Are the Operating Instructions understandable and in sufficient detail? Yes___ No___
   Comment _____
   Are the Sense Switch options adequately described (if applicable)? Yes___ No___
   Are the mnemonic labels identified or sufficiently understandable? Yes___ No___
   Comment _____

5. Does the source program compile satisfactorily (if applicable)? Yes___ No___
   Comment _____

6. Does the object program run satisfactorily? Yes___ No___
   Comment _____

7. Number of test cases run _____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes___ No___
   Comment _____

8. Does the Program Meet the minimal standards of the 1620 Users Group? Yes___ No___
   Comment _____

9. Were all necessary parts of the program received? Yes___ No___
   Comment _____

10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

Mr. Richard L. Pratt
Data Corporation
7500 Old Xenia Pike
Dayton, Ohio 45432

Your Name _____

Company _____

Address _____

User Group Code _____

THIS REVIEW FORM IS PART OF THE 1620 USER GROUP ORGANIZATION'S PROGRAM REVIEW AND EVALUATION PROCEDURE. NONMEMBERS ARE CORDIALLY INVITED TO PARTICIPATE IN THIS EVALUATION.

11/09/64

- THE 141 DATA PROCESSING SYSTEM -

AN EDUCATIONAL COMPUTER FOR INSTRUCTION IN BASIC PROGRAMMING

By

Kenneth P. Swallow
College of San Mateo

and

Richard E. Gentry

Submitted by

College of San Mateo
1700 West Hillsdale Blvd.
San Mateo, California
Telephone: 341 - 6161

Users Group # 5194 November 12, 1964

Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for IBM Data Processing Systems. When such an announcement occurs, users should order a complete new program from the Program Information Department.

1620 USERS GROUP LIBRARY

PROGRAM ABSTRACT

1. TITLE: The 141 Data Processing System - An Educational Computer for Instruction in Basic Programming.
   SUBJECT CLASSIFICATION: 13.0.

2. AUTHOR; ORGANIZATION: Kenneth P. Swallow, College of San Mateo and Richard E. Gentry,
   USERS GROUP MEMBERSHIP CODE: 5194

3. DIRECT INQUIRIES TO: Kenneth P. Swallow, College of San Mateo, 1700 West Hillsdale Blvd., San Mateo, California.
   Phone: 341 - 6161

4. DESCRIPTION/PURPOSE: The 141 Data Processing System is an educational tool for teaching basic computer concepts through a 1401 type machine language and 1401 SPS. The 141 Simulator set of basic 1401 instructions includes: SW, CW, R, P, W, MCW, LCA, CS, B, C, A, S, H, and NOP. This set is sufficient to illustrate such concepts as: (1) reading, punching, and printing, (2) looping for iterative processes, (3) sequence checking, (4) counted loops, (5) program switches, (6) load routines, (7) address modification, (8) subroutines and subroutine linkages, etc. Basic utility routines are incorporated in the 141 Simulator for easy debugging of 141 programs. 141 written subroutines are provided for multiplication, division, zero suppression, and editing.
   The 141 SPS Assembler processes the 141 set of instructions and all 1401 pseudo operations including: DCW, DC, DS, DSA, ORG, EX, and END.

7. SPECIFICATIONS:
   a. STORAGE USED BY PROGRAM: 20,000 positions of storage.
   b. EQUIPMENT REQUIRED BY PROGRAM:
      Version A - Basic 1620 card system
      Version B - 1620, 1622, and 1443
      Version C - 1620, 1622, 1311, and indirect addressing
      Version D - 1620, 1622, 1443, 1311, and indirect addressing
   c. PROGRAMMING TYPE:
      Versions A and B - SPS - 1620/1710
      Versions C and D - SPS II-D

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141SPS - B, 141SIM - B } 13.0.016 — B1, B14

141SPS - C, 141SIM - C } 13.0.017 — C1, C14

141SPS - D, 141SIM - D } 13.0.018 — D1, D13

DECK LABELING

Card Number - Columns 77 - 80

Version A - Basic 1620 -13.0.015

141 SPS Assembler	1001 - 1154
141 Simulator	2001 - 2201

Version B - 1620 with 1443 Printer - 13.0.016

141 SPS Assembler	3001 - 3151
141 Simulator	4001 - 4195

Version C - 1620 with 1311 Disk Storage Drive and Indirect Addressing -13.0.017

141 SPS Assembler	5001 - 5109
141 Simulator	6001 - 6144

Version D - 1620 with 1443 Printer, 1311 Disk Storage Drive, and Indirect Addressing -13.0.018

141 SPS Assembler	7001 - 7108
141 Simulator	8001 - 8139

The program decks for Versions C and D are in 1620 Monitor System Output Format. They can be loaded onto the disk by means of the Disk Utility Program using an *DLOAD card with the program name, 141SPS or 141SIM, in columns 7 - 12 and 02402CM in columns 44 - 50.

PROGRAM WRITEUP

AND

STUDENT MANUAL

FOR

- THE 141 DATA PROCESSING SYSTEM -

AN EDUCATIONAL COMPUTER FOR

INSTRUCTION IN BASIC PROGRAMMING

VI

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THE 141 DATA PROCESSING SYSTEM

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Section 2	-	141 Symbolic Programming System
Section 3	-	Exercises
Section 4	-	Subroutines
Section 5	-	Operating Procedures

SECTION 1

THE 141 DATA PROCESSING MACHINE

INTRODUCTION

A basic course in the use of computers for data processing can serve many purposes, such as: introducing the terminology that is peculiar to the industry, describing the elements that are common to all computer systems, enumerating the application areas in data processing, exploring the coding systems used with computers, and many others. But undoubtedly the greatest service that a basic computer course can give to the beginner is to provide a firm, even if limited, foundation in stored programming concepts. The degree to which a beginning programmer grasps these basic principles will, to a large extent, determine his success in future programming classes.

The choice of the computer, the programming language, and the exercises to be used in the basic course is an important factor in the ease with which stored program concepts can be imparted to the student. The 141 was designed solely as a vehicle for teaching these initial concepts.

The 141 has sufficient instructions to allow the coding of a wide range of programming problems, but at the same time the instruction set is small enough that the primary effort of the student is directed toward the understanding of programming concepts and not the memorization of a large number of operational rules. The 141 set of fourteen instructions will permit field definition, data movement, input/output operations, comparing, arithmetic operations, and branching. Simple exercises in 141 programming can illustrate such concepts as (1) reading, punching and printing, (2) looping for iterative processes, (3) sequence checking, (4) counted loops, (5) address modification, (6) program switches, (7) subroutine linkages, etc.

If coding a program builds confidence in the new programmer, seeing his program run and seeing it printed as it is represented in core storage can only strengthen that confidence and cement further the whole concept of stored programming in his mind. Any 141 program can be run on an IBM 1401, 1460, or 1410 Data Processing System. It can also be run on an IBM 1620 Data Processing System through the use of a special simulator program.

In addition to the concept of stored programming, a basic computer course should also include the introduction to a symbolic assembly

language. 141 programs can be written in IBM 1401 SPS (Symbolic Programming System) and assembled on a 1401. If instead an IBM 1620 is available, programs written for the 141 in SPS can be assembled on the 1620.

DESCRIPTION

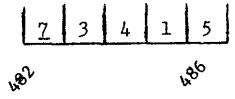
The 141 Data Processing System is an abbreviated version of the IBM 1401 Data Processing System. It is an internally stored program machine with the following features:

1. Input: IBM Card Reader.
2. Output: IBM Card Punch and 100 character per line Printer.
3. Storage: 1000 positions of core storage with three digit numerical addresses.
4. Instuction length and date length: Variable.

Each position is designated by a three digit address in the range of 000 through 999 and is capable of storing one character: a letter of the alphabet, a numeric digit or a special character such as . , / + or ⊔ . A group of consecutive storage positions make up a field. Both data and instruction fields are variable in length so that no storage space need be wasted with meaningless blanks or zeros.

DATA

If a field is used for data it is referred to by the address of its low order, or right most, position. A special indicator called a word mark is placed in the high order, or left most, position to indicate the length of the field. The machine processes data fields from right to left starting at the addressed low order position and continuing until a character with a word mark is met. For example, a five-digit data field in storage locations 482 through 486 would have a word mark (indicated by an underline) in position 482 and would be addressed by 486. Notice that the low order position has the highest address.



INSTRUCTIONS

When a field contains an instruction it is addressed by the high order, or left most, position of the field. This position contains the operation code character and a word mark. In addition to the operation code an instruction may also contain one or two three-digit addresses and/or a modifying character. An instruction may therefore contain one, four, five, seven, or eight characters. The machine reads instructions from left to right starting with the addressed high order position and continuing until it meets the word mark in the high order position of the next instruction.

CHARACTER CODING

Each position of storage is made up of eight magnetic cores, each of which can hold one "yes-or-no" bit. Four bits are needed to represent the digit portion of the Hollerith code of the characters; two more bits are needed to represent the zone portion of the Hollerith code of the characters; another bit is used to indicate the presence or absence of a word mark; and the eighth bit is used for checking.

The digit portion is coded in the Binary Code Decimal (BCD) system in which the four bits have the values of 8, 4, 2, and 1 respectively. The sum of the "yes" bits is equal to the value of the digit. Notice that the digit 0 is represented by the 8 bit and the 2 bit rather than no bits at all.

