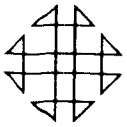
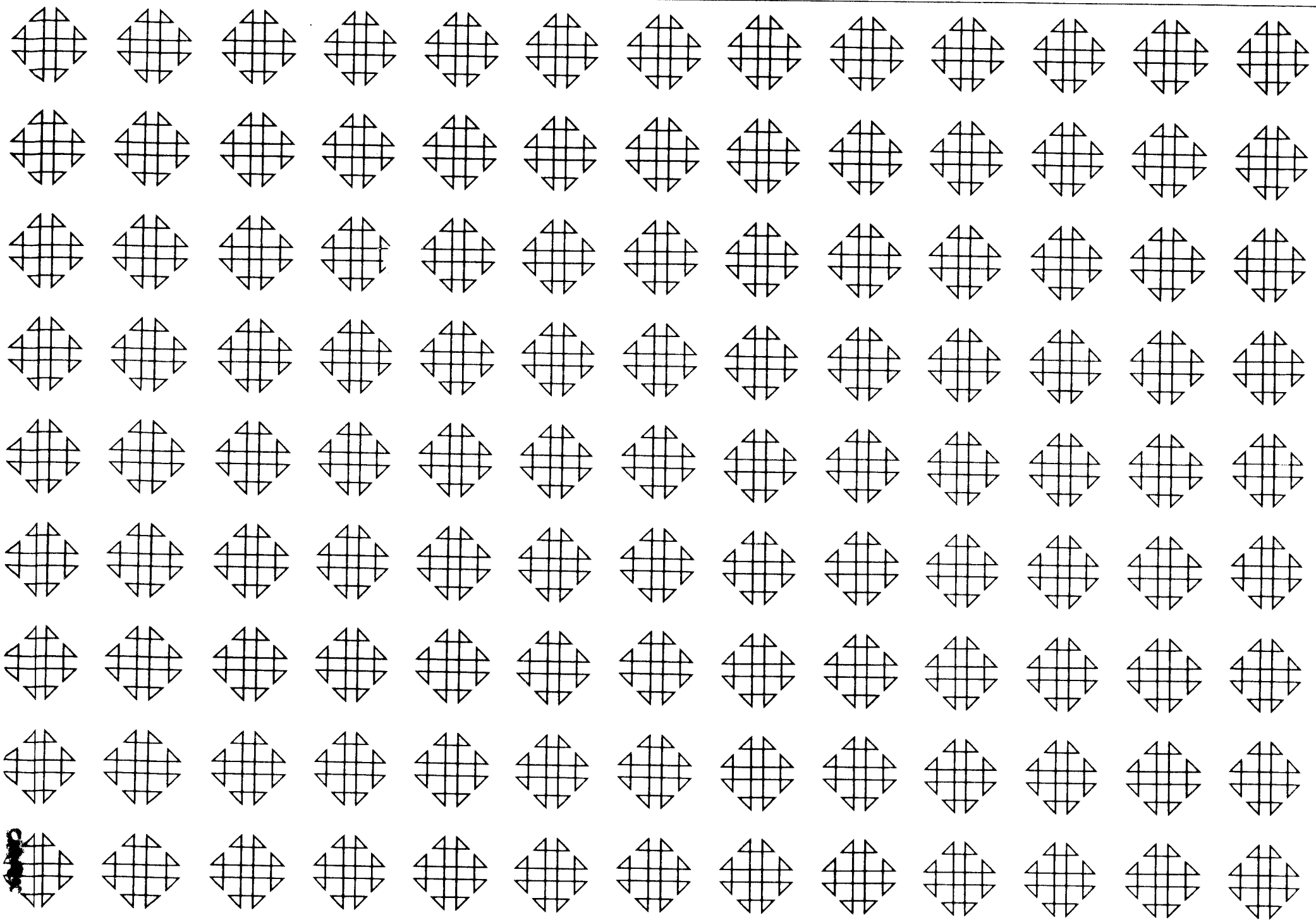


L Stuart



Disclaimer

Although this program was tested by its author prior to submission, no warranty, express or implied, is made by the author or IBM as to the accuracy and functioning of the program and related program material and no responsibility is assumed by the author, or IBM in connection therewith.

TABLE OF CONTENTS

Title: SCION II (Floating Point for 1401 Systems)

Author: John Discola
IBM - Los Angeles East
6252 East Telegraph Road, Los Angeles 22, California

Date: August, 1961

Purpose:

A. SCION II provides the programmer with the ability to generate - with one system deck - a complete source program deck containing customized floating point operations ready for SPS assembly. In particular, the SCION system will process a preliminary SPS program containing floating point macro-type instructions and create linkages to the floating point subroutines which are themselves generated initially by the system deck. These subroutines are customized in regard to the size mantissa to be used and the compilation - on a "call" type basis - of the subroutines required by the source program. Also compiled optionally is a tracing routine to aid in debugging whose operation at object time is controlled by the source program.

The mantissa sizes that may be compiled range from 4 digits to 16 digits by increments of 2 - viz. 2-4, 2-6, 2-8, 2-10, 2-12, 2-14, and 2-16 characteristic-mantissa type floating point format.

The arithmetic operations are FAD, FSB, FMP, and FDV. Mode conversion operations included optionally are floating-to-fixed (FIX) and fixed-to-floating (FLT) conversions. Their capabilities are 3 and 2 times the mantissa size, respectively.

B. SCION II avails to the programmer desirous of maximizing execution efficiency attendant "one-for-one" SPS coding and/or does not have the 1401 Fortran hardware configuration.

Equipment Specifications: IBM 1401 Model B, C, D, E, or F with the following special features:

1. Multiply-Divide
2. Advanced Programming

Source Language: SPS II

C. Two digit characteristic (excess-fifty mode) gives the following range for floating point arithmetic operations:

$$.1000..0 \times 10^{-50} \text{ to } .9999..9 \times 10^{49}$$

Accuracy: Subroutines truncate significant digits of results after normalizing.

D. Storage Requirements:

All operations plus tracing

no. positions=939+6xΔn; where $\Delta n = n-4$; and n=mantissa size

F. SCION subroutines are not restricted to memories larger than 4K since the Modify-Address (MA) instruction peculiar to the larger memory configurations is not used in any of the subject routines.

Index registers 1, 2, and 3 are used by the subroutines. This should not concern the programmer because they are restored to their entry conditions at exit time. One proviso is made however, namely - that word marks are not left in their tens and units positions at entry time.