Digit	BCD Code			
	8	4	2	1
1				X
2			X	
3			X	X
4		X		
5		X		X
6		X	X	
7		X	X	X
8	X			
9	X			X
0	X		X	

In representing alphabetic and special characters the zone is represented by the A and the B bits as follows:

Zone		B	A
12	(A - I)	X	X
11	(J - R)	X	
0	(S - Z)		X
no	(0 - 9)		

The C bit is used for parity checking and is chosen so that the character will always contain an odd number of "yes" bits. For example, the letter "F" which is represented by the 12 and 6 punches on an IBM card is represented in the seven-bit alphameric code as:

Character	Card Code	Seven-bit Alphameric Code C	B	A	8	4	2	1
F	12-6	X	X	X		X	X	

Table 1 gives the seven-bit alphameric code for each Hollerith character used with the 141 Data Processing Machine.

TABLE 1

Character	Card Code	Seven-bit Alphameric Code *C	B	A	8	4	2	1
Blank	Blank	X						
.	12 - 3 - 8		X	X	X		X	X
¤	12 - 4 - 8	X	X	X	X	X		
&	12	X	X	X				
-	11		X					
/	0 - 1	X		X				X
,	0 - 3 - 8	X		X	X		X	X
A	12 - 1		X	X				X
B	12 - 2		X	X			X	
C	12 - 3	X	X	X			X	X
D	12 - 4		X	X		X		
E	12 - 5	X	X	X		X		X
F	12 - 6	X	X	X		X	X	
G	12 - 7		X	X		X	X	X
H	12 - 8		X	X	X			
I	12 - 9	X	X	X	X			X
J	11 - 1	X	X					X
K	11 - 2	X	X				X	
L	11 - 3		X				X	X
M	11 - 4	X	X			X		
N	11 - 5		X			X		X
O	11 - 6		X			X	X	
P	11 - 7	X	X			X	X	X
Q	11 - 8	X	X		X			
R	11 - 9		X		X			X
S	0 - 2	X		X			X	
T	0 - 3			X			X	X
U	0 - 4	X		X		X		
V	0 - 5			X		X		X
W	0 - 6			X		X	X	
X	0 - 7	X		X		X	X	X
Y	0 - 8	X		X	X			
Z	0 - 9			X	X			X
0	0	X			X		X	
1	1							X
2	2						X	
3	3	X					X	X
4	4					X		
5	5	X				X		X
6	6	X				X	X	
7	7					X	X	X
8	8				X			
9	9	X			X			X

* Check bit to produce odd-parity. Table shows values for positions with no word mark. Reverse if word mark is present.

141 INSTRUCTIONS

(IN ALPHABETIC ORDER OF SPS MNEMONICS)

Add — A

Op-Code	A-address	B-address
A	aaa	bbb

Description The Add instruction causes the data in the A-field to be added algebraically to the data in the B-field. The A-field is not disturbed and the resulting sum is stored in the B-field.

Word Marks The defining word mark of the B-field terminates the operation. If the A-field is shorter than the B-field, the A-field word mark will halt transmission of data from the A-field but any resulting carries will be added to the B-field until the B-field word mark is sensed. If a carry results beyond the B-field word mark, it is lost or if the A-field is longer, the high order positions of the A-field which exceed the limits imposed by the B-field word mark are lost. These both represent overflow conditions.

Add (Single Address) — A

Op-Code	A-address
A	aaa

Description The four position Add instruction causes the A-field to be added to itself with the sum replacing the original A-field.

Word Marks The word mark is not affected.

Branch — B

Op-Code	I-address
B	iii

Description The Branch instruction causes the program to branch to the instruction specified by the I-address.

Branch If Indicator On — B

Op-Code	I-address	d-character
B	iii	d

Description The Branch If Indicator On instruction is a conditional branch. The d-character specifies the indicator to be tested as a criterion for the branch. If the indicator is on, then the program branches to the instruction specified by the I-address. If the indicator is off, the next sequential instruction is executed. The indicators to be tested and their d-character codings are:

Indicator		d-character
Unequal compare	(B ≠ A)	/
Equal compare	(B = A)	S
Low compare	(B < A)	T
High compare	(B > A)	U

Testing of an indicator does not affect its setting.

Branch If Character Equal — B

Op-Code	I-address	B-address	d-character
B	iii	bbb	d

Description The Branch If Character Equal instruction causes the single character at the B-address to be compared to the d-character. If they are identical, the program branches to the instruction specified by the I-address. If they are different, the program proceeds to the next instruction in sequence.

Word Marks Word marks at the B-address are ignored and thus do not affect the comparison.

Compare — C

Op-Code	A-address	B-address
C	aaa	bbb

Description The Compare instruction causes the information in the B-field to be compared with an equal number of characters in the A-field. The bit configuration of each character of the two fields is compared and appropriate indicators are set as described below.

Word Marks The first word mark encountered terminates the operation. If the A-field is longer than the B-field, extra positions beyond the length of the B-field will not be compared.

Indicators If the two fields are identical, character by character, an Equal Compare results and the Equal Indicator is turned on. If the fields are not equal then an Unequal Compare results and the Unequal Indicator is turned on. In addition, the High Indicator is turned on if the B-field is greater than the A-field and the Low indicator if the A-field is greater than the B-field. If the B-field is longer than the A-field, the Unequal and High Indicators are turned on regardless of their contents. All indicators are reset only by another Compare instruction.

Clear Storage — CS

Op-Code	A-address
/	aaa

Description The Clear Storage instruction causes the storage to be cleared to blanks beginning at the location specified by the A-address and continuing downward through the nearest hundreds position.

Word Marks Both word marks and data are cleared by this instruction.

Clear Storage and Branch — CS

Op-Code	I-address	B-address
/	iii	bbb

Description The Clear Storage and Branch instruction causes the storage to be cleared (including word marks) to blanks beginning at the location specified by the B-address and continuing downward through the nearest hundreds position in the same manner as the Clear Storage instruction. Upon completion of the clearing operation the program branches to the instruction specified by the I-address.

Clear Word Mark — CW

Op-Code	A-address	B-address
¤ or)	aaa	
¤ or)	aaa	bbb

Description The Clear Word Mark instruction causes a word mark to be cleared from the location specified by the A-address. If a B-address is also used, word marks will be cleared from the locations specified by each address. If no word mark existed in either location prior to the instruction, there will be no change at that location. Data will not be disturbed.

Halt — H

Op-Code
.

Description The Halt instruction causes the computer to stop. Depressing the start key will cause the program to proceed to the next instruction in sequence.

Halt and Branch — H

Op-Code	I-address
.	iii

Description The Halt and Branch instruction causes the computer to stop. Depressing the start key will cause the computer to proceed to the instruction designated by the I-address.

Load Characters to A Word Mark — LCA

Op-Code	A-address	B-address
L	aaa	bbb

Description The Load Characters to A Word Mark instruction causes the characters and word mark from the A-field to replace the B-field. The A-field remains undisturbed.

Word Marks The A-field must contain a word mark to terminate the transmission of data. All word marks in the B-field are cleared and a word mark is placed in the B-field corresponding to that in the A-field.

Move Characters to A or B Word Mark — MCW

Op-Code	A-address	B-address
M	aaa	bbb

Description The Move Characters to A or B Word Mark instruction causes the field specified by the A-address (A-field) to be moved to corresponding positions of the B-field. The A-field remains undisturbed but the B-field is lost.

Word Marks The first word mark encountered in either field stops the transmission of data. Existing word marks in either field are not disturbed.

No Operation — NOP

Op-Code

N

Description The only purpose of the No Operation instruction is to cause the program to proceed to the next instruction in sequence. The instruction may have the format of any allowable instruction, that is, it may have an A-address, an A-address and a B-address, etc.

Punch a Card — P

Op-Code

4

Description The Punch a Card instruction causes information in storage locations 101 through 180 (PUNCH area) to be punched in columns 1 through 80 respectively of a Hollerith coded card. The machine coding is converted to Hollerith coding prior to punching. The information stored in the PUNCH area is undisturbed. This instruction punches only information from the PUNCH area of storage onto the card.

Word Marks Word marks are not punched, are not affected by the Punch instruction and do not affect punching in any manner.

Punch and Branch — P

Op-Code	I-address
4	iii

Description The Punch and Branch instruction causes the computer to punch the contents of the PUNCH area (in the same manner as the Punch a Card instruction) then branch to the instruction specified by the I-address.

Read a Card — R

Op-Code

1

Description The Read a Card instruction causes the information in columns 1 through 80 of a Hollerith coded card to be read into storage positions 001 through 080 respectively. The Hollerith code from each column is converted to the appropriate computer coding as it is read into the computer. The Read a Card instruction always reads into positions 001 through 080 (the READ area).

Word Marks Word marks which exist in the READ area prior to execution of the instruction are not disturbed nor do they affect the reading of information.

Read and Branch — R

Op-Code	I-address
1	iii

Description The Read and Branch instruction causes the computer to read one Hollerith coded card (in the same manner as the Read a Card instruction) then branch to the instruction specified by the I-address.

Subtract — S

Op-Code	A-address	B-address
S	aaa	bbb

Description The Subtract instruction causes the data in the A-field to be subtracted algebraically from the data in the B-field. The A-field is not disturbed and the resulting difference is stored in the B-field.

Word Marks Word marks control the subtract operation in the same manner as the Add instruction.

Subtract (Single Address) — S

Op-Code	A-address
S	aaa

Description The four position Subtract instruction causes the A-field to be subtracted from itself with zero replacing the original A-field.

Word Marks The word mark is not affected.

Set Word Mark SW

Op-Code	A-address	B-address
2	aaa	
2	aaa	bbb

Description The Set Word Mark instruction causes a word mark to be set at the location specified by the A-address. If a B-address is also used, word marks will be set at the locations specified by each address. Existing word marks are undisturbed. Data at the location (or locations) will not be disturbed.

Write a Line W

Op-Code
2

Description The Write a Line instruction causes the information in storage locations 201 through 300 (the WRITE area) to be printed on the printer (or typewriter). The information will remain in the WRITE area of storage after execution of the instruction. This instruction always prints information from all 100 positions of the WRITE area.

Word Marks Word marks are not printed, are not affected by the instruction and do not affect printing in any manner.

Write and Branch W

Op-Code	I-address
2	iii

Description The Write and Branch instruction causes the computer to print the contents of the PRINT area (in the manner as the Write a Line instruction) then branch to the instruction specified by the I-address.

SECTION 2

141 SYMBOLIC PROGRAMMING SYSTEM

The Symbolic Programming System, SPS, has been developed to facilitate logical, efficient programming with a minimum of actual coding effort. It almost completely relieves the programmer of the task of assigning actual storage location to the instructions and data of the program and allows him to refer to them by easy-to-remember names of his choice.

INSTRUCTIONS

Instructions written in SPS contain a label, an operation code, an A-operand, a B-operand, and a d-character. Any of the parts except the operation code may be left blank.

The label is the symbolic representation of the location in memory in which the instruction will be stored. It may have from one to six alphameric characters, the first of which must be alphameric and must be placed in column 8 of the coding sheet. The label may be left blank if no reference is made to the instruction elsewhere in the program.

The operation code is mnemonic and consists of from one to three characters starting in column 14.

If the instruction requires an A-operand it is written in columns 17 through 26. If no A-operand is used those columns may be left blank. The address of an operand may be expressed as a symbol, an actual location, or an asterisk. If it is written symbolically, it takes the same form as a label. If it is written as an actual location, it must be a four-digit number with leading zeros where necessary (although four digits are written on the coding sheet, only three characters will be used in memory). If an asterisk is used its equivalent address is that of the right most, or low order, position in the instruction defined by the statement.

The address of an operand may be adjusted by placing the number of characters of adjustment in columns 24 through 26 and the sign of the adjustment in colum 23. Leading zeros may be omitted but the units digit of the adjustment must be in column 26.