SCION II SYSTEM FLOWCHART

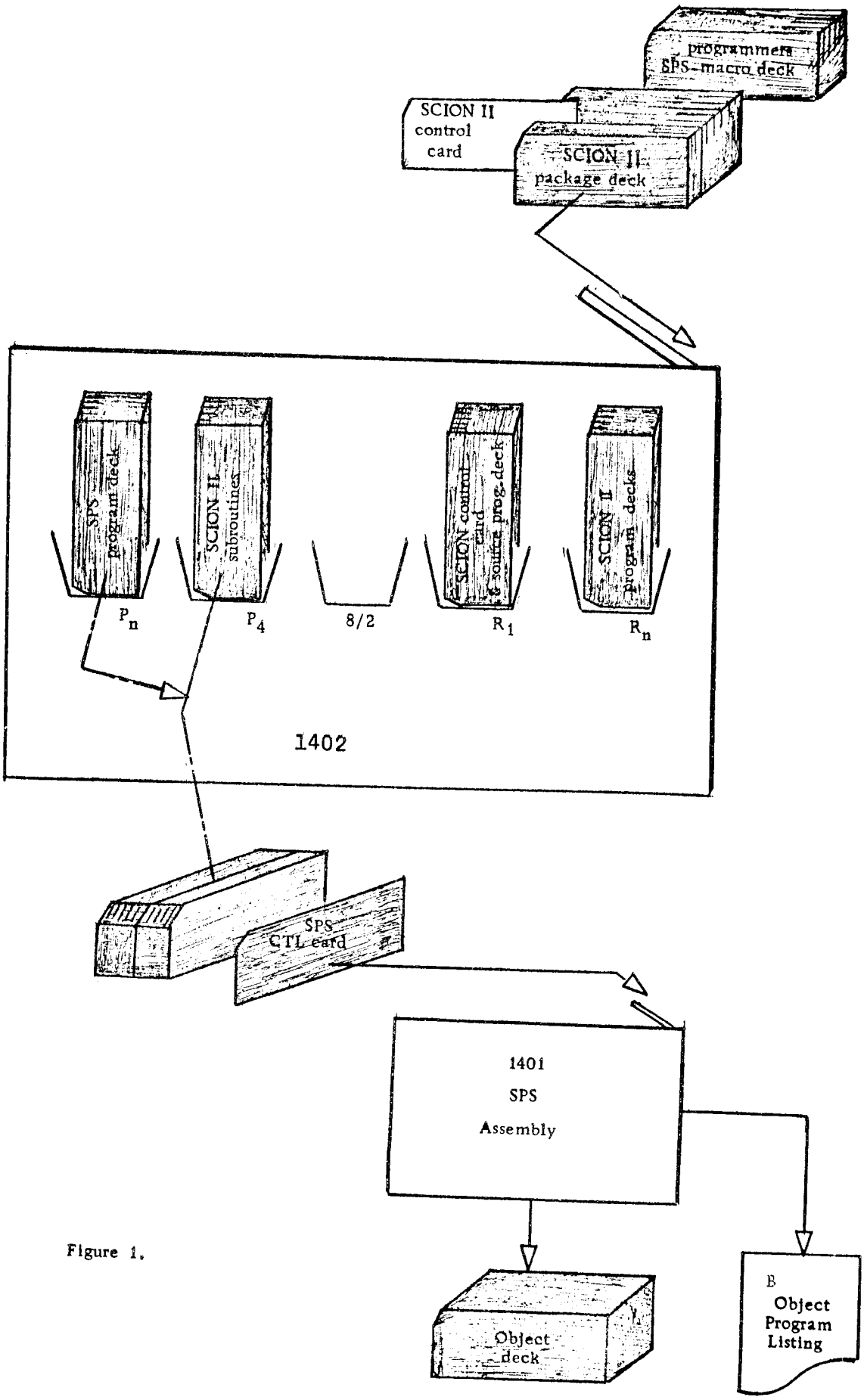


Figure 1.

I. The SCION System

The expressed purpose of this system is to avail to the programmer coding an application for the 1401 the ability to incorporate into his program "tailored" floating point operations with a minimum of difficulty. In particular, the programmer may make a determination of the optimal mantissa field size required by the algorithm of an application in order to maximize execution efficiency and available memory work-area space. It should be noted that this is not possible with fixed word length type computers.

SCION II provides this capability as its primary function in addition to allowing macro-type coding of floating point operations in the mother SPS language. Including assembly, the system (source to object program) may be considered a two pass proposition.

The first pass is the SCION pass which requires only the system deck, a control card, and the source program with macro instructions. This pass initially generates a deck of floating point subroutines in symbolic form based on the specifications indicated in the control card. It then processes the source deck - reproducing it exactly except for the macro instructions, in which case it generates two legitimate SPS instructions that represent the linkage to the aforementioned subroutines. It simultaneously produces a 1403 listing of the resulting symbolic source program with annotations indicating errors in macro coding.

The SCION control card designates three things to the processor: the mantissa size, the number of routines required, and whether or not a special tracing routine is to be compiled with the routines.

The tracing feature may be of invaluable assistance in the debugging of the program without the use of a great deal of 1401 time because of a selective tracing option that is programmable in the source program.

The cards produced from the SCION pass can be used immediately for SPS assembly without the addition of any other supplementary decks. Figure 1 illustrates diagrammatically the two passes described above.

A. Subroutine Generation

The SCION control card specifies mantissa size (nn) in card columns 6,7. Actually the sizes possible range from 4 digits to 16 digits by increments of 2. Considering the 2 digit characteristic they are nominally: 2-4, 2-6, 2-8, 2-10, 2-12, 2-14, and 2-16.

Six floating point operations are available in SCION II - four are the arithmetic operations of addition, subtraction, multiplication, and division (FAD, FSB, FMP, and FDV). The remaining two are fixed-to-floating and floating-to-fixed mode conversion operations (FLT and FIX). Two or more of these individual operations may be compiled on a "call" type basis. However, the arbitrary selection of combinations of particular operations is not entirely possible because of the dependence of some routines to others. Figure 2, illustrates figuritively these dependencies and indicates the control card constant (p) to be punched card column 8 specifying the scope of operations to be compiled. For example, p=5 will compile all the operations.

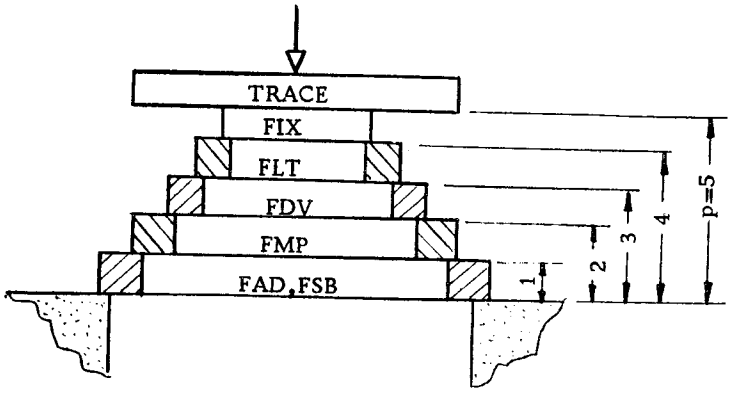


Figure 2.

The tracing feature that may be compiled with the operations is called by TRACE in the SCION control card in card columns 9-13. This routine does not become functional at object time until an instruction in the source program "turns on" the trace. This instruction is symbolically in the source program:

```
### ###### ######
B   TRACON
### ###### ######
```

Upon encountering any floating point operations following this instruction the print area will be cleared and the following information is printed at the 1403 after execution of the operation:

1. floating point pseudo operation code
2. actual A-field address
3. actual B-field address
4. contents of A-field
5. contents of B-field
6. contents of answer field (AC) or contents of FIX field (REG)
7. NSI (next sequential instruction)
   eg. BXXX

All subsequent floating point operations will be traced until another instruction is executed which turns the trace off, and it is symbolically:

```
### ######  ######
B   TRCOFF
### ######  ######
```

The output of the sample program of Section III illustrates the use, results, and format of the trace operation.

B. Macro Instructions and Linkage

The second function of the SCION system is to re-create the source program and to substitute two entry instructions for every macro-type floating point instruction that is encountered in the original source program. This entry and linkage to the subroutines is performed ostensibly by two SPS instructions - viz.

```
###  ######  ######
B    SCION
op   AAA     BBB
###  ######  ######
```

The second instruction (7 characters) in reality is the entry data that designates the operation type and the two data addresses. It should be noted that this instruction is not executed. The linkage created within the routines returns at exit time to the first position following this "dummy" instruction. This should imply immediately that this position must contain a valid operation code with word mark to preclude a Process Error Stop.

The following is an epitomy of the functions of this portion of the first pass in addition to the creation of the aforementioned entry instructions:

1. reproduce all normal SPS information per card in their normal sequence.
2. reproduce the supplementary fields of the macro instruction into the first of the entry instructions.
3. Increase the line count by 1 and create an abbreviated form of the source macro instruction into comments field of the second entry instruction.
4. Check for invalid macro operation codes.
5. Simultaneously print an image of each SPS card produced.

Certain symbolic labels and addresses will common to both the subroutines and the source program in order to afford a working correspondence between the source program and the subroutines. All results of floating point operations are left in one of two fixed fields in SCION. These fields are addressed AC andREG and their explicit functions are outlined in Section II. Three labels also have correspondence with the source program - TRACON, TRCOFF, and SCION. The index registers #1, #2, and #3 are defined by DCW's - X1, X2, and X3, respectively.

II. The Floating Point Operations

A. Form of Data

The form of the floating point data word/field used and accommodated by the SCION subroutines is similar in nature to earlier schemes that have been used. The word/field consists of a two digit characteristic in the "excess-50 mode" and a mantissa which may be one of seven sizes as indicated previously. The range of the mantissa is $-1.0 < M < 1.0$

eg: 324.56789 is represented in memory as:

5332456789 ($.32456789 \times 10^3$)

One should note that the ordering is characteristic-mantissa which is logically more desirable. This ordering allows simplified and faster methods for the determination of relative magnitudes between datum.

The sign of the mantissa is always associated with the units position of the word/field and conforms to the sign or zoning standards of the 1401.

The following are the stipulations that are made concerning the condition of the floating point operands upon entry to the arithmetic operations:

1. Word marks must not exist in any position of the operand following the high order position of the field. A word mark in the high order position is optional.
2. The units position of the operand field should be zoned with a B-bit for negative datum.
3. The operand address of the floating point instruction should always be that of the units position of the field.

B. The Operations

Six floating point operations are provided in the SCION package. These operations differ in method somewhat from the normal 1401 arithmetic operations in which the result is left in the B-field thereby destroying the contents of one of the operand fields. The result of any SCION operation is left in a fixed field AC located within the memory space reserved by the subroutines (except for the FIX operation). The answer field AC is addressable in the source program and may used as the operand of any other instruction.