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1620
Correction

Applicable
13.0.015
April 15, 1965

The program decks have been revised and the listings reflecting these changes are attached. These pages replace pages A2 through A27 that are currently in the writeup.

```
00010*                                                          A
00020*
00030*
00040* INITIALIZATION AND STORE PROGRAM ROUTINE
00050*
00060 ASMBLY TFM   CDCNT,0
00070        TF    11,INIT+11
00080        BLC   *+12
00090        TFM   ERRCNT,0
00100        TFM   MOD+30,STORE
00110        TFM   ICTR,0333,8
00120        TFM   MADDR+6,LABEL-15
00130        TFM   MLABEL+6,LABEL-18
00140        TDM   OVERSW,0
00150        CF    IDENT-1
00160 LC     BLC   NOEND
00170        RACD  LAREA
00180        AM    CDCNT,1,10
00190        C     END+4,LAREA+30
00200        BE    MOD
00210        C     AST,LAREA+14
00220        BE    MOD
00230        C     CCTL,LAREA+30
00240        BE    MOD
00250        C     CEX,LAREA+30
00260        BE    MOD
00270        C     CDCW-2,LAREA+28
00280        BE    DCDSR
00290        C     CDSA-2,LAREA+28
00300        BE    DCDSR
00310        C     CORG,LAREA+30
00320        BE    ORGR
00330        C     CB,LAREA+30
00340        BNE   *+60
00350        C     BLANK,LAREA+64
00360        BE    *+36
00370        TFM   CNT,8,9
00380        B     REPL
00390        TFM   CNT,0,9
00400        BD    INCR,LAREA+75
00410        BD    INCR,LAREA+76
00420        B     *+24
00430 INCR   AM    CNT,1,10
00440        C     BLANK,LAREA+64
00450        BNE   *+60
00460        C     BLANK,LAREA+42
00470        BNE   *+60
00480        AM    CNT,1,10
00490        B     REPL
00500        AM    CNT,7,10
00510        B     REPL
00520        AM    CNT,4,10
00530 REPL   TD    LAREA+12,CNT
00540        TDM   LAREA+11,7
00550        TD    LAREA+10,CNT-1
00560        C     BLANK,LAREA+24
```

```
00570           BE    REPLIM
00580           TF    LOC,ICTR
00590           BTM   LTABLE
00600 REPLIM    A     ICTR,CNT
00610           BD    MOD,OVERSW
00620           BD    OVERR,ICTR-3
00630 MOD       CM    CDCNT,100
00640           BH    *+48
00650           TF    0,LAREA+108
00660           AM    *-6,110,9
00670           B     *+24
00680           WACD  LAREA
00690           C     END+4,LAREA+30
00700           BE    PASS2
00710           B     LC
00720           DC    5,0
00730 LTABLE    AM    MLABEL+6,15,10
00740           AM    MADDR+6,15,10
00750           CM    MADDR+6,LABEL+15*90
00760           BNL   LBLERR
00770           SF    LAREA+13
00780 MLABEL    TF    0,LAREA+24
00790           SF    LOC-2
00800 MADDR     TF    0,LOC
00810           CF    LAREA+13
00820           BB
00830 LBLERR    RCTY
00840           WATY  LBLMSG
00850           B     OVERR+36
00860 LBLMSG    DAC   18,LABEL TABLE FULL.@,
00870 ORGR      TD    ICTR,LAREA+38
00880           TD    ICTR-1,LAREA+36
00890           TD    ICTR-2,LAREA+34
00900           B     MOD
00910 DCDSR     TD    CNT,LAREA+12
00920           TD    CNT-1,LAREA+10
00930           C     CDSA,LAREA+30
00940           BNE   *+48
00950           TF    CNT,C3
00960           TFM   LAREA+12,0073,8
00970           CF    LAREA+9
00980           C     AST,LAREA+32
00990           BNE   ABSLT
01000           A     ICTR,CNT
01010           C     BLANK,LAREA+24
01020           BE    REPLIM+12
01030           TF    LOC,ICTR
01040           SM    LOC,1,10
01050           BTM   LTABLE
01060           B     REPLIM+12
01070 ABSLT     TD    LOC,LAREA+38
01080           TD    LOC-1,LAREA+36
01090           TD    LOC-2,LAREA+34
01100           BTM   LTABLE
01110           B     MOD
01120 NOEND     RCTY
```

```
01130          WATY ENDMSG
01140          RCTY
01150          H
01160          B    LC+12
01170 OVERR    TDM  OVERSW,1
01180          RCTY
01190          WATY OVMSG
01200          RCTY
01210          WATY LAREA
01220          RCTY
01230          B    MOD
01240 LAREA    DAC  50,                                                ,
01250          DS   10
01260 LDIN     DAC  20,L       1056          ,
01270 IDENT    DAC  7,       @,
01280 ADDRAR   DC   5,@,
01290 ICTR     DC   4,0
01300 BLANK    DC   12,0
01310 LOC      DC   4,0
01320 CNT      DC   3,0
01330 LABEL    DSB  15,90
01340 CDCNT    DC   5,0
01350          DC   1,@
01360 ERRCNT   DC   5,0
01370          DC   1,@
01380 STORE    DSB  110,100,9109
01390 END      DAC  3,END,
01400 ENDMSG   DAC  48,END CARD MISSING. LOAD END CARD AND PUSH START.@,
01410 OVMSG    DAC  22,PROGRAM EXCEEDS CORE.@,
01420*
01430* PASS2
01440*
01450 PASS2    BD   ASMBLY,OVERSW
01460          TFM  ICTR,0332,8
01470          CM   CDCNT,100
01480          BNH  *+60
01490          RCTY
01500          WATY P2MSG
01510          RCTY
01520          H
01530          TFM  CDCNT,0
01540          TFM  PULIM+11,STORE
01550          SF   LAREA+149
01560          TF   CS1+158,IDENT+8
01570          TF   CS2+158,IDENT+8
01580          TF   BS+158,IDENT+8
01590          BC2  PCS
01600          RCTY
01610          WATY CS1
01620          RCTY
01630          WATY CS2
01640          RCTY
01650          WATY BS
01660          RCTY
01670          RCTY
01680 PCS      BC1  LOOP2
```

```
01690          WACD CS1
01700          WACD CS2
01710          WACD BS
01720 LOOP2    CM   CDCNT,100
01730          BL   *+48
01740          RACD LAREA
01750          TF   IDENT+8,BS+158
01760          B    *+24
01770 PULIM    TF   LAREA+108,0
01780          TF   LDIN+38,CLDIN+38
01790          AM   CDCNT,1,10
01800          TD   CNT,LAREA+12
01810          TD   CNT-1,LAREA+10
01820          TDM  ERRSW,0
01830          C    AST,LAREA+14
01840          BE   ORGR2+48
01850          C    END+4,LAREA+30
01860          BE   ENDCD
01870          C    CORG,LAREA+30
01880          BE   ORGR2
01890          C    CCTL,LAREA+30
01900          BE   ORGR2+48
01910          C    CEX,LAREA+30
01920          BE   EXR2
01930          TF   ADDRAR-1,ICTR
01940          AM   ADDRAR-1,1,10
01950          A    ICTR,CNT
01960          TFM  LDIN+11,70707
01970          TD   LDIN+12,ICTR
01980          TD   LDIN+10,ICTR-1
01990          TD   LDIN+8,ICTR-2
02000          C    CDCW,LAREA+30
02010          BE   DCWR2
02020          C    CDC,LAREA+30
02030          BE   DCWR2-12
02040          C    CDS,LAREA+30
02050          BE   DSR
02060          C    CDSA,LAREA+30
02070          BE   DSAR
02080          SF   LAREA+10
02090          TF   WA,CNT
02100          AM   WA,66,10
02110          TFM  LDIN+5,70707
02120          TD   LDIN+6,WA
02130          TD   LDIN+4,WA-1
02140          TD   LDIN+2,WA-2
02150          BTM  TABLE,0
02160          C    C8,CNT
02170          BNE  *+84
02180          TFM  DMOD+6,LDIN+36
02190          TFM  DMOD+18,LDIN+35
02200          BTM  DMOD,0
02210          BTM  BADD,0
02220          BTM  AADD,0
02230          B    TESTSW
02240          C    C7,CNT
```

```
02250           BNE   *+48
02260           BTM   BADD
02270           BTM   AADD
02280           B     TESTSW
02290           C     C5,CNT
02300           BNE   *+60
02310           TFM   DMOD+6,LDIN+30
02320           TFM   DMOD+18,LDIN+29
02330           BTM   DMOD
02340           B     *-84
02350           C     C4,CNT
02360           BE    *-108
02370           C     C2,CNT
02380           BNE   TESTSW
02390           TFM   DMOD+6,LDIN+24
02400           TFM   DMOD+18,LDIN+23
02410           BTM   DMOD,0
02420           B     TESTSW
02430           TFM   LDIN,54,10
02440 DCWR2     C     TT,CNT
02450           BL    *+36
02460           C     BLANK-10,CNT
02470           BL    *+72
02480           AM    ERRCNT,1,10
02490           TDM   ERRSW,1
02500           TF    LDIN+12,LBS
02510           TF    LDIN+6,LBS
02520           B     TESTSW
02530           C     BSIGN,LAREA+44
02540           BNE   MINUS+12
02550           SF    LAREA+10
02560           TFM   MINUS+6,LAREA+43
02570           A     MINUS+6,CNT
02580           A     MINUS+6,CNT
02590 MINUS     TDM   0,5
02600           TFM   T24,23,9
02610           A     T24,CNT
02620           TF    LDIN+6,ZERO
02630           TD    LDIN+6,T24
02640           TD    LDIN+4,T24-1
02650           TD    LDIN+2,T24-2
02660           C     AST,LAREA+32
02670           BE    AAA
02680           S     ICTR,CNT
02690           TD    LDIN+12,LAREA+38
02700           TD    LDIN+10,LAREA+36
02710           TD    LDIN+8,LAREA+34
02720 AAA       TD    ADDRAR-1,LDIN+12
02730           TD    ADDRAR-2,LDIN+10
02740           TD    ADDRAR-3,LDIN+8
02750           B     TESTSW
02760 DSR       TFM   LDIN,55,10
02770           TF    LDIN+28,LDIN+12
02780           TF    LDIN+12,BRRD
02790           TFM   LDIN+22,70,10
02800           C     AST,LAREA+32
```

```
02810           BE    *+60
02820           S     ICTR,CNT
02830           SF    LAREA+31
02840           TF    LDIN+28,LAREA+38
02850           CF    LAREA+31
02860           TD    ADDRAR-1,LDIN+28
02870           TD    ADDRAR-2,LDIN+26
02880           TD    ADDRAR-3,LDIN+24
02890           B     TESTSW
02900 DSAR      TFM   LDIN+6,7276,8
02910           BTM   BADD
02920           CF    LDIN+30
02930           TF    LAREA+50,LDIN+34
02940           CF    LAREA+45
02950           TF    LDIN+34,BLANK-6
02960           B     MINUS+72
02970           DC    5,0
02980 TABLE     C     CMCW,LAREA+30
02990           BE    INM
03000           C     CR,LAREA+30
03010           BE    INM+24
03020           C     CW,LAREA+30
03030           BE    INM+48
03040           C     CP,LAREA+30
03050           BE    INM+72
03060           C     CSW,LAREA+30
03070           BE    INM+96
03080           C     CCW,LAREA+30
03090           BE    INM+120
03100           C     CA,LAREA+30
03110           BE    INM+144
03120           C     CS,LAREA+30
03130           BE    INS
03140           C     CC,LAREA+30
03150           BE    INS+24
03160           C     CH,LAREA+30
03170           BE    INS+48
03180           C     CB,LAREA+30
03190           BE    INS+72
03200           C     CCS,LAREA+30
03210           BE    INS+96
03220           C     CLCA,LAREA+30
03230           BE    INS+120
03240           C     CNOP,LAREA+30
03250           BE    INS+144
03260           TF    LDIN+22,LBS-4
03270           B     INLBS+12
03280 INM       TFM   LDIN+22,54,10
03290           BB
03300           TFM   LDIN+22,71,10
03310           BB
03320           TFM   LDIN+22,72,10
03330           BB
03340           TFM   LDIN+22,74,10
03350           BB
03360           TFM   LDIN+22,23,10
```

```
03370          BB
03380          TFM   LDIN+22,04,10
03390          BB
03400          TFM   LDIN+22,41,10
03410          BB
03420 INS      TFM   LDIN+22,62,10
03430          BB
03440          TFM   LDIN+22,43,10
03450          BB
03460          TFM   LDIN+22,03,10
03470          BB
03480          TFM   LDIN+22,42,10
03490          BB
03500          TFM   LDIN+22,21,10
03510          BB
03520          TFM   LDIN+22,53,10
03530          BB
03540          TFM   LDIN+22,55,10
03550          BB
03560* DMOD ROUTINE
03570          DC    5,0
03580 DMOD     TD    LDIN+36,LAREA+76
03590          TD    LDIN+35,LAREA+75
03600          BB
03610*B ADDRESS ROUTINE
03620          DC    5,0
03630 BADD     BD    *+36,LAREA+54
03640          BD    *+24,LAREA+53
03650          B     INLBS
03660          C     S9,LAREA+54
03670          BL    BINACT
03680          C     AST,LAREA+54
03690          BNE   *+72
03700          TF    LDIN+34,ZERO
03710          TD    LDIN+34,ICTR
03720          TD    LDIN+32,ICTR-1
03730          TD    LDIN+30,ICTR-2
03740          B     BCADJ
03750          TFM   LEXIT+6,BCADJ
03760          TF    LDIN+34,ZERO
03770          TFM   LOOK+23,LAREA+64
03780          TFM   XX+6,LDIN+34
03790          B     LOOK
03800 BCADJ    C     BLANK-6,LAREA+74
03810          BNE   ADJB
03820          BB
03830 INLBS    TF    LDIN+34,LBS
03840          AM    ERRCNT,1,10
03850          TDM   ERRSW,1
03860          BB
03870 BINACT   TF    LDIN+34,ZERO
03880          TD    LDIN+34,LAREA+60
03890          TD    LDIN+32,LAREA+58
03900          TD    LDIN+30,LAREA+56
03910          B     BCADJ
03920 ADJB     TD    WA1,LAREA+72
```

```
03930           TD    WA1-1,LAREA+70
03940           TD    WA1-2,LAREA+68
03950           SF    WA1-2
03960           TD    WA2,LDIN+34
03970           TD    WA2-1,LDIN+32
03980           TD    WA2-2,LDIN+30
03990           SF    WA2-2
04000           C     BSIGN,LAREA+66
04010           BNE   *+36
04020           S     WA2,WA1
04030           B     *+24
04040           A     WA2,WA1
04050           CF    WA2
04060           TD    LDIN+34,WA2
04070           TD    LDIN+32,WA2-1
04080           TD    LDIN+30,WA2-2
04090           BB
04100*A ADDRESS ROUTINE
04110           DC    5,0
04120 AADD      BD    *+36,LAREA+32
04130           BD    *+24,LAREA+31
04140           B     INLBSA
04150           C     S9,LAREA+32
04160           BL    AINACT
04170           C     AST,LAREA+32
04180           BNE   *+72
04190           TF    LDIN+28,ZERO
04200           TD    LDIN+28,ICTR
04210           TD    LDIN+26,ICTR-1
04220           TD    LDIN+24,ICTR-2
04230           B     ACADJ
04240           TFM   LEXIT+6,ACADJ
04250           TF    LDIN+28,ZERO
04260           TFM   LOOK+23,LAREA+42
04270           TFM   XX+6,LDIN+28
04280           B     LOOK
04290 ACADJ     C     BLANK-6,LAREA+52
04300           BNE   ADJA
04310           BB
04320 INLBSA    TF    LDIN+28,LBS
04330           B     INLBS+12
04340 AINACT    TF    LDIN+28,ZERO
04350           TD    LDIN+28,LAREA+38
04360           TD    LDIN+26,LAREA+36
04370           TD    LDIN+24,LAREA+34
04380           B     ACADJ
04390 ADJA      TD    WA1,LAREA+50
04400           TD    WA1-1,LAREA+48
04410           TD    WA1-2,LAREA+46
04420           SF    WA1-2
04430           TD    WA2,LDIN+28
04440           TD    WA2-1,LDIN+26
04450           TD    WA2-2,LDIN+24
04460           SF    WA2-2
04470           C     BSIGN,LAREA+44
04480           BNE   *+36
```

```
04490           S     WA2,WA1
04500           B     *+24
04510           A     WA2,WA1
04520           CF    WA2
04530           TD    LDIN+28,WA2
04540           TD    LDIN+26,WA2-1
04550           TD    LDIN+24,WA2-2
04560           BB
04570* LABEL TABLE LOOK UP
04580 LOOK      TFM   *+18,LABEL-3
04590           C     0,0
04600           BE    MVADDR
04610           C     MLABEL+6,LOOK+18
04620           BE    INSLB
04630           AM    LOOK+18,15,10
04640           B     LOOK+12
04650 MVADDR    TF    XX+11,LOOK+18
04660           AM    XX+11,3,10
04670           TF    XX+23,XX+11
04680 XX        TD    0,0
04690           BNF   *+24
04700 LEXIT     B     0
04710           SM    XX+6,2,10
04720           SM    XX+11,1,10
04730           SM    XX+23,1,10
04740           B     XX
04750 INSLB     TDM   ERRSW,1
04760           AM    ERRCNT,1,10
04770           TF    *+18,XX+6
04780           TF    0,LBS
04790           B     LEXIT
04800 TESTSW    CF    ADDRAR-3
04810           BD    PRINT,ERRSW
04820           BNC2  PRINT
04830           BC1   *+24
04840           WACD  LAREA
04850           AM    PULIM+11,110,9
04860           B     LOOP2
04870 ENDCD     TF    LDIN+12,ENDC
04880           BTM   AADD
04890           TF    LDIN+6,LDIN+28
04900           TF    LDIN+28,BLANK
04910           TF    LDIN+16,BLANK-8
04920           BD    *+24,ERRSW
04930           BC2   *+36
04940           RCTY
04950           WATY  LAREA
04960           BC1   *+24
04970           WACD  LAREA
04980           RCTY
04990           RCTY
05000           SPTY
05010           WNTY  CDCNT-2
05020           WATY  CNTMSG
05030           WNTY  ERRCNT-2
05040           WATY  ERRMSG
```

```
05050           RCTY
05060           BNLC  ASMBLY
05070           H
05080  INIT     B     ASMBLY,0,0
05090  ORGR2    TD    ICTR,LAREA+38
05100           TD    ICTR-1,LAREA+36
05110           TD    ICTR-2,LAREA+34
05120           SM    ICTR,1,10
05130           TFM   LDIN,55,10
05140           TF    LDIN+12,BRRD
05150           TF    ADDRAR-1,BLANK-8
05160           B     TESTSW
05170  EXR2     BTM   AADD
05180           TF    LDIN+6,LDIN+28
05190           TF    LDIN+28,BLANK-6
05200           TFM   LDIN,42,10
05210           TF    LDIN+12,BLANK-6
05220           B     TESTSW
05230  PRINT    WATY  LAREA
05240           C     BLANK-9,ADDRAR-1
05250           BE    *+24
05260           WNTY  ADDRAR-3
05270           RCTY
05280           B     TESTSW+36
05290  CS1      DAC   50,,008015,022026,030034,041,045,053,0570731026      ,
05300           DAC   31,                                          @,
05310  CS2      DAC   50,L072116,110106,105117B101/999,027A074028)027B00102,
05320           DAC   31,70B026/0991,001/00111710      @,
05330  BS       DAC   50,,008015,022029,056063/056029                      ,
05340           DAC   31,     ,0240671056              @,
05350  CLDIN    DAC   20,L0010561056         ,
05360  AST      DAC   1,*,
05370  P2MSG    DAC   46,PLACE CARDS PUNCHED IN READ FEED. PUSH START.@,
05380  CNTMSG   DAC   9, CARDS  @,
05390  ERRMSG   DAC   8, ERRORS@,
05400  ENDC     DC    14,21707070707870
05410  BRRD     DC    8,71707576
05420  ZERO     DC    6,707070
05430  CMCW     DC    6,544366
05440  CR       DC    6,590000
05450  CW       DC    6,660000
05460  CP       DC    6,570000
05470  CSW      DC    6,626600
05480  CCW      DC    6,436600
05490  CA       DC    6,410000
05500  CS       DC    6,620000
05510  CC       DC    6,430000
05520  CH       DC    6,480000
05530  CB       DC    6,420000
05540  CCS      DC    6,436200
05550  CLCA     DC    6,534341
05560  CNOP     DC    6,555657
05570  CDCW     DC    6,444366
05580  CDSA     DC    6,446241
05590  CDC      DC    6,444300
05600  CDS      DC    6,446200
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```
05610 CORG    DC    6,565947
05620 CCTL    DC    6,436353
05630 CEX     DC    6,456700
05640 LBS     DC    6,333333
05650 TT      DC    3,32
05660 T24     DC    3,23
05670 S9      DC    2,69
05680 BSIGN   DC    2,20
05690 WA      DC    3,0
05700 C8      DC    3,8
05710 C7      DC    3,7
05720 C5      DC    3,5
05730 C4      DC    3,4
05740 C3      DC    3,3
05750 C2      DC    3,2
05760 WA1     DC    3,0
05770 WA2     DC    3,0
05780 OVERSW  DC    1,0
05790 ERRSW   DC    1,0
05800         DEND  ASMBLY
```

SYMBOL TABLE
1401 SPS-A

ASMBLY	00402	LC	00522	INCR	00846	REPL	00966	REPLIM	01050
MOD	01086	LTABLE	01200	MLABEL	01260	MADDR	01284	LBLERR	01320
LBLMSG	01357	ORGR	01392	DCDSR	01440	ABSLT	01632	NOEND	01692
OVERR	01752	LAREA	01837	LDIN	01947	IDENT	01987	ADDRAR	02004
ICTR	02008	BLANK	02020	LOC	02024	CNT	02027	LABEL	02042
CDCNT	03382	ERRCNT	03388	STORE	09109	END	03391	ENDMSG	03397
OVMSG	03493	PASS2	03536	PCS	03812	LOOP2	03860	PULIM	03920
DCWR2	04724	MINUS	04904	AAA	05060	DSR	05108	DSAR	05276
TABLE	05366	INM	05726	INS	05894	DMOD	06068	BADD	06110
BCADJ	06314	INLBS	06350	BINACT	06398	ADJB	06458	AADD	06680
ACADJ	06884	INLBSA	06920	AINACT	06944	ADJA	07004	LOOK	07220
MVADDR	07304	XX	07340	LEXIT	07364	INSLB	07424	TESTSW	07484
ENDCD	07568	INIT	07820	ORGR2	07832	EXR2	07928	PRINT	08000
CS1	08073	CS2	08235	BS	08397	CLDIN	08559	AST	08599
P2MSG	08601	CNTMSG	08693	ERRMSG	08711	ENDC	08739	BRRD	08747
ZERO	08753	CMCW	08759	CR	08765	CW	08771	CP	08777
CSW	08783	CCW	08789	CA	08795	CS	08801	CC	08807
CH	08813	CB	08819	CCS	08825	CLCA	08831	CNOP	08837
CDCW	08843	CDSA	08849	CDC	08855	CDS	08861	CORG	08867
CCTL	08873	CEX	08879	LBS	08885	TT	08888	T24	08891
S9	08893	BSIGN	08895	WA	08898	C8	08901	C7	08904
C5	08907	C4	08910	C3	08913	C2	08916	WA1	08919
WA2	08922	OVERSW	08923	ERRSW	08924				