1. Floating Addition and Subtraction

   FAD/FSB AAA+/- BBB—▷AC

   The mantissa answer field is a result of truncation subsequent to normalization within this field. A positive mantissa is always left unzoned in AC.

2. Floating Multiply

   FMP AAA x BBB—▷AC

   A $2(N_m)$ product field is developed and truncated as in 1., where N_m is the mantissa size.

3. Floating Divide

   FDV AAA / BBB—▷AC

   A (N_m+1) quotient is developed and truncated as in 1.

Note: In all of the arithmetic operations indexing is allowed. Indexing of the A-operand of the following FLT and FIX operations is also allowed except when using index register #3.

4. Fixed-point to Floating-point Conversion

   FLT AAA,L—▷AC, where L is a literal placed left-justified in the symbolic B-field which specifies the number of A-field decimal places.

   The maximum length of "unword-marked" A-field that may be floated is $(2 N_m)$. Truncation and normalization are as in 1.

   It should be noted that the decimal point in the A-field is an assumed position; that is, it does not physically exist as a memory position.

5. Floating-point to Fixed-point Conversion

   FIX AAA, L—▷REG, where L is a literal placed left-justified in the symbolic B-field which specifies the number of REG-field decimal places.

   The size of the REG-field which is left with the fixed data is $(3 N_m+1)$.

   All data that exceeds the capacity of the REG field will be placed right-justified in the REG field in the original floating point form with the character X separating the characteristic from the mantissa.

Note: Concerning blank or partially blank fields - no guarantee is given for proper operation should blanks exist in any operand field except for the FLT instruction . Blanks are legitimate in the A-operand field in this operation and the resultant AC field will not be left with blanks.

C. Example Results of Floating Point Operations

Assume the following data fields in memory:

$$\underset{A}{5110000000}\,\underset{B}{5099999995}\,\underset{C}{0333333333}$$

$$\underset{D}{5066666670}\,\underset{E}{5555555559}\,\underset{G}{8765432100}\,\underset{F}{0000000000}$$

Macro Op Code	A-field Address	B-field Address	XXXXXXXXXX A C	XXXXXXXXXXXXXXXXXXXXXXXX REG
FAD	A	B	5119999999	
FAD	A	C	5066666670	
FAD	AC	D	0000000000	
FSB	B	A	4410000000	
FSB	E	AC	5555555555	
FMP	B	C	5033333332	
FMP	E	G	9999999999 (1)	
FMP	F	AC	0000000000	
FDV	C	B	5033333333	
FDV	F-4	G	0000000000 (2)	
FDV	E	F	9999999999 (3)	
FLT	G	8	5855555598	
FLT	D-4	3	5350666600	
FIX	C	5		000000000000000000033333
FIX	E	20		555555550000000000000000
FIX	E	10		000000000555555550000000
FIX	G	0		000000000000076543210X98

(1) Characteristic Overflow...see Section IV. A.
(2) Characteristic Underflow..see Section IV. A.
(3) Division by Zero.....see Section IV. B.

III. Sample Problem

SPS Listing of Sample Problem Input

```
                1010  * THE FOLLOWING IS A PROGRAM DESIGNED TO
                1020  *   ILLUSTRATE THE USE OF SCION AND TO
                1030  *   CORROBORATE THE OPERATION RESULTS SHOWN
                1040  *   ON PAGE 4 OF THE SCION WRITEUP.
                1050  *
 01  060         START  CC                                          1
 01  070                MCW  OPCODE          0209
 01  080                MCW  AFLD            0226
 01  090                MCW  BFLD            0247
 01  091                MCW  ACFLD           0272
 01  100                MCW  NSI             0295
 01  120                CC                                         T
*01  110                W
 01  130                CS   0295
 01  140                B    TRACON
 01  150                FAD  A               B
 01  160                FAD  A               C
 01  170                FAD  AC              D
 01  180          LABEL FSB  B               A
 01  190                FSB  E               AC
 01  200                FMP  B               C
 02  010                FMP  F               G
 02  020                FMP  F               AC
 02  030                FDV  C               B
 02  040                FDV  F     -  4      G
*01  050                FDV  E               F
 02  060                FLT  G               8
 02  070                FLT  D     -  4      a
 02  080                FIX  C               5
 02  081                FIX  F               20
 02  090                FIX  E               10
 02  100                FIX  G               0
 02  110                FXP  G
 02  120                B    TRCOFF
 02  130                H    START
 02  150  10  A         DCW  *       5110000000
 02  160  10  B         DC   *       5099999999
 02  170  10  C         DC   *      -5033333333
 02  180  10  D         DCW  *      -5066666670
 02  190  10  E         DCW  *       5555555555
 02  200  10  G         DC   *       9876543210
 03  020  10  F         DC   *       0000000000
 03  030  03  NSI       DCW  *       NSI
 03  050  07  AFLD      DCW  *       A-FIELD
 03  050  07  BFLD      DCW  *       B-FIELD
 03  051  12  ACFLD     DCW  *       AC-FIELD/REG
 03  060  10  OPCODE    DCW  *       OP  A   B
          3070  *NOTE SCION CONTROL CARD *SCION085TRACE*
          3080  *   LOCATED AFTER PACKAGE DECK =1
 03  090                END  START
```

014

III. 1403 Output of SCION Pass

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```
                        CTL  33
                01C10   *  THE FOLLOWING IS A PROGRAM DESIGNED TO
                01C20   *    ILLUSTRATE THE USE OF SCION AND TO
                01C30   *    CORROBORATE THE OPERATION RESULTS SHOWN
                01C40   *    ON PAGE 4 OF THE SCION WRITEUP.
                01C50   *
     01C60      START   CC                                        I
     01C70              MCW  CPCODE          0209
     01C80              MCW  AFLD            0226
     01C90              MCW  BFLD            0247
     01C91              MCW  ACFLD           0272
     01100              MCW  NSI             0295
     01120              CC                                        T
     01110              H
     01130              CS   0295
     01140              B    TRACON
     01150              B    SCION
     01151              ZA   A               B                    *FADA     B
     01160              B    SCION
     01161              ZA   A               C                    *FADA     C
     01170              B    SCION
     01171              ZA   AC              D                    *FADAC    D
     01180      LABEL   B    SCION
     01181              ZS   B               A                    *FSDB     A
     01190              B    SCION
     01191              ZS   E               AC                   *FSBE     AC
     01200              B    SCION
     01201              MP   B               C                    *FMPB     C
     02010              B    SCION
     02011              MP   E               G                    *FMPE     G
     02020              B    SCION
     02021              MP   F               AC                   *FMPF     AC
     02030              B    SCION
     02031              DC   C               B                    *FDVC     B
     02040              B    SCION
     02041              DP   F     -    4    G                    *FDVF     G
     01050              B    SCION
     01051              DP   E               F                    *FDVE     F
     02060              B    SCION
     02061                P  G               1008                 *FLTG     8
     02070              B    SCION
     02071                P  D     -    4    1003                 *FLTD     3
     02080              B    SCION
     02081                X  C               1005                 *FIXC     5
     02082              B    SCION
     02090                X  E               1020                 *FIXE     20
     02091              B    SCION
     02100                X  E               1010                 *FIXE     10
     02101              B    SCION
     02110                X  G               1000                 *FIXG     0
     02111              B    SCION
     02120                X  G               1000                 *FXP*OP CODE ERR
     02130              B    TRCOFF
     02140              H    START
     02150  10  A       DCW  *          511  0  000000
     02160  10  B       DC   *          509  9  999999
     02170  10  C       DC   *         -503  3  333333
     02180  10  D       DCW  *         -506  6  666670
     02190  10  E       DCW  *          555  5  555555
     02200  10  G       DC   *          987  6  543210
     03020  10  F       DC   *          000  0  000000
     03030  03  NSI     DCW  *          NSI
     03050  07  AFLD    DCW  *          A-F  9  FLD
     03050  07  BFLD    DCW  *          B-F  9  FLD
     03051  12  ACFLD   DCW  *          AC-  6  IELD/REG
     03060  10  CPCODE  DCW  *          OP       A     B
                03070   *NOTE SCION CONTROL CARD *SCION085TRACE*
                03080   *    LOCATED AFTER PACKAGE DECK #1
     03090              END  START
```

III. SPS Post-List of Total Program after Assembly, Page 1 of 4

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```
CLEAR STORAGE 1     ,008015;022026;030034;041;045;053;0570731026
CLEAR STORAGE 2     L072116;111106;105117B101I99;027A074028H027B0010270B026/0991,001/00111710
BOOTSTRAP CARD      ,008015;022029;056063/056029                              ,0240671056
```