- 141 - SIMULATOR
FOR BASIC 1620

```
00010*
00020*
00030*
00040* INITIALIZER ROUTINE
00050*
00060 BEGIN   TR    19998,ASK+41
00070         TF    11,PRELD+11
00080         SF    17982
00090         BC4   INITZR
00100         RCTY
00110         WATY  HEADG
00120         RCTY
00130         BTM   WRT,WORD
00140         BTM   WRT,WORD+10
00150         BTM   WRT,WORD+22
00160         BTM   WRT,WORD+34
00170         BTM   WRT,WORD+44
00180         B     INITZR
00190 WRT     BC4   INITZR
00200         RCTY
00210         WATY  FUNCT,,2
00220         BC4   INITZR
00230         TF    *+18,WRT-1
00240         WATY  0
00250         AM    WRT+30,80,10
00260         BB
00270 INITZR  RCTY
00280         RCTY
00290         WATY  ASK
00300         RATY  TESTL
00310         SF    TESTL-1
00320         C     TESTL+6,WORD+6
00330         BE    START
00340         C     TESTL+8,WORD+18
00350         BE    CLEAR
00360         C     TESTL+8,WORD+30
00370         BE    ALTER
00380         C     TESTL+6,WORD+40
00390         BE    DSTART
00400         C     TESTL+12,WORD+56
00410         BE    INBRCH
00420         WATY  INERR
00430         RCTY
00440         RCTY
00450         B     INITZR
00460 INBRCH  WATY  BGMSG
00470         RNTY  TESTL-1
00480         TD    17985,TESTL-1
00490         TD    17987,TESTL
00500         TD    17989,TESTL+1
00510         RCTY
00520         RCTY
00530         SF    17990
00540         B     B
00550 TESTL   DAC   10,LOAD       ,
00560 HEADG   DAC   36,FUNCTIONS PERFORMED                    ,
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```
00570          DAC   18,REQUEST BY TYPING@,
00580 FUNCT    DAC   40,    LOAD PROGRAM FROM CARD READER        @,
00590          DAC   40,    CLEAR 141 STORAGE                    @,
00600          DAC   40,    ALTER STORAGE FROM TYPEWRITER        @,
00610          DAC   40,    DUMP CONTENTS OF 141 STORAGE         @,
00620          DAC   40,    BEGIN EXECUTION OF PROGRAM           @,
00630 WORD     DAC   5,LOAD@,
00640          DAC   6,CLEAR@,
00650          DAC   6,ALTER@,
00660          DAC   5,DUMP@,
00670          DAC   8,EXECUTE@,
00680 ASK      DAC   23,REQUESTED FUNCTION IS @,
00690 BGMSG    DAC   15, BEGINNING AT @,
00700 INERR    DAC   24,  INVALID REQUEST WORD.@,
00710*
00720* LOADER ROUTINE
00730*
00740 START    RCTY
00750          RCTY
00760          BC3   LDUMP
00770          TF    18161,BLANKS
00780          TF    18141,BLANKS
00790          TF    18121,BLANKS
00800          TF    18101,BLANKS
00810          TF    18081,BLANKS
00820          TF    18061,BLANKS
00830          TF    18041,BLANKS
00840          TF    18021,BLANKS-1
00850          RACD  18003
00860          TFM   FTEST+11,18002
00870          B     NEXTIN
00880*
00890* INSTRUCTION ACCESS ROUTINE
00900*
00910 NEXTIN   BNC1  *+60
00920          BTM   CVTREG,0,10
00930          TF    *+35,17983
00940          TF    *+18,IREG-1
00950          H     0,0
00960          AM    FTEST+11,2,10
00970          BT    TESTHI,FTEST+11
00980 FTEST    BNF   *+48,0,7
00990          TF    *+23,FTEST+11
01000          TF    17984,0
01010          B     TABLE
01020          AM    FTEST+11,6,10
01030          BT    TESTHI,FTEST+11
01040          TF    *+23,FTEST+11
01050          TF    17990,0
01060          TF    *+23,FTEST+11
01070          BNF   *+24,0
01080          B     TABLE
01090          CM    17983,42,10
01100          BNE   *+72
01110          BD    *+60,17990
01120          TF    *+35,FTEST+11
```

```
01130          AM    *+23,1,10
01140          BD    *+24,0
01150          B     B+12
01160          AM    FTEST+11,2,10
01170          BT    TESTHI,FTEST+11
01180          TF    *+23,FTEST+11
01190          BNF   *+48,0
01200          TF    *+23,FTEST+11
01210          TF    17992,0
01220          B     TABLE+288
01230          AM    FTEST+11,4,10
01240          BT    TESTHI,FTEST+11
01250          TF    *+23,FTEST+11
01260          TF    17996,0
01270          TF    *+23,FTEST+11
01280          BNF   *+24,0
01290          B     TABLE+96
01300          CM    17983,23,10
01310          BE    SW
01320          CM    17983,21,10
01330          BE    CS-60
01340          AM    FTEST+11,2,10
01350          BT    TESTHI,FTEST+11
01360          TF    *+23,FTEST+11
01370          BNF   *-36,0
01380          TF    *+23,FTEST+11
01390          TF    17998,0
01400          B     TABLE+288
01410* TEST FOR WRAP-AROUND OFF HIGH END OF CORE.
01420          DC    5,0
01430 TESTHI   CM    *-1,20000
01440          BNL   *+24
01450          BB
01460          RCTY
01470          WATY HIMSG
01480          RCTY
01490          H
01500          B     DSTART
01510 HIMSG    DAC   47,HI LIMIT OF CORE EXCEEDED. PUSH START TO DUMP.@,
01520*
01530* TABLE SEARCH FOR OPERATIONAL SUBROUTINE
01540*   TABLE ORDER - R,W,P,H,SW,A,S,CS,CW,MCW,C,LCA,B,NOP.
01550*
01560 TABLE    CM    17983,71,10
01570          BE    R
01580          CM    17983,72,10
01590          BE    W
01600          CM    17983,74,10
01610          BE    P
01620          CM    17983,03,10
01630          BE    H
01640          CM    17983,23,10
01650          BE    SW
01660          CM    17983,41,10
01670          BE    A
01680          CM    17983,62,10
```

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01690          BE    S
01700          CM    17983,21,10
01710          BE    CS-84
01720          CM    17983,04,10
01730          BE    CW
01740          CM    17983,54,10
01750          BE    MCW
01760          CM    17983,43,10
01770          BE    C
01780          CM    17983,53,10
01790          BE    LCA
01800          CM    17983,42,10
01810          BE    B
01820          CM    17983,55,10
01830          BE    NEXTIN
01840* INVALID OP CODE ROUTINE
01850 ERROR1   RCTY
01860          WATY  OPMSG
01870          RCTY
01880          B     CORLIM+36
01890 OPMSG    DAC   41,INVALID INSTRUCTION. PUSH START TO DUMP.@,
01900*
01910* OPERATIONAL SUBROUTINES
01920*
01930* WRITE SUBROUTINE
01940 W        TFM   *+23,18561
01950          C     ZEROES-38,0
01960          BNE   RE
01970          SM    W+23,2,10
01980          CM    W+23,18401
01990          BNE   W+12
02000          B     SECL
02010 RE       AM    W+23,2,10
02020          TF    *+47,W+23
02030          TF    *+42,W+23
02040          TF    *+54,W+23
02050          TD    *+47,0
02060          TD    0,400
02070          WATY  18403
02080          TDM   0,0
02090 SECL     RCTY
02100          TD    *+59,18562
02110          BV    *+12
02120          SF    18562
02130          C     18601,ZEROES
02140          TDM   18562,0
02150          BNE   *+36
02160          BV    *+24
02170          B     B-24
02180          TD    *+47,18603
02190          TD    18603,400
02200          WATY  18563
02210          TDM   18603,0
02220          RCTY
02230          B     B-24
02240 ZEROES   DC    40,0
```

```
02250* READ A CARD  SUBROUTINE
02260 R       RACD 18003
02270         B    B-24
02280* PUNCH A CARD SUBROUTINE
02290 P       WACD 18203
02300         B    B-24
02310* HALT SUBROUTINE
02320 H       BTM  CVTREG,0,10
02330         TF   *+35,17983
02340         TF   *+18,IREG-1
02350         H    0,0
02360         B    B-24
02370* SET WORD MARK SUBROUTINE
02380 SW      BTM  CONVTA
02390         TF   *+30,17989
02400         SM   *+18,1,10
02410         SF   0
02420         BNF  *+24,17990
02430         B    NEXTIN
02440         BTM  CONVTB
02450         TF   *+30,17995
02460         SM   *+18,1,10
02470         SF   0
02480         B    NEXTIN
02490* CLEAR WORD MARK SUBROUTINE
02500 CW      BTM  CONVTA
02510         TF   *+30,17989
02520         SM   *+18,1,10
02530         CF   0
02540         BNF  *+24,17990
02550         B    NEXTIN
02560         BTM  CONVTB
02570         TF   *+30,17995
02580         SM   *+18,1,10
02590         CF   0
02600         B    NEXTIN
02610* MOVE CHARACTER TO A OR B FIELD WORD MARK SUBROUTINE
02620 MCW     BTM  CONVTA
02630         TF   MOVE+11,17989
02640         TF   MOVE+23,17989
02650         SM   MOVE+23,1,10
02660         BTM  CONVTB
02670         TF   MOVE+6,17995
02680         TF   MOVE+18,17995
02690         SM   MOVE+18,1,10
02700         TF   *+23,MOVE+18
02710         BNF  MOVE,0
02720         TDM  SFCF+1,2
02730         TDM  MOVE+25,9
02740 MOVE    TD   0,0
02750         TD   0,0
02760         NOP  SFCF-24
02770         TF   *+23,MOVE+18
02780         BNF  SFCF+24,0
02790         TDM  SFCF+1,3
02800         TDM  MOVE+25,1
```

```
02810          TF    *+18,MOVE+18
02820 SFCF     SF    0,0
02830          B     NEXTIN
02840          SM    MOVE+6,2,10
02850          SM    MOVE+11,2,10
02860          SM    MOVE+18,2,10
02870          SM    MOVE+23,2,10
02880          CM    MOVE+18,18000
02890          BL    CORLIM
02900          CM    MOVE+23,18000
02910          BNL   MOVE-48
02920 CORLIM   RCTY
02930          WATY  CORMSG
02940          RCTY
02950          BTM   CVTREG,0,10
02960          TF    *+35,17983
02970          TF    *+18,IREG-1
02980          H     0,0
02990          B     DSTART
03000 CORMSG   DAC   48,LOW LIMIT OF CORE EXCEEDED. PUSH START TO DUMP.@,
03010* COMPARE SUBROUTINE
03020 C        BTM   CONVTA
03030          TF    *+47,17989
03040          BTM   CONVTB
03050          TF    *+18,17995
03060          C
03070          BNH   *+36
03080 HIGH     SF    HIGH
03090          B     *+24
03100          CF    HIGH
03110          BNE   *+36
03120 EQUAL    SF    EQUAL
03130          B     *+24
03140          CF    EQUAL
03150          B     NEXTIN
03160* BRANCH SUBROUTINE
03170          BNF   B+12,17984
03180          B     NEXTIN
03190 B        BNF   DMOD,17990
03200          BTM   CONVTA
03210          TF    FTEST+11,17989
03220          SM    FTEST+11,1,10
03230          TF    *+23,FTEST+11
03240          BNF   ERROR1
03250          B     NEXTIN
03260 DMOD     BNF   BCE,17992
03270          SF    17990
03280          CM    17991,21,10
03290          BE    SLASH
03300          CM    17991,62,10
03310          BE    SAME
03320          CM    17991,63,10
03330          BE    TINY
03340          CM    17991,64,10
03350          BE    UPPER
03360          B     ERROR1
```

```
03370 SLASH   BNF   B+12,EQUAL
03380         B     NEXTIN
03390 SAME    BNF   NEXTIN,EQUAL
03400         B     B+12
03410 TINY    BNF   *+24,EQUAL
03420         B     NEXTIN
03430         BNF   B+12,HIGH
03440         B     NEXTIN
03450 UPPER   BNF   *+24,EQUAL
03460         B     NEXTIN
03470         BNF   NEXTIN,HIGH
03480         B     B+12
03490 BCE     SF    17996
03500         BTM   CONVTB
03510         TF    *+23,17995
03520         C     17997,0
03530         BE    B+12
03540         B     NEXTIN
03550* ADD SUBROUTINE
03560 A       TFM   ADD+1,21,10
03570         B     *+24
03580* SUBTRACT SUBROUTINE
03590 S       TFM   ADD+1,22,10
03600         BTM   CONVTA
03610         BNF   *+36,17990
03620         TF    17995,17989
03630         B     *+24
03640         BTM   CONVTB
03650         TFM   STRIPA+6,FIELDA-1
03660         TF    STRIPA+11,17989
03670         TF    STRIPA+35,17989
03680         SM    STRIPA+35,1,10
03690         TF    TSIGNA+11,STRIPA+35
03700         TFM   STRIPB+6,FIELDB-1
03710         TF    STRIPB+11,17995
03720         TF    STRIPB+35,17995
03730         SM    STRIPB+35,1,10
03740         TF    TSIGNB+11,STRIPB+35
03750         TF    SN-25,STRIPB+35
03760         TF    SN+6,STRIPB+35
03770         TFM   SN+47,FIELDB-2
03780         TF    SN-6,17995
03790         TF    SN+42,17995
03800         SM    SN+42,2,10
03810         TF    SN+59,17995
03820         SM    SN+59,3,10
03830         TF    SN+102,SN+59
03840 TSIGNB  TD    *+22,0
03850         CM    *+9,5000,8
03860         BE    STRIPB-12
03870         TF    *+23,17995
03880         C     *+22,0
03890         BE    STRIPB-12,,9
03900         TDM   FIELDB,0
03910         B     *+24
03920         TDM   FIELDB,0,11
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03930 STRIPB TD    0,0
03940        SM    STRIPB+6,1,10
03950        BNF   *+60
03960        TF    POSCNT,17995
03970        S     POSCNT,STRIPB+11
03980        AM    POSCNT,1,10
03990        B     TSIGNA-24
04000        SM    STRIPB+11,2,10
04010        SM    STRIPB+35,2,10
04020        CM    STRIPB+6,FIELDB-33
04030        BE    ERROR2
04040        B     STRIPB
04050        TF    *+18,STRIPB+6
04060        TDM   0,0,11
04070 TSIGNA TD    *+22,0
04080        CM    *+9,5000,8
04090        BE    STRIPA-12
04100        TF    *+23,17989
04110        C     *+22,0
04120        BE    STRIPA-12,,9
04130        TDM   FIELDA,0
04140        B     *+24
04150        TDM   FIELDA,0,11
04160 STRIPA TD    0,0
04170        SM    POSCNT,1,10
04180        BNF   *+24
04190        B     ADD-24
04200        CM    POSCNT,0
04210        BE    ADD-24
04220        SM    STRIPA+6,1,10
04230        SM    STRIPA+11,2,10
04240        SM    STRIPA+35,2,10
04250        B     STRIPA
04260        TF    *+18,STRIPA+6
04270        SF    0,0
04280 ADD    H     FIELDB,FIELDA
04290        BNF   *+36,FIELDB
04300        TDM   SN+11,5
04310        B     *+24
04320        TDM   SN+11,7
04330        BNF   *+24,0
04340        SF    SN+11
04350        TD    0,FIELDB-1
04360 SN     TDM   0,0
04370        BNF   *+24,SN+11
04380        B     NEXTIN
04390        TD    0,0
04400        BNF   *+48,0
04410        TF    *+18,*+42
04420        TDM   0,7,11
04430        B     NEXTIN
04440        TDM   0,7
04450        SM    SN+42,2,10
04460        SM    SN+47,1,10
04470        SM    SN+59,2,10
04480        SM    SN+102,2,10
```

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04490          B     SN+36
04500 ERROR2   RCTY
04510          WATY  AMSG
04520          RCTY
04530          B     CORLIM+36
04540 AMSG     DAC   47,B-FIELD OF ADD OR SUB INSTR OVER 32 POSITIONS. ,
04550          DAC   20,PUSH START TO DUMP.@,
04560 POSCNT   DC    5,0
04570 FIELDA   DS    33,
04580 FIELDB   DS    34,
04590* CLEAR STORAGE SUBROUTINE
04600          BNF   *+24,17990
04610          B     CS
04620          BTM   CONVTA
04630          TF    FTEST+11,17989
04640          SM    FTEST+11,1,10
04650          SF    17990
04660          TF    17989,17995
04670 CS       TFM   CS+210,18000
04680          TD    CS+248,17985
04690          A     CS+208,CS+248
04700          A     CS+208,CS+248
04710          TFM   CS+234,18000
04720          TD    CS+249,17987
04730          A     CS+233,CS+249
04740          A     CS+233,CS+249
04750          TFM   CS+191,BLANKS-19
04760          TD    CS+248,17989
04770          A     CS+191,CS+248
04780          A     CS+191,CS+248
04790          TD    CS+248,17987
04800          BTM   CONVTA
04810          TF    CS+186,17989
04820          TF    0,0
04830          BD    CS+228,CS+248
04840          CF    0,0
04850          B     NEXTIN
04860          TF    0,BLANKS
04870          SM    *+8,1,710
04880          SM    CS+234,20,10
04890          B     CS+192
04900* LOAD CHARACTERS TO A-FIELD WORD MARK SUBROUTINE
04910 LCA      BTM   CONVTA,0
04920          TF    LCA+59,17989
04930          BTM   CONVTB
04940          TF    LCA+54,17995
04950          TF    0,0
04960          B     NEXTIN
04970* CONVERT A SUBROUTINE TO CONVERT FROM 141 TO 1620 ADDRESSING
04980          DC    5,0
04990 CONVTA   TD    17988,17987
05000          TD    17987,17985
05010          TFM   17986,0,10
05020          A     17989,17989
05030          AM    17989,18001
05040          BB
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05050* CONVERT B SUBROUTINE TO CONVERT FROM 141 TO 1620 ADDRESSING
05060          DC    5,0
05070 CONVTB   TD    17994,17993
05080          TD    17993,17991
05090          TFM   17992,0,10
05100          A     17995,17995
05110          AM    17995,18001
05120          BB
05130*
05140* CLEAR ROUTINE
05150*
05160 CLEAR    RCTY
05170          RCTY
05180          TFM   CLEAR+42,19999
05190          TF    19999,BLANKS,2
05200          SM    CLEAR+42,20,10
05210          CM    CLEAR+42,17999
05220          BNE   CLEAR+36
05230 PRELD    B     INITZR,,0
05240 BLANKS   DC    21,0
05250*
05260* DUMP ROUTINE
05270*
05280 DSTART   RCTY
05290          RCTY
05300          TF    OPREG+10,17983
05310          BTM   CVTREG,0,10
05320          RCTY
05330          WATY  TITLE
05340          RCTY
05350          SPTY
05360          WNTY  IREG-3
05370          WATY  OPREG
05380          RCTY
05390          RCTY
05400          CF    BLNKS-49
05410          CF    BLNKS-99
05420          TFM   CARDNO,0,10
05430          TFM   ADDR1,0,9
05440          TFM   ADDR2,49,9
05450          TFM   SAVC+11,18101
05460          TFM   INSRM+6,18101
05470          TFM   IN+18,18101
05480          TFM   INSRM+23,18000
05490 SAVC     TD    IN+23,0
05500 INSRM    TD    0,400
05510          TR    BANDA+37,0
05520          AM    CARDNO,01,10
05530          TD    BANDA,CARDNO-1
05540          TD    BANDA+2,CARDNO
05550          AM    CARDNO,01,10
05560          TD    BANDB,CARDNO-1
05570          TD    BANDB+2,CARDNO
05580          TDM   BANDA+137,0
05590          TD    BANDA+18,ADDR1-1
05600          TD    BANDA+16,ADDR1-2
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05610           TD    BANDA+30,ADDR2-1
05620           TD    BANDA+28,ADDR2-2
05630           BNC2  *+48
05640           TDM   BANDA+138,0
05650           WACD  BANDA
05660           B     PWM
05670           BNC1  *+24
05680           H
05690 TYPE      TFM   *+23,BANDA+136
05700           C     ZEROES-38,0
05710           BNE   *+36
05720           SM    TYPE+23,2,10
05730           B     TYPE+12
05740           AM    TYPE+23,2,10
05750           TF    *+30,TYPE+23
05760           TF    *+42,TYPE+23
05770           TD    0,400
05780           WATY  BANDA+16
05790           TDM   0,0
05800           RCTY
05810 PWM       TF    BANDB+138,BLNKS
05820           TFM   TEST5+11,BANDA+37
05830           TFM   TEST5+18,BANDB+38
05840           TFM   INSRM2+6,BANDB+16
05850 TEST5     BNF   INCR,0,27
05860           TFM   0,71,10
05870           TF    INSRM2+6,*-6
05880 INCR      AM    TEST5+11,2,10
05890           AM    TEST5+18,2
05900           CM    TEST5+11,BANDA+137
05910           BNE   TEST5
05920 WRITE     BNC2  *+120
05930           CM    CARDNO,40,10
05940           BNE   *+60
05950           TFM   BANDB+9,70707
05960           TD    BANDB+10,IREG-1
05970           TD    BANDB+8,IREG-2
05980           TD    BANDB+6,IREG-3
05990           WACD  BANDB
06000           TF    BANDB+10,ZEROES-34
06010           B     *+60
06020           AM    INSRM2+6,2,10
06030 INSRM2    TD    0,400
06040           WATY  BANDB+16
06050           RCTY
06060           BD    OUT,SWENDD
06070 IN        AM    SAVC+11,100,9
06080           TDM   0,0
06090           TF    INSRM+6,SAVC+11
06100           TF    IN+18,SAVC+11
06110           AM    INSRM+23,100,9
06120           AM    ADDR1,50,10
06130           AM    ADDR2,50,10
06140           CM    SAVC+11,20001
06150           BNE   SAVC
06160           TD    1,400
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06170          TDM   SWENDD,1
06180          TR    BANDA+37,19900
06190          B     INSRM+24
06200 OUT      TDM   1,9
06210          TDM   SWENDD,0
06220          B     INITZR
06230 BANDA    DAC   50,01       000 - 049                    ,
06240          DAC   30,                                      ,
06250 BANDB    DAC   50,02                                    ,
06260          DAC   30,                                      ,
06270          DC    22,0
06280          DC    50,0
06290 BLNKS    DC    50,0
06300 SWENDD   DC    1,0
06310 ADDR1    DC    3,0
06320 ADDR2    DC    3,49
06330 CARDNO   DC    2,0
06340* PRINT REGISTERS SUBROUTINE
06350 TITLE    DAC   14,I-REG  OP-REG@,
06360 IREG     DC    6,@,
06370 OPREG    DAC   7,      @,
06380 DIV      DC    6,0
06390          DC    5,0
06400 CVTREG   TF    IREG-1,FTEST+11
06410          SM    IREG-1,18000
06420          TF    DIV-1,IREG-1
06430          S     DIV,IREG-1
06440          S     DIV,IREG-1
06450          S     DIV,IREG-1
06460          S     DIV,IREG-1
06470          S     DIV,IREG-1
06480          TF    IREG-1,DIV-1
06490          BB
06500*
06510* ALTER ROUNTINE AND
06520* LOAD DUMP CARDS ROUTINE
06530*
06540 ALTER    WATY  BGMSG
06550          RNTY  TESTL-1
06560          SF    TESTL-1
06570          TF    FIRST+2,TESTL+1
06580          TDM   ALTSW,1
06590 NEXTL    RCTY
06600          RCTY
06610          CF    FIRST
06620          WNTY  FIRST
06630          SF    FIRST
06640          RCTY
06650          TFM   READ1+6,18001
06660          A     READ1+6,FIRST+2
06670          A     READ1+6,FIRST+2
06680 READ1    RATY  0
06690          RCTY
06700          RNTY  WMS+19
06710          TF    STFLG+6,READ1+6
06720          SM    STFLG+6,1,10
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06730 COMMON TFM   TDIG+11,WMS+19
06740        TFM   TRM+11,WMS+19
06750 TRM    BNR   *+24,0
06760        B     RM
06770 TDIG   BD    *+36,0
06780        TDM   STFLG+1,3
06790        B     *+24
06800        TDM   STFLG+1,2
06810 STFLG  SF    0
06820        AM    STFLG+6,2,10
06830        AM    TDIG+11,1,10
06840        AM    TRM+11,1,10
06850        CM    TDIG+11,WMS+119
06860        BNE   TRM
06870 RM     SM    TDIG+11,WMS+19
06880        SF    TDIG+9
06890        A     FIRST+2,TDIG+11
06900        BD    NEXTL,ALTSW
06910        BD    EXEC,WMS+3
06920 LDUMP  SF    BANDC+16
06930        RACD  BANDC
06940        TD    BANDC+138,400
06950        BD    *+24,BANDC+19
06960        B     CDERR
06970        TD    FIRST+2,BANDC+20
06980        TD    FIRST+1,BANDC+18
06990        TD    FIRST,BANDC+16
07000        TFM   TR+6,18000
07010        A     TR+6,FIRST+2
07020        A     TR+6,FIRST+2
07030 TR     TR    0,BANDC+37
07040        RNCD  WMS
07050        TD    WMS+69,400
07060        BD    CDERR,WMS+16
07070        TF    STFLG+6,TR+6
07080        SF    WMS
07090        CM    WMS+1,40,10
07100        BE    *+48
07110        TF    *+30,TR+6
07120        AM    *+18,101,9
07130        TDM   0,0
07140        TDM   ALTSW,0
07150        B     COMMON
07160 EXEC   TD    17985,WMS+3
07170        TD    17987,WMS+4
07180        TD    17989,WMS+5
07190        SF    17990
07200        TFM   1,49,10
07210        B     B
07220 CDERR  WATY  CDMSG
07230        RCTY
07240        H
07250        B     START
07260 ALTSW  DC    1,0
07270 CDMSG  DAC   38,SEQUENCE ERROR. PUSH START TO RE-LOAD@,
07280 FIRST  DSC   4,000@,
```

```
07290 WMS     DSS  120
07300 BANDC   DAC  50,
07310         DAC  30,
07320         DEND BEGIN
```