PC	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION			COMMENTS
				CTL	33							
1	011			ORG	0333							
1	021	3	X1	DCW	0089							AUG61
1	031	3	X2	DCW	0094			0089				
1	041	3	X3	DCW	0099			0094				
1	051	1	WMKZZZ	DCW	*			0099				
1	061	24	REG	DC	*		AUG61	0333				
1	071	10	PFZZZZ	DCW	*			0357				
1	081	10	QFZZZZ	DCW	*			0367				
1	091	10	AC	DCW	*			0377				
1	101	4	SCION	SBR	* & 19			0387				
1	111	7		MCW	X3	BOXZZZ		0388	H	410		AUG61
1	121	4		MCW	X2			0392	M	099	873	AUG61
1	131	4		MCW	X1			0399	M	094		AUG61
1	141	7		MCW	0000	CPZZZZ		0403	M	089		AUG61
1	151	4		SAR	X3			0407	M	000	577	AUG61
1	161	7		SW	0005 3	0002 3		0414	Q	099		AUG61
1	171	7		MCW	0007 3	ALRZZZ- 4		0418	.	065	062	AUG61
1	181	7		MCW	0004 3	ALRZZZ& 3		0425	M	087	457	AUG61
1	191	4		MN	0009 3			0432	M	064	464	AUG61
1	201	4		SAR	EXIZZZ& 3			0439	D	089		AUG61
1	211	7		MCW	BOXZZZ	X3		0443	Q	733		AUG61
2	011	7		ZA	0000	QFZZZZ		0447	M	873	099	AUG61
2	021	7	ADRZZZ	ZA	0000	PFZZZZ		0454	&	000	377	AUG61
2	031	7		SW	PFZZZZ- 7	QFZZZZ- 7		0461	&	000	367	AUG61
2	041	7		ZA	KZRZZZ	REG		0468	&	360	370	AUG61
2	051	7		MN	OPZZZZ	OPNZZZ		0475	&	861	357	AUG61
2	061	8		B	MOVZZZ	CPNZZZ		0482	D	577	874	AUG61
2	071	8		B	FFXZZZ	CPNZZZ	7	0489	B	875	874	7 AUG61
2	081	7		MCW	K07ZZZ	X1		0497	B	982	874	7 AUG61
2	091	7		MCW	K07ZZZ	X2		0505	M	864	089	AUG61
2	101	7		ZA	PFZZZZ- 8	X3		0512	M	864	094	AUG61
2	111	7		S	QFZZZZ- 8	X3		0519	&	359	099	AUG61
2	121	8		BWZ	QBGZZZ	X3	K	0526	S	369	099	AUG61
2	131	7		S	X3	X2		0533	V	734	099	K AUG61
2	141	8		BWZ	NOQZZZ	X2	K	0541	S	099	094	AUG61
2	151	7		MZ	KZRZZZ	X2		0548	V	774	094	K AUG61
2	161	7		ZA	PFZZZZ- 8	X3		0556	Y	861	094	AUG61
2	171	7		MZ	QFZZZZ	QFZZZZ- 7 2		0563	&	359	099	AUG61
2	181	7	OPZZZZ	ZA	QFZZZZ- 7 2	REG - 16		0570	Y	377	3P0	AUG61
2	191	7		A	PFZZZZ- 7 1	REG - 16		0577	&	3P0	341	AUG61
2	201	7		MZ	REG - 16	REG - 8		0584	A	3W0	341	AUG61
3	011	4		ZA	REG - 8			0591	Y	341	349	AUG61
3	021	7	COMZZZ	MCW	KZRZZZ	X1		0598	&	349		AUG61
3	031	8	SIGZZZ	B	INDZZZ	REG - 24 1	6	0602	M	861	089	AUG61
3	041	7		ZA	REG - 17 1	AC		0609	B	808	313	0 AUG61
3	051	7		MZ	REG - 8	AC		0617	&	300	387	AUG61
3	061	7		A	K1ZZZZ	X3		0624	Y	349	287	AUG61
3	071	7		S	X1	X3		0631	A	857	099	AUG61
3	081	8		B	UNDZZZ& 4	AC - 7	0	0638	S	089	099	AUG61
3	091	7		MCW	X3	AC - 8		0645	B	842	380	0 AUG61
3	101	8		B	OVRZZZ	X3 - 2	1	0653	M	099	379	AUG61
3	111	8		BWZ	UNDZZZ	X3	K	0660	B	819	097	1 AUG61
3	121	8	NOZZZZ	BWZ	SKIZZZ	AC	K	0668	V	838	099	K AUG61
3	131	7		MZ	KZRZZZ	AC		0676	V	691	387	K AUG61
3	141	7	SKIZZZ	MZ	KZRZZZ	AC - 8		0684	Y	861	387	AUG61
3	151	7	RESZZZ	MCW	BOXZZZ	X3		0691	Y	861	379	AUG61
3	161	7		MCW	BOXZZZ- 3	X2		0698	M	873	099	AUG61
3	171	7		MCW	BOXZZZ- 6	X1		0705	M	870	024	AUG61
3	181	7		CW	PFZZZZ- 7	QFZZZZ- 7		0712	M	867	089	AUG61
3	191	4		NOP	TRCZZZ			0719	¤	360	370	AUG61
3	201	4	EXIZZZ	B	C00C			0726	N	794		AUG61
4	011	7	QBCZZZ	A	X3	X1		0730	B	000		AUG61
4	021	8		BWZ	NOPZZZ	X1	K	0734	A	099	089	AUG61
4	031	7		MZ	KZRZZZ	X1		0741	V	786	089	K AUG61
4	041	7		ZA	QFZZZZ- 8	X3		0749	Y	861	089	AUG61
4	051	7		MZ	PFZZZZ	PFZZZZ- 7 1		0756	&	369	099	AUG61
4	061	4		B	CPZZZZ			0763	Y	367	3W0	AUG61
4	071	7	NOGZZZ	MCW	PFZZZZ	AC		0770	B	577		AUG61
4	081	1		MCW				0774	M	367	387	AUG61
								0781	M			AUG61

III. SPS Post-List of Total Program, Page 2 of 4

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PAGE 2

```
PG LIN  CT  LABEL   OP    A OPERAND          B OPERAND          D    LOC   INSTRUCTION COMMENTS    SCIO
 4 091   4          B     NOZZZZ                                     0782  B 676                  AUG61
 4 101   7  NOPZZZ  MCW   CPZZZZ             *      & 5             0786  M 577 797              AUG61
 4 111   4          CW    CFZZZZ-  7                                0793  ¤ 370                  AUG61
 4 121   7          ZA    CFZZZZ             AC                    0797  & 377 387              AUG61
 4 131   4          B     NOZZZZ                                     0804  B 676                  AUG61
 4 141   7  INDZZZ  A     K1ZZZZ             X1                    0808  A 857 089              AUG61
 4 151   4          B     SIGZZZ                                     0815  B 609                  AUG61
 4 161   4  OVRZZZ  NOP   *       & 1                              0819  N 823                  AUG61
 4 171   7          MCW   K9ZZZZ             AC                    0823  M 858 387              AUG61
 4 181   4          MCW   AC                                       0830  M 387                  AUG61
 4 191   4          B     RESZZZ                                     0834  B 698                  AUG61
 5 011   4  UNDZZZ  NOP   *       & 1                              0838  N 842                  AUG61
 5 021   7          MCW   KZRZZZ             AC                    0842  M 861 387              AUG61
 5 031   4          MCW   AC      - 2                              0849  M 385                  AUG61
 5 041   4          B     RESZZZ                                     0853  B 698                  AUG61
 5 051   1  K1ZZZZ  DCW   *                                  1       0857
 5 061   1  K9ZZZZ  DCW   *                                  9       0858
 5 071   3  KZRZZZ  DCW   *                                000       0861
 5 081   3  K07ZZZ  DCW   *                                007       0864
 5 091   9  BCXZZZ  DCW   *                                          0873
 5 101   1  CPNZZZ  DCW   *                                          0874
 5 111          * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 5 122   7  MOVZZZ  ZA    PFZZZZ-  8         X3                    0875  & 359 099              AUG61
 5 132   8          B     DIVZZZ             CPZZZZ          &     0882  B 924 577 &            AUG61
 5 142   7          S     K50ZZZ             X3                    0890  S 923 099              AUG61
 5 152   7          A     CFZZZZ-  8         X3                    0897  A 369 099              AUG61
 5 162   7          ZA    CFZZZZ             REG    - 17           0904  & 377 340              AUG61
 5 172   7          M     PFZZZZ             REG    - 8            0911  & 367 349              AUG61
 5 182   4          B     COMZZZ                                     0918  B 602                  AUG61
 5 192   2  K5CZZZ  DCW   *                                   50    0923
 5 202          * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 6 013   8  DIVZZZ  B     OVRZZZ&  4         CFZZZZ-  7      0       0924  B 823 370 0            AUG61
 6 023   7          MZ    PFZZZZ             RLG                   0932  Y 367 357              AUG61
 6 033   7          MN    PFZZZZ             REG    - 8            0939  D 367 349              AUG61
 6 043   1          MCW                                            0946  M                      AUG61
 6 053   7          D     CFZZZZ             REG    - 15           0947  & 377 342              AUG61
 6 063   7          S     CFZZZZ-  8         X3                    0954  S 369 099              AUG61
 6 073   7          A     K57ZZZ             X3                    0961  A 981 099              AUG61
 6 083   7  LAPZZZ  MZ    REG    - 9         REG    - 8            0968  Y 348 349              AUG61
 6 093   1          MZ                                             0975  Y                      AUG61
 6 103   4          B     COMZZZ                                     0976  B 602                  AUG61
 6 113   2  K57ZZZ  DCW   *                                   57    0981
 6 123          * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 6 134   7  FFXZZZ  ZS    ADRZZZ-  4         X3                    0982  - 457 099              AUG61
 6 144   8          B     FIXZZZ             CPZZZZ          X     0989  B ‡31 577 X            AUG61
 6 154   7          MCW   ADRZZZ&  3        *      & 18           0997  M 464 ‡21              AUG61
 6 164   7          MCW   *       & 1       *      & 8            1004  M ‡11 ‡18              AUG61
 6 174   7          A     K65ZZZ             X3                    1011  A ‡30 099              AUG61
 6 184   7          A     0000               REG    - 9            1018  A 000 348              AUG61
 6 194   4          B     LAPZZZ                                     1025  B 968                  AUG61
 6 204   2  K65ZZZ  DCW   *                                   65    1030
 6 214          * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 7 015   7  FIXZZZ  S     PFZZZZ-  8         X3                    1031  S 359 099              AUG61
 7 025   7          A     K51ZZZ             X3                    1038  A 793 099              AUG61
 7 035   8          BWZ   NOFZZZ             X3              B     1045  V 768 099 B            AUG61
 7 045   7          ZS    X3                 X2                    1053  - 099 094              AUG61
 7 055   7          S     K24ZZZ             X2                    1060  S 791 094              AUG61
 7 065   8          BWZ   NOFZZZ             X2              B     1067  V 768 094 B            AUG61
 7 075   7          MCW   K17ZZZ             X1                    1075  M 789 089              AUG61
 7 085   7          A     X2                 X1                    1082  A 094 089              AUG61
 7 095   8          BWZ   MIDZZZ             X1              K     1089  V 743 089 K            AUG61
 7 105   7          MCW   X2                 X1                    1097  M 094 089              AUG61
 7 115   7          MZ    KZRZZZ             X1                    1104  Y 861 089              AUG61
 7 125   7          MCW   K07ZZZ             X2                    1111  M 864 094              AUG61
 7 135   7  SETZZZ  A     PFZZZZ-  7 2       REG    - 17 1         1118  A 300 300              AUG61
 7 145   7          MZ    KZRZZZ             REG    - 17 1         1125  Y 861 300              AUG61
 7 155   7          MZ    PFZZZZ             REG                   1132  Y 367 357              AUG61
 7 165   4          B     RESZZZ                                     1139  B 698                  AUG61
 7 175   7  MIDZZZ  MCW   X3                 X2                    1143  M 099 094              AUG61
 7 185   7          MZ    KZRZZZ             X2                    1150  Y 861 094              AUG61
 7 195   7          MCW   K17ZZZ             X1                    1157  M 789 089              AUG61
 7 205   4          B     SETZZZ                                     1164  B 718                  AUG61
 8 015   7  NOFZZZ  MCW   PFZZZZ-  8         REG                   1168  M 359 357              AUG61
 8 025   4          MCW   CPZZZZ                                     1175  M 577                  AUG61
 8 035   4          MCW   PFZZZZ                                     1179  M 367                  AUG61
```

IBM 1401-1403 PLANNING AND TESTING SHEET


```
PG LIN  CT  LABEL   OP    A OPERAND          B OPERAND          D        LOC   INSTRUCTION COMMENTS      SCIO
 8 045   4          B     RESZZZ                                      1183  B 698          AUG61
 8 055   3  K17ZZZ  DCW   *                                    017    1189
 8 065   2  K24ZZZ  DCW   *                                     24    1191
 8 075   2  K51ZZZ  DCW   *                                     51    1193
 8 086   4  TRCZZZ  CS    0299                                        1194  /  299          AUG61
 8 096   7          MCW   CPZZZZ             0201                  1198  M  577  201     AUG61
 8 106   7          SW    0203               0207                  1205  ,  203  207     AUG61
 8 116   7          MCW   ADRZZZ&  3         0205                  1212  M  464  205     AUG61
 8 126   7          MCW   ADRZZZ-  4         0209                  1219  M  457  209     AUG61
 8 136   7          MCW   PFZZZZ             0230                  1226  M  367  230     AUG61
 8 146   8          B     RFDZZZ             CPZZZZ          X     1233  B  S66  577  X  AUG61
 8 156   7          MCW   CFZZZZ             0251                  1241  M  377  251     AUG61
 8 166   7          MCW   AC                 0272                  1248  M  387  272     AUG61
 8 176   7  XXZZZZ  MCW   EXIZZZ&  3         0295                  1255  M  733  295     AUG61
 8 186   4          W     EXIZZZ                                    1262  2  730           AUG61
 8 196   7  RFDZZZ  MCW   REG                0282                  1266  M  357  282     AUG61
 8 206   4          B     XXZZZZ                                    1273  B  S55           AUG61
 8 216                  * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 8 226   4  TRACON  SBR   *      & 11                               1277  H  S91           AUG61
 8 236   7          MCW   EXIZZZ             EXIZZZ-  4            1281  M  730  726     AUG61
 8 246   4          B     0000                                      1288  B  000           AUG61
 8 256   4  TRCCFF  SBR   *      & 11                               1292  H  T06           AUG61
 8 266   7          MCW   NZZZZZ             EXIZZZ-  4            1296  M  T07  726     AUG61
 8 276   4          B     C000                                      1303  B  000           AUG61
 8 286   1  NZZZZZ  DCW   *                                     N    1307
 8 296                  *  THE PROGRAMMERS DECK -SPS- FOLLOWS
 8 306                  *  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
 1 010                  *  THE FOLLOWING IS A PROGRAM DESIGNED TO
 1 020                  *    ILLUSTRATE THE USE OF SCION AND TO
 1 030                  *    CORROBORATE THE OPERATION RESULTS SHOWN
 1 040                  *    ON PAGE 4 OF THE SCION WRITEUP.
 1 050                  *
 1 060   2  START   CC                                        I     1308  F  1
 1 070   7          MCW   OPCODE             C209                  1310  M  W70  209
 1 080   7          MCW   AFLD               0226                  1317  M  W41  226
 1 090   7          MCW   BFLD               0247                  1324  M  W48  247
 1 091   7          MCW   ACFLD              0272                  1331  M  W60  272
 1 100   7          MCW   NSI                0295                  1338  M  W34  295
 1 120   2          CC                                        T     1345  F  T
 1 110   1          W                                               1347  2
 1 130   4          CS    0295                                      1348  /  295
 1 140   4          B     TRACON                                    1352  B  S77
 1 150   4          B     SCION                                     1356  B  388
 1 151   7          ZA    A                  B                      1360  &  V71  V81     *FADA      B
 1 160   4          B     SCION                                     1367  B  388
 1 161   7          ZA    A                  C                      1371  &  V71  V91     *FADA      C
 1 170   4          B     SCION                                     1378  B  388
 1 171   7          ZA    AC                 D                      1382  &  387  W01     *FADAC     D
 1 180   4  LABEL   B     SCION                                     1389  B  388
 1 181   7          ZS    B                  A                      1393  -  V81  V71     *FSBB      A
 1 190   4          B     SCION                                     1400  B  388
 1 191   7          ZS    F                  AC                     1404  -  W11  387     *FSBE      AC
 1 200   4          B     SCION                                     1411  B  388
 1 201   7          M     B                  C                      1415  @  V81  V91     *FMPB      C
 2 010   4          B     SCION                                     1422  B  388
 2 011   7          M     F                  G                      1426  @  W11  W21     *FMPE      G
 2 020   4          B     SCION                                     1433  B  388
 2 021   7          M     F                  AC                     1437  @  W31  387     *FMPF      AC
 2 030   4          B     SCION                                     1444  B  388
 2 031   7          D     B                  B                      1448  %  V91  V81     *FDVC      B
 2 040   4          B     SCION                                     1455  B  388
 2 041   7          D     F      -   4       G                      1459  %  W27  W21     *FDVF      G
 2 050   4          B     SCION                                     1466  B  388
 2 051   7          D     F                  F                      1470  %  W11  W31     *FDVE      F
 2 060   4          B     SCION                                     1477  B  388
 2 061   7          B  P  G                  1008                   1481  P  W21  #08     *FLTG      8
 2 070   4          B     SCION                                     1488  B  388
 2 071   7          B  P  D      -   4       1003                   1492  P  V97  #03     *FLTD      3
 2 080   4          B     SCION                                     1499  B  388
 2 081   7          B  X  C                  1005                   1503  X  V91  #05     *FIXC      5
 2 090   4          B     SCION                                     1510  B  388
 2 091   7          B  X  E                  1020                   1514  X  W11  #20     *FIXE      20
 2 100   4          B     SCION                                     1521  B  388
                                                                    1525  X  W11  #10     *FIXE      10
                                                                    1532  B  388
```

III. SPS Post-List of Total Program, Page 4 of 4

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PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION		COMMENTS	
2	101	7		X	G	1000		1536	X W21	#00	*FIXG	U
2	110	4		B	SCION			1543	B 388			
2	111	7		X	G	1C00		1547	X W21	#00	*FXPG	
2	120	4		B	TRCOFF			1554	B S92			
2	130	4		H	START			1558	. T08			
2	150	10	A	DCW	*		5110000000	1571				
2	160	10	B	DC	*		5099999999	1581				
2	170	10	C	DC	*		503333333L	1591				
2	180	10	D	DCW	*		5066666670	1601				
2	190	10	E	DCW	*		5555555555	1611				
2	200	10	G	DC	*		9876543210	1621				
3	020	10	F	DC	*		0000000000	1631				
3	030	3	NSI	DCW	*		NSI	1634				
3	050	7	AFLD	DCW	*		A-FIELD	1641				
3	050	7	BFLD	DCW	*		B-FIELD	1648				
3	051	12	ACFLD	DCW	*		AC-FIELD/REG	1660				
3	060	10	OPCODE	DCW	*		OP A B	1670				
3	070				*NOTE SCION CONTROL CARD *SCION085TRACE*							
3	080				* LOCATED AFTER PACKAGE DECK #1							
3	090			END	START				/ T08	080		

240 CARDS

III. Object Sample Program Output / Sample Trace

P	A	B	A-FIELD	B-FIELD	AC-FIELD/REG	NSI
&	V71	V81	5110000006	5099999911	5119999999	BT67
&	V71	V91	5110000008	50333333LL	5066666670	BT78
&	387	h01	5066666678	506666667-	0000000000	BT89
-	V81	V71	5099999911	5110000006	4410000000-	BU00
@	V81	V91	5099999991	441000000-	5555555555	BU11
@	W11	h21	5555555555	5033333331	503333333K	BU22
a	W31	387	0000000006	9876543216	9999999999	BU33
%	V91	V81	5033333331	9999999991	0000000000	BU44
%	W27	h21	3210000006	5099999991	5033333331	BU55
%	W11	W31	5555555556	9876543216	0000000000	BU66
P	W21	‡08	9876543216	0000000006	9999999999	BU77
P	V97	‡03	0000506666	0004046116	5855555598	BU88
X	V91	‡05	5033333331	0004464026	5350666600	BU99
X	W11	‡20	5555555556		000000000000000000003333L	BV10
X	W11	‡10	5555555556		555555550000000000000006	BV21
X	W21	‡00	9876543216		000000000005555555500000006	BV32
X	W21	‡00	9876543216		000000000000007654321 6X98	BV43
					0000000000000007654321 6X98	BV54

IV. Error Conditions

A. Overflow and Underflow

Two special conditions, peculiar to floating point arithmetic, known as Overflow and Underflow occur as a consequence of operations yielding answers that are not in the range of numbers prescribed for excess-50 floating point.

The overflow condition exists when a resultant characteristic is larger than 99. The SPS coding shown below indicates the manner in which this condition is detected and acted upon by the SCION subroutines (the characteristic is accumulated in IR#3).

```
          ###  ######  ######   #
          B    OVR     X3 -2    1
          ###  ######  ######   #
OVR       NOP  *+1
          MCW  9       AC
          MCW  AC
          B    EXIT
          ###  ######  ######   #
```

The point of the matter is that the SCION subroutines simply replace the AC-field with all nines when overflow is encountered. A normal exit is made and no other indication of the existance of overflow is given other than the contents of the AC-field.

B. Division by Zero

When an attempt is made to divide (FDV) by zero, SCION replaces the AC-field by all nines and procedes to make a normal exit. This condition is detected within SCION by the first instruction in the divide (DIVZZZ) subroutine.

```
######   ###   #######   ######   #
DIV      B     ALL9S     HIORB    0
######   ###   #######   ######   #
```

One should note that the zero B-field determination is based on the presence of a zero in the high order position of the mantissa of the B-field. Actually the A-field address, ALL9S, is the label of the second instruction of the Overflow routine thereby maintaining the uniqueness of any special overflow procedure used.

The task of modifying the division-by-zero logic of SCION explained above is different than the procedure given for overflow and underflow. What is required is an overlay of the A-field address of the DIVZZZ instruction with the address of the routine programmed by the coder. It is important, however, that the programmer subsequently return to RESZZZ.

The important thing to observe about the SPS coding shown is that the first instruction of the OVR entry is a No-Operation code with the next instruction address in the A-field. Therefore, if the programmer finds it necessary to treat overflow in some special manner he has available to himself the ability to overlay the NOP instruction to effect one of three options:

1. Halt and proceed.
2. Halt and branch to a special routine.
3. Branch immediately to a special routine.

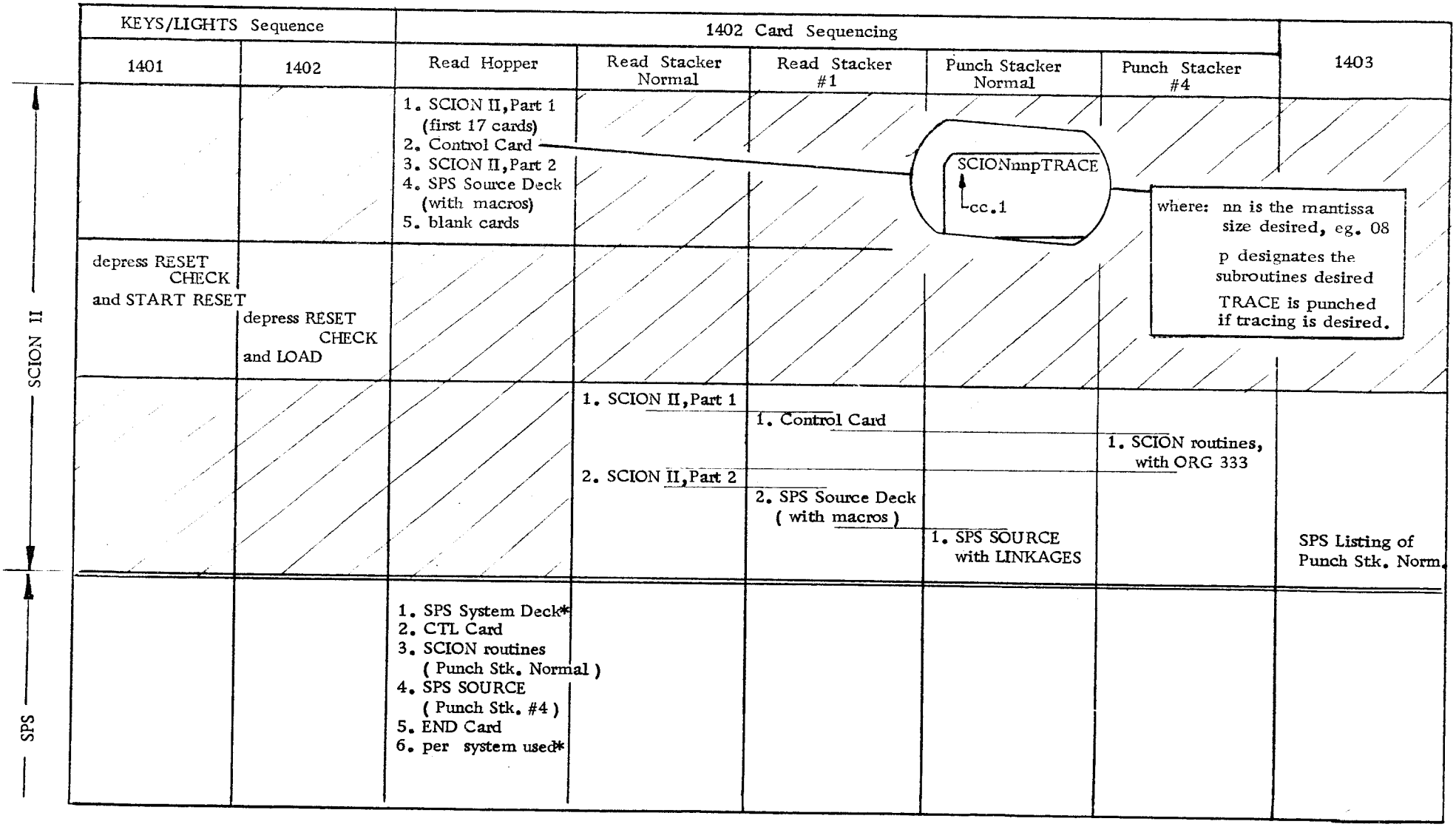
The last two options must be accompanied by a subsequent return to OVR+4 (OVRZZZ+4) or to EXIT (RESZZZ) if further processing is desired.

The Underflow condition is somewhat similar to the Overflow logic except that is detected by finding the resultant characteristic (IR#3) to be negative; whereupon, the AC field is replaced by all zeros and normal exit is made.

Again, the first instruction of this error condition entry (UNDZZZ) is a NOP type instruction. Hence, the same modification procedures as were explained for overflow are applicable for the special treatment of the underflow condition

V. Using The System

A. Operating Procedures



* The SPS system utilized will determine the ordering of the decks required, if any.

V. B. Restrictions and Precautions

Index registers #1, #2, #3 are utilized by SCION. Upon assembly of the total program the subroutines will have defined these index registers by DCW's designating each as a three position field. Within the subroutines these index registers are used as accummulators, therefore, it is imperative that no other word marks be entered into these fields or that the high order word mark be removed at entry time. If the index registers are used in their normal manner this should of little concern to the programmer, because the SCION routine preserves the contents of these registers.

The first card produced for the stipulated SCION subroutines will always be an ORG 0333. However, if the programmer desires to map the subroutines some other place in memory he has this opportunity to change the ORG card before SPS assembly. In this event, there does exist one restriction that the work areas of the subroutines not be located in memory above 3999. This restriction is a result index register logic peculiar to memory above 3999.

Instruction modification using the SPS device of character adjustment relative to the executing instruction (eg - MCW *-5) should be utilized with discretion for the two following reasons:

1. Subsequent patching
2. Macro instructions are actually eleven characters in length, but appear to be seven characters at the SPS level.

An example of erroneous coding is:

```
###   ######   ######
MCW   ADRES    * +14
FAD   TANGT    ANGLE
MCW   AC       0000
```

One correct method would be:

```
      ###   ######   ######
      MCW   ADRES    LBL +6
      FAD   TANGT    ANGLE
LBL   MCW   AC       0000
```

VI. Appendix

A. SCION System Program Listings, Page 1 of 3

IBM 1401-1403 PLANNING AND TESTING SHEET

```
CLEAR STORAGE 1
CLEAR STORAGE 2
BOOTSTRAP CARD
,008015,022026,030034,041,045,053,057073,1026
L072116,110106,105117B101,199,027A074028□027B00102708026/0991,001/00111710
,008015,022029,056083/056029                                  ,0240671056

PG LIN  CT  LABEL   OP     A OPERAND          B OPERAND          D   LOC   INSTRUCTION COMMENTS                PAGE 1
                    CTL    61
                    * THE FOLLOWING IS SCION DECK #1
  1 010             ORG    0333
  1 020   4 INI     CS     0080                                      0333  / 080          AUG61
 11 030   4         CS     0199                                      0337  / 199          AUG61
 11 040   4         SW     0005                                      0341  . 005          AUG61
 11 050   7         SW     0001                                      0345  . 001  076     AUG61
 11 060   1         R                 0076                          0352  1              AUG61
 11 070   2         SS                                              0353  K 1            AUG61
 11 080   7         C      0003                                     0355  C 003  649652   AUG61
 11 090   5         B      ERRCTL     SCI                   1      0342  B 635  /        AUG61
 11 091   7         MCW    0009                                    0367  M 009  654      AUG61
 11 100   7         MCW    0008       TRCDGT                       0374  M 008  644      AUG61
 11 110   7         MCW    0007       MODULE                       0381  M 007  646      AUG61
 11 120   7         ZA     MANTIS     MANTIS                       0388  & 646  099      AUG61
 11 130   7         S      FOUR       X3                           0395  S 639  099      AUG61
 11 131   8         B      ERRCTL     X3                           0402  B 635  099 K   AUG61
 11 140   4         A      X3                             K       0410  A 099           AUG61
 11 150   7         MZ     X3     -   2   X3                       0414  Y 097  099      AUG61
 11 160   4         S      SEQ                                     0421  S 653           AUG61
 11 170   1         R                                              0425  1              AUG61
 11 180   8 RETRN   B      FO                                      0426  B 446  075 X   AUG61
 11 181   4         CW     0005       0075                  X       0434  / 080          AUG61
 11 182   4         SW     0001       0008                          0438  . 001          AUG61
 11 183   4         B      0001                                     0442  B 001          AUG61
 11 190   7 FO      S      0004       SEQ                           0446  S 004  653      AUG61
 11 200   8         BWZ    F1         SEQ                           0453  V 465  653 K   AUG61
 12 010   4         H      IN1                            K       0461  . 333          AUG61
 12 020   7 F1      ZA     0004       SEQ                           0465  & 004  653      AUG61
 12 040   7         ZA     MODULE     X2                            0472  & 644  094      AUG61
 12 050   7         S      0005       X2                            0479  S 005  094      AUG61
 12 060   8         BWZ    FEED       X2                            0486  V 533  094 K   AUG61
 12 070   7 F2      MCW    0080       0180                          0494  M 080  180      AUG61
 12 080   7         MCW    0044       0144                          0501  M 044  144      AUG61
 12 090   7         MCW    0004       0104                          0508  M 004  104      AUG61
 12 100   8         B      SPCL       0074                          0515  B 558  074 *    AUG61
 12 110   1 RDPCH   RP                                              0523  5              AUG61
 12 111   2         SS                                              0524  K 4            AUG61
 12 120   7         CS     RETRN      0180                  4       0526  / 426  180      AUG61
 12 130   8 FEED    B      TESTTR     0005                  6       0533  B 546  005 6   AUG61
 12 131   1         R                                              0541  1              AUG61
 12 140   4         B      RETRN                                    0542  B 426          AUG61
 12 150   8 TESTTR  B      F2         TRCDGT                1       0546  B 494  654 1   AUG61
 12 151   4         B      FEED  &  8                              0554  B 541          AUG61
 12 160   7 SPCL    MCW    0048     3 ACCUM                          0558  M 008  643      AUG61
 12 170   4         SW     ACCUM  -   1                           0565  . 642          AUG61
 12 180   8         B      DCWTYP     0073                  *       0569  B 599  073 *    AUG61
 12 190   7         MCW    ACCUM      0137                          0577  M 643  137      AUG61
 12 200   7         MCW    ACCUM  -   2   0126                     0584  M 641  126      AUG61
  3 010   4         CW     ACCUM  -   1                           0591  □ 642          AUG61
  3 020   4         B      RDPCH                                   0595  B 523          AUG61
  3 030   7 DCWTYP  MCW    ACCUM  -   2   0107                     0599  M 641  107      AUG61
  3 040   7         ZA     ACCUM  -   2   X2                       0606  & 641  094      AUG61
  3 050   7         MZ     X2     -   2   X2                       0613  Y 092  094      AUG61
  3 060   7         MCW    ACCUM      0123          2              0620  M 643  1K3      AUG61
  3 070   4         CW     ACCUM  -   1                           0627  □ 642          AUG61
  3 080   4         B      RDPCH                                   0631  B 523          AUG61
  3 090   4 ERRCTL  H      0999                                    0635  . 999          AUG61
  3 100             * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  3 110   3 X3      DCW    0099                                    0099
  3 120   3 X2      DCW    0094                                    0094
 13 130   1 FOUR    DCW    *                                       0639
 13 140   4 ACCUM   DCW    *                              4        0643
 13 150   1 MODULE  DCW    *                                       0644
 13 160   2 MANTIS  DCW    *                                       0646
 13 170   3 SCI     DCW    *                                       0649
 13 180   4 SEQ     DCW    *                              SCI      0653
 13 181   1 TRCDGT  DCW    *                                       0654
                    * XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61
                    * THE  SCION CTL CARD SHOULD BE INSERTED NEXT
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VI. A. SCION System Program Listings, Page 2 of 3

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CLEAR STORAGE 1     ,000015,022026,030034,041,045,053,057073102G
CLEAR STORAGE 2     L072116,111106,105117B101/199,027A074028B027B0010270B026/0991,001/00111/10
BOOTSTRAP CARD      ,00F015,022029,C5C063/056029                                    ,02406/1056
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FC	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	L	LOC	INSTRUCTION			COMMENTS
				CTL	31							
10	010			* THIS IS DECK#3- CREATES SCION LINKAGES FOR SPS								
10	020			ORG	0333							
10	030	7	DECK3	SW	0001	C101		0333	,	001	101	AUG61
10	040	4		S	SEC			0340	S	974		AUG61
10	050	5	SKIP	CC	READ		1	0344	F	762	1	AUG61
10	060			* XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXAUG61								
10	070	4	MACRO	CS	0139			0349	/	139		AUG61
10	080	4		CS	C251			0353	/	251		AUG61
10	090	7		MCW	0013	C113		0357	M	013	113	AUG61
10	100	7		SW	0202	C211		0364	,	202	211	AUG61
10	110	7		MCW	0005	C206		0371	M	005	206	AUG61
10	120	7		MCW	0013	C216		0378	M	013	216	AUG61
10	130	7		MCW	BSCION	C122		0385	M	932	122	AUG61
10	140	7		SW	0222	C101		0392	,	222	101	AUG61
10	150	7		MCW	BSCION	C227		0399	M	932	227	AUG61
10	160	7		MCW	BSCION- 8	C218		0406	M	924	218	AUG61
10	170	1		WP				0413	6			AUG61
10	180	4		CS	0267			0414	/	267		AUG61
10	190	8		B	FC	C004		0418	B	433	004	AUG61
10	200	7		A	K1	C105		0426	A	923	105	AUG61
11	010	7	FC	MCW	0105	C206		0433	M	105	206	AUG61
11	020	4		SW	0252			0440	,	252		AUG61
11	021	7		MCW	0257	C113		0444	M	257	113	AUG61
11	030	7		MN	0038	C267		0451	D	038	267	AUG61
11	040	7		MCW	0032			0458	M	032		AUG61
11	050	7		MN	0027	C261		0462	D	027	261	AUG61
11	060	4		MCW	0021			0469	M	021		AUG61
11	070	7		MCW	0016	C255		0473	M	016	255	AUG61
11	071	7		MCW	ASTER	C252		0480	M	963	252	AUG61
11	080	7		MCW	0267	C155		0487	M	267	155	AUG61
11	090	7		SW	0222	C236		0494	,	222	236	AUG61
11	100	7		MCW	0037	C245		0501	M	037	245	AUG61
11	110	7		MCW	0026	C231		0508	M	026	231	AUG61
11	120	7		MCW	0245	C137		0515	M	245	137	AUG61
11	130	7		MCW	0231	C126		0522	M	231	126	AUG61
11	140	7		MN	0038	C138		0529	D	038	138	AUG61
11	150	7		MN	0027	C127		0536	D	027	127	AUG61
11	160	8		B	FA	C015	A	0543	B	684	015	A AUG61
11	170	8		B	FS	C015	S	0551	B	702	015	S AUG61
11	180	8		B	FM	C015	M	0559	B	720	015	M AUG61
11	190	8		B	FD	C015	D	0567	B	738	015	D AUG61
11	200	8		B	FL	C015	L	0575	B	616	015	L AUG61
12	010	8		B	FI	C015	I	0583	B	598	015	I AUG61
12	020	7		MCW	ERRFLT	C267		0591	M	962	267	AUG61
12	030	7	FI	MCW	FIX	C220		0598	M	944	220	AUG61
12	040	7		MCW	FIX	C116		0605	M	944	116	AUG61
12	050	4		B	FLTFIX			0612	B	630		AUG61
12	060	7	FL	MCW	FLT	C220		0616	M	947	220	AUG61
12	070	7		MCW	FLT	C116		0623	M	947	116	AUG61
12	080	7	FLTFIX	ZA	0236	DEC		0630	E	236	965	AUG61
12	090	8		B	FI	C237		0637	B	652	237	AUG61
12	100	7		ZA	0237	DEC		0645	E	237	965	AUG61
12	110	7	FI	MCW	THOUSN	C239		0652	M	969	239	AUG61
12	120	7		MZ	DEC - 1	DEC		0659	Y	964	965	AUG61
12	130	7		A	DEC	C239		0666	A	965	239	AUG61
12	140	7		MCW	0239	0131		0673	M	239	131	AUG61
12	150	4		B	F2			0680	B	752		AUG61
12	160	7	FA	MCW	FAD	C116		0684	M	941	116	AUG61
12	170	7		MCW	FAD	C220		0691	M	941	220	AUG61
12	180	4		B	F2			0698	B	752		AUG61
12	190	7	FS	MCW	FSB	C116		0702	M	938	116	AUG61
12	200	7		MCW	FSB	C220		0709	M	938	220	AUG61
13	010	4		B	F2			0716	B	752		AUG61
13	020	7	FM	MCW	FMP	C116		0720	M	935	116	AUG61
13	030	7		MCW	FMP	C220		0727	M	935	220	AUG61
13	040	4		B	F2			0734	B	752		AUG61
13	050	7	FD	MCW	FDV	C116		0738	M	950	116	AUG61
13	060	7		MCW	FDV	C220		0745	M	950	220	AUG61
13	070	1	F2	WP				0752	6			AUG61

IBM 1401-1403 PLANNING AND TESTING SHEET

PC	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION			COMMENTS	DCK
13	080	4		CS	0267			0753	/ 267				AUG61
13	090	5		B	SKIP			0757	B 344	@			AUG61
13	100	1	READ	R			@	0762	1				AUG61
13	110	2		SS				0763	K 1				AUG61
13	120	7		S	0005		1	0765	S 005	974			AUG61
13	130	8		BWZ	F3	SEQ		0772	V 787	974	K		AUG61
13	140	7		MCW	ASTER	SEQ	K	0780	M 963	201			AUG61
13	150	7	F3	ZA	0005	0201		0787	S 005	974			AUG61
13	160	7		MCW	0055	SEQ		0794	M 055	155			AUG61
13	170	7		MCW	0055	0155		0801	M 055	267			AUG61
13	180	8		B	F2	0267		0808	B 752	008	*		AUG61
13	190	8		B	MACRO	0008	*	0816	B 349	014	F		AUG61
13	191	4		CS	0251	C014	F	0824	/ 251				AUG61
13	200	7		SW	0249			0828	, 249	236			AUG61
14	010	7		SW	0222	0236		0835	, 222	218			AUG61
14	020	7		SW	0211	0218		0842	, 211	208			AUG61
14	030	7		SW	0202	0208		0849	, 202	201			AUG61
14	040	7		MCW	0039	0201		0856	M 039	249			AUG61
14	050	7		MCW	0038	0249		0863	D 038	247			AUG61
14	060	7		MCW	0037	0247		0870	M 037	245			AUG61
14	070	7		MCW	0027	0245		0877	D 027	233			AUG61
14	080	7		MCW	0026	0233		0884	M 026	231			AUG61
14	090	7		MCW	0016	0231		0891	M 016	220			AUG61
14	100	7		MCW	0013	0220		0898	M 013	216			AUG61
14	110	7		MCW	0007	0216		0905	M 007	209			AUG61
14	120	7		MCW	0005	0209		0912	M 005	206			AUG61
14	130	4		B	F2	0206		0919	B 752				AUG61
14	140	1	K1	DCW	*		1	0923					
14	150	9	BSCION	DCW	*		B SCION	0932					
14	160	3	FMP	DCW	*		M	0935					
14	170	3	FSB	DCW	*		ZS	0938					
14	180	3	FAC	DCW	*		ZA	0941					
14	190	3	FIX	DCW	*		X	0944					
14	200	3	FLT	DCW	*		P	0947					
15	010	3	FLV	DCW	*		D	0950					
15	020	12	ERRFLT	DCW	*		*OP CODE ERR	0962					
15	030	1	ASTER	DCW	*		*	0963					
15	040	2	DEC	DCW	*			0965					
15	050	4	TFCUSN	DCW	*		1000	0969					
15	060	5	SEC	DCW	*			0974					
15	070				* THIS DECK IS FOLLOWED BY THE SPS SOURCE PROGRM								
15	C80			END	DECK3				/ 333 080				

112 CARDS