SYMBOL TABLE
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BEGIN	00402	WRT	00558	INITZR	00654	INBRCH	00882	TESTL	00991
HEADG	01011	FUNCT	01119	WORD	01519	ASK	01579	BGMSG	01625
INERR	01655	START	01702	NEXTIN	01870	FTEST	01954	TESTHI	02476
HIMSG	02573	TABLE	02666	ERROR1	03002	OPMSG	03051	W	03132
RE	03216	SECL	03312	ZEROES	03531	R	03532	P	03556
H	03580	SW	03640	CW	03772	MCW	03904	MOVE	04048
SFCF	04144	CORLIM	04264	CORMSG	04361	C	04456	HIGH	04528
EQUAL	04576	B	04648	DMOD	04732	SLASH	04864	SAME	04888
TINY	04912	UPPER	04960	BCE	05008	A	05080	S	05104
TSIGNB	05404	STRIPB	05512	TSIGNA	05680	STRIPA	05788	ADD	05932
SN	06028	ERROR2	06196	AMSG	06245	POSCNT	06382	FIELDA	06415
FIELDB	06449	CS	06534	LCA	06810	CONVTA	06888	CONVTB	06966
CLEAR	07038	PRELD	07122	BLANKS	07154	DSTART	07156	SAVC	07408
INSRM	07420	TYPE	07648	PWM	07792	TEST5	07840	INCR	07876
WRITE	07924	INSRM2	08056	IN	08104	OUT	08260	BANDA	08297
BANDB	08457	BLNKS	08737	SWENDD	08738	ADDR1	08741	ADDR2	08744
CARDNO	08746	TITLE	08749	IREG	08781	OPREG	08783	DIV	08801
CVTREG	08808	ALTER	08928	NEXTL	08988	READ1	09096	COMMON	09156
TRM	09180	TDIG	09204	STFLG	09252	RM	09324	LDUMP	09384
TR	09516	EXEC	09672	CDERR	09744	ALTSW	09792	CDMSG	09795
FIRST	09870	WMS	09874	BANDC	09995